

APPENDICES

Appendix A POTABLE WATER SERVICING

A.1 WATER DEMAND CALCULATIONS



Half Moon Bay South Phase 8 - Domestic Water Demand Estimates

Project No. 16051657

Based on concept 2 (draft) provided by Korsiak Urban Planning dated 2021-06-28

Densities as per City Guidelines:		
Townhomes	2.7	ppu



Building ID	Amenity Area (m ²)	No. of Units	Population	Daily Rate of Demand (L/cap/d or L/ha/d)	Avg Day Demand		Max Day Demand ¹		Peak Hour Demand ²	
					(L/min)	(L/s)	(L/min)	(L/s)	(L/min)	(L/s)
Back-to-Back Townhomes										
Block 1	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 2	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 3	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 4	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 5	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 6	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 7	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 8	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 9	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 10	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 11	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 12	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 13	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 14	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 15	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 16	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 17	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 18	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Block 19	-	12	32.4	350	7.9	0.13	19.7	0.33	43.3	0.72
Outdoor amenity areas	1956		0	28000	38.0	0.63	57.1	0.95	102.7	1.71
Total Site :		228.0	616		187.7	3.13	431.1	7.19	925.6	15.43

Average day water demand for residential areas: 350 L/cap/d , 28000/L/ha/d for commercial/amenity areas

The City of Ottawa water demand criteria used to estimate peak demand rates for residential areas are as follows:

- 1 maximum day demand rate = 2.5 x average day demand rate for residential
- 2 peak hour demand rate = 2.2 x maximum day demand rate for residential
- 3 Water demand criteria used to estimate peak demand rates for amenity/common areas are as follows:
 maximum daily demand rate = 1.5 x average day demand rate
 peak hour demand rate = 1.8 x maximum day demand rate

A.2 FIRE FLOW REQUIREMENTS PER FUS GUIDELINES





FUS Fire Flow Calculation Sheet

Stantec Project #: 160401657
 Project Name: Mattamy Homes -Half Moon Bay South Phase 8
 Date: 7/20/2021

Fire Flow Calculation #: 1
 Description: 4 Back-to-Back 12-Unit Townhouse Block (Block 8)

Notes: Worst Case: 3-storey building with slab on grade. Back-to-back townhouse units with fire separation to limit building area to a maximum of 600m². Building Classification C.

Step	Task	Notes	Value Used	Req'd Fire Flow (L/min)					
1	Determine Type of Construction	Ordinary Construction	1	-					
2	Determine Ground Floor Area of One Unit	Approx. area of a single storey of a single unit	470	-					
	Determine Number of Adjoining Units	-	1	-					
3	Determine Height in Storeys	Doesnot include floors >50% below grade or open attic space	3	-					
4	Determine Required Fire Flow	(F = 220 x C x A ^{1/2}). Rbund to nearest 1000 L/min	-	8000					
5	Determine Occupancy Charge	Limited Combustible	-15%	6800					
6	Determine Sprinkler Reduction	None	0%	0					
		Non-Standard Water Supply or N/A	0%						
		Not Fully Supervised or N/A	0%						
		% Coverage of Sprinkler System	0%						
7	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Storeys)	Length-Height Factor (m x storeys)	Construction of Adjacent Wall	-	-
		North	10.1 to 20	21	3	61-90	Wood Frame or Non-Combustible	14%	3536
		East	3.1 to 10	21	3	61-90	Wood Frame or Non-Combustible	19%	
		South	20.1 to 30	27	3	61-90	Wood Frame or Non-Combustible	9%	
		West	20.1 to 30	31	3	91-120	Wood Frame or Non-Combustible	10%	
8	Determine Final Required Fire Flow	Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min							10000
		Total Required Fire Flow in L/s							166.7
		Required Duration of Fire Flow (hrs)							2.00
		Required Volume of Fire Flow (m ³)							1200

A.3 HYDRAULIC CAPACITY AND MODELLING BY GEOADVICE (JULY 2021)





Hydraulic Capacity and Modeling Analysis Brazeau Lands

Final Report

Prepared for:

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Project: 2019-091-DSE

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R2	June 10, 2020	Updated Draft	Ferdinand de Schoutheete	Werner de Schaetzen
R3	July 28, 2020	Final	Ferdinand de Schoutheete	Werner de Schaetzen

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1 Introduction

GeoAdvice Engineering Inc. (“GeoAdvice”) was retained by David Schaeffer Engineering Ltd. (“DSEL”) to size the proposed water main network for the Brazeau Lands development (“Development”) in the City of Ottawa, ON (“City”).

Under existing conditions, the development will be serviced by the Barrhaven pressure zone; however, in the future, it will be serviced by pressure zone 3C.

There are 347 single detached dwellings, 279 traditional townhomes and 1 park serviced as part of the development.

The Brazeau Lands development will have three (3) connections to the City water distribution system:

- Connection 1: Apolune Street and Cambrian Road;
- Connection 2: Jackdaw Avenue and Future Greenbank Road; and
- Connection 3: Dundonald Drive and Future Greenbank Road.

The development site is shown in **Figure 1.1** on the following page, with the final recommended pipe diameters.

This report describes the assumptions and results of the hydraulic modeling and capacity analysis using InfoWater (Innovyze), a GIS water distribution system modeling and management software application.

The results presented in this memo are based on the analysis of steady state simulations. The predicted available fire flows, as calculated by the hydraulic model, represent the flow available in the water main while maintaining a residual pressure of 20 psi. No extended period simulations were completed in this analysis to assess the water quality or to assess the hydraulic impact on storage and pumping.

Connection #1
Cambrian Road

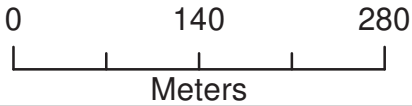
Connection #2
Brambling Way

The Meadows
Phases 7/8

Connection #3
Dundonald Drive

Phase 1

Phase 2



Legend

- Junction
- ⊃ Connection Point
- Pipe Diameter
 - 200 mm
 - 250 mm
 - 300 mm



GeoAdvice Engineering Inc.

Project: Hydraulic Capacity and Modeling Analysis of
the Brazeau Lands
Client: David Schaeffer Engineering Ltd.
Date: June 2020
Created by: BL
Reviewed by: WdS

DISCLAIMER: GeoAdvice does not warrant in any way the accuracy and completeness of the information shown on this map. Field verification of the accuracy and completeness of the information shown on this map is the sole responsibility of the user.

Brazeau Lands Site
Layout and Connection
Points

Figure 1.1



2 Modeling Considerations

2.1 Water Main Configuration

The water main network was modeled based on the drawing prepared by DSEL (1030_Gen_Rev4.dwg) and provided to GeoAdvice on June 2nd, 2020.

2.2 Elevations

Elevations of the modeled junctions were assigned according to a site grading plan prepared by DSEL (1030_Grad_Rev4.dwg) and provided to GeoAdvice on June 2nd, 2020.

2.3 Consumer Demands

Demand factors used for this analysis were taken according to the City of Ottawa 2010 Design Guidelines *Table 4.2 Consumption Rate for Subdivisions of 501 to 3,000 Persons*. Population densities were assigned according to *Table 4.1 Per Unit Populations* from the City of Ottawa Design Guidelines. A summary of these tables highlighting relevant data for this development is shown in **Table 2.1** below.

Table 2.1: City of Ottawa Demand Factors

Demand Type	Amount	Units
Average Day Demand		
Residential	350	L/c/d
Park	28,000	L/ha/d
Maximum Daily Demand		
Residential	2.5 x avg. day	L/c/d
Park	1.5 x avg. day	L/ha/d
Peak Hour Demand		
Residential	2.2 x max. day	L/c/d
Park	1.8 x max. day	L/ha/d
Minimum Hour Demand		
Residential	0.5 x avg. day	L/c/d
Park	0.5 x avg. day	L/ha/d

Table 2.2 and **Table 2.4** summarize the residential water demand calculations for the Brazeau Lands development.



Table 2.2: Development Population and Demand Calculations – Phase 1

Dwelling Type	Number of Units	Persons Per Unit*	Population	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Single Detached	172	3.4	585	2.37	5.92	13.03	1.18
Traditional Townhome	133	2.7	360	1.46	3.65	8.02	0.73

*City of Ottawa Design Guidelines

Table 2.3: Development Population and Demand Calculations – Phases 1&2

Dwelling Type	Number of Units	Persons Per Unit*	Population	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Single Detached	347	3.4	1,180	4.78	11.95	26.29	2.39
Traditional Townhome	279	2.7	754	3.05	7.64	16.80	1.53

*City of Ottawa Design Guidelines

Table 2.6 summarizes the non-residential water demand calculations for the Brazeau Lands development (included in both Phase 1 and Phases 1&2).

Table 2.4: Non-Residential Demand Calculations

Land Use Type	Area (ha)	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Park	1.72	0.56	0.84	1.51	0.28

Table 2.5 summarizes the demands for the Meadows Phases 7/8 subdivision development located north of the Brazeau Lands and downstream of Connections 1 and 2 (accounted for in the HGLs provided by the City in the boundary conditions request).



Table 2.5: The Meadows Phases 7/8

Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
6.20	13.50	28.50	3.10

Demands were grouped into demand polygons then uniformly distributed to the model nodes located within each polygon. Detailed calculations of demands as well as the illustrated allocation areas are shown in **Appendix A**.

2.4 Fire Flow Demand

Fire flow calculations were completed for all dwelling types in accordance with the Fire Underwriters Survey's (FUS) Water Supply for Public Fire Protection Guideline (1999) and City of Ottawa Technical Bulletin ISTB-2018-02 as summarized in **Appendix B**.

All the single detached dwellings have a minimum separation of 10 m between the backs of adjacent units and are, therefore, subject to the 10,000 L/min (167 L/s) cap outlined in City of Ottawa Technical Bulletin ISDTB-2014-02.

Most of the traditional townhouse dwellings comply with the City of Ottawa Technical Bulletin ISDTB-2014-02 and are, therefore, subject to the 10,000 L/min (167 L/s) cap.

The traditional townhouse dwellings located on Blocks 168 and 384 do not have a minimum separation of 10 m between the backs of adjacent units and therefore do not comply with the provisions under the City of Ottawa Technical Bulletin ISDTB-2014-02. The required fire flow for those blocks were calculated to be 167 L/s based on the Fire Underwriters Survey's (FUS) Water Supply for Public Fire Protection Guideline (1999). The agreement of this calculation with the City of Ottawa cap of 167 L/s is purely coincidental.

At this time, there is not enough information available to calculate the required fire flow of the park. As such, a required fire flow of 250 L/s was assumed for the park. This is a typical, conservative value for similar land use.

Fire flow simulations were completed at each model node in the Brazeau development. The locations of nodes do not necessarily represent hydrant locations.

Detailed FUS fire flow calculations as well as the illustrated spatial allocation of the required fire flows are shown in **Appendix B**.



2.5 Boundary Conditions

The boundary conditions were provided by the City of Ottawa in the form of Hydraulic Grade Line (HGL) at the following locations:

- Connection 1: Apolune Street and Cambrian Road;
- Connection 2: Jackdaw Avenue and Future Greenbank Road; and
- Connection 3: Dundonald Drive and Future Greenbank Road.

The above connection points are illustrated in **Figure 1.1**.

Boundary conditions were provided for Peak Hour, Maximum Day plus Fire and Minimum Hour (high pressure check) conditions.

Under existing conditions, the Brazeau Lands development will be serviced by the Barrhaven pressure zone; however, in the future, it will be serviced by pressure zone 3C. As such, boundary conditions were provided under the existing and future pressure zone configurations.

In total, two (2) sets of boundary conditions were provided by the City and can be found in **Appendix C**.

The boundary conditions for the existing pressure zone configuration are more conservative. As such, the results presented in this report are based on the boundary conditions for the existing pressure zone configuration.

Table 2.6 summarizes the boundary conditions used to size the Brazeau Lands water network.

Table 2.6: Existing Boundary Conditions

Condition	Connection 1 HGL (m)	Connection 2 HGL (m)	Connection 3 HGL (m)
Min Hour (max. pressure)	156.4	156.4	156.4
Peak Hour (min. pressure)	135.7	135.6	135.7
Max Day + Fire Flow (167 L/s)	144.0	141.2	142.0
Max Day + Fire Flow (250 L/s)	135.4	129.9	131.5



3 Hydraulic Capacity Design Criteria

3.1 Pipe Characteristics

Pipe characteristics of internal diameter (ID) and Hazen-Williams C factors were assigned in the model according to the City of Ottawa Design Guidelines for PVC water main material. Pipe characteristics used for the development are outlined in **Table 3.1** below.

Table 3.1: Model Pipe Characteristics

Nominal Diameter (mm)	ID PVC (mm)	Hazen Williams C-Factor (/)
200	204	110
250	250	110
300	297	120

3.2 Pressure Requirements

As outlined in the City of Ottawa Design Guidelines, the generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi). The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way shall not exceed 552 kPa (80 psi). Pressure requirements are outlined in **Table 3.2**.

Table 3.2: Pressure Requirements

Demand Condition	Minimum Pressure		Maximum Pressure	
	(kPa)	(psi)	(kPa)	(psi)
Normal Operating Pressure (maximum daily flow)	350	50	480	70
Peak Hour Demand (minimum allowable pressure)	276	40	-	-
Maximum Fixture Pressure (Ontario Building Code)	-	-	552	80
Maximum Distribution Pressure (minimum hour check)	-	-	552	80
Maximum Day Plus Fire	140	20	-	-



4 Hydraulic Capacity Analysis

The proposed water mains within the development were sized to the minimum diameter which would satisfy the greater of maximum day plus fire and peak hour demand. Modeling was carried out for minimum hour, peak hour and maximum day plus fire flow using InfoWater. Only the existing pressure zone configuration was analyzed, since the boundary conditions are more conservative.

Detailed pipe and junction model input data can be found in **Appendix D**.

4.1 Development Pressure Analysis

Modeled service pressures for the development are summarized in **Table 4.1** below.

Table 4.1: Summary of the Brazeau Lands Available Service Pressures

Phase	Minimum Hour Demand Maximum Pressure	Peak Hour Demand Minimum Pressure
Phase 1	538 kPa (78 psi)	290 kPa (42 psi)
Phases 1&2	538 kPa (78 psi)	262 kPa (38 psi)

As outlined in the City of Ottawa Design Guidelines, the generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi). The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way shall not exceed 552 kPa (80 psi).

Low pressures are predicted at junctions J-66, J-70, J-71, J-72, J-73, J-74, J-75, J-76 and J-77 under peak hour demand. Those low pressures are due to high elevations in the southern part of the Brazeau Lands development and are within 5% of the minimum allowable pressure of 276 kPa (40 psi). The future Zone 3C boundary conditions will provide an additional head of about seven (7) meters at each connection point, and will thus resolve the low PHD pressures at the southern part of the Brazeau Lands development.

Detailed pipe and junction result tables and maps can be found in **Appendix E**.



4.2 Development Fire Flow Analysis

A summary of the minimum available fire flows in the Brazeau Lands development is shown below in **Table 4.2**.

Table 4.2: Summary of the Brazeau Lands Minimum Available Fire Flows

Phase	Required Fire Flow	Minimum Available Flow	Junction ID
Phase 1	167 L/s	177 L/s	J-45
	250 L/s	249 L/s	J-47
Phases 1&2	167 L/s	194 L/s	J-66
	250 L/s	269 L/s	J-47

As shown in the table above, the available fire flow is greater than the required fire flow under both Phase 1 and Phases 1&2 conditions.

A summary of the residual pressures in the Brazeau Lands is shown below in **Table 4.3**. The minimum allowable pressure under fire flow conditions is 140 kPa (20 psi) at the location of the fire.



Table 4.3: Summary of the Brazeau Lands Residual Pressures (MDD + FF)

Phase	Maximum Residual Pressure	Average Residual Pressure	Minimum Residual Pressure
Phase 1	365 kPa (53 psi)	296 kPa (43 psi)	140 kPa (20 psi)
Phases 1&2	365 kPa (53 psi)	296 kPa (43 psi)	159 kPa (23 psi)

There is sufficient residual pressure at all the junctions within the Brazeau Lands development.

Detailed fire flow results and figures illustrating the fire flow results can be found in **Appendix F**.



5 Other Servicing Considerations

5.1 Water Supply Security

The City of Ottawa Design Guidelines allow single feed systems for developments up to a total average day demand of 50 m³/day and require two (2) feeds if the development exceeds 50 m³/day for supply security, according to Technical Bulletin ISDTB-2014-02.

The Brazeau Lands services a total average day demand of 725 m³/day; as such, two (2) feeds are required.

5.2 Valves

No comment has been made in this technical memorandum with respect to exact placement of isolation valves within the distribution network for the Brazeau Lands other than to summarize the City of Ottawa Design Guidelines for number, location, and spacing of isolation valves:

- Tee intersection – two (2) valves
- Cross intersection – three (3) valves
- Valves shall be located 2 m away from the intersection
- 300 m spacing for 150 mm to 400 mm diameter valves
- Gate valves for 100 mm to 300 mm diameter mains
- Butterfly valves for 400 mm and larger diameter mains

Drain valves are not strictly required under the City of Ottawa Design Guidelines for water mains under 600 mm in diameter. The Guidelines indicate that “small diameter water mains shall be drained through hydrant via pumping if needed.”

Air valves are not strictly required under the City of Ottawa Design Guidelines for water mains up to and including 400 mm in diameter. The Guidelines indicate that air removal “can be accomplished by the strategic positioning of hydrant at the high points to remove the air or by installing or utilizing available 50 mm chlorination nozzles in 300 mm and 400 mm chambers.”

The detailed engineering drawings for the Brazeau Lands are expected to identify valves in accordance with the requirements noted above.



5.3 Hydrants

No comment has been made in this technical memorandum with respect to exact placement of hydrants within the distribution network for the Brazeau Lands other than to summarize the City of Ottawa Design Guidelines for maximum hydrant spacing:

- 125 m for single family unit residential areas on lots where frontage at the street line is 15 m or longer
- 110 m for single family unit residential areas on lots where frontage at the street line is less than 15 m and for residential areas zoned for row housing, doubles or duplexes
- 90 m for institutional, commercial, industrial, apartments and high-density areas

The detailed engineering drawings for the Brazeau Lands development are expected to identify hydrants in accordance with the requirements noted above.



6 Conclusions

The hydraulic capacity and modeling analysis of Phase 1 of the Brazeau Lands development yielded the following conclusions:

- The proposed water main network can deliver all domestic flows, with service pressures expected to range between 290 kPa (42 psi) and 538 kPa (78 psi).
- The proposed water main network is able to deliver fire flows to all junctions.
- Hydraulic modeling was only completed for the existing pressure zone configuration since the boundary conditions are more conservative.

The hydraulic capacity and modeling analysis of Phases 1&2 of the Brazeau Lands development yielded the following conclusions:

- The proposed water main network can deliver all domestic flows except for junctions J-66, J-70, J-71, J-72, J-73, J-74, J-75, J-76 and J-77, with service pressures expected to range between 262 kPa (38 psi) and 538 kPa (78 psi).
- The junctions with low pressures are due to high elevations in the southern part of the Brazeau Lands development and are within 5% of the minimum allowable pressure of 276 kPa (40 psi).
- The future Zone 3C boundary conditions will provide an additional head of about seven (7) meters at each connection point, and will thus resolve the low PHD pressures at the southern part of the Brazeau Lands development.
- The proposed water main network is able to deliver fire flows to all junctions.
- Hydraulic modeling was only completed for the existing pressure zone configuration since the boundary conditions are more conservative.



Submission

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The Brazeau Lands development will have three (3) connections to the City water distribution system:

- Connection 1: Apolune Street and Cambrian Road;
- Connection 2: Jackdaw Avenue and Future Greenbank Road; and
- Connection 3: Dundonald Drive and Future Greenbank Road.

The development site is shown in **Figure 1.1** on the following page, with the final recommended pipe diameters.

This report describes the assumptions and results of the hydraulic modeling and capacity analysis using InfoWater (Innovyze), a GIS water distribution system modeling and management software application.

The results presented in this memo are based on the analysis of steady state simulations. The predicted available fire flows, as calculated by the hydraulic model, represent the flow available in the water main while maintaining a residual pressure of 20 psi. No extended period simulations were completed in this analysis to assess the water quality or to assess the hydraulic impact on storage and pumping.

Connection #1
Cambrian Road

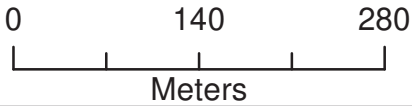
Connection #2
Brambling Way

The Meadows
Phases 7/8

Connection #3
Dundonald Drive

Phase 1

Phase 2



Legend

- Junction
- ⊔ Connection Point
- Pipe Diameter
 - 200 mm
 - 250 mm
 - 300 mm



Project: Hydraulic Capacity and Modeling Analysis of the Brazeau Lands
 Client: David Schaeffer Engineering Ltd.
 Date: June 2020
 Created by: BL
 Reviewed by: WdS

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Brazeau Lands Site
 Layout and Connection
 Points

Figure 1.1



2 Modeling Considerations

2.1 Water Main Configuration

The water main network was modeled based on the drawing prepared by DSEL (1030_Gen_Rev4.dwg) and provided to GeoAdvice on June 2nd, 2020.

2.2 Elevations

Elevations of the modeled junctions were assigned according to a site grading plan prepared by DSEL (1030_Grad_Rev4.dwg) and provided to GeoAdvice on June 2nd, 2020.

2.3 Consumer Demands

Demand factors used for this analysis were taken according to the City of Ottawa 2010 Design Guidelines *Table 4.2 Consumption Rate for Subdivisions of 501 to 3,000 Persons*. Population densities were assigned according to *Table 4.1 Per Unit Populations* from the City of Ottawa Design Guidelines. A summary of these tables highlighting relevant data for this development is shown in **Table 2.1** below.

Table 2.1: City of Ottawa Demand Factors

Demand Type	Amount	Units
Average Day Demand		
Residential	350	L/c/d
Park	28,000	L/ha/d
Maximum Daily Demand		
Residential	2.5 x avg. day	L/c/d
Park	1.5 x avg. day	L/ha/d
Peak Hour Demand		
Residential	2.2 x max. day	L/c/d
Park	1.8 x max. day	L/ha/d
Minimum Hour Demand		
Residential	0.5 x avg. day	L/c/d
Park	0.5 x avg. day	L/ha/d

Table 2.2 and **Table 2.4** summarize the residential water demand calculations for the Brazeau Lands development.



Table 2.2: Development Population and Demand Calculations – Phase 1

Dwelling Type	Number of Units	Persons Per Unit*	Population	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Single Detached	172	3.4	585	2.37	5.92	13.03	1.18
Traditional Townhome	133	2.7	360	1.46	3.65	8.02	0.73

*City of Ottawa Design Guidelines

Table 2.3: Development Population and Demand Calculations – Phases 1&2

Dwelling Type	Number of Units	Persons Per Unit*	Population	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Single Detached	347	3.4	1,180	4.78	11.95	26.29	2.39
Traditional Townhome	279	2.7	754	3.05	7.64	16.80	1.53

*City of Ottawa Design Guidelines

Table 2.6 summarizes the non-residential water demand calculations for the Brazeau Lands development (included in both Phase 1 and Phases 1&2).

Table 2.4: Non-Residential Demand Calculations

Land Use Type	Area (ha)	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Park	1.72	0.56	0.84	1.51	0.28

Table 2.5 summarizes the demands for the Meadows Phases 7/8 subdivision development located north of the Brazeau Lands and downstream of Connections 1 and 2 (accounted for in the HGLs provided by the City in the boundary conditions request).



Table 2.5: The Meadows Phases 7/8

Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
6.20	13.50	28.50	3.10

Demands were grouped into demand polygons then uniformly distributed to the model nodes located within each polygon. Detailed calculations of demands as well as the illustrated allocation areas are shown in **Appendix A**.

2.4 Fire Flow Demand

Fire flow calculations were completed for all dwelling types in accordance with the Fire Underwriters Survey's (FUS) Water Supply for Public Fire Protection Guideline (1999) and City of Ottawa Technical Bulletin ISTB-2018-02 as summarized in **Appendix B**.

All the single detached dwellings have a minimum separation of 10 m between the backs of adjacent units and are, therefore, subject to the 10,000 L/min (167 L/s) cap outlined in City of Ottawa Technical Bulletin ISDTB-2014-02.

Most of the traditional townhouse dwellings comply with the City of Ottawa Technical Bulletin ISDTB-2014-02 and are, therefore, subject to the 10,000 L/min (167 L/s) cap.

The traditional townhouse dwellings located on Blocks 168 and 384 do not have a minimum separation of 10 m between the backs of adjacent units and therefore do not comply with the provisions under the City of Ottawa Technical Bulletin ISDTB-2014-02. The required fire flow for those blocks were calculated to be 167 L/s based on the Fire Underwriters Survey's (FUS) Water Supply for Public Fire Protection Guideline (1999). The agreement of this calculation with the City of Ottawa cap of 167 L/s is purely coincidental.

At this time, there is not enough information available to calculate the required fire flow of the park. As such, a required fire flow of 250 L/s was assumed for the park. This is a typical, conservative value for similar land use.

Fire flow simulations were completed at each model node in the Brazeau development. The locations of nodes do not necessarily represent hydrant locations.

Detailed FUS fire flow calculations as well as the illustrated spatial allocation of the required fire flows are shown in **Appendix B**.



2.5 Boundary Conditions

The boundary conditions were provided by the City of Ottawa in the form of Hydraulic Grade Line (HGL) at the following locations:

- Connection 1: Apolune Street and Cambrian Road;
- Connection 2: Jackdaw Avenue and Future Greenbank Road; and
- Connection 3: Dundonald Drive and Future Greenbank Road.

The above connection points are illustrated in **Figure 1.1**.

Boundary conditions were provided for Peak Hour, Maximum Day plus Fire and Minimum Hour (high pressure check) conditions.

Under existing conditions, the Brazeau Lands development will be serviced by the Barrhaven pressure zone; however, in the future, it will be serviced by pressure zone 3C. As such, boundary conditions were provided under the existing and future pressure zone configurations.

In total, two (2) sets of boundary conditions were provided by the City and can be found in **Appendix C**.

The boundary conditions for the existing pressure zone configuration are more conservative. As such, the results presented in this report are based on the boundary conditions for the existing pressure zone configuration.

Table 2.6 summarizes the boundary conditions used to size the Brazeau Lands water network.

Table 2.6: Existing Boundary Conditions

Condition	Connection 1 HGL (m)	Connection 2 HGL (m)	Connection 3 HGL (m)
Min Hour (max. pressure)	156.4	156.4	156.4
Peak Hour (min. pressure)	135.7	135.6	135.7
Max Day + Fire Flow (167 L/s)	144.0	141.2	142.0
Max Day + Fire Flow (250 L/s)	135.4	129.9	131.5



3 Hydraulic Capacity Design Criteria

3.1 Pipe Characteristics

Pipe characteristics of internal diameter (ID) and Hazen-Williams C factors were assigned in the model according to the City of Ottawa Design Guidelines for PVC water main material. Pipe characteristics used for the development are outlined in **Table 3.1** below.

Table 3.1: Model Pipe Characteristics

Nominal Diameter (mm)	ID PVC (mm)	Hazen Williams C-Factor (/)
200	204	110
250	250	110
300	297	120

3.2 Pressure Requirements

As outlined in the City of Ottawa Design Guidelines, the generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi). The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way shall not exceed 552 kPa (80 psi). Pressure requirements are outlined in **Table 3.2**.

Table 3.2: Pressure Requirements

Demand Condition	Minimum Pressure		Maximum Pressure	
	(kPa)	(psi)	(kPa)	(psi)
Normal Operating Pressure (maximum daily flow)	350	50	480	70
Peak Hour Demand (minimum allowable pressure)	276	40	-	-
Maximum Fixture Pressure (Ontario Building Code)	-	-	552	80
Maximum Distribution Pressure (minimum hour check)	-	-	552	80
Maximum Day Plus Fire	140	20	-	-



4 Hydraulic Capacity Analysis

The proposed water mains within the development were sized to the minimum diameter which would satisfy the greater of maximum day plus fire and peak hour demand. Modeling was carried out for minimum hour, peak hour and maximum day plus fire flow using InfoWater. Only the existing pressure zone configuration was analyzed, since the boundary conditions are more conservative.

Detailed pipe and junction model input data can be found in **Appendix D**.

4.1 Development Pressure Analysis

Modeled service pressures for the development are summarized in **Table 4.1** below.

Table 4.1: Summary of the Brazeau Lands Available Service Pressures

Phase	Minimum Hour Demand Maximum Pressure	Peak Hour Demand Minimum Pressure
Phase 1	538 kPa (78 psi)	290 kPa (42 psi)
Phases 1&2	538 kPa (78 psi)	262 kPa (38 psi)

As outlined in the City of Ottawa Design Guidelines, the generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi). The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way shall not exceed 552 kPa (80 psi).

Low pressures are predicted at junctions J-66, J-70, J-71, J-72, J-73, J-74, J-75, J-76 and J-77 under peak hour demand. Those low pressures are due to high elevations in the southern part of the Brazeau Lands development and are within 5% of the minimum allowable pressure of 276 kPa (40 psi). The future Zone 3C boundary conditions will provide an additional head of about seven (7) meters at each connection point, and will thus resolve the low PHD pressures at the southern part of the Brazeau Lands development.

Detailed pipe and junction result tables and maps can be found in **Appendix E**.



4.2 Development Fire Flow Analysis

A summary of the minimum available fire flows in the Brazeau Lands development is shown below in **Table 4.2**.

Table 4.2: Summary of the Brazeau Lands Minimum Available Fire Flows

Phase	Required Fire Flow	Minimum Available Flow	Junction ID
Phase 1	167 L/s	177 L/s	J-45
	250 L/s	249 L/s	J-47
Phases 1&2	167 L/s	194 L/s	J-66
	250 L/s	269 L/s	J-47

As shown in the table above, the available fire flow is greater than the required fire flow under both Phase 1 and Phases 1&2 conditions.

A summary of the residual pressures in the Brazeau Lands is shown below in **Table 4.3**. The minimum allowable pressure under fire flow conditions is 140 kPa (20 psi) at the location of the fire.



Table 4.3: Summary of the Brazeau Lands Residual Pressures (MDD + FF)

Phase	Maximum Residual Pressure	Average Residual Pressure	Minimum Residual Pressure
Phase 1	365 kPa (53 psi)	296 kPa (43 psi)	140 kPa (20 psi)
Phases 1&2	365 kPa (53 psi)	296 kPa (43 psi)	159 kPa (23 psi)

There is sufficient residual pressure at all the junctions within the Brazeau Lands development.

Detailed fire flow results and figures illustrating the fire flow results can be found in **Appendix F**.



5 Other Servicing Considerations

5.1 Water Supply Security

The City of Ottawa Design Guidelines allow single feed systems for developments up to a total average day demand of 50 m³/day and require two (2) feeds if the development exceeds 50 m³/day for supply security, according to Technical Bulletin ISDTB-2014-02.

The Brazeau Lands services a total average day demand of 725 m³/day; as such, two (2) feeds are required.

5.2 Valves

No comment has been made in this technical memorandum with respect to exact placement of isolation valves within the distribution network for the Brazeau Lands other than to summarize the City of Ottawa Design Guidelines for number, location, and spacing of isolation valves:

- Tee intersection – two (2) valves
- Cross intersection – three (3) valves
- Valves shall be located 2 m away from the intersection
- 300 m spacing for 150 mm to 400 mm diameter valves
- Gate valves for 100 mm to 300 mm diameter mains
- Butterfly valves for 400 mm and larger diameter mains

Drain valves are not strictly required under the City of Ottawa Design Guidelines for water mains under 600 mm in diameter. The Guidelines indicate that “small diameter water mains shall be drained through hydrant via pumping if needed.”

Air valves are not strictly required under the City of Ottawa Design Guidelines for water mains up to and including 400 mm in diameter. The Guidelines indicate that air removal “can be accomplished by the strategic positioning of hydrant at the high points to remove the air or by installing or utilizing available 50 mm chlorination nozzles in 300 mm and 400 mm chambers.”

The detailed engineering drawings for the Brazeau Lands are expected to identify valves in accordance with the requirements noted above.



5.3 Hydrants

No comment has been made in this technical memorandum with respect to exact placement of hydrants within the distribution network for the Brazeau Lands other than to summarize the City of Ottawa Design Guidelines for maximum hydrant spacing:

- 125 m for single family unit residential areas on lots where frontage at the street line is 15 m or longer
- 110 m for single family unit residential areas on lots where frontage at the street line is less than 15 m and for residential areas zoned for row housing, doubles or duplexes
- 90 m for institutional, commercial, industrial, apartments and high-density areas

The detailed engineering drawings for the Brazeau Lands development are expected to identify hydrants in accordance with the requirements noted above.



6 Conclusions

The hydraulic capacity and modeling analysis of Phase 1 of the Brazeau Lands development yielded the following conclusions:

- The proposed water main network can deliver all domestic flows, with service pressures expected to range between 290 kPa (42 psi) and 538 kPa (78 psi).
- The proposed water main network is able to deliver fire flows to all junctions.
- Hydraulic modeling was only completed for the existing pressure zone configuration since the boundary conditions are more conservative.

