425 King Street East

Stormwater Management Report

Cobourg, Ontario

Mason Homes

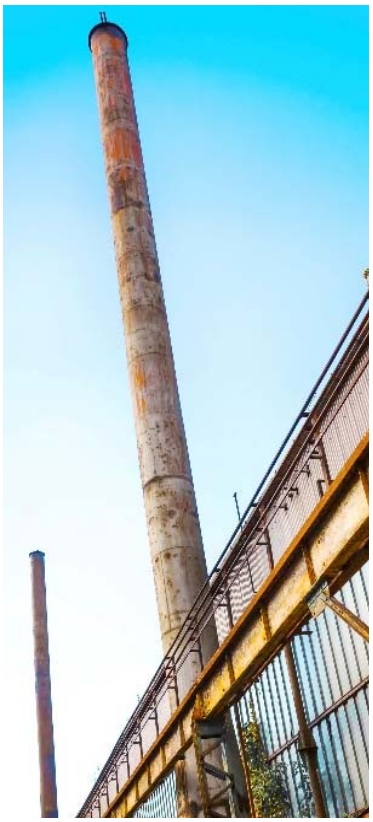


Table of Contents

Figure Index

Table Index

Appendix Index

Drawing Index

1. Introduction

1.1 Project Background

GHD Limited was retained by Mason Homes to provide engineering services related to the proposed development of 425 King Street East, a 1.58 ha site consisting of 5 townhouse blocks in the Town of Cobourg. The proposed development is bound by King Street East to the north, and residential properties to the south, east and west, as shown on **Figure 1**. This report will investigate the Stormwater servicing requirements for the development of the subject property.

The following reports and documents have been utilized in the preparation of this report:

- "Technical and Engineering Guidelines for Stormwater Management Submission" prepared by Ganaraska Region Conservation Authority, dated December 2014
- "Functional Servicing Report" prepared by Engage Engineering Ltd, dated February 2018
- "Addendum to Stormwater Management Report" prepared by MMK Engineering Inc., dated April 2010
- "Coverdale Avenue Storm Sewer and Roadway Improvements Drainage Plan" and "Storm Sewer Design Chart", prepared by Totten Sims Hubicki Associates, dated July 2005
- "King Street East / Coverdale Trunk Storm Sewer Analysis" prepared by GHD Limited., dated April 2019
- "425 King Street East – Functional Servicing and Stormwater Management Report" prepared by GHD Limited, dated August 2019

0 10 20 30m

SCALE 1:1000 AT ORIGINAL SIZE

N

GHD

Mason Homes
425 King Street East
Sewer Analysis

Site Location Plan

Job Number 11192099
Revision A
Date March 2019

Figure 1

65 Sunray Street, Whitby Ontario L1N 8Y3 **T** 1 905 686 6402 **F** 1 905 432 7877 **E** ytomail@ghd.com **W** www.ghd.com

Plot Date: 14 March 2019 - 11:39 AM Plotted by: Ryan Brockie Cad File No: C:\Users\rbrockle\Desktop\11192099\Letter\Figures\Figure 1 - Site Location Plan.dwg

2. Stormwater Drainage

2.1 Existing Drainage

The site is currently an open grassed field, and an abandoned asphalt driveway. The site drains in a north eastern to south westerly direction towards Molly Baker Trail along the southern property line, where it is directed to the Brook Street South roadside ditch. Under existing conditions, Molly Baker Trail forms a small dam, blocking drainage from continuing south towards Brook Road South causing water to be directed to the small depression on the northern side of Molly Baker Road. This causes flooding to occur on the neighboring property, 38 Brook Road, however will spill to the roadside ditches before approaching the dwelling.

In general, the residential properties to the east of the development fronting onto Orchard Avenue drain in a rear to front fashion, where it is conveyed east to Coverdale Avenue. The lots fronting onto King Street East are split draining with a portion of the lot draining onto King Street East right of way, and the remainder draining to the subject property. However, a 0.74 ha external drainage area consisting of the rear yards of the properties immediately east of the subject property will drain through the property, as illustrated on **Figure 2**.

2.2 Proposed Drainage

In post-development conditions, approximately 0.47ha of drainage area consisting of the rear yards adjacent to the western property line, will continue to drain to Brook Road South uncontrolled. A storm sewer system is proposed to capture the remaining 1.85ha drainage area consisting of the remainder of the subject property and external drainage area. The post development drainage pattern is shown in **Figure 3**.The minor system is sized to capture and convey the 5 year storm event to the underground storage facility. Major system flows (rainfall events exceeding the 5 year storm) are to be conveyed overland through the road network to a local low point, where they will be captured by catchbasins and conveyed into the underground storage facility. Catchbasin capture calculations are provided for review in **Appendix B**.

Once flows are captured, they are to be stored onsite and discharged through a proposed sewer within the Orchard Avenue right of way, where flows will be conveyed to the existing 1650 mm concrete sewer within the Coverdale Avenue right of way as illustrated on Drawing 11192099-G102. Flows will then follow the existing drainage pattern, continuing south and ultimately discharging to Lake Ontario.

Foundation drainage will be provided through sump pump connections to avoid basement flooding. This will avoid hydraulic grade line issues with the foundation drainage due to the shallow storm system and the underground storage system. A typical sump connection detail is shown in **Figure 4**.

LEGEND:

1.00 ha / 0.45 — AREA IN HECTARES / RUNOFF COEFFICIENT

OVERLAND FLOW

DRAINAGE AREA BOUNDARY

EXISTING COMMERCIAL

EXISTING YOUTH CENTRE

KING STREET EAST (THE KING'S HIGHWAY NO. 2)

EXISTING SIGNALIZED INTERSECTION

EXISTING RESIDENTIAL

EXT. FRAME GARAGE

EXT. 2 STOREY

EXT. 1.5 STOREY

EXT. 1 STOREY

NO ALLEYWAY BETWEEN LOTS 12 AND 13 (ASSUMED BY REGISTERED PLAN, NOT INDICATED ON SURVEY)

BROOK ROAD SOUTH

ORCHARD AVENUE

EXISTING DITCH

"MOLLY BAKER TRAIL"

EXISTING MUNICIPAL OPEN SPACE

EXISTING RESIDENTIAL FOOTE CRESCENT SUBDIVISION

1.17 ha / 0.40

1.30 ha / 0.40

0.74 ha / 0.34

1.58 ha / 0.20

0.39 ha / 0.25

0 10 20 30m

SCALE 1:1000 AT ORIGINAL SIZE

N

Mason Homes
425 King Street East
Sewer Analysis

Pre-Development Site Drainage Plan

Job Number 11192099
Revision A
Date April 2019

Figure 2

65 Sunray Street, Whitby Ontario L1N 8Y3 **T** 1 905 686 6402 **F** 1 905 432 7877 **E** ytomail@ghd.com **W** www.ghd.com

Plot Date: 26 November 2019 - 1:40 PM Plotted by: Ryan Brockle

Cad File No: G:\111\11192099\Technical\Water Resources\Reports\Stormwater Management Report\Figures\Figure 2 - Pre-Development Site Drainage Plan.dwg

LEGEND:

1.00 ha / 0.45 — AREA IN HECTARES / RUNOFF COEFFICIENT

OVERLAND FLOW

DRAINAGE AREA BOUNDARY

EXISTING COMMERCIAL

EXISTING YOUTH CENTRE

KING STREET EAST (THE KING'S HIGHWAY NO. 2)

EXISTING SIGNALIZED INTERSECTION

23

1.17 ha / 0.40

1.30 ha / 0.40

0.74 ha / 0.34

0.47 ha / 0.32

0.39 ha / 0.25

1.11 ha / 0.63

EXISTING RESIDENTIAL

1 STOREY

EXT. 1 STOREY

EXT. 1.5 STOREY

EXT. 2 STOREY

EXT. FRAME GARAGE

ROAD ALLOWANCE BETWEEN LOTS 12 AND 13 CLOSED BY BY-LAW 5 REGISTERED AS INSTRUMENT NO. (TO BE INSERTED)

BROOK ROAD SOUTH

ORCHARD AVENUE

SEWER TO CONNECT TO ORCHARD AVENUE

"MOLLY BAKER TRAIL"

EXISTING MUNICIPAL OPEN SPACE

EXISTING RESIDENTIAL FOOTE CRESCENT SUBDIVISION

EXISTING DITCH

PROPOSED SEWER

0 10 20 30m

SCALE 1:1000 AT ORIGINAL SIZE

N

GHD

Mason Homes
425 King Street East
Sewer Analysis

Post-Development Site Drainage Plan

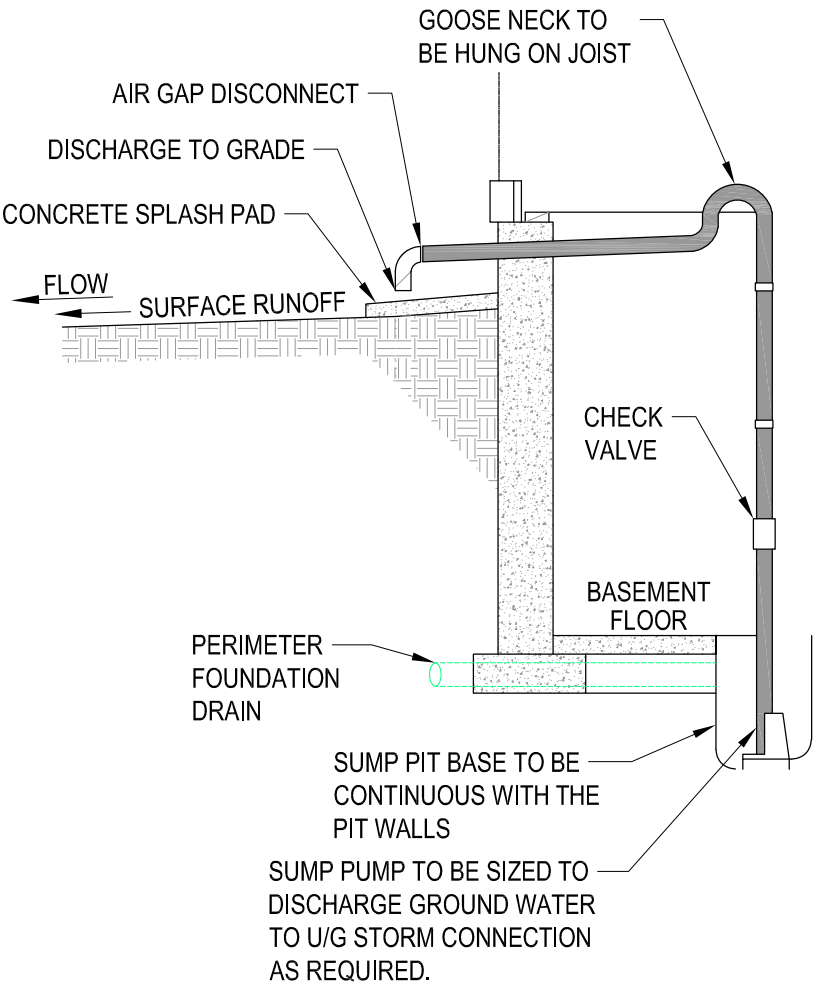
Job Number 11192099
Revision A
Date April 2019

Figure 3

65 Sunray Street, Whitby Ontario L1N 8Y3 **T** 1 905 686 6402 **F** 1 905 432 7877 **E** ytomail@ghd.com **W** www.ghd.com

Plot Date: 12 December 2019 - 9:37 AM Plotted by: Ryan Brockle

Cad File No: G:\111\11192099\Technical\Water Resources\Reports\Stormwater Management Report\Figures\Figure 2 - Pre-Development Site Drainage Plan.dwg



SUMP PUMP
DISCHARGE TO GRADE

N.T.S.

0 10 20 30m
SCALE 1:1000 AT ORIGINAL SIZE

N

Mason Homes
425 King Street East
Sewer Analysis
Sump Pump Detail

Job Number 11192099
Revision A
Date March 2019

Figure 4

65 Sunray Street, Whitby Ontario L1N 8Y3 T 1 905 686 6402 F 1 905 432 7877 E ytomail@ghd.com W www.ghd.com

Plot Date: 10 May 2019 - 8:35 AM Plotted by: Ryan Brockie Cad File No: G:\111\11192099\Technical\Water Resources\Reports\Figures\Figures 4&5.dwg

3. Stormwater Management

3.1 Stormwater Management Criteria

Based on criteria from the Town of Cobourg and Ganaraska Region Conservation Authority (GRCA), the Stormwater Management (SWM) controls that will be required for the proposed development are as follows:

- Quantity Control — Drainage directed eastwards to the Coverdale Avenue Trunk Storm Sewer must not impact downstream properties
- Quality Control — An “Enhanced” level of protection
- Erosion Control — Not required for this development

In order to ensure the above criteria are achieved, the following measures will be implemented:

3.2 Quantity Control

3.2.1 Runoff Coefficient

The typical runoff coefficient for townhouse units as per GRCA and Town of Cobourg criteria is 0.65. However in discussion with both the GRCA and the Town, it was agreed to calculate the runoff coefficient for this development from first principles. This calculation is shown in **Appendix B** and the runoff coefficients used are shown in **Figure 3**.

3.2.2 Coverdale Avenue

The natural drainage direction for the subject property is westerly towards Brook Road South. A topographic survey of the existing Brook Road South ditch and culvert system was completed, it was found that there is flooding issues in pre-development conditions. Therefore, it was suggested to investigate the possibility of directing the subdivision flows eastwards to Coverdale Avenue, where a large trunk storm sewer conveys flows to Lake Ontario. To that end, an analysis of the King Street East and Coverdale Avenue trunk storm sewer was performed under a separate cover, the “King Street East / Coverdale Trunk Storm Sewer Analysis” prepared by GHD Limited, dated April 2019. It is understood that the Town of Cobourg and GRCA are in general agreement with the findings of the study. This analysis is attached as **Appendix C**. Since the proposed development flows are not tributary to this sewer, the subject property must discharge at a flow rate that does not cause an adverse impact to any properties serviced by the existing Coverdale Avenue trunk storm sewer.

Manhole 17 adjacent to Coverdale Park was determined to be the most sensitive location in this system. A 750mm overflow outlet to Coverdale Park has been provided at the obvert of the trunk storm sewer at Manhole 17. Downstream of this location a small tributary makes its way through the park and private property before rejoining Brook Creek. Therefore, this was determined to be the crucial location in the system. The hydraulic grade line in the trunk sewer at this location controls the flow rate through Coverdale Park and private property. As such, an increase to the hydraulic grade line will cause a higher flow rate to discharge to Coverdale Park from the outlet pipe.

A discharge from the proposed development was applied and the resultant hydraulic grade line traced through trunk storm sewer. The release rate from the development to the Coverdale Sewer was selected such that there was no increase in the calculated hydraulic grade line at Manhole 17. This release rate was found to be 0.020m^3/s.

As shown on the Post Development drainage area plan, a total of 1.85 ha of drainage area will be collected by the storm sewer system. The uncontrolled post-development flow rates exceed 20L/s, therefore on site storage must be provided to attenuate these flows, supporting calculations are provided in **Appendix B**.

Using the modified rational method, the total storage volume required to attenuate the 100-year post-development peak flow is found to be 583 m^3. It is proposed to provide the onsite storage volume in the form of an underground chamber; Stormtech MC-3500 (or approved equivalent) storage chambers are proposed. In order to accommodate the tree protection setbacks along the southern property line, the storage units are proposed to be placed within the road allowance, as illustrated on Drawing 11192099-G102. As such, two chamber cells are required and are referred to as the “north” and “east” bed in the design provided by StormTech, which has been attached in **Appendix B**. A total of 99 MC-3500 chambers and 10 end caps will provide approximately 556m^3 of storage volume. The proposed on-site storm sewer pipes and manholes will provide an additional 38m^3 of storage volume, for a total storage volume of 594m^3.This, in conjunction with an 83mm plate orifice located at the downstream outlet of MH13 with an invert of 82.81m, will control the post-development peak flows such that the 100- year post-development controlled flow rate will not exceed 0.020m^3/s. Storage calculations can be found in **Appendix B**.

3.2.3 Brook Road South

As noted previously, the subject property is currently an open grassed field with an abandoned asphalt driveway. This 2.71ha drainage area currently drains southwest towards Brook Road South. Upon development, approximately half the rooftops and the existing and proposed rear yards along the western property line will not be captured in the storm sewer system but will continue to drain towards Brook Road South. Approximately 0.86ha (0.47ha internal, 0.39ha external) of post-development drainage area is proposed to continue draining towards Brook Road South, where it will follow the existing drainage pattern. Using the rational method, pre-development and the uncontrolled post-development peak flows are determined for the 2 through 100-year storm events. The results are as summarized below in **Table 3.1**, supporting calculations are provided in **Appendix B**.

Table 3.1 Pre and Post Development Flows Brook Road

Return Period (year)	Pre-Development Flows - Total (m^3/s)	Uncontrolled Post-Development Flows(m^3/s)
2	0.120	0.046
5	0.150	0.057
10	0.171	0.065
25	0.222	0.084
50	0.229	0.087
100	0.245	0.093

As demonstrated above, there is a reduction in flows being directed towards Brook Road South in post-development conditions. As such, no quantity controls are required for draining the rear yards to the southwest, where they will continue to follow the existing drainage pattern.

The letter “Infiltration Assessment” was prepared by GHD Limited, dated April 29, 2019, attached as **Appendix E**, in order to determine the suitability of the soil to provide infiltration. It was found that the soil is in fact suitable, with an infiltration rate ranging from 12 to 15 mm/hr. As such, an infiltration gallery is proposed along the rear yards of Blocks 4 and 5. The infiltration gallery is sized to infiltrate the runoff generated by the 25 mm storm event, resulting in a required infiltration volume of 47 m^3. The gallery is proposed to be 125.0 m long, 1.90 m wide and 0.50 m deep, providing a total volume of 47 m^3. Supporting calculations are provided in **Appendix B**.

3.2.4 Molly Baker Trail

In examining the existing grades in the area, drainage from the subject property does not currently have a direct flow path towards Brook Road. The existing Molly Baker Trail is elevated compared to the surrounding land, forming a small dam blocking drainage from the north. A depression with a low point elevation of 82.88m adjacent to 38 Brook Road exists, which is approximately a foot below the existing trail. Drainage will pool at this low point to an elevation of 83.08m where it will begin to spill out onto Brook Road. Approximately 1.54ha currently drains towards the finger adjacent to 38 Brook Road, with the remainder of the site draining through the existing 400mm CPP, as illustrated on **Figure 5**. Using the Rational Method, the existing 100 year peak flow being conveyed to Brook Road through this depression is approximately 0.111m^3/s. A ponding elevation of 83.15m is required to convey the existing flows to Brook Road. As such, the neighbor at 38 Brook Road would currently experience flooding in his rear yard due to the Trail blocking flows and lack of a positive drainage outlet. The rear yard grade adjacent to the existing dwelling is at an elevation of 84.23m, with rear yard grades at 82.91m along the property line. Flows will spill to Brook Road South prior to water reaching the existing dwelling.

As noted in Section 3.2.3, the flows from the proposed rear yards and roof tops adjacent to the western property line will be directed to a rear yard swale that will be underlain with an infiltration trench, thereby reducing the volume of runoff directed to Brook Road. The infiltration trench is sized to capture and infiltrate the 25 mm storm event from the proposed rear yards. Flows in excess of this 25mm storm event will be conveyed south by the rear yard swale toward Molly Baker Trail.

Due to the existing grading constraints associated with the existing property, the ability to provide positive grade to Brook Road is limited. Although peak flows being conveyed along Molly Baker Train have bene reduced in post-development conditions, it is typically undesirable to have depressed areas where stormwater can accumulate. To alleviate the drainage concerns along Molly Baker Trail a 3.5m long 300mm diameter CSP culvert is proposed under the trail. The culvert is proposed to meet existing grades at both the upstream and downstream inverts to reduce the amount of excavation required, and minimize the disruption to the surrounding root systems. The upstream and downstream inverts of the culvert are 82.94 m and 82.89 m respectively, resulting in a longitudinal grade of approximately 1.5%. The introduction of the proposed culvert will reduce local ponding in the area and lower the 100 year ponding elevation from the pre-development elevation of 83.15m to 83.13m.

LEGEND:

1.00 ha / 0.45 — AREA IN HECTARES / RUNOFF COEFFICIENT

OVERLAND FLOW

DRAINAGE AREA BOUNDARY

EXISTING COMMERCIAL

EXISTING YOUTH CENTRE

KING STREET EAST (THE KING'S HIGHWAY NO. 2)

EXISTING SIGNALIZED INTERSECTION

BROOK ROAD SOUTH

EXISTING RESIDENTIAL

EXT. FRAME GARAGE

EXT. 2 STOREY

EXT. 1 STOREY

EXT. 1.5 STOREY

ROAD ALLOWANCE BETWEEN LOTS 12 AND 13 (CLOSED BY BY-LAW 4, REGISTERED INSTRUMENT NO. 1000)

ORCHARD AVENUE

1.17 ha / 0.40

1.30 ha / 0.40

1.17 ha / —

1.54 ha / 0.20

AREA DRAINING TO REAR YARD/DEPRESSION

AREA DRAINING TO EXISTING 400mm CPP CULVERT

EXISTING DITCH

EXISTING MUNICIPAL OPEN SPACE "MOLLY BAKER TRAIL"

EXISTING RESIDENTIAL FOOTE CRESCENT SUBDIVISION

0 10 20 30m

SCALE 1:1000 AT ORIGINAL SIZE

N

Mason Homes
425 King Street East
Sewer Analysis

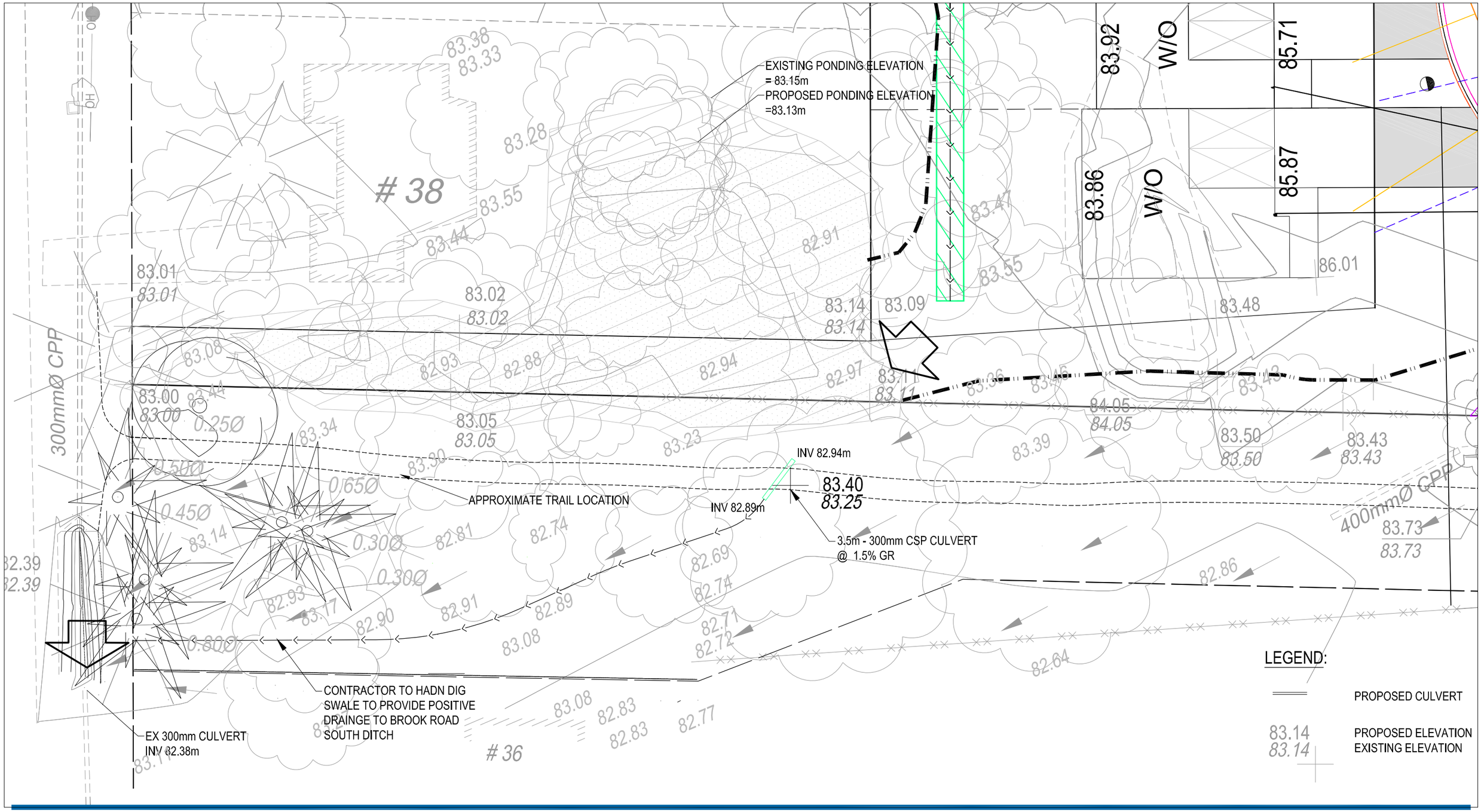
Pre-Development Site Drainage Plan

Job Number 11192099
Revision A
Date April 2019

Figure 5

65 Sunray Street, Whitby Ontario L1N 8Y3 **T** 1 905 686 6402 **F** 1 905 432 7877 **E** ytomail@ghd.com **W** www.ghd.com

Plot Date: 24 April 2020 - 1:59 PM Plotted by: Jamie Iantomasi Cad File No: G:\111\11192099\Technical\Water Resources\Reports\Stormwater Management Report\Dec 2019 Submission\Figures\Figure 5 - Pre-Development Culvert Drainage Plan.dwg



0 2.5 5.0 7.5m
SCALE 1:250 AT ORIGINAL SIZE

N

GHD

Mason Homes
425 King Street East
Sewer Analysis

Brook Road South
Overland Flow Route Analysis

Job Number 11192099
Revision A
Date JULY 2019

Figure 6

65 Sunray Street, Whitby Ontario L1N 8Y3 **T** 1 905 686 6402 **F** 1 905 432 7877 **E** ytomail@ghd.com **W** www.ghd.com

Plot Date: 27 April 2020 - 11:45 AM Plotted by: Jamie Iantomasi Cad File No: G:\111\11192099\Technical\Water Resources\Reports\Stormwater Management Report\Figures\Figures 6 Overland Flow.dwg

3.3 Quality Control

As per the Ministry of the Environment Guidelines, 'Enhanced Level' of protection is required for the development. As such, a long term T.S.S. removal rate of 80% is required. Additionally, extended detention for downstream erosion control is not required to be implemented on site due to the receiving storm sewer system discharging directly into Lake Ontario.

Per the Town of Cobourg comments, the treatment train approach initially proposed didn't satisfy the 80% T.S.S. removal. Therefore, a Jellyfish JF6-4-1 Unit, or approved equal, is proposed, removing 89% of total suspended solids before entering the receiving storm sewer. Sizing calculations for the Jellyfish unit has been provided in **Appendix D**. Furthermore, the Stormtech chambers have an isolator row which will allow for initial settlement of particles from the "first flush" of each storm event. The open bottom chambers also allow infiltration to occur below the chamber, which further increases the quality of the effluent stormwater discharging to Coverdale Avenue. Additionally, rear yard infiltration has been proposed for the lots on the western flankage of Orchard Avenue. Should a different chamber system be used, an equivalent treatment measure to the isolator row should be implemented.

3.4 Erosion and Sediment Controls during Construction

During construction, there is potential for sediment laden runoff to leave the site and enter the municipal right of ways. As such, prior to works involving grading activities occurring, the following erosion control practices are to be implemented:

- Silt fence installed along the perimeter of the site
- "Mud-Mat" on the access used during construction
- Rock check dams
- Snow fence around proposed infiltration galleries
- Catch basin filters installed on existing catchbasins within the municipal right of way
- Good engineering and housekeeping practices

Details for erosion and sedimentation control during construction are as illustrated on Drawing 11192099-ERS101.

4. Conclusions

The preceding Stormwater Management Report demonstrates the criteria pertaining to stormwater management, quantity, quality and erosion controls are met as per Town of Cobourg and Ganaraska Region Conservation Authority guidelines.

The site can be serviced as follows:

- Storm sewers will be provided for the minor system flows. Major system flows will be conveyed by the roadway to an onsite storage system. 1.11ha of the subject property and 0.74ha of external drainage area will be discharged to the Coverdale trunk storm sewer.
- Quantity controls are proposed in order to attenuate the post-development peak flows to the target flow rate of 0.020m³/s to the Coverdale Avenue sewer.
- The target flow rate will necessitate 583 m3 of onsite storage provided in the form of Stormtech MC-3500 underground storage. The available onsite storage volume provided by the Stormtech MC-3500 chambers and pipe storage is 594 m3.
- An 83 mm plate orifice with an invert of 82.81m is proposed at the downstream invert of MH13 in conjunction with the storage chambers to control flows to the target flow rate of 0.020 m³/s.
- An enhanced level of treatment is provided through a combination of a JellyFish JF6-4-1 unit and infiltration methods.
- A minor portion of drainage will continue to drain west to Brook Road at lower than pre-development levels.
- A 300mm culvert is proposed along Molly Baker Trail to alleviate existing ponding adjacent to 38 Brook Road.
- Extended detention for downstream erosion control is not necessary, as the receiving storm sewer system discharges directly to Lake Ontario

All of Which is Respectfully Submitted,

GHD

Emily Lightstone, E.I.T.
Water Resources

Jamie Iantomasi, P. Eng.
Water Resources Engineer

Appendix **A**

Design Sheets

65 Sunray St.
Whitby, Ontario
L1N 8Y3
905-686-6402

Town of Cobourg
STORM SEWER DESIGN SHEET - 5YR

Project Name: 425 King Street East
Project No. 11192099

PREPARED BY: M.Brown
CHECKED BY: G.Becker
DATE: 24-Apr-2020

15 MINUTE ENTRY TIME
5yr-Design Storm

Street	From MH	To MH	A Area (ha)	R Runoff Coeff.	2.78AR	Accum. 2.78AR	Time of Conc. (min)	Rainfall (mm/hr)	Q Peak Flow (l/s)	Pipe Diameter (mm)	Design Slope (%)	Length (m)	Capacity (l/s)	Capacity Problem	Velocity (m/s)	Time in Section (min)	Total Time (min)	Remarks
ORCHARD AVENUE	CBMH2	MH3	0.11	0.63	0.193	0.193	15.00	79.48	15	300	1.00	25.6	101	No	1.38	0.31	15.31	
ORCHARD AVENUE	RYCB1	CHAMBER 1	0.13	0.63	0.228	0.228	15.00	79.48	18	300	1.70	35.6	132	No	1.80	0.33	15.33	
ORCHARD AVENUE	CHAMBER 1	DCBMH6	0.29	0.63	0.508	0.928	15.31	78.70	73	375	0.50	16.4	129	No	1.13	0.24	15.55	
ORCHARD AVENUE	DCBMH6	MH8	0.20	0.63	0.350	1.279	15.55	78.10	100	450	0.35	8.7	176	No	1.07	0.14	15.68	
ORCHARD AVENUE	RYCB2	CHAMBER 2	0.20	0.63	0.350	0.350	15.00	79.48	28	300	1.90	35.9	139	No	1.91	0.31	15.31	
ORCHARD AVENUE	CHAMBER 2	DCBMH9	0.00	0.63	0.000	1.629	15.68	77.77	127	600	0.30	30.3	351	No	1.20	0.42	16.10	
ORCHARD AVENUE	DCBMH9	MH13	0.18	0.63	0.315	1.944	16.10	76.75	149	600	0.30	18.2	351	No	1.20	0.25	16.36	
ORCHARD AVENUE	RYCB3	MH13	0.74	0.34	0.699	0.699	15.00	79.48	56	300	2.00	50.2	143	No	1.96	0.43	15.43	
ORCHARD AVENUE	MH13	JF6-4-1	0.00	0.40	0.000	2.644	16.36	76.15	20	300	0.30	4.0	55	No	0.76	0.09	16.45	84mmØ ORIFICE REDUCES FLOW TO 20 L/s
ORCHARD AVENUE	DICB1	JF6-4-1	1.18	0.40	1.312	1.312	15.00	79.48	104	300	3.40	9.9	186	No	2.55	0.06	15.06	
ORCHARD AVENUE	JF6-4-1	MH12	0.00	0.40	0.000	3.956	16.45	75.94	124	525	0.30	42.1	246	No	1.10	0.64	17.08	
ORCHARD AVENUE	MH12	CBMH13	0.00	0.40	0.000	3.956	17.08	74.48	124	525	0.30	90.0	246	No	1.10	1.36	18.45	
ORCHARD AVENUE	CBMH13	MH14	0.00	0.40	0.000	3.956	18.45	71.53	124	525	0.30	20.8	246	No	1.10	0.32	18.76	
COVERDALE AVENUE	*Ex.MH18*	MH14	80.10	0.44	97.978	97.978	42.72	41.96	4,111	1650	0.60	13.1	7,365	No	3.34	0.07	42.79	42.72 Tc FROM EXISTING STORM
COVERDALE AVENUE	MH14	*Ex.MH12*	0.00	0.40	0.000	101.934	42.79	41.92	4,397	1650	0.60	50.9	7,365	No	3.34	0.25	43.04	DESIGN SHEET (NORTH AND EAST FLOWS INTO Ex.MH18)

5yr: I = 2464 / (T + 16)
n = 0.013
As per Design Guidelines for The Corporation of the Town of Cobourg, Ontario, Canada, Revised April, 2015

Date	Submission
17-Dec-2019	First Submission
24-Apr-2020	Second Submission

65 Sunray St.
Whitby, Ontario
L1N 8Y3
905-686-6402

Town of Cobourg
STORM SEWER DESIGN SHEET - 100YR

Project Name: 425 King Street East
Project No. 11192099

PREPARED BY: M.Brown
CHECKED BY: G.Becker
DATE: 24-Apr-2020

15 MINUTE ENTRY TIME
100yr-Design Storm

Street	From MH	To MH	A Area (ha)	R Runoff Coeff.	2.78AR	Accum. 2.78AR	Time of Conc. (min)	Rainfall (mm/hr)	Q Peak Flow (l/s)	Pipe Diameter (mm)	Design Slope (%)	Length (m)	Capacity (l/s)	Capacity Problem	Velocity (m/s)	Time in Section (min)	Total Time (min)	Remarks
ORCHARD AVENUE	CBMH2	MH3	0.11	0.63	0.193	0.193	15.00	129.95	25	300	1.00	25.6	101	No	1.38	0.31	15.31	
ORCHARD AVENUE	RYCB1	CHAMBER 1	0.13	0.63	0.228	0.228	15.00	129.95	30	300	1.70	35.6	132	No	1.80	0.33	15.33	
ORCHARD AVENUE	CHAMBER 1	DCBMH6	0.29	0.63	0.508	0.928	15.31	129.03	120	375	0.50	16.4	129	No	1.13	0.24	15.55	
ORCHARD AVENUE	DCBMH6	MH8	0.20	0.63	0.350	1.279	15.55	128.31	164	450	0.35	8.7	176	No	1.07	0.14	15.68	
ORCHARD AVENUE	RYCB2	CHAMBER 2	0.20	0.63	0.350	0.350	15.00	129.95	46	300	1.90	35.9	139	No	1.91	0.31	15.31	
ORCHARD AVENUE	CHAMBER 2	DCBMH9	0.00	0.63	0.000	1.629	15.68	127.92	208	600	0.30	30.3	351	No	1.20	0.42	16.10	
ORCHARD AVENUE	DCBMH9	MH13	0.18	0.63	0.315	1.944	16.10	126.70	246	600	0.30	18.2	351	No	1.20	0.25	16.36	
ORCHARD AVENUE	RYCB3	MH13	0.74	0.34	0.699	0.699	15.00	129.95	91	300	2.00	50.2	143	No	1.96	0.43	15.43	
ORCHARD AVENUE	MH13	JF6-4-1	0.00	0.40	0.000	2.644	16.36	125.98	20	300	0.30	4.0	55	No	0.76	0.09	16.45	85mmØ ORIFICE REDUCES FLOW TO 20 L/s
ORCHARD AVENUE	DICB1	JF6-4-1	1.18	0.40	1.312	1.312	15.00	129.95	171	300	3.40	9.9	186	No	2.55	0.06	15.06	
ORCHARD AVENUE	JF6-4-1	MH12	0.00	0.40	0.000	3.956	16.45	125.73	191	525	0.30	42.1	246	No	1.10	0.64	17.08	
ORCHARD AVENUE	MH12	CBMH13	0.00	0.40	0.000	3.956	17.08	123.95	191	525	0.30	90.0	246	No	1.10	1.36	18.45	
ORCHARD AVENUE	CBMH13	MH14	0.00	0.40	0.000	3.956	18.45	120.31	191	525	0.30	20.8	246	No	1.10	0.32	18.76	
COVERDALE AVENUE	*Ex.MH18*	MH14	80.10	0.44	97.978	97.978	42.72	79.02	7,742	1650	0.60	13.1	7,365	Yes	3.34	0.07	42.79	42.72 Tc FROM EXISTING STORM
COVERDALE AVENUE	MH14	*Ex.MH12*	0.00	0.40	0.000	101.934	42.79	78.94	8,237	1650	0.60	50.9	7,365	Yes	3.34	0.25	43.04	DESIGN SHEET (NORTH AND EAST FLOWS INTO Ex.MH18)

100yr: I = 5588 / (T + 28)
n = 0.013
As per Design Guidelines for The Corporation of the Town of Cobourg, Ontario, Canada, Revised April, 2015

Date	Submission
17-Dec-2019	First Submission
24-Apr-2020	Second Submission

Appendix **B**

Stormwater Management Calculations

Project Name	Cobourg King Street East Sewer Analysis
Project No.	11192099
Subject	Runoff Coefficient

Total Area 15799 m2

Proposed Site

	Area (m2)	C	AC
Block 1	702	0.90	632
Block 2	718	0.90	647
Block 3	669	0.90	602
Block 4	442	0.90	398
Block 5	442	0.90	398
Sidewalk	309	0.90	278
Drive Aisle	2077	0.90	1869
Driveway	1495	0.90	1346
Landscape	4330	0.20	866
Sum	**11184**		**7035**
Composite 'C'		**0.63**	

External Drainage Area (East)

	Area (m2)	C	AC
Impervious Surface	1510	0.90	1359
Pervious Surface	5840	0.20	1168
Sum	**7350**		**2527**
Composite 'C'		**0.34**	

External Drainage Area (West)

	Area (m2)	C	AC
Impervious Surface	481	0.90	433
Pervious Surface	3408	0.20	682
Sum	**3889**		**1115**
Composite 'C'		**0.29**	

Drainage Area to Coverdale Ave

	Area (m2)	C	AC
Site	11184	0.63	7046
External Area	7350	0.34	2527
Sum	**18534**		**9573**
Composite 'C'		**0.52**	

Drainage Area to Brook Road

	Area (m2)	C	AC
Impervious Surface	792	0.90	713
Pervious Surface	3925	0.20	785
External Drainage	3889	0.29	1115
Sum	**8606**		**2612**
Composite 'C'		**0.30**	

CALCULATIONS

Prepared by R.B.
Checked by J.I.