The hydraulic capacity and modeling analysis of Phases 1&2 of the Brazeau Lands development yielded the following conclusions:

- The proposed water main network can deliver all domestic flows except for junctions J-66, J-70, J-71, J-72, J-73, J-74, J-75, J-76 and J-77, with service pressures expected to range between 262 kPa (38 psi) and 538 kPa (78 psi).
- The junctions with low pressures are due to high elevations in the southern part of the Brazeau Lands development and are within 5% of the minimum allowable pressure of 276 kPa (40 psi).
- The future Zone 3C boundary conditions will provide an additional head of about seven (7) meters at each connection point, and will thus resolve the low PHD pressures at the southern part of the Brazeau Lands development.
- The proposed water main network is able to deliver fire flows to all junctions.
- Hydraulic modeling was only completed for the existing pressure zone configuration since the boundary conditions are more conservative.



Submission

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Appendix A Domestic Water Demand Calculations and Allocation



Appendix A Domestic Water Demand Calculations and Allocation

Legend

- Junction
- ⊡ Connection Point
- Water Main
- Demand Polygon

Connection #3
Dundonald Drive



GeoAdvice Engineering Inc.

Project: Hydraulic Capacity and Modeling Analysis of the Brazeau Lands
Client: David Schaeffer Engineering Ltd.
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Demand Allocation Phases 1&2

Figure A.1

Consumer Water Demands

Phase 1 Residential Demands

Dwelling Type	Number of Units	Population **		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	172	3.4	585	350	204,750	2.37	5.92	167*	13.03	1.18
Traditional Townhome	133	2.7	360		126,000	1.46	3.65	167*	8.02	0.73
Subtotal	305		945		330,750	3.83	9.57		21.05	1.91

Phases 1&2 Residential Demands

Dwelling Type	Number of Units	Population **		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	347	3.4	1,180	350	413,000	4.78	11.95	167*	26.29	2.39
Traditional Townhome	279	2.7	754		263,900	3.05	7.64	167*	16.80	1.53
Subtotal	626		1,934		676,900	7.83	19.59		43.09	3.92

Non Residential Demands

Property Type	Area (ha)	Average Day Demand			Max Day 1.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 1.8 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)	
		** (L/ha/d)	(L/d)	(L/s)					
Park w/ Splash Pad	1.72		28,000	48,160	0.56	0.84	250**	1.51	0.28
Subtotal	1.72			48,160	0.56	0.84		1.51	0.28

The Meadows Phases 7/8

	ADD (L/s)	MDD (L/s)	PHD (L/s)	MHD (L/s)
Total Demand:	6.20	13.50	28.50	3.10

	ADD (L/s)	MDD (L/s)	PHD (L/s)	MHD (L/s)	
Without the Meadows Phases 7/8 Demands	Phase 1	4.39	10.41	22.56	2.19
	Phases 1&2	8.39	20.42	44.59	4.20

	ADD (L/s)	MDD (L/s)	PHD (L/s)	MHD (L/s)	
With the Meadows Phases 7/8 Demands	Phase 1	10.59	23.91	51.06	5.29
	Phases 1&2	14.59	33.92	73.09	7.30

*Based on FUS fire flow calculation

**Assumed based on similar information from previously completed projects, as agreed upon with DSEL

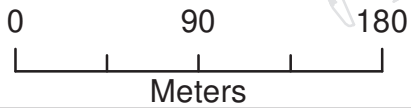


Appendix B FUS Fire Flow Calculations and Allocation

Legend

- Junction
- ☒ Connection Point
- Water Main

Connection #3
Dundonald Drive



GeoAdvice Engineering Inc.

Project: Hydraulic Capacity and Modeling Analysis of the Brazeau Lands

Client: David Schaeffer Engineering Ltd.

Date: June 2020

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Required Fire Flow
Phases 1&2

Figure B.1

FUS Required Fire Flow Calculation

Client: David Schaeffer Engineering Ltd.

Project: 2019-091-DSE

Development: Brazeau Lands

Blocks 300-313, Single Detached

Zoning: Multi Family Residential

Date: November 6, 2019

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.



A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 1927 m²
 Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2
 Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

D. Required Fire Flow*: $F = 220C\sqrt{A}$
 C: Coefficient related to the type of construction
 A: Effective area
 The total floor area in m² in the building being considered

Note: The single detached dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 14 units is considered in this calculation.

$$C = \frac{1.5}{A = 3854 \text{ m}^2} \quad (\text{Combined area of 14 units})$$

$$F = 20,486 \text{ L/min} \quad D = 20,000 \text{ L/min}^*$$

E. Occupancy
 Occupancy content hazard: Limited Combustible
 -15 % of D -3,000 L/min $E = 17,000 \text{ L/min}$

F. Sprinkler Protection
 Automatic sprinkler protection: None
 0 % of E 0 L/min $F = 17,000 \text{ L/min}$

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	20.1 to 30 m	0-30 m-storeys	Wood Frame or Non-Combustible	8%
East	20.1 to 30 m	0-30 m-storeys	Wood Frame or Non-Combustible	8%
North	10.1 to 20 m	Over 120 m-storeys	Wood Frame or Non-Combustible	15%
South	20.1 to 30 m	Over 120 m-storeys	Wood Frame or Non-Combustible	10%
Total				41%

$$\% \text{ of E } \quad + 6,970 \text{ L/min} \quad G = 23,970 \text{ L/min}$$

H. Wood Shake Charge No 0 L/min $H = 23,970 \text{ L/min}$
 For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The single detached dwellings comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	10,000 L/min*
	167 L/s
Required Duration of Fire Flow	2 Hrs
Required Volume of Fire Flow	1,200 m³

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m ²)	3,854
Required Fire Flow (L/min)	20,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	8%
East (%)	8%
South (%)	15%
West (%)	10%
Total Exposure (%)	41%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167

FUS Required Fire Flow Calculation

Client: David Schaeffer Engineering Ltd.

Project: 2019-091-DSE

Development: Brazeau Lands

Blocks 173, Traditional Townhouse

Zoning: Multi Family Residential

Date: November 6, 2019

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.



A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 474 m²
 Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2
 Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

D. Required Fire Flow*: $F = 220C\sqrt{A}$
 C: Coefficient related to the type of construction
 A: Effective area
 The total floor area in m² in the building being considered

Note: The townhouse dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 5 units is considered in this calculation.

$$C = \frac{1.5}{A = 947 \text{ m}^2} \quad (\text{Combined area of 5 units})$$

$$F = 10,156 \text{ L/min} \quad D = 10,000 \text{ L/min}^*$$

E. Occupancy
 Occupancy content hazard: Limited Combustible
 -15 % of D -1,500 L/min $E = 8,500 \text{ L/min}$

F. Sprinkler Protection
 Automatic sprinkler protection: None
 0 % of E 0 L/min $F = 8,500 \text{ L/min}$

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
East	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
North	10.1 to 20 m	61-90 m-storeys	Wood Frame or Non-Combustible	14%
South	20.1 to 30 m	31-60 m-storeys	Wood Frame or Non-Combustible	8%
Total				56%

$$\% \text{ of E } \quad + 4,760 \text{ L/min} \quad G = 13,260 \text{ L/min}$$

H. Wood Shake Charge No 0 L/min $H = 13,260 \text{ L/min}$
 For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The townhouse dwellings comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	10,000 L/min*
	167 L/s
Required Duration of Fire Flow	2 Hrs
Required Volume of Fire Flow	1,200 m³

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m ²)	947
Required Fire Flow (L/min)	10,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	17%
East (%)	17%
South (%)	14%
West (%)	8%
Total Exposure (%)	56%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167

FUS Required Fire Flow Calculation

Client: David Schaeffer Engineering Ltd.

Project: 2019-091-DSE

Development: Brazeau Lands

Zoning: Multi Family Residential

Blocks 384, Traditional Townhouse

Date: November 6, 2019

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.



A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 380 m²
 Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2
 Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

D. Required Fire Flow*: $F = 220C\sqrt{A}$
 C: Coefficient related to the type of construction
 A: Effective area
 The total floor area in m² in the building being considered

Note: The townhouse dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 4 units is considered in this calculation.

$$C = \frac{1.5}{A = 760 \text{ m}^2} \quad (\text{Combined area of 4 units})$$

$$F = 9,095 \text{ L/min} \quad D = 9,000 \text{ L/min}^*$$

E. Occupancy
 Occupancy content hazard: Limited Combustible
 -15 % of D -1,350 L/min $E = 7,650 \text{ L/min}$

F. Sprinkler Protection
 Automatic sprinkler protection: None
 0 % of E 0 L/min $F = 7,650 \text{ L/min}$

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	10.1 to 20 m	0-30 m-storeys	Wood Frame or Non-Combustible	12%
East	Beyond 45 m	0-30 m-storeys	Wood Frame or Non-Combustible	0%
North	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
South	20.1 to 30 m	0-30 m-storeys	Wood Frame or Non-Combustible	8%
Total				37%

$$\% \text{ of E } \quad + 2,831 \text{ L/min} \quad G = 10,481 \text{ L/min}$$

H. Wood Shake Charge No 0 L/min $H = 10,481 \text{ L/min}$
 For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The townhouse dwellings do not comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	10,000 L/min*
	167 L/s
Required Duration of Fire Flow	2 Hrs
Required Volume of Fire Flow	1,200 m³

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m ²)	760
Required Fire Flow (L/min)	9,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	12%
East (%)	0%
South (%)	17%
West (%)	8%
Total Exposure (%)	37%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167

FUS Required Fire Flow Calculation

Client: David Schaeffer Engineering Ltd.

Project: 2019-091-DSE

Development: Brazeau Lands

Zoning: Multi Family Residential

Blocks 168, Traditional Townhouse

Date: November 6, 2019

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.



A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 380 m²
 Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2
 Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

D. Required Fire Flow*: $F = 220C\sqrt{A}$
 C: Coefficient related to the type of construction
 A: Effective area
 The total floor area in m² in the building being considered

Note: The townhouse dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 4 units is considered in this calculation.

$$C = \frac{1.5}{760 \text{ m}^2} \quad (\text{Combined area of 4 units})$$

$$F = 9,095 \text{ L/min} \quad D = 9,000 \text{ L/min}^*$$

E. Occupancy
 Occupancy content hazard: Limited Combustible
 -15 % of D -1,350 L/min $E = 7,650 \text{ L/min}$

F. Sprinkler Protection
 Automatic sprinkler protection: None
 0 % of E 0 L/min $F = 7,650 \text{ L/min}$

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	30.1 to 45 m	0-30 m-storeys	Wood Frame or Non-Combustible	5%
East	10.1 to 20 m	0-30 m-storeys	Wood Frame or Non-Combustible	12%
North	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
South	Beyond 45 m	31-60 m-storeys	Wood Frame or Non-Combustible	0%
Total				34%

$$\% \text{ of E } \quad + 2,601 \text{ L/min} \quad G = 10,251 \text{ L/min}$$

H. Wood Shake Charge No 0 L/min $H = 10,251 \text{ L/min}$
 For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The townhouse dwellings do not comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	10,000 L/min*
	167 L/s
Required Duration of Fire Flow	2 Hrs
Required Volume of Fire Flow	1,200 m³

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m ²)	760
Required Fire Flow (L/min)	9,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	5%
East (%)	12%
South (%)	17%
West (%)	0%
Total Exposure (%)	34%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167



Appendix C Boundary Conditions

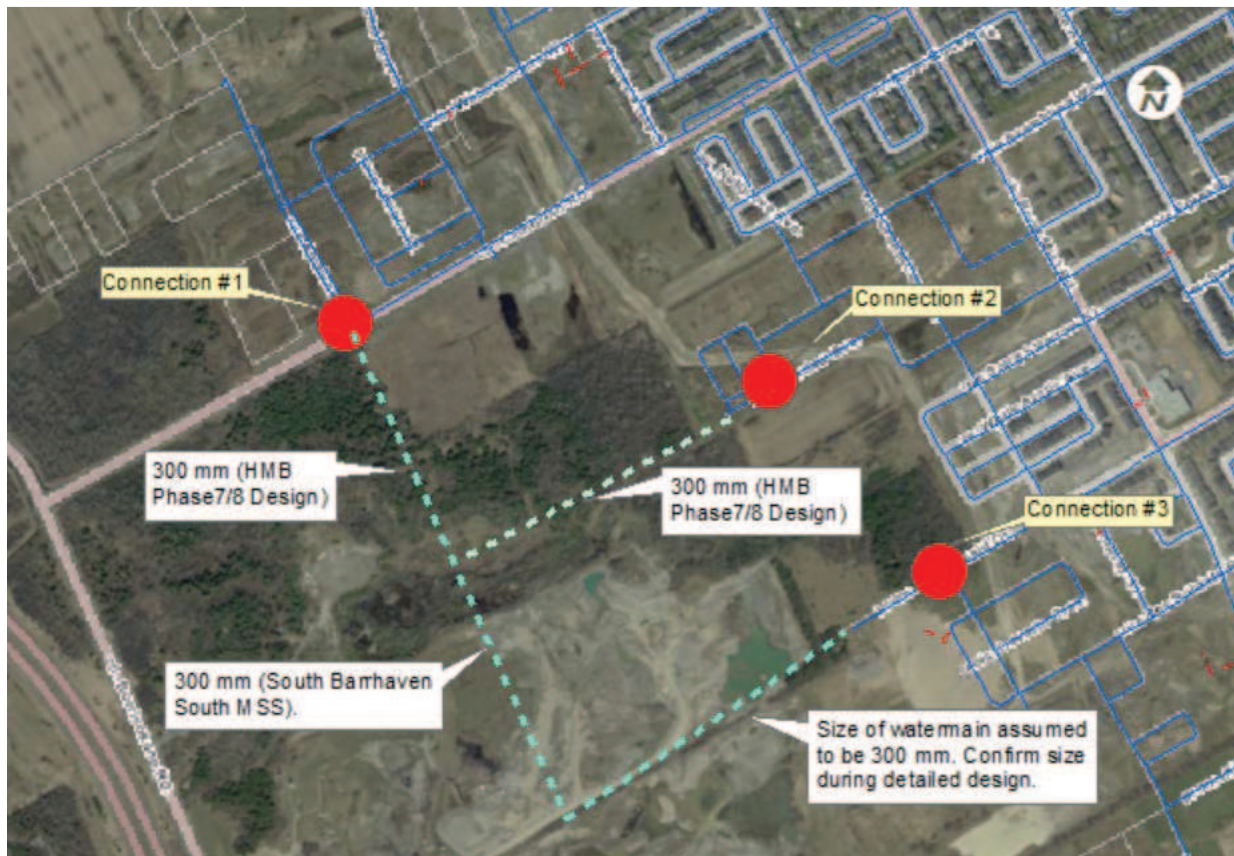
Boundary Conditions for HMB Phases 7 and 8 and Brazeau Lands

Information Provided:

Date provided: September 2019

Scenario	Demand	
	L/min	L/s
Average Daily Demand	846	14.10
Maximum Daily Demand	1961	32.69
Peak Hour	4224	70.40
Fire Flow Demand #1	10000	166.67
Fire Flow Demand #2	15000	250.00
Fire Flow Demand #3	17000	283.33

Location:



Results

Connection 1 - Cambrian Road

Demand Scenario	Existing Barrhaven PZ		Future Zone 3C	
	Head (m)	Pressure ¹ (psi)	Head (m)	Pressure ¹ (psi)
Maximum HGL	156.4	102.9	147.7	77.3
Peak Hour	135.7	60.4	142.8	70.4
Max Day plus Fire (#1)	144.0	72.2	140.0	66.4
Max Day plus Fire (#2)	135.4	59.9	134.9	59.2
Max Day plus Fire (#3)	133.7	57.4	132.5	55.7

¹ Ground Elevation = 93.3 m

Connection 2 - Brambling Way

Demand Scenario	Existing Barrhaven PZ		Future Zone 3C	
	Head (m)	Pressure ¹ (psi)	Head (m)	Pressure ¹ (psi)
Maximum HGL	156.4	100.1	147.7	74.6
Peak Hour	135.6	57.4	142.7	67.5
Max Day plus Fire (#1)	141.2	65.4	139.9	63.5
Max Day plus Fire (#2)	129.9	49.4	134.6	56.0
Max Day plus Fire (#3)	126.6	44.7	132.1	52.4

¹ Ground Elevation = 95.2 m

Connection 3 - Dundonald Drive

Demand Scenario	Existing Barrhaven PZ		Future Zone 3C	
	Head (m)	Pressure ¹ (psi)	Head (m)	Pressure ¹ (psi)
Maximum HGL	156.4	86.5	147.7	61.0
Peak Hour	135.7	43.9	142.6	53.7
Max Day plus Fire (#1)	142.0	52.9	138.6	48.1
Max Day plus Fire (#2)	131.5	38.0	132.2	38.9
Max Day plus Fire (#3)	128.7	34.0	128.9	34.3

¹ Ground Elevation = 104.8 m

Notes:

- 1) As per the Ontario Building Code in areas that may be occupied, the static pressure at any fixture shall not exceed 552 kPa (80 psi.) Pressure control measures to be considered are as follows, in order of preference:
 - a) If possible, systems to be designed to residual pressures of 345 to 552 kPa (50 to 80 psi) in all occupied areas outside of the public right-of-way without special pressure control equipment.

- b) Pressure reducing valves to be installed immediately downstream of the isolation valve in the home/ building, located downstream of the meter so it is owner maintained.
- 2) A third pump was turned on during all fire simulations under Existing Barrhaven Pressure.
 - 3) Future pipes were added to the water model as shown in the figure above.

Disclaimer

The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.



Appendix D Pipe and Junction Model Inputs

Model Inputs - Phases 1 and 2

ID	From	To	Length (m)	Diameter (mm)	Roughness ()
P-100	J-82	J-83	63.79	204	110
P-101	J-83	J-46	60.03	204	110
P-102	J-79	J-84	53.32	204	110
P-103	J-84	J-85	55.04	204	110
P-104	J-85	J-45	66.63	204	110
P-105	J-78	J-86	72.81	297	120
P-106	J-86	J-87	55.90	297	120
P-107	J-87	J-88	48.49	297	120
P-108	J-45	J-88	59.54	204	110
P-109	J-88	J-89	55.04	297	120
P-110	J-89	J-41	65.11	297	120
P-111	J-90	J-47	61.51	204	110
P-112	J-43	J-90	59.19	204	110
P-42	J-33	J-34	40.11	297	120
P-43	J-33	J-35	114.35	297	120
P-44	J-35	J-36	77.83	297	120
P-45	J-36	J-37	59.20	297	120
P-46	J-37	J-38	62.88	297	120
P-47	J-38	J-39	74.92	297	120
P-48	J-39	J-40	87.18	297	120
P-49	J-40	J-41	59.39	297	120
P-50	J-41	J-60	67.93	297	120
P-51	J-60	CONNECTION_3	138.92	297	120
P-52	J-40	J-42	58.39	204	110
P-53	J-42	J-43	83.72	204	110
P-54	J-43	J-44	72.67	204	110
P-55	J-44	J-38	58.67	204	110
P-56	J-45	J-46	59.20	204	110
P-57	J-46	J-90	81.24	204	110
P-58	J-47	J-48	84.62	204	110
P-59	J-48	J-61	59.65	297	120
P-60	J-61	J-37	60.99	297	120
P-61	J-59	J-58	94.07	297	120
P-62	J-58	J-48	82.47	297	120
P-63	J-48	J-49	63.07	204	110
P-64	J-49	J-50	57.71	204	110
P-65	J-50	J-51	84.62	204	110
P-66	J-51	J-52	106.76	204	110
P-67	J-33	J-52	62.05	204	110
P-68	J-52	J-53	60.2	204	110
P-69	J-53	J-54	112.78	204	110
P-70	J-54	J-49	90	204	110
P-71	J-49	J-57	56.32	204	110
P-72	J-57	J-56	92.28	204	110
P-73	J-53	J-55	55.27	204	110
P-74	J-55	J-56	113.38	204	110
P-75	J-56	J-62	58.69	204	110
P-76	J-62	J-63	119.4	204	110
P-77	J-63	J-64	56.35	204	110
P-78	J-64	J-65	58.6	204	110
P-79	J-65	J-66	100.76	204	110
P-80	J-66	J-70	70.42	204	110
P-81	J-70	J-71	55.7	204	110
P-82	J-71	J-69	54.8	204	110
P-83	J-64	J-67	125.85	204	110
P-84	J-67	J-69	97.99	204	110
P-85	J-62	J-68	92.12	204	110
P-86	J-68	J-69	56.42	204	110
P-87	J-69	J-59	63.46	204	110
P-88	J-59	J-72	59.77	297	120
P-89	J-72	J-73	28.67	297	120
P-90	J-72	J-74	96.85	297	120
P-91	J-74	J-75	110.13	297	120
P-92	J-75	J-76	78.16	297	120
P-93	J-77	J-76	30.34	297	120
P-94	J-76	J-78	58.2	297	120
P-95	J-78	J-79	59.97	204	110
P-96	J-79	J-80	59.39	204	110
P-97	J-80	J-81	85.15	204	110
P-98	J-81	J-59	79.25	204	110
P-99	J-80	J-82	51.74	204	110

ID	Elevation (m)	ADD (L/s)
J-33	101.29	0.18
J-34	101.41	0.00
J-35	101.33	0.16
J-36	101.25	0.16
J-37	101.64	0.06
J-38	101.46	0.14
J-39	101.83	0.20
J-40	101.96	0.14
J-41	102.65	0.04
J-42	101.87	0.16
J-43	101.72	0.18
J-44	101.59	0.16
J-45	103.27	0.06
J-46	102.38	0.08
J-47	101.77	0.12
J-48	101.83	0.06
J-49	101.74	0.14
J-50	101.40	0.12
J-51	101.41	0.18
J-52	101.35	0.20
J-53	102.22	0.20
J-54	101.87	0.20
J-55	102.52	0.20
J-56	103.00	0.20
J-57	102.46	0.12
J-58	102.95	0.06
J-59	105.68	0.64
J-60	102.80	0.00
J-61	101.51	0.06
J-62	104.21	0.00
J-63	106.39	0.20
J-64	106.74	0.20
J-65	107.17	0.20
J-66	107.78	0.18
J-67	106.62	0.20
J-68	106.00	0.22
J-69	107.07	0.14
J-70	108.43	0.14
J-71	108.62	0.16
J-72	107.85	0.12
J-73	108.47	0.16
J-74	107.68	0.00
J-75	108.00	0.24
J-76	108.27	0.16
J-77	108.93	0.08
J-78	106.17	0.00
J-79	105.57	0.06
J-80	105.54	0.18
J-81	105.54	0.18
J-82	104.30	0.28
J-83	103.10	0.12
J-84	104.73	0.20
J-85	103.68	0.12
J-86	105.81	0.20
J-87	105.51	0.08
J-88	104.78	0.08
J-89	103.69	0.04
J-90	102.07	0.08



Appendix E MHD and PHD Model Results

Minimum Hour Demand Modeling Results - Phase 1

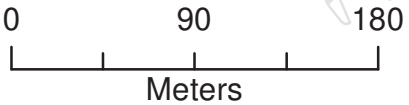
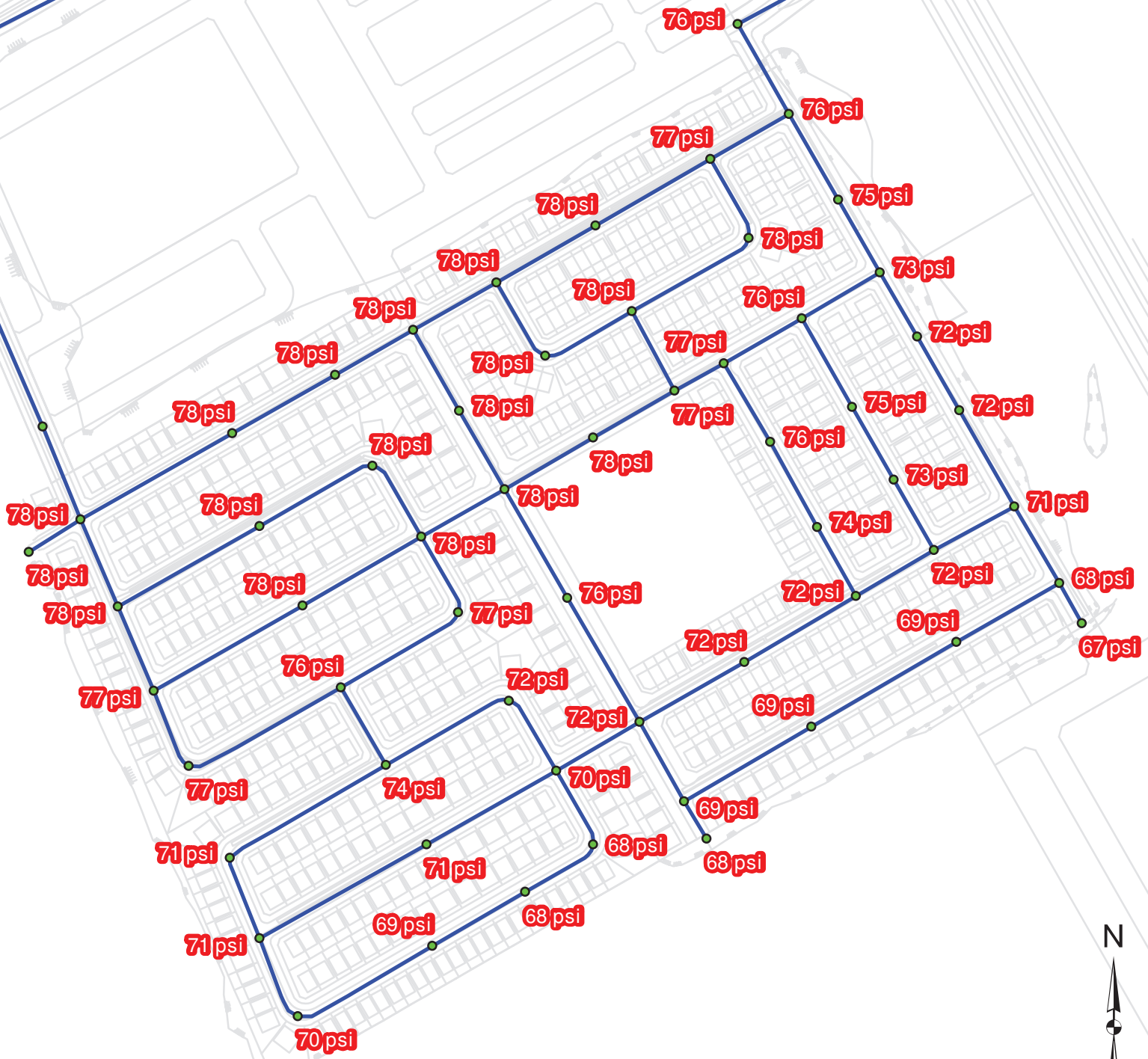
ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)
P-42	J-33	J-34	40.11	297	120	0.00	0.00	0.00	0.00
P-43	J-33	J-35	114.35	297	120	-0.09	0.00	0.00	0.00
P-44	J-35	J-36	77.83	297	120	-0.16	0.00	0.00	0.00
P-45	J-36	J-37	59.20	297	120	-0.25	0.00	0.00	0.00
P-46	J-37	J-38	62.88	297	120	-0.88	0.01	0.00	0.00
P-47	J-38	J-39	74.92	297	120	-1.05	0.02	0.00	0.00
P-48	J-39	J-40	87.18	297	120	-1.15	0.02	0.00	0.00
P-49	J-40	J-41	59.39	297	120	-1.68	0.02	0.00	0.00
P-50	J-41	J-60	67.93	297	120	-1.69	0.02	0.00	0.00
P-51	J-60	CONNECTION_3	138.92	297	120	-1.69	0.02	0.00	0.00
P-52	J-40	J-42	58.39	204	110	0.45	0.01	0.00	0.00
P-53	J-42	J-43	91.90	204	110	0.37	0.01	0.00	0.00
P-54	J-43	J-44	64.49	204	110	-0.02	0.00	0.00	0.00
P-55	J-44	J-38	58.67	204	110	-0.10	0.00	0.00	0.00
P-56	J-45	J-46	59.20	204	110	-0.03	0.00	0.00	0.00
P-57	J-46	J-90	37.06	204	110	-0.08	0.00	0.00	0.00
P-58	J-47	J-48	67.31	204	110	0.16	0.00	0.00	0.00
P-59	J-48	J-61	59.65	297	120	-0.58	0.01	0.00	0.00
P-60	J-61	J-37	60.99	297	120	-0.61	0.01	0.00	0.00
P-61	J-59	J-58	94.07	297	120	-0.32	0.00	0.00	0.00
P-62	J-58	J-48	82.47	297	120	-0.35	0.01	0.00	0.00
P-63	J-48	J-49	63.07	204	110	0.36	0.01	0.00	0.00
P-64	J-49	J-50	57.71	204	110	0.04	0.00	0.00	0.00
P-65	J-50	J-51	84.62	204	110	-0.02	0.00	0.00	0.00
P-66	J-51	J-52	106.76	204	110	-0.11	0.00	0.00	0.00
P-67	J-33	J-52	62.05	204	110	0.42	0.01	0.00	0.00
P-68	J-52	J-53	60.20	204	110	0.21	0.01	0.00	0.00
P-69	J-53	J-54	112.78	204	110	-0.01	0.00	0.00	0.00
P-70	J-54	J-49	90.00	204	110	-0.10	0.00	0.00	0.00
P-71	J-49	J-57	56.32	204	110	0.14	0.00	0.00	0.00
P-72	J-57	J-56	92.28	204	110	0.08	0.00	0.00	0.00
P-73	J-53	J-55	55.27	204	110	0.12	0.00	0.00	0.00
P-74	J-55	J-56	113.38	204	110	0.02	0.00	0.00	0.00
P-111	J-90	J-47	61.51	204	110	0.22	0.01	0.00	0.00
P-112	J-43	J-90	59.19	204	110	0.30	0.01	0.00	0.00

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-33	0.09	101.29	156	78
J-34	0.00	101.41	156	78
J-35	0.08	101.33	156	78
J-36	0.08	101.25	156	78
J-37	0.03	101.64	156	78
J-38	0.07	101.46	156	78
J-39	0.10	101.83	156	78
J-40	0.07	101.96	156	77
J-41	0.02	102.65	156	76
J-42	0.08	101.87	156	78
J-43	0.09	101.72	156	78
J-44	0.08	101.59	156	78
J-45	0.03	103.27	156	76
J-46	0.04	102.38	156	77
J-47	0.06	101.77	156	78
J-48	0.03	101.83	156	78
J-49	0.07	101.74	156	78
J-50	0.06	101.40	156	78
J-51	0.09	101.41	156	78
J-52	0.10	101.35	156	78
J-53	0.10	102.22	156	77
J-54	0.10	101.87	156	78
J-55	0.10	102.52	156	77
J-56	0.10	103.00	156	76
J-57	0.06	102.46	156	77
J-58	0.03	102.95	156	76
J-59	0.32	105.68	156	72
J-60	0.00	102.80	156	76
J-61	0.03	101.51	156	78
J-90	0.00	102.07	156	77

Legend

- Junction
- ⊡ Connection Point
- Water Main

Connection #3
Dundonald Drive



GeoAdvice Engineering Inc.

Project: Hydraulic Capacity and Modeling Analysis of the Brazeau Lands
Client: David Schaeffer Engineering Ltd.
Date: June 2020
Created by: BL
Reviewed by: WdS

DISCLAIMER: GeoAdvice does not warrant in any way the accuracy and completeness of the information shown on this map. Field verification of the accuracy and completeness of the information shown on this map is the sole responsibility of the user.

MHD Pressure Results - Phases 1&2

Figure E.2

Peak Hour Demand Modeling Results - Phase 1

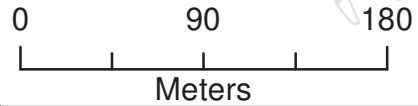
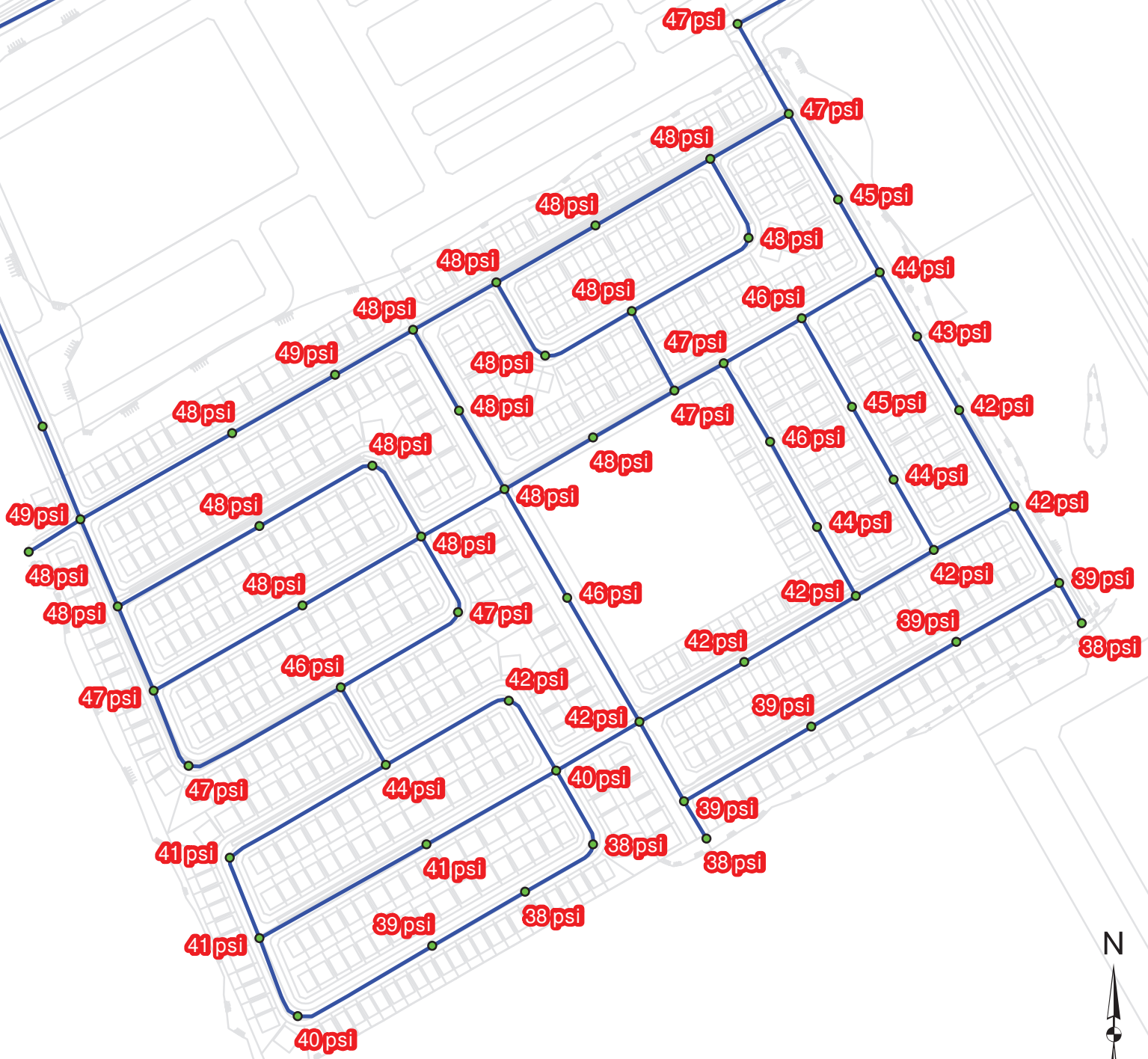
ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)
P-42	J-33	J-34	40.11	297	120	0.00	0.00	0.00	0.00
P-43	J-33	J-35	114.35	297	120	-2.53	0.04	0.00	0.01
P-44	J-35	J-36	77.83	297	120	-3.36	0.05	0.00	0.01
P-45	J-36	J-37	59.20	297	120	-4.27	0.06	0.00	0.02
P-46	J-37	J-38	62.88	297	120	-10.16	0.15	0.01	0.11
P-47	J-38	J-39	74.92	297	120	-11.85	0.17	0.01	0.15
P-48	J-39	J-40	87.18	297	120	-13.00	0.19	0.02	0.18
P-49	J-40	J-41	59.39	297	120	-18.81	0.27	0.02	0.35
P-50	J-41	J-60	67.93	297	120	-18.99	0.27	0.02	0.36
P-51	J-60	CONNECTION_3	138.92	297	120	-18.99	0.27	0.05	0.36
P-52	J-40	J-42	58.39	204	110	5.02	0.15	0.01	0.23
P-53	J-42	J-43	91.90	204	110	4.12	0.13	0.01	0.16
P-54	J-43	J-44	64.49	204	110	-0.06	0.00	0.00	0.00
P-55	J-44	J-38	58.67	204	110	-0.91	0.03	0.00	0.01
P-56	J-45	J-46	59.20	204	110	-0.36	0.01	0.00	0.00
P-57	J-46	J-90	37.06	204	110	-0.84	0.03	0.00	0.01
P-58	J-47	J-48	67.31	204	110	1.65	0.05	0.00	0.03
P-59	J-48	J-61	59.65	297	120	-5.28	0.08	0.00	0.03
P-60	J-61	J-37	60.99	297	120	-5.59	0.08	0.00	0.04
P-61	J-59	J-58	94.07	297	120	-1.96	0.03	0.00	0.01
P-62	J-58	J-48	82.47	297	120	-2.26	0.03	0.00	0.01
P-63	J-48	J-49	63.07	204	110	4.29	0.13	0.01	0.17
P-64	J-49	J-50	57.71	204	110	0.63	0.02	0.00	0.00
P-65	J-50	J-51	84.62	204	110	-0.06	0.00	0.00	0.00
P-66	J-51	J-52	106.76	204	110	-1.04	0.03	0.00	0.01
P-67	J-33	J-52	62.05	204	110	4.28	0.13	0.01	0.17
P-68	J-52	J-53	60.20	204	110	2.10	0.06	0.00	0.04
P-69	J-53	J-54	112.78	204	110	-0.21	0.01	0.00	0.00
P-70	J-54	J-49	90.00	204	110	-1.27	0.04	0.00	0.02
P-71	J-49	J-57	56.32	204	110	1.63	0.05	0.00	0.03
P-72	J-57	J-56	92.28	204	110	0.95	0.03	0.00	0.01
P-73	J-53	J-55	55.27	204	110	1.17	0.04	0.00	0.02
P-74	J-55	J-56	113.38	204	110	0.11	0.00	0.00	0.00
P-111	J-90	J-47	61.51	204	110	2.31	0.07	0.00	0.05
P-112	J-43	J-90	59.19	204	110	3.16	0.10	0.01	0.10

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-33	0.99	101.29	136	49
J-34	0.00	101.41	136	49
J-35	0.83	101.33	136	49
J-36	0.91	101.25	136	49
J-37	0.30	101.64	136	48
J-38	0.78	101.46	136	49
J-39	1.15	101.83	136	48
J-40	0.78	101.96	136	48
J-41	0.18	102.65	136	47
J-42	0.90	101.87	136	48
J-43	1.02	101.72	136	48
J-44	0.84	101.59	136	48
J-45	0.36	103.27	136	46
J-46	0.48	102.38	136	47
J-47	0.66	101.77	136	48
J-48	0.38	101.83	136	48
J-49	0.76	101.74	136	48
J-50	0.68	101.40	136	49
J-51	0.99	101.41	136	49
J-52	1.14	101.35	136	49
J-53	1.14	102.22	136	47
J-54	1.06	101.87	136	48
J-55	1.06	102.52	136	47
J-56	1.06	103.00	136	46
J-57	0.68	102.46	136	47
J-58	0.30	102.95	136	46
J-59	1.96	105.68	136	42
J-60	0.00	102.80	136	47
J-61	0.30	101.51	136	48
J-90	0.00	102.07	136	48

Legend

- Junction
- ☒ Connection Point
- Water Main

Connection #3
Dundonald Drive



Project: Hydraulic Capacity and Modeling Analysis of the Brazeau Lands
Client: David Schaeffer Engineering Ltd.
Date: June 2020
Created by: BL
Reviewed by: WdS

DISCLAIMER: GeoAdvice does not warrant in any way the accuracy and completeness of the information shown on this map. Field verification of the accuracy and completeness of the information shown on this map is the sole responsibility of the user.

PHD Pressure Results - Phases 1&2

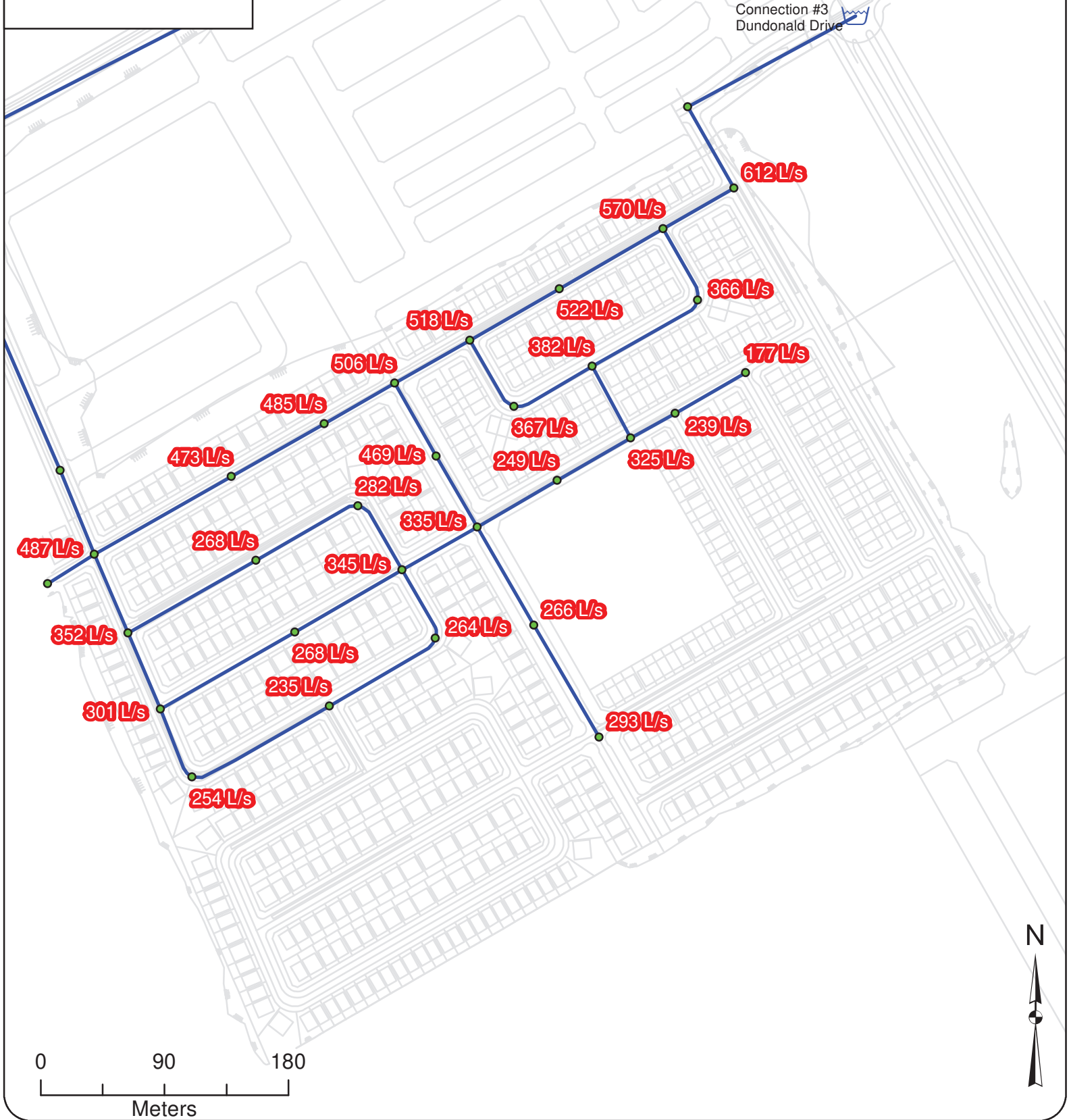
Figure E.4



Appendix F MDD+FF Model Results

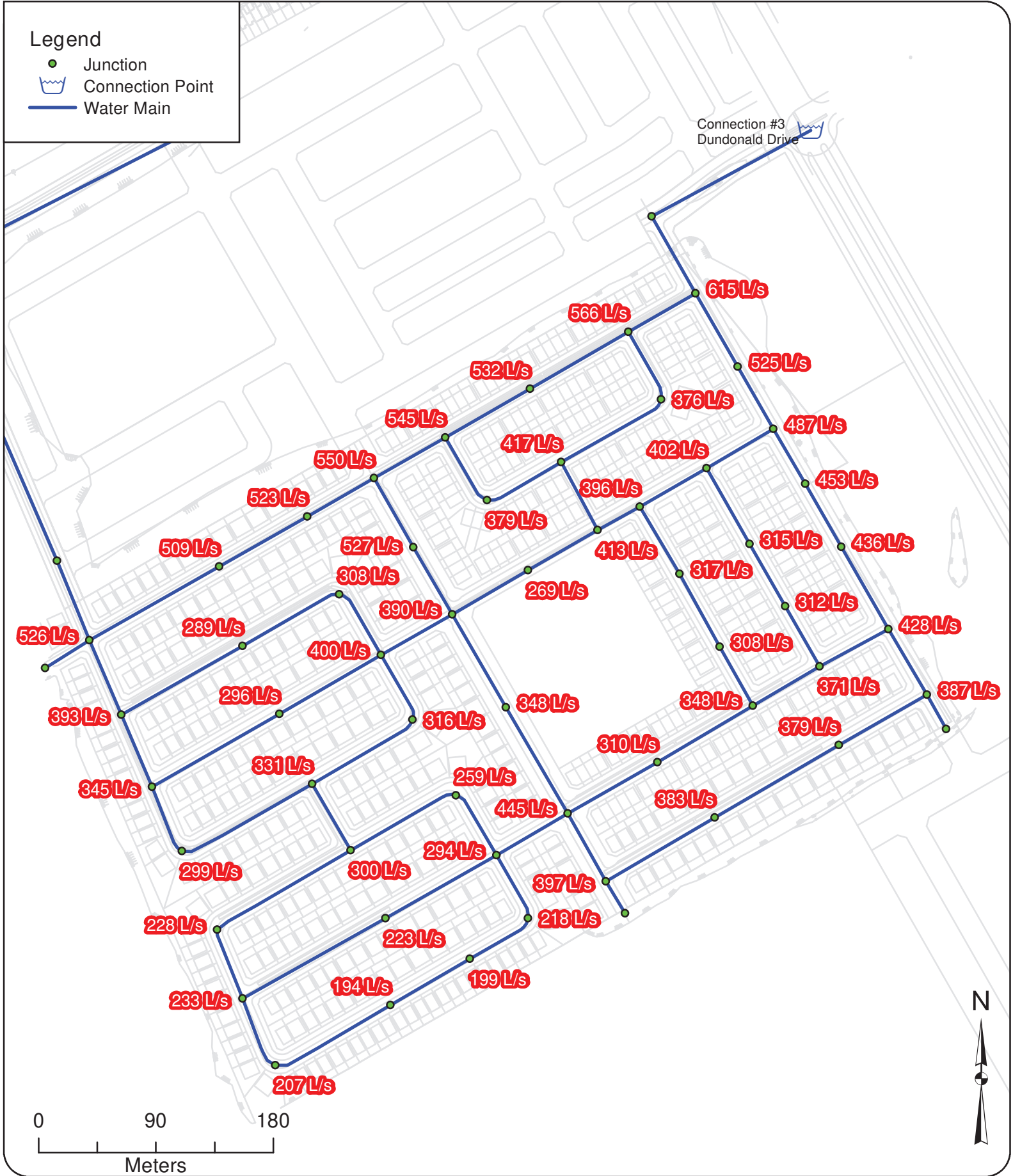
Legend

- Junction
- ☒ Connection Point
- Water Main



Legend

- Junction
- Connection Point
- Water Main



GeoAdvice Engineering Inc.

Project: Hydraulic Capacity and Modeling Analysis of the Brazeau Lands
 Client: David Schaeffer Engineering Ltd.
 Date: June 2020
 Created by: BL
 Reviewed by: WdS

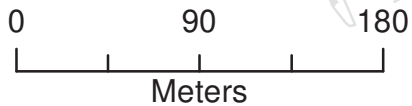
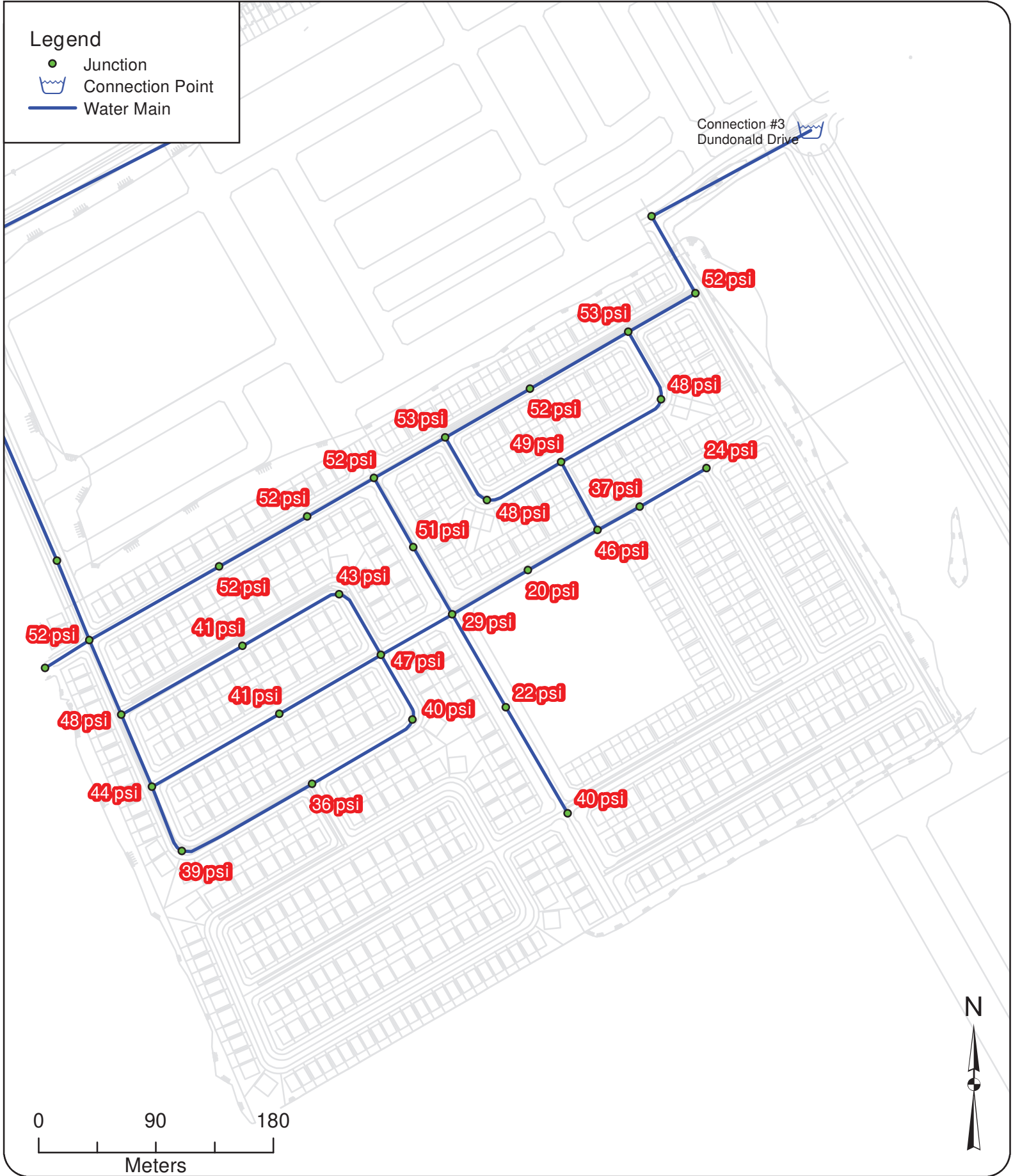
DISCLAIMER: GeoAdvice does not warrant in any way the accuracy and completeness of the information shown on this map. Field verification of the accuracy and completeness of the information shown on this map is the sole responsibility of the user.

Available Fire Flow @
 20 psi - Phases 1&2

Figure F.2

Legend

- Junction
- ⊔ Connection Point
- Water Main



GeoAdvice Engineering Inc.

Project: Hydraulic Capacity and Modeling Analysis of the Brazeau Lands

Client: David Schaeffer Engineering Ltd.

Date: June 2020

Created by: BL

Reviewed by: WdS

DISCLAIMER: GeoAdvice does not warrant in any way the accuracy and completeness of the information shown on this map. Field verification of the accuracy and completeness of the information shown on this map is the sole responsibility of the user.

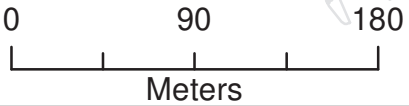
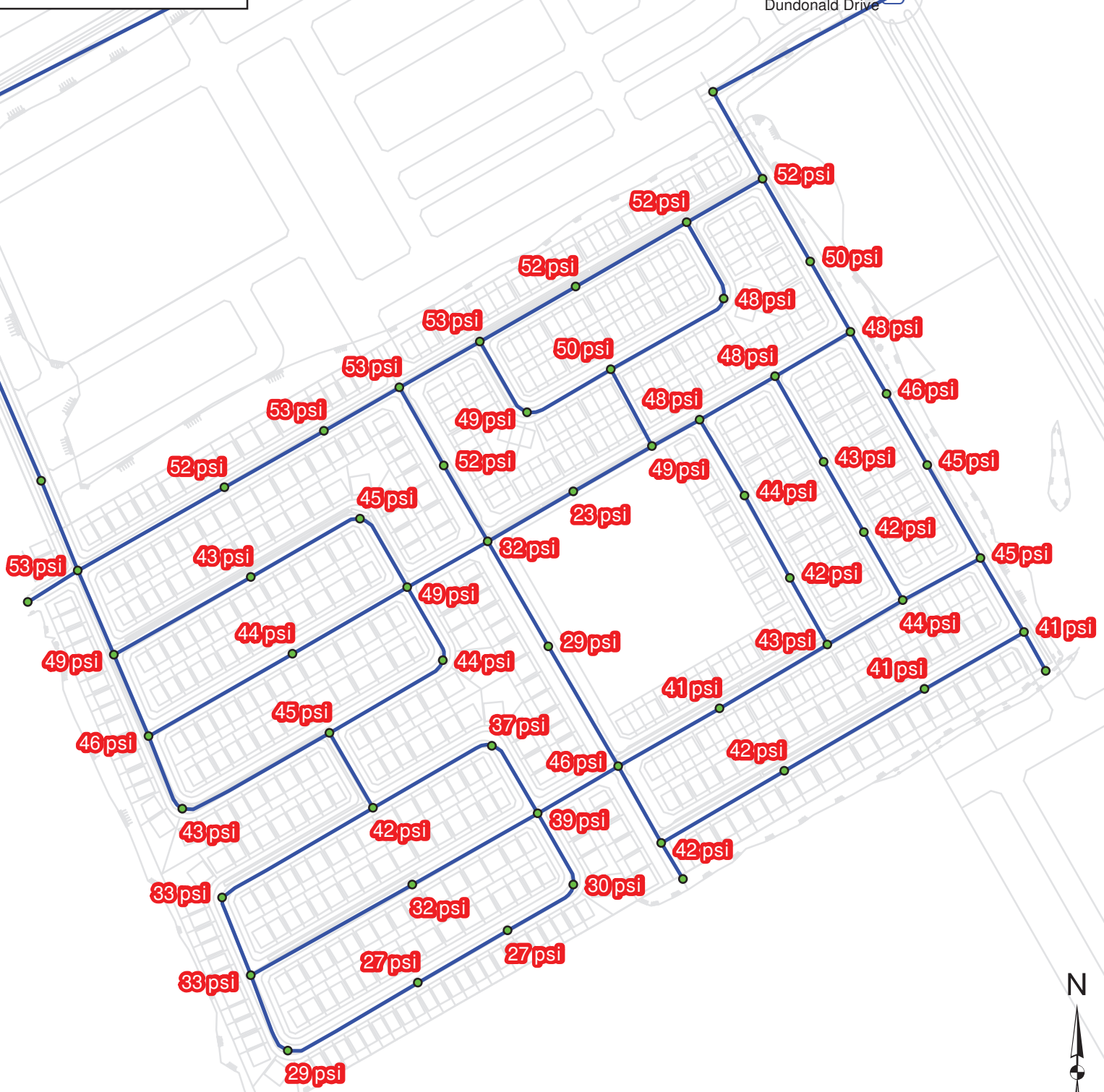
Residual Pressure @
Required Fire Flow -
Phase 1

Figure F.3

Legend

- Junction
- ⊡ Connection Point
- Water Main

Connection #3
Dundonald Drive



Project: Hydraulic Capacity and Modeling Analysis of the Brazeau Lands
Client: David Schaeffer Engineering Ltd.
Date: June 2020
Created by: BL
Reviewed by: WdS

DISCLAIMER: GeoAdvice does not warrant in any way the accuracy and completeness of the information shown on this map. Field verification of the accuracy and completeness of the information shown on this map is the sole responsibility of the user.

Residual Pressure @
Required Fire Flow -
Phases 1&2

Figure F.4

Fire Flow Modeling Results - Phase 1

ID	Static Demand (L/s)	Fire-Flow Demand (L/s)	Residual Pressure (psi)	Available Flow at Hydrant (L/s)	Available Flow Pressure (psi)
J-33	0.45	167	52	487	20
J-35	0.38	167	52	473	20
J-36	0.41	167	52	485	20
J-37	0.14	167	52	506	20
J-38	0.36	167	53	518	20
J-39	0.52	167	52	522	20
J-40	0.36	167	53	570	20
J-41	0.08	167	52	612	20
J-42	0.41	167	48	366	20
J-43	0.47	167	49	382	20
J-44	0.38	167	48	367	20
J-45	0.16	167	24	177	20
J-46	0.22	167	37	239	20
J-49	0.34	167	47	345	20
J-50	0.31	167	43	282	20
J-51	0.45	167	41	268	20
J-52	0.52	167	48	352	20
J-53	0.52	167	44	301	20
J-54	0.48	167	41	268	20
J-55	0.48	167	39	254	20
J-56	0.48	167	36	235	20
J-57	0.31	167	40	264	20
J-59	1.04	167	40	293	20
J-61	0.14	167	51	469	20
J-90	0.00	167	46	325	20
J-47	0.30	250	20	249	20
J-48	0.17	250	29	335	20
J-58	0.14	250	22	266	20

Fire Flow Modeling Results - Phases 1 and 2

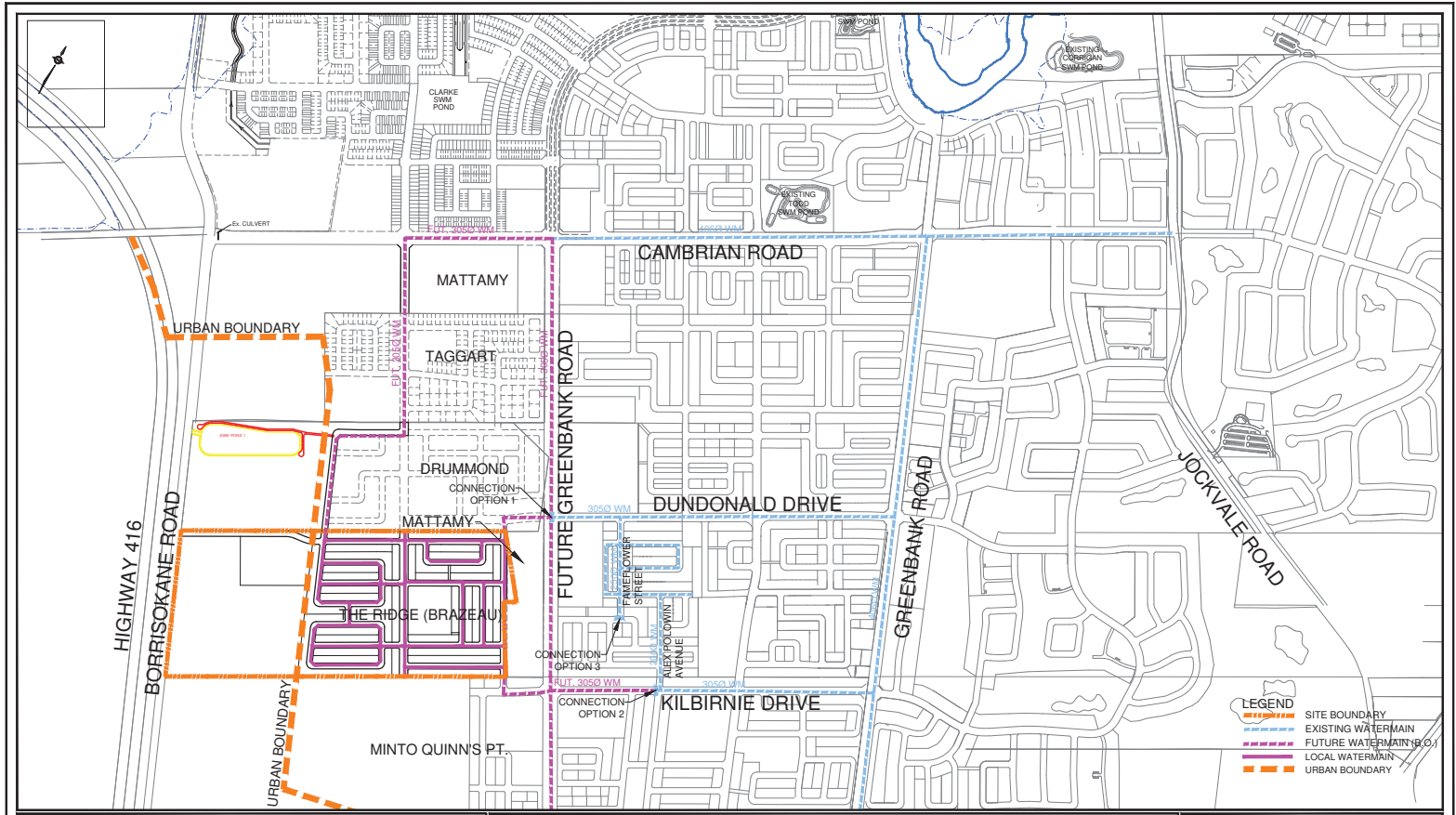
ID	Static Demand (L/s)	Fire-Flow Demand (L/s)	Residual Pressure (psi)	Available Flow at Hydrant (L/s)	Available Flow Pressure (psi)
J-33	0.45	167	53	526	20
J-35	0.38	167	52	509	20
J-36	0.41	167	53	523	20
J-37	0.14	167	53	550	20
J-38	0.36	167	53	545	20
J-39	0.52	167	52	532	20
J-40	0.36	167	52	566	20
J-41	0.08	167	52	615	20
J-42	0.41	167	48	376	20
J-43	0.47	167	50	417	20
J-44	0.38	167	49	379	20
J-45	0.16	167	48	402	20
J-46	0.22	167	48	396	20
J-49	0.34	167	49	400	20
J-50	0.31	167	45	308	20
J-51	0.45	167	43	289	20
J-52	0.52	167	49	393	20
J-53	0.52	167	46	345	20
J-54	0.48	167	44	296	20
J-55	0.48	167	43	299	20
J-56	0.48	167	45	331	20
J-57	0.31	167	44	316	20
J-59	1.04	167	46	445	20
J-61	0.14	167	52	527	20
J-62	0.52	167	42	300	20
J-63	0.48	167	33	228	20
J-64	0.52	167	33	233	20
J-65	0.45	167	29	207	20
J-66	0.52	167	27	194	20
J-67	0.55	167	32	223	20
J-68	0.34	167	37	259	20
J-69	0.34	167	39	294	20
J-70	0.41	167	27	199	20
J-71	0.28	167	30	218	20
J-72	0.41	167	42	397	20
J-74	0.58	167	42	383	20
J-75	0.41	167	41	379	20
J-76	0.21	167	41	387	20
J-78	0.16	167	45	428	20
J-79	0.44	167	44	371	20
J-80	0.44	167	43	349	20
J-81	0.71	167	41	310	20
J-82	0.30	167	42	308	20
J-83	0.49	167	44	317	20
J-84	0.27	167	42	312	20
J-85	0.49	167	43	315	20
J-86	0.19	167	45	436	20
J-87	0.19	167	46	453	20
J-88	0.11	167	48	487	20
J-89	0.19	167	50	525	20
J-90	0.00	167	49	413	20
J-47	0.30	250	23	269	20
J-48	0.17	250	32	390	20
J-58	0.14	250	29	348	20

Connection point 1:
Existing watermain
node off Haiku/
Obsidian street
intersection fronting
Block 1.