Project Name	Cobourg King Street East Sewer Analysis
Project No.	11192099
Subject	Pre-Development Release Rate (to Brook Street South)

Utilizing the rational method, the allowable release rate can be determined:

Q = C I A where,

Q =	Allowable Release Rate (m^3/s)	
C =	Runoff Coefficient =	0.25
I =	Intensity (mm/hr)	
A =	Area (ha) =	2.71

The Intensity for Cobourg can be calculated as:

I = a / (b + t)^c where,

		2 Year	**5 Year**	**10 Year**	**25 Year**	**50 Year**	**100 Year**
I =	Intensity (mm/hr)						
a =	Constant =	1778	2464	2819	3886	4750	5588
b =	Constant =	13	16	16	18	24	28
c =	Constant =	1	1	1	1	1	1
t =	Time of Concentration (min) =	15	15	15	15	15	15
I =	Intensity (mm/hr)	63.50	79.48	90.94	117.76	121.79	129.95
Q =	**Allowable Release Rate (m^3/s)**	**0.120**	**0.150**	**0.171**	**0.222**	**0.229**	**0.245**

CALCULATIONS

Prepared by R.B.
Checked by J.I.

Project Name	Cobourg King Street East Sewer Analysis
Project No.	11192099
Subject	Pre-Development Release Rate (to adjacent 38 Brook Road)

Utilizing the rational method, the allowable release rate can be determined:

Q = C I A where,

Q =	Allowable Release Rate (m^3/s)	
C =	Runoff Coefficient =	0.20
I =	Intensity (mm/hr)	
A =	Area (ha) =	1.54

The Intensity for Cobourg can be calculated as:

I = a / (b + t)^c where,

		2 Year	**5 Year**	**10 Year**	**25 Year**	**50 Year**	**100 Year**
I =	Intensity (mm/hr)						
a =	Constant =	1778	2464	2819	3886	4750	5588
b =	Constant =	13	16	16	18	24	28
c =	Constant =	1	1	1	1	1	1
t =	Time of Concentration (min) =	15	15	15	15	15	15
I =	Intensity (mm/hr)	63.50	79.48	90.94	117.76	121.79	129.95
Q =	**Allowable Release Rate (m^3/s)**	**0.054**	**0.068**	**0.078**	**0.101**	**0.104**	**0.111**

CALCULATIONS

Prepared by R.B.
Checked by J.I.

Project Name	Cobourg King Street East Sewer Analysis
Project No.	11192099
Subject	Post Development Uncontrolled Release Rate (to Brook Street South)

Utilizing the rational method, the post development release rate can be determined:

Q = C I A where,

Q = Flow rate (cms)
C = Runoff Coefficient
I = Intensity (mm/hr)
A = Area (ha)

The Intensity for Cobourg can be calculated as:

I = a / (b + t)^c where,

		2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
I =	Intensity (mm/hr)						
a =	Constant =	1778	2464	2819	3886	4750	5588
b =	Constant =	13	16	16	18	24	28
c =	Constant =	1	1	1	1	1	1
t =	Time of Concentration (min) =	15	15	15	15	15	15
I =		63.50	79.48	90.94	117.76	121.79	129.95

Based on the proposed land use the post development flow rates are:

Area ID	Area Description	Area (ha)	Runoff Coefficient	Flow Rates (m^3/s)					
				2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
101	Site + External Drainage Area	0.86	0.30	0.046	0.057	0.065	0.084	0.087	0.093
Total		0.86	0.30	0.046	0.057	0.065	0.084	0.087	0.093

CALCULATIONS

Prepared by R.B.
Checked by J.I.

Project Name	Cobourg King Street East Sewer Analysis
Project No.	11192099
Subject	Post Development Uncontrolled Release Rate (to Coverdale Avenue)

Utilizing the rational method, the post development release rate can be determined:

Q = C I A where,

Q = Flow rate (cms)
C = Runoff Coefficient
I = Intensity (mm/hr)
A = Area (ha)

The Intensity for Cobourg can be calculated as:

I = a / (b + t)^c where,

		2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
I =	Intensity (mm/hr)						
a =	Constant =	1778	2464	2819	3886	4750	5588
b =	Constant =	13	16	16	18	24	28
c =	Constant =	1	1	1	1	1	1
t =	Time of Concentration (min) =	15	15	15	15	15	15
I =		63.50	79.48	90.94	117.76	121.79	129.95

Based on the proposed land use the post development flow rates are:

Area ID	Area Description	Area (ha)	Runoff Coefficient	Flow Rates (m^3/s)					
				2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
101	Site + External Drainage Area	1.85	0.52	0.170	0.212	0.243	0.315	0.325	0.347
Total		1.85	0.52	0.170	0.212	0.243	0.315	0.325	0.347

CALCULATIONS

Prepared by E.L.
Checked by J.I.

Project Name	Cobourg King Street East Sewer Analysis
Project No.	11192099
Subject	Orifice Calculations

Controlled Site Area =	1.85	ha
Qo - Allowable Orifice Release Rate =	**0.020**	**m^3/s**

Catchment ID =	Site	
Orifice Location =	CBMH3	
Orifice Type =	Orifice Plate	
Invert Elevation =	82.81	m
Diameter of Orifice =	**83**	**mm**
Area of Orifice (A)=	0.005	m^2
Orifice Coefficient (C_d) =	0.620	

Calculation of Head

Water Elevation =	84.61	m
Upstream Head[a], H =	1.756	m

$$Q_A = C_d A (2 g h)^{1/2}$$

Actual Controlled Discharge, Q_A=	**0.020**	**m^3/s**

[a]Head is based on depth of water above orifice midpoint

[b]Velocity based on orifice area @ orifice face not Vena Contracta

CALCULATIONS

Prepared by R.B.
Checked by J.I.

Project Name	Cobourg King Street East Sewer Analysis
Project No.	11192099
Subject	Modified Rational Storage Calculations

100 Year

Catchment ID =	101	
Time of Concentration (t_c) =	15	minutes
Time Step (t_1) =	10	minutes
Runoff Coefficient (C) =	0.52	
Catchment Area (A) =	1.85	ha

Target Release Rate (Q_o) =	0.020	m^3/s

Time $t = t_c + t_1$ (min.)	Intensity $I=a/(t_c+b)^c$ (mm/hr)	Runoff $Q=CIA$ (m^3/s)	Storage Rate $Q_s = Q - Q_o$ (m^3/s)	Required Storage $V = Q_s t$ (m^3)
15	130	0.347	0.327	295
25	105	0.282	0.262	393
35	89	0.237	0.217	456
45	77	0.205	0.185	498
55	67	0.180	0.160	528
65	60	0.161	0.141	548
75	54	0.145	0.125	562
85	49	0.132	0.112	572
95	45	0.121	0.101	578
105	42	0.112	0.092	581
115	39	0.104	0.084	583
125	37	0.098	0.078	582
135	34	0.092	0.072	580
145	32	0.086	0.066	577
155	31	0.082	0.062	573
165	29	0.077	0.057	568
175	28	0.074	0.054	562
185	26	0.070	0.050	556
195	25	0.067	0.047	549
205	24	0.064	0.044	542
215	23	0.061	0.041	535
225	22	0.059	0.039	527
235	21	0.057	0.037	519
245	20	0.055	0.035	510
255	20	0.053	0.033	501
265	19	0.051	0.031	492
275	18	0.049	0.029	483
285	18	0.048	0.028	474
295	17	0.046	0.026	464
305	17	0.045	0.025	455

100 Year Storage Required =	583	m^3

CALCULATIONS

Prepared by E.L.
Checked by J.I.

Project Name	425 King Street East - Cobourg
Project No.	11192099
Subject	Pipe Storage Volume

Storage Volume Needed:	27	m^3

Pipe Storage

From	To	Size (mm)	Length (m)	Volume (m^3)
CBMH2	MH3	300	25.6	1.81
STMTECH	DCBMH6	375	16.4	1.81
DCBMH6	MH8	450	8.7	1.38
STMTECH	DCBMH9	600	30.3	8.57
DCBMH9	MH13	600	18.2	5.15
RYCB1	STMTECH	300	35.6	2.52
RYCB2	STMTECH	300	35.9	2.54
RYCB3	MH13	300	50.2	3.55
			TOTAL	27.32

Top of Clear Stone Elevation:	84.61	m

Manhole Storage

Manhole	Diameter (mm)	Bottom Elevation (m)	Depth (m)	Volume (m^3)
CBMH2	1200	84.11	0.50	0.57
MH3	1200	83.98	0.63	0.71
DCBMH6	1500	83.19	1.42	2.51
MH8	1200	83.16	1.45	1.64
DCBMH9	1500	82.61	2.00	3.53
MH13	1200	82.78	1.83	2.07
			TOTAL	11.03

Storage Volume Achieved:	38.35	m^3

CALCULATIONS

Prepared by E.L.
Checked by J.I.

Project Name	425 King Street East - Cobourg
Project No.	11192099
Subject	CB1 & CBMH2 Capacity

Contributing drainage area =	0.11	ha
Max allowable ponding above grate =	0.15	m
Peak Flow (100 year storm) entering grate =	0.03	m^3/s
Assume % Loss due to Grating =	60	%
Surface area of grate =	0.72	m^2

1 x 600mmx600mm CB1 x 600x600mm CBMH2 (O.P.S.D. 705.010)

Use orifice equation to determine inflow at a ponding depth of 0.15 **m**

Orifice Calculation to Determine Inlet Capacity:

Q =	0.03		m^3/s
C =	0.62		
$A_{40\% Grate}$ =	0.29		m^2
h =	0.15		m
g =	9.81		m/s^2

$Q = C \times A \times (2gh)^{1/2}$

$Q = 0.306$ m^3/s

$Q_{50\%} = 0.153$ m^3/s Inlet Capacity Assuming 50% Blockage

$Q_{Major} = Q_{100}$

$= 0.025$ m^3/s < 0.153 m^3/s

$d_{ponding} = 0.001$ m < 0.15 m

**the resulting ponding depth is less than the maximum allowable ponding depth

Project Name	425 King Street East - Cobourg
Project No.	11192099
Subject	DCBMH4 & DCB5 Capacity

Contributing drainage area =	0.29	ha
Max allowable ponding above grate =	0.15	m
Peak Flow (100 year storm) entering grate =	0.07	m^3/s
Assume % Loss due to Grating =	60	%
Surface area of grate =	1.44	m^2

1 x 1200mmx600mm DCB4 + 1 1200x600mm DCB5 (O.P.S.D. 705.010)

Use orifice equation to determine inflow at a ponding depth of 0.15 **m**

Orifice Calculation to Determine Inlet Capacity:

Q =	0.07	m^3/s
C =	0.62	
$A_{40\% Grate}$ =	0.58	m^2
h =	0.15	m
g =	9.81	m/s^2

$Q = C \times A \times (2gh)^{1/2}$

$Q = 0.613 \ m^3/s$

$Q_{50\%} = 0.306 \ m^3/s$ Inlet Capacity Assuming 50% Blockage

$Q_{Major} = Q_{100}$

$= 0.066 \ m^3/s < 0.306 \ m^3/s$

$d_{ponding} = 0.002 \ m < 0.15 \ m$

**the resulting ponding depth is less than the maximum allowable ponding depth

Project Name	425 King Street East - Cobourg
Project No.	11192099
Subject	DCBMH6 & DCB7 Capacity

Contributing drainage area =	0.20	ha
Max allowable ponding above grate =	0.15	m
Peak Flow (100 year storm) entering grate =	0.05	m^3/s
Assume % Loss due to Grating =	60	%
Surface area of grate =	1.44	m^2

1 x 1200mmx600mm DCBMH6 + 1 1200x600mm DCB7 (O.P.S.D. 705.010)

Use orifice equation to determine inflow at a ponding depth of 0.15 **m**

Orifice Calculation to Determine Inlet Capacity:

Q =	0.05	m^3/s
C =	0.62	
$A_{40\% Grate}$ =	0.58	m^2
h =	0.15	m
g =	9.81	m/s^2

$Q = C \times A \times (2gh)^{1/2}$

$Q = 0.613 \ m^3/s$

$Q_{50\%} = 0.306 \ m^3/s$ Inlet Capacity Assuming 50% Blockage

$Q_{Major} = Q_{100}$

$= 0.045 \ m^3/s < 0.306 \ m^3/s$

$d_{ponding} = 0.001 \ m < 0.15 \ m$

**the resulting ponding depth is less than the maximum allowable ponding depth

Project Name	425 King Street East - Cobourg
Project No.	11192099
Subject	DCBMH9 & DCB10 Capacity

Contributing drainage area =	0.18	ha
Max allowable ponding above grate =	0.15	m
Peak Flow (100 year storm) entering grate =	0.04	m^3/s
Assume % Loss due to Grating =	60	%
Surface area of grate =	1.44	m^2

1 x 1200mmx600mm DCBMH9 + 1 1200x600mm DCB10 (O.P.S.D. 705.010)

Use orifice equation to determine inflow at a ponding depth of 0.15 **m**

Orifice Calculation to Determine Inlet Capacity:

Q =	0.04	m^3/s
C =	0.62	
$A_{40\% Grate}$ =	0.58	m^2
h =	0.15	m
g =	9.81	m/s^2

$Q = C \times A \times (2gh)^{1/2}$

$Q = 0.613$ m^3/s

$Q_{50\%} = 0.306$ m^3/s Inlet Capacity Assuming 50% Blockage

$Q_{Major} = Q_{100}$

$= 0.041$ m^3/s < 0.306 m^3/s

$d_{ponding} = 0.001$ m < 0.15 m

**the resulting ponding depth is less than the maximum allowable ponding depth

Project Name	425 King Street East - Cobourg
Project No.	11192099
Subject	RYCB1 Capacity

Contributing drainage area =		0.13	ha
Max allowable ponding above grate =		0.30	m
Peak Flow (100 year storm) entering grate =		0.03	m^3/s
Assume % Loss due to Grating =		60	%
600x600mm CB (O.P.S.D. 705.010)	Surface area of grate =	0.36	m^2

Use orifice equation to determine inflow at a ponding depth of 0.3 **m**

Orifice Calculation to Determine Inlet Capacity:

Q =		0.03	m^3/s
C =		0.62	
$A_{40\%}$ =		0.14	m^2
h =		0.30	m
g =		9.81	m/s^2

$Q = C \times A \times (2gh)^{1/2}$

$Q = 0.108 \ m^3/s$

$Q_{50\%} = 0.054 \ m^3/s$ Inlet Capacity Assuming 50% Blockage

$Q_{Major} = Q_{100}$

$= 0.030 \ m^3/s < 0.054 \ m^3/s$

$d_{ponding} = 0.01 \ m < 0.30 \ m$

**the resulting ponding depth is less than the maximum allowable ponding depth therefore no flooding of the neighbouring proerty will occur

Project Name	425 King Street East - Cobourg
Project No.	11192099
Subject	RYCB2 Capacity

Contributing drainage area =		0.2	ha
Max allowable ponding above grate =		0.30	m
Peak Flow (100 year storm) entering grate =		0.05	m^3/s
Assume % Loss due to Grating =		60	%
600x600mm CB (O.P.S.D. 400.120)	Surface area of grate =	0.36	m^2

Use orifice equation to determine inflow at a ponding depth of 0.3 **m**

Orifice Calculation to Determine Inlet Capacity:

Q =		0.05	m^3/s
C =		0.62	
$A_{40\% Grate}$ =		0.14	m^2
h =		0.30	m
g =		9.81	m/s^2

$Q = C \times A \times (2gh)^{1/2}$

$Q = 0.217 \ m^3/s$

**the catchbasin grate as per OPSD 400.120, will not clog as it is rasied.

$Q_{Major} = Q_{100}$

$= 0.046 \ m^3/s < 0.217 \ m^3/s$

$d_{ponding} = 0.01 \ m < 0.30 \ m$

CALCULATIONS

Prepared by E.L.
Checked by J.I.

Project Name	425 King Street East - Cobourg
Project No.	11192099
Subject	RYCB3 Capacity

Contributing drainage area =		0.74	ha
Max allowable ponding above grate =		0.30	m
Peak Flow (100 year storm) entering grate =		0.09	m^3/s
Assume % Loss due to Grating =		60	%
600x600mm CB (O.P.S.D. 400.120)	Surface area of grate =	0.36	m^2

Use orifice equation to determine inflow at a ponding depth of 0.3 **m**

Orifice Calculation to Determine Inlet Capacity:

Q =		0.09	m^3/s
C =		0.62	
$A_{40\% Grate}$ =		0.14	m^2
h =		0.30	m
g =		9.81	m/s^2

$Q = C \times A \times (2gh)^{1/2}$

$Q = 0.217 \ m^3/s$

**the catchbasin grate as per OPSD 400.120, will not clog as it is rasied.

$Q_{Major} = Q_{100}$

$= 0.091 \ m^3/s < 0.217 \ m^3/s$

$d_{ponding} = 0.05 \ m < 0.30 \ m$

GHD INC.

65 Sunray St.
Whitby, ON
L1N 8Y3

T . 905 . 686 . 6402
F . 905 . 432 . 7877
www.ghd.com

Date: 04/22/20
Project: 425 KING STREET EAST, COBOURG
Proj. No.: 11192099

Max allowable ponding above grate =	0.55	m
Peak Flow (100 year storm) entering grate =	0.171	m^3/s
Assume % of Grate is Blocked (clogged)	50	%
Assume % of Area Loss due to Grate	55	%
DICB1 600mm x 600mm (O.P.S.D. 705.030)		
Surface area of grate =	0.4	m^2

Capacity of Grate at Maximum Ponding Depth

$$Q = C\,A\sqrt{2gh}$$

Q =		m^3/s
C =	0.62	
A =	0.09	m^2
h_1 =	0.55	m
g =	9.81	m/s^2

Q_1= 0.183 m^3/s > **0.17 m^3/s (PEAK FLOW)**

Head Above Centreline of Pipe at Max Flow

Outlet Flow - **300 mm dia pipe**

$$h = Q^2 \div C^2 \times A^2 \times 2g$$

Q =	0.171	m^3/s
C =	0.62	
A =	0.0703	m^2
h =		m
g =	9.81	m/s^2

h_2 = 0.78 m

Maximum Capacity of Pipe

300 mm dia pipe @ 3.50 % Slope

$$Q = (1.0 \times A \times R^{2/3} \times S^{1/2}) \div n$$

Q =		m^3/s
C =	0.62	
A =	0.0703	m^2
n =	0.013	
S =	3.5	%
R =	0.07484	

Q_2= 0.180 m^3/s > **0.17 m^3/s (PEAK FLOW)**

Worksheet for Pre-Development Weir

Project Description

Solve For	Headwater Elevation

Input Data

Discharge		0.11	m^3/s
Crest Elevation		83.08	m
Tailwater Elevation		83.08	m
Crest Surface Type	Gravel		
Crest Breadth		1.50	m
Crest Length		4.00	m

Results

Headwater Elevation	83.15	m
Headwater Height Above Crest	0.07	m
Tailwater Height Above Crest	0.00	m
Weir Coefficient	1.44	SI
Submergence Factor	1.00	
Adjusted Weir Coefficient	1.44	SI
Flow Area	0.29	m^2
Velocity	0.38	m/s
Wetted Perimeter	4.14	m
Top Width	4.00	m

Culvert Calculator Report
Molly Baker Trail

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	0.30	m	Headwater Depth/Height	0.62	
Computed Headwater Elev	83.13	m	Discharge	0.0230	m³/s
Inlet Control HW Elev.	83.10	m	Tailwater Elevation	83.00	m
Outlet Control HW Elev.	83.13	m	Control Type	Outlet Control	

Grades					
Upstream Invert	82.94	m	Downstream Invert	82.89	m
Length	3.50	m	Constructed Slope	0.014286	m/m

Hydraulic Profile					
Profile	M2		Depth, Downstream	0.11	m
Slope Type	Mild		Normal Depth	0.13	m
Flow Regime	Subcritical		Critical Depth	0.11	m
Velocity Downstream	0.91	m/s	Critical Slope	0.021074	m/m

Section					
Section Shape	Circular		Mannings Coefficient	0.025	
Section Material	12-15 inch (Corrugated Interior)		Span	0.30	m
Section Size	300 mm		Rise	0.30	m
Number Sections	1				

Corrugated Section Material: HDPE

Outlet Control Properties					
Outlet Control HW Elev.	83.13	m	Upstream Velocity Head	0.03	m
Ke	0.90		Entrance Loss	0.03	m

Inlet Control Properties					
Inlet Control HW Elev.	83.10	m	Flow Control	Unsubmerged	
Inlet Type	Groove end projecting		Area Full	0.1	m²
K	0.00450		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	3	
C	0.03170		Equation Form	1	
Y	0.69000				

Worksheet for Post-Development Weir

Project Description

Solve For	Headwater Elevation

Input Data

Discharge		0.07	m³/s
Crest Elevation		83.08	m
Tailwater Elevation		83.08	m
Crest Surface Type	Gravel		
Crest Breadth		1.50	m
Crest Length		4.00	m

Results

Headwater Elevation	83.13	m
Headwater Height Above Crest	0.05	m
Tailwater Height Above Crest	0.00	m
Weir Coefficient	1.42	SI
Submergence Factor	1.00	
Adjusted Weir Coefficient	1.42	SI
Flow Area	0.21	m²
Velocity	0.33	m/s
Wetted Perimeter	4.11	m
Top Width	4.00	m

= Weir Discharge (@ 83.13m) + Culvert Discharge (@83.13m) =
0.07m3/s + 0.020m3/s
= 0.09m3/s
Therefore, the post-development ponding elevation is 83.13m, as the 100year flows will be able to pass.

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER:	CODY NEATH 519-465-9958 CODY.NEATH@ADS-PIPE.COM
ADS SALES REP:	MICHAEL REID 613-822-4186 MICHAEL.REID@ADS-PIPE.COM
PROJECT NO:	S156422

ADVANCED DRAINAGE SYSTEMS, INC.

SiteASSIST™ by StormTech

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425 KING STREET EAST

COBOURG, ON.

MC-3500 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-3500.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL BE CERTIFIED TO CSA B184, "POLYMERIC SUB-SURFACE STORMWATER MANAGEMENT STRUCTURES", AND MEET THE REQUIREMENTS OF ASTM F2418-16a, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. 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 CSA S6 CL-625 TRUCK AND THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
6. CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 75 mm (3").
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 500 LBS/IN/IN. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 23° C / 73° F), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE 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 SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. 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 - 150 mm (6") SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 300 mm (12") INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE 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. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
11. 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 CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 900 mm (36") 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.

PROPOSED LAYOUT - NORTH BED

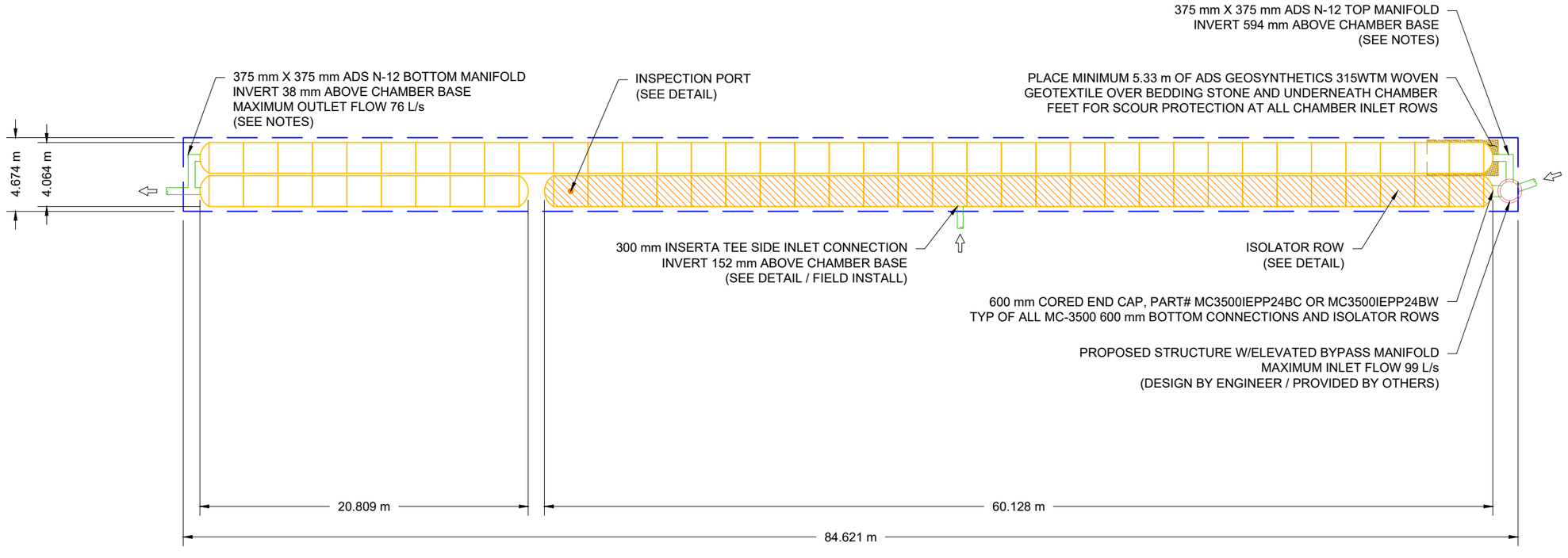
73	STORMTECH MC-3500 CHAMBERS
6	STORMTECH MC-3500 END CAPS
305	STONE ABOVE (mm)
229	STONE BELOW (mm)
40	% STONE VOID
403.0	**INSTALLED SYSTEM VOLUME (m^3) (PERIMETER STONE INCLUDED)**
395.4	SYSTEM AREA (m^2)
178.5	SYSTEM PERIMETER (m)

PROPOSED ELEVATIONS - NORTH BED

86.469	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):
84.641	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):
84.488	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):
84.488	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):
84.488	MINIMUM ALLOWABLE GRADE (TOP OF RIGID PAVEMENT):
84.336	TOP OF STONE:
84.031	TOP OF MC-3500 CHAMBER:
83.482	375 mm TOP MANIFOLD INVERT:
83.040	INSERTA TEE SIDE INLET CONNECTION INVERT:
82.940	600 mm ISOLATOR ROW INVERT:
82.928	375 mm BOTTOM MANIFOLD INVERT:
82.888	BOTTOM OF MC-3500 CHAMBER:
82.659	BOTTOM OF STONE:

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECHNICAL NOTE 6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.



425 KING STREET EAST
COBOURG, ON.

DATE: 10/31/19 | DRAWN: RCT | CHECKED: JMQ
PROJECT #: S156422

DATE	DRWN	CHKD	DESCRIPTION

StormTech
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ADS
ADVANCED DRAINAGE SYSTEMS, INC.
4640 TRUEMAN BLVD
HILLIARD, OH 43026

SCALE = 1 : 300

PROPOSED LAYOUT - EAST BED

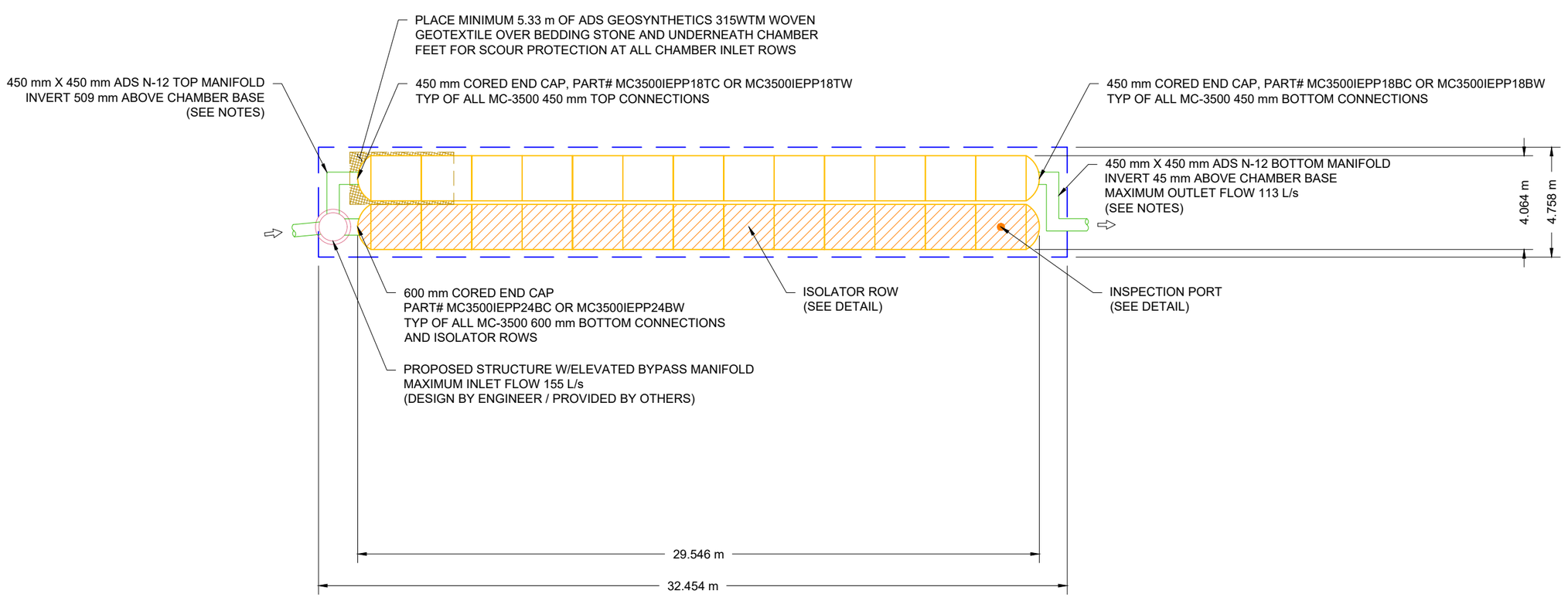
26	STORMTECH MC-3500 CHAMBERS
4	STORMTECH MC-3500 END CAPS
305	STONE ABOVE (mm)
229	STONE BELOW (mm)
40	% STONE VOID
153.1	**INSTALLED SYSTEM VOLUME (m^3) (PERIMETER STONE INCLUDED)**
154.4	SYSTEM AREA (m^2)
74.4	SYSTEM PERIMETER (m)

PROPOSED ELEVATIONS - EAST BED

86.469	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):
84.641	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):
84.488	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):
84.488	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):
84.488	MINIMUM ALLOWABLE GRADE (TOP OF RIGID PAVEMENT):
84.336	TOP OF STONE:
84.031	TOP OF MC-3500 CHAMBER:
83.397	450 mm TOP MANIFOLD INVERT:
82.940	600 mm ISOLATOR ROW INVERT:
82.934	450 mm BOTTOM MANIFOLD INVERT:
82.888	BOTTOM OF MC-3500 CHAMBER:
82.659	BOTTOM OF STONE:

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECHNICAL NOTE 6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.