Connection point 2:
Existing watermain
node on Obsidian
street





120 Iber Road, Unit 103
 Stittsville, ON K2S 1E9
 TEL: (613) 836-0856
 FAX: (613) 836-7183
 www.DSEL.ca

CAIVAN - BRAZEAU
 WATERMAIN SERVICING PLAN
 CITY OF OTTAWA

PROJECT No.:	18-1030
SCALE:	1:10,000
DATE:	APRIL 2020
FIGURE:	WAT-1

Appendix B DRAFT SITE PLAN





HALF MOON BAY SOUTH
Concept 2 DRAFT
 City of Ottawa

DWELLING TYPE	UNIT COUNT
Stacked Towns	228

Legend:
 Pavers
 Site Area: 4.31 ha
 Residential Area: 3.09 ha
 Commercial Area: 1.22 ha
 Density*: 73 UPH
 *Density calculated using residential area

Stacked Towns Required Parking: **Stacked Total Amenity Area:**
 Residents: 274 (1.2 spaces/unit)
 Visitor: 46 (0.2 spaces/unit)
 Total: 320 spaces
 Required: 1,368m² (6m² per unit)
 Provided: ±1,938m² (±8.5m² per unit)

Stacked Towns Proposed Parking: **Communal Amenity Area:**
 Residents: 274 (1.2 spaces/unit)
 Visitor: 46 (0.2 spaces/unit)
 Total: 320 spaces
 Required: 684m² (50% of total required amenity area)
 Provided: ±1,956m²

Bike Parking: 114 Spots (0.5/unit)
Landscaped Area: 30.1%

Scale 1:1500

June 28, 2021

286-271 Lakeshore Road East
 Ottawa, Ontario K1S 1S1
 T 905-247-8227
 ott@korsiaki.com

Appendix C SANITARY SERVICING

C.1 SANITARY SEWER DESIGN SHEET





SUBDIVISION:
HALFMOON BAY PHASE 8
 DATE: 7/21/2021
 REVISION: 1
 DESIGNED BY: MJS
 CHECKED BY: DT

**SANITARY SEWER
 DESIGN SHEET**
 (City of Ottawa)

FILE NUMBER: 160401657	MAX PEAK FACTOR (RES.1) 4.0 MIN PEAK FACTOR (RES.1) 2.0 PEAKING FACTOR (INDUSTRIAL) 2.4 PEAKING FACTOR (0.25%) 1.5 PERSONS / SINGLE 3.4 PERSONS / TOWNHOME 2.7 PERSONS / APARTMENT 1.8	AVG DAILY FLOW / PERSON 280 lpd/day COMMERCIAL 28,000 lpd/day INDUSTRIAL (HEAVY) 55,000 lpd/day INDUSTRIAL (LIGHT) 35,000 lpd/day INSTITUTIONAL 28,000 lpd/day INFILTRATION 0.33 lpd/day	MINIMUM VELOCITY 0.80 m/s MAXIMUM VELOCITY 3.00 m/s MANNING'S N 0.013 BEDDING CLASS B MINIMUM COVER 2.50 m HARMON CORRECTION FACTOR 0.8
------------------------	--	---	--

AREA ID NUMBER	LOCATION		RESIDENTIAL AREA AND POPULATION							COMMERCIAL		INDUSTRIAL (LI)		INDUSTRIAL (RI)		INSTITUTIONAL		GREEN / UNUSED		C-HI	INFILTRATION			TOTAL FLOW (l/s)	LENGTH (m)	DIA (mm)	MATERIAL	CLASS	SLOPE (%)	CAP (ft/s)	CAP V PEAK FLOW (%)	VEL (m/s)	VEL (ft/s)	
	FROM MH	TO MH	AREA SINGLE (ha)	UNITS TOWN	POP APT	CUMULATIVE AREA (ha)	POP	PEAK FACT	PEAK FLOW (l/s)	AREA (ha)	ACCU AREA (ha)	AREA (ha)	ACCU AREA (ha)	AREA (ha)	ACCU AREA (ha)	AREA (ha)	ACCU AREA (ha)	AREA (ha)	ACCU AREA (ha)		PEAK FLOW (l/s)	AREA (ha)	ACCU AREA (ha)											INFILT FLOW (l/s)
R7A	7	6	0.15	0	12	0	32	0.15	32	3.68	0.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.15	0.1	0.4	28.2	200	PVC	SDR 35	1.00	33.4	1.31%	1.05	0.30
R10A	10	9	0.57	0	39	0	105	0.57	105	3.59	1.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.57	0.2	1.4	100.1	200	PVC	SDR 35	0.40	21.1	6.68%	0.67	0.31
R12A	12	11	0.53	0	36	0	97	0.53	97	3.60	1.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.53	0.2	1.3	102.9	200	PVC	SDR 35	0.40	21.1	6.19%	0.67	0.30
R13A	13	11	0.14	0	12	0	32	0.14	32	3.68	0.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.14	0.0	0.4	26.5	200	PVC	SDR 35	1.00	33.4	1.30%	1.05	0.30
R11A	11	9	0.15	0	12	0	32	0.82	162	3.54	1.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.82	0.3	2.1	36.1	200	PVC	SDR 35	0.40	21.1	10.08%	0.67	0.36	
R9A	9	8	0.34	0	18	0	49	1.72	316	3.46	3.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	1.72	0.6	4.1	61.5	200	PVC	SDR 35	0.40	21.1	19.42%	0.67	0.42	
R8B	8	6	0.37	0	27	0	73	2.09	389	3.42	4.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	2.09	0.7	5.0	72.1	200	PVC	SDR 35	0.40	21.1	23.66%	0.67	0.45	
G6A	6	2	0.00	0	0	0	0	2.25	421	3.41	4.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.0	0.4	39.1	200	PVC	SDR 35	0.40	21.1	25.58%	0.67	0.47	
R5A	5	4	0.13	0	12	0	32	0.13	32	3.68	0.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.13	0.0	0.4	22.6	200	PVC	SDR 35	1.00	33.4	1.29%	1.05	0.30	
R8A	8	4	0.16	0	12	0	32	0.16	32	3.68	0.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.16	0.1	0.4	39.3	200	PVC	SDR 35	1.00	33.4	1.31%	1.05	0.30	
R4A	4	2	0.30	0	24	0	65	0.59	130	3.57	1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.59	0.2	1.7	72.2	200	PVC	SDR 35	0.40	21.1	8.00%	0.67	0.33	
R3A	3	2	0.17	0	24	0	65	0.17	65	3.63	0.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.17	0.1	0.8	30.3	200	PVC	SDR 35	0.50	23.6	3.47%	0.74	0.29	
G2A	2	1	0.00	0	0	0	0	3.01	616	3.34	6.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	3.09	1.0	7.7	29.4	200	PVC	SDR 35	0.40	21.1	36.34%	0.67	0.52	
	1	EX MH 3A	0.00	0	0	0	0	3.01	616	3.34	6.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	3.09	1.0	7.7	3.8	200	PVC	SDR 35	0.40	21.1	36.34%	0.67	0.52

Appendix D STORMWATER MANAGEMENT

D.1 STORM SEWER DESIGN SHEET





HALFMOON BAY PHASE 8
 DATE: 2021-07-21
 REVISION: 1
 DESIGNED BY: MJS
 CHECKED BY: DT

**STORM SEWER
 DESIGN SHEET**
 (City of Ottawa)

FILE NUMBER: 160401657

DESIGN PARAMETERS

$r = a / (k \cdot ab)^2$ (As per City of Ottawa Guidelines, 2012)

12" V, 15" V, 18" V, 24" V
 a = 72.251, 98.071, 117.164, 172.658
 b = 4.199, 6.053, 6.014, 6.014
 c = 0.810, 0.814, 0.816, 0.820

MANNINGS N = 0.013
 MINIMUM COVER: 2.00 m
 TIME OF ENTRY: 10 min

BEDDING CLASS = 8

DRAINAGE AREA

AREA ID NUMBER	LOCATION	FROM MH	TO MH	AREA (m ²)											CUMULATIVE AREA (m ²)											T of C (min)	S _{max}	S _{min}	S _{max}	S _{min}	Q _{max} (L/s)	Q _{min} (L/s)	ACCOM. (CAN/300)	LENGTH (m)	PIPE WIDTH (mm)	PIPE HEIGHT (mm)	PIPE SHAPE	MATERIAL	CLASS	SLOPE (%)	Q _{cap} (L/s)	% FULL	VEL. (m/s)	TIME OF FLOW (min)						
				(2-YEAR)	(5-YEAR)	(10-YEAR)	(15-YEAR)	(ROOF)	(5-YEAR)	(5-YEAR)	(10-YEAR)	(10-YEAR)	(15-YEAR)	(15-YEAR)	A+C	ACUM. A+C (2-YEAR)	ACUM. A+C (5-YEAR)	ACUM. A+C (10-YEAR)	ACUM. A+C (15-YEAR)	ACUM. A+C (ROOF)	ACUM. A+C (2-YEAR)	ACUM. A+C (5-YEAR)	ACUM. A+C (10-YEAR)	ACUM. A+C (15-YEAR)																										
L105A		106	105	0.31	0.00	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.260	0.260	0.000	0.000	0.000	0.000	0.000	0.000	10.00	78.81	104.19	122.14	178.56	0.0	0.0	55.4	75.5	300	300	CIRCULAR	PVC	-	0.50	68.0	81.48%	0.97	0.96	1.31										
L106		108A	108	0.16	0.00	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.108	0.108	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	22.7	17.3	200	200	CIRCULAR	PVC	-	1.00	33.3	68.16%	1.05	0.98	0.29										
L105C, L105A		108	107	0.15	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.108	0.215	0.000	0.000	0.000	0.000	0.000	0.000	10.00	75.69	105.27	120.38	175.05	0.0	0.0	45.1	34.9	300	300	CIRCULAR	PVC	-	0.40	65.8	74.51%	0.96	0.93	1.70										
L107A		107	105	0.31	0.00	0.00	0.00	0.00	0.86	0.00	0.00	0.00	0.267	0.482	0.000	0.000	0.000	0.000	0.000	0.000	10.00	69.90	94.71	110.98	162.16	0.0	0.0	93.8	36.1	450	450	CIRCULAR	CONCRETE	-	0.40	198.1	49.75%	1.15	0.98	0.61										
L105C, L105A		105	104	0.33	0.00	0.00	0.00	0.00	0.52	0.00	0.00	0.00	0.171	0.912	0.000	0.000	0.000	0.000	0.000	0.000	10.00	68.05	92.17	107.98	157.78	0.0	0.0	172.5	85.0	525	525	CIRCULAR	CONCRETE	-	0.40	293.8	60.78%	1.27	1.15	1.23										
		104	103	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.912	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.00	19.84	64.65	87.50	102.50	149.71	0.0	0.0	163.9	72.1	525	525	CIRCULAR	CONCRETE	-	0.40	293.8	57.75%	1.27	1.13	1.06									
L103A		103A	103	0.11	0.00	0.00	0.00	0.00	0.78	0.00	0.00	0.00	0.089	0.089	0.000	0.000	0.000	0.000	0.000	0.000	10.00	75.81	104.19	122.14	178.56	0.0	0.0	18.9	16.1	200	200	CIRCULAR	PVC	-	1.00	33.3	56.84%	1.05	0.93	0.29										
L103C, L103B		103	101	0.51	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.419	1.420	0.000	0.000	0.000	0.000	0.000	0.000	10.00	14.50	62.01	81.89	98.24	143.47	0.0	0.0	244.8	38.1	525	525	CIRCULAR	CONCRETE	-	0.40	293.8	86.21%	1.27	1.28	0.50									
L102A, L102B		102	101	0.23	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.191	0.191	0.000	0.000	0.000	0.000	0.000	0.000	10.00	75.81	104.19	122.14	178.56	0.0	0.0	40.7	72.2	300	300	CIRCULAR	PVC	-	0.40	60.8	67.01%	0.86	0.81	1.49										
L101A		101	100	0.26	0.00	0.00	0.00	0.00	0.76	0.00	0.00	0.00	0.187	1.798	0.000	0.000	0.000	0.000	0.000	0.000	10.00	60.85	82.30	96.38	140.73	0.0	0.0	308.8	30.2	600	600	CIRCULAR	CONCRETE	-	0.40	456.1	75.02%	1.39	1.34	0.37										
100 EX MH 102		100	EX MH 102	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	1.798	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.00	15.77	60.01	81.15	95.03	138.75	0.0	0.0	299.7	10.4	750	750	CIRCULAR	CONCRETE	-	0.40	734.5	40.81%	1.61	1.30	0.13									

Appendix E EXTERNAL REPORTS

E.1 DESIGN BRIEF (SITE SERVICING STUDY) FOR THE RIDGE (BRAZEAU LANDS) BY DSEL (JULY 2020)



DESIGN BRIEF

FOR

CAIVAN GREENBANK DEVELOPMENT CORPORATION

THE RIDGE (BRAZEAU LANDS)

3809 BORRISOKANE ROAD

CITY OF OTTAWA

PROJECT NO.: 18-1030
JULY 27TH, 2020
4TH SUBMISSION
© DSEL

**DESIGN BRIEF
FOR
CAIVAN GREENBANK DEVELOPMENT CORPORATION**

THE RIDGE (BRAZEAU LANDS)

PROJECT NO: 18-1030

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**DESIGN BRIEF
FOR
CAIVAN GREENBANK DEVELOPMENT CORPORATION**

THE RIDGE (BRAZEAU LANDS)

**CITY OF OTTAWA
PROJECT NO: 18-1030**

1.0 INTRODUCTION

David Schaeffer Engineering Limited (DSEL) has been retained to prepare the detailed design of the Brazeau Lands development area located at 3809 Borrisokane Road within the Barrhaven South Urban Expansion Area (**BSUEA**) on behalf of Caivan Greenbank Development Corporation (CGDC). This design brief is submitted in support of that development. The development is now being referred to as “The Ridge” Subdivision for marketing purposes.

The proposed development area is illustrated in **Figure 1** (see **Appendix A**) and is located north of Barnsdale Road, east of Highway 416 (and Borrisokane Road), south of Cambrian Road and west of the future New Greenbank Road alignment. The current zoning is Mineral Extraction (ME) and is amended to permit low-rise residential uses. The western portion of the property is outside of the urban boundary and will remain at the current zoning while the eastern side (approximately 24.7 ha) is within the urban boundary and is to be rezoned as noted above. The development will also include a 0.91 ha block for a road connection to Borrisokane Road, a future 0.89 ha right-of-way (ROW) area within the Drummond Lands (also owned by CGDC) for servicing outlets, and a 3.94 ha pond block within the Drummond Lands that will service both properties. The lands are planned to be developed with a mix of detached single homes, townhomes, park blocks, SWM blocks, open space and a road network (see **Figure 2** for the lotted legal plan in **Appendix A**).

This design brief is prepared to demonstrate conformance with the design criteria of the City of Ottawa, background studies, including the Master Servicing Study, and general industry practice.

1.1 Existing Conditions

The Ridge subdivision was previously an aggregate extraction pit operated in accordance with the Ontario Aggregate Resources Act and Regulations. Processes have been undertaken to remove this designation.

The property ground surface is significantly disturbed as a result of the mineral extraction activities that have occurred over the years with stockpiles of materials at

various locations and elevations. The eastern portion of the site adjacent to the New Greenbank Road future alignment range in elevations from approximately 108.0m to 104.5m. On-site elevations vary due to the various stockpiles of materials but are general averaging about 99.0m. Drainage is generally conveyed westward towards Borrisokane Road which is owned by, and under the jurisdiction of, the Ministry of Transportation.

The property is within the Jock River watershed and is under the jurisdiction of the Rideau Valley Conservation Authority (RVCA).

2.0 GUIDELINES, PREVIOUS STUDIES, AND REPORTS

2.1 Existing Studies, Guidelines, and Reports

The following studies were utilized in the preparation of this report.

- Ottawa Sewer Design Guidelines,
City of Ottawa, *SDG002*, October 2012
(Sewer Design Guidelines)
 - Technical Bulletin ISDTB-2014-01
City of Ottawa, February 5, 2014
(ITSB-2014-01)
 - Technical Bulletin PIEDTB-2016-01
City of Ottawa, September 6, 2016
(PIEDTB-2016-01)
 - Technical Bulletin ISTB-2018-01
City of Ottawa, March 21, 2018
(ISTB-2018-01)
 - Technical Bulletin ISTB-2018-04
City of Ottawa, June 27, 2018
(ISTB-2018-04)
- Ottawa Design Guidelines – Water Distribution
City of Ottawa, July 2010.
(Water Supply Guidelines)
 - Technical Bulletin ISD-2010-2
City of Ottawa, December 15, 2010.
(ISD-2010-2)
 - Technical Bulletin ISDTB-2014-2
City of Ottawa, May 27, 2014.
(ISDTB-2014-2)

- Technical Bulletin ISTB-2018-02
City of Ottawa, March 21, 2018
(*ISTB-2018-02*)
- Design Guidelines for Sewage Works,
Ministry of the Environment, Conservation and Parks, 2008. (formerly MOECC)
(***MECP Design Guidelines***)
- Highway Drainage Design Standards (MTO 2008)
- Drainage Management Manual (MTO 1997),
Ministry of Transportation.
(***MTO Manuals***)
- Stormwater Planning and Design Manual,
Ministry of the Environment, March 2003.
(***SWMP Design Manual***)
- City of Ottawa Official Plan,
adopted by Council 2003.
(***Official Plan***)
- South Nepean Collector: Phase 2 Hydraulics Review / Assessment Technical
Memorandum
Novatech, August 2015
(***Novatech SNC Memo***)
- Master Servicing Study – Barrhaven South Urban Expansion Area, J.L. Richards
& Associates Limited, Revision 2, May 2018
(***BSUEA MSS***)
- Servicing Brief – Quinn’s Pointe Residential Stages 2, 3 & 4, J.L. Richards &
Associates Limited, Revision 1, October 2018 (File No. 26610-001.1)
(***Quinn’s Pointe Brief***)
- Stormwater Management Report for Brazeau Subdivision, by J.F. Sabourin and
Associates (July 2020)
(***JFSA SWM Report***)
- Pond Design Brief for Brazeau Subdivision, by J.F. Sabourin and Associates
(July 2020)
(***JFSA Pond Report***)
- Caivan Brazeau/Drummond Development – LID Design Update, by J.F. Sabourin
and Associates (July 2020)
(***JFSA LID Analysis***)

- Geotechnical Investigation, Proposed Residential Development, Brazeau Lands – Borrisokane Road, Paterson Group (January 2019)
(Geotechnical Report)
- Groundwater Infiltration Review, Proposed Residential Development, Brazeau Pit and Drummonds Pit – Borrisokane Road, Paterson Group (August 2019)
(Infiltration Review)
- Supplemental Hydrogeological Review, Proposed Residential Development, The Ridge – Borrisokane Road, Paterson Group (March 4, 2020)
(Hydrogeological Review)
- Borrisokane Ditch Erosion Assessment: The Ridge (Brazeau) Subdivision, J.F. Sabourin and Associates Inc. (June 2020)
(JFSA Erosion Assessment)

3.0 WATER SUPPLY SERVICING

3.1 Existing Water Supply Services

The **BSUEA MSS** provided an overview of the existing watermain infrastructure associated with the BSUEA. The **BSUEA MSS** completed an overall assessment of the water supply for the area in order to examine the feasibility of the extension of existing infrastructure that would meet the required City and MECP criteria for the whole of the development area.

The ‘Master Watermain’ plan (Drawing MWM) from the **BSUEA MSS** is provided in **Appendix B** and illustrates the existing watermains in proximity to The Ridge development area. In addition, a conceptual watermain plan (Drawing CWM) from the preliminary Servicing Brief for Minto’s Quinn’s Pointe (Stages 2, 3 & 4) residential area is provided for reference. The proposed watermain servicing connections points for The Ridge development area are as follows:

- Existing 300mm diameter watermain terminating at Dundonald Drive and the future New Greenbank Road alignment;
- Proposed 300mm diameter watermain from the existing Cambrian Road 400mm diameter watermain forming part of the Tamarack Meadows development network located north of The Ridge and Drummond lands.

As adjacent developments to the east are advanced there will be a future required connection to the development from the existing 300mm diameter watermain on Kilbirnie Drive at Alex Polowin Avenue (or future extension location that is dependent upon the advancement of the Quinn’s Pointe development).

3.2 Water Supply Servicing Design

The **BSUEA MSS** presents overall watermain infrastructure details for the BSUEA. The subject property was deemed serviceable and the **MSS** reviewed a number of servicing scenarios (i.e. existing and built-out conditions) that confirmed that the area could be adequately serviced conforming to relevant City and MECP Guidelines and Policies.

The water analysis contained in the **BSUEA MSS** utilized system level water demands as developed by the City due to the fact that the number of units and densities resulted in an overall population that would exceed 3,000. The excerpt of the system level demands listed in Table 7-1 of the **MSS** can be found in **Appendix B** and are summarized as follows:

Table 1A: Water Supply Design Criteria (System Level Demands)

Land Use Type	Consumption Rate
JLR BSUEA MSS, May 2018 for Population Exceeding 3000 Persons	
Single Family Residential	180 L/cap/day
Multi-unit Residential (Townhouse / Back to Back)	198 L/cap/day
Apartment Residential	219 L/cap/day
Commercial	50,000 L/ha/day
Institutional	50,000 L/ha/day
Outdoor Water Demand	1049 L/unit/day (single detached)

The estimated water demands within the **BSUEA MSS** were summarized in Table 7-2 (excerpt found in **Appendix B**). The table summarized a total population of 1,194 for the Brazeau Lands development area along with some commercial and institutional components. Based on the current development concept the water demand table is refined to reflect a revised residential unit count and the removal of the commercial, institutional and high density components. Based on the development layout illustrated in **Figure 2** the development area will have 347 single family homes and 279 towns with associated populations of 1,180 and 754 respectively. The adjusted water demands for comparison purposes are summarized in the following table:

Table 1B: Estimated Water Demands - Brazeau Land Updates

Design Parameter	Area (ha)	Units	Pop.	ADD SFH ¹	ADD MLT ²	ADD APT ³	ADD COM ⁴	ADD INS ⁵	Total BSDY	OWD ⁶	Total MXDY
From Table 7-2 of MSS	12.72	398	1194	1.56	0.87	0.17	0.39	0.85	3.84	2.67	6.51
Revised per Updated Development Plan (Residential Area)	23.83	626 ⁷	1934	2.45	1.73	0	0	0	4.18	4.21	8.39
		+228	+740						+0.34	+1.54	+1.88

1 Daily Demand, Single Family Homes, L/s (see Table 1A for Consumption Rate)

2 Average Daily Demand, Multi-Units (Townhouses and Back to Back Unit) L/s

3 Average Daily Demand, Apartment Units, L/s

4 Average Daily Demand, Commercial, L/s

5 Average Daily Demand, Institutional, L/s

6 Outdoor Water Demand, L/s, calculated as 1,049 L per SFH unit per day per MSS

7 Comprised of 347 Singles Family Homes and 279 Townhouses

With reference to Table 7-2, the overall Total BSDY increased by 0.34 L/s (to 19.00 L/s) which is a 1.8% increase over the previous 18.66 L/s. The total MXDY increases by 1.88 L/s which is a 5.9% increase over the previous 31.48 L/s.

The typical Water Supply Design Criteria used are as summarized in the following table:

Table 1C: Water Supply Design Criteria

Design Parameter	Value
Residential – Single Family	3.4 p/unit
Residential – Semi-Detached	2.7 p/unit
Residential – Townhome	2.7 p/unit
Residential – Average Daily Demand	350 L/p/day
Residential – Maximum Daily Demand	2.5 x Average Daily Demand
Residential – Maximum Hourly Demand	2.2 x Maximum Daily Demand
Residential – Minimum Hourly Demand	0.5 x Average Daily Demand
Commercial / Institutional Average Daily Demand	50,000 L/ha/day
Park Average Daily Demand	28,000 L/ha/day
Commercial / Institutional / Park Maximum Daily Demand	1.5 x Average Daily Demand
Commercial / Institutional / Park Maximum Hour Demand	1.8 x Maximum Daily Demand
Commercial / Institutional / Park Minimum Hourly Demand	0.5 x Average Daily Demand
Fire Flow	Calculated as per the Fire Underwriter's Survey 1999.
Minimum Watermain Size	150 mm diameter
Service Lateral Size	19 mm dia. Copper or equivalent
Minimum Depth of Cover	2.4 m from top of watermain to finished grade
Peak hourly demand operating pressure	275 kPa and 690 kPa
Fire flow operating pressure minimum	140 kPa
<i>Extracted from Section 4: Ottawa Design Guidelines, Water Distribution (July 2010), ISDTB-2010-2</i>	

A boundary condition request was submitted (provided in **Appendix B** for reference) in order to obtain water supply parameters for use in the hydraulic modelling assessment of the network. A hydraulic analysis was prepared for the water distribution network to confirm that water supply is available within the required pressure range, under the anticipated demand during average day, peak hour and fire flow conditions and was based on boundary conditions requested from the City of Ottawa. Refer to the *Hydraulic Capacity and Modeling Analysis, Brazeau Lands* prepared by *GeoAdvice Engineering Inc. dated June 10, 2020 (GeoAdvice Water Analysis)*, enclosed in **Appendix B**.

The proposed water layout is shown in the general plan of services overview presented in **Figures 3, 3A, 3B** at the back of this report as well as in the GeoAdvice report figures. The Ridge development will initially require a minimum of two watermain feeds to the service the property. Based on the nearby existing infrastructure, and surrounding development plans, it is proposed that an extension of the existing Dundonald Drive 300mm watermain will provide service to the northeast portion of the property. In addition, the second proposed feed to service The Ridge will be through the Drummond Lands from the proposed 300mm watermain that is being advanced for the Tamarack Meadows development north of the property. Ultimately there will be future connections to Greenbank Road and Kilbirnie Drive (to the south) when those development areas are advanced.

3.3 Summary of Hydraulic Modeling Analysis

A complete watermain analysis has been prepared to confirm that the network is sized adequately, which is the greater of maximum day plus fire and maximum hour for both the Phase 1 and Phase 1&2 scenario. Refer to the **GeoAdvice Report**, enclosed in **Appendix B**.

System Pressures

The modeling indicates that the development can be adequately serviced by the proposed watermain network. Modeled service pressures for the development are summarized in the following table. The detailed pipe and junction tables are contained in the **GeoAdvice Report**, enclosed in **Appendix B**.

Table 1D: Summary of Available System Pressures

	Minimum Hour Demand Maximum Pressure		Peak Hour Demand Minimum Pressure	
	kPA	psi	kPA	psi
Phase 1	538	78	290	42
Phases 1&2	538	78	262	38

The generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi) as outlined in the City of Ottawa Design Guidelines. Low pressures (slightly below 40 psi) are predicted in the south and southeast area of the site due to higher ground elevations. However, this is without considering provision of the future watermain connection from the Quinn's Pointe development area. Per Section 4.1 of the **GeoAdvice Report**, this future additional connection (as required by the **BSUEA MSS**) will provide an additional head of up to seven meters and resolve this low pressure condition. Should the availability of the additional watermain feed not be in place during the advancement of Phase 2 of The Ridge, it would be recommended that oversized service laterals be provided in order to compensate. For now, the current design drawings have demonstrated the requirement of a 25mm water service lateral in the areas that are slightly below the 40psi threshold.

3.4 Fire Flows – Fire Underwriters Survey

Fire Flow requirements are established in the boundary condition request found in **Appendix B** as prepared by GeoAdvice. Calculations for the single detached dwellings and traditional townhomes reached the City of Ottawa's cap of 10,000 L/min (167 L/s) as outlined in *ISDTB-2014-02*. At this time, there is not enough information available to calculate the required fire flows of the park so a required fire flow of 250 L/s was assumed, which is a typical requirement for similar land uses. The fire flows are calculated in accordance with the Fire Underwriters Survey's Water Supply for Public

Fire Protection Guideline (1999). Detailed FUS calculations can be found in the GeoAdvice reporting.

Available Fire Flows

The minimum allowable pressure under fire flow conditions is 140 kPa (20 psi) at the location of the fire. A summary of the available fire flows is presented in the following table. The detailed fire flow reports are found in the **GeoAdvice Report** enclosed in **Appendix B**.

1E: Summary of Available Fire Flows

	Required Fire Flow (L/s)	Minimum Available Flow (L/s)	Junction ID
Phase 1	167	177	J-45
	250	249	J-47
Phase 1 & 2	167	194	J-66
	250	269	J-47

As shown in the above table the model predicts the network will be able to provide all required fire flows within the development limits. Detailed results are included in the **GeoAdvice Report**, enclosed in **Appendix B**.

3.5 Water Supply Conclusion

The subject lands have been previously reviewed within the **BSUEA MSS** for the BSUEA development areas. The interim condition of The Ridge subdivision can be serviced by City of Ottawa infrastructure through the extension of the existing 300mm watermain from Dundonald Road from the east side of the property and a proposed connection north of the property, through the Drummond Lands, to a new 300mm watermain extension from Cambrian Road. In the interim condition for Phase 2 areas (i.e. only two feeds into the development area) there are pockets of low pressure (slightly below 40psi) areas along the southern boundary that are proposed to have 25mm water service laterals to compensate. Ultimately there will be additional connections to future watermains along Greenbank Road and Kilbirnie Drive (from the south as the Minto Quinn's Pointe development advances) that will alleviate the low pressure condition. See **Figure WAT-1** in **Appendix B** for the watermain network overview. These extensions are in accordance with the **MSS** projected infrastructure. The proposed water supply design conforms to all relevant City and MECP Guidelines and Policies.

4.0 WASTEWATER SERVICING

4.1 Existing Wastewater Services

Sanitary flows from the **BSUEA** were proposed to outlet to the existing 900mm diameter Greenbank Road sanitary trunk sewer. The existing South Nepean Collector (SNC) will provide the sanitary outlet for the entire Barrhaven South Community, which includes the BSUEA development area.

Trunk sanitary sewers exist north of the Brazeau Lands area and are located along Cambrian Road (see JLR's *Master Sanitary Drainage Area* plan 'MSAN' in **Appendix C**). The outlet connection point to existing for the Brazeau Lands is as follows:

- Existing 500 mm / 600 mm / 750 mm diameter sanitary trunk running east on Cambrian Road then extending north along existing Greenbank Road and east to the South Nepean Collector (SNC). The current sewer termination is at the New Greenbank Road alignment.

As per the **BSUEA MSS** the subject property is tributary to the existing sanitary trunk sewer along Cambrian Road.

4.2 Wastewater Design

The subject property will be serviced by an internal gravity sanitary sewer system that will generally follow the local road network with select servicing easements and land crossing permissions as required to achieve efficiencies in servicing and grading designs. The wastewater layout can be found in the general plan of services overview presented in **Figures 3, 3A and 3B** at the back of this report. The sanitary drainage area plans and design sheets, along with background **BSUEA MSS** information, can all be found in **Appendix C** for reference.

The **BSUEA MSS** proposed that the wastewater outlet from the Brazeau Lands would tie into the off-site Cambrian Road trunk sewer at existing sanitary 'EX MH57A' via the Future Greenbank Road alignment and that is now the intent of The Ridge (Brazeau) design. The *Master Sanitary Drainage Area* plan 'MSAN' from the **BSUEA MSS** is provided in **Appendix C** for reference. Sanitary flows from the adjacent Drummond Lands were originally proposed to be conveyed to Cambrian Road (MA11 to MA10) through Tamarack's "The Meadows Phase 7 & 8" (**Meadows**) development area at 3640 Greenbank Road (D07-16-18-0011) in the **BSUEA MSS**. Although there were prior concepts of bringing The Ridge sanitary flows through the Drummond/Tamarack properties, the current sanitary sewer alignments, that are in line with the **BSUEA MSS**, are proposed in order to minimize overall sewer depths and alleviate City concerns with alternate routing.

4.2.1 Brazeau (The Ridge) Lands

In the **BSUEA MSS**, Table 6-3 (provided in **Appendix C**) summarized the anticipated flows from the “Brazeau Aggregate Extraction Area” lands (i.e. The Ridge development). With the more detailed development concept, the site statistics are refined and the sanitary design sheet found in **Appendix C** more accurately reflects the anticipated sanitary flows. As per Section 3.2 of this report, the anticipated unit count for The Ridge is 347 single family homes and 279 townhouse units.

When applying the City of Ottawa wastewater design criteria the estimated peak sanitary flows from The Ridge and other areas tributary to the sewer network results in the following:

- i) The Ridge residential area + 4.3 ha of Drummond lands (~31.06 L/s);
- ii) Drummond Lands (direct to Greenbank Road (~20.29 L/s);
- iii) Mattamy lands adjacent to Future Greenbank Road (residential area of 1.90 ha and commercial area of 2.99 ha) (~4.45 L/s);
- iv) Future Brazeau commercial area (13.83 ha) west of the subdivision (~9.05 L/s)
- v) Commercial area (ABIC) (~4.84 L/s)

For comparison to the **MSS** Table 6-3 values, criteria the estimated peak sanitary flows from The Ridge and Mattamy areas is approximately 49.38 L/s. This would be in comparison to the **MSS** sum of the 21.50 L/s (Brazeau Lands flow), 1.8 L/s Mattamy Commercial, and approximately 1.9 L/s Mattamy Residential. For comparison this would be 69.69 L/s versus the 25.2 L/s (i.e. +44.49 L/s) previously summarized in the JLR’s Table 6-3.

Table 6-4 in the **BSUEA MSS** identified critical residual capacities in existing trunk sanitary sewers associated with the BSUEA area. Specifically, the Cambrian Road sewer is the outlet for the Brazeau Lands property and has a limiting pipe reach from existing MH13A to MH15A with a residual capacity of approximately 52.9 L/s. The additional 44.49 L/s of anticipated sanitary flows uses approximately ~84% of the residual capacity leaving 8.41 L/s. Review of the **BSUEA MSS** sanitary design sheet indicates that there are no other sanitary sewer constraints up to the SNC.