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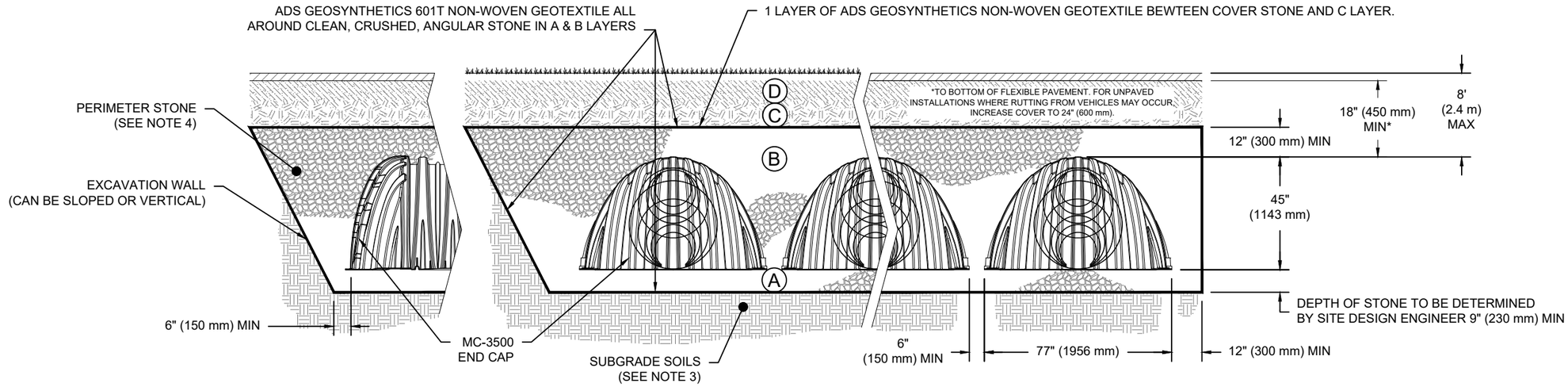
ADVANCED DRAINAGE SYSTEMS, INC.
4640 TRUEMAN BLVD
HILLIARD, OH 43026

SCALE = 1 : 200

ACCEPTABLE FILL MATERIALS: STORMTECH MC-3500 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF 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 AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.



NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418-16a, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
2. MC-3500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 500 LBS/IN/IN. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.

425 KING STREET EAST
COBOURG, ON.

DATE: 10/31/19 | DRAWN: RCT | CHECKED: JMQ
PROJECT #: S156422

DATE	DRWN	CHKD	DESCRIPTION

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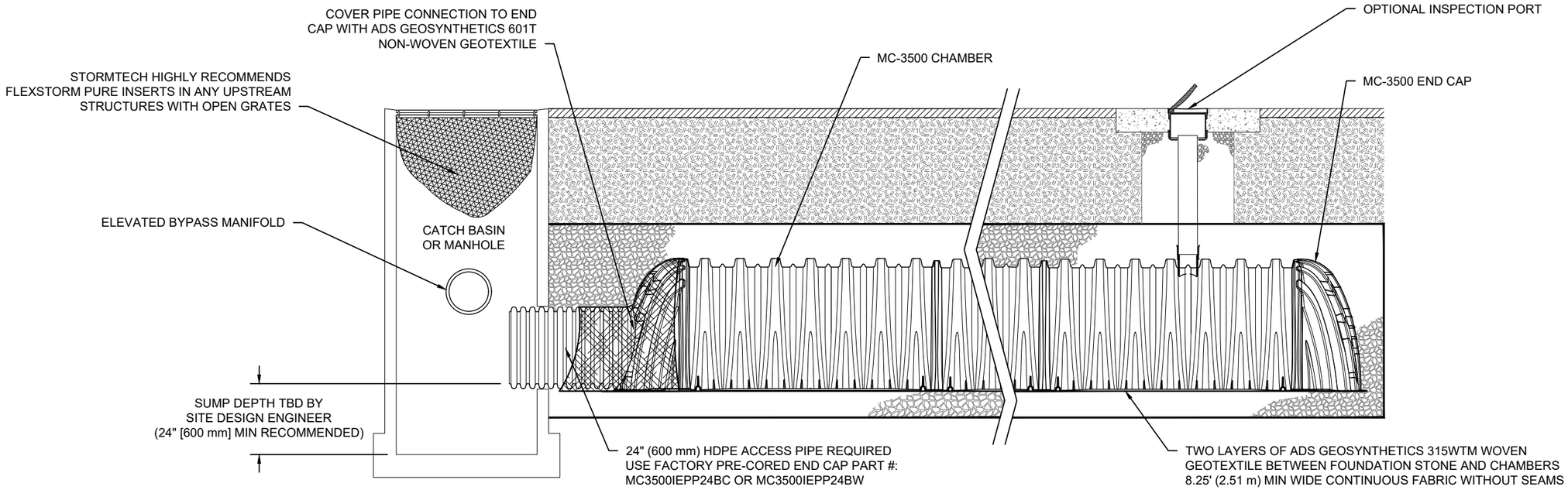


MC-3500 ISOLATOR ROW DETAIL
NTS

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

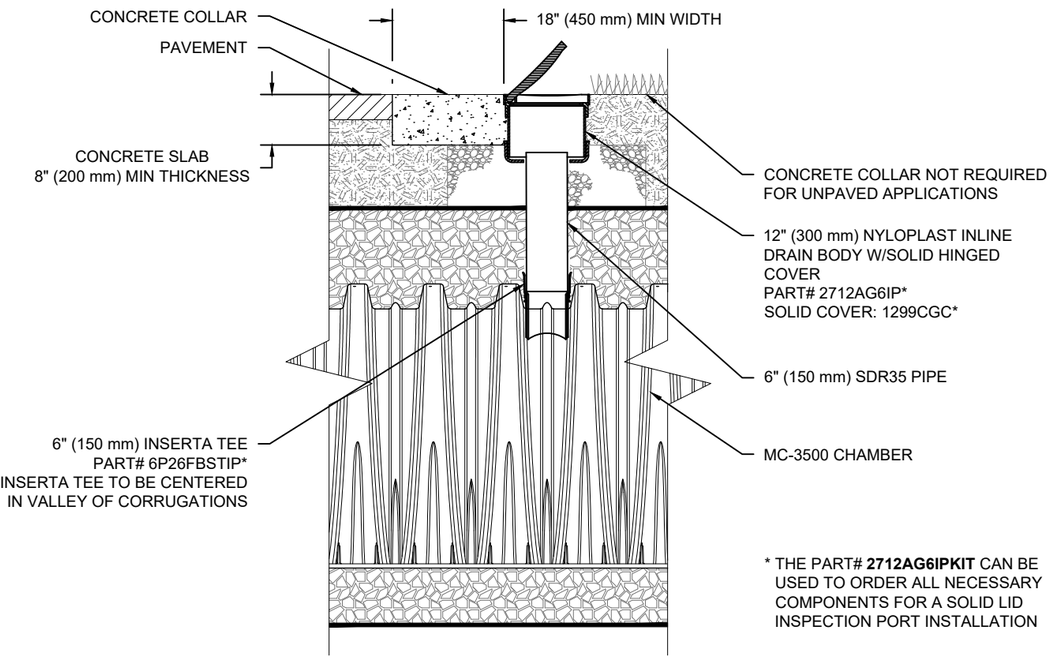
STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.

2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.



* THE PART# **2712AG6IPKIT** CAN BE USED TO ORDER ALL NECESSARY COMPONENTS FOR A SOLID LID INSPECTION PORT INSTALLATION

MC-3500 6" (150 mm) INSPECTION PORT DETAIL
NTS

425 KING STREET EAST
COBOURG, ON.

DATE: 10/31/19 | DRAWN: RCT | CHECKED: JMQ
PROJECT #: S156422

DATE	DRWN	CHKD	DESCRIPTION

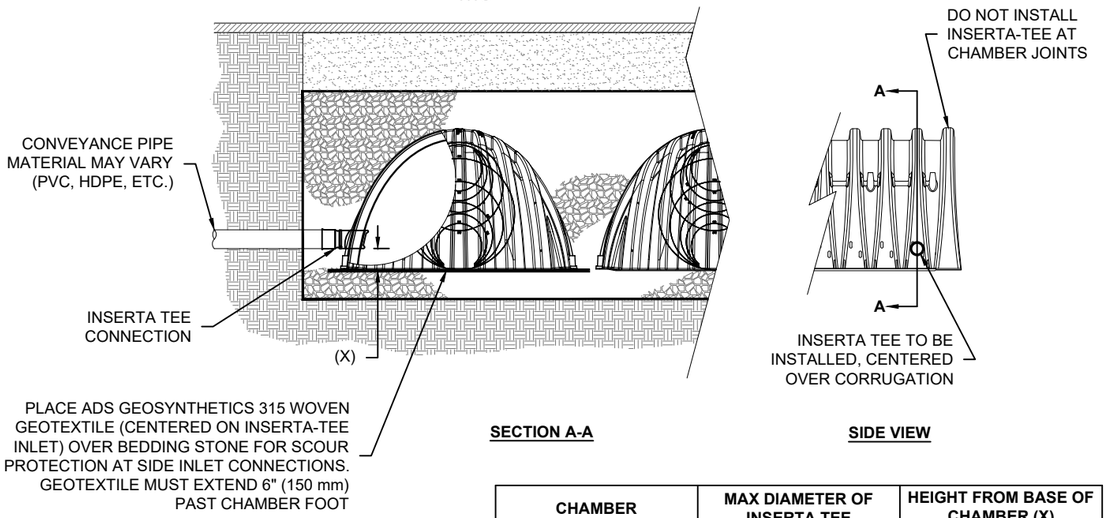
THIS DRAWING HAS BEEN PREPARED BASED ON INFORMATION PROVIDED TO ADS UNDER THE DIRECTION OF THE SITE DESIGN ENGINEER SHALL REVIEW THIS DRAWING PRIOR TO CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE SITE DESIGN ENGINEER TO ENSURE THAT THE PRODUCT(S) DEPICTED AND ALL ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.

StormTech
Detention • Retention • Water Quality
70 INWOOD ROAD, SUITE 3 | ROCKY HILL | CT | 06067
860-529-8188 | 888-892-2694 | WWW.STORMTECH.COM

ADS
ADVANCED DRAINAGE SYSTEMS, INC.
4640 TRUEMAN BLVD
HILLIARD, OH 43026

INSERTA TEE DETAIL

NTS



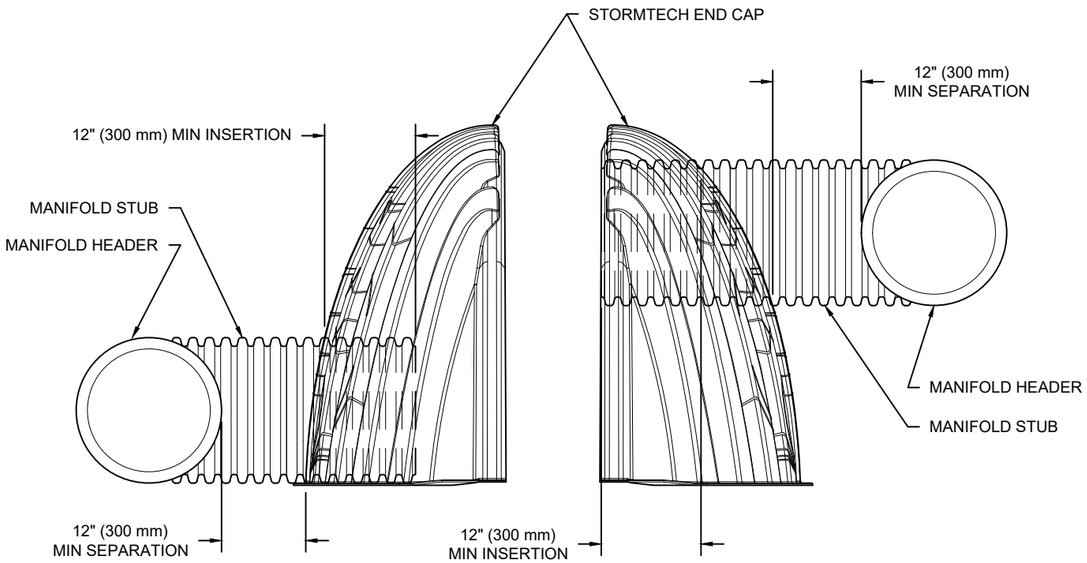
SECTION A-A **SIDE VIEW**

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 FITTINGS AVAILABLE FOR SDR 26, SDR 35, SCH 40 IPS GASKETED & SOLVENT WELD, N-12, HP STORM, C-900 OR DUCTILE IRON		

NOTE:
PART NUMBERS WILL VARY BASED ON INLET PIPE MATERIALS. CONTACT STORMTECH FOR MORE INFORMATION.

MC-SERIES END CAP INSERTION DETAIL

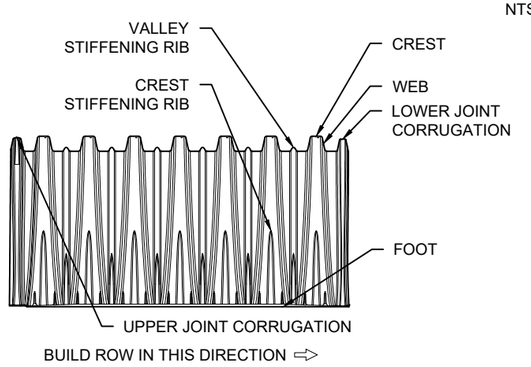
NTS

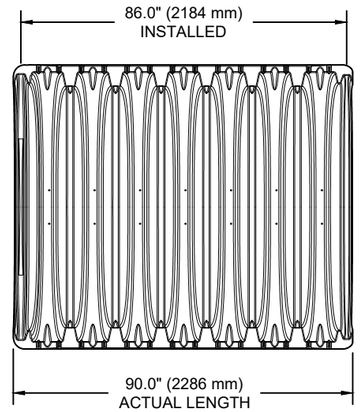


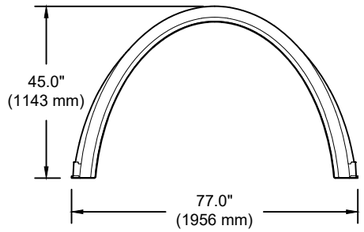
NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

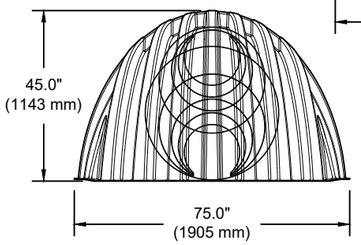
MC-3500 TECHNICAL SPECIFICATION

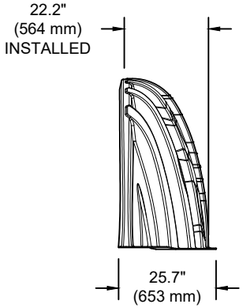
NTS











NOMINAL CHAMBER SPECIFICATIONS

SIZE (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 CUBIC FEET	(3.11 m³)
MINIMUM INSTALLED STORAGE*	175.0 CUBIC FEET	(4.96 m³)
WEIGHT	134 lbs.	(60.8 kg)

NOMINAL END CAP SPECIFICATIONS

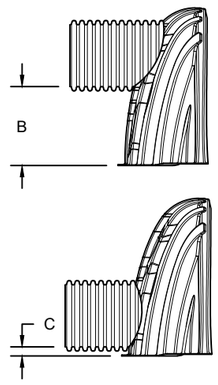
SIZE (W X H X INSTALLED LENGTH)	75.0" X 45.0" X 22.2"	(1905 mm X 1143 mm X 564 mm)
END CAP STORAGE	14.9 CUBIC FEET	(0.42 m³)
MINIMUM INSTALLED STORAGE*	45.1 CUBIC FEET	(1.28 m³)
WEIGHT	49 lbs.	(22.2 kg)

*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION, 6" (152 mm) STONE BETWEEN CHAMBERS, 6" (152 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY.

STUBS AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
STUBS AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A WELDED CROWN PLATE END WITH "C"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "W"

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)	---
MC3500IEPP18TW			
MC3500IEPP18BC		---	1.77" (45 mm)
MC3500IEPP18BW			
MC3500IEPP24TC	24" (600 mm)	14.48" (368 mm)	---
MC3500IEPP24TW			
MC3500IEPP24BC		---	2.06" (52 mm)
MC3500IEPP24BW			
MC3500IEPP30BC	30" (750 mm)	---	2.75" (70 mm)

NOTE: ALL DIMENSIONS ARE NOMINAL



CUSTOM PRECORED INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS. CUSTOM INVERT LOCATIONS ON THE MC-3500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm). THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHEST POSSIBLE FOR THE PIPE SIZE.

425 KING STREET EAST
COBOURG, ON.

DATE: 10/31/19 | DRAWN: RCT | CHECKED: JMQ
PROJECT #: S156422

DATE	DESCRIPTION	CHKD	DRWN

StormTech
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ADS
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4640 TRUEMAN BLVD
HILLIARD, OH 43026

E INV 83.24

ORCHARD AVENUE

300mmø STM

1.5m CONC. SIDEWALK

MH2A
GRATE 85.85
NW INV 81.70
S INV 81.78

Ex. 1.8m HIGH
CHAIN LINK
FENCE

RYCB1
GRATE 85.67
INV 83.87

300mmø STM

Ex. 1.8m HIGH
CHAIN LINK
FENCE

RYCB2
GRATE 85.15
INV 83.28

MC-3500 SYSTEM FOOT
PRINT

200mmø SAN

150mmø WATERMAIN

MH3A
GRATE 85.56
N INV 82.10
SE INV 82.16

200mmø SAN

MH4A
GRATE 85.46
INV 82.25

CBMH2
GRATE 85.42
E INV 82.94
NW INV 82.99
N INV 83.08

375mmø STM

MH5A
GRATE 85.51
INV 82.63

1.5m CONC. SIDEWALK

300mmø STM

450mmø STM

525mmø STM

200mmø SAN

300mmø STM

MC-3500 SYSTEM FOOT
PRINT

Ex. 1.8m HIGH
BOARD FENCE

CBMH3

300mmø STM

Ex. 200mmØ WATERMA
300mmØ CPP

EDGE OF ASPHALT

EXISTING CENTRELINE

EDGE OF ASPHALT

300mmø STM

300mmØ CPP

421

48

44

42

40

38

431

427

2

Appendix **C**

King Street East/Coverdale Trunk Storm Sewer Analysis

65 Sunray St.
Whitby, Ontario
L1N 8Y3
905-686-6402

Town of Cobourg
PRE-DEVELOPMENT STORM SEWER DESIGN SHEET

Project Name: Cobourg King Street East Sewer Analysis
Project No. 11192099

PREPARED BY: R.B.
CHECKED BY: J.I.
DATE: 20-Apr-20

15 MINUTE ENTRY TIME
100yr-Design Storm

Street	From MH	To MH	A Area (ha)	R Runoff Coeff.	2.78AR	Accum. 2.78AR	Time of Conc. (min)	Rainfall (mm/hr)	Q Peak Flow (l/s)	Pipe Diameter (mm)	Design Slope (%)	Length (m)	Capacity (l/s)	Capacity Problem	Velocity (m/s)	Time in Section (min)	Total Time (min)	Remarks
Future Basin North of King	27	26	38.27	0.47	50.004	50.004	29.15	97.78	4,889	1500	0.45	1.0	4,947	No	2.71	0.01	29.16	
	27	26	2.68	0.40	2.980	2.980	29.15	97.78	291	1500	0.45	1.0	4,947	No	2.71	0.01	29.16	
East Village	27	26	11.80				29.15	97.78	148	1500	0.45	1.0	4,947	No	2.71	0.01	29.16	East Village Controlled Flow
King Street East	26	25	3.09	0.40	3.436	56.420	29.16	97.77	5,664	1500	0.45	288.0	4,947	Yes	2.71	1.77	30.93	
	25	24	1.53	0.40	1.701	58.121	30.93	94.83	5,660	1500	0.50	100.0	5,215	Yes	2.86	0.58	31.51	
	24	21	1.67	0.40	1.857	59.978	31.51	93.90	5,780	1500	0.56	107.0	5,519	Yes	3.03	0.59	32.10	
Brook Road North	231	23	12.10	0.40			40.60	81.46	373	750	0.79	14.0	1,032	No	2.26	0.10	40.70	Gates of Camelot Phase 1 Controlled Flow
	231	23	5.09	0.40	5.660	5.660	15.00	129.95	736	750	0.79	14.0	1,032	No	2.26	0.10	15.10	
King Street East	23	22	1.17	0.40	1.301	6.961	40.70	81.34	939	750	0.50	70.0	821	Yes	1.80	0.65	41.35	
	22	21	1.03	0.40	1.145	8.106	41.35	80.58	1,026	825	0.56	79.0	1,121	No	2.03	0.65	42.00	
Coverdale Avenue	21	20	1.35	0.40	1.501	69.586	42.00	79.83	6,076	1650	0.59	143.0	7,304	No	3.31	0.72	42.72	
Orchard Avenue West	201	20	1.30	0.40	1.446	1.446	17.15	123.77	179	525	1.00	1.0	449	No	2.01	0.01	17.16	Including external drainage area see Figure 2
Orchard Avenue East	202	20	1.30	0.40	1.446	1.446	15.81	127.55	184	375	1.00	1.0	183	Yes	1.60	0.01	15.82	
Coverdale Avenue	20	19	1.42	0.40	1.579	74.056	42.72	79.02	6,373	1650	0.60	143.0	7,365	No	3.34	0.71	43.43	
Hamilton Avenue West	191	19	0.58	0.40	0.645	0.645	17.08	123.96	80	300	0.50	1.0	71	Yes	0.98	0.02	17.10	
Hamilton Avenue East	192	19	12.69	0.40	14.111	14.111	21.52	112.84	1,592	750	1.40	1.0	1,374	Yes	3.01	0.01	21.53	
CoverdaleAvenue	19	18	0.79	0.40	0.878	89.691	43.43	78.23	7,537	1800	0.60	83.0	9,289	No	3.54	0.39	43.82	
	18	17	0.00	0.40		89.691	43.82	77.80	7,499	1800	0.54	16.0	8,812	No	3.35	0.08	43.90	
	17	16	0.63	0.40	0.701	90.391	43.90	77.72	7,546	1800	0.28	147.5	6,345	Yes	2.42	1.02	44.92	
Springbrook Road	163	161	1.20	0.40	1.334	1.334	15.00	129.95	173	375	1.00	110.0	183	No	1.60	1.14	16.14	
	164	161	1.20	0.40	1.334	1.334	15.00	129.95	173	375	1.00	85.0	183	No	1.60	0.88	15.88	
	161	16	0.00	0.40		2.669	15.88	127.34	340	450	1.00	110.0	297	Yes	1.81	1.01	16.89	
Coverdale Avenue	16	10	0.99	0.40	1.101	94.161	44.92	76.63	7,737	1800	0.37	19.0	7,294	Yes	2.78	0.11	45.03	
	10	9	0.62	0.40	0.689	94.851	45.03	76.51	7,778	1800	0.23	55.5	5,751	Yes	2.19	0.42	45.46	
Gardiner Crescent	91	9	1.05	0.40	1.168	1.168	15.00	129.95	152	300	1.00	95.0	101	Yes	1.38	1.15	16.15	
Coverdale Avenue	9	7	0.60	0.40	0.667	96.685	45.46	76.07	7,876	1800	0.86	18.5	11,121	No	4.23	0.07	45.53	
	7	4	0.36	0.40	0.400	97.086	45.53	76.00	7,899	1800	0.86	115.0	11,121	No	4.23	0.45	45.98	
Gardiner Crescent	41	4	1.20	0.40	1.334	1.334	15.00	129.95	173	375	1.00	90.0	183	No	1.60	0.93	15.93	

65 Sunray St.
Whitby, Ontario
L1N 8Y3
905-686-6402

Town of Cobourg
PRE-DEVELOPMENT STORM SEWER DESIGN SHEET

Project Name: Cobourg King Street East Sewer Analysis
Project No. 11192099

PREPARED BY: R.B.
CHECKED BY: J.I.
DATE: 20-Apr-20

15 MINUTE ENTRY TIME
100yr-Design Storm

Street	From MH	To MH	A Area (ha)	R Runoff Coeff.	2.78AR	Accum. 2.78AR	Time of Conc. (min)	Rainfall (mm/hr)	Q Peak Flow (l/s)	Pipe Diameter (mm)	Design Slope (%)	Length (m)	Capacity (l/s)	Capacity Problem	Velocity (m/s)	Time in Section (min)	Total Time (min)	Remarks
Springbrook Road	43	42	1.30	0.40	1.446	1.446	15.00	129.95	188	375	1.00	65.0	183	Yes	1.60	0.68	15.68	
	42	4	0.55	0.40	0.612	2.057	15.68	127.94	263	375	1.00	105.5	183	Yes	1.60	1.10	16.77	
Coverdale Avenue	4	1	0.50	0.40	0.556	101.033	45.98	75.53	8,152	1800	0.82	100.0	10,859	No	4.13	0.40	46.38	
Lakeshore Road West	111	1	0.50	0.40	0.556	0.556	15.00	129.95	72	300	1.00	60.0	101	No	1.38	0.72	15.72	
Lakeshore Road East	112	1	1.17	0.40	1.301	1.301	15.00	129.95	169	375	1.00	75.0	183	No	1.60	0.78	15.78	
Existing Outlet - Coverdale	1	100	0.00	0.40		102.890	46.38	75.12	8,250	1800	0.47	85.2	8,221	Yes	3.13	0.45	46.84	

Runoff Coefficients

0.20	Parks-Cemeteries-Playground	0.70	Schools & Churches		
0.50	Single Family Residential	0.80	Industrial Areas		
0.55	Semi-Detached Residential	0.90	Commercial Areas	100yr: I = 5588 / (T + 28)	
0.65	Townhouses	0.90	Heavily Developed Areas	n = 0.013	
0.70	High Density Residential				

Gates of Camelot Phase 1 - 100 Year Discharge Rate 373 L/s
East Village - 100 Year Discharge Rate 148 L/s

Date	Submission
5-Mar-19	1st Submission

65 Sunray St.
Whitby, Ontario
L1N 8Y3
905-686-6402

Town of Cobourg
POST-DEVELOPMENT STORM SEWER DESIGN SHEET

Project Name: Cobourg King Street East Sewer Analysis
Project No. 11192099

PREPARED BY: R.B.
CHECKED BY: K.E.
DATE: 15-Mar-19

15 MINUTE ENTRY TIME
100yr-Design Storm

Street	From MH	To MH	A Area (ha)	R Runoff Coeff.	2.78AR	Accum. 2.78AR	Time of Conc. (min)	Rainfall (mm/hr)	Q Peak Flow (l/s)	Pipe Diameter (mm)	Design Slope (%)	Length (m)	Capacity (l/s)	Capacity Problem	Velocity (m/s)	Time in Section (min)	Total Time (min)	Remarks
Future Basin North of King	27	26	38.27	0.47	50.004	50.004	29.15	97.78	4,889	1500	0.45	1.0	4,947	No	2.71	0.01	29.16	
	27	26	2.68	0.40	2.980	2.980	29.15	97.78	291	1500	0.45	1.0	4,947	No	2.71	0.01	29.16	
East Village	27	26	11.80	0.40			29.15	97.78	148	1500	0.45	1.0	4,947	No	2.71	0.01	29.16	East Village Controlled Flow
King Street East	26	25	3.09	0.40	3.436	56.420	29.16	97.77	5,664	1500	0.45	288.0	4,947	Yes	2.71	1.77	30.93	
	25	24	1.53	0.40	1.701	58.121	30.93	94.83	5,660	1500	0.50	100.0	5,215	Yes	2.86	0.58	31.51	
	24	21	1.67	0.40	1.857	59.978	31.51	93.90	5,780	1500	0.56	107.0	5,519	Yes	3.03	0.59	32.10	
Brook Road North	231	23	12.10	0.40			40.60	81.46	373	750	0.79	14.0	1,032	No	2.26	0.10	40.70	Gates of Camelot Phase 1 Controlled Flow
	231	23	5.09	0.40	5.660	5.660	15.00	129.95	736	750	0.79	14.0	1,032	No	2.26	0.10	15.10	
King Street East	23	22	1.17	0.40	1.301	6.961	40.70	81.34	939	750	0.50	70.0	821	Yes	1.80	0.65	41.35	
	22	21	1.03	0.40	1.145	8.106	41.35	80.58	1,026	825	0.56	79.0	1,121	No	2.03	0.65	42.00	
Coverdale Avenue	21	20	1.35	0.40	1.501	69.586	42.00	79.83	6,076	1650	0.59	143.0	7,304	No	3.31	0.72	42.72	
Proposed Development	**SITE**	**201**	**1.95**	**0.50**			**15.00**	129.95	**20**	**525**	**1.00**	**1.0**	**449**	**No**	**2.01**	**0.01**		425 King Street East Controlled Flows
Orchard Avenue West	201	20	1.30	0.40	1.446	1.446	17.15	123.77	199	525	1.00	1.0	449	No	2.01	0.01	17.16	Including external drainage area see Figure 2
Orchard Avenue East	202	20	1.30	0.40	1.446	1.446	15.81	127.55	184	375	1.00	1.0	183	Yes	1.60	0.01	15.82	
Coverdale Avenue	20	19	1.42	0.40	1.579	74.056	42.72	79.02	6,393	1650	0.60	143.0	7,365	No	3.34	0.71	43.43	
Hamilton Avenue West	191	19	0.58	0.40	0.645	0.645	17.08	123.96	80	300	0.50	1.0	71	Yes	0.98	0.02	17.10	
Hamilton Avenue East	192	19	12.69	0.40	14.111	14.111	21.52	112.84	1,592	750	1.40	1.0	1,374	Yes	3.01	0.01	21.53	
CoverdaleAvenue	19	18	0.79	0.40	0.878	89.691	43.43	78.23	7,557	1800	0.60	83.0	9,289	No	3.54	0.39	43.82	
	18	17	0.00	0.40		89.691	43.82	77.80	7,519	1800	0.54	16.0	8,812	No	3.35	0.08	43.90	
Coverdale Avenue	17	16	0.63	0.40	0.701	90.391	43.90	77.72	7,566	1800	0.28	147.5	6,345	Yes	2.42	1.02	44.92	
Springbrook Road	163	161	1.20	0.40	1.334	1.334	15.00	129.95	173	375	1.00	110.0	183	No	1.60	1.14	16.14	
	164	161	1.20	0.40	1.334	1.334	15.00	129.95	173	375	1.00	85.0	183	No	1.60	0.88	15.88	
	161	16	0.00	0.40		2.669	15.88	127.34	340	450	1.00	110.0	297	Yes	1.81	1.01	16.89	
Coverdale Avenue	16	10	0.99	0.40	1.101	94.161	44.92	76.63	7,757	1800	0.37	19.0	7,294	Yes	2.78	0.11	45.03	
	10	9	0.62	0.40	0.689	94.851	45.03	76.51	7,798	1800	0.23	55.5	5,751	Yes	2.19	0.42	45.46	
Gardiner Crescent	91	9	1.05	0.40	1.168	1.168	15.00	129.95	152	300	1.00	95.0	101	Yes	1.38	1.15	16.15	
Coverdale Avenue	9	7	0.60	0.40	0.667	96.685	45.46	76.07	7,896	1800	0.86	18.5	11,121	No	4.23	0.07	45.53	
	7	4	0.36	0.40	0.400	97.086	45.53	76.00	7,919	1800	0.86	115.0	11,121	No	4.23	0.45	45.98	

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Town of Cobourg
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100yr-Design Storm

Street	From MH	To MH	A Area (ha)	R Runoff Coeff.	2.78AR	Accum. 2.78AR	Time of Conc. (min)	Rainfall (mm/hr)	Q Peak Flow (l/s)	Pipe Diameter (mm)	Design Slope (%)	Length (m)	Capacity (l/s)	Capacity Problem	Velocity (m/s)	Time in Section (min)	Total Time (min)	Remarks
Gardiner Crescent	41	4	1.20	0.40	1.334	1.334	15.00	129.95	173	375	1.00	90.0	183	No	1.60	0.93	15.93	
Springbrook Road	43	42	1.30	0.40	1.446	1.446	15.00	129.95	188	375	1.00	65.0	183	Yes	1.60	0.68	15.68	
	42	4	0.55	0.40	0.612	2.057	15.68	127.94	263	375	1.00	105.5	183	Yes	1.60	1.10	16.77	
Coverdale Avenue	4	1	0.50	0.40	0.556	101.033	45.98	75.53	8,172	1800	0.82	100.0	10,859	No	4.13	0.40	46.38	
Lakeshore Road West	111	1	0.50	0.40	0.556	0.556	15.00	129.95	72	300	1.00	60.0	101	No	1.38	0.72	15.72	
Lakeshore Road East	112	1	1.17	0.40	1.301	1.301	15.00	129.95	169	375	1.00	75.0	183	No	1.60	0.78	15.78	
Existing Outlet - Coverdale	1	100	0.00	0.40		102.890	46.38	75.12	8,270	1800	0.47	85.2	8,221	Yes	3.13	0.45	46.84	

Runoff Coefficients

0.20	Parks-Cemeteries-Playground	0.70	Schools & Churches	Gates of Camelot Phase 1 - 100 Year Discharge Rate	373 L/s
0.50	Single Family Residential	0.80	Industrial Areas	East Village - 100 Year Discharge Rate	148 L/s
0.55	Semi-Detached Residential	0.90	Commercial Areas	Subject Property Discharge Rate	20 L/s
0.65	Townhouses	0.90	Heavily Developed Areas		
0.70	High Density Residential				