4.2.2 Greenbank Road Sewer Alignment

As noted, the sanitary outlet for The Ridge will be along the Future Greenbank Road EA alignment as per the **BSUEA MSS**. As per JLR’s *Master Sanitary Drainage Area* plan ‘MSAN’ in **Appendix C** this alignment is represented by the sewer run from MH900 to EXMH57A on Cambrian Road ranging in size from 250mm to 375mm. The proposed design has a 375mm sanitary (capacities of the design can be seen in the sewer design sheet). MH900 would equate to the MH402A proposed within The Ridge design. Per Section 6.3.1.2 the depth of the sewer at this location was estimated to have a cover depth of approximately 7.43m. Based on The Ridge detailed design, which has taken into consideration all of the site grading and sewer crossing constraints that result from

detailed design, the proposed cover is 8.5m at MH402A per the profile drawing for this trunk sewer (See Drawing 61 in **Appendix C**). The elevated EA road profile results in the greater depth of the sewer at this location. As the sewer progresses northward towards Cambrian Road the depth of cover is gradually reduced as the road profile drops down in elevation. The proposed sanitary sewer is set at either minimum slopes, to mitigate depth of cover, or at slopes to establish flow capacities that are approximately 75%-78% of the proposed sewer's capacity. See markups of the profile drawings in **Appendix C** for reference.

4.2.3 Wastewater Design Criteria

The following table summarizes the City design guidelines and criteria applied in the preliminary sanitary design information above and detailed in **Appendix C**.

Table 2: Wastewater Design Criteria

Design Parameter	Value
Current Design Guidelines	
Residential - Single Family / Townhome	3.4 p/unit & 2.7 p/unit respectively
Residential – Apartment	1.8 p/unit
Average Daily Demand	280 L/d/person
Peaking Factor	Harmon's Peaking Factor. Max 4.0, Min 2.0
Commercial / Institutional Flows	28,000 L/ha/day
Commercial / Institutional Peak Factor	1.5
Infiltration and Inflow Allowance	0.33 L/s/ha
Park Flows	28,000 L/ha/d
Park Peaking Factor	1.0
Sanitary sewers are to be sized employing the Manning's Equation	$Q = \frac{1}{n} AR^{2/3} S^{1/2}$
Minimum Sewer Size	200mm diameter
Minimum Manning's 'n'	0.013
Minimum Depth of Cover	2.5m from crown of sewer to grade
Minimum Full Flowing Velocity	0.6m/s
Maximum Full Flowing Velocity	3.0m/s
<i>Extracted from Sections 4 and 6 of the City of Ottawa Sewer Design Guidelines, October 2012, and recent residential subdivisions in City of Ottawa.</i>	

4.3 Wastewater Servicing Conclusion

The subject property will be serviced by local sanitary sewers which will outlet to the Future Greenbank Road ROW alignment via new sanitary sewers. The sewer will connect to existing sewers along Cambrian Road as demonstrated in the **BSUEA MSS** at 'EX MH57A' per JLR's **Drawing MSAN**. There is residual capacity in the downstream sewers providing sufficient capacity for the peak sanitary flows for the subject property.

5.0 STORMWATER CONVEYANCE

5.1 Existing Stormwater Drainage

The **BSUEA** is tributary to three sub-watersheds as depicted in the 'Figure 3-1' excerpt from the **BSUEA MSS** provided in **Appendix D**. The Brazeau Lands are within the Jock River Subwatershed.

Due to the recent land use for mineral extraction the majority of the land area is lower than the surrounding topography. As identified in the **BSUEA MSS**, the **BSUEA Existing Condition Report** identified that the original drainage pattern for the development area was northwards via overland flow paths with no defined channels. Per the existing topography characterized within available City of Ottawa base mapping, flows from the subject property will now be ultimately conveyed to the Jock River by storm systems (pipes and ditches as required) along Borrisokane Road.

5.2 Proposed Stormwater Management Strategy

The future flows from the land area are planned to meet the following criteria per the **BSUEA MSS**:

- Meet the existing flow in the downstream system;
- Meet the quality control target of 80% TSS removal as per the Jock River Reach One Subwatershed Study (Stantec, 2007); and,
- Preserve pre-infiltration condition levels (Section 5.3.4 of **BSUEA MSS**)

In order to provide drainage conveyance to a Borrisokane Road storm outlet, the site grading will be adjusted to convey flows westward. As noted in the **BSUEA MSS**, the **Existing Conditions Report** for the **BSUEA** identified that the culvert downstream of the aggregate properties receives a pre-development flow of 1,300 L/s during the 1:100 year event (see Figure 3-1, and Tables 5-2 and 5-5 in **Appendix D** from the ECR noting the constrained culvert CVR-C1). Servicing of both The Ridge and Drummond properties have been developed such that the downstream pre-development flow is not exceeded. Any downstream systems should have sufficient capacity for the pre-development flow.

The **BSUEA MSS** conceptualized the following requirements for the development areas:

- The design of the storm drainage system has been undertaken using the dual-drainage approach. The **BSUEA MSS** sets out the design criteria for future draft plan and site plan applications for the **BSUEA**.

- Two (2) separate storm servicing solutions were developed; one conventional servicing strategy and one that incorporates the Etobicoke Exfiltration System (EES) or alternative, which was recommended (see **BSUEA MSS** Drawing MST-2 for details and Section 5.2.1 of this report for discussion).
- The downstream boundary conditions or flow criteria to achieve are developed in the **BSUEA MSS** and are used in the design constraints.
- Allowable minor system release rates were set at the required storm event and future design should maintain the same release rate criteria.
- Stormwater management facilities have been identified in the stormwater management solution for the aggregate extraction areas.

The stormwater management designs will consist of:

- A storm sewer system designed to capture at least the minimum design capture events required under PIETB-2016-01;
- One dry Stormwater Management (SWM) Pond designed to provide required quantity controls along with oil-grit separator (OGS) units that will provide an Enhanced Level of Protection [80% total suspended solids (TSS) removal] per MECP guidelines. The SWM pond will provide controls to levels which respect any downstream pre-development flows;
- An on-site road network designed to maximize the available storage in the on-site road network for the 100-year design event, where possible, with controlled release of stormwater to the minor storm system; and
- An overland flow route designed to safely convey stormwater runoff flows in excess of the on-site road storage.

5.2.1 Infiltration – Etobicoke Exfiltration System (EES)

Within the **BSUEA MSS**, Section 5.4.4 discussed the recommendation of distributed infiltration for development areas. An analysis was carried out and summarized in the *Existing Conditions Report* which determined the various contributions of the water budget based on long-term simulation.

The section also notes that the overall pre-development infiltration from the **BSUEA MSS** area was determined but that the aggregate extraction areas were excluded in that determination. Ongoing investigations for both the Brazeau and Drummond properties have been completed and are summarized in the attached “*Groundwater Infiltration Review*” memorandum completed by Paterson Group (see **Appendix D** for reference). The memorandum summarizes the estimate infiltration rates that could be anticipated throughout the sites for various soil type conditions that were found during their investigations. These values were used during the detailed design determinations.

Section 5.5 of the **BSUEA MSS** discusses the various storm servicing strategies for the development areas. The section went through the various options to achieve the required infiltration targets with the preferred arrangement being the Etobicoke Exfiltration System (EES) Infiltration Strategy. Other alternatives were reviewed, however the EES system is the most suitable for the site and is proposed to be implemented in accordance with the City's preference.

A key point of note, as required by the **MSS**, is that capture of stormwater by the exfiltration system has strategically located insofar as the system is to be installed on local roads (where required to achieve the required infiltration levels) where the surface runoff is less impacted by the City's winter road salting program. Therefore collector and arterial roads will have conventional storm sewer installations that will convey flows to a proposed downstream oil-grit-separator (OGS) units and end-of-line dry pond facility. JFSA has prepared their **JFSA LID Analysis** design memo to assess the infiltration volumes anticipated for the EES system proposed. See **Appendix D** for the analysis. A visual representation of the EES system and drainage capture areas can be seen in the *Figure 2* of the JFSA technical memorandum and can also be seen in the Storm Drainage Area plans.

As summarized in the JFSA analysis, there will be a total of 24 EES systems implemented within the development area in order to meet the infiltration requirements. The EES units will be installed underneath storm sewers within the ROW in specific areas determined as being suitable based on site constraints. Each system will consist of one or two 250 mm diameter perforated pipes surrounded by a 0.85 m deep by 1.20 m wide clear stone trench. Goss traps will be installed in upstream catchbasins in order to prevent/mitigate debris and potential oils from entering the perforated pipe system. Detail drawings of the proposed EES units provided in Figure 1 of the **JFSA LID Analysis**. See **Appendix D** for the full summary of the design parameters for each EES in Tables A1 and A2 (pipe diameter, system lengths and volumes, inverts etc).

For protection measures of the EES system during construction see Section 7.1.

5.2.2 EES Temporary Monitoring

As per Section 5.5.1.8 of the **BSUEA MSS** there are requirements for temporary monitoring of the proposed infiltration system in order to assess and confirm that the EES operates as intended. The objectives of the monitoring will be to estimate the drawdown time of the EES (i.e. time for water levels to drop) to see if the infiltration values projected are in line with the results, and to determine the average rate of capture before runoff is conveyed by the traditional storm sewer system. The final locations and configuration will be coordinated with City staff through this detailed design process as it has been indicated that the City has vetted a "Smart Cover" arrangement through the advancement of the adjacent Minto development area.

Proposed monitoring locations have been circulated to the City and are identified in a markup of the *Figure 2* from the *JFSA LID Analysis* provided in *Appendix D*. The City has concurred with the preliminary locations pending full acceptance of the EES design.

5.3 Post-Development Stormwater Management Targets

Stormwater management requirements for the proposed alternative Stormwater management scheme have been adopted from the *Jock River SWS*, *City Standards*, and the *MECP SWMP Manual*.

Given the general criteria mentioned above, the following specific standards are expected to be required for stormwater management within the subject property:

- Enhanced quality treatment will be provided for stormwater runoff from the subject property, corresponding to a long-term average TSS removal efficiency of 80%, as defined by the MECP prescribed treatment levels;
- Downstream receiving drainage features, culverts, and sewers will be assessed for responses to planned stormwater management outflows, and infrastructure rehabilitation or capacity improvement measures will be planned, as required;
- Storm sewers on local roads are to be designed to provide at least a 2-year level of service without any ponding per the City's latest Technical Bulletin PIEDTB-2016-01;
- Storm sewers on collector roads are to be designed to provide at least a 5-year level of service without any ponding per the City's latest Technical Bulletin PIEDTB-2016-01;
- For less frequent storms (i.e. larger than 2-year or 5-year), the minor system sewer capture will be restricted with the use of inlet control devices to prevent excessive hydraulic surcharges;
- Under full flow conditions, the allowable velocity in storm sewers is to be no less than 0.80 m/s and no greater than 6.0 m/s;
- For the 100-year storm and for all roads, the maximum depth of water (static and/or dynamic) on streets, rear yards, public space and parking areas shall not exceed 0.35 m at the gutter;
- The major system shall be designed with sufficient capacity to allow the excess runoff of a 100-year storm to be conveyed within the public right-of-way ROW, or adjacent to the ROW, provided the water level does not touch any part of the building envelope; must remain below all building openings during the stress test event (100-year + 20%); and must maintain 15 cm vertical clearance between spill elevation on the street and the ground elevation at the nearest building envelope;

- Flow across road intersections shall not be permitted for minor storms (generally 5-year or less);
- When catchbasins are installed in rear yards, safe overland flow routes are to be provided to allow the release of excess flows from such areas. A minimum of 30 cm of vertical clearance is required between the rear yard spill elevation and the ground elevation at the adjacent building envelope; and
- The product of the maximum flow depths on streets and maximum flow velocity must be less than 0.60 m²/s on all roads.

5.3.1 Quality Control

As per the **Jock River SWS**, Enhanced quality treatment will be provided for stormwater runoff from the subject property, corresponding to a long-term average Total Suspended Solid removal efficiency of 80%, as described by the MECP prescribed treatment levels. This will be achieved via the proposed EES system installations (where possible) and OGS unit(s) for all other areas. The location/details of the OGS units near the SWM pond inlet can be seen in 'Storm Drainage Plan' Drawing No. 88 and SWM Pond Drawings No. 77/79 found in **Appendix D**.

The **BSUEA MSS** reviewed the quality control aspects of the proposed EES installations. Section 5.5.1.3 of the **MSS** concludes that based on the EES sizing for the 22mm rainfall (i.e. 95th percentile rainfall event) the storage requirements satisfies the requirements for water quality control per the MECP land uses and further downstream control measures would not be required.

5.3.1.1 EES Infiltration Targets

As a part of the **BSUEA MSS** it was determined that pre-development infiltration within the study area accounted for 40% of the overall site's water budget. The City and RVCA determined that pre-development infiltration levels should be maintained under post-development conditions and that the infiltration should be provided across the development and not simply concentrated to one or two locations.

The EES is intended to capture frequent storm events and the initial "first flush" of large storm events by trapping flow in the perforated pipe sub drain and surrounding media. It is also intended to infiltrate runoff from frequent events into the surrounding soils, while runoff from larger events will overtop the capacity of the EES system and would then overflow to the conventional storm sewer system above

As specified by the Master Servicing Study, the proposed development should infiltrate 40% of the annual runoff. As the hourly rainfall data used in this simulation does not extend the full year, the infiltration target for this analysis has been assumed to be 40% of the average simulated rainfall volume (552.0 mm), which is calculated to be 220.8mm or 59,744 m³ based on the study area. See the **JFSA LID Analysis** for full details.

5.3.2 Quantity Control – Dry Pond

The **BSUEA MSS** currently shows a stormwater pond servicing scenario on each of The Ridge and Brazeau Lands outside of the urban development area (refer to attached '*Barrhaven South Urban Expansion Area – Master Storm Drainage Plan EES*') drawing from the **BSUEA MSS** for illustration). However, this two pond concept was proposed in the **BSUEA MSS** due to the desire at that time in order to not have the two properties 'linked' and therefore they would not be dependent upon one another in order to advance development.

As noted in prior sections of this report, the two properties have now coordinated servicing strategies to the benefit of both properties, as well as the City, as follows (refer to the Storm Drainage Area Plan and Pond Plan in **Appendix D**):

- The single pond option will be a dry facility with OGS units to treat stormwater requiring treatment. This is in line with the **MSS**;
- If a pond was proposed within the Brazeau Lands location shown in the **MSS**, it would have required a large box culvert outlet in order to convey emergency flow out to Borrisokane Road due to topography constraints. Based on an increase in elevation downstream of that outlet, the emergency flows could not be conveyed overland. With the single pond concept on the Drummond Lands, a box culvert would no longer be required due to the more suitable topography at the Drummond outlet and the associated availability of emergency relief;
- A single pond option keeps more infrastructure within the new development areas and minimizes infrastructure proposed within the Borrisokane Road right-of-way (ROW);
- In accordance with the City's typical preference, there will be a reduction in maintenance costs with one less facility to manage.

Similar to the changes associated with the sanitary outlet revision, the only impacted properties are those proponents that are directly benefitting from the changes and would be considered a Minor Change per Section 11.1.1 of the **BSUEA MSS**.

As noted in the **Jock River SWS**, quantity control is not required for the Jock River; however, based on past reports (**BSUEA MSS** and Existing Condition Report), the limited capacity of the ditch infrastructure along Borrisokane Road will require that the stormwater management facility provide a storage volume for quantity control. Any infrastructure upgrades or adjustments relating to the Borrisokane Road ROW will require appropriate permits and approvals from the Ministry of Transportation until such time as the ongoing process for the transfer of the roadway to be under the jurisdiction of the City of Ottawa is completed.

5.3.2.1 Erosion Targets – Borrisokane Road ROW

As requested by City staff an erosion assessment has been completed for the Borrisokane Road ditch outlet. JFSA has prepared a technical memorandum under separate cover entitled “*Borrisokane Ditch Erosion Assessment: The Ridge (Brazeau) Subdivision*” (June 2020) which reviewed the pond outlet for the site (the west ditch of Borrisokane Road north of Cambrian Road). The study concluded that the critical erosion velocity of the receiver is approximately 1.2 m/s which was then converted to a critical discharge threshold using a 1D HEC-RAS model of the ditch which determined that the threshold ranges from 4.20 m³/s to 7.9 m³/s for the middle and lower reaches of the ditch. From JFSA’s hydrologic modelling of the ditch, under proposed conditions, the peak flow is assessed at 3.82 m³/s for the 100-year 24-hour SCS event which is lower than the existing threshold range determined.

5.4 Stormwater Management Design

As shown in the *Storm Drainage Area Plan*, the proposed stormwater management design consists of OGS units for quality control and an end-of-line dry SWM pond for quantity control prior to discharge along Borrisokane Road. The pond will be located within the portion of the Drummond quarry land that is between the future Drummond residential area to be developed (within the urban boundary) and Borrisokane Road. The facility will be sized to meet the required level of quantity control based on a restricted outflow of 1,300 L/s as noted in Section 5.2. See the ***JFSA Pond Report*** under separate cover for full details of the SWM pond design.

In accordance with the Paterson ***Hydrogeological Review*** (under separate cover) for the area of the pond, the bottom elevation has been set at an elevation of 96.00m and will be lined as required to mitigate the inflow of perched groundwater in the area due to seasonal conditions.

The SWM pond will outlet to the Borrisokane Road roadside ditch. It is proposed that there will be a new 900mm/1200mm storm sewer installation along Borrisokane Road which extends northward to the vicinity of Cambrian Road where it discharges to the western roadside ditch. The proposed alignment was submitted via the City’s Municipal Consent process at the City’s request. No significant concerns were raised with the proposal.

5.4.1 Borrisokane Road – Ministry of Transportation Requirements

Borrisokane Road, along the frontage of The Ridge development area and northwards to Cambrian Road, is currently owned by, and under the jurisdiction of, the Ministry of Transportation. As such, any proposed underground stormwater infrastructure or grading/landscaping will require permits to facilitate the design and implementation of those works until such time that the process underway to transfer jurisdiction to the City of Ottawa is complete. We are working directly with MTO for the required permitting.

Culverts:

For any stormwater flows outletting to any existing, or new, Borrisokane Road ROW culverts the stormwater management reporting will evaluate peak flow rates, velocities and headwater levels at pre- and post-development conditions for design and regulatory storms.

Ditches:

For any stormwater flows outletting to existing Borrisokane Road ROW ditches, the stormwater management reporting will evaluate peak flow rates, velocities and depth of flow at pre- and post-development conditions for design and regulatory storms.

Inlet Control Devices:

Insofar as the Ministry has indicated that they do not recognize any benefit from the attenuation of storm water runoff from inlet control devices. In the circumstance where on-site SWM measures do not operate as intended water from the pond will spill to the Borrisokane roadside ditch via a reinforced grassed emergency spillway as shown in the 'SWM Pond' Drawing No. 76.

5.5 Proposed Minor System

The subject property will be serviced by an internal gravity storm sewer system that follows the local road network and servicing easements as required. The drainage is conveyed within the underground piped sewer system to the proposed SWM pond with select areas of local streets that will have the EES installed to achieve infiltration targets.

Street catchbasins will collect drainage from the streets and front yards, while rear yard catchbasins will capture drainage from backyards. Perforated catch basin leads will be provided in rear yards, to add to the infiltration network, except the last segment where it connects to the right-of-way which will be solid pipe, per City standards.

The preliminary rational method design of the minor system captures drainage for storm events up to and including the 2-year (local) and 5-year (collector) event assuming the use of inlet control devices (ICD) for all catchbasins within the subject property. The peak design flows are calculated based on an average predicted runoff coefficient (C-value) ranging from 0.71 to 0.54 for most of the development area (see storm design sheet in **Appendix D** for details. The storm system has also been sized to consider the potential for future commercial lands to the west where required.

The following table summarizes the standards that will be employed in the detailed design of the storm sewer network. The drainage area information can be found in the *Storm Drainage Plans* and rational method design sheets provided in **Appendix D**.

Table 3: Storm Sewer Design Criteria

Design Parameter	Value
Minor System Design Return Period	1:2 yr (PIEDTB-2016-01) for local roads, without ponding 1:5 yr for collector roads, without ponding
Major System Design Return Period	1:100 year
Intensity Duration Frequency Curve (IDF) 2-year storm event: A=732.951 B=6.199 C=0.810 5-year storm event: A = 998.071 B = 6.053 C = 0.814	$i = \frac{A}{(t_c + B)^C}$
Minimum Time of Concentration	10 minutes
Rational Method	$Q = CiA$
Storm sewers are to be sized employing the Manning's Equation	$Q = \frac{1}{n} AR^{2/3} S^{1/2}$
Runoff coefficient for paved and roof areas	0.9
Runoff coefficient for landscaped areas	0.2
Minimum Sewer Size	250 mm diameter
Minimum Manning's 'n' for pipe flow	0.013
Minimum Depth of Cover	1.5 m from crown of sewer to grade
Minimum Full Flowing Velocity	0.8 m/s
Maximum Full Flowing Velocity	6.0 m/s
Clearance from 100-Year Hydraulic Grade Line to Building Opening	0.30 m
Max. Allowable Flow Depth on Municipal Roads	35 cm above gutter (PIEDTB-2016-01)
Extent of Major System	Contained within the ROW, or adjacent to the ROW, provided that the water level not touch any part of the building envelope and remains below the lowest building opening during the stress test event (100-year + 20%) and 15cm vertical clearance is maintained between spill elevation on the street and the ground elevation at the building envelope (PIEDTB-2016-01)
Stormwater Management Model	DDSWMM (release 2.1), SWMHYMO (v. 5.02)
Model Parameters	Fo = 76.2 mm/hr, Fc = 13.2 mm/hr, DCAY = 4.14/hr, D.Stor.Imp. = 1.57 mm, D.Stor.Per. = 4.67 mm
Imperviousness	Based on runoff coefficient (C) where Percent Imperviousness = (C - 0.2) / 0.7 x 100%.
Design Storms	Chicago 3-hour Design Storms and 24-hour SCS Type II Design Storms. Max. Intensity averaged over 10 minutes.
Historical Events	July 1st, 1979, August 4th, 1988 and August 8th, 1996
Climate Change Street Test	20% increase in the 100-year, 3-hour Chicago storm
Design Parameter	Value
<i>Extracted from City of Ottawa Sewer Design Guidelines, October 2012, and ISSU,</i>	

5.6 Quality Control (OGS Units)

Enhanced quality treatment for the development, corresponding to a long-term average Total Suspended Solid removal efficiency of 80%, will be achieved via the proposed EES system installations and two OGS unit(s). The location/details of the OGS units near the SWM pond inlet can be seen in 'Storm Drainage Plan' Drawing No. 88 and SWM Pond Drawings No. 77/79 found in **Appendix D** along with the details of the OGS unit sizing provided by Contech. The units have been configured as off-line units to allow for the bypass of larger flows.

5.7 Hydraulic Grade Line Analysis

A detailed hydraulic grade line (HGL) modelling analysis has been completed for the proposed system based on the 100-year 3-hour Chicago, 12-hour SCS, and 24-hour SCS design storms, including historical design storms and climate change stress test as required. The HGL is provided in the plan and profile drawings for the subdivision and details of the modelling can be found in the **JFSA SWM Report**.

5.8 Proposed Major System

Major system conveyance, or overland flow (OLF), is provided to accommodate flows in excess of the minor system capacity. OLF is accommodated by generally storing stormwater up to the 100-year design event in road sags then routing additional surface flow along the road network and service easements towards the proposed drainage features to the Jock River, as shown in the *Storm Drainage Plans*. Stormwater ultimately discharges to the Borrisokane Road ROW which will require appropriate permits and approvals from the Ministry of Transportation if the process to change the jurisdiction to the City of Ottawa does not occur.

5.9 Stormwater Servicing Conclusions

The stormwater runoff is designed to be captured by an internal gravity sewer system that is to convey flows to an end-of-line dry SWM pond facility and OGS units for the quality control treatment of stormwater flows that originate from collector and arterial roadways due to City salting procedures. An Enhanced Level of protection will be provided for stormwater runoff from the subject property before ultimately being discharged to the Jock River. Quantity control is not required for the Jock River, notwithstanding, some quantity control by on-site and SWM pond storage will be provided due to downstream infrastructure constraints.

Infiltration targets noted in the MSS will be achieved via the installation of the EES system within local ROWs which will also provide Enhanced Level quality control as detailed in the **MSS**.

6.0 PROPOSED GRADING

The grading design includes a saw-toothed road design with varying road grades in order to maximize available surface storage for management of flows up to the 100-year design event where possible. The proposed site grading has also been developed to optimize earthworks and provide major system conveyance to the end-of-line facility which eventually outlets to the Borrisokane Road ROW and then to the Jock River. Roadway connections to the future New Greenbank Road will be coordinated with that future design based on the Environmental Assessment Study profile for that roadway. Reduced size grading plans are found in **Appendix E** in order to provide an overview context for the proposed grading.

The geotechnical review of the site makes note of the significant grade raises that will be found within the development area. No grade raise restrictions are indicated for the site. However, an extensive earthworks program is being undertaken which will be continuously monitored by the geotechnical consultant in order to ensure that appropriate fill material, placement, and compaction are provided throughout the property. The monitoring program is based on the detailed grading proposed and will ultimately be reviewed and signed off by a licensed Geotechnical Engineer. Any grading onto adjacent properties has been coordinated with adjacent landowners for permissions and retaining walls will be implemented where required.

7.0 EROSION AND SEDIMENT CONTROL

Soil erosion occurs naturally and is a function of soil type, climate and topography. The extent of erosions losses is exaggerated during construction where the vegetation has been removed and the top layer of soil is disturbed.

- Erosion and sediment controls must be in place during construction. The following recommendations to the contractor will be included in contract documents.
- Limit extent of exposed soils at any given time.
- Re-vegetate exposed areas as soon as possible.
- Minimize the area to be cleared and grubbed.
- Protect exposed slopes with plastic or synthetic mulches.
- Install silt fence to prevent sediment from entering existing ditches.
- No refueling or cleaning of equipment near existing watercourses.
- Provide sediment traps and basins during dewatering.
- Install filter cloth between catch basins and frames.
- Installation of mud mats at construction accesses.

7.1 EES Protection During Construction

From the *Low Impact Development Stormwater Management Planning and Design Guide* prepared by CVC and TRCA (ver 1.0, 2010):

- Prior to site works, the location of LIDs should be marked and vehicles are to avoid the area other than during the installation of the LID. Drainage not to be directed to the LID;
- To minimize siltation in the newly installed EES system, both the upstream and downstream ends of the EES system should be plugged immediately during the construction phase. The upstream plug is to be removed at approximately an occupancy of 80% similar to the Quinn's Pointe development;
- Upland drainage areas need to be properly stabilized with vegetation as soon as possible in order to reduce sediment loads;
- The facility should be excavated to design dimensions from the side using a backhoe or excavator. The base of the facility should be level or match the slope of the above storm sewer;
- The bottom of the facility should be scarified to improve infiltration; and
- Geotextile fabric should be correctly installed to optimize system function. When laying the geotextile, the width should include sufficient material to compensate for perimeter irregularities in the facility and a 150mm minimum top overlap.

8.0 CONCLUSION AND RECOMMENDATIONS

This report provides details on the planned on-site municipal services for the subject property and demonstrates that adequate municipal infrastructure capacity for the planned development of the subject property:

- The subject lands have been reviewed by the **BSUEA MSS** and has shown that water supply to the property can be provided. An analysis completed by GeoAdvice also documents the water supply network and results. The network will be expanded through neighboring properties to enhance/meet the water demands of the proposed development as adjacent properties are also developed.
- Sanitary service is to be provided to the subject property via connection to the sanitary sewer located along Cambrian Road through the Future Greenbank Road ROW as per the **MSS**. With the inclusion of the subject property, the existing downstream sewers have sufficient capacity to accommodate the subject property's proposed sanitary flows.

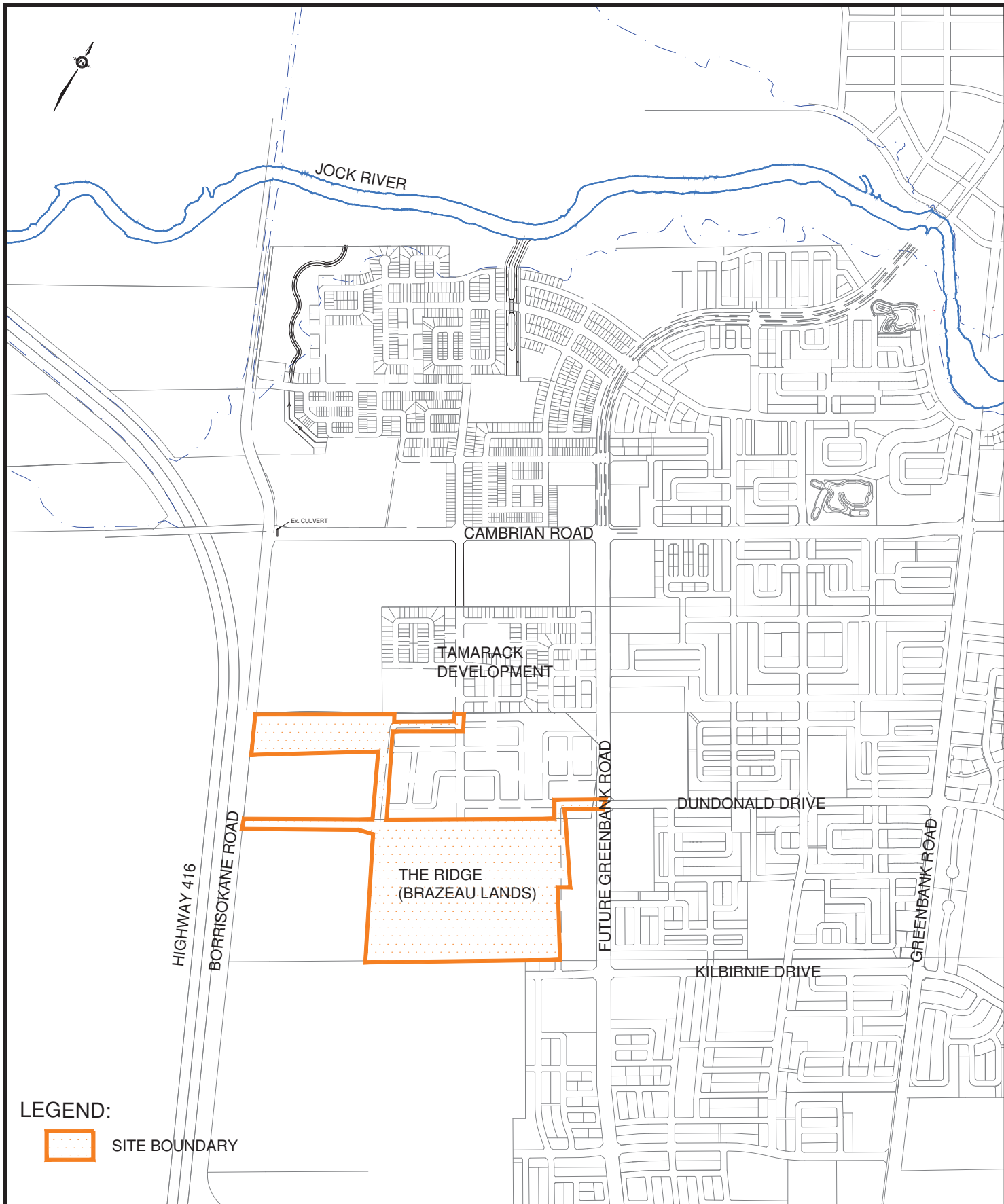
- Stormwater service is to be provided by capturing stormwater runoff via an internal gravity sewer system that will convey flows to a proposed end-of-line dry SWM pond facility for quantity control. Quality control will be provided for arterial and collector roadway (and select local roadway) drainage via the use of OGS units to an Enhanced Level of protection (80% TSS removal) prior to discharge to the SWM Pond. Quality control for local streets will be provided via the proposed Etobicoke Exfiltration System as documented in the **MSS**, as well as within the OGS units downstream. Quantity control is not required for the Jock River, however, some quantity control by on-site and SWM pond storage will be provided due to downstream infrastructure constraints. An erosion threshold assessment has been completed by JFSA for the Borrisokane Road west side ditch north of Cambrian Road (pond outlet) and has confirmed that the projected flows are lower than the threshold determined.
- As suggested in the **BSUEA MSS** the infiltration will be achieved via use of the preferred EES system. The JFSA reporting demonstrates that the required infiltration targets are met.
- Erosion and sediment control measures will be implemented and maintained throughout construction.
- The design of The Ridge has been completed in general conformance with the City of Ottawa Design Guidelines and criteria presented in other background study documents.

Prepared by,
David Schaeffer Engineering Ltd.



Per: Kevin L. Murphy, P.Eng.

APPENDIX A

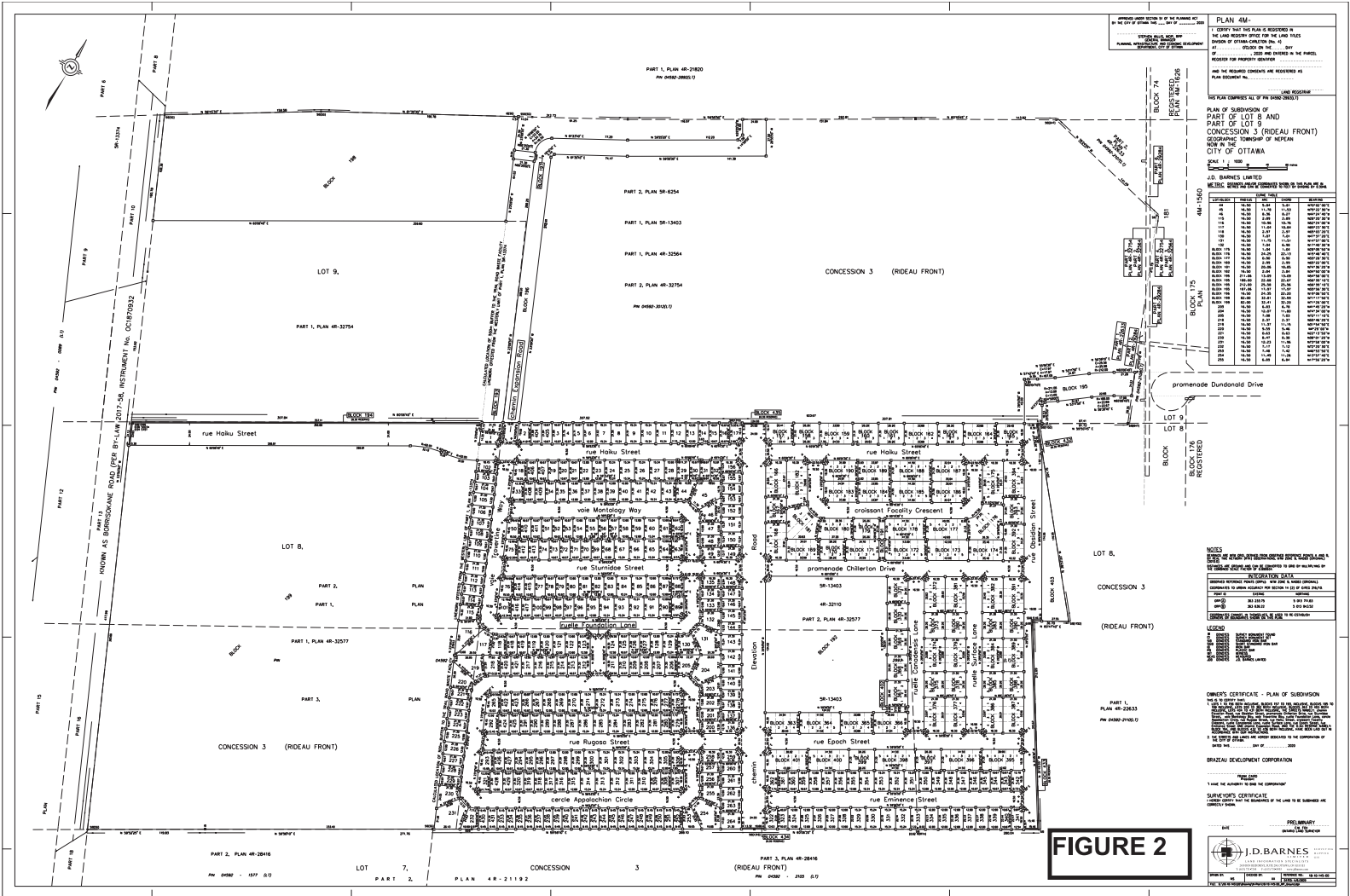


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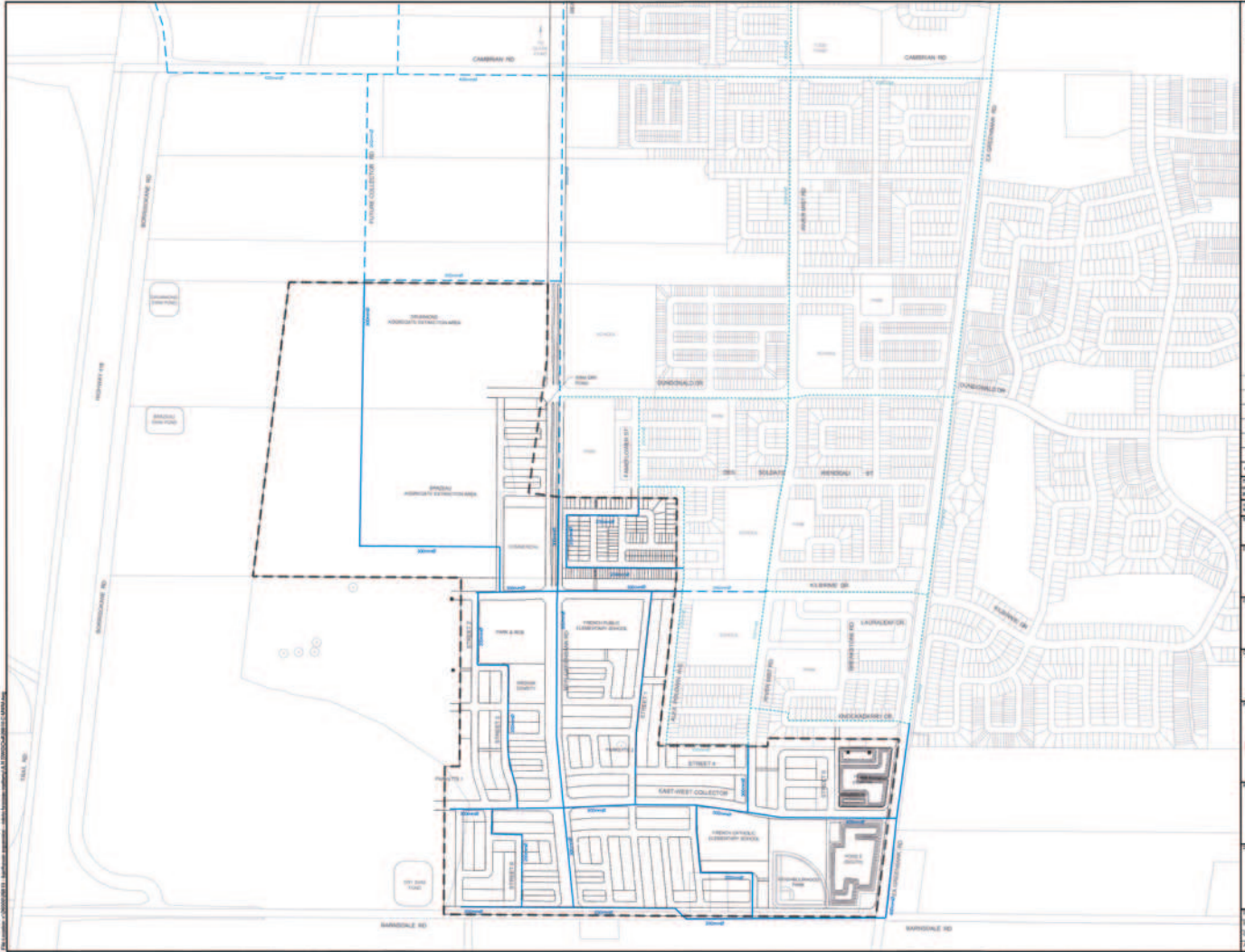
CAIVAN COMMUNITIES
 THE RIDGE (BRAZEAU LANDS)
 KEY PLAN

CITY OF OTTAWA

DATE:	SEPT 2019
SCALE:	1:15,000
PROJECT No.:	18-1030
FIGURE:	1



APPENDIX B



LEGEND

- PROPOSED WATERMAIN PER BSUEA AREA
- FUTURE WATERMAIN PER BSUEA AREA
- EXISTING WATERMAIN
- LOT OF STUDY AREA BOUNDARY

4	ISSUED FOR PLANNING COMMITTEE APPROVAL	08/2018
4	ADDITION COMMENTS	08/2018
4	ISSUED AS PART OF DRAFT A/E	08/2017
1	ISSUED FOR PRE-TIC WORKING MEETING	03/2017

NO. 100-10-1000

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DATE: 1/2020

SCALE: 1:4000

PROJECT: BARRHAVEN SOUTH URBAN EXPANSION AREA (BSUEA)

CLIENT: MWM

DESIGNER: J.L. Richards & Associates Limited

DATE: 2020

PROJECT: MWM

Master Servicing Study

Barrhaven South Urban Expansion Area

- Feeder mains, which have been provided primarily for the purpose of redundancy, shall meet, at a minimum, the basic day plus fire flow demand.

In addition to the above targets, servicing should be carried out to minimize dead-ends.

7.2.2 Domestic Water Demand

The water demands presented in this section are based on the same unit and population estimates as per the wastewater servicing flows described in Section 6.2.1, which reflects the CDP unit count. The zone/system level criteria for water demands are based on land use type and are in Table 7-1 below. The water demand criteria are consistent with those used in Stantec's Revised Potable Water Servicing Analysis (October 19, 2016). Calculations are summarized below.

Basic Day (BSDY) demands are calculated from the system level water demands for residential, commercial and institutional land uses. Maximum Day (MXDY) demands are calculated by adding an Outdoor Water Demand (OWD) also shown in Table 7-1 below. Peak hour demands result from applying the 72-hour diurnal patterns developed by the City to each type of MXDY demand. The 72-hour diurnal patterns are unique to each type of land use to reflect the different use patterns. The maximum hourly demand observed within the 72-hour patterns is the Peak Hour (PKHR) demand.

The review of the Demonstration Plan (Figure 4-2) has revealed that the number of units and associated densities will result in an overall population that will exceed 3,000. As a result, the water supply analysis presented herein is to be conducted using system level water demands as developed by the City. These system level demands are summarized in Table 7-2.

Table 7-1: Theoretical Water Consumption Rate

Land Use Type	Consumption Rate	Units
Single Family Residential	180	L/cap/day
Multi-unit Residential (Townhouse / Back to Back)	198	
Apartment Residential	219	
Commercial	50,000	L/ha/day
Institutional	50,000	
Outside Water Demand	1,049	L/SFH/day

The above system level demands were applied to each of the blocks depicted on the Demonstration Plan. As previously noted, the Brazeau and Drummond aggregate properties have now been accounted as residential usage. It was assumed that residential densities for both properties would be consistent with those for the BSUEA. Based on this exercise, overall water demands of 18.66 L/s and 31.48 L/s were calculated for the basic day (BSDY) and maximum day

Master Servicing Study

Barrhaven South Urban Expansion Area

(MXDY), respectively. It should be noted that MXDY of 31.48 L/s includes an outside water usage of 10.15 L/s.

Table 7-2: Estimated Water Demands

Land Use	Area (ha)	Units	Pop.	ADD SFH ⁴	ADD MLT ⁵	ADD APT ⁶	ADD COM ⁷	ADD INS ⁸	Total BSDY	OWD ⁹	Total MXDY
Minto and Mattamy Lands											
Schools	4.55							2.63	2.63		2.63
Commercial	2.13						1.23		1.23		1.23
Medium-Low Density Residential	32.90	1080	3378	4.68	2.60				7.27	8.01	15.29
High Density Residential	0.90	120	216			0.55			0.55		0.55
Total	40.48	1200	3594	4.68	2.60	0.55	1.23	2.63	11.69	8.01	19.71
Brazeau Aggregate Extraction Area											
Schools	1.47							0.85	0.85		0.85
Commercial	0.67						0.39		0.39		0.39
Medium-Low Density Residential	10.30	360	1126	1.56	0.87				2.42	2.67	5.10
High Density Residential	0.28	38	68			0.17			0.17		0.17
Total	12.72	398	1194	1.56	0.87	0.17	0.39	0.85	3.84		6.51
Drummond Aggregate Extraction Area											
Schools	1.25							0.72	0.72		0.72
Commercial	0.57						0.33		0.33		0.33

⁴ Daily Demand, Single Family Homes, L/s

⁵ Average Daily Demand, Multi-Units (Townhouses and Back to Back Unit) L/s

⁶ Average Daily Demand, Apartment Units, L/s

⁷ Average Daily Demand, Commercial, L/s

⁸ Average Daily Demand, Institutional, L/s

Master Servicing Study Barrhaven South Urban Expansion Area

Medium-Low Density Residential	8.72	288	900	1.25	0.69				1.94	2.14	4.07
High Density Residential	0.24	32	58			0.15			0.15		0.15
Total	10.78	320	958	1.25	0.69	0.15	0.33	0.72	3.14	2.14	5.28
Barrhaven South Urban Expansion Area Totals											
Total	63.98	1918	5746	7.48	4.16	0.87	1.95	4.21	18.66	10.15	31.48

7.2.3 Watermain Sizing and Roughness

The overall watermain layout for the BSUEA is shown on Drawing MWM. Watermain roughness coefficients were determined using the friction factors presented in Section 4.2.12 of the Design Guidelines and summarized in Table 7-3 below. The internal pipe diameters were modelled based on Section 4.3.5 of the Design Guidelines, as summarized in Table 7-4 below.

Table 7-3: Watermain Roughness Coefficients

Watermain Diameter	C-Factor
150 mm	100
200 to 250 mm	110
300 to 600 mm	120
Over 600 mm	130

Table 7-4: PVC Watermain Internal Diameters

Nominal Diameter	Inside Diameter
150 mm	155 mm
200 mm	204 mm
300 mm	297 mm
400 mm	393 mm

7.2.4 Fire Flow

The City standard in regard to fire protection is the Fire Underwriters Survey and Technical Bulletin ISDTB-2014-02. To evaluate the proposed water distribution system, a fire flow of 13,000 L/min (217 L/s) was used in this system level analysis in accordance with the recommendations of the 2013 Water Master Plan.

September 16, 2019

Sent by email: KMurphy@dseI.ca



David Schaeffer Engineering Ltd.
120 Iber Road, Unit 103
Stittsville, ON K2S 1E9

Attention: Mr. Kevin Murphy, P.Eng.
Senior Client Manager

Re: Water Distribution Network Boundary Condition Request
Brazeau Land Development
GeoAdvice Project ID: 2019-091-DSE

Dear Mr. Murphy,

In order to carry out the watermain analysis and hydraulic modeling for the Brazeau Land Development in the City of Ottawa, we request the hydraulic boundary conditions (HGL) for the proposed connection points as shown on the attached schematic. Flow conditions are outlined in the attached consumer water demand calculations.

Boundary conditions at the Connection Points 1 and 2 are required for the following demand conditions:

- **Phase 1 (Includes The Meadows Phases 7/8 demands)**
 - Minimum hour demand = 5.23 L/s
 - Average day demand = 10.45 L/s
 - Maximum day demand = 23.56 L/s
 - Maximum day demand + fire flow
 - 167 L/s fire flow = 190.56 L/s
 - 250 L/s fire flow = 273.56 L/s
 - Peak hour demand = 50.30 L/s

- **Phase 1 + 2 (Includes The Meadows Phases 7/8 demands)**
 - Minimum hour demand = 7.05 L/s
 - Average day demand = 14.10 L/s
 - Maximum day demand = 32.69 L/s
 - Maximum day demand + fire flow
 - 167 L/s fire flow = 199.69 L/s
 - 250 L/s fire flow = 282.69 L/s
 - Peak hour demand = 70.37 L/s

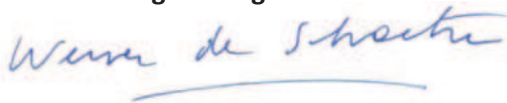
Please note the following:

- Demands from the Meadows Phases 7/8 are included in the above demand conditions. The inclusion of these demands is required due to the location of Connection 1. It is recommended that these demands only be applied to Connection 1. No other development demands were included (e.g. Drummond and Minto).
- The Phase 1 and 2 demands and fire flows should be applied equally between Connection Points 1 and 2.
- The attached FUS calculations have been completed in accordance with the latest City of Ottawa Technical Bulletin ISTB-2018-02 and ISDTB-2014-02 4.2.
- For the traditional townhomes not complying with the conditions of City of Ottawa Technical Bulletin ISDTB-2014-02 4.2 (Blocks 384 and 168), additional FUS calculations were completed, resulting in required fire flows of 167 L/s for each block.

If you have any questions, please do not hesitate to contact me.

Yours truly,

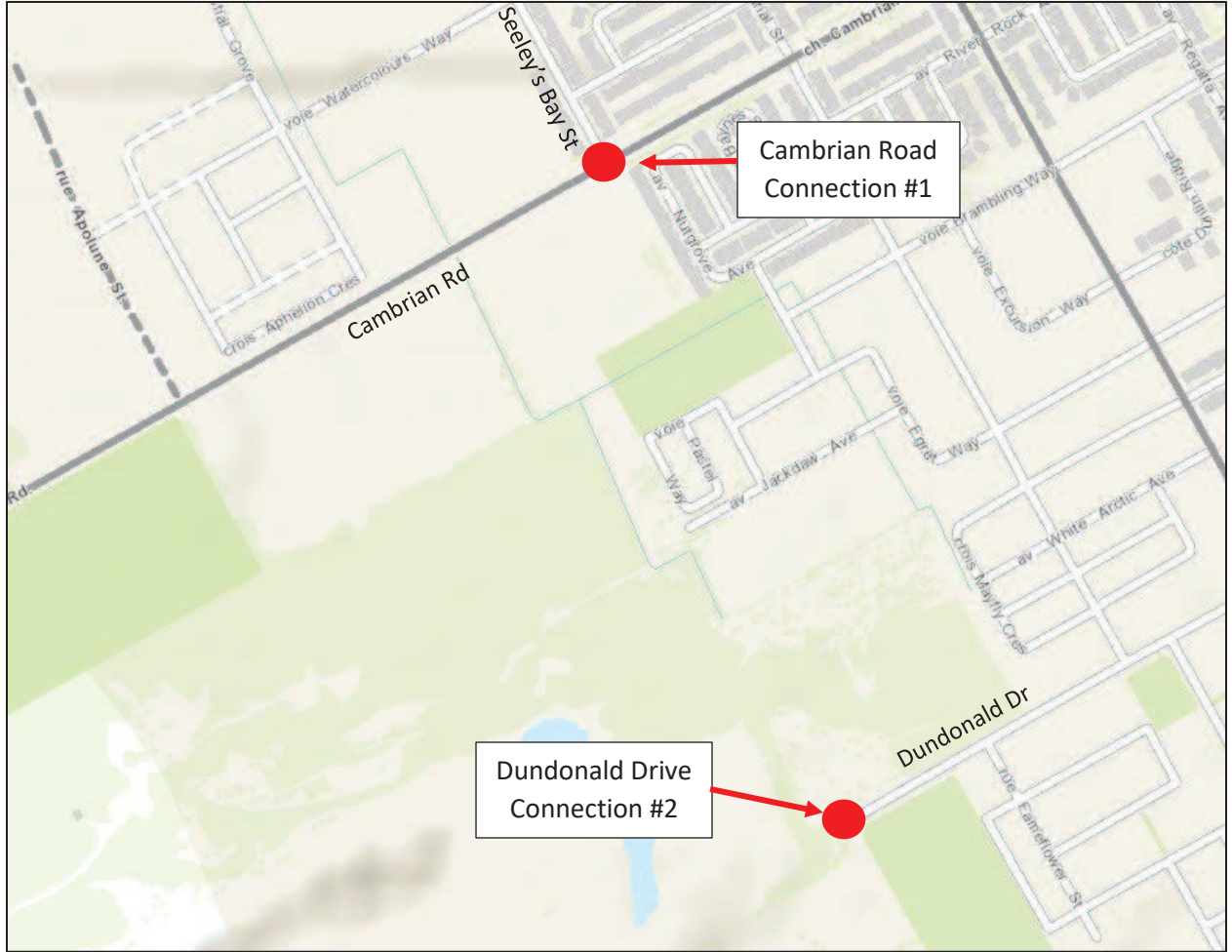
GeoAdvice Engineering Inc.

A handwritten signature in blue ink that reads "Werner de Schaetzen".

Werner de Schaetzen, Ph.D., P.Eng.
President and Chief Executive Officer
werner@geoadvice.com
GeoAdvice Engineering Inc.

Attachments: Mark up for connection locations, demand calculations and FUS Fire Flow Calculations

Connection Locations



Consumer Water Demands

Phase 1 Residential Demands

Dwelling Type	Number of Units	Population **		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	162	3.4	551	350	192,850	2.23	5.58	167*	12.28	1.12
Traditional Townhome	133	2.7	360		126,000	1.46	3.65	167*	8.02	0.73
Subtotal	295		911		318,850	3.69	9.23		20.30	1.85

Phase 1 + 2 Residential Demands

Dwelling Type	Number of Units	Population **		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	311	3.4	1,058	350	370,300	4.29	10.71	167*	23.57	2.14
Traditional Townhome	279	2.7	754		263,900	3.05	7.64	167*	16.80	1.53
Subtotal	590		1,812		634,200	7.34	18.35		40.37	3.67

Phase 1 Non Residential Demands

Property Type	Area (ha)	Average Day Demand			Max Day 1.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 1.8 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)	
		** (L/ha/d)	(L/d)	(L/s)					
Park	1.72		28,000	48,160	0.56	0.84	250**	1.51	0.28
Subtotal	1.72			48,160	0.56	0.84		1.51	0.28

The Meadows Phases 7/8

	ADD	MDD	PHD	MHD
Total Demand:	6.20	13.50	28.50	3.10

	ADD	MDD	PHD	MHD
Without the Meadows Phases 7/8 Demands				
Phase 1	4.25	10.06	21.80	2.12
Phase 1 + 2	7.90	19.19	41.88	3.95

	ADD	MDD	PHD	MHD
With the Meadows Phases 7/8 Demands				
Phase 1	10.45	23.56	50.30	5.23
Phase 1 + 2	14.10	32.69	70.37	7.05

*Based on FUS fire flow calculation

**Assumed based on similar information from previously completed projects, as agreed upon with DSEL

FUS Required Fire Flow Calculation

Client: David Schaeffer Engineering Ltd.

Project: 2019-091-DSE

Development: Brazeau Lands

Blocks 300-313, Single Detached

Zoning: Multi Family Residential

Date: September 16, 2019

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.



A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 1927 m²
 Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2
 Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

D. Required Fire Flow*: $F = 220C\sqrt{A}$
 C: Coefficient related to the type of construction
 A: Effective area
 The total floor area in m² in the building being considered

Note: The single detached dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 14 units is considered in this calculation.

$$C = \frac{1.5}{A = 3854 \text{ m}^2} \quad (\text{Combined area of 14 units})$$

$$F = 20,486 \text{ L/min} \quad D = 20,000 \text{ L/min}^*$$

E. Occupancy
 Occupancy content hazard: Limited Combustible
 -15 % of D -3,000 L/min $E = 17,000 \text{ L/min}$

F. Sprinkler Protection
 Automatic sprinkler protection: None
 0 % of E 0 L/min $F = 17,000 \text{ L/min}$

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	20.1 to 30 m	0-30 m-storeys	Wood Frame or Non-Combustible	8%
East	20.1 to 30 m	0-30 m-storeys	Wood Frame or Non-Combustible	8%
North	10.1 to 20 m	Over 120 m-storeys	Wood Frame or Non-Combustible	15%
South	20.1 to 30 m	Over 120 m-storeys	Wood Frame or Non-Combustible	10%
Total				41%

$$\% \text{ of E } \quad + 6,970 \text{ L/min} \quad G = 23,970 \text{ L/min}$$

H. Wood Shake Charge No 0 L/min $H = 23,970 \text{ L/min}$
 For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.1. The single detached dwellings comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	10,000 L/min*
	167 L/s
Required Duration of Fire Flow	2 Hrs
Required Volume of Fire Flow	1,200 m³

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m ²)	3,854
Required Fire Flow (L/min)	20,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	8%
East (%)	8%
South (%)	15%
West (%)	10%
Total Exposure (%)	41%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167

FUS Required Fire Flow Calculation

Client: David Schaeffer Engineering Ltd.

Project: 2019-091-DSE

Development: Brazeau Lands

Blocks 173, Traditional Townhouse

Zoning: Multi Family Residential

Date: September 16, 2019

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.



A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 474 m²
 Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2
 Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

D. Required Fire Flow*: $F = 220C\sqrt{A}$
 C: Coefficient related to the type of construction
 A: Effective area
 The total floor area in m² in the building being considered

Note: The townhouse dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 5 units is considered in this calculation.

$$C = \frac{1.5}{A = 947 \text{ m}^2} \quad (\text{Combined area of 5 units})$$

$$F = 10,156 \text{ L/min} \quad D = 10,000 \text{ L/min}^*$$

E. Occupancy
 Occupancy content hazard: Limited Combustible
 -15 % of D -1,500 L/min $E = 8,500 \text{ L/min}$

F. Sprinkler Protection
 Automatic sprinkler protection: None
 0 % of E 0 L/min $F = 8,500 \text{ L/min}$

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
East	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
North	10.1 to 20 m	61-90 m-storeys	Wood Frame or Non-Combustible	14%
South	20.1 to 30 m	31-60 m-storeys	Wood Frame or Non-Combustible	8%
Total				56%

$$\% \text{ of E } \quad + 4,760 \text{ L/min} \quad G = 13,260 \text{ L/min}$$

H. Wood Shake Charge No 0 L/min $H = 13,260 \text{ L/min}$
 For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The townhouse dwellings comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	10,000 L/min*
	167 L/s
Required Duration of Fire Flow	2 Hrs
Required Volume of Fire Flow	1,200 m³

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m ²)	947
Required Fire Flow (L/min)	10,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	17%
East (%)	17%
South (%)	14%
West (%)	8%
Total Exposure (%)	56%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167

FUS Required Fire Flow Calculation

Client: David Schaeffer Engineering Ltd.

Project: 2019-091-DSE

Development: Brazeau Lands

Zoning: Multi Family Residential

Blocks 384, Traditional Townhouse

Date: September 16, 2019

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.



A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 380 m²
 Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2
 Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

D. Required Fire Flow*: $F = 220C\sqrt{A}$
 C: Coefficient related to the type of construction
 A: Effective area
 The total floor area in m² in the building being considered

Note: The townhouse dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 4 units is considered in this calculation.

$$C = \frac{1.5}{760 \text{ m}^2} \quad (\text{Combined area of 4 units})$$

$$F = 9,095 \text{ L/min} \quad D = 9,000 \text{ L/min}^*$$

E. Occupancy
 Occupancy content hazard: Limited Combustible
 -15 % of D -1,350 L/min $E = 7,650 \text{ L/min}$

F. Sprinkler Protection
 Automatic sprinkler protection: None
 0 % of E 0 L/min $F = 7,650 \text{ L/min}$

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	10.1 to 20 m	0-30 m-storeys	Wood Frame or Non-Combustible	12%
East	Beyond 45 m	0-30 m-storeys	Wood Frame or Non-Combustible	0%
North	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
South	20.1 to 30 m	0-30 m-storeys	Wood Frame or Non-Combustible	8%
Total				37%

$$\% \text{ of E } \quad + 2,831 \text{ L/min} \quad G = 10,481 \text{ L/min}$$

H. Wood Shake Charge No 0 L/min $H = 10,481 \text{ L/min}$
 For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The townhouse dwellings do not comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	10,000 L/min*
	167 L/s
Required Duration of Fire Flow	2 Hrs
Required Volume of Fire Flow	1,200 m³

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m ²)	760
Required Fire Flow (L/min)	9,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	12%
East (%)	0%
South (%)	17%
West (%)	8%
Total Exposure (%)	37%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167

FUS Required Fire Flow Calculation

Client: David Schaeffer Engineering Ltd.

Project: 2019-091-DSE

Development: Brazeau Lands

Zoning: Multi Family Residential

Blocks 168, Traditional Townhouse

Date: September 16, 2019

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.



A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 380 m²
 Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2
 Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

D. Required Fire Flow*: $F = 220C\sqrt{A}$
 C: Coefficient related to the type of construction
 A: Effective area
 The total floor area in m² in the building being considered

Note: The townhouse dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 4 units is considered in this calculation.

$$C = \frac{1.5}{760 \text{ m}^2} \quad (\text{Combined area of 4 units})$$

$$F = 9,095 \text{ L/min} \quad D = 9,000 \text{ L/min}^*$$

E. Occupancy
 Occupancy content hazard: Limited Combustible
 -15 % of D -1,350 L/min $E = 7,650 \text{ L/min}$

F. Sprinkler Protection
 Automatic sprinkler protection: None
 0 % of E 0 L/min $F = 7,650 \text{ L/min}$

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	30.1 to 45 m	0-30 m-storeys	Wood Frame or Non-Combustible	5%
East	10.1 to 20 m	0-30 m-storeys	Wood Frame or Non-Combustible	12%
North	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
South	Beyond 45 m	31-60 m-storeys	Wood Frame or Non-Combustible	0%
Total				34%

$$\% \text{ of E } \quad + 2,601 \text{ L/min} \quad G = 10,251 \text{ L/min}$$

H. Wood Shake Charge No 0 L/min $H = 10,251 \text{ L/min}$
 For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The townhouse dwellings do not comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	10,000 L/min*
	167 L/s
Required Duration of Fire Flow	2 Hrs
Required Volume of Fire Flow	1,200 m³

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m ²)	760
Required Fire Flow (L/min)	9,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	5%
East (%)	12%
South (%)	17%
West (%)	0%
Total Exposure (%)	34%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167



Hydraulic Capacity and Modeling Analysis Brazeau Lands

Final Report

Prepared for:

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Submission Date: July 28, 2020

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Project: 2019-091-DSE

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Document History and Version Control

Revision No.	Date	Document Description	Revised By	Reviewed By
R0	November 7, 2019	Draft	Ben Loewen	Werner de Schaetzen
R1	December 20, 2019	Final	Ben Loewen	Werner de Schaetzen
R2	June 10, 2020	Updated Draft	Ferdinand de Schoutheete	Werner de Schaetzen
R3	July 28, 2020	Final	Ferdinand de Schoutheete	Werner de Schaetzen

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Project ID: 2019-091-DSE

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1 Introduction

GeoAdvice Engineering Inc. (“GeoAdvice”) was retained by David Schaeffer Engineering Ltd. (“DSEL”) to size the proposed water main network for the Brazeau Lands development (“Development”) in the City of Ottawa, ON (“City”).

Under existing conditions, the development will be serviced by the Barrhaven pressure zone; however, in the future, it will be serviced by pressure zone 3C.

There are 347 single detached dwellings, 279 traditional townhomes and 1 park serviced as part of the development.

The Brazeau Lands development will have three (3) connections to the City water distribution system:

- Connection 1: Apolune Street and Cambrian Road;
- Connection 2: Jackdaw Avenue and Future Greenbank Road; and
- Connection 3: Dundonald Drive and Future Greenbank Road.

The development site is shown in **Figure 1.1** on the following page, with the final recommended pipe diameters.

This report describes the assumptions and results of the hydraulic modeling and capacity analysis using InfoWater (Innovyze), a GIS water distribution system modeling and management software application.

The results presented in this memo are based on the analysis of steady state simulations. The predicted available fire flows, as calculated by the hydraulic model, represent the flow available in the water main while maintaining a residual pressure of 20 psi. No extended period simulations were completed in this analysis to assess the water quality or to assess the hydraulic impact on storage and pumping.

Connection #1
Cambrian Road

Connection #2
Brambling Way

Legend

- Junction
- ⊡ Connection Point

Pipe Diameter

- 200 mm
- 250 mm
- 300 mm

The Meadows
Phases 7/8

Connection #3
Dundonald Drive



Phase 1

Phase 2

0 140 280
Meters



GeoAdvice Engineering Inc.

Project: Hydraulic Capacity and Modeling Analysis of
the Brazeau Lands
Client: David Schaeffer Engineering Ltd.
Date: June 2020
Created by: BL
Reviewed by: WdS

DISCLAIMER: GeoAdvice does not warrant in any way the accuracy and completeness of the information shown on this map. Field verification of the accuracy and completeness of the information shown on this map is the sole responsibility of the user.

Brazeau Lands Site
Layout and Connection
Points

Figure 1.1



2 Modeling Considerations

2.1 Water Main Configuration

The water main network was modeled based on the drawing prepared by DSEL (1030_Gen_Rev4.dwg) and provided to GeoAdvice on June 2nd, 2020.

2.2 Elevations

Elevations of the modeled junctions were assigned according to a site grading plan prepared by DSEL (1030_Grad_Rev4.dwg) and provided to GeoAdvice on June 2nd, 2020.

2.3 Consumer Demands

Demand factors used for this analysis were taken according to the City of Ottawa 2010 Design Guidelines *Table 4.2 Consumption Rate for Subdivisions of 501 to 3,000 Persons*. Population densities were assigned according to *Table 4.1 Per Unit Populations* from the City of Ottawa Design Guidelines. A summary of these tables highlighting relevant data for this development is shown in **Table 2.1** below.