100yr: I = 5588 / (T + 28)
n = 0.013

Date	Submission
5-Mar-19	1st Submission

110 Scotia Ct, Unit 41
Whitby, Ontario
L1N 8Y7
905-686-6402

MUNICIPALITY OF CLARINGTON
100 YEAR PRE-DEVELOPMENT STORM HYDRAULIC GRADE LINE CALCULATIONS

Project Name: Cobourg King Street East Sewer Analysis
Project No. 11192099

PREPARED BY: R.B.
CHECKED BY: K.E.
DATE: 43539

STREET NAME	From MH	To MH	PROPOSED PIPE									MANHOLE LOSSES @ D/S MANHOLE										HGL Elevation		EGL Elevation		Surcharge	
			Bend Angle in D/S MH	Box Culvert? (Y/N)	Size mm	Length m	Slope %	Lower Inv. m	Upper Inv. m	Lower Obv. m	Upper Obv. m	Flow cms	Pipe Capacity cms	% Capacity	Frict'n Slope %	Frict'n Loss m	Vel. in m/s	Vel. out m/s	$v_i^2/2g$ m	$kv_o^2/2g$ m	$v_o^2/2g - v_{lat}^2/2g$ m	D/S MH Losses m	Lower m	Upper m	Lower m	Upper m	Lower m	Upper m
Existing Outlet - Coverdale	100	1	0	N	1800	85.2	0.47	75.800	76.200	77.629	78.029	8.250	8.221	100.4%	0.47	0.403	3.14	3.13	0.503	0.050	-0.003	0.046	77.63	78.03	77.626	78.535	0.00	0.00
0	1	4	0	N	1800	100.0	0.82	76.670	77.500	78.499	79.329	8.152	10.859	75.1%	0.46	0.462	3.10	3.14	0.491	0.050	0.012	0.062	78.50	79.33	78.585	79.452	0.00	0.00
0	4	7	0	N	1800	115.0	0.86	77.500	78.510	79.329	80.339	7.899	11.121	71.0%	0.43	0.499	3.01	3.10	0.461	0.049	0.030	0.079	79.33	80.34	79.501	80.289	0.00	0.00
0	7	9	0	N	1800	18.5	0.86	78.510	78.670	80.339	80.499	7.876	11.121	70.8%	0.43	0.080	3.00	3.01	0.458	0.046	0.003	0.049	80.34	80.50	80.335	80.877	0.00	0.00
	9	10	0	N	1800	55.5	0.23	78.700	78.830	80.529	80.659	7.778	5.751	135.3%	0.42	0.234	2.96	3.00	0.447	0.046	0.011	0.057	80.53	80.76	80.923	81.209	0.00	0.10
Coverdale Avenue	10	16	45	N	1800	19.0	0.37	78.850	78.920	80.679	80.749	7.737	7.294	106.1%	0.42	0.079	2.95	2.96	0.442	0.134	0.005	0.139	80.90	80.98	81.343	81.422	0.22	0.23
0	16	17	45	N	1800	147.5	0.28	78.950	79.370	80.779	81.199	7.546	6.345	118.9%	0.40	0.584	2.87	2.95	0.421	0.133	0.022	0.154	81.13	81.72	81.555	82.139	0.36	0.52
0	17	18	0	N	1800	16.0	0.54	79.400	79.486	81.229	81.315	7.499	8.812	85.1%	0.39	0.063	2.85	2.87	0.415	0.042	0.005	0.047	81.77	81.83	82.181	82.244	0.54	0.51
0	18	19	0	N	1800	83.0	0.60	79.516	80.014	81.345	81.843	7.537	9.289	81.1%	0.40	0.328	2.87	2.85	0.420	0.042	-0.004	0.037	81.87	82.19	82.285	82.613	0.52	0.35
0	19	20	0	N	1650	143.0	0.60	80.044	80.902	81.721	82.579	6.373	7.365	86.5%	0.45	0.642	2.89	2.87	0.425	0.042	-0.005	0.037	82.23	82.87	82.655	83.298	0.51	0.29
Coverdale Avenue	20	21	0	N	1650	143.0	0.59	80.932	81.776	82.609	83.453	6.076	7.304	83.2%	0.41	0.584	2.75	2.89	0.386	0.042	0.039	0.081	82.95	83.54	83.340	83.924	0.34	0.09
	21	22	90	N	825	79.0	0.56	81.806	82.249	82.644	83.087	1.026	1.121	91.6%	0.47	0.371	1.86	2.75	0.176	0.309	0.210	0.519	84.06	84.43	84.233	84.604	1.41	1.34
King Street East	22	23	0	N	750	70.0	0.50	82.279	82.629	83.041	83.391	0.939	0.821	114.4%	0.65	0.458	2.06	1.86	0.216	0.018	-0.040	-0.022	84.41	84.86	84.622	85.079	1.36	1.47
	21	24	90	N	1500	107.0	0.56	81.806	82.405	83.330	83.929	5.780	5.519	104.7%	0.61	0.657	3.17	2.75	0.512	0.309	-0.125	0.184	83.72	84.38	84.233	84.890	0.39	0.45
	24	25	0	N	1500	100.0	0.50	82.435	82.935	83.959	84.459	5.660	5.215	108.5%	0.59	0.589	3.10	3.17	0.491	0.051	0.021	0.072	84.45	85.04	84.941	85.530	0.49	0.58
King Street East	25	26	0	N	1500	288.0	0.45	82.965	84.261	84.489	85.785	5.664	4.947	114.5%	0.59	1.699	3.11	3.10	0.491	0.049	-0.001	0.048	85.09	86.79	85.580	87.278	0.60	1.00

110 Scotia Ct, Unit 41
Whitby, Ontario
L1N 8Y7
905-686-6402

MUNICIPALITY OF CLARINGTON
100 YEAR POST-DEVELOPMENT STORM HYDRAULIC GRADE LINE CALCULATIONS

Project Name: Cobourg King Street East Sewer Analysis
Project No. 11192099

PREPARED BY: R.B.
CHECKED BY: J.I.
DATE: 20-Apr-20

STREET NAME	From MH	To MH	PROPOSED PIPE									MANHOLE LOSSES @ D/S MANHOLE										HGL Elevation		EGL Elevation		Surcharge	
			Bend Angle in D/S MH	Box Culvert? (Y/N)	Size mm	Length m	Slope %	Lower Inv. m	Upper Inv. m	Lower Obv. m	Upper Obv. m	Flow cms	Pipe Capacity cms	% Capacity	Frict'n Slope %	Frict'n Loss m	Vel. in m/s	Vel. out m/s	$v_i^2/2g$ m	$kv_o^2/2g$ m	$v_o^2/2g - v_{lat}^2/2g$ m	D/S MH Losses m	Lower m	Upper m	Lower m	Upper m	Lower m	Upper m
Existing Outlet - Coverdale	100	1	0	N	1800	85.2	0.47	75.800	76.200	77.629	78.029	8.270	8.221	100.6%	0.48	0.405	3.15	3.13	0.505	0.050	-0.006	0.044	77.63	78.03	77.623	78.540	0.00	0.01
0	1	4	0	N	1800	100.0	0.82	76.670	77.500	78.499	79.329	8.172	10.859	75.3%	0.46	0.464	3.11	3.15	0.493	0.051	0.012	0.062	78.50	79.33	78.590	79.457	0.00	0.00
0	4	7	0	N	1800	115.0	0.86	77.500	78.510	79.329	80.339	7.919	11.121	71.2%	0.44	0.502	3.01	3.11	0.463	0.049	0.030	0.079	79.33	80.34	79.506	80.294	0.00	0.00
0	7	9	0	N	1800	18.5	0.86	78.510	78.670	80.339	80.499	7.896	11.121	71.0%	0.43	0.080	3.01	3.01	0.461	0.046	0.003	0.049	80.34	80.50	80.340	80.880	0.00	0.00
	9	10	0	N	1800	55.5	0.23	78.700	78.830	80.529	80.659	7.798	5.751	135.6%	0.42	0.235	2.97	3.01	0.449	0.046	0.011	0.057	80.53	80.76	80.926	81.213	0.00	0.10
Coverdale Avenue	10	16	45	N	1800	19.0	0.37	78.850	78.920	80.679	80.749	7.757	7.294	106.3%	0.42	0.079	2.95	2.97	0.444	0.135	0.005	0.140	80.90	80.98	81.347	81.427	0.22	0.23
0	16	17	45	N	1800	147.5	0.28	78.950	79.370	80.779	81.199	7.566	6.345	119.2%	0.40	0.587	2.88	2.95	0.423	0.133	0.022	0.155	81.14	81.72	81.560	82.147	0.36	0.53
0	17	18	0	N	1800	16.0	0.54	79.400	79.486	81.229	81.315	7.519	8.812	85.3%	0.39	0.063	2.86	2.88	0.418	0.042	0.005	0.047	81.77	81.84	82.190	82.253	0.54	0.52
0	18	19	0	N	1800	83.0	0.60	79.516	80.014	81.345	81.843	7.557	9.289	81.4%	0.40	0.330	2.88	2.86	0.422	0.042	-0.004	0.038	81.87	82.20	82.294	82.624	0.53	0.36
0	19	20	0	N	1650	143.0	0.60	80.044	80.902	81.721	82.579	6.393	7.365	86.8%	0.45	0.646	2.90	2.88	0.428	0.042	-0.006	0.037	82.24	82.89	82.666	83.313	0.52	0.31
Coverdale Avenue	20	21	0	N	1650	143.0	0.59	80.932	81.776	82.609	83.453	6.076	7.304	83.2%	0.41	0.584	2.75	2.90	0.386	0.043	0.041	0.084	82.97	83.55	83.355	83.939	0.36	0.10
	21	22	90	N	825	79.0	0.56	81.806	82.249	82.644	83.087	1.026	1.121	91.6%	0.47	0.371	1.86	2.75	0.176	0.309	0.210	0.519	84.07	84.44	84.248	84.619	1.43	1.36
King Street East	22	23	0	N	750	70.0	0.50	82.279	82.629	83.041	83.391	0.939	0.821	114.4%	0.65	0.458	2.06	1.86	0.216	0.018	-0.040	-0.022	84.42	84.88	84.637	85.095	1.38	1.49
	21	24	90	N	1500	107.0	0.56	81.806	82.405	83.330	83.929	5.780	5.519	104.7%	0.61	0.657	3.17	2.75	0.512	0.309	-0.125	0.184	83.74	84.39	84.248	84.906	0.41	0.46
	24	25	0	N	1500	100.0	0.50	82.435	82.935	83.959	84.459	5.660	5.215	108.5%	0.59	0.589	3.10	3.17	0.491	0.051	0.021	0.072	84.47	85.06	84.957	85.546	0.51	0.60
King Street East	25	26	0	N	1500	288.0	0.45	82.965	84.261	84.489	85.785	5.664	4.947	114.5%	0.59	1.699	3.11	3.10	0.491	0.049	-0.001	0.048	85.10	86.80	85.595	87.294	0.61	1.02

April 18, 2019 Reference No. 11192099

Terry Hoekstra
Town of Cobourg
740 Division Street, Building 7
Cobourg, ON K9A 0H6

Dear Mr. Hoekstra:

Re: King Street East / Coverdale Trunk Storm Sewer Analysis
425 King Street East
Town of Cobourg

This analysis has been prepared to investigate the capacity of the existing trunk storm sewer system on King Street East and Coverdale Avenue in the Town of Cobourg. It is proposed to provide a storm outlet to this trunk storm system for a development located at 425 King Street East which currently drains westward to Brook Road South. It is therefore important to understand if this sewer has capacity to accept additional flows.

1.1 Existing Site

The site is locally known as 425 King Street East in the Town of Cobourg. The site is bound to the north by King Street East, and residential properties to the east, west and south. The site is approximately 1.58ha, consisting of an asphalt surface and an open grassed field, as shown on **Figure 1 – Site Location Plan**. Presently, the property drains in a north eastern to a south westerly direction towards a drainage ditch along the southern property limit, where it is conveyed west to the Brook Road South roadside ditch. An additional drainage area of approximately 0.74ha external to the site flows through the subject property, towards the drainage ditch adjacent to the southern property line. In general, the residential properties to the east of the development fronting onto Orchard Avenue will drain in a rear to front fashion, where it is conveyed east to Coverdale Avenue. Lots fronting onto King Street East are split draining, with a portion of the lot draining into the King Street East right of way and the remaining draining to Orchard Avenue as well. However, the rear yards of the lots immediately east of the development drain through the subject property, as illustrated on **Figure 2 – Pre-Development Site Drainage Plan**.

1.2 Existing Coverdale Avenue Trunk Sewer

As part of the design of the trunk storm sewer by Totten Sims Hubicki Associates in 2005, storm sewer design sheets and a drainage area plan was prepared. This information along with plan/profile drawings for Coverdale Avenue was provided to GHD Ltd. by the Town of Cobourg, has been appended to this letter. This documentation formed the basis of the current analysis of the existing storm sewer and its capacity. Further to the information provided, an overall drainage plan has been prepared by this office, to illustrate the updated drainage areas. The overall area drainage plan is depicted in drawing **11192099-ODA1**.

0 10 20 30m

SCALE 1:1000 AT ORIGINAL SIZE

N

GHD

Mason Homes
425 King Street East
Sewer Analysis

Site Location Plan

Job Number 11192099
Revision A
Date March 2019

Figure 1

65 Sunray Street, Whitby Ontario L1N 8Y3 **T** 1 905 686 6402 **F** 1 905 432 7877 **E** ytomail@ghd.com **W** www.ghd.com

Plot Date: 14 March 2019 - 11:39 AM Plotted by: Ryan Brockie Cad File No: C:\Users\rbrockle\Desktop\11192099\Letter\Figures\Figure 1 - Site Location Plan.dwg

LEGEND:

1.00 ha / 0.45 — AREA IN HECTARES / RUNOFF COEFFICIENT

OVERLAND FLOW

DRAINAGE AREA BOUNDARY

EXISTING COMMERCIAL

EXISTING YOUTH CENTRE

KING STREET EAST (THE KING'S HIGHWAY NO. 2)

EXISTING SIGNALIZED INTERSECTION

BROOK ROAD SOUTH

EXISTING RESIDENTIAL

EXT. FRAME GARAGE

EXT. 2 STOREY

EXT. 1 STOREY

EXT. 1.5 STOREY

(NO ALLOWANCE BETWEEN LOTS 12 AND 13 ASSUMED BY REGISTERED PLAN, AS PER INSTRUMENT NO. [illegible])

1.17 ha / 0.40

1.30 ha / 0.40

0.74 ha / 0.34

1.58 ha / 0.20

ORCHARD AVENUE

"MOLLY BAKER TRAIL"

EXISTING MUNICIPAL OPEN SPACE

EXISTING RESIDENTIAL FOOTE CRESCENT SUBDIVISION

EXISTING DITCH

0 10 20 30m

SCALE 1:1000 AT ORIGINAL SIZE

N

Mason Homes
425 King Street East
Sewer Analysis

Pre-Development Site Drainage Plan

Job Number 11192099
Revision A
Date April 2019

Figure 2

65 Sunray Street, Whitby Ontario L1N 8Y3 **T** 1 905 686 6402 **F** 1 905 432 7877 **E** ytomail@ghd.com **W** www.ghd.com

Plot Date: 17 April 2019 - 8:28 AM Plotted by: Ryan Brockle Cad File No: G:\111\11192099\TechnIcal\Water Resources\Letter\Figures\Figure 2 - Pre-Development Site Drainage Plan.dwg

A rational method calculation was performed to estimate the capacity of the existing storm sewer during the 5 year and 100 year storm events. Runoff coefficients for the existing drainage areas are as taken from the TSH design sheet. The Yarnell storm IDF curve was used. Additionally, 100 year storm HGL calculations were performed using the rational method. Storm sewer design sheets for the existing 5 year, 100 year and 100 year HGL are appended to this letter.

The storm design sheets prepared by Totten Sims Hubicki have been updated as follows for the existing development:

1. Manhole 27 to 26 – TSH area of 59.51 ha, C 0.45, Tc 29.15min. This area has now been split into the basin north of the Railway, East Village Phase 5 Tributary to the SWM pond and future development.
    a. North Basin is 38.27 ha, assumed runoff coefficient 0.47, plus future development 2.68 ha for a total of 40.95ha , C of 0.46, Tc = 37mins.
    b. East Village Phase 5 - Engage Engineering is responsible for the detailed design of the Gates of Camelot Phase 2 subdivision, which is to be constructed north of King Street East and discharge into the King Street east storm sewer. Engage has provided GHD Ltd. with the maximum allowable post-development release rate for the Gates of Camelot Phase 2 stormwater management facility. The stormwater management facility will control flows entering the King Street East storm sewer to a maximum flow rate of 148L/s during the 100 year storm event. The flows from the stormwater management facilities for the proposed site and Gates of Camelot Phases 1 & 2 are modelled to discharge at a constant flow rate in the storm sewer design sheet prepared by this office. The constant flows from these catchments are carried throughout the peak flow calculations for the storm sewer system and are not calculated using the rational method. The post development drainage plan received from Engage and email detailing flows are appended to this brief.
2. Manhole 231 to 23 TSH area of 9.45 ha, C 0.39, Tc 40.60min
    a. The Gates of Camelot Phase 1 subdivision, which was constructed north of King Street East and is tributary to the trunk storm sewer, has a stormwater management facility in place to limit post development flow rates to the sewer system to be less than 0.446 m^3/s as per the TSH design sheet. The flow rates discharging from the stormwater management facility in the Gates of Camelot Phase 1 subdivision are obtained from “Addendum to Stormwater Management Report” prepared by MMK Engineering Inc. dated April 2010 for the 5 and 100 year storm events, they are 193L/s and 373L/s respectively. The constant flows from these catchments are carried throughout the peak flow calculations for the storm sewer system and are not calculated using the rational method. The Tc used for this area matches the previously used 40.6 minutes from the TSH sheet. Outflows from the stormwater pond peak at 2.20 hours so this Tc is conservative.
    b. Brook Road North Catchment matches TSH 5.09 ha, C 0.4, Tc 15 min
3. King Street East Manhole 231 to 23 TSH area of 9.45 ha, C 0.39, Tc 40.60min – additional drainage from lots on south frontage of King St added drainage area now 1.17 ha
4. Orchard Avenue West MH 201 to 20 TSH area of 0.53 ha, C 0.40 Tc 17.15 drainage area has been increased to 1.30 ha

All other drainage basins are assumed to match the TSH Sheet.

At MH 17 a sewer overflow from the trunk system, a 750mm diameter pipe, outlets to Coverdale Park. The overflow pipe is placed at the obvert of the trunk sewer such that water will release from the sewer system upon surcharge of the trunk sewer. The ditch in the park continues south westerly to Brook Road South. Therefore, MH 17 is found to be the most sensitive to a hydraulic grade line increase as an increase in the hydraulic grade line at this location will result in more flows being sent to the ditch. As such, the 100-year post-development flow rate from the subject property discharging through Orchard Avenue to the existing storm sewer system is to be controlled such that the hydraulic grade line does not increase at MH 17. This in turn ensures flows discharging to the existing watercourse will continue at pre-development levels in post-development conditions.

1.3 Proposed Site

The proposed development at 425 King Street East was the subject of a previously submitted FSSR for the subdivision by Engage Engineering Ltd. submitted February 2018. At this time GHD has been employed by the owner Mason Homes to complete the FSSR as well as this analysis. In the previously submitted report, post development runoff and storage was calculated based on assumed runoff coefficients. In this particular development lots are larger than typical, therefore it was agreed at the meeting March 11, 2019 between the Town of Cobourg, GRCA, Mason Homes and GHD, that the runoff coefficient for this development could be calculated from first principals. The impervious and pervious areas were measured, and the appropriate runoff coefficients were applied to each, from that a total composite runoff coefficient for the drainage area was obtained, including the external drainage area. Table 1 below details the results of the first principle measurement and calculation.

Table 1 Site Composite Runoff Coefficient

	Area (m^2)	Runoff Coefficient (C)	A▪C
Pervious	5215	0.20	1043
Impervious	6855	0.90	6169
External Drainage	7350	0.34	2527
Total	19419	**0.50**	9739

As noted above, in existing conditions site drainage is directed west towards Brook Road South, including the external drainage area. In post-development conditions, it is proposed to capture and convey 1.95ha of drainage from the subject site through Orchard Avenue towards the Coverdale Avenue storm sewer. The runoff from the existing lots fronting King Street East and Orchard Avenue will continue to follow the existing drainage pattern.

1.4 Coverdale Avenue Trunk Sewer – Including 425 King Street

Using the Rational Method, the peak flow and capacity for the trunk storm sewers was determined. The storm design sheets previously prepared by TSH provided the initial times of concentration throughout the

system. These values were used as they were deemed to be more conservative than those determined in the hydraulic modeling in “Addendum to Stormwater Management Report” prepared by MMK Engineering Inc. dated April 2010. Additionally, the Rational Method hydraulic gradeline analysis assumes 100% capture of the 100 year storm event by the minor storm system, providing an increased level of conservatism. It is understood that, in general, flows in excess of the 25 year storm event will not enter the minor storm sewer system and be conveyed overland. Through the analysis, it is found that the maximum allowable discharge rate from the subject property to the storm sewer, such that no increase to the hydraulic grade line occurs at MH 17, is 0.013m^3/s. The results of the 100 year hydraulic grade line analysis for the existing and proposed conditions are summarized below in Table 2.

Table 2 100 Year Hydraulic Grade Line

Manhole		Hydraulic Grade Line Existing Conditions		Hydraulic Grade Line Proposed Conditions	
Lower	Upper	Lower	Upper	Lower	Upper
100	1	77.63	78.03	77.63	78.03
1	4	78.50	79.33	78.50	79.33
4	7	79.33	80.34	79.33	80.34
7	9	80.34	80.50	80.34	80.50
9	10	80.53	80.76	80.53	80.76
10	16	80.90	80.97	80.90	80.97
16	**17**	81.13	**81.70**	81.13	**81.70**
17	18	**81.75**	81.81	**81.75**	81.81
18	19	81.85	82.17	81.85	82.17
19	20	82.21	82.84	82.21	82.84
20	21	82.92	83.49	82.93	83.50
21	22	83.99	84.36	84.00	84.37
22	23	84.34	84.80	84.35	84.81
21	24	83.67	84.31	83.68	84.32
24	25	84.38	84.96	84.39	84.97
25	26	85.00	86.66	85.01	86.67

As shown above, by limiting the discharge to the existing storm sewer to 0.013m^3/s there is no increase to the hydraulic gradeline at MH 17. Furthermore, it is shown that there is no appreciable impact on the hydraulic grade line throughout the system. The runoff coefficient for the entire 1.95ha drainage area discharging to Orchard Avenue is found to be 0.50, using the rational method, a post-development peak flow is calculated. With the post-development flow being higher than the target flow rate of 0.013m^3/s, onsite controls are required in order to attenuate flows to meet the target flow rate. Using the modified rational method, the volume required to attenuate post-development flow to 0.013m^3/s is 305m^3. The volume is proposed to be provided in the form of underground storage. The onsite storage in conjunction

with an orifice will control flows discharging to the existing storm sewer to the target flow rate of 0.013m³/s during the 100 year storm event, ensuring there is no adverse impacts to the existing hydraulic grade line.

1.5 Conclusions

The preceding letter/report outlines the proposed outfall design for the development of 425 King Street and its impact on the Coverdale Avenue trunk storm sewer. The analysis of the Coverdale Avenue storm sewer found that if there is negligible impact on the trunk sewer if the proposed development controls post-development peak flows to 0.013m³/s. A Functional Servicing and Stormwater Management Report will follow this analysis shortly, detailing how the proposed controls will be implemented within the development in accordance with these findings.

Should you have any questions or require additional information, please do not hesitate to contact our office.

Sincerely,

GHD

Ryan Brockie, E.I.T.
Water Resources

Karen Edgington, P.Eng.
Water Resources Group Manager

KE/RB/mp

Encl.

cc: Mason Homes; Attn: Ashley Mason
GRCA; Attn: Leslie Benson

LEGEND:

- RUNOFF COEFFICIENT / AREA IN HECTARES / MANHOLE NUMBER (1.00 ha | 0.45 | 23)
- OVERLAND FLOW
- DRAINAGE AREA BOUNDARY
- 27 EXISTING STORM MANHOLE

No.	Revision	Drawn	Job Manager	Project Director	Date

Drawing Revisions

Note: * indicates signatures on original issue of drawing or last revision of drawing

N

0 40 80 120 160 200

SCALE 1:4000 AT ORIGINAL SIZE

65 Sunray Street
Whitby Ontario L1N 8Y3
T 1 905 686 6402 F 1 905 432 7877
E ytomail@ghd.com W www.ghd.com

Client: **MASON HOMES**

Project: **425 KING STREET EAST TRUNK SEWER ANALYSIS**

Title: **TRUNK SEWER OVERALL DRAINAGE AREA PLAN**

Scale	AS SHOWN	DO NOT SCALE
Drawn	R.B.	
Designer	R.B.	
Drafting Check	K.E.	
Design Check	K.E.	
Approved (Project Director)	K.E.	
Date	APRIL 2019	

This Drawing must not be used for Construction unless signed as Approved

Drawing No. **11192099-ODA1**

Original Size **Arch D**

Rev. **A**

Plot Date: 18 April 2019 - 2:01 PM Plotted by: Ryan Brocke Cad File No: G:\111\11192099\Technical\Water Resources\Letter\Figures\Figure 3 - Overall Drainage Plan.dwg

Project Name	Cobourg King Street East Sewer Analysis
Project No.	11192099
Subject	Runoff Coefficient

Total Area 15799 m2

Proposed Site

	Area (m2)	C	AC
Block 1	702	0.90	632
Block 2	718	0.90	647
Block 3	669	0.90	602
Block 4	442	0.90	398
Block 5	442	0.90	398
Sidewalk	309	0.90	278
Drive Aisle	2077	0.90	1869
Driveway	1495	0.90	1346
Landscape	5215	0.20	1043
Sum	**12069**		**7212**
Composite 'C'		**0.60**	

External Drainage Area

	Area (m2)	C	AC
Impervious Surface	1510	0.90	1359
Pervious Surface	5840	0.20	1168
Sum	**7350**		**2527**
Composite 'C'		**0.34**	

Entire Drainage Area

	Area (m2)	C	AC
Site	12069	0.60	7212
External Area	7350	0.34	2527
Sum	**19419**		**9739**
Composite 'C'		**0.50**	

Drainage Area to Brook Road

	Area (m2)	C	AC
Impervious Surface	792	0.90	713
Pervious Surface	2938	0.20	588
Sum	**3730**		**1300**
Composite 'C'		**0.35**	

CALCULATIONS

Prepared by R.B.
Checked by K.E.

Project Name	Cobourg King Street East Sewer Analysis
Project No.	11192099
Subject	Post Development Uncontrolled Release Rate

Utilizing the rational method, the post development release rate can be determined:

Q = C I A where,

Q = Flow rate (cms)
C = Runoff Coefficient
I = Intensity (mm/hr)
A = Area (ha)

The Intensity for Cobourg can be calculated as:

I = a / (b + t)^c where,

		2 Year	5 Year	10 Year	25 Year	25 Year	100 Year
I =	Intensity (mm/hr)						
a =	Constant =	1778	2464	2819	3886	4750	5588
b =	Constant =	13	16	16	18	24	28
c =	Constant =	1	1	1	1	1	1
t =	Time of Concentration (min) =	15	15	15	15	15	15
I =		63.50	79.48	90.94	117.76	121.79	129.95

Based on the proposed land use the post development flow rates are:

Area ID	Area Description	Area (ha)	Runoff Coefficient	Flow Rates (m^3/s)					
				2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
101	Site + External Drainage Area	1.95	0.50	0.172	0.215	0.246	0.319	0.330	0.352
Total		1.95	0.50	0.172	0.215	0.246	0.319	0.330	0.352

CALCULATIONS

Prepared by R.B.
Checked by K.E.

Project Name	Cobourg King Street East Sewer Analysis
Project No.	11192099
Subject	Modified Rational Storage Calculations

100 Year

Catchment ID =	101	
Time of Concentration (t_c) =	15	minutes
Time Step (t_1) =	5	minutes
Runoff Coefficient (C) =	0.50	
Catchment Area (A) =	1.95	ha

Target Release Rate (Q_o) =	0.013	m^3/s

Time $t = t_c + t_1$ (min.)	Intensity $I=a/(t_c+b)^c$ (mm/hr)	Runoff $Q=CIA$ (m^3/s)	Storage Rate $Q_s = Q - Q_o$ (m^3/s)	Required Storage $V = Q_s t$ (m^3)
15	130	0.352	0.339	305
20	116	0.315	0.302	363
25	105	0.286	0.273	409
30	96	0.261	0.248	446
35	89	0.240	0.227	477
40	82	0.223	0.210	503
45	77	0.207	0.194	525
50	72	0.194	0.181	543

100 Year Storage Required =	305	m^3

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Town of Cobourg
PRE-DEVELOPMENT STORM SEWER DESIGN SHEET

Project Name: Cobourg King Street East Sewer Analysis
Project No. 11192099

PREPARED BY: R.B.
CHECKED BY: K.E.
DATE: 15-Mar-19

15 MINUTE ENTRY TIME
5yr-Design Storm

Street	From MH	To MH	A Area (ha)	R Runoff Coeff.	2.78AR	Accum. 2.78AR	Time of Conc. (min)	Rainfall (mm/hr)	Q Peak Flow (l/s)	Pipe Diameter (mm)	Design Slope (%)	Length (m)	Capacity (l/s)	Capacity Problem	Velocity (m/s)	Time in Section (min)	Total Time (min)	Remarks
Future Basin North of King	27	26	39.97	0.47	52.225	52.225	29.15	54.57	2,850	1500	0.45	1.0	4,947	No	2.71	0.01	29.16	
East Village	27	26	11.80	0.40			29.15	54.57	50	1500	0.45	1.0	4,947	No	2.71	0.01	29.16	East Village Controlled Flow
King Street East	26	25	3.09	0.40	3.436	55.661	29.16	54.57	3,087	1500	0.45	288.0	4,947	No	2.71	1.77	30.93	
	25	24	1.53	0.40	1.701	57.362	30.93	52.51	3,062	1500	0.50	100.0	5,215	No	2.86	0.58	31.51	
	24	21	1.67	0.40	1.857	59.219	31.51	51.86	3,121	1500	0.56	107.0	5,519	No	3.03	0.59	32.10	
Brook Road North	231	23	12.10	0.40			40.60	43.53	193	750	0.79	14.0	1,032	No	2.26	0.10	40.70	Gates of Camelot Phase 1 Controlled Flow
	231	23	5.09	0.40	5.660	5.660	15.00	79.48	450	750	0.79	14.0	1,032	No	2.26	0.10	15.10	
King Street East	23	22	1.17	0.40	1.301	6.961	40.70	43.46	496	750	0.50	70.0	821	No	1.80	0.65	41.35	Incldng external drainage area see Figure 2
	22	21	1.03	0.40	1.145	8.106	41.35	42.97	541	825	0.56	79.0	1,121	No	2.03	0.65	42.00	
Coverdale Avenue	21	20	1.35	0.40	1.501	68.827	42.00	42.49	3,167	1650	0.59	143.0	7,304	No	3.31	0.72	42.72	
Orchard Avenue West	201	20	1.30	0.40	1.446	1.446	17.15	74.33	107	525	1.00	1.0	449	No	2.01	0.01	17.16	Incldng external drainage area see Figure 2
Orchard Avenue East	202	20	1.30	0.40	1.446	1.446	15.81	77.46	112	375	1.00	1.0	183	No	1.60	0.01	15.82	
Coverdale Avenue	20	19	1.42	0.40	1.579	73.297	42.72	41.96	3,319	1650	0.60	143.0	7,365	No	3.34	0.71	43.43	
Hamilton Avenue West	191	19	0.58	0.40	0.645	0.645	17.08	74.49	48	300	0.50	1.0	71	No	0.98	0.02	17.10	
Hamilton Avenue East	192	19	12.69	0.40	14.111	14.111	21.52	65.67	927	750	1.40	1.0	1,374	No	3.01	0.01	21.53	
CoverdaleAvenue	19	18	0.79	0.40	0.878	88.932	43.43	41.46	3,930	1800	0.60	83.0	9,289	No	3.54	0.39	43.82	
	18	17	0.00	0.40		88.932	43.82	41.19	3,906	1800	0.54	16.0	8,812	No	3.35	0.08	43.90	
Coverdale Avenue	17	16	0.63	0.40	0.701	89.632	43.90	41.13	3,930	1800	0.28	147.5	6,345	No	2.42	1.02	44.92	
Springbrook Road	163	161	1.20	0.40	1.334	1.334	15.00	79.48	106	375	1.00	110.0	183	No	1.60	1.14	16.14	
	164	161	1.20	0.40	1.334	1.334	15.00	79.48	106	375	1.00	85.0	183	No	1.60	0.88	15.88	
	161	16	0.00	0.40		2.669	15.88	77.28	206	450	1.00	110.0	297	No	1.81	1.01	16.89	
Coverdale Avenue	16	10	0.99	0.40	1.101	93.402	44.92	40.45	4,021	1800	0.37	19.0	7,294	No	2.78	0.11	45.03	
	10	9	0.62	0.40	0.689	94.092	45.03	40.37	4,042	1800	0.23	55.5	5,751	No	2.19	0.42	45.46	
Gardiner Crescent	91	9	1.05	0.40	1.168	1.168	15.00	79.48	93	300	1.00	95.0	101	No	1.38	1.15	16.15	
Coverdale Avenue	9	7	0.60	0.40	0.667	95.926	45.46	40.09	4,089	1800	0.86	18.5	11,121	No	4.23	0.07	45.53	
	7	4	0.36	0.40	0.400	96.327	45.53	40.05	4,101	1800	0.86	115.0	11,121	No	4.23	0.45	45.98	
Gardiner Crescent	41	4	1.20	0.40	1.334	1.334	15.00	79.48	106	375	1.00	90.0	183	No	1.60	0.93	15.93	
Springbrook Road	43	42	1.30	0.40	1.446	1.446	15.00	79.48	115	375	1.00	65.0	183	No	1.60	0.68	15.68	
	42	4	0.55	0.40	0.612	2.057	15.68	77.79	160	375	1.00	105.5	183	No	1.60	1.10	16.77	

65 Sunray St.
Whitby, Ontario
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905-686-6402

Town of Cobourg
PRE-DEVELOPMENT STORM SEWER DESIGN SHEET

Project Name: Cobourg King Street East Sewer Analysis
Project No. 11192099

PREPARED BY: R.B.
CHECKED BY: K.E.
DATE: 15-Mar-19

15 MINUTE ENTRY TIME
5yr-Design Storm

Street	From MH	To MH	A Area (ha)	R Runoff Coeff.	2.78AR	Accum. 2.78AR	Time of Conc. (min)	Rainfall (mm/hr)	Q Peak Flow (l/s)	Pipe Diameter (mm)	Design Slope (%)	Length (m)	Capacity (l/s)	Capacity Problem	Velocity (m/s)	Time in Section (min)	Total Time (min)	Remarks
Coverdale Avenue	4	1	0.50	0.40	0.556	100.274	45.98	39.75	4,229	1800	0.82	100.0	10,859	No	4.13	0.40	46.38	
Lakeshore Road West	111	1	0.50	0.40	0.556	0.556	15.00	79.48	44	300	1.00	60.0	101	No	1.38	0.72	15.72	
Lakeshore Road East	112	1	1.17	0.40	1.301	1.301	15.00	79.48	103	375	1.00	75.0	183	No	1.60	0.78	15.78	
Existing Outlet - Coverdale	1	100	0.00	0.40		102.131	46.38	39.50	4,277	1800	0.47	85.2	8,221	No	3.13	0.45	46.84	

Runoff Coefficients

0.20	Parks-Cemeteries-Playground
0.50	Single Family Residential
0.55	Semi-Detached Residential
0.65	Townhouses
0.70	High Density Residential
0.70	Schools & Churches
0.80	Industrial Areas
0.90	Commercial Areas
0.90	Heavily Developed Areas

Gates of Camelot Phase 1 - 5 Year Discharge Rate 373 L/s
East Village - 5 Year Discharge Rate 50 L/s

5yr: I = 2464 / (T + 16)
n = 0.013

Date	Submission
5-Mar-19	1st Submission

65 Sunray St.
Whitby, Ontario
L1N 8Y3
905-686-6402

Town of Cobourg
PRE-DEVELOPMENT STORM SEWER DESIGN SHEET

Project Name: Cobourg King Street East Sewer Analysis
Project No. 11192099

PREPARED BY: R.B.
CHECKED BY: K.E.
DATE: 15-Mar-19

15 MINUTE ENTRY TIME
100yr-Design Storm

Street	From MH	To MH	A Area (ha)	R Runoff Coeff.	2.78AR	Accum. 2.78AR	Time of Conc. (min)	Rainfall (mm/hr)	Q Peak Flow (l/s)	Pipe Diameter (mm)	Design Slope (%)	Length (m)	Capacity (l/s)	Capacity Problem	Velocity (m/s)	Time in Section (min)	Total Time (min)	Remarks
Future Basin North of King	27	26	39.97	0.47	52.225	52.225	29.15	97.78	5,106	1500	0.45	1.0	4,947	Yes	2.71	0.01	29.16	
East Village	27	26	11.80				29.15	97.78	148	1500	0.45	1.0	4,947	No	2.71	0.01	29.16	East Village Controlled Flow
King Street East	26	25	3.09	0.40	3.436	55.661	29.16	97.77	5,590	1500	0.45	288.0	4,947	Yes	2.71	1.77	30.93	
	25	24	1.53	0.40	1.701	57.362	30.93	94.83	5,588	1500	0.50	100.0	5,215	Yes	2.86	0.58	31.51	
	24	21	1.67	0.40	1.857	59.219	31.51	93.90	5,709	1500	0.56	107.0	5,519	Yes	3.03	0.59	32.10	
Brook Road North	231	23	12.10	0.40			40.60	81.46	373	750	0.79	14.0	1,032	No	2.26	0.10	40.70	Gates of Camelot Phase 1 Controlled Flow
	231	23	5.09	0.40	5.660	5.660	15.00	129.95	736	750	0.79	14.0	1,032	No	2.26	0.10	15.10	
King Street East	23	22	1.17	0.40	1.301	6.961	40.70	81.34	939	750	0.50	70.0	821	Yes	1.80	0.65	41.35	
	22	21	1.03	0.40	1.145	8.106	41.35	80.58	1,026	825	0.56	79.0	1,121	No	2.03	0.65	42.00	
Coverdale Avenue	21	20	1.35	0.40	1.501	68.827	42.00	79.83	6,016	1650	0.59	143.0	7,304	No	3.31	0.72	42.72	
Orchard Avenue West	201	20	1.30	0.40	1.446	1.446	17.15	123.77	179	525	1.00	1.0	449	No	2.01	0.01	17.16	Including external drainage area see Figure 2
Orchard Avenue East	202	20	1.30	0.40	1.446	1.446	15.81	127.55	184	375	1.00	1.0	183	Yes	1.60	0.01	15.82	
Coverdale Avenue	20	19	1.42	0.40	1.579	73.297	42.72	79.02	6,313	1650	0.60	143.0	7,365	No	3.34	0.71	43.43	
Hamilton Avenue West	191	19	0.58	0.40	0.645	0.645	17.08	123.96	80	300	0.50	1.0	71	Yes	0.98	0.02	17.10	
Hamilton Avenue East	192	19	12.69	0.40	14.111	14.111	21.52	112.84	1,592	750	1.40	1.0	1,374	Yes	3.01	0.01	21.53	
CoverdaleAvenue	19	18	0.79	0.40	0.878	88.932	43.43	78.23	7,478	1800	0.60	83.0	9,289	No	3.54	0.39	43.82	
	18	17	0.00	0.40		88.932	43.82	77.80	7,440	1800	0.54	16.0	8,812	No	3.35	0.08	43.90	
	17	16	0.63	0.40	0.701	89.632	43.90	77.72	7,487	1800	0.28	147.5	6,345	Yes	2.42	1.02	44.92	
Springbrook Road	163	161	1.20	0.40	1.334	1.334	15.00	129.95	173	375	1.00	110.0	183	No	1.60	1.14	16.14	
	164	161	1.20	0.40	1.334	1.334	15.00	129.95	173	375	1.00	85.0	183	No	1.60	0.88	15.88	
	161	16	0.00	0.40		2.669	15.88	127.34	340	450	1.00	110.0	297	Yes	1.81	1.01	16.89	
Coverdale Avenue	16	10	0.99	0.40	1.101	93.402	44.92	76.63	7,679	1800	0.37	19.0	7,294	Yes	2.78	0.11	45.03	
	10	9	0.62	0.40	0.689	94.092	45.03	76.51	7,720	1800	0.23	55.5	5,751	Yes	2.19	0.42	45.46	
Gardiner Crescent	91	9	1.05	0.40	1.168	1.168	15.00	129.95	152	300	1.00	95.0	101	Yes	1.38	1.15	16.15	
Coverdale Avenue	9	7	0.60	0.40	0.667	95.926	45.46	76.07	7,818	1800	0.86	18.5	11,121	No	4.23	0.07	45.53	
	7	4	0.36	0.40	0.400	96.327	45.53	76.00	7,842	1800	0.86	115.0	11,121	No	4.23	0.45	45.98	
Gardiner Crescent	41	4	1.20	0.40	1.334	1.334	15.00	129.95	173	375	1.00	90.0	183	No	1.60	0.93	15.93	
Springbrook Road	43	42	1.30	0.40	1.446	1.446	15.00	129.95	188	375	1.00	65.0	183	Yes	1.60	0.68	15.68	
	42	4	0.55	0.40	0.612	2.057	15.68	127.94	263	375	1.00	105.5	183	Yes	1.60	1.10	16.77	

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Town of Cobourg
PRE-DEVELOPMENT STORM SEWER DESIGN SHEET

Project Name: **Cobourg King Street East Sewer Analysis**
Project No. **11192099**

PREPARED BY: R.B.
CHECKED BY: K.E.
DATE: 15-Mar-19

15 MINUTE ENTRY TIME
100yr-Design Storm

Street	From MH	To MH	A Area (ha)	R Runoff Coeff.	2.78AR	Accum. 2.78AR	Time of Conc. (min)	Rainfall (mm/hr)	Q Peak Flow (l/s)	Pipe Diameter (mm)	Design Slope (%)	Length (m)	Capacity (l/s)	Capacity Problem	Velocity (m/s)	Time in Section (min)	Total Time (min)	Remarks
Coverdale Avenue	4	1	0.50	0.40	0.556	100.274	45.98	75.53	8,095	1800	0.82	100.0	10,859	No	4.13	0.40	46.38	
Lakeshore Road West	111	1	0.50	0.40	0.556	0.556	15.00	129.95	72	300	1.00	60.0	101	No	1.38	0.72	15.72	
Lakeshore Road East	112	1	1.17	0.40	1.301	1.301	15.00	129.95	169	375	1.00	75.0	183	No	1.60	0.78	15.78	
Existing Outlet - Coverdale	1	100	0.00	0.40		102.131	46.38	75.12	8,193	1800	0.47	85.2	8,221	No	3.13	0.45	46.84	

Runoff Coefficients

0.20	Parks-Cemeteries-Playground	0.70	Schools & Churches	Gates of Camelot Phase 1 - 100 Year Discharge Rate	373 L/s
0.50	Single Family Residential	0.80	Industrial Areas	East Village - 100 Year Discharge Rate	148 L/s
0.55	Semi-Detached Residential	0.90	Commercial Areas	100yr: I = 5588 / (T + 28)	
0.65	Townhouses	0.90	Heavily Developed Areas	n = 0.013	
0.70	High Density Residential				

Date	Submission
5-Mar-19	1st Submission

110 Scotia Ct, Unit 41
Whitby, Ontario
L1N 8Y7
905-686-6402

MUNICIPALITY OF CLARINGTON
100 YEAR PRE-DEVELOPMENT STORM HYDRAULIC GRADE LINE CALCULATIONS

Project Name: Cobourg King Street East Sewer Analysis
Project No. 11192099

PREPARED BY: R.B.
CHECKED BY: K.E.
DATE: 43539

STREET NAME	From MH	To MH	PROPOSED PIPE									MANHOLE LOSSES @ D/S MANHOLE										HGL Elevation		EGL Elevation		Surcharge	
			Bend Angle in D/S MH	Box Culvert? (Y/N)	Size mm	Length m	Slope %	Lower Inv. m	Upper Inv. m	Lower Obv. m	Upper Obv. m	Flow cms	Pipe Capacity cms	% Capacity	Frict'n Slope %	Frict'n Loss m	Vel. in m/s	Vel. out m/s	$v_i^2/2g$ m	$kv_o^2/2g$ m	$v_o^2/2g - v_{lat}^2/2g$ m	D/S MH Losses m	Lower m	Upper m	Lower m	Upper m	Lower m	Upper m
Existing Outlet - Coverdale	100	1	0	N	1800	85.2	0.47	75.800	76.200	77.629	78.029	8.193	8.221	99.7%	0.47	0.398	3.12	3.13	0.496	0.050	0.003	0.053	77.63	78.03	77.632	78.523	0.00	0.00
0	1	4	0	N	1800	100.0	0.82	76.670	77.500	78.499	79.329	8.095	10.859	74.5%	0.46	0.456	3.08	3.12	0.484	0.050	0.012	0.061	78.50	79.33	78.572	79.438	0.00	0.00
0	4	7	0	N	1800	115.0	0.86	77.500	78.510	79.329	80.339	7.841	11.121	70.5%	0.43	0.492	2.99	3.08	0.454	0.048	0.030	0.078	79.33	80.34	79.487	80.275	0.00	0.00
0	7	9	0	N	1800	18.5	0.86	78.510	78.670	80.339	80.499	7.818	11.121	70.3%	0.43	0.079	2.98	2.99	0.452	0.045	0.003	0.048	80.34	80.50	80.320	80.869	0.00	0.00
	9	10	0	N	1800	55.5	0.23	78.700	78.830	80.529	80.659	7.720	5.751	134.2%	0.41	0.230	2.94	2.98	0.440	0.045	0.011	0.056	80.53	80.76	80.914	81.199	0.00	0.10
Coverdale Avenue	10	16	45	N	1800	19.0	0.37	78.850	78.920	80.679	80.749	7.678	7.294	105.3%	0.41	0.078	2.92	2.94	0.436	0.132	0.005	0.137	80.90	80.97	81.331	81.409	0.22	0.22
0	16	17	45	N	1800	147.5	0.28	78.950	79.370	80.779	81.199	7.487	6.345	118.0%	0.39	0.575	2.85	2.92	0.414	0.131	0.021	0.152	81.13	81.70	81.540	82.115	0.35	0.50
0	17	18	0	N	1800	16.0	0.54	79.400	79.486	81.229	81.315	7.440	8.812	84.4%	0.38	0.062	2.83	2.85	0.409	0.041	0.005	0.047	81.75	81.81	82.156	82.218	0.52	0.49
0	18	19	0	N	1800	83.0	0.60	79.516	80.014	81.345	81.843	7.478	9.289	80.5%	0.39	0.323	2.85	2.83	0.413	0.041	-0.004	0.037	81.85	82.17	82.258	82.581	0.50	0.32
0	19	20	0	N	1650	143.0	0.60	80.044	80.902	81.721	82.579	6.313	7.365	85.7%	0.44	0.630	2.86	2.85	0.417	0.041	-0.004	0.037	82.21	82.84	82.623	83.253	0.48	0.26
Coverdale Avenue	20	21	0	N	1650	143.0	0.59	80.932	81.776	82.609	83.453	6.015	7.304	82.4%	0.40	0.572	2.73	2.86	0.379	0.042	0.038	0.080	82.92	83.49	83.294	83.867	0.31	0.04
	21	22	90	N	825	79.0	0.56	81.806	82.249	82.644	83.087	1.026	1.121	91.6%	0.47	0.371	1.86	2.73	0.176	0.303	0.202	0.505	83.99	84.36	84.170	84.541	1.35	1.28
King Street East	22	23	0	N	750	70.0	0.50	82.279	82.629	83.041	83.391	0.939	0.821	114.4%	0.65	0.458	2.06	1.86	0.216	0.018	-0.040	-0.022	84.34	84.80	84.558	85.016	1.30	1.41
	21	24	90	N	1500	107.0	0.56	81.806	82.405	83.330	83.929	5.709	5.519	103.4%	0.60	0.641	3.13	2.73	0.499	0.303	-0.121	0.182	83.67	84.31	84.170	84.811	0.34	0.38
	24	25	0	N	1500	100.0	0.50	82.435	82.935	83.959	84.459	5.588	5.215	107.2%	0.57	0.574	3.06	3.13	0.478	0.050	0.021	0.071	84.38	84.96	84.861	85.435	0.42	0.50
King Street East	25	26	0	N	1500	288.0	0.45	82.965	84.261	84.489	85.785	5.590	4.947	113.0%	0.57	1.655	3.06	3.06	0.479	0.048	0.000	0.047	85.00	86.66	85.483	87.137	0.51	0.87

65 Sunray St.
Whitby, Ontario
L1N 8Y3
905-686-6402

Town of Cobourg
POST-DEVELOPMENT STORM SEWER DESIGN SHEET

Project Name: Cobourg King Street East Sewer Analysis
Project No. 11192099

PREPARED BY: R.B.
CHECKED BY: K.E.
DATE: 15-Mar-19

15 MINUTE ENTRY TIME
5yr-Design Storm

Street	From MH	To MH	A Area (ha)	R Runoff Coeff.	2.78AR	Accum. 2.78AR	Time of Conc. (min)	Rainfall (mm/hr)	Q Peak Flow (l/s)	Pipe Diameter (mm)	Design Slope (%)	Length (m)	Capacity (l/s)	Capacity Problem	Velocity (m/s)	Time in Section (min)	Total Time (min)	Remarks
Future Basin North of King	27	26	38.27	0.47	50.004	50.004	29.15	54.57	2,729	1500	0.45	1.0	4,947	No	2.71	0.01	29.16	
	27	26	2.68	0.40	2.980	2.980	29.15	54.57	163	1500	0.45	1.0	4,947	No	2.71	0.01	29.16	
East Village	27	26	11.80	0.40			29.15	54.57	50	1500	0.45	1.0	4,947	No	2.71	0.01	29.16	East Village Controlled Flow
King Street East	26	25	3.09	0.40	3.436	53.440	29.16	54.57	2,966	1500	0.45	288.0	4,947	No	2.71	1.77	30.93	
	25	24	1.53	0.40	1.701	55.141	30.93	52.51	2,945	1500	0.50	100.0	5,215	No	2.86	0.58	31.51	
	24	21	1.67	0.40	1.857	56.998	31.51	51.86	3,006	1500	0.56	107.0	5,519	No	3.03	0.59	32.10	
Brook Road North	231	23	12.10	0.40			40.60	43.53	193	750	0.79	14.0	1,032	No	2.26	0.10	40.70	Gates of Camelot Phase 1 Controlled Flow
	231	23	5.09	0.40	5.660	5.660	15.00	79.48	450	750	0.79	14.0	1,032	No	2.26	0.10	15.10	
King Street East	23	22	1.17	0.40	1.301	6.961	40.70	43.46	496	750	0.50	70.0	821	No	1.80	0.65	41.35	Inclding external drainage area see Figure 2
	22	21	1.03	0.40	1.145	8.106	41.35	42.97	541	825	0.56	79.0	1,121	No	2.03	0.65	42.00	
Coverdale Avenue	21	20	1.35	0.40	1.501	66.606	42.00	42.49	3,073	1650	0.59	143.0	7,304	No	3.31	0.72	42.72	
Proposed Development	**SITE**	**201**	**1.95**	**0.50**			**15.00**	**79.48**	**9**	**525**	**1.00**	**1.0**	**449**	**No**	**2.01**	**0.01**	**15.01**	425 King Street East Controlled Flows
Orchard Avenue West	201	20	1.30	0.40	1.446	1.446	17.15	74.33	116	525	1.00	1.0	449	No	2.01	0.01	17.16	Inclding external drainage area see Figure 2
Orchard Avenue East	202	20	1.30	0.40	1.446	1.446	15.81	77.46	112	375	1.00	1.0	183	No	1.60	0.01	15.82	
Coverdale Avenue	20	19	1.42	0.40	1.579	71.076	42.72	41.96	3,235	1650	0.60	143.0	7,365	No	3.34	0.71	43.43	
Hamilton Avenue West	191	19	0.58	0.40	0.645	0.645	17.08	74.49	48	300	0.50	1.0	71	No	0.98	0.02	17.10	
Hamilton Avenue East	192	19	12.69	0.40	14.111	14.111	21.52	65.67	927	750	1.40	1.0	1,374	No	3.01	0.01	21.53	
CoverdaleAvenue	19	18	0.79	0.40	0.878	86.711	43.43	41.46	3,847	1800	0.60	83.0	9,289	No	3.54	0.39	43.82	
	18	17	0.00	0.40		86.711	43.82	41.19	3,824	1800	0.54	16.0	8,812	No	3.35	0.08	43.90	
Coverdale Avenue	17	16	0.63	0.40	0.701	87.411	43.90	41.13	3,848	1800	0.28	147.5	6,345	No	2.42	1.02	44.92	
Springbrook Road	163	161	1.20	0.40	1.334	1.334	15.00	79.48	106	375	1.00	110.0	183	No	1.60	1.14	16.14	
	164	161	1.20	0.40	1.334	1.334	15.00	79.48	106	375	1.00	85.0	183	No	1.60	0.88	15.88	
	161	16	0.00	0.40		2.669	15.88	77.28	206	450	1.00	110.0	297	No	1.81	1.01	16.89	
Coverdale Avenue	16	10	0.99	0.40	1.101	91.181	44.92	40.45	3,940	1800	0.37	19.0	7,294	No	2.78	0.11	45.03	
	10	9	0.62	0.40	0.689	91.870	45.03	40.37	3,961	1800	0.23	55.5	5,751	No	2.19	0.42	45.46	
Gardiner Crescent	91	9	1.05	0.40	1.168	1.168	15.00	79.48	93	300	1.00	95.0	101	No	1.38	1.15	16.15	
Coverdale Avenue	9	7	0.60	0.40	0.667	93.705	45.46	40.09	4,009	1800	0.86	18.5	11,121	No	4.23	0.07	45.53	
	7	4	0.36	0.40	0.400	94.106	45.53	40.05	4,021	1800	0.86	115.0	11,121	No	4.23	0.45	45.98	
Gardiner Crescent	41	4	1.20	0.40	1.334	1.334	15.00	79.48	106	375	1.00	90.0	183	No	1.60	0.93	15.93	

65 Sunray St.
Whitby, Ontario
L1N 8Y3
905-686-6402

Town of Cobourg
POST-DEVELOPMENT STORM SEWER DESIGN SHEET

Project Name: Cobourg King Street East Sewer Analysis
Project No. 11192099

PREPARED BY: R.B.
CHECKED BY: K.E.
DATE: 15-Mar-19

15 MINUTE ENTRY TIME
5yr-Design Storm

Street	From MH	To MH	A Area (ha)	R Runoff Coeff.	2.78AR	Accum. 2.78AR	Time of Conc. (min)	Rainfall (mm/hr)	Q Peak Flow (l/s)	Pipe Diameter (mm)	Design Slope (%)	Length (m)	Capacity (l/s)	Capacity Problem	Velocity (m/s)	Time in Section (min)	Total Time (min)	Remarks
Springbrook Road	43	42	1.30	0.40	1.446	1.446	15.00	79.48	115	375	1.00	65.0	183	No	1.60	0.68	15.68	
	42	4	0.55	0.40	0.612	2.057	15.68	77.79	160	375	1.00	105.5	183	No	1.60	1.10	16.77	
Coverdale Avenue	4	1	0.50	0.40	0.556	98.053	45.98	39.75	4,150	1800	0.82	100.0	10,859	No	4.13	0.40	46.38	
Lakeshore Road West	111	1	0.50	0.40	0.556	0.556	15.00	79.48	44	300	1.00	60.0	101	No	1.38	0.72	15.72	
Lakeshore Road East	112	1	1.17	0.40	1.301	1.301	15.00	79.48	103	375	1.00	75.0	183	No	1.60	0.78	15.78	
Existing Outlet - Coverdale	1	100	0.00	0.40		99.910	46.38	39.50	4,198	1800	0.47	85.2	8,221	No	3.13	0.45	46.84	

Runoff Coefficients

0.20	Parks-Cemeteries-Playground	0.70	Schools & Churches	
0.50	Single Family Residential	0.80	Industrial Areas	
0.55	Semi-Detached Residential	0.90	Commercial Areas	
0.65	Townhouses	0.90	Heavily Developed Areas	
0.70	High Density Residential			

Gates of Camelot Phase 1 - 5 Year Discharge Rate 373 L/s
East Village - 5 Year Discharge Rate 50 L/s
Subject Property Controlled Discharge Rate 9 L/s
5yr: I = 2464 / (T + 16)
n = 0.013

Date	Submission
5-Mar-19	1st Submission

65 Sunray St.
Whitby, Ontario
L1N 8Y3
905-686-6402

Town of Cobourg
POST-DEVELOPMENT STORM SEWER DESIGN SHEET

Project Name: **Cobourg King Street East Sewer Analysis**
Project No. **11192099**

PREPARED BY: R.B.
CHECKED BY: K.E.
DATE: 15-Mar-19

15 MINUTE ENTRY TIME
100yr-Design Storm

Street	From MH	To MH	A Area (ha)	R Runoff Coeff.	2.78AR	Accum. 2.78AR	Time of Conc. (min)	Rainfall (mm/hr)	Q Peak Flow (l/s)	Pipe Diameter (mm)	Design Slope (%)	Length (m)	Capacity (l/s)	Capacity Problem	Velocity (m/s)	Time in Section (min)	Total Time (min)	Remarks
Future Basin North of King	27	26	38.27	0.47	50.004	50.004	29.15	97.78	4,889	1500	0.45	1.0	4,947	No	2.71	0.01	29.16	
	27	26	2.68	0.40	2.980	2.980	29.15	97.78	291	1500	0.45	1.0	4,947	No	2.71	0.01	29.16	
East Village	27	26	11.80	0.40			29.15	97.78	148	1500	0.45	1.0	4,947	No	2.71	0.01	29.16	East Village Controlled Flow
King Street East	26	25	3.09	0.40	3.436	53.440	29.16	97.77	5,373	1500	0.45	288.0	4,947	Yes	2.71	1.77	30.93	
	25	24	1.53	0.40	1.701	55.141	30.93	94.83	5,377	1500	0.50	100.0	5,215	Yes	2.86	0.58	31.51	
	24	21	1.67	0.40	1.857	56.998	31.51	93.90	5,500	1500	0.56	107.0	5,519	No	3.03	0.59	32.10	
Brook Road North	231	23	12.10	0.40			40.60	81.46	373	750	0.79	14.0	1,032	No	2.26	0.10	40.70	Gates of Camelot Phase 1 Controlled Flow
	231	23	5.09	0.40	5.660	5.660	15.00	129.95	736	750	0.79	14.0	1,032	No	2.26	0.10	15.10	
King Street East	23	22	1.17	0.40	1.301	6.961	40.70	81.34	939	750	0.50	70.0	821	Yes	1.80	0.65	41.35	
	22	21	1.03	0.40	1.145	8.106	41.35	80.58	1,026	825	0.56	79.0	1,121	No	2.03	0.65	42.00	
Coverdale Avenue	21	20	1.35	0.40	1.501	66.606	42.00	79.83	5,838	1650	0.59	143.0	7,304	No	3.31	0.72	42.72	
Proposed Development	**SITE**	**201**	**1.95**	**0.50**			**15.00**	129.95	**20**	**525**	**1.00**	**1.0**	**449**	**No**	**2.01**	**0.01**		425 King Street East Controlled Flows
Orchard Avenue West	201	20	1.30	0.40	1.446	1.446	17.15	123.77	199	525	1.00	1.0	449	No	2.01	0.01	17.16	Including external drainage area see Figure 2
Orchard Avenue East	202	20	1.30	0.40	1.446	1.446	15.81	127.55	184	375	1.00	1.0	183	Yes	1.60	0.01	15.82	
Coverdale Avenue	20	19	1.42	0.40	1.579	71.076	42.72	79.02	6,157	1650	0.60	143.0	7,365	No	3.34	0.71	43.43	
Hamilton Avenue West	191	19	0.58	0.40	0.645	0.645	17.08	123.96	80	300	0.50	1.0	71	Yes	0.98	0.02	17.10	
Hamilton Avenue East	192	19	12.69	0.40	14.111	14.111	21.52	112.84	1,592	750	1.40	1.0	1,374	Yes	3.01	0.01	21.53	
CoverdaleAvenue	19	18	0.79	0.40	0.878	86.711	43.43	78.23	7,324	1800	0.60	83.0	9,289	No	3.54	0.39	43.82	
	18	17	0.00	0.40		86.711	43.82	77.80	7,287	1800	0.54	16.0	8,812	No	3.35	0.08	43.90	
Coverdale Avenue	17	16	0.63	0.40	0.701	87.411	43.90	77.72	7,334	1800	0.28	147.5	6,345	Yes	2.42	1.02	44.92	
Springbrook Road	163	161	1.20	0.40	1.334	1.334	15.00	129.95	173	375	1.00	110.0	183	No	1.60	1.14	16.14	
	164	161	1.20	0.40	1.334	1.334	15.00	129.95	173	375	1.00	85.0	183	No	1.60	0.88	15.88	
	161	16	0.00	0.40		2.669	15.88	127.34	340	450	1.00	110.0	297	Yes	1.81	1.01	16.89	
Coverdale Avenue	16	10	0.99	0.40	1.101	91.181	44.92	76.63	7,528	1800	0.37	19.0	7,294	Yes	2.78	0.11	45.03	
	10	9	0.62	0.40	0.689	91.870	45.03	76.51	7,570	1800	0.23	55.5	5,751	Yes	2.19	0.42	45.46	
Gardiner Crescent	91	9	1.05	0.40	1.168	1.168	15.00	129.95	152	300	1.00	95.0	101	Yes	1.38	1.15	16.15	
Coverdale Avenue	9	7	0.60	0.40	0.667	93.705	45.46	76.07	7,669	1800	0.86	18.5	11,121	No	4.23	0.07	45.53	
	7	4	0.36	0.40	0.400	94.106	45.53	76.00	7,693	1800	0.86	115.0	11,121	No	4.23	0.45	45.98	
Gardiner Crescent	41	4	1.20	0.40	1.334	1.334	15.00	129.95	173	375	1.00	90.0	183	No	1.60	0.93	15.93	

65 Sunray St.
Whitby, Ontario
L1N 8Y3
905-686-6402

Town of Cobourg
POST-DEVELOPMENT STORM SEWER DESIGN SHEET

Project Name: Cobourg King Street East Sewer Analysis
Project No. 11192099

PREPARED BY: R.B.
CHECKED BY: K.E.
DATE: 15-Mar-19

15 MINUTE ENTRY TIME
100yr-Design Storm

Street	From MH	To MH	A Area (ha)	R Runoff Coeff.	2.78AR	Accum. 2.78AR	Time of Conc. (min)	Rainfall (mm/hr)	Q Peak Flow (l/s)	Pipe Diameter (mm)	Design Slope (%)	Length (m)	Capacity (l/s)	Capacity Problem	Velocity (m/s)	Time in Section (min)	Total Time (min)	Remarks
Springbrook Road	43	42	1.30	0.40	1.446	1.446	15.00	129.95	188	375	1.00	65.0	183	Yes	1.60	0.68	15.68	
	42	4	0.55	0.40	0.612	2.057	15.68	127.94	263	375	1.00	105.5	183	Yes	1.60	1.10	16.77	
Coverdale Avenue	4	1	0.50	0.40	0.556	98.053	45.98	75.53	7,947	1800	0.82	100.0	10,859	No	4.13	0.40	46.38	
Lakeshore Road West	111	1	0.50	0.40	0.556	0.556	15.00	129.95	72	300	1.00	60.0	101	No	1.38	0.72	15.72	
Lakeshore Road East	112	1	1.17	0.40	1.301	1.301	15.00	129.95	169	375	1.00	75.0	183	No	1.60	0.78	15.78	
Existing Outlet - Coverdale	1	100	0.00	0.40		99.910	46.38	75.12	8,047	1800	0.47	85.2	8,221	No	3.13	0.45	46.84	

Runoff Coefficients

0.20	Parks-Cemeteries-Playground	0.70	Schools & Churches
0.50	Single Family Residential	0.80	Industrial Areas
0.55	Semi-Detached Residential	0.90	Commercial Areas
0.65	Townhouses	0.90	Heavily Developed Areas
0.70	High Density Residential		

Gates of Camelot Phase 1 - 100 Year Discharge Rate 373 L/s
East Village - 100 Year Discharge Rate 148 L/s
Subject Property Discharge Rate 20 L/s

100yr: I = 5588 / (T + 28)
n = 0.013

Date	Submission
5-Mar-19	1st Submission

110 Scotia Ct, Unit 41
Whitby, Ontario
L1N 8Y7
905-686-6402

MUNICIPALITY OF CLARINGTON
100 YEAR POST-DEVELOPMENT STORM HYDRAULIC GRADE LINE CALCULATIONS

Project Name: Cobourg King Street East Sewer Analysis
Project No. 11192099

PREPARED BY: R.B.
CHECKED BY: K.E.
DATE: 43539

STREET NAME	From MH	To MH	PROPOSED PIPE: Bend Angle in D/S MH	Box Culvert? (Y/N)	Size mm	Length m	Slope %	Lower Inv. m	Upper Inv. m	Lower Obv. m	Upper Obv. m	MANHOLE LOSSES @ D/S MANHOLE: Flow cms	Pipe Capacity cms	% Capacity	Frict'n Slope %	Frict'n Loss m	Vel. in m/s	Vel. out m/s	$v_i^2/2g$ m	$kv_o^2/2g$ m	$v_o^2/2g - v_{lat}^2/2g$ m	D/S MH Losses m	HGL Elevation Lower m	HGL Elevation Upper m	EGL Elevation Lower m	EGL Elevation Upper m	Surcharge Lower m	Surcharge Upper m
Existing Outlet - Coverdale	100	1	0	N	1800	85.2	0.47	75.800	76.200	77.629	78.029	8.047	8.221	97.9%	0.45	0.384	3.06	3.13	0.478	0.050	0.021	0.071	77.63	78.03	77.650	78.491	0.00	0.00
0	1	4	0	N	1800	100.0	0.82	76.670	77.500	78.499	79.329	7.947	10.859	73.2%	0.44	0.439	3.03	3.06	0.467	0.048	0.012	0.060	78.50	79.33	78.539	79.405	0.00	0.00
0	4	7	0	N	1800	115.0	0.86	77.500	78.510	79.329	80.339	7.693	11.121	69.2%	0.41	0.473	2.93	3.03	0.437	0.047	0.029	0.076	79.33	80.34	79.451	80.239	0.00	0.00
0	7	9	0	N	1800	18.5	0.86	78.510	78.670	80.339	80.499	7.669	11.121	69.0%	0.41	0.076	2.92	2.93	0.434	0.044	0.003	0.046	80.34	80.50	80.283	80.849	0.00	0.00
	9	10	0	N	1800	55.5	0.23	78.700	78.830	80.529	80.659	7.570	5.751	131.6%	0.40	0.221	2.88	2.92	0.423	0.043	0.011	0.055	80.53	80.75	80.892	81.173	0.00	0.09
Coverdale Avenue	10	16	45	N	1800	19.0	0.37	78.850	78.920	80.679	80.749	7.528	7.294	103.2%	0.39	0.075	2.87	2.88	0.419	0.127	0.005	0.132	80.88	80.96	81.300	81.375	0.20	0.21
0	16	17	45	N	1800	147.5	0.28	78.950	79.370	80.779	81.199	7.334	6.345	115.6%	0.37	0.552	2.79	2.87	0.397	0.126	0.021	0.147	81.10	81.66	81.501	82.053	0.32	0.46
0	17	18	0	N	1800	16.0	0.54	79.400	79.486	81.229	81.315	7.287	8.812	82.7%	0.37	0.059	2.77	2.79	0.392	0.040	0.005	0.045	81.70	81.76	82.092	82.151	0.47	0.44
0	18	19	0	N	1800	83.0	0.60	79.516	80.014	81.345	81.843	7.324	9.289	78.9%	0.37	0.310	2.79	2.77	0.396	0.039	-0.004	0.035	81.79	82.10	82.191	82.500	0.45	0.26
0	19	20	0	N	1650	143.0	0.60	80.044	80.902	81.721	82.579	6.157	7.365	83.6%	0.42	0.600	2.79	2.79	0.397	0.040	0.000	0.039	82.14	82.74	82.540	83.140	0.42	0.16
Coverdale Avenue	20	21	0	N	1650	143.0	0.59	80.932	81.776	82.609	83.453	5.838	7.304	79.9%	0.38	0.539	2.65	2.79	0.357	0.040	0.040	0.080	82.82	83.45	83.179	83.718	0.21	0.00
	21	22	90	N	825	79.0	0.56	81.806	82.249	82.644	83.087	1.026	1.121	91.6%	0.47	0.371	1.86	2.65	0.176	0.285	0.180	0.466	83.83	84.20	84.004	84.375	1.18	1.11
King Street East	22	23	0	N	750	70.0	0.50	82.279	82.629	83.041	83.391	0.939	0.821	114.4%	0.65	0.458	2.06	1.86	0.216	0.018	-0.040	-0.022	84.18	84.63	84.392	84.850	1.14	1.24
	21	24	90	N	1500	107.0	0.56	81.806	82.405	83.330	83.929	5.500	5.519	99.7%	0.56	0.595	3.02	2.65	0.463	0.285	-0.107	0.179	83.54	84.14	84.004	84.599	0.21	0.21
	24	25	0	N	1500	100.0	0.50	82.435	82.935	83.959	84.459	5.377	5.215	103.1%	0.53	0.532	2.95	3.02	0.443	0.046	0.021	0.067	84.20	84.73	84.645	85.177	0.24	0.27
King Street East	25	26	0	N	1500	288.0	0.45	82.965	84.261	84.489	85.785	5.373	4.947	108.6%	0.53	1.529	2.95	2.95	0.442	0.044	0.001	0.045	84.78	86.31	85.221	86.750	0.29	0.52

TOTTEN SIMS HUBICKI ASSOCIATES
STORM SEWER DESIGN CHART
YARNELL 5 YEAR STORM

Project Description : ULTIMATE SYSTEM
COVERDALE AVENUE
Project Number : 12-29292-03

Date : 07 18 2005
Prepared By : G.J.W.