Table 2.1: City of Ottawa Demand Factors

Demand Type	Amount	Units
Average Day Demand		
Residential	350	L/c/d
Park	28,000	L/ha/d
Maximum Daily Demand		
Residential	2.5 x avg. day	L/c/d
Park	1.5 x avg. day	L/ha/d
Peak Hour Demand		
Residential	2.2 x max. day	L/c/d
Park	1.8 x max. day	L/ha/d
Minimum Hour Demand		
Residential	0.5 x avg. day	L/c/d
Park	0.5 x avg. day	L/ha/d

Table 2.2 and **Table 2.4** summarize the residential water demand calculations for the Brazeau Lands development.



Table 2.2: Development Population and Demand Calculations – Phase 1

Dwelling Type	Number of Units	Persons Per Unit*	Population	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Single Detached	172	3.4	585	2.37	5.92	13.03	1.18
Traditional Townhome	133	2.7	360	1.46	3.65	8.02	0.73

*City of Ottawa Design Guidelines

Table 2.3: Development Population and Demand Calculations – Phases 1&2

Dwelling Type	Number of Units	Persons Per Unit*	Population	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Single Detached	347	3.4	1,180	4.78	11.95	26.29	2.39
Traditional Townhome	279	2.7	754	3.05	7.64	16.80	1.53

*City of Ottawa Design Guidelines

Table 2.6 summarizes the non-residential water demand calculations for the Brazeau Lands development (included in both Phase 1 and Phases 1&2).

Table 2.4: Non-Residential Demand Calculations

Land Use Type	Area (ha)	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Park	1.72	0.56	0.84	1.51	0.28

Table 2.5 summarizes the demands for the Meadows Phases 7/8 subdivision development located north of the Brazeau Lands and downstream of Connections 1 and 2 (accounted for in the HGLs provided by the City in the boundary conditions request).



Table 2.5: The Meadows Phases 7/8

Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
6.20	13.50	28.50	3.10

Demands were grouped into demand polygons then uniformly distributed to the model nodes located within each polygon. Detailed calculations of demands as well as the illustrated allocation areas are shown in **Appendix A**.

2.4 Fire Flow Demand

Fire flow calculations were completed for all dwelling types in accordance with the Fire Underwriters Survey's (FUS) Water Supply for Public Fire Protection Guideline (1999) and City of Ottawa Technical Bulletin ISTB-2018-02 as summarized in **Appendix B**.

All the single detached dwellings have a minimum separation of 10 m between the backs of adjacent units and are, therefore, subject to the 10,000 L/min (167 L/s) cap outlined in City of Ottawa Technical Bulletin ISDTB-2014-02.

Most of the traditional townhouse dwellings comply with the City of Ottawa Technical Bulletin ISDTB-2014-02 and are, therefore, subject to the 10,000 L/min (167 L/s) cap.

The traditional townhouse dwellings located on Blocks 168 and 384 do not have a minimum separation of 10 m between the backs of adjacent units and therefore do not comply with the provisions under the City of Ottawa Technical Bulletin ISDTB-2014-02. The required fire flow for those blocks were calculated to be 167 L/s based on the Fire Underwriters Survey's (FUS) Water Supply for Public Fire Protection Guideline (1999). The agreement of this calculation with the City of Ottawa cap of 167 L/s is purely coincidental.

At this time, there is not enough information available to calculate the required fire flow of the park. As such, a required fire flow of 250 L/s was assumed for the park. This is a typical, conservative value for similar land use.

Fire flow simulations were completed at each model node in the Brazeau development. The locations of nodes do not necessarily represent hydrant locations.

Detailed FUS fire flow calculations as well as the illustrated spatial allocation of the required fire flows are shown in **Appendix B**.



2.5 Boundary Conditions

The boundary conditions were provided by the City of Ottawa in the form of Hydraulic Grade Line (HGL) at the following locations:

- Connection 1: Apolune Street and Cambrian Road;
- Connection 2: Jackdaw Avenue and Future Greenbank Road; and
- Connection 3: Dundonald Drive and Future Greenbank Road.

The above connection points are illustrated in **Figure 1.1**.

Boundary conditions were provided for Peak Hour, Maximum Day plus Fire and Minimum Hour (high pressure check) conditions.

Under existing conditions, the Brazeau Lands development will be serviced by the Barrhaven pressure zone; however, in the future, it will be serviced by pressure zone 3C. As such, boundary conditions were provided under the existing and future pressure zone configurations.

In total, two (2) sets of boundary conditions were provided by the City and can be found in **Appendix C**.

The boundary conditions for the existing pressure zone configuration are more conservative. As such, the results presented in this report are based on the boundary conditions for the existing pressure zone configuration.

Table 2.6 summarizes the boundary conditions used to size the Brazeau Lands water network.

Table 2.6: Existing Boundary Conditions

Condition	Connection 1 HGL (m)	Connection 2 HGL (m)	Connection 3 HGL (m)
Min Hour (max. pressure)	156.4	156.4	156.4
Peak Hour (min. pressure)	135.7	135.6	135.7
Max Day + Fire Flow (167 L/s)	144.0	141.2	142.0
Max Day + Fire Flow (250 L/s)	135.4	129.9	131.5



3 Hydraulic Capacity Design Criteria

3.1 Pipe Characteristics

Pipe characteristics of internal diameter (ID) and Hazen-Williams C factors were assigned in the model according to the City of Ottawa Design Guidelines for PVC water main material. Pipe characteristics used for the development are outlined in **Table 3.1** below.

Table 3.1: Model Pipe Characteristics

Nominal Diameter (mm)	ID PVC (mm)	Hazen Williams C-Factor (/)
200	204	110
250	250	110
300	297	120

3.2 Pressure Requirements

As outlined in the City of Ottawa Design Guidelines, the generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi). The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way shall not exceed 552 kPa (80 psi). Pressure requirements are outlined in **Table 3.2**.

Table 3.2: Pressure Requirements

Demand Condition	Minimum Pressure		Maximum Pressure	
	(kPa)	(psi)	(kPa)	(psi)
Normal Operating Pressure (maximum daily flow)	350	50	480	70
Peak Hour Demand (minimum allowable pressure)	276	40	-	-
Maximum Fixture Pressure (Ontario Building Code)	-	-	552	80
Maximum Distribution Pressure (minimum hour check)	-	-	552	80
Maximum Day Plus Fire	140	20	-	-



4 Hydraulic Capacity Analysis

The proposed water mains within the development were sized to the minimum diameter which would satisfy the greater of maximum day plus fire and peak hour demand. Modeling was carried out for minimum hour, peak hour and maximum day plus fire flow using InfoWater. Only the existing pressure zone configuration was analyzed, since the boundary conditions are more conservative.

Detailed pipe and junction model input data can be found in **Appendix D**.

4.1 Development Pressure Analysis

Modeled service pressures for the development are summarized in **Table 4.1** below.

Table 4.1: Summary of the Brazeau Lands Available Service Pressures

Phase	Minimum Hour Demand Maximum Pressure	Peak Hour Demand Minimum Pressure
Phase 1	538 kPa (78 psi)	290 kPa (42 psi)
Phases 1&2	538 kPa (78 psi)	262 kPa (38 psi)

As outlined in the City of Ottawa Design Guidelines, the generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi). The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way shall not exceed 552 kPa (80 psi).

Low pressures are predicted at junctions J-66, J-70, J-71, J-72, J-73, J-74, J-75, J-76 and J-77 under peak hour demand. Those low pressures are due to high elevations in the southern part of the Brazeau Lands development and are within 5% of the minimum allowable pressure of 276 kPa (40 psi). The future Zone 3C boundary conditions will provide an additional head of about seven (7) meters at each connection point, and will thus resolve the low PHD pressures at the southern part of the Brazeau Lands development.

Detailed pipe and junction result tables and maps can be found in **Appendix E**.



4.2 Development Fire Flow Analysis

A summary of the minimum available fire flows in the Brazeau Lands development is shown below in **Table 4.2**.

Table 4.2: Summary of the Brazeau Lands Minimum Available Fire Flows

Phase	Required Fire Flow	Minimum Available Flow	Junction ID
Phase 1	167 L/s	177 L/s	J-45
	250 L/s	249 L/s	J-47
Phases 1&2	167 L/s	194 L/s	J-66
	250 L/s	269 L/s	J-47

As shown in the table above, the available fire flow is greater than the required fire flow under both Phase 1 and Phases 1&2 conditions.

A summary of the residual pressures in the Brazeau Lands is shown below in **Table 4.3**. The minimum allowable pressure under fire flow conditions is 140 kPa (20 psi) at the location of the fire.



Table 4.3: Summary of the Brazeau Lands Residual Pressures (MDD + FF)

Phase	Maximum Residual Pressure	Average Residual Pressure	Minimum Residual Pressure
Phase 1	365 kPa (53 psi)	296 kPa (43 psi)	140 kPa (20 psi)
Phases 1&2	365 kPa (53 psi)	296 kPa (43 psi)	159 kPa (23 psi)

There is sufficient residual pressure at all the junctions within the Brazeau Lands development.

Detailed fire flow results and figures illustrating the fire flow results can be found in **Appendix F**.



5 Other Servicing Considerations

5.1 Water Supply Security

The City of Ottawa Design Guidelines allow single feed systems for developments up to a total average day demand of 50 m³/day and require two (2) feeds if the development exceeds 50 m³/day for supply security, according to Technical Bulletin ISDTB-2014-02.

The Brazeau Lands services a total average day demand of 725 m³/day; as such, two (2) feeds are required.

5.2 Valves

No comment has been made in this technical memorandum with respect to exact placement of isolation valves within the distribution network for the Brazeau Lands other than to summarize the City of Ottawa Design Guidelines for number, location, and spacing of isolation valves:

- Tee intersection – two (2) valves
- Cross intersection – three (3) valves
- Valves shall be located 2 m away from the intersection
- 300 m spacing for 150 mm to 400 mm diameter valves
- Gate valves for 100 mm to 300 mm diameter mains
- Butterfly valves for 400 mm and larger diameter mains

Drain valves are not strictly required under the City of Ottawa Design Guidelines for water mains under 600 mm in diameter. The Guidelines indicate that “small diameter water mains shall be drained through hydrant via pumping if needed.”

Air valves are not strictly required under the City of Ottawa Design Guidelines for water mains up to and including 400 mm in diameter. The Guidelines indicate that air removal “can be accomplished by the strategic positioning of hydrant at the high points to remove the air or by installing or utilizing available 50 mm chlorination nozzles in 300 mm and 400 mm chambers.”

The detailed engineering drawings for the Brazeau Lands are expected to identify valves in accordance with the requirements noted above.



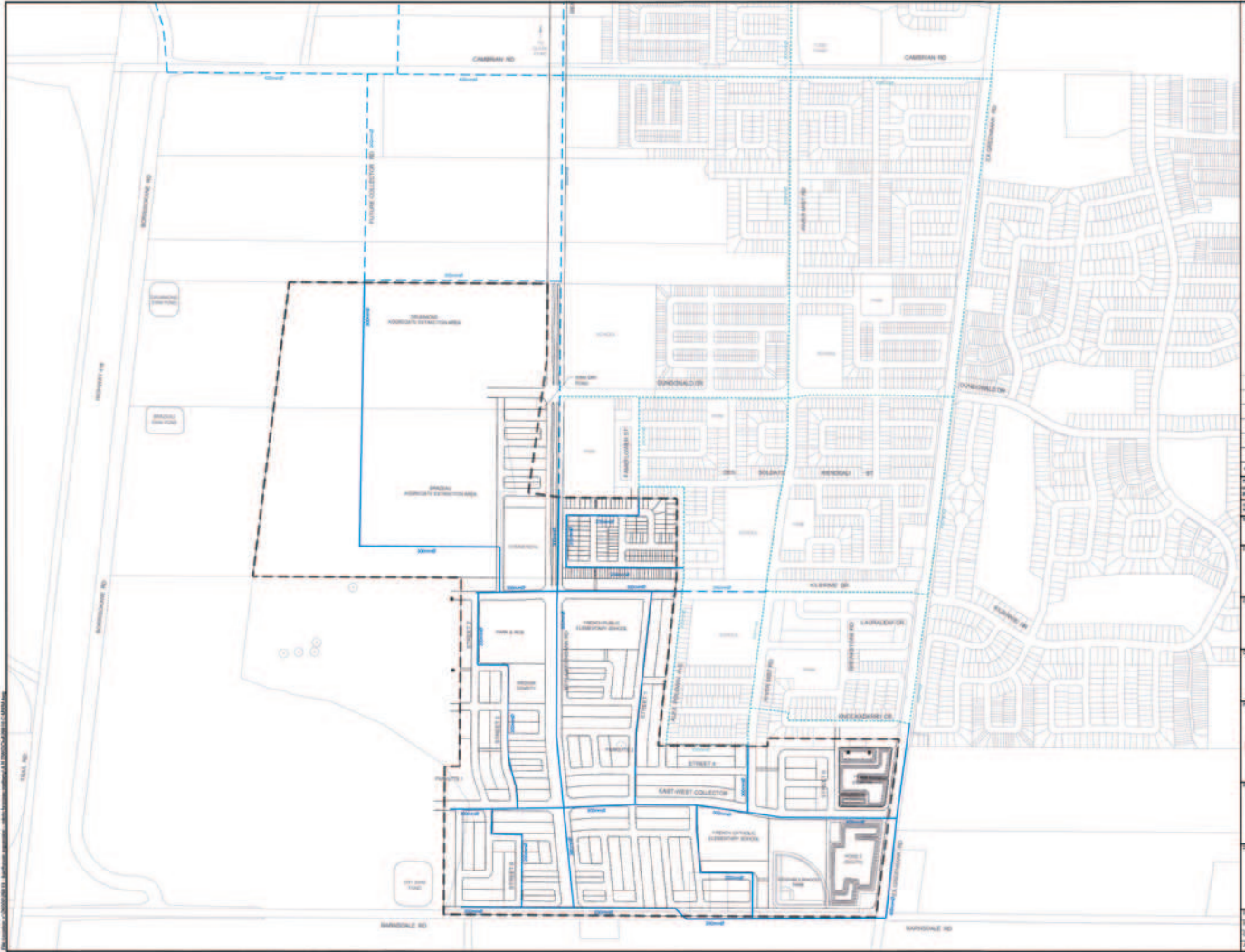
5.3 Hydrants

No comment has been made in this technical memorandum with respect to exact placement of hydrants within the distribution network for the Brazeau Lands other than to summarize the City of Ottawa Design Guidelines for maximum hydrant spacing:

- 125 m for single family unit residential areas on lots where frontage at the street line is 15 m or longer
- 110 m for single family unit residential areas on lots where frontage at the street line is less than 15 m and for residential areas zoned for row housing, doubles or duplexes
- 90 m for institutional, commercial, industrial, apartments and high-density areas

The detailed engineering drawings for the Brazeau Lands development are expected to identify hydrants in accordance with the requirements noted above.

APPENDIX B



LEGEND

- PROPOSED WATERMAIN PER BSUEA MASTER PLAN
- FUTURE WATERMAIN PER BSUEA MASTER PLAN
- EXISTING WATERMAIN
- LOT FOOTPRINT

4	ISSUED FOR PLANNING COMMITTEE APPROVAL	08/2018
4	ADDITIONAL COMMENTS	08/2018
4	ISSUED AS PART OF DRAFT M&P	08/2017
1	ISSUED FOR PRELIMINARY MEETING	04/2017

NO. 100-10-1000

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DATE: 1/2020

SCALE: 1:4000

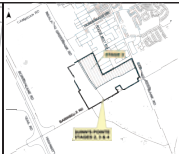
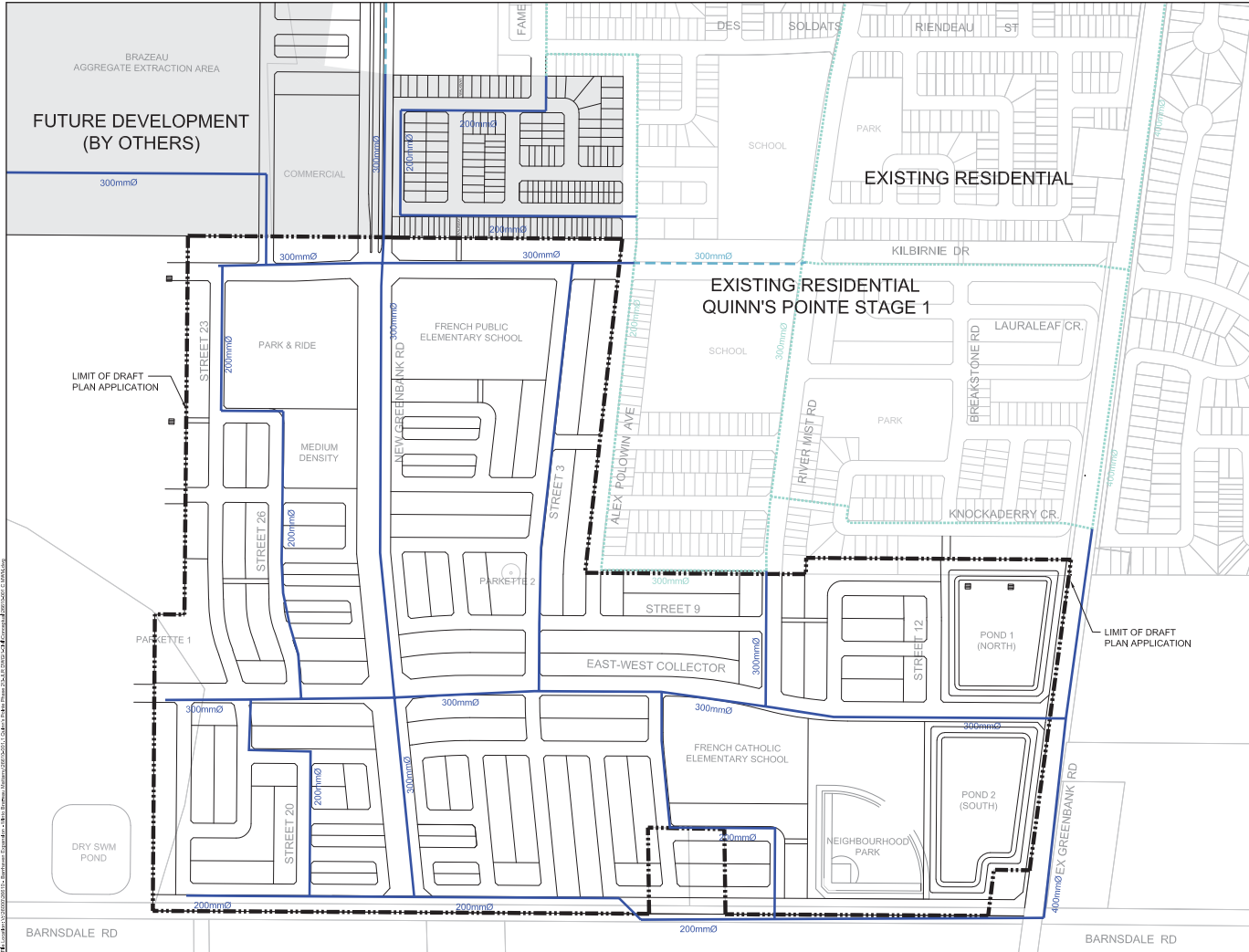
PROJECT: BARRHAVEN SOUTH URBAN EXPANSION AREA (BSUEA)

CLIENT: MWM

DESIGNER: J.L. Richards & Associates Limited

DATE: 01/2020

PROJECT: MWM



LEGEND

- PROPOSED WATERMAIN FOR 2018 BUDA MGD
- FUTURE WATERMAIN FOR 2018 BUDA MGD
- EXISTING WATERMAIN
- LIMIT OF STUDY AREA FOR BUDA



2	ISSUED FOR REVIEW/REVISION - 2018 SUBMITTAL	03/09/18
1	ISSUED WITH DESIGN/REVISION - 18 SUBMITTAL	07/08/18
0	ISSUED FOR REVIEW	05/04/17

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SCALE: 1:2000

DATE: 03/09/18

CONTRACTOR: **J.L. Richards**
ENGINEERING ARCHITECTS PLANNERS

PROFESSIONAL STAMP: PROJECT NORTH

PROJECT: MINTO COMMUNITIES INC., QUINN'S POINT STAGES 2, 3 & 4

CONTRACT: BSUEA CONCEPTUAL WATERMAIN

DATE: AT
DRAWN: CMA
CHECKED: LD
DATE: 2018-03-09

DATE: AT
DRAWN: CMA
CHECKED: LD
DATE: 2018-03-09

M:\Projects\2018\20180309_Quinn's Pointe Stages 2, 3 & 4\Drawings\20180309_Quinn's Pointe Stages 2, 3 & 4\Conceptual Watermain.dwg

NOT DATE: 2018-03-09 11:52:00 AM

Master Servicing Study

Barrhaven South Urban Expansion Area

- Feeder mains, which have been provided primarily for the purpose of redundancy, shall meet, at a minimum, the basic day plus fire flow demand.

In addition to the above targets, servicing should be carried out to minimize dead-ends.

7.2.2 Domestic Water Demand

The water demands presented in this section are based on the same unit and population estimates as per the wastewater servicing flows described in Section 6.2.1, which reflects the CDP unit count. The zone/system level criteria for water demands are based on land use type and are in Table 7-1 below. The water demand criteria are consistent with those used in Stantec's Revised Potable Water Servicing Analysis (October 19, 2016). Calculations are summarized below.

Basic Day (BSDY) demands are calculated from the system level water demands for residential, commercial and institutional land uses. Maximum Day (MXDY) demands are calculated by adding an Outdoor Water Demand (OWD) also shown in Table 7-1 below. Peak hour demands result from applying the 72-hour diurnal patterns developed by the City to each type of MXDY demand. The 72-hour diurnal patterns are unique to each type of land use to reflect the different use patterns. The maximum hourly demand observed within the 72-hour patterns is the Peak Hour (PKHR) demand.

The review of the Demonstration Plan (Figure 4-2) has revealed that the number of units and associated densities will result in an overall population that will exceed 3,000. As a result, the water supply analysis presented herein is to be conducted using system level water demands as developed by the City. These system level demands are summarized in Table 7-2.

Table 7-1: Theoretical Water Consumption Rate

Land Use Type	Consumption Rate	Units
Single Family Residential	180	L/cap/day
Multi-unit Residential (Townhouse / Back to Back)	198	
Apartment Residential	219	
Commercial	50,000	L/ha/day
Institutional	50,000	
Outside Water Demand	1,049	L/SFH/day

The above system level demands were applied to each of the blocks depicted on the Demonstration Plan. As previously noted, the Brazeau and Drummond aggregate properties have now been accounted as residential usage. It was assumed that residential densities for both properties would be consistent with those for the BSUEA. Based on this exercise, overall water demands of 18.66 L/s and 31.48 L/s were calculated for the basic day (BSDY) and maximum day

Master Servicing Study

Barrhaven South Urban Expansion Area

(MXDY), respectively. It should be noted that MXDY of 31.48 L/s includes an outside water usage of 10.15 L/s.

Table 7-2: Estimated Water Demands

Land Use	Area (ha)	Units	Pop.	ADD SFH ⁴	ADD MLT ⁵	ADD APT ⁶	ADD COM ⁷	ADD INS ⁸	Total BSDY	OWD ⁹	Total MXDY
Minto and Mattamy Lands											
Schools	4.55							2.63	2.63		2.63
Commercial	2.13						1.23		1.23		1.23
Medium-Low Density Residential	32.90	1080	3378	4.68	2.60				7.27	8.01	15.29
High Density Residential	0.90	120	216			0.55			0.55		0.55
Total	40.48	1200	3594	4.68	2.60	0.55	1.23	2.63	11.69	8.01	19.71
Brazeau Aggregate Extraction Area											
Schools	1.47							0.85	0.85		0.85
Commercial	0.67						0.39		0.39		0.39
Medium-Low Density Residential	10.30	360	1126	1.56	0.87				2.42	2.67	5.10
High Density Residential	0.28	38	68			0.17			0.17		0.17
Total	12.72	398	1194	1.56	0.87	0.17	0.39	0.85	3.84		6.51
Drummond Aggregate Extraction Area											
Schools	1.25							0.72	0.72		0.72
Commercial	0.57						0.33		0.33		0.33

⁴ Daily Demand, Single Family Homes, L/s

⁵ Average Daily Demand, Multi-Units (Townhouses and Back to Back Unit) L/s

⁶ Average Daily Demand, Apartment Units, L/s

⁷ Average Daily Demand, Commercial, L/s

⁸ Average Daily Demand, Institutional, L/s

Master Servicing Study Barrhaven South Urban Expansion Area

Medium-Low Density Residential	8.72	288	900	1.25	0.69				1.94	2.14	4.07
High Density Residential	0.24	32	58			0.15			0.15		0.15
Total	10.78	320	958	1.25	0.69	0.15	0.33	0.72	3.14	2.14	5.28
Barrhaven South Urban Expansion Area Totals											
Total	63.98	1918	5746	7.48	4.16	0.87	1.95	4.21	18.66	10.15	31.48

7.2.3 Watermain Sizing and Roughness

The overall watermain layout for the BSUEA is shown on Drawing MWM. Watermain roughness coefficients were determined using the friction factors presented in Section 4.2.12 of the Design Guidelines and summarized in Table 7-3 below. The internal pipe diameters were modelled based on Section 4.3.5 of the Design Guidelines, as summarized in Table 7-4 below.

Table 7-3: Watermain Roughness Coefficients

Watermain Diameter	C-Factor
150 mm	100
200 to 250 mm	110
300 to 600 mm	120
Over 600 mm	130

Table 7-4: PVC Watermain Internal Diameters

Nominal Diameter	Inside Diameter
150 mm	155 mm
200 mm	204 mm
300 mm	297 mm
400 mm	393 mm

7.2.4 Fire Flow

The City standard in regard to fire protection is the Fire Underwriters Survey and Technical Bulletin ISDTB-2014-02. To evaluate the proposed water distribution system, a fire flow of 13,000 L/min (217 L/s) was used in this system level analysis in accordance with the recommendations of the 2013 Water Master Plan.

September 16, 2019

Sent by email: KMurphy@dseI.ca



David Schaeffer Engineering Ltd.
120 Iber Road, Unit 103
Stittsville, ON K2S 1E9

Attention: Mr. Kevin Murphy, P.Eng.
Senior Client Manager

Re: Water Distribution Network Boundary Condition Request
Brazeau Land Development
GeoAdvice Project ID: 2019-091-DSE

Dear Mr. Murphy,

In order to carry out the watermain analysis and hydraulic modeling for the Brazeau Land Development in the City of Ottawa, we request the hydraulic boundary conditions (HGL) for the proposed connection points as shown on the attached schematic. Flow conditions are outlined in the attached consumer water demand calculations.

Boundary conditions at the Connection Points 1 and 2 are required for the following demand conditions:

- **Phase 1 (Includes The Meadows Phases 7/8 demands)**
 - Minimum hour demand = 5.23 L/s
 - Average day demand = 10.45 L/s
 - Maximum day demand = 23.56 L/s
 - Maximum day demand + fire flow
 - 167 L/s fire flow = 190.56 L/s
 - 250 L/s fire flow = 273.56 L/s
 - Peak hour demand = 50.30 L/s

- **Phase 1 + 2 (Includes The Meadows Phases 7/8 demands)**
 - Minimum hour demand = 7.05 L/s
 - Average day demand = 14.10 L/s
 - Maximum day demand = 32.69 L/s
 - Maximum day demand + fire flow
 - 167 L/s fire flow = 199.69 L/s
 - 250 L/s fire flow = 282.69 L/s
 - Peak hour demand = 70.37 L/s

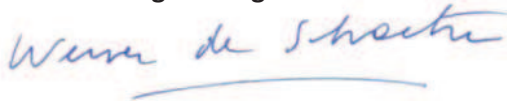
Please note the following:

- Demands from the Meadows Phases 7/8 are included in the above demand conditions. The inclusion of these demands is required due to the location of Connection 1. It is recommended that these demands only be applied to Connection 1. No other development demands were included (e.g. Drummond and Minto).
- The Phase 1 and 2 demands and fire flows should be applied equally between Connection Points 1 and 2.
- The attached FUS calculations have been completed in accordance with the latest City of Ottawa Technical Bulletin ISTB-2018-02 and ISDTB-2014-02 4.2.
- For the traditional townhomes not complying with the conditions of City of Ottawa Technical Bulletin ISDTB-2014-02 4.2 (Blocks 384 and 168), additional FUS calculations were completed, resulting in required fire flows of 167 L/s for each block.

If you have any questions, please do not hesitate to contact me.

Yours truly,

GeoAdvice Engineering Inc.

A handwritten signature in blue ink that reads "Werner de Schaetzen".

Werner de Schaetzen, Ph.D., P.Eng.

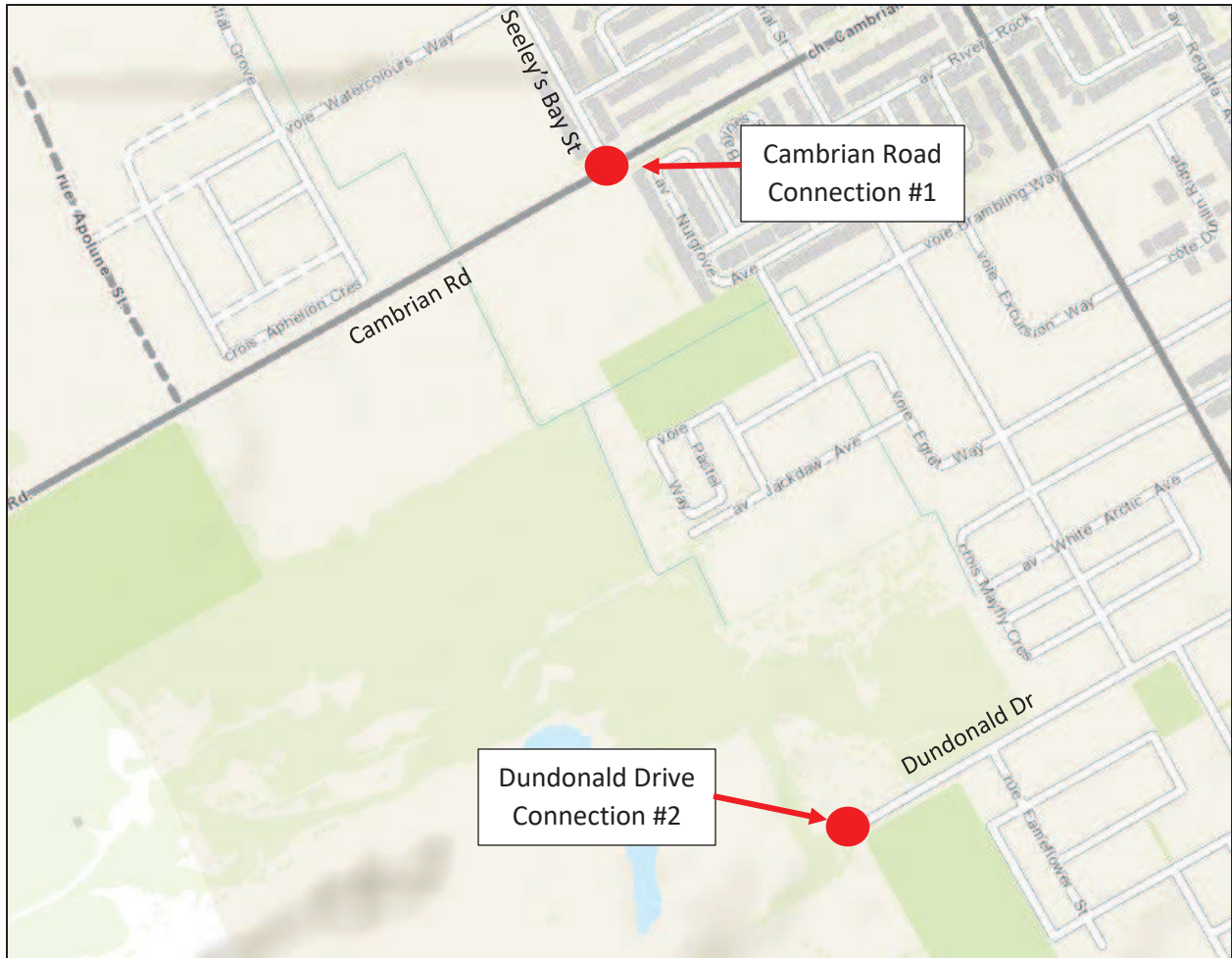
President and Chief Executive Officer

werner@geoadvice.com

GeoAdvice Engineering Inc.