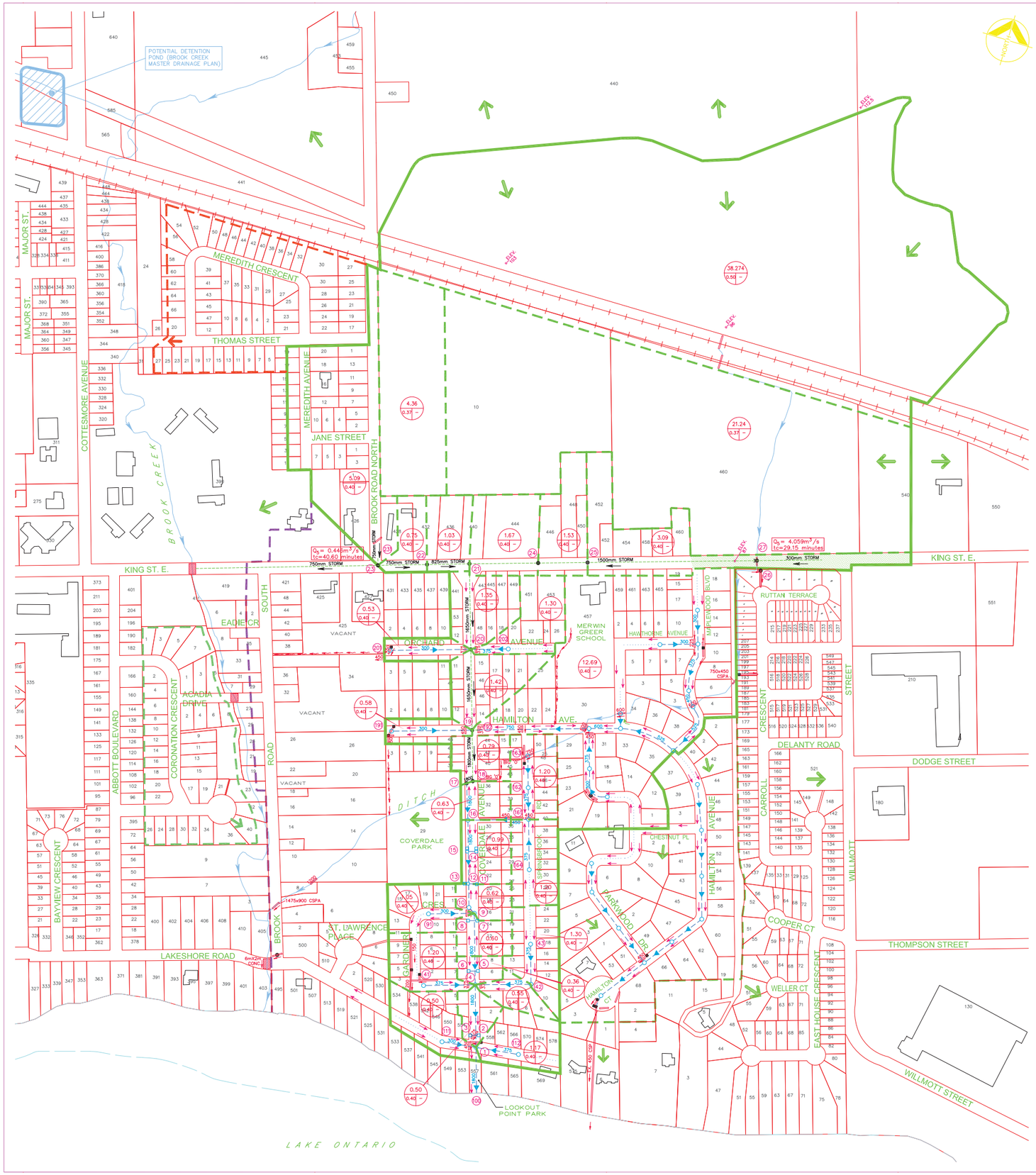
LOCATION	MANHOLE FROM	MANHOLE TO	LENGTH (m)	AREA (ha)	RUNOFF COEF.	A X R INCR.	A X R TOTAL	MAXIMUM T of C (min)	INTENSITY (mm/hr)	TOT. AREA FLOW (cms)	TOT. CONT. FLOW (cms)	DESIGN FLOW (cms)	SEWER SLOPE (%)	SIZE (mm)	CAPACITY (cms)	FLOW CAPACITY RATIO	VELOCITY FULL (m/s)	VELOCITY ACTUAL (m/s)	TRAVEL TIME (min)	PIPE TYPE
FUTURE BASIN NORTH OF KING	27	26	1.0	59.51	.450	26.78	26.78	29.15	54.57	4.059	.000	4.059	.45	1500	4.742	.856	2.68	3.02	.01	C.P.
EXISTING KING STREET EAST	26	25	288.0	3.09	.400	1.24	28.02	29.16	54.56	4.246	.000	4.246	.45	1500	4.742	.895	2.68	3.04	1.58	C.P.
	25	24	100.0	1.53	.400	.61	28.63	30.74	52.72	4.192	.000	4.192	.50	1500	4.998	.839	2.83	3.17	.53	C.P.
	24	21	107.0	1.67	.400	.67	29.30	31.26	52.13	4.242	.000	4.242	.56	1500	5.290	.802	2.99	3.33	.54	C.P.
FUTURE BROOK ROAD NORTH	231	23	14.0	9.45	.390	3.69	3.69	40.60	43.53	.446	.000	.446	.79	750	.989	.450	2.24	2.19	.11	C.P.
EXISTING KING STREET EAST	23	22	70.0	.75	.400	.30	3.99	40.71	43.45	.481	.000	.481	.50	750	.787	.611	1.78	1.87	.62	C.P.
	22	21	79.0	1.03	.400	.41	4.40	41.33	42.98	.525	.000	.525	.56	825	1.074	.489	2.01	2.00	.66	C.P.
EXISTING COVERDALE AVENUE	21	20	143.0	1.35	.400	.54	34.23	41.99	42.49	4.040	.000	4.040	.59	1650	7.001	.577	3.27	3.40	.70	C.P.
FUTURE ORCHARD AVENUE WEST	201	20	1.0	.53	.400	.21	.21	17.15	74.32	.044	.000	.044	.50	300	.068	.640	.57	1.03	.02	P.V.C
FUTURE ORCHARD AVENUE EAST	202	20	1.0	1.30	.400	.52	.52	15.81	77.45	.112	.000	.112	1.00	375	.175	.638	1.59	1.69	.01	P.V.C
EXISTING COVERDALE AVENUE	20	19	158.8	1.42	.400	.57	35.53	42.69	41.98	4.144	.000	4.144	.60	1650	7.060	.587	3.30	3.44	.77	C.P.
FUTURE HAMILTON AVENUE WES	191	19	1.0	.58	.400	.23	.23	17.08	74.48	.048	.000	.048	.50	300	.068	.702	.97	1.05	.02	P.V.C
FUTURE HAMILTON AVENUE EAS	192	19	1.0	12.69	.400	5.08	5.08	21.52	65.67	.926	.000	.926	1.40	750	1.317	.703	2.98	3.23	.01	C.P.
EXISTING COVERDALE AVENUE	19	18	83.0	.79	.400	.32	41.16	43.46	41.44	4.737	.000	4.737	.60	1800	8.904	.532	3.50	3.56	.39	C.P.
	18	17	16.0	.00	.400	.00	41.16	43.85	41.17	4.707	.000	4.707	.54	1800	8.447	.557	3.32	3.41	.08	C.P.
PROPOSED COVERDALE AVENUE	17	16	60.0	.63	.400	.25	41.41	43.92	41.12	4.729	.000	4.729	.29	1800	6.190	.764	2.43	2.68	.37	C.P.
FUTURE SPRINGBROOK ROAD -	163	161	110.0	1.20	.400	.48	.48	15.00	79.48	.106	.000	.106	1.00	375	.175	.604	1.59	1.67	1.10	P.V.C
FUTURE SPRINGBROOK ROAD -	164	161	85.0	1.20	.400	.48	.48	15.00	79.48	.106	.000	.106	1.00	375	.175	.604	1.59	1.67	.85	P.V.C
FUTURE EASEMENT - SPRINGBR	161	16	110.0	.00	.400	.00	.96	16.10	76.75	.205	.000	.205	1.00	450	.285	.718	1.79	1.95	.94	P.V.C
PROPOSED COVERDALE AVENUE	16	15	46.5	.00	.400	.00	42.37	44.30	40.86	4.809	.000	4.809	.29	1800	6.190	.777	2.43	2.69	.29	C.P.
	15	13	59.0	.99	.400	.40	42.76	44.59	40.67	4.831	.000	4.831	.29	1800	6.190	.780	2.43	2.69	.37	C.P.
	13	10	36.0	.62	.400	.25	43.01	44.95	40.42	4.830	.000	4.830	.29	1800	6.190	.780	2.43	2.69	.22	C.P.
	10	9	17.5	.00	.400	.00	43.01	45.17	40.28	4.812	.000	4.812	.34	1800	6.703	.718	2.63	2.87	.10	C.P.

STORM SEWER DESIGN CHART
YARNELL 5 YEAR STORM

Project Description : ULTIMATE SYSTEM
COVERDALE AVENUE
Project Number : 12-29292-03

Date : 07 18 2005
Prepared By : G.J.W.

LOCATION	MANHOLE FROM	MANHOLE TO	LENGTH (m)	AREA (ha)	RUNOFF COEF.	A X R INCR.	A X R TOTAL	MAXIMUM T of C (min)	INTENSITY (mm/hr)	TOT. AREA FLOW (cms)	TOT. CONT. FLOW (cms)	DESIGN FLOW (cms)	SEWER SLOPE (%)	SIZE (mm)	CAPACITY (cms)	FLOW CAPACITY RATIO	VELOCITY FULL (m/s)	VELOCITY ACTUAL (m/s)	TRAVEL TIME (min)	PIPE TYPE
FUTURE GARDINER CRES. N TO	91	9	95.0	1.05	.400	.42	.42	15.00	79.48	.093	.000	.093	1.00	300	.097	.959	1.37	1.56	1.02	P.V.C
PROPOSED COVERDALE AVENUE	9	7	18.5	.60	.400	.24	43.67	45.28	40.21	4.878	.000	4.878	.60	1800	8.904	.548	3.50	3.58	.09	C.P.
	7	4	115.0	.36	.400	.14	43.82	45.36	40.15	4.887	.000	4.887	.60	1800	8.904	.549	3.50	3.58	.53	C.P.
FUTURE GARDINER CRES. S TO	41	4	90.0	1.20	.400	.48	.48	15.00	79.48	.106	.000	.106	1.00	375	.175	.604	1.59	1.67	.90	P.V.C
FUTURE SPRINGBROOK ROAD TO	43	42	65.0	1.30	.400	.52	.52	15.00	79.48	.115	.000	.115	1.00	375	.175	.655	1.59	1.70	.64	P.V.C
	42	4	105.5	.55	.400	.22	.74	15.64	77.87	.160	.000	.160	1.00	375	.175	.913	1.59	1.80	.98	P.V.C
PROPOSED COVERDALE AVENUE	4	1	100.0	.50	.400	.20	45.24	45.90	39.81	5.002	.000	5.002	.60	1800	8.904	.562	3.50	3.61	.46	C.P.
FUTURE LAKESHORE ROAD W TO	111	1	60.0	.50	.400	.20	.20	15.00	79.48	.044	.000	.044	1.00	300	.097	.457	1.37	1.34	.75	P.V.C
FUTURE LAKESHORE ROAD E TO	112	1	75.0	1.17	.400	.47	.47	15.00	79.48	.103	.000	.103	1.00	375	.175	.589	1.59	1.66	.76	P.V.C
PROPOSED OUTLET - COVERDAL	1	100	85.2	.00	.400	.00	45.90	46.36	39.51	5.038	.000	5.038	.47	1800	7.880	.639	3.10	3.29	.43	C.P.



LEGEND

- EXISTING CULVERT (375)
- EXISTING STORM SEWER (1500)
- EXISTING MANHOLE
- EXISTING CATCH BASIN
- PROPOSED STORM SEWER (450)
- STRUCTURE NUMBER (1)
- DRAINAGE AREA BOUNDARY KING ST./COVERDALE AVE. SEWERS
- SUBDRAINAGE AREA BOUNDARIES:
- HAMILTON AVENUE
- BROOK CREEK (EAST SIDE)
- MEREDITH CRES./THOMAS ST.
- CORONATION CRES./ACADIA DR.
- FLOW DIRECTION
- BASEMENT DRAIN HEADER SYSTEM
- DRAINAGE AREA (ha) (0.50 / 0.40)
- RUNOFF COEFFECIENT

NOTE :

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NO.	DATE	ISSUES / REVISIONS

LICENSED PROFESSIONAL ENGINEER G. J. WATSON PROVINCE OF ONTARIO

tsh engineers architects planners
513 Division Street
Cobourg, Ontario
K9A 5G9
TEL: 905-372-2121
FAX: 905-372-3821
E-mail: cobourg@tsh.ca
www.tsh.ca

CLIENT:

THE CORPORATION OF THE TOWN OF COBOURG

VICTORIA HALL
55 KING STREET WEST
COBOURG, ONTARIO
K9A 2M2

PROJECT:

COVERDALE AVENUE STORM SEWER AND ROADWAY IMPROVEMENTS

LAKE ONTARIO TO 105m SOUTH OF HAMILTON AVE.

DRAWING:

COVERDALE AVENUE TRUNK STORM SEWER

DRAINAGE AREA PLAN

DRAWN BY:	CHECKED BY:	PROJECT No.:
A. BEAVIS	G. J. WATSON	12-29292-03
DESIGNED BY:	APPROVED BY:	DRAWING No.
R. LAWONDE	W. WILCOX	SD-1
SCALE: 1:2500	DATE: JUNE 2005	

Ryan Brockie

From: Jason Armstrong <jason@engageeng.ca>
Sent: Thursday, April 11, 2019 8:41 AM
To: Ryan Brockie
Cc: Karen Edgington; Brad Parsons
Subject: RE: Gates of Camelot Phase II - Post Development Flow Rates
Attachments: TSH Coverdale Storm Sewer Design Sheets.pdf; TSH Coverdale Storm Sewer Drainage Areas.pdf; 4 - 18041-Post DA.pdf

Hi Ryan,

I've attached our Post-development drainage area for the site.

Flows from PR1 will be controlled to a maximum 5-yr release of 0.148m³/sec.

Flows from PXT2 & PXT3 will be conveyed through the site directly into the storm sewer.

I've also attached some older information the Town had provided to us from the original TSH review.

Hope this helps if you have any questions feel free to give me a call.

Thanks,

Jason Armstrong
Engage Engineering Ltd.
P: 705.755.0427 x203 C: 705.760.1006

From: Ryan.Brockie@ghd.com <Ryan.Brockie@ghd.com>
Sent: April 5, 2019 3:42 PM
To: Jason Armstrong <jason@engageeng.ca>
Cc: Karen Edgington <Karen.Edgington@ghd.com>
Subject: Gates of Camelot Phase II - Post Development Flow Rates

Hi Jason,

Further to our conversation, I am looking for the ultimate post-development flow rates that will discharge to the King Street East sewer from the "Gates of Camelot – Phase II" lands, I have attached a screen grab of the area for reference. Based on the information we have been provided by the Town of Cobourg, it is approximately 13.5ha.

Any information on the drainage areas and design flows for the future subdivision would be greatly appreciated.

Thank you,
Ryan

Ryan Brockie
Water Resources, EIT

GHD
T: + 1 905 215 0545 | V: 886545 | E: ryan.brockie@ghd.com
65 Sunray Street Whitby ON L1N 8Y3 | **www.ghd.com**

PXT2
0.46 38.27

PR1
0.33 11.80

PXT3
0.40 2.68

LEGEND

PRE-DEVELOPMENT STORM DRAINAGE AREA

OVERLAND FLOW DIRECTION

EX1 — CATCHMENT NAME

RUNOFF COEFFICIENT — 0.79 | 0.231 — AREA (ha)

ENGAGE ENGINEERING

EAST VILLAGE PHASE 5

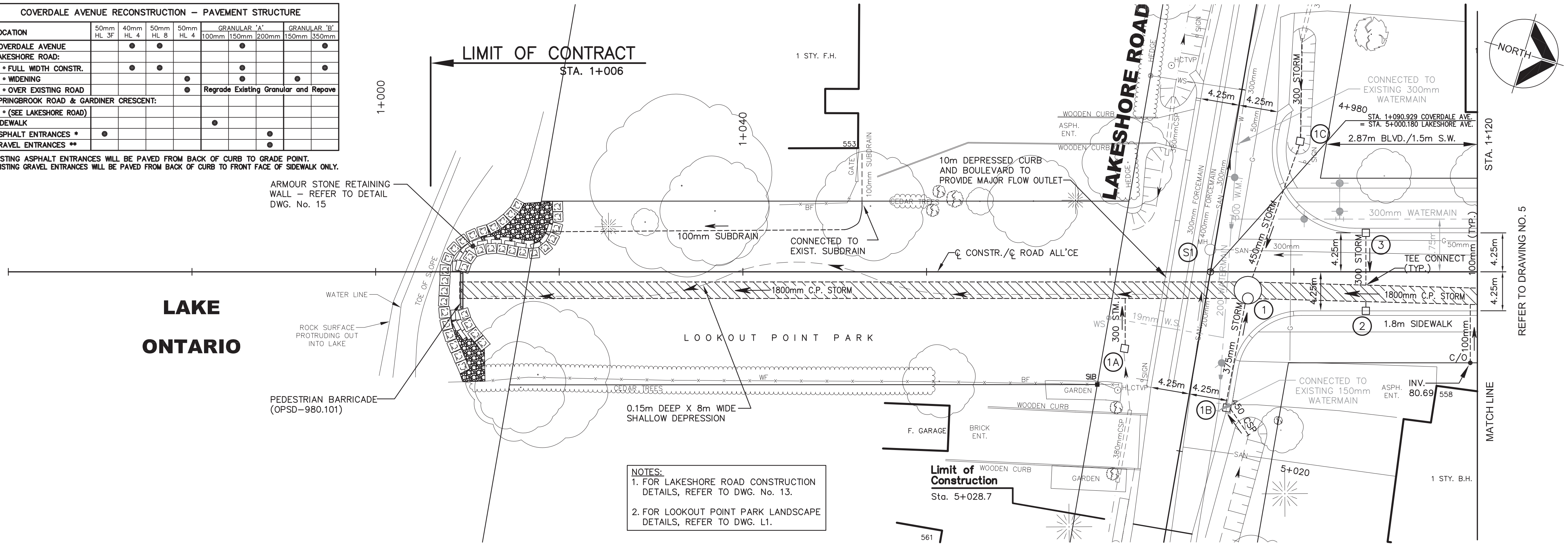
FIGURE 4 - POST-DEVELOPMENT DRAINAGE AREA PLAN

DRAWN:	APPROVED:	SCALE:	DATE:	PROJECT No.:
B.PARSONS	P.HURLEY	1:4000	11-15-18	18041

S:\01 - Projects\18000\18041 East Village Phase 5\02 Design\Drawings\Current Drawings\18041-DA1.dwg PRINTED: Nov 30, 2018

COVERDALE AVENUE RECONSTRUCTION – PAVEMENT STRUCTURE									
LOCATION	50mm HL 3F	40mm HL 4	50mm HL 8	50mm HL 4	GRANULAR 'A' 100mm	GRANULAR 'A' 150mm	GRANULAR 'A' 200mm	GRANULAR 'B' 150mm	GRANULAR 'B' 350mm
COVERDALE AVENUE		●	●			●			●
LAKESHORE ROAD:									
• FULL WIDTH CONSTR.		●	●			●			●
• WIDENING				●		●		●	
• OVER EXISTING ROAD				●	Regrade Existing Granular and Repave				
SPRINGBROOK ROAD & GARDINER CRESCENT:									
• (SEE LAKESHORE ROAD)									
SIDEWALK					●				
ASPHALT ENTRANCES *	●						●		
GRAVEL ENTRANCES **							●		

* EXISTING ASPHALT ENTRANCES WILL BE PAVED FROM BACK OF CURB TO GRADE POINT.
** EXISTING GRAVEL ENTRANCES WILL BE PAVED FROM BACK OF CURB TO FRONT FACE OF SIDEWALK ONLY.



LEGEND

STM.	EXISTING STORM SEWER
SAN.	EXISTING SANITARY SEWER
WM.	EXISTING WATERMAIN
G	EXISTING GAS MAIN
B	EXISTING BURIED BELL CABLE
CTV	EXISTING BURIED CTV CABLE
H	EXISTING BURIED HYDRO CABLE
300mm	AS CONSTRUCTED STORM SEWER
	AS CONSTRUCTED STORM SERVICE
	AS CONSTRUCTED WATER SERVICE
	AS CONSTRUCTED WATERMAIN
	CURB & GUTTER
	DROP CURB
	SIDEWALK

B.M. 101 ELEV.81.458
N. & W. IN N. FACE OF HBP/CTV, S. SIDE OF LAKESHORE ROAD, 1st. POLE W. OF COVERDALE AVE.
Sta. 4+978.72, O/S 7.95m Rt.

NOTE :

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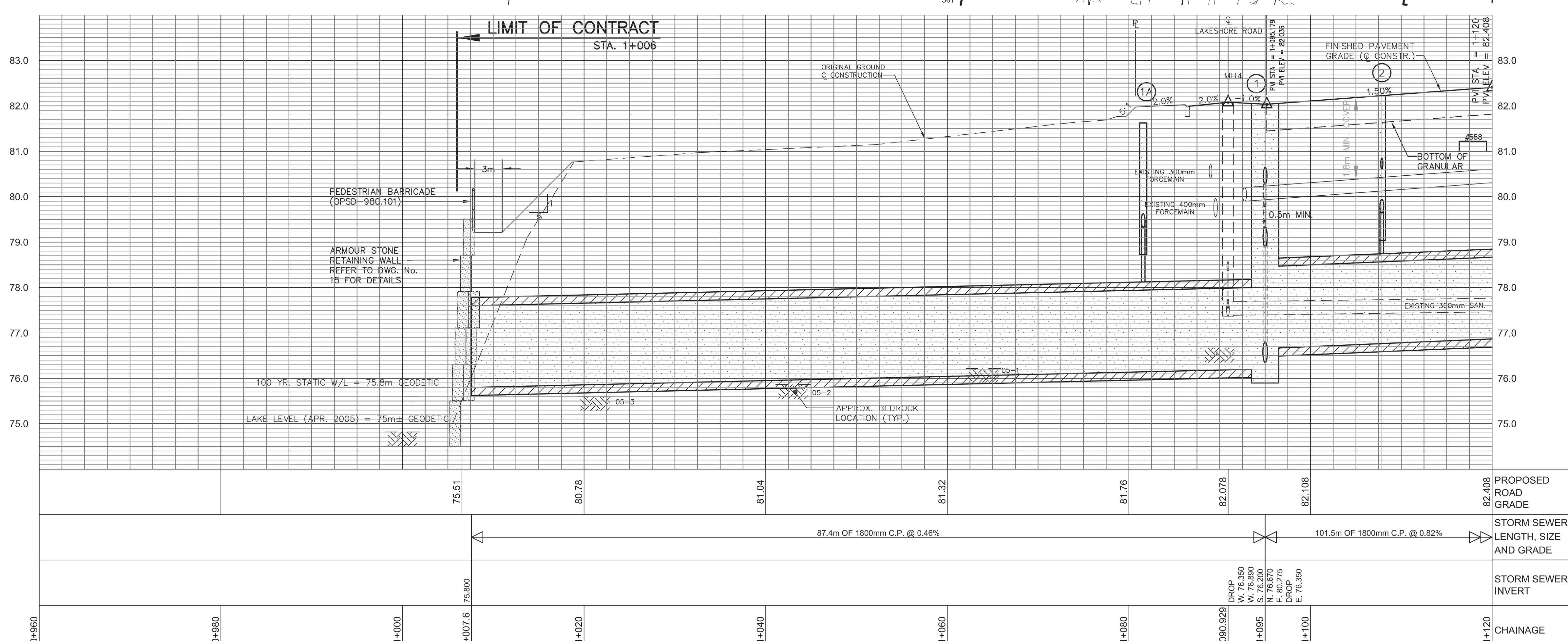
No.	DATE	BY	ISSUES / REVISIONS
3	04/17/07	S.M.	AS CONSTRUCTED DETAILS ADDED
2	09/30/05	J.B.	ISSUED FOR CONSTRUCTION
1	08/25/05	J.B.	ISSUED FOR TENDER/APPROVALS



513 Division Street
Cobourg, Ontario
K9A 5G6
TEL: 905-372-2121
FAX: 905-372-3621
E-mail cobourg@tsh.ca
www.tsh.ca
TSH engineers architects planners
Totten Sims Hubicki Associates (1997) Limited

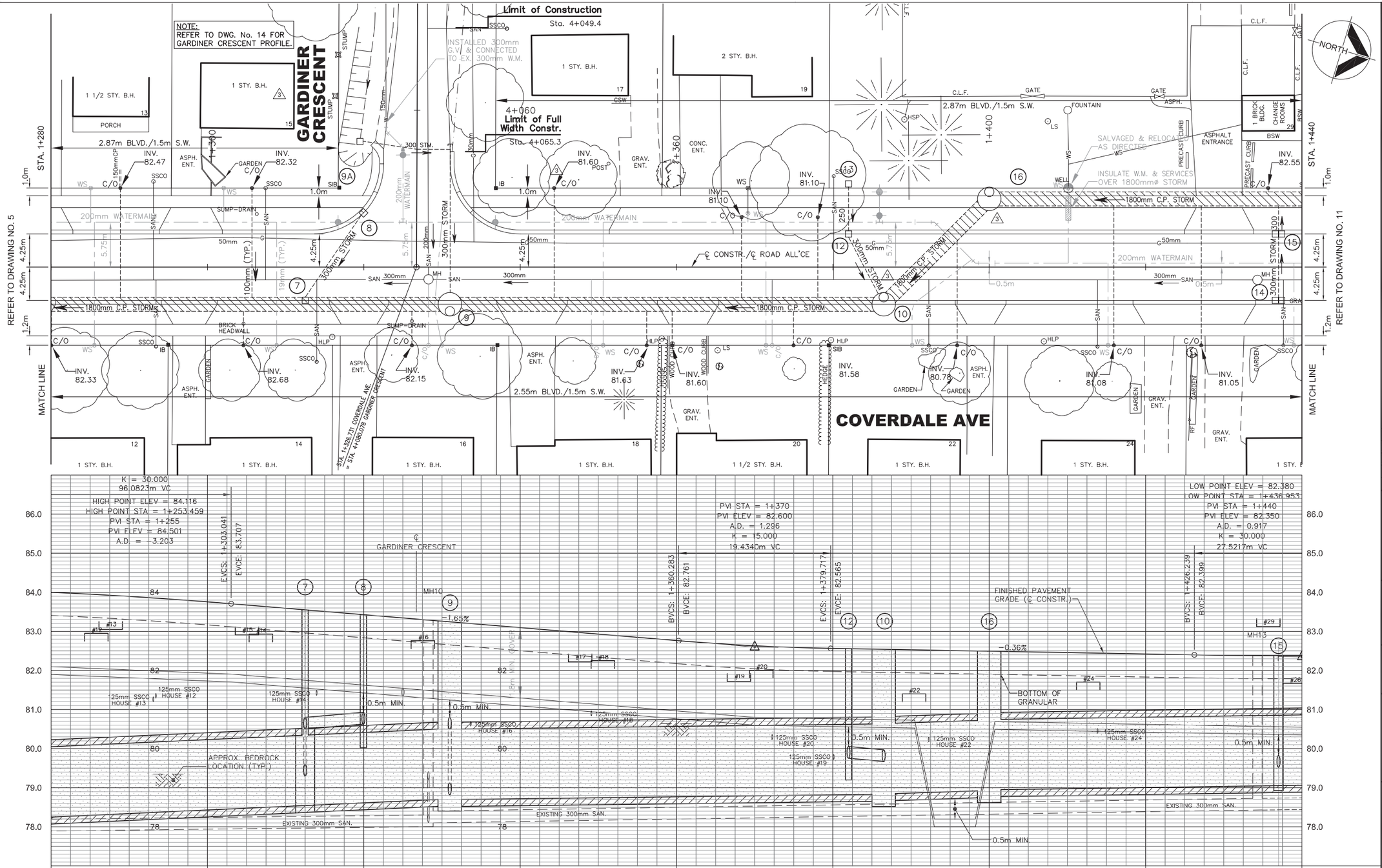
CLIENT:
THE CORPORATION OF THE TOWN OF COBOURG
PUBLIC WORKS DIVISION
ENGINEERING DEPARTMENT
VICTORIA HALL
55 KING STREET WEST
COBOURG, ONTARIO
K9A 2M2

PROJECT:
COVERDALE AVENUE RECONSTRUCTION
LAKE ONTARIO TO 105m SOUTH OF HAMILTON AVENUE

CONTRACT No. CO-05-25

DRAWING:
NEW CONSTRUCTION AND STORM SEWERS STA. 1+000 TO STA. 1+120 AS CONSTRUCTED

DRAWN BY:	CHECKED BY:	PROJECT No. :
J. BEAVAN	G.J. WATSON	12-29292-03
DESIGNED BY: J. BEAVAN, G. J. WATSON	APPROVED BY: W. WILCOX	DRAWING No. 2
SCALE: HORZ. 1:250, VERT. 1:50	DATE: AUGUST 2005	



LEGEND

- STM. — EXISTING STORM SEWER
- SAN. — EXISTING SANITARY SEWER
- WM. — EXISTING WATERMAIN
- G — EXISTING GAS MAIN
- B — EXISTING BURIED BELL CABLE
- CTV — EXISTING BURIED CTV CABLE
- H — EXISTING BURIED HYDRO CABLE
- 300mm — AS CONSTRUCTED STORM SEWER
- AS CONSTRUCTED STORM SERVICE
- AS CONSTRUCTED WATER SERVICE
- AS CONSTRUCTED WATERMAIN
- CURB & GUTTER
- DROP CURB
- SIDEWALK

B.M. 102 ELEV.84.016
R.R. SPIKE IN W. FACE OF HLP, E. SIDE OF COVERDALE AVE., BETWEEN Hs. #16 & Hs. #14.
Sta. 1+315.97 O/S 8.90m Rt.

NOTE:

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No.	DATE	BY	ISSUES / REVISIONS
4	04/17/07	S.M.	AS CONSTRUCTED DETAILS ADDED
3	05/30/06	J.B.	STORM SEWER REVISED
2	09/30/05	J.B.	ISSUED FOR CONSTRUCTION
1	08/25/05	J.B.	ISSUED FOR TENDER/APPROVALS

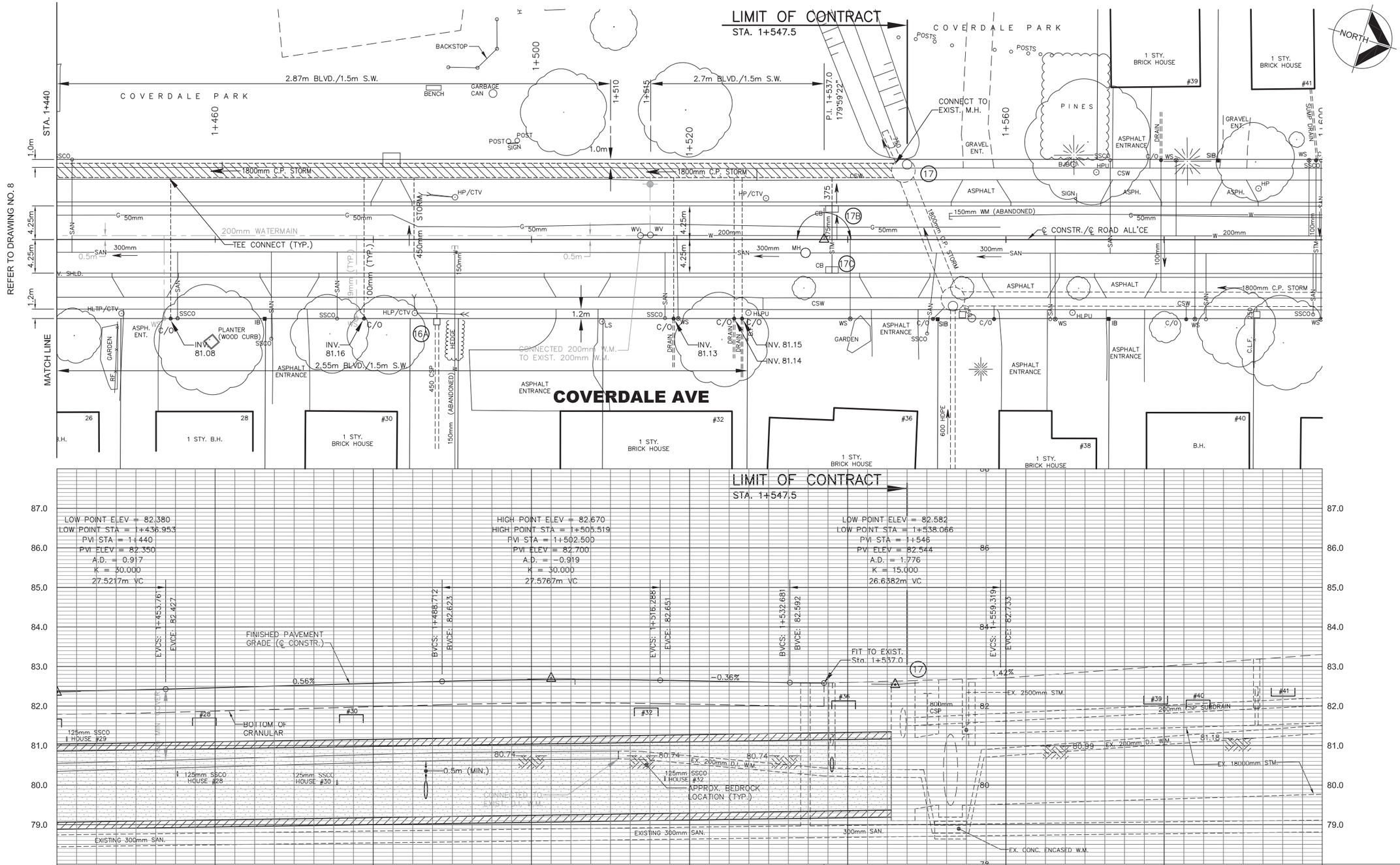
tsh engineers architects planners
513 Division Street
Cobourg, Ontario
K9A 5G6
TEL: 905-372-2121
FAX: 905-372-3621
E-mail cobourg@tsh.ca
www.tsh.ca
Totten Sims Hubicki Assodates (1997) Limited

CLIENT:
THE CORPORATION OF THE TOWN OF COBOURG
PUBLIC WORKS DIVISION
ENGINEERING DEPARTMENT
VICTORIA HALL
55 KING STREET WEST
COBOURG, ONTARIO
K9A 2M2

PROJECT:
COVERDALE AVENUE RECONSTRUCTION
LAKE ONTARIO TO 105m
SOUTH OF HAMILTON AVENUE
CONTRACT No. CO-05-25

DRAWING:
NEW CONSTRUCTION AND STORM SEWERS STA. 1+280 TO STA. 1+440 AS CONSTRUCTED

DRAWN BY:	CHECKED BY:	PROJECT No.:
J. BEAVAN	G.J. WATSON	12-29292-03
DESIGNED BY: J. BEAVAN, G. J. WATSON	APPROVED BY: W. WILCOX	DRAWING No. 8
SCALE: HORZ. 1:500, VERT. 1:100	DATE: AUGUST 2005	



LEGEND

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- SAN. — EXISTING SANITARY SEWER
- WM — EXISTING WATERMAIN
- G — EXISTING GAS MAIN
- B — EXISTING BURIED BELL CABLE
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- AS CONSTRUCTED WATER SERVICE
- AS CONSTRUCTED WATERMAIN
- CURB & GUTTER
- DROP CURB
- SIDEWALK

B.M. 102 ELEV.84.016
R.R. SPIKE IN W. FACE OF HLP, E. SIDE OF COVERDALE AVE., BETWEEN Hs. #16 & Hs. #14.
Sta. 1+315.97 O/S 8.90m Rt.

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No.	DATE	BY	ISSUES / REVISIONS
4	04/17/07	S.M.	AS CONSTRUCTED DETAILS ADDED
3	05/30/06	J.B.	STORM REVISED / MH#16 DELETED
2	09/30/05	J.B.	ISSUED FOR CONSTRUCTION
1	08/25/05	J.B.	ISSUED FOR TENDER/APPROVALS

engineers architects planners
Totten Sims Hubicki Associates (1997) Limited
513 Division Street
Cobourg, Ontario
K9A 5G8
TEL: 905-372-2121
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CLIENT:
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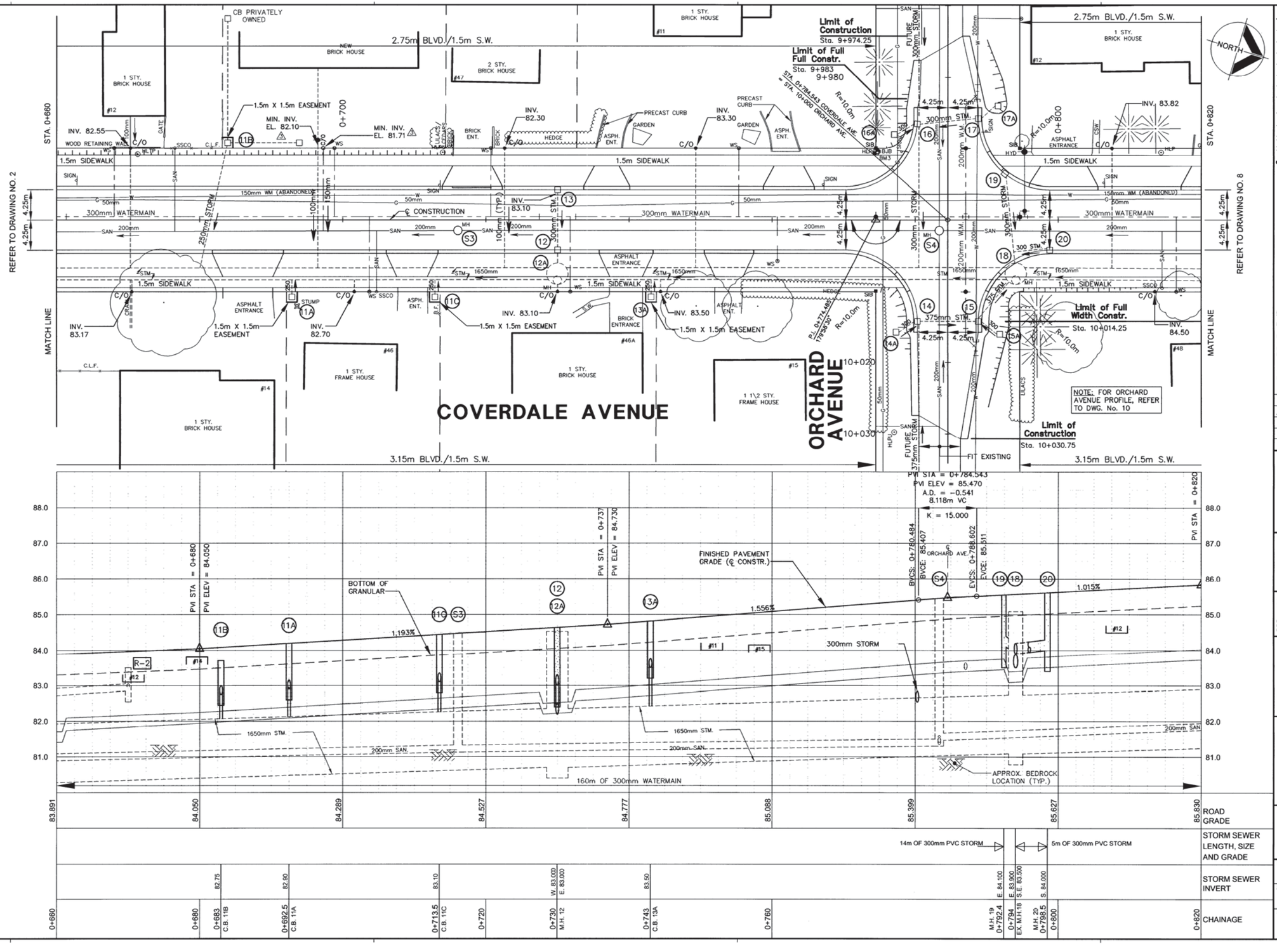
PUBLIC WORKS DIVISION
ENGINEERING DEPARTMENT
VICTORIA HALL
55 KING STREET WEST
COBOURG, ONTARIO
K9A 2M2

PROJECT:
COVERDALE AVENUE RECONSTRUCTION
LAKE ONTARIO TO 105m
SOUTH OF HAMILTON AVENUE
CONTRACT No. CO-05-25

DRAWING:
NEW CONSTRUCTION AND STORM SEWERS
STA. 1+440 TO STA. 1+600
AS CONSTRUCTED

DRAWN BY:	CHECKED BY:	PROJECT No.:
J. BEAVAN	G.J. WATSON	12-29292-03
DESIGNED BY: J. BEAVAN, G. J. WATSON	APPROVED BY: W. WILCOX	DRAWING No. 11
SCALE: HORZ. 1:500, VERT. 1:100	DATE: AUGUST 2005	



LEGEND

- STM — STORM SEWER
- SAN — SANITARY SEWER
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- G — GAS MAIN
- B — BURIED BELL CABLE
- CTV — BURIED CTV CABLE
- H — BURIED HYDRO CABLE
- 300mm — STORM SEWER AS CONSTRUCTED
- 200mm — WATERMAIN AS CONSTRUCTED
- CURB & GUTTER
- DROP CURB
- 100mm PVC C/O — BASEMENT DRAINS W/ CLEAN-OUT (REFER TO S-303 MOD.)

B.M.3 ELEV. 83.789
N&W IN EAST FACE OF HLP AT SOUTH-WEST CORNER OF COVERDALE AVENUE AND ORCHARD AVENUE.
STA. 0+774.52, O/S 9.56m Lt.

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No.	DATE	BY	ISSUES / REVISIONS
4	07.22.04	A.D.O.	AS CONSTRUCTED DETAILS ADDED
3	10.17.03	J.B.	STORM & SANITARY SERVICE ADDED (0+697)
2	10.09.03	J.B.	ISSUED FOR CONSTRUCTION
1	9.19.03	J.B.	ISSUED FOR TENDER

LICENSED PROFESSIONAL ENGINEER W. WILCOX PROVINCE OF ONTARIO

TSH engineers architects planners
513 Division Street
Cobourg, Ontario
K9A 5G6
TEL: 905-372-2121
FAX: 905-372-3621
E-mail cobourg@tsh.ca
www.tsh.ca

CLIENT:

THE CORPORATION OF THE TOWN OF COBOURG

VICTORIA HALL
55 KING STREET WEST
COBOURG, ONTARIO
K9A 2M2

PROJECT:

COVERDALE AVENUE RECONSTRUCTION

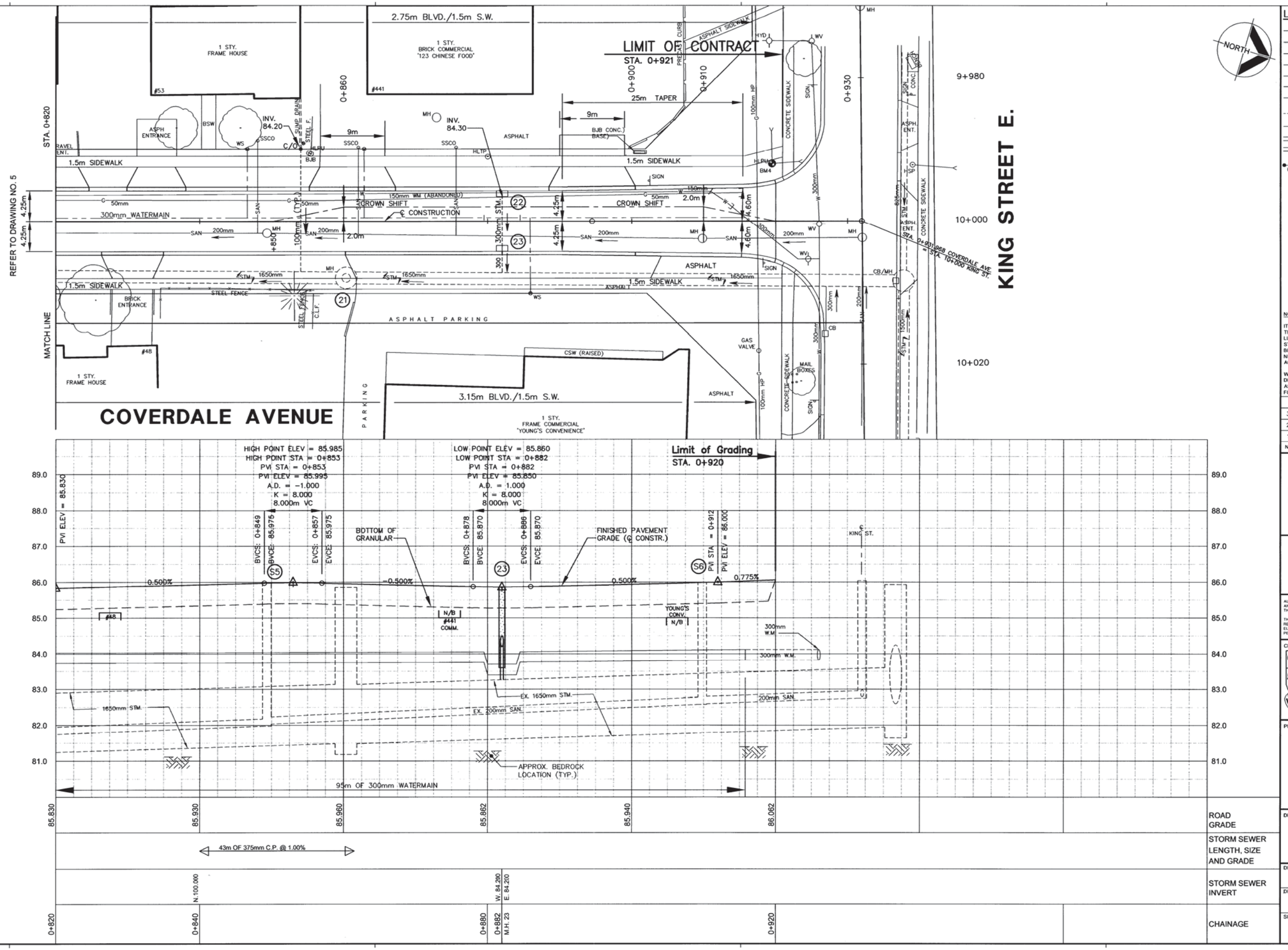
KING STREET TO 130m SOUTH OF HAMILTON AVENUE

CONTRACT No. 2-03-03

DRAWING:

NEW CONSTRUCTION AND STORM SEWERS AS CONSTRUCTED STA. 0+660 TO STA. 0+820

DRAWN BY:	CHECKED BY:	PROJECT No. :
J. BEAVAN	R.P. LARONDE	12-29292
DESIGNED BY:	APPROVED BY:	DRAWING No.
R.P. LARONDE	W. WILCOX	5
SCALE: HORZ. 1:250 VERT. 1:50	DATE: SEPTEMBER 2003	



LEGEND

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- SAN — SANITARY SEWER
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- B — BURIED BELL CABLE
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- 300mm — STORM SEWER AS CONSTRUCTED
- 200mm — WATERMAIN AS CONSTRUCTED
- CURB & GUTTER
- DROP CURB
- 100mm PVC C/O — BASEMENT DRAINS W/ CLEAN-OUT (REFER TO S-303 MOD.)

B.M.4 ELEV. 86.490
N&W IN EAST FACE OF HLPU AT SOUTH-WEST CORNER OF COVERDALE AVENUE AND KING STREET EAST.
STA. 0+919.48, 0/S 8.02m Lt.

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No.	DATE	BY	ISSUES / REVISIONS
3	07.22.04	A.D.O.	AS CONSTRUCTED DETAILS ADDED
2	10.09.03	J.B.	ISSUED FOR CONSTRUCTION
1	9.19.03	J.B.	ISSUED FOR TENDER

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CLIENT:
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VICTORIA HALL
55 KING STREET WEST
COBOURG, ONTARIO
K9A 2M2

PROJECT:
COVERDALE AVENUE RECONSTRUCTION
KING STREET TO 130m SOUTH OF HAMILTON AVENUE

CONTRACT No. 2-03-03

DRAWING:
NEW CONSTRUCTION AND STORM SEWERS AS CONSTRUCTED STA. 0+820 TO STA. 0+921

DRAWN BY:	CHECKED BY:	PROJECT No.:
J. BEAVAN	R.P. LARONDE	12-29292
DESIGNED BY:	APPROVED BY:	DRAWING No.
R.P. LARONDE	W. WILCOX	8
SCALE: HORZ. 1:250 VERT. 1:50	DATE: SEPTEMBER 2003	

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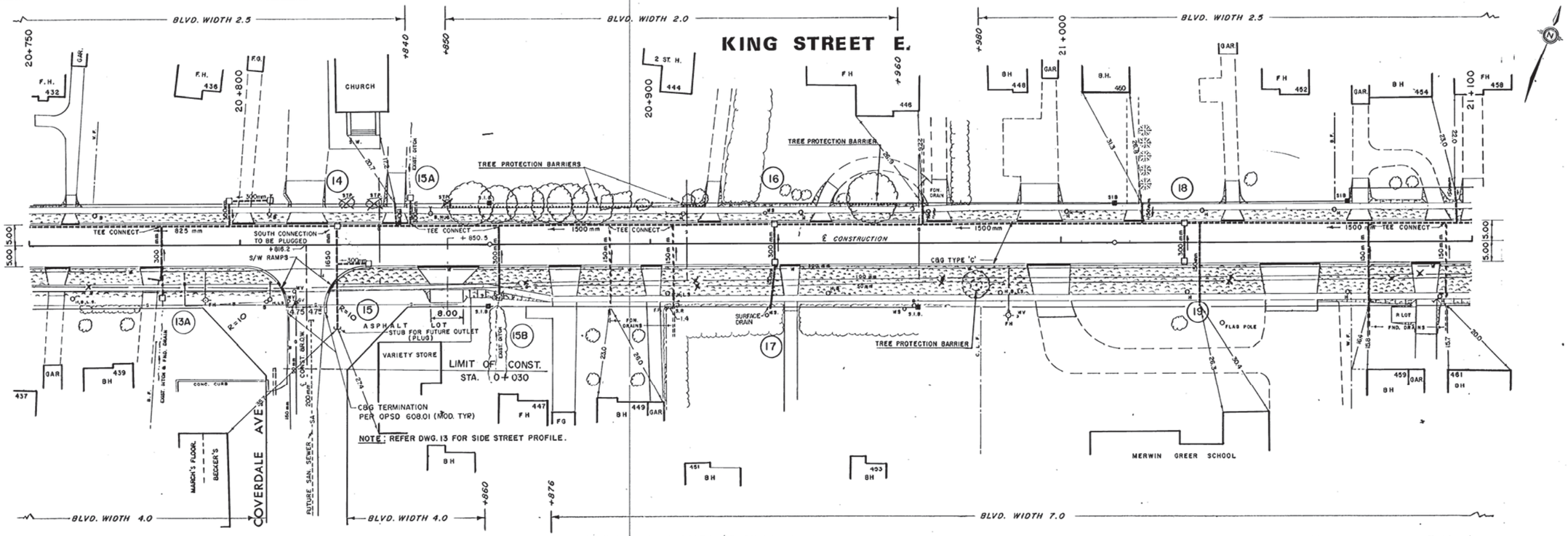
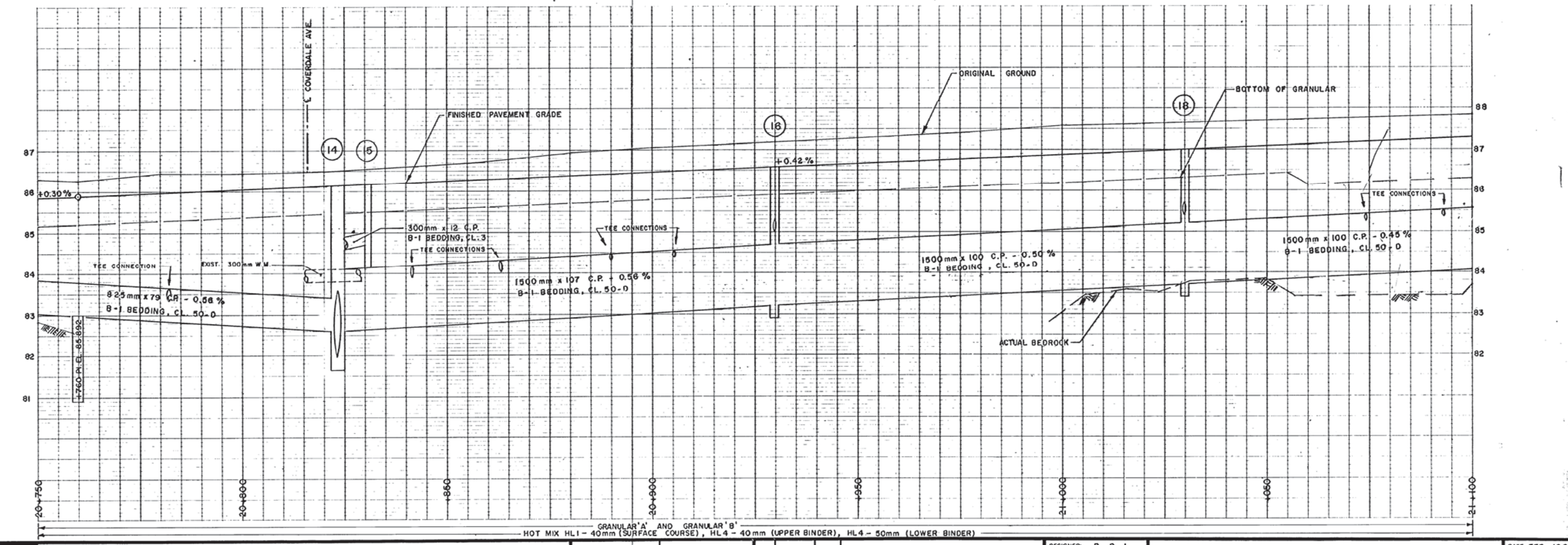
KING STREET E.





totten sims hubicki associates

ENGINEERS ARCHITECTS AND PLANNERS

COBOURG WHITBY KINGSTON TORONTO BRACEBRIDGE OTTAWA SIMCOE

No.	DATE	BY	REVISIONS
1	OCT./89	P.C.	AS CONSTRUCTED DETAILS ADDED

DESIGNED: R. P. L.
DRAWN: J. R. M.
CHECKED: R. P. L.
APPROVED: H. D. G.
SCALE: 1:500 HOR. 1:50 VERT.

TOWN OF COBOURG

KING STREET EAST — HIGHWAY NO. 2

STREET CONSTRUCTION AND STORM SEWERS

DATE: FEB, 1988
PROJECT: 7294
DRAWING: 6

KING STREET E.

BLVD. WIDTH 2.5 | BLVD. WIDTH 3.0 | BLVD. WIDTH 4.0

21+100 | 21+200 | 21+300 | 21+324 | 21+400 | 21+450

RIP-RAP, 300mm DEPTH. (4.2 WIDE x 3.0 LENGTH)

CONCRETE HEADWALL PER AND GRATING PER OPSD-804.05 (TYPE 'A')

CONSTRUCT 3.0 WIDE FLAT BOTTOM DITCH, 2:1 SIDE SLOPES. 1220mm x 1920mm H.E.C.P.

STRAW-HAY BALE CHECK DAM (REFER DWG 28-1)

WEST CONNECTION TO BE PLUGGED

1500 mm | 300 mm | 5.00 | 6.75

CBG TYPE 'C'

STONE PILLERS

S/W RAMP

CBG TERMINATION PER OPSD 608.01 (MOD. TYP)

R=10

LIMIT OF CONST. STA. 0+030

730mm x 1150mm H.E.C.P.

TREE PROTECTION BARRIERS

STRAW-HAY BALE CHECK DAM (REFER DWG. 28-1)

NOTE: REFER DWG. No. 13 FOR SIDE STREET PROFILES.

MAPLEWOOD BLVD. | FITZHUGH LANE

BLVD. WIDTH 7.0 | BLVD. WIDTH 3.0

BH 461 | BH 463 | BH 465 | BH 15

FH 458

+216.322

21+315 | 21+390 | 21+445

20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29

FINISHED PAVEMENT GRADE

ORIGINAL GROUND

BOTTOM OF GRANULAR

+0.92 % | -0.30 % | +0.99 %

1500 mm x 101 C.P. - 0.45 % B-I BEDDING, CL. 50-D

1500 mm x 87 C.P. - 0.45 % B-I BEDDING, CL. 50-D

300 mm x 100 C.P. - 0.99 %, B-I BEDDING, CL. 3

300 mm x 12 C.P. + 0.99 % B-I BEDDING, CL. 3

WEST CONNECTION TO BE PLUGGED

ACTUAL BEDROCK

+228 PI EL. 87.695 K=35 L=26

+340 PI EL. 87.505 K=30 L=38

90 | 89 | 88 | 87 | 86 | 85 | 84

150 | 200 | 250 | 300 | 350 | 400 | 450

GRANULAR 'A' AND GRANULAR 'B'

HOT MIX HL1 - 40mm (SURFACE COURSE), HL4 - 40mm (UPPER BINDER), HL4 - 50mm (LOWER BINDER)

totten sims hubicki associates

ENGINEERS ARCHITECTS AND PLANNERS

COBOURG WHITBY KINGSTON TORONTO BRACEBRIDGE OTTAWA SIMCOE

No.	DATE	BY	REVISIONS
1	OCT./89	P.C.	AS CONSTRUCTED DETAILS ADDED

DESIGNED: R. P. L.
DRAWN: J. R. M.
CHECKED: R. P. L.
APPROVED: H. D. G.
SCALE: 1:500 HOR. 1:50 VERT.

TOWN OF COBOURG

KING STREET EAST - HIGHWAY NO. 2

STREET CONSTRUCTION AND STORM SEWERS

DATE: FEB, 1988
PROJECT: 7294
DRAWING: 8

Appendix **D**

Stormceptor Design Brief

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Friday, July 12, 2019
Project Name	425 King St. E
Project Number	
Location	Cobourg

Jellyfish Filter Design Overview

This report provides information for the sizing and specification of the Jellyfish Filter. When designed properly in accordance to the guidelines detailed in the Jellyfish Filter Technical Manual, the Jellyfish Filter will exceed the performance and longevity of conventional horizontal bed and granular media filters.

Please see ***www.ImbriumSystems.com*** *for more information.*

Jellyfish Filter System Recommendation

The Jellyfish Filter model JF6-4-1 is recommended to meet the water quality objective by treating a flow of 22.7 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 32 years of PETERBOROUGH A rainfall data for this site. This model has a sediment capacity of 256 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF6-4-1	4	1	1.8	22.7	256

The Jellyfish Filter System

The patented Jellyfish Filter is an engineered stormwater quality treatment technology featuring unique membrane filtration in a compact stand-alone treatment system that removes a high level and wide variety of stormwater pollutants. Exceptional pollutant removal is achieved at high treatment flow rates with minimal head loss and low maintenance costs. Each lightweight Jellyfish Filter cartridge contains an extraordinarily large amount of membrane surface area, resulting in superior flow capacity and pollutant removal capacity.

Maintenance

Regular scheduled inspections and maintenance is necessary to assure proper functioning of the Jellyfish Filter. The maintenance interval is designed to be a minimum of 12 months, but this will vary depending on site loading conditions and upstream pretreatment measures. Quarterly inspections and inspections after all storms beyond the 5-year event are recommended until enough historical performance data has been logged to comfortably initiate an alternative inspection interval.

Please see ***www.ImbriumSystems.com*** *for more information.*

Thank you for the opportunity to present this information to you and your client.

Performance

Jellyfish efficiently captures a high level of Stormwater pollutants, including:

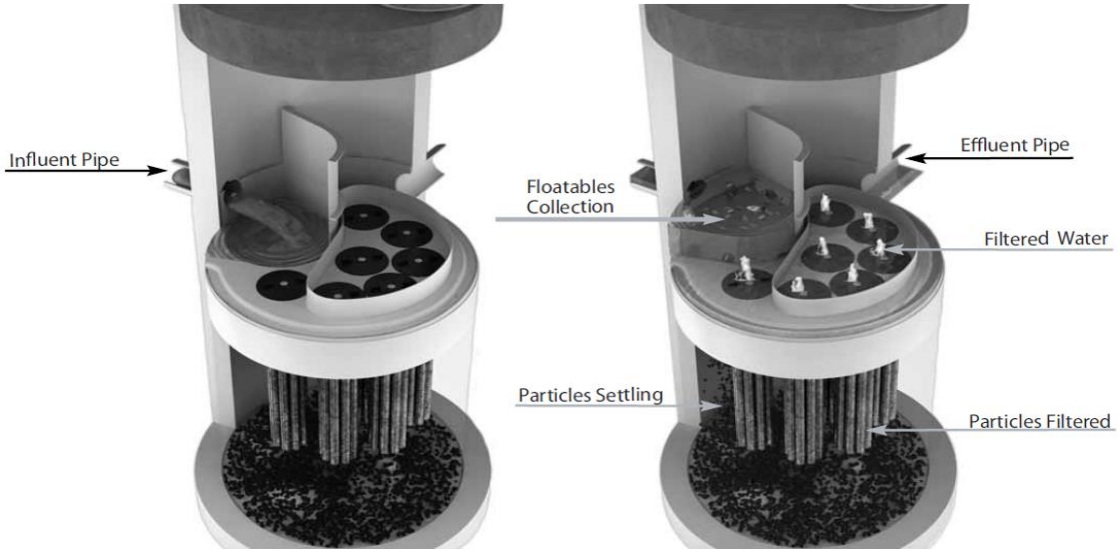
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 59% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash and debris

Field Proven Peformance

The Jellyfish filter has been field-tested on an urban site with 25 TARP qualifying rain events and field monitored according to the TARP field test protocol, demonstrating:

- A median TSS removal efficiency of 89%, and a median SSC removal of 99%;
- The ability to capture fine particles as indicated by an effluent d50 median of 3 microns for all monitotred storm events, and a median effluent turbidity of 5 NTUs;
- A median Total Phosphorus removal of 59%, and a median Total Nitrogen removal of 51%.

Jellyfish Filter Treatment Functions



Pre-treatment and Membrane Filtration

Jellyfish® Filter

Project Information

Date:	Friday, July 12, 2019
Project Name:	425 King St. E
Project Number:	
Location:	Cobourg

Designer Information

Company:	GHD Group
Contact:	Ryan Brockie
Phone #:	

Notes

Rainfall

Name:	PETERBOROUGH A
State:	ON
ID:	6418
Record:	1971 to 2002
Co-ords:	44°14'N, 78°22'W

Drainage Area

Total Area:	1.85 ha
Runoff Coefficient:	0.5

Upstream Detention

Peak Release Rate:	n/a
Pretreatment Credit:	n/a

Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 32 years of PETERBOROUGH A rainfall data:	**22 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 2952 m³, with a suspended sediment concentration of 60 mg/L.	**177 kg**

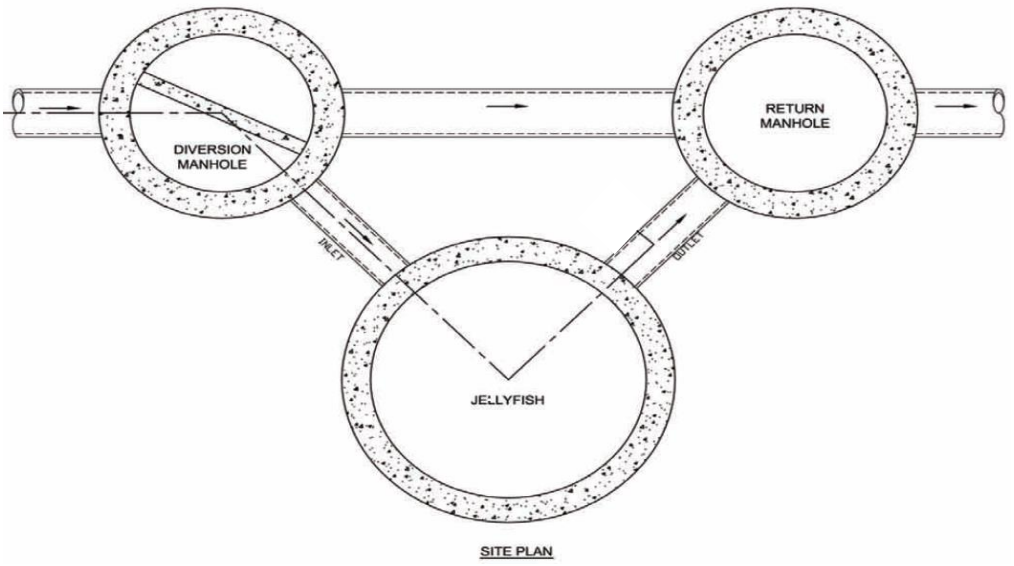
Recommendation

The Jellyfish Filter model JF6-4-1 is recommended to meet the water quality objective by treating a flow of 22.7 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 32 years of PETERBOROUGH A rainfall data for this site. This model has a sediment capacity of 256 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Wet Vol Below Deck (L)	Sump Storage (m³)	Oil Capacity (L)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-1-1	1	1	1.2	2313	0.34	379	7.6	85
JF4-2-1	2	1	1.2	2313	0.34	379	12.6	142
JF6-3-1	3	1	1.8	5205	0.79	848	17.7	199
JF6-4-1	**4**	**1**	**1.8**	**5205**	**0.79**	**848**	**22.7**	**256**
JF6-5-1	5	1	1.8	5205	0.79	848	27.8	313
JF6-6-1	6	1	1.8	5205	0.79	848	28.6	370
JF8-6-2	6	2	2.4	9252	1.42	1469	35.3	398
JF8-7-2	7	2	2.4	9252	1.42	1469	40.4	455
JF8-8-2	8	2	2.4	9252	1.42	1469	45.4	512
JF8-9-2	9	2	2.4	9252	1.42	1469	50.5	569
JF8-10-2	10	2	2.4	9252	1.42	1469	50.5	626
JF10-11-3	11	3	3.0	14456	2.21	2302	63.1	711
JF10-12-3	12	3	3.0	14456	2.21	2302	68.2	768
JF10-12-4	12	4	3.0	14456	2.21	2302	70.7	796
JF10-13-4	13	4	3.0	14456	2.21	2302	75.7	853
JF10-14-4	14	4	3.0	14456	2.21	2302	78.9	910
JF10-15-4	15	4	3.0	14456	2.21	2302	78.9	967
JF10-16-4	16	4	3.0	14456	2.21	2302	78.9	1024
JF10-17-4	17	4	3.0	14456	2.21	2302	78.9	1081
JF10-18-4	18	4	3.0	14456	2.21	2302	78.9	1138
JF10-19-4	19	4	3.0	14456	2.21	2302	78.9	1195
JF12-20-5	20	5	3.6	20820	3.2	2771	113.6	1280
JF12-21-5	21	5	3.6	20820	3.2	2771	113.7	1337
JF12-22-5	22	5	3.6	20820	3.2	2771	113.7	1394
JF12-23-5	23	5	3.6	20820	3.2	2771	113.7	1451
JF12-24-5	24	5	3.6	20820	3.2	2771	113.7	1508
JF12-25-5	25	5	3.6	20820	3.2	2771	113.7	1565
JF12-26-5	26	5	3.6	20820	3.2	2771	113.7	1622
JF12-27-5	27	5	3.6	20820	3.2	2771	113.7	1679

Jellyfish Filter Design Notes

- Typically the Jellyfish Filter is designed in an offline configuration, as all stormwater filter systems will perform for a longer duration between required maintenance services when designed and applied in off-line configurations. Depending on the design parameters, an optional internal bypass may be incorporated into the Jellyfish Filter, however note the inspection and maintenance frequency should be expected to increase above that of an off-line system. Speak to your local representative for more information.



Jellyfish Filter Typical Layout

- Typically, 18 inches (457 mm) of driving head is designed into the system, calculated as the difference in elevation between the top of the diversion structure weir and the invert of the Jellyfish Filter outlet pipe. Alternative driving head values can be designed as 12 to 24 inches (305 to 610mm) depending on specific site requirements, requiring additional sizing and design assistance.
- Typically, the Jellyfish Filter is designed with the inlet pipe configured 6 inches (150 mm) above the outlet invert elevation. However, depending on site parameters this can vary to an optional configuration of the inlet pipe entering the unit below the outlet invert elevation.
- The Jellyfish Filter can accommodate multiple inlet pipes within certain restrictions.
- While the optional inlet below deck configuration offers 0 to 360 degree flexibility between the inlet and outlet pipe, typical systems conform to the following:

Model Diameter (m)	Minimum Angle Inlet / Outlet Pipes	Minimum Inlet Pipe Diameter (mm)	Minimum Outlet Pipe Diameter (mm)
1.2	62º	150	200
1.8	**59º**	**200**	**250**
2.4	52º	250	300
3.0	48º	300	450
3.6	40º	300	450

- The Jellyfish Filter can be built at all depths of cover generally associated with conventional stormwater conveyance systems. For sites that require minimal depth of cover for the stormwater infrastructure, the Jellyfish Filter can be applied in a shallow application using a hatch cover. The general minimum depth of cover is 36 inches (915 mm) from top of the underslab to outlet invert.
- If driving head caclulations account for water elevation during submerged conditions the Jellyfish Filter will function effectively under submerged condtions.
- Jellyfish Filter systems may incorporate grated inlets depending on system configuration.
- For sites with water quality treatment flow rates or mass loadings that exceed the design flow rate of the largest standard Jellyfish Filter manhole models, systems can be designed that hydraulically connect multiple Jellyfish Filters in series or alternatively Jellyfish Vault units can be designed.

STANDARD SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

Specifies requirements for construction and performance of an underground stormwater quality membrane filtration treatment device that removes pollutants from stormwater runoff through the unit operations of sedimentation, floatation, and membrane filtration.

1.2 REFERENCE STANDARDS

ASTM C 891: Specification for Installation of Underground Precast Concrete Utility Structures
ASTM C 478: Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 443: Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM D 4101: Specification for Copolymer steps construction

CAN/CSA-A257.4-M92
Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections and Fittings Using Rubber Gaskets

CAN/CSA-A257.4-M92
Precast Reinforced Circular Concrete Manhole Sections, Catch Basins and Fittings

Canadian Highway Bridge Design Code

1.3 SHOP DRAWINGS

Shop drawings for the structure and performance are to be submitted with each order to the contractor. Contractor shall forward shop drawing submittal to the consulting engineer for approval. Shop drawings are to detail the structure's precast concrete and call out or note the fiberglass (FRP) internals/components.

1.4 PRODUCT SUBSTITUTIONS

No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the engineer of record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

1.5 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 The device shall be a cylindrical or rectangular, all concrete structure (including risers), constructed from precast concrete riser and slab components or monolithic precast structure(s), installed to conform to ASTM C 891 and to any required state highway, municipal or local specifications; whichever is more stringent. The device shall be watertight.

2.1.2 Cartridge Deck The cylindrical concrete device shall include a fiberglass deck. The rectangular concrete device shall include a coated aluminum deck. In either instance, the insert shall be bolted and sealed watertight inside the precast concrete chamber. The deck shall serve as: (a) a horizontal divider between the lower treatment zone and the upper treated effluent zone; (b) a deck for attachment of filter cartridges such that the membrane filter elements of each cartridge extend into the lower treatment zone; (c) a platform for maintenance workers to service the filter cartridges (maximum manned weight = 450 pounds (204 kg)); (d) a conduit for conveyance of treated water to the effluent pipe.

2.1.3 Membrane Filter Cartridges Filter cartridges shall be comprised of reusable cylindrical membrane filter elements connected to a perforated head plate. The number of membrane filter elements per cartridge shall be a minimum of eleven 2.75-inch (70-mm) diameter elements. The length of each filter element shall be a minimum 15 inches (381 mm). Each cartridge shall be fitted into the cartridge deck by insertion into a cartridge receptacle that is permanently mounted into the cartridge deck. Each cartridge shall be secured by a cartridge lid that is threaded onto the receptacle, or similar mechanism to secure the cartridge into the deck. The maximum treatment flow rate of a filter cartridge shall be controlled by an orifice in the cartridge lid, or on the individual cartridge itself, and based on a design flux rate (surface loading rate) determined by the maximum treatment flow rate per unit of filtration membrane surface area. The maximum design flux rate shall be 0.21 gpm/ft² (0.142 lps/m²).

Each membrane filter cartridge shall allow for manual installation and removal. Each filter cartridge shall have filtration membrane surface area and dry installation weight as follows (if length of filter cartridge is between those listed below, the surface area and weight shall be proportionate to the next length shorter and next length longer as shown below):

Filter Cartridge Length (in / mm)	Minimum Filtration Membrane Surface Area (ft2 / m2)	Maximum Filter Cartridge Dry Weight (lbs / kg)
15	106 / 9.8	10.5 / 4.8
27	190 / 17.7	15.0 / 6.8
40	282 / 26.2	20.5 / 9.3
54	381 / 35.4	25.5 / 11.6

2.1.4 Backwashing Cartridges The filter device shall have a weir extending above the cartridge deck, or other mechanism, that encloses the high flow rate filter cartridges when placed in their respective cartridge receptacles within the cartridge deck. The weir, or other mechanism, shall collect a pool of filtered water during inflow events that backwashes the high flow rate cartridges when the inflow

event subsides. All filter cartridges and membranes shall be reusable and allow for the use of filtration membrane rinsing procedures to restore flow capacity and sediment capacity; extending cartridge service life.

2.1.5 Maintenance Access to Captured Pollutants The filter device shall contain an opening(s) that provides maintenance access for removal of accumulated floatable pollutants and sediment, removal of and replacement of filter cartridges, cleaning of the sump, and rinsing of the deck. Access shall have a minimum clear vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

2.1.6 Bend Structure The device shall be able to be used as a bend structure with minimum angles between inlet and outlet pipes of 90-degrees or less in the stormwater conveyance system.

2.1.7 Double-Wall Containment of Hydrocarbons The cylindrical precast concrete device shall provide double-wall containment for hydrocarbon spill capture by a combined means of an inner wall of fiberglass, to a minimum depth of 12 inches (305 mm) below the cartridge deck, and the precast vessel wall.

2.1.8 Baffle The filter device shall provide a baffle that extends from the underside of the cartridge deck to a minimum length equal to the length of the membrane filter elements. The baffle shall serve to protect the membrane filter elements from contamination by floatables and coarse sediment. The baffle shall be flexible and continuous in cylindrical configurations, and shall be a straight concrete or aluminum wall in rectangular configurations.

2.1.9 Sump The device shall include a minimum 24 inches (610 mm) of sump below the bottom of the cartridges for sediment accumulation, unless otherwise specified by the design engineer. Depths less than 24 inches may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

2.2 PRECAST CONCRETE SECTIONS

All precast concrete components shall be manufactured to a minimum live load of HS-20 truck loading or greater based on local regulatory specifications, unless otherwise modified or specified by the design engineer, and shall be watertight.

2.3 JOINTS All precast concrete manhole configuration joints shall use nitrile rubber gaskets and shall meet the requirements of ASTM C443, Specification C1619, Class D or engineer approved equal to ensure oil resistance. Mastic sealants or butyl tape are not an acceptable alternative.

2.4 GASKETS Only profile neoprene or nitrile rubber gaskets in accordance to CSA A257.3-M92 will be accepted. Mastic sealants, butyl tape or Conseal CS-101 are not acceptable gasket materials.

2.5 FRAME AND COVER Frame and covers must be manufactured from cast-iron or other composite material tested to withstand H-20 or greater design loads, and as approved by the

local regulatory body. Frames and covers must be embossed with the name of the device manufacturer or the device brand name.

2.6 DOORS AND HATCHES If provided shall meet designated loading requirements or at a minimum for incidental vehicular traffic.

2.7 CONCRETE All concrete components shall be manufactured according to local specifications and shall meet the requirements of ASTM C 478.

2.8 FIBERGLASS The fiberglass portion of the filter device shall be constructed in accordance with the following standard: ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

2.9 STEPS Steps shall be constructed according to ASTM D4101 of copolymer polypropylene, and be driven into preformed or pre-drilled holes after the concrete has cured, installed to conform to applicable sections of state, provincial and municipal building codes, highway, municipal or local specifications for the construction of such devices.

2.10 INSPECTION All precast concrete sections shall be inspected to ensure that dimensions, appearance and quality of the product meet local municipal specifications and ASTM C 478.

PART 3 – PERFORMANCE

3.1 GENERAL

3.1.1 Verification – The stormwater quality filter must be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV).

3.1.2 Function - The stormwater quality filter treatment device shall function to remove pollutants by the following unit treatment processes; sedimentation, floatation, and membrane filtration.

3.1.3 Pollutants - The stormwater quality filter treatment device shall remove oil, debris, trash, coarse and fine particulates, particulate-bound pollutants, metals and nutrients from stormwater during runoff events.

3.1.4 Bypass - The stormwater quality filter treatment device shall typically utilize an external bypass to divert excessive flows. Internal bypass systems shall be equipped with a floatables baffle, and must avoid passage through the sump and/or cartridge filtration zone.

3.1.5 Treatment Flux Rate (Surface Loading Rate) – The stormwater quality filter treatment device shall treat 100% of the required water quality treatment flow based on a maximum design treatment flux rate (surface loading rate) across the membrane filter cartridges of 0.21 gpm/ft² (0.142 lps/m²).

3.2 FIELD TEST PERFORMANCE

At a minimum, the stormwater quality filter device shall have been field tested and verified with a minimum 25 TARP qualifying storm events and field monitoring shall have been conducted according to the TARP 2009 NJDEP TARP field test protocol, and have received NJCAT verification.

3.2.1 Suspended Solids Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median TSS removal efficiency of 85% and a minimum median SSC removal efficiency of 95%.

3.2.2 Runoff Volume – The stormwater quality filter treatment device shall be engineered, designed, and sized to treat a minimum of 90 percent of the annual runoff volume determined from use of a minimum 15-year rainfall data set.

3.2.3 Fine Particle Removal - The stormwater quality filter treatment device shall have demonstrated the ability to capture fine particles as indicated by a minimum median removal efficiency of 75% for the particle fraction less than 25 microns, an effluent d_{50} of 15 microns or lower for all monitored storm events.

3.2.4 Turbidity Reduction - The stormwater quality filter treatment device shall have demonstrated the ability to reduce the turbidity from influent from a range of 5 to 171 NTU to an effluent turbidity of 15 NTU or lower.

3.2.5 Nutrient (Total Phosphorus & Total Nitrogen) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Phosphorus removal of 55%, and a minimum median Total Nitrogen removal of 50%.

3.2.6 Metals (Total Zinc & Total Copper) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Zinc removal of 55%, and a minimum median Total Copper removal of 85%.

3.3 INSPECTION and MAINTENANCE

The stormwater quality filter device shall have the following features:

3.3.1 Durability of membranes are subject to good handling practices during inspection and maintenance (removal, rinsing, and reinsertion) events, and site specific conditions that may have heavier or lighter loading onto the cartridges, and pollutant variability that may impact the membrane structural integrity. Membrane maintenance and replacement shall be in accordance with manufacturer's recommendations.

3.3.2 Inspection which includes trash and floatables collection, sediment depth determination, and visible determination of backwash pool depth shall be easily conducted from grade (outside the structure).

3.3.3 Manual rinsing of the reusable filter cartridges shall promote restoration of the flow capacity and sediment capacity of the filter cartridges, extending cartridge service life.

3.3.4 The filter device shall have a minimum 12 inches (305 mm) of sediment storage depth, and a minimum of 12 inches between the top of the sediment storage and bottom of the filter cartridge tentacles, unless otherwise specified by the design engineer. Variances may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

3.3.5 Sediment removal from the filter treatment device shall be able to be conducted using a standard maintenance truck and vacuum apparatus, and a minimum one point of entry to the sump that is unobstructed by filter cartridges.

3.3.6 Maintenance access shall have a minimum clear height that provides suitable vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

3.3.7 Filter cartridges shall be able to be maintained without the requirement of additional lifting equipment.

PART 4 – EXECUTION

4.1 INSTALLATION

4.1.1 PRECAST DEVICE CONSTRUCTION SEQUENCE

The installation of a watertight precast concrete device should conform to ASTM C 891 and to any state highway, municipal or local specifications for the construction of manholes, whichever is more stringent. Selected sections of a general specification that are applicable are summarized below.

4.1.1.1 The watertight precast concrete device is installed in sections in the following sequence:

- aggregate base
- base slab
- treatment chamber and cartridge deck riser section(s)
- bypass section
- connect inlet and outlet pipes
- concrete riser section(s) and/or transition slab (if required)
- maintenance riser section(s) (if required)
- frame and access cover

4.1.2 The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

4.1.3 Adjustment of the stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary to restore original condition and watertight seals. Once the stormwater quality treatment device has been constructed, any/all lift holes must be plugged watertight with mortar or non-shrink grout.

4.1.4 Inlet and Outlet Pipes Inlet and outlet pipes should be securely set into the device using approved pipe seals (flexible boot connections, where applicable) so that the structure is watertight, and such that any pipe intrusion into the device does not impact the device functionality.

4.1.5 Frame and Cover Installation Adjustment units (e.g. grade rings) should be installed to set the frame and cover at the required elevation. The adjustment units should be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover should be set in a full bed of mortar at the elevation specified.

4.2 MAINTENANCE ACCESS WALL
In some instances the Maintenance Access Wall, if provided, shall require an extension attachment and sealing to the precast wall and cartridge deck at the job site, rather than at the precast facility. In this instance, installation of these components shall be performed according to instructions provided by the manufacturer.

4.3 FILTER CARTRIDGE INSTALLATION Filter cartridges shall be installed in the cartridge deck only after the construction site is fully stabilized and in accordance with the manufacturer's guidelines and recommendations. Contractor to contact the manufacturer to schedule cartridge delivery and review procedures/requirements to be completed to the device prior to installation of the cartridges and activation of the system.

PART 5 – QUALITY ASSURANCE

5.1 FILTER CARTRIDGE INSTALLATION Manufacturer shall coordinate delivery of filter cartridges and other internal components with contractor. Filter cartridges shall be delivered and installed complete after site is stabilized and unit is ready to accept cartridges. Unit is ready to accept cartridges after is has been cleaned out and any standing water, debris, and other materials have been removed. Contractor shall take appropriate action to protect the filter cartridge receptacles and filter cartridges from damage during construction, and in accordance with the manufacturer's recommendations and guidance. For systems with cartridges installed prior to full site stabilization and prior to system activation, the contractor can plug inlet and outlet pipes to prevent stormwater and other influent from entering the device. Plugs must be removed during the activation process.

5.2 INSPECTION AND MAINTENANCE

5.2.1 The manufacturer shall provide an Owner's Manual upon request.

5.2.2 After construction and installation, and during operation, the device shall be inspected and cleaned as necessary based on the manufacturer's recommended inspection and maintenance guidelines and the local regulatory agency/body.

5.3 REPLACEMENT FILTER CARTRIDGES When replacement membrane filter elements and/or other parts are required, only membrane filter elements and parts approved by the manufacturer for use with the stormwater quality filter device shall be installed.

END OF SECTION

Appendix **E**

Infiltration Asessment

29 April 2019 Reference No. 11139281-44

Mason Homes Limited
70 Innovator Avenue, Unit #1
Stouffville, Ontario
L4A 0Y2

Dear Ashley Mason:

Re: Infiltration Assessment, Mason Homes
425 King Street East, Cobourg Ontario

1. Introduction

This letter report presents an infiltration assessment of shallow soils located at 425 King Street East in Cobourg. Mason Homes requested information on the infiltration rate of the underlying soil for storm water management. This was carried out at the south central area of the site where an infiltration gallery was proposed and at the eastern boundary of Block 2 where further on site infiltration may be utilized.

2. Soil Classification

On March 13, 2019 GHD observed the advancement of three (3) test holes at 425 King Street East in order to access soil conditions at the site. Test holes were excavated by Behan along the southern portion of the property in the area of the proposed storm water management infiltration gallery and along the eastern boundary where further infiltration measures may be required. The test holes were excavated to a depth of 2.3 metres at the locations shown on Figure 1 and the elevations were estimated using the contours on the site plan.

All the holes encountered a layer of topsoil/earth fill ranging in depths of 0.3 to 0.6 metres. Underlying the topsoil/earth fill was a layer of silty clay, described as firm to stiff and in a moist condition which extended to depths of 1.2 to 1.5 metres. Underlying the silty clay was a layer of sandy silt few clay till, described as compact and in a moist condition. One (1) sample of the silty clay and one (1) sample of the sandy silt few clay were submitted for grain size analysis and the results indicate a composition of 0% gravel, 19% sand, 38% silt and 43% clay sized particles for the silty clay and the gradation of 14% gravel, 26% sand, 50% silt and 10% clay for the sandy silt few clay till. All test holes were terminated within the sandy silt till at a depth of 2.3 m. In test hole TP-3 in the area of the infiltration gallery water seepage was observed at a 2.2 m depth while at test holes TP-1 and TP-2, the test holes were dry at the completion of the excavation.

GHD
347 Pido Road Unit 29 Peterborough Ontario K9J 6X7 Canada
T 705 749 3317 **F** 705 749 9248 **W** www.ghd.com
SMQ ISO 9001:2008

3. Infiltration Testing

Infiltration testing was conducted at all three (3) test pits. Locations of the test pits is shown on the Test Hole Location Plan, Figure 2. Tests were carried out at two depths in each test hole. Infiltration rates are provided in Table 3.1 based on the results of the infiltration testing, our observations and the soils data and are uncorrected as per Table C2 of the TRCA Low Impact Development Stormwater Management Planning and Design Guide.

Table 3.1 Infiltration Testing

Infiltration Location	Depth of Test (m)	Field Saturated Hydraulic Conductivity (cm/sec)	Percolation Time (minutes/cm)	Infiltration Rate (mm/hour)
TP-1	0.9 – 1.2	10^{-05} to 10^{-06}	40	15
TP-1	1.8 – 2.1	10^{-11} to 10^{-12}	100	6
TP-2	0.9 – 1.2	10^{-05} to 10^{-06}	40	15
TP-2	1.8 – 2.1	10^{-06} to 10^{-07}	50	12
TP-3	0.9 – 1.2	10^{-05} to 10^{-06}	40	15
TP-3	1.8 – 2.1	10^{-06} to 10^{-07}	50	12

4. Summary and Conclusions

The results of the excavated test holes, grain size analysis and the infiltration testing indicates that the native soil profile is a silty clay layer overlying a sandy silt till soil. In the infiltration gallery, the shallow soil had an average infiltration rate of 15 mm/hr and the lower layer had an infiltration rate of 12 mm/hr. The consistency of the soil, gradation and infiltration measured relates to a factor of safety from Appendix C of the Low Impact Storm Water Management Planning and Design Guide of 2.5.

We trust this letter report meets with your immediate requirements. Should you have any questions please contact our office.

Sincerely, GHD.

Steve Gagne H.B.Sc.

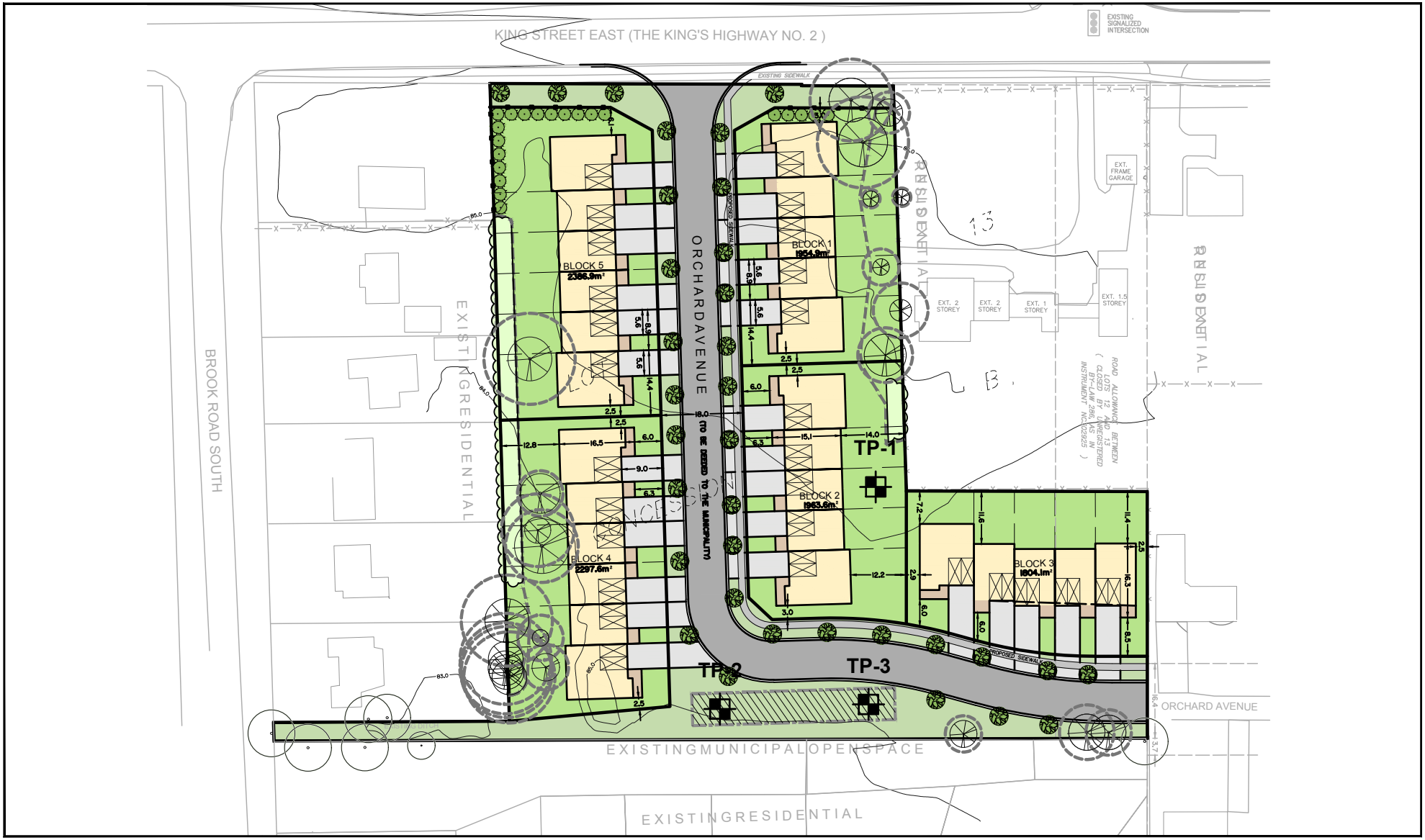
Andy Fawcett, P.Eng.

gvb/sg/nm/1

Encl.
Test Hole Location Plan
Test Hole Logs
Laboratory Tests

Enclosures

Figure 1
Location Plan



Source: Site Plan from drawing titled "Development Site Plan, 425 King Street, East", dated February 7, 2018, by RFA Planning Consultant Inc. as provided by Client.

0 10 20 30m

Coordinate System:
WGS 1984 UTM Zone 17T

MASON HOMES
425 KING STREET EAST, COBOURG, ON
INFILTRATION ASSESSMENT

11139281-44

Apr 22, 2019

TEST HOLE LOCATION PLAN

FIGURE 1

CAD File: I:\Geo-Logic General\2017\Projects\B - Testing and Inspections\11139281 Andy Fawcett General Number\44 Mason, King Street, Cobourg\AutoCAD\11139281-44, 19-04-22, Test Hole Location Plan, ss.dwg

Attachment A
Test Pit Logs

REFERENCE No.: 11139281-44 ENCLOSURE No.:

TEST PIT No.: TP-1
ELEVATION: Existing Grade

TEST PIT REPORT

Page: 1 of 1

CLIENT: Mason Homes
PROJECT: Mason Homes, King St E, Cobourg
LOGGED BY: K. Geraldi DATE: 13 March 2019
EXCAVATION COMPANY: Client METHOD: Backhoe
NOTES:

LEGEND
GS - GRAB SAMPLE
▼ - WATER LEVEL

UTM: 17T 0728950E 4871785N

Depth (ft / m)	m Below Existing Grade	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Moisture Content (%)	Vapours (ppm)	Shear test (Cu) / Sensitivity (S) / Water content (%) / Atterberg limits (%) (△ Field, □ Lab)	COMMENTS
	0.0		GROUND SURFACE		%	ppm	10 20 30 40 50 60 70 80 90	
			TOPSOIL (300 mm)	GS-1	--	--		
1 / 0.5	0.30		**SILTY CLAY** - Brown Silty Clay with Sand, Moist, Compact	GS-2	--	--		GS-2: 0% Gravel 19% Sand 81% Silt/Clay
4 / 1.5	1.22		**TILL** - Brown Silty Sand With Clay, Gravel, Moist, Compact	GS-3	--	--		
6 / 2.0	1.83		END OF TEST PIT					No Groundwater Seepage Encountered

TEST PIT LOG ENVIRO 11139281-44, 19-03-14, TEST PIT LOGS, KG.GPJ GEOLOGIC.GDT 8/5/19

REFERENCE No.: 11139281-44 ENCLOSURE No.:

TEST PIT No.: TP-2
ELEVATION: Existing Grade

TEST PIT REPORT

Page: 1 of 1

CLIENT: Mason Homes
PROJECT: Mason Homes, King St E, Cobourg
LOGGED BY: K. Geraldi DATE: 13 March 2019
EXCAVATION COMPANY: Client METHOD: Backhoe
NOTES:

LEGEND
GS - GRAB SAMPLE
▼ - WATER LEVEL

UTM: 17T 0728973E 4871739N

Depth (ft)	Depth (m)	m Below Existing Grade	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Moisture Content (%)	Vapours (ppm)	Shear test (Cu) / Sensitivity (S) / Water content (%) / Atterberg limits (%) (△ Field, □ Lab)	COMMENTS
		0.0		GROUND SURFACE				10 20 30 40 50 60 70 80 90	
				TOPSOIL Topsoil and Earth Fill	GS-1	--	--		
1	0.5								
2		0.61		**SILTY CLAY** - Brown Silty Clay With Sand and Gravel, Moist, Compact					
3	1.0				GS-2	--	--		
4		1.22		**TILL** - Brown Silty Sand With Clay, Gravel and Cobbles, Moist, Compact					
5	1.5								GS-3: 18% Gravel 44% Sand 38% Silt/Clay
6		1.83		END OF TEST PIT	GS-3	--	--		No Groundwater Seepage Encountered
7	2.0								

REFERENCE No.: 11139281-44 ENCLOSURE No.:

TEST PIT No.: TP-3
ELEVATION: Existing Grade

TEST PIT REPORT

Page: 1 of 1

CLIENT: Mason Homes
PROJECT: Mason Homes, King St E, Cobourg
LOGGED BY: K. Geraldi DATE: 13 March 2019
EXCAVATION COMPANY: Client METHOD: Backhoe
NOTES:

LEGEND
GS - GRAB SAMPLE
▼ - WATER LEVEL

UTM: 17T 0728940E 4871725N

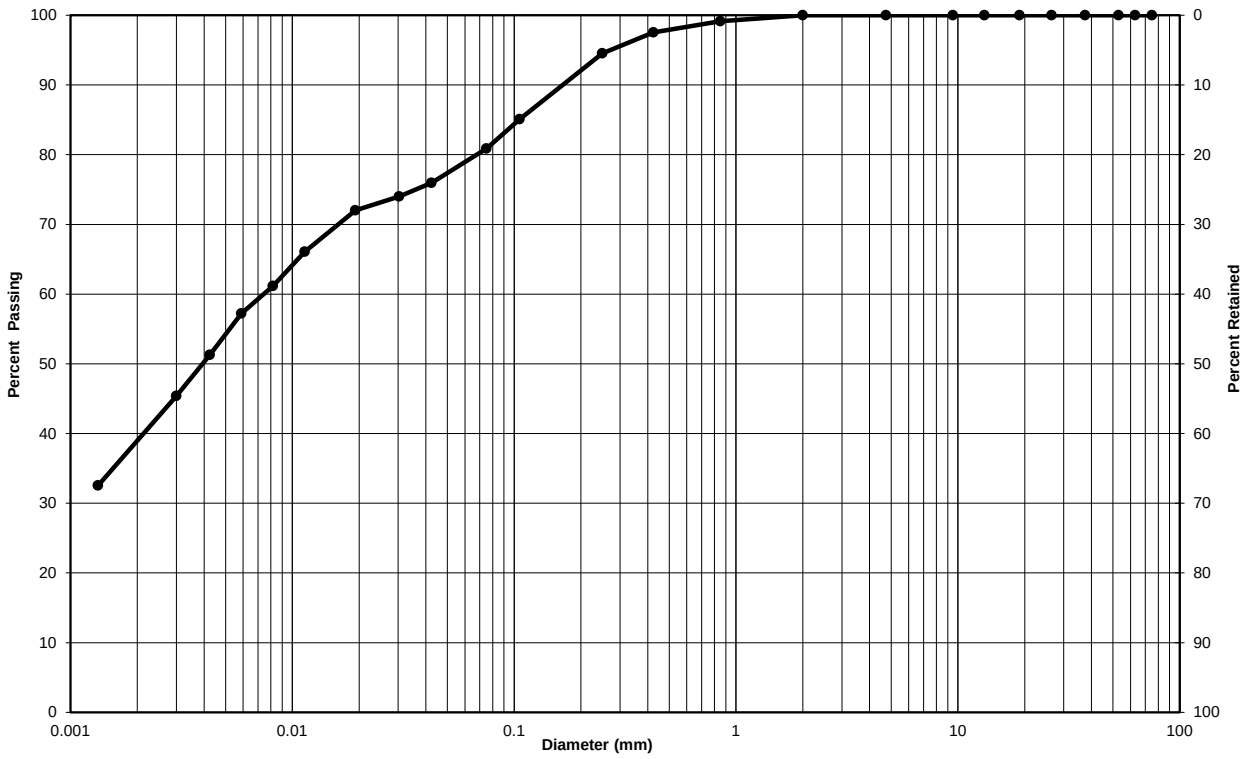
Depth (ft)	Depth (m)	m Below Existing Grade	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	Type and Number	Moisture Content (%)	Vapours (ppm)	Shear test (Cu) / Sensitivity (S) / Water content (%) / Atterberg limits (%) (△ Field, □ Lab) 10 20 30 40 50 60 70 80 90	COMMENTS
		0.0		GROUND SURFACE					
				TOPSOIL Topsoil and Earth Fill	GS-1	--	--		
1	0.5								
2		0.61		**SILTY CLAY** - Brown Silty Clay With Sand and Gravel, Moist, Compact					
3	1.0				GS-2	--	--		
4									Seepage Encountered at 1.2m
5	1.5	1.52		**TILL** - Brown Silty Sand With Clay, Gravel and Cobbles, Moist, Compact					
6		1.83		END OF TEST PIT	GS-3	--	--		
7	2.0								

Attachment B
Laboratory Data

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Mason Homes	**Lab no.:**	SS-19-11
Project/Site:	King Street E., Cobourg	**Project no.:**	11139281-44

Borehole no.:	TP-1	Sample no.:	GS-2
Depth:	2'	Enclosure:	



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Soil Description	Gravel	Sand	Clay & Silt
	0	19	81

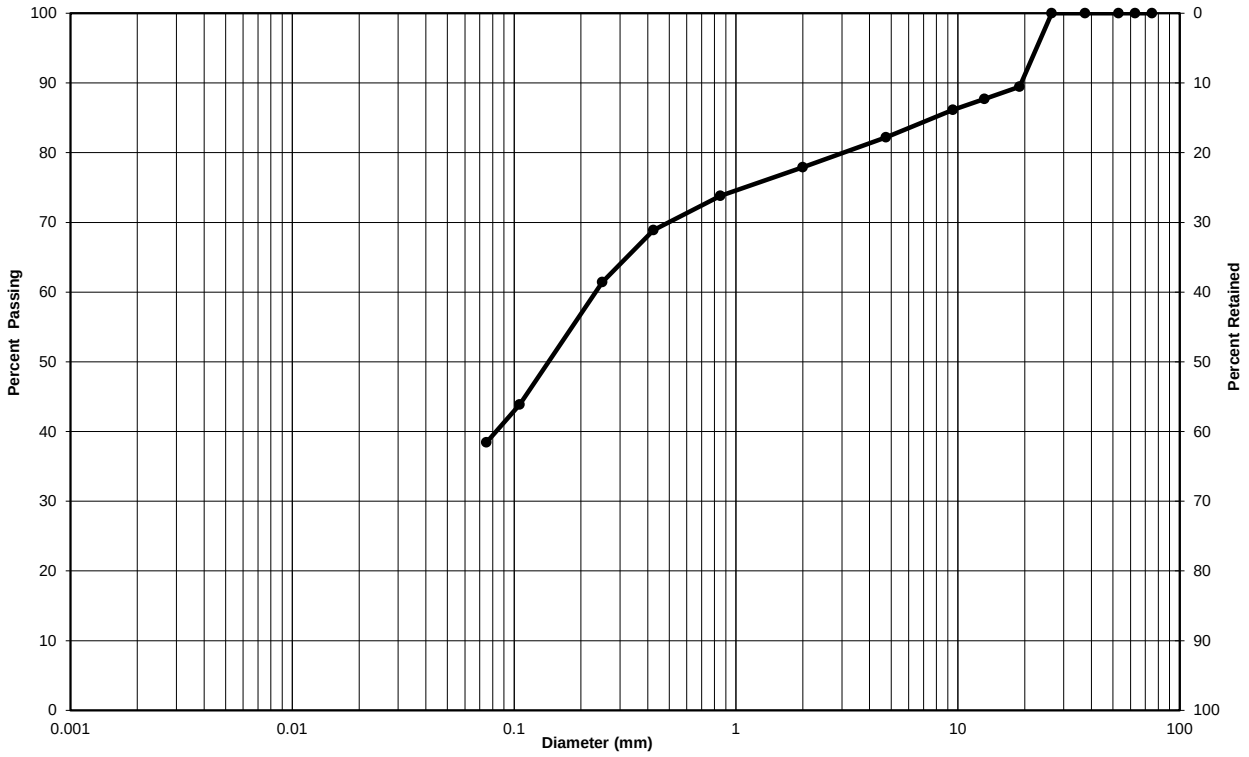
Remarks:

Performed by:	J. Sullivan	**Date:**	March 22, 2019
Verified by:		**Date:**	March 22, 2019

Particle-Size Analysis of Soils (Geotechnical) (USCS) (ASTM D422)

Client:	Mason Homes	**Lab no.:**	SS-19-11
Project/Site:	King Street E, Cobourg	**Project no.:**	11139281-44

Borehole no.:	TP-2	Sample no.:	GS-3
Depth:	6'	Enclosure:	



Clay & Silt	Sand			Gravel	
	Fine	Medium	Coarse	Fine	Coarse
Unified Soil Classification System					

Soil Description	Gravel	Sand	Clay & Silt
	18	44	38

Remarks:

Performed by:	J. Sullivan	**Date:**	March 22, 2019
Verified by:		**Date:**	March 22, 2019

about GHD

GHD is one of the world's leading professional services companies operating in the global markets of water, energy and resources, environment, property and buildings, and transportation. We provide engineering, environmental, and construction services to private and public sector clients.

Emily Lightstone, EIT
Emily.Lightstone@ghd.com
905.215.5050

Jamie Iantomasi, P. Eng.
Jamie.Iantomasi@ghd.com
905.429.5053

www.ghd.com