Attachments: Mark up for connection locations, demand calculations and FUS Fire Flow Calculations

Connection Locations



Consumer Water Demands

Phase 1 Residential Demands

Dwelling Type	Number of Units	Population **		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	162	3.4	551	350	192,850	2.23	5.58	167*	12.28	1.12
Traditional Townhome	133	2.7	360		126,000	1.46	3.65	167*	8.02	0.73
Subtotal	295		911		318,850	3.69	9.23		20.30	1.85

Phase 1 + 2 Residential Demands

Dwelling Type	Number of Units	Population **		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	311	3.4	1,058	350	370,300	4.29	10.71	167*	23.57	2.14
Traditional Townhome	279	2.7	754		263,900	3.05	7.64	167*	16.80	1.53
Subtotal	590		1,812		634,200	7.34	18.35		40.37	3.67

Phase 1 Non Residential Demands

Property Type	Area (ha)	Average Day Demand			Max Day 1.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 1.8 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)	
		** (L/ha/d)	(L/d)	(L/s)					
Park	1.72		28,000	48,160	0.56	0.84	250**	1.51	0.28
Subtotal	1.72			48,160	0.56	0.84		1.51	0.28

The Meadows Phases 7/8

	ADD	MDD	PHD	MHD
Total Demand:	6.20	13.50	28.50	3.10

	ADD	MDD	PHD	MHD
Without the Meadows Phases 7/8 Demands				
Phase 1	4.25	10.06	21.80	2.12
Phase 1 + 2	7.90	19.19	41.88	3.95

	ADD	MDD	PHD	MHD
With the Meadows Phases 7/8 Demands				
Phase 1	10.45	23.56	50.30	5.23
Phase 1 + 2	14.10	32.69	70.37	7.05

*Based on FUS fire flow calculation

**Assumed based on similar information from previously completed projects, as agreed upon with DSEL

FUS Required Fire Flow Calculation

Client: David Schaeffer Engineering Ltd.

Project: 2019-091-DSE

Development: Brazeau Lands

Blocks 300-313, Single Detached

Zoning: Multi Family Residential

Date: September 16, 2019

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.



A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 1927 m²
 Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2
 Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

D. Required Fire Flow*: $F = 220C\sqrt{A}$

C: Coefficient related to the type of construction

A: Effective area

The total floor area in m² in the building being considered

$$C = \frac{1.5}{1}$$

$$A = 3854 \text{ m}^2 \quad (\text{Combined area of 14 units})$$

$$F = 20,486 \text{ L/min} \quad D = 20,000 \text{ L/min}^*$$

E. Occupancy

Occupancy content hazard Limited Combustible

$$-15 \% \text{ of } D \quad -3,000 \text{ L/min} \quad E = 17,000 \text{ L/min}$$

F. Sprinkler Protection

Automatic sprinkler protection None

$$0 \% \text{ of } E \quad 0 \text{ L/min} \quad F = 17,000 \text{ L/min}$$

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	20.1 to 30 m	0-30 m-storeys	Wood Frame or Non-Combustible	8%
East	20.1 to 30 m	0-30 m-storeys	Wood Frame or Non-Combustible	8%
North	10.1 to 20 m	Over 120 m-storeys	Wood Frame or Non-Combustible	15%
South	20.1 to 30 m	Over 120 m-storeys	Wood Frame or Non-Combustible	10%
Total				41%

$$\% \text{ of } E \quad + 6,970 \text{ L/min} \quad G = 23,970 \text{ L/min}$$

H. Wood Shake Charge

For wood shingle or shake roofs No

$$0 \text{ L/min} \quad H = 23,970 \text{ L/min}$$

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.1. The single detached dwellings comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	10,000 L/min*
	167 L/s
Required Duration of Fire Flow	2 Hrs
Required Volume of Fire Flow	1,200 m³

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m ²)	3,854
Required Fire Flow (L/min)	20,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	8%
East (%)	8%
South (%)	15%
West (%)	10%
Total Exposure (%)	41%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167

FUS Required Fire Flow Calculation

Client: David Schaeffer Engineering Ltd.

Project: 2019-091-DSE

Development: Brazeau Lands

Blocks 173, Traditional Townhouse

Zoning: Multi Family Residential

Date: September 16, 2019

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.



A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 474 m²
 Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2
 Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

D. Required Fire Flow*: $F = 220C\sqrt{A}$
 C: Coefficient related to the type of construction
 A: Effective area
 The total floor area in m² in the building being considered

Note: The townhouse dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 5 units is considered in this calculation.

$$C = \frac{1.5}{A = 947 \text{ m}^2} \quad (\text{Combined area of 5 units})$$

$$F = 10,156 \text{ L/min} \quad D = 10,000 \text{ L/min}^*$$

E. Occupancy
 Occupancy content hazard: Limited Combustible
 -15 % of D -1,500 L/min $E = 8,500 \text{ L/min}$

F. Sprinkler Protection
 Automatic sprinkler protection: None
 0 % of E 0 L/min $F = 8,500 \text{ L/min}$

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
East	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
North	10.1 to 20 m	61-90 m-storeys	Wood Frame or Non-Combustible	14%
South	20.1 to 30 m	31-60 m-storeys	Wood Frame or Non-Combustible	8%
Total				56%

$$\% \text{ of E } \quad + 4,760 \text{ L/min} \quad G = 13,260 \text{ L/min}$$

H. Wood Shake Charge No 0 L/min $H = 13,260 \text{ L/min}$
 For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The townhouse dwellings comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	10,000 L/min*
	167 L/s
Required Duration of Fire Flow	2 Hrs
Required Volume of Fire Flow	1,200 m³

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m ²)	947
Required Fire Flow (L/min)	10,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	17%
East (%)	17%
South (%)	14%
West (%)	8%
Total Exposure (%)	56%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167

FUS Required Fire Flow Calculation

Client: David Schaeffer Engineering Ltd.

Project: 2019-091-DSE

Development: Brazeau Lands

Zoning: Multi Family Residential

Blocks 384, Traditional Townhouse

Date: September 16, 2019

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.



A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 380 m²
 Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2
 Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

D. Required Fire Flow*: $F = 220C\sqrt{A}$
 C: Coefficient related to the type of construction
 A: Effective area
 The total floor area in m² in the building being considered

Note: The townhouse dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 4 units is considered in this calculation.

$$C = \frac{1.5}{760 \text{ m}^2} \quad (\text{Combined area of 4 units})$$

$$F = 9,095 \text{ L/min} \quad D = 9,000 \text{ L/min}^*$$

E. Occupancy
 Occupancy content hazard: Limited Combustible
 -15 % of D -1,350 L/min $E = 7,650 \text{ L/min}$

F. Sprinkler Protection
 Automatic sprinkler protection: None
 0 % of E 0 L/min $F = 7,650 \text{ L/min}$

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	10.1 to 20 m	0-30 m-storeys	Wood Frame or Non-Combustible	12%
East	Beyond 45 m	0-30 m-storeys	Wood Frame or Non-Combustible	0%
North	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
South	20.1 to 30 m	0-30 m-storeys	Wood Frame or Non-Combustible	8%
Total				37%

$$\% \text{ of E } \quad + 2,831 \text{ L/min} \quad G = 10,481 \text{ L/min}$$

H. Wood Shake Charge No 0 L/min $H = 10,481 \text{ L/min}$
 For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The townhouse dwellings do not comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	10,000 L/min*
	167 L/s
Required Duration of Fire Flow	2 Hrs
Required Volume of Fire Flow	1,200 m³

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m ²)	760
Required Fire Flow (L/min)	9,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	12%
East (%)	0%
South (%)	17%
West (%)	8%
Total Exposure (%)	37%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167

FUS Required Fire Flow Calculation

Client: David Schaeffer Engineering Ltd.

Project: 2019-091-DSE

Development: Brazeau Lands

Zoning: Multi Family Residential

Blocks 168, Traditional Townhouse

Date: September 16, 2019

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.



A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 380 m²
 Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2
 Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

D. Required Fire Flow*: $F = 220C\sqrt{A}$
 C: Coefficient related to the type of construction
 A: Effective area
 The total floor area in m² in the building being considered

Note: The townhouse dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 4 units is considered in this calculation.

$$C = \frac{1.5}{760 \text{ m}^2} \quad (\text{Combined area of 4 units})$$

$$F = 9,095 \text{ L/min} \quad D = 9,000 \text{ L/min}^*$$

E. Occupancy
 Occupancy content hazard: Limited Combustible
 -15 % of D -1,350 L/min $E = 7,650 \text{ L/min}$

F. Sprinkler Protection
 Automatic sprinkler protection: None
 0 % of E 0 L/min $F = 7,650 \text{ L/min}$

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	30.1 to 45 m	0-30 m-storeys	Wood Frame or Non-Combustible	5%
East	10.1 to 20 m	0-30 m-storeys	Wood Frame or Non-Combustible	12%
North	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
South	Beyond 45 m	31-60 m-storeys	Wood Frame or Non-Combustible	0%
Total				34%

$$\% \text{ of E } \quad + 2,601 \text{ L/min} \quad G = 10,251 \text{ L/min}$$

H. Wood Shake Charge No 0 L/min $H = 10,251 \text{ L/min}$
 For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The townhouse dwellings do not comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	10,000 L/min*
	167 L/s
Required Duration of Fire Flow	2 Hrs
Required Volume of Fire Flow	1,200 m³

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m ²)	760
Required Fire Flow (L/min)	9,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	5%
East (%)	12%
South (%)	17%
West (%)	0%
Total Exposure (%)	34%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167



Hydraulic Capacity and Modeling Analysis Brazeau Lands

Final Report

Prepared for:

David Schaeffer Engineering Ltd.
120 Iber Road, Unit 103
Stittsville, ON K2S 1E9

Prepared by:

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Port Moody, BC V3H 2B4

Submission Date: July 28, 2020

Contact: Mr. Werner de Schaetzen, Ph.D., P.Eng.

Project: 2019-091-DSE

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Document History and Version Control

Revision No.	Date	Document Description	Revised By	Reviewed By
R0	November 7, 2019	Draft	Ben Loewen	Werner de Schaetzen
R1	December 20, 2019	Final	Ben Loewen	Werner de Schaetzen
R2	June 10, 2020	Updated Draft	Ferdinand de Schoutheete	Werner de Schaetzen
R3	July 28, 2020	Final	Ferdinand de Schoutheete	Werner de Schaetzen

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Project ID: 2019-091-DSE

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ENGINEERS &
GEOLOGISTS
BRITISH COLUMBIA





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1 Introduction

GeoAdvice Engineering Inc. (“GeoAdvice”) was retained by David Schaeffer Engineering Ltd. (“DSEL”) to size the proposed water main network for the Brazeau Lands development (“Development”) in the City of Ottawa, ON (“City”).

Under existing conditions, the development will be serviced by the Barrhaven pressure zone; however, in the future, it will be serviced by pressure zone 3C.

There are 347 single detached dwellings, 279 traditional townhomes and 1 park serviced as part of the development.

The Brazeau Lands development will have three (3) connections to the City water distribution system:

- Connection 1: Apolune Street and Cambrian Road;
- Connection 2: Jackdaw Avenue and Future Greenbank Road; and
- Connection 3: Dundonald Drive and Future Greenbank Road.

The development site is shown in **Figure 1.1** on the following page, with the final recommended pipe diameters.

This report describes the assumptions and results of the hydraulic modeling and capacity analysis using InfoWater (Innovyze), a GIS water distribution system modeling and management software application.

The results presented in this memo are based on the analysis of steady state simulations. The predicted available fire flows, as calculated by the hydraulic model, represent the flow available in the water main while maintaining a residual pressure of 20 psi. No extended period simulations were completed in this analysis to assess the water quality or to assess the hydraulic impact on storage and pumping.

Connection #1
Cambrian Road

Connection #2
Brambling Way

The Meadows
Phases 7/8

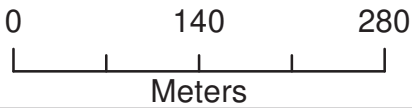
Connection #3
Dundonald Drive

Legend

- Junction
- ⊡ Connection Point
- Pipe Diameter
 - 200 mm
 - 250 mm
 - 300 mm

Phase 1

Phase 2



GeoAdvice Engineering Inc.

Project: Hydraulic Capacity and Modeling Analysis of the Brazeau Lands

Client: David Schaeffer Engineering Ltd.

Date: June 2020

Created by: BL

Reviewed by: WdS

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Brazeau Lands Site
Layout and Connection
Points

Figure 1.1



2 Modeling Considerations

2.1 Water Main Configuration

The water main network was modeled based on the drawing prepared by DSEL (1030_Gen_Rev4.dwg) and provided to GeoAdvice on June 2nd, 2020.

2.2 Elevations

Elevations of the modeled junctions were assigned according to a site grading plan prepared by DSEL (1030_Grad_Rev4.dwg) and provided to GeoAdvice on June 2nd, 2020.

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Demand factors used for this analysis were taken according to the City of Ottawa 2010 Design Guidelines *Table 4.2 Consumption Rate for Subdivisions of 501 to 3,000 Persons*. Population densities were assigned according to *Table 4.1 Per Unit Populations* from the City of Ottawa Design Guidelines. A summary of these tables highlighting relevant data for this development is shown in **Table 2.1** below.

Table 2.1: City of Ottawa Demand Factors

Demand Type	Amount	Units
Average Day Demand		
Residential	350	L/c/d
Park	28,000	L/ha/d
Maximum Daily Demand		
Residential	2.5 x avg. day	L/c/d
Park	1.5 x avg. day	L/ha/d
Peak Hour Demand		
Residential	2.2 x max. day	L/c/d
Park	1.8 x max. day	L/ha/d
Minimum Hour Demand		
Residential	0.5 x avg. day	L/c/d
Park	0.5 x avg. day	L/ha/d

Table 2.2 and **Table 2.4** summarize the residential water demand calculations for the Brazeau Lands development.



Table 2.2: Development Population and Demand Calculations – Phase 1

Dwelling Type	Number of Units	Persons Per Unit*	Population	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Single Detached	172	3.4	585	2.37	5.92	13.03	1.18
Traditional Townhome	133	2.7	360	1.46	3.65	8.02	0.73

*City of Ottawa Design Guidelines

Table 2.3: Development Population and Demand Calculations – Phases 1&2

Dwelling Type	Number of Units	Persons Per Unit*	Population	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Single Detached	347	3.4	1,180	4.78	11.95	26.29	2.39
Traditional Townhome	279	2.7	754	3.05	7.64	16.80	1.53

*City of Ottawa Design Guidelines

Table 2.6 summarizes the non-residential water demand calculations for the Brazeau Lands development (included in both Phase 1 and Phases 1&2).

Table 2.4: Non-Residential Demand Calculations

Land Use Type	Area (ha)	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Park	1.72	0.56	0.84	1.51	0.28

Table 2.5 summarizes the demands for the Meadows Phases 7/8 subdivision development located north of the Brazeau Lands and downstream of Connections 1 and 2 (accounted for in the HGLs provided by the City in the boundary conditions request).



Table 2.5: The Meadows Phases 7/8

Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
6.20	13.50	28.50	3.10

Demands were grouped into demand polygons then uniformly distributed to the model nodes located within each polygon. Detailed calculations of demands as well as the illustrated allocation areas are shown in **Appendix A**.

2.4 Fire Flow Demand

Fire flow calculations were completed for all dwelling types in accordance with the Fire Underwriters Survey's (FUS) Water Supply for Public Fire Protection Guideline (1999) and City of Ottawa Technical Bulletin ISTB-2018-02 as summarized in **Appendix B**.

All the single detached dwellings have a minimum separation of 10 m between the backs of adjacent units and are, therefore, subject to the 10,000 L/min (167 L/s) cap outlined in City of Ottawa Technical Bulletin ISDTB-2014-02.

Most of the traditional townhouse dwellings comply with the City of Ottawa Technical Bulletin ISDTB-2014-02 and are, therefore, subject to the 10,000 L/min (167 L/s) cap.

The traditional townhouse dwellings located on Blocks 168 and 384 do not have a minimum separation of 10 m between the backs of adjacent units and therefore do not comply with the provisions under the City of Ottawa Technical Bulletin ISDTB-2014-02. The required fire flow for those blocks were calculated to be 167 L/s based on the Fire Underwriters Survey's (FUS) Water Supply for Public Fire Protection Guideline (1999). The agreement of this calculation with the City of Ottawa cap of 167 L/s is purely coincidental.

At this time, there is not enough information available to calculate the required fire flow of the park. As such, a required fire flow of 250 L/s was assumed for the park. This is a typical, conservative value for similar land use.

Fire flow simulations were completed at each model node in the Brazeau development. The locations of nodes do not necessarily represent hydrant locations.

Detailed FUS fire flow calculations as well as the illustrated spatial allocation of the required fire flows are shown in **Appendix B**.



2.5 Boundary Conditions

The boundary conditions were provided by the City of Ottawa in the form of Hydraulic Grade Line (HGL) at the following locations:

- Connection 1: Apolune Street and Cambrian Road;
- Connection 2: Jackdaw Avenue and Future Greenbank Road; and
- Connection 3: Dundonald Drive and Future Greenbank Road.

The above connection points are illustrated in **Figure 1.1**.

Boundary conditions were provided for Peak Hour, Maximum Day plus Fire and Minimum Hour (high pressure check) conditions.

Under existing conditions, the Brazeau Lands development will be serviced by the Barrhaven pressure zone; however, in the future, it will be serviced by pressure zone 3C. As such, boundary conditions were provided under the existing and future pressure zone configurations.

In total, two (2) sets of boundary conditions were provided by the City and can be found in **Appendix C**.

The boundary conditions for the existing pressure zone configuration are more conservative. As such, the results presented in this report are based on the boundary conditions for the existing pressure zone configuration.

Table 2.6 summarizes the boundary conditions used to size the Brazeau Lands water network.

Table 2.6: Existing Boundary Conditions

Condition	Connection 1 HGL (m)	Connection 2 HGL (m)	Connection 3 HGL (m)
Min Hour (max. pressure)	156.4	156.4	156.4
Peak Hour (min. pressure)	135.7	135.6	135.7
Max Day + Fire Flow (167 L/s)	144.0	141.2	142.0
Max Day + Fire Flow (250 L/s)	135.4	129.9	131.5



3 Hydraulic Capacity Design Criteria

3.1 Pipe Characteristics

Pipe characteristics of internal diameter (ID) and Hazen-Williams C factors were assigned in the model according to the City of Ottawa Design Guidelines for PVC water main material. Pipe characteristics used for the development are outlined in **Table 3.1** below.

Table 3.1: Model Pipe Characteristics

Nominal Diameter (mm)	ID PVC (mm)	Hazen Williams C-Factor (/)
200	204	110
250	250	110
300	297	120

3.2 Pressure Requirements

As outlined in the City of Ottawa Design Guidelines, the generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi). The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way shall not exceed 552 kPa (80 psi). Pressure requirements are outlined in **Table 3.2**.

Table 3.2: Pressure Requirements

Demand Condition	Minimum Pressure		Maximum Pressure	
	(kPa)	(psi)	(kPa)	(psi)
Normal Operating Pressure (maximum daily flow)	350	50	480	70
Peak Hour Demand (minimum allowable pressure)	276	40	-	-
Maximum Fixture Pressure (Ontario Building Code)	-	-	552	80
Maximum Distribution Pressure (minimum hour check)	-	-	552	80
Maximum Day Plus Fire	140	20	-	-



4 Hydraulic Capacity Analysis

The proposed water mains within the development were sized to the minimum diameter which would satisfy the greater of maximum day plus fire and peak hour demand. Modeling was carried out for minimum hour, peak hour and maximum day plus fire flow using InfoWater. Only the existing pressure zone configuration was analyzed, since the boundary conditions are more conservative.

Detailed pipe and junction model input data can be found in **Appendix D**.

4.1 Development Pressure Analysis

Modeled service pressures for the development are summarized in **Table 4.1** below.

Table 4.1: Summary of the Brazeau Lands Available Service Pressures

Phase	Minimum Hour Demand Maximum Pressure	Peak Hour Demand Minimum Pressure
Phase 1	538 kPa (78 psi)	290 kPa (42 psi)
Phases 1&2	538 kPa (78 psi)	262 kPa (38 psi)

As outlined in the City of Ottawa Design Guidelines, the generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi). The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way shall not exceed 552 kPa (80 psi).

Low pressures are predicted at junctions J-66, J-70, J-71, J-72, J-73, J-74, J-75, J-76 and J-77 under peak hour demand. Those low pressures are due to high elevations in the southern part of the Brazeau Lands development and are within 5% of the minimum allowable pressure of 276 kPa (40 psi). The future Zone 3C boundary conditions will provide an additional head of about seven (7) meters at each connection point, and will thus resolve the low PHD pressures at the southern part of the Brazeau Lands development.

Detailed pipe and junction result tables and maps can be found in **Appendix E**.



4.2 Development Fire Flow Analysis

A summary of the minimum available fire flows in the Brazeau Lands development is shown below in **Table 4.2**.

Table 4.2: Summary of the Brazeau Lands Minimum Available Fire Flows

Phase	Required Fire Flow	Minimum Available Flow	Junction ID
Phase 1	167 L/s	177 L/s	J-45
	250 L/s	249 L/s	J-47
Phases 1&2	167 L/s	194 L/s	J-66
	250 L/s	269 L/s	J-47

As shown in the table above, the available fire flow is greater than the required fire flow under both Phase 1 and Phases 1&2 conditions.

A summary of the residual pressures in the Brazeau Lands is shown below in **Table 4.3**. The minimum allowable pressure under fire flow conditions is 140 kPa (20 psi) at the location of the fire.



Table 4.3: Summary of the Brazeau Lands Residual Pressures (MDD + FF)

Phase	Maximum Residual Pressure	Average Residual Pressure	Minimum Residual Pressure
Phase 1	365 kPa (53 psi)	296 kPa (43 psi)	140 kPa (20 psi)
Phases 1&2	365 kPa (53 psi)	296 kPa (43 psi)	159 kPa (23 psi)

There is sufficient residual pressure at all the junctions within the Brazeau Lands development.

Detailed fire flow results and figures illustrating the fire flow results can be found in **Appendix F**.



5 Other Servicing Considerations

5.1 Water Supply Security

The City of Ottawa Design Guidelines allow single feed systems for developments up to a total average day demand of 50 m³/day and require two (2) feeds if the development exceeds 50 m³/day for supply security, according to Technical Bulletin ISDTB-2014-02.

The Brazeau Lands services a total average day demand of 725 m³/day; as such, two (2) feeds are required.

5.2 Valves

No comment has been made in this technical memorandum with respect to exact placement of isolation valves within the distribution network for the Brazeau Lands other than to summarize the City of Ottawa Design Guidelines for number, location, and spacing of isolation valves:

- Tee intersection – two (2) valves
- Cross intersection – three (3) valves
- Valves shall be located 2 m away from the intersection
- 300 m spacing for 150 mm to 400 mm diameter valves
- Gate valves for 100 mm to 300 mm diameter mains
- Butterfly valves for 400 mm and larger diameter mains

Drain valves are not strictly required under the City of Ottawa Design Guidelines for water mains under 600 mm in diameter. The Guidelines indicate that “small diameter water mains shall be drained through hydrant via pumping if needed.”

Air valves are not strictly required under the City of Ottawa Design Guidelines for water mains up to and including 400 mm in diameter. The Guidelines indicate that air removal “can be accomplished by the strategic positioning of hydrant at the high points to remove the air or by installing or utilizing available 50 mm chlorination nozzles in 300 mm and 400 mm chambers.”

The detailed engineering drawings for the Brazeau Lands are expected to identify valves in accordance with the requirements noted above.



5.3 Hydrants

No comment has been made in this technical memorandum with respect to exact placement of hydrants within the distribution network for the Brazeau Lands other than to summarize the City of Ottawa Design Guidelines for maximum hydrant spacing:

- 125 m for single family unit residential areas on lots where frontage at the street line is 15 m or longer
- 110 m for single family unit residential areas on lots where frontage at the street line is less than 15 m and for residential areas zoned for row housing, doubles or duplexes
- 90 m for institutional, commercial, industrial, apartments and high-density areas

The detailed engineering drawings for the Brazeau Lands development are expected to identify hydrants in accordance with the requirements noted above.



6 Conclusions

The hydraulic capacity and modeling analysis of Phase 1 of the Brazeau Lands development yielded the following conclusions:

- The proposed water main network can deliver all domestic flows, with service pressures expected to range between 290 kPa (42 psi) and 538 kPa (78 psi).
- The proposed water main network is able to deliver fire flows to all junctions.
- Hydraulic modeling was only completed for the existing pressure zone configuration since the boundary conditions are more conservative.

The hydraulic capacity and modeling analysis of Phases 1&2 of the Brazeau Lands development yielded the following conclusions:

- The proposed water main network can deliver all domestic flows except for junctions J-66, J-70, J-71, J-72, J-73, J-74, J-75, J-76 and J-77, with service pressures expected to range between 262 kPa (38 psi) and 538 kPa (78 psi).
- The junctions with low pressures are due to high elevations in the southern part of the Brazeau Lands development and are within 5% of the minimum allowable pressure of 276 kPa (40 psi).
- The future Zone 3C boundary conditions will provide an additional head of about seven (7) meters at each connection point, and will thus resolve the low PHD pressures at the southern part of the Brazeau Lands development.
- The proposed water main network is able to deliver fire flows to all junctions.
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Submission

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Approved by:

Werner de Schaetzen, Ph.D., P.Eng.
Senior Modeling Review / Project Manager



Hydraulic Capacity and Modeling Analysis Brazeau Lands

Final Report

Prepared for:

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120 Iber Road, Unit 103
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Prepared by:

GeoAdvice Engineering Inc.
Unit 203, 2502 St. John's Street
Port Moody, BC V3H 2B4

Submission Date: July 28, 2020

Contact: Mr. Werner de Schaetzen, Ph.D., P.Eng.

Project: 2019-091-DSE

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Document History and Version Control

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R0	November 7, 2019	Draft	Ben Loewen	Werner de Schaetzen
R1	December 20, 2019	Final	Ben Loewen	Werner de Schaetzen
R2	June 10, 2020	Updated Draft	Ferdinand de Schoutheete	Werner de Schaetzen
R3	July 28, 2020	Final	Ferdinand de Schoutheete	Werner de Schaetzen

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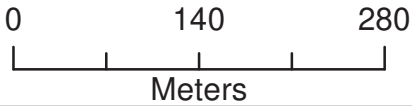
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Brambling Way

The Meadows
Phases 7/8

Connection #3
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Phase 1

Phase 2



Legend

- Junction
- ⊡ Connection Point
- Pipe Diameter
- 200 mm
- 250 mm
- 300 mm



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Table 2.2 and **Table 2.4** summarize the residential water demand calculations for the Brazeau Lands development.



Table 2.2: Development Population and Demand Calculations – Phase 1

Dwelling Type	Number of Units	Persons Per Unit*	Population	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
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Table 2.3: Development Population and Demand Calculations – Phases 1&2

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Under existing conditions, the Brazeau Lands development will be serviced by the Barrhaven pressure zone; however, in the future, it will be serviced by pressure zone 3C. As such, boundary conditions were provided under the existing and future pressure zone configurations.

In total, two (2) sets of boundary conditions were provided by the City and can be found in **Appendix C**.

The boundary conditions for the existing pressure zone configuration are more conservative. As such, the results presented in this report are based on the boundary conditions for the existing pressure zone configuration.

Table 2.6 summarizes the boundary conditions used to size the Brazeau Lands water network.

Table 2.6: Existing Boundary Conditions

Condition	Connection 1 HGL (m)	Connection 2 HGL (m)	Connection 3 HGL (m)
Min Hour (max. pressure)	156.4	156.4	156.4
Peak Hour (min. pressure)	135.7	135.6	135.7
Max Day + Fire Flow (167 L/s)	144.0	141.2	142.0
Max Day + Fire Flow (250 L/s)	135.4	129.9	131.5



3 Hydraulic Capacity Design Criteria

3.1 Pipe Characteristics

Pipe characteristics of internal diameter (ID) and Hazen-Williams C factors were assigned in the model according to the City of Ottawa Design Guidelines for PVC water main material. Pipe characteristics used for the development are outlined in **Table 3.1** below.

Table 3.1: Model Pipe Characteristics

Nominal Diameter (mm)	ID PVC (mm)	Hazen Williams C-Factor (/)
200	204	110
250	250	110
300	297	120

3.2 Pressure Requirements

As outlined in the City of Ottawa Design Guidelines, the generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi). The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way shall not exceed 552 kPa (80 psi). Pressure requirements are outlined in **Table 3.2**.

Table 3.2: Pressure Requirements

Demand Condition	Minimum Pressure		Maximum Pressure	
	(kPa)	(psi)	(kPa)	(psi)
Normal Operating Pressure (maximum daily flow)	350	50	480	70
Peak Hour Demand (minimum allowable pressure)	276	40	-	-
Maximum Fixture Pressure (Ontario Building Code)	-	-	552	80
Maximum Distribution Pressure (minimum hour check)	-	-	552	80
Maximum Day Plus Fire	140	20	-	-



4 Hydraulic Capacity Analysis

The proposed water mains within the development were sized to the minimum diameter which would satisfy the greater of maximum day plus fire and peak hour demand. Modeling was carried out for minimum hour, peak hour and maximum day plus fire flow using InfoWater. Only the existing pressure zone configuration was analyzed, since the boundary conditions are more conservative.

Detailed pipe and junction model input data can be found in **Appendix D**.

4.1 Development Pressure Analysis

Modeled service pressures for the development are summarized in **Table 4.1** below.

Table 4.1: Summary of the Brazeau Lands Available Service Pressures

Phase	Minimum Hour Demand Maximum Pressure	Peak Hour Demand Minimum Pressure
Phase 1	538 kPa (78 psi)	290 kPa (42 psi)
Phases 1&2	538 kPa (78 psi)	262 kPa (38 psi)

As outlined in the City of Ottawa Design Guidelines, the generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi). The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way shall not exceed 552 kPa (80 psi).

Low pressures are predicted at junctions J-66, J-70, J-71, J-72, J-73, J-74, J-75, J-76 and J-77 under peak hour demand. Those low pressures are due to high elevations in the southern part of the Brazeau Lands development and are within 5% of the minimum allowable pressure of 276 kPa (40 psi). The future Zone 3C boundary conditions will provide an additional head of about seven (7) meters at each connection point, and will thus resolve the low PHD pressures at the southern part of the Brazeau Lands development.

Detailed pipe and junction result tables and maps can be found in **Appendix E**.



4.2 Development Fire Flow Analysis

A summary of the minimum available fire flows in the Brazeau Lands development is shown below in **Table 4.2**.

Table 4.2: Summary of the Brazeau Lands Minimum Available Fire Flows

Phase	Required Fire Flow	Minimum Available Flow	Junction ID
Phase 1	167 L/s	177 L/s	J-45
	250 L/s	249 L/s	J-47
Phases 1&2	167 L/s	194 L/s	J-66
	250 L/s	269 L/s	J-47

As shown in the table above, the available fire flow is greater than the required fire flow under both Phase 1 and Phases 1&2 conditions.

A summary of the residual pressures in the Brazeau Lands is shown below in **Table 4.3**. The minimum allowable pressure under fire flow conditions is 140 kPa (20 psi) at the location of the fire.



Table 4.3: Summary of the Brazeau Lands Residual Pressures (MDD + FF)

Phase	Maximum Residual Pressure	Average Residual Pressure	Minimum Residual Pressure
Phase 1	365 kPa (53 psi)	296 kPa (43 psi)	140 kPa (20 psi)
Phases 1&2	365 kPa (53 psi)	296 kPa (43 psi)	159 kPa (23 psi)

There is sufficient residual pressure at all the junctions within the Brazeau Lands development.

Detailed fire flow results and figures illustrating the fire flow results can be found in **Appendix F**.



5 Other Servicing Considerations

5.1 Water Supply Security

The City of Ottawa Design Guidelines allow single feed systems for developments up to a total average day demand of 50 m³/day and require two (2) feeds if the development exceeds 50 m³/day for supply security, according to Technical Bulletin ISDTB-2014-02.

The Brazeau Lands services a total average day demand of 725 m³/day; as such, two (2) feeds are required.

5.2 Valves

No comment has been made in this technical memorandum with respect to exact placement of isolation valves within the distribution network for the Brazeau Lands other than to summarize the City of Ottawa Design Guidelines for number, location, and spacing of isolation valves:

- Tee intersection – two (2) valves
- Cross intersection – three (3) valves
- Valves shall be located 2 m away from the intersection
- 300 m spacing for 150 mm to 400 mm diameter valves
- Gate valves for 100 mm to 300 mm diameter mains
- Butterfly valves for 400 mm and larger diameter mains

Drain valves are not strictly required under the City of Ottawa Design Guidelines for water mains under 600 mm in diameter. The Guidelines indicate that “small diameter water mains shall be drained through hydrant via pumping if needed.”

Air valves are not strictly required under the City of Ottawa Design Guidelines for water mains up to and including 400 mm in diameter. The Guidelines indicate that air removal “can be accomplished by the strategic positioning of hydrant at the high points to remove the air or by installing or utilizing available 50 mm chlorination nozzles in 300 mm and 400 mm chambers.”

The detailed engineering drawings for the Brazeau Lands are expected to identify valves in accordance with the requirements noted above.



5.3 Hydrants

No comment has been made in this technical memorandum with respect to exact placement of hydrants within the distribution network for the Brazeau Lands other than to summarize the City of Ottawa Design Guidelines for maximum hydrant spacing:

- 125 m for single family unit residential areas on lots where frontage at the street line is 15 m or longer
- 110 m for single family unit residential areas on lots where frontage at the street line is less than 15 m and for residential areas zoned for row housing, doubles or duplexes
- 90 m for institutional, commercial, industrial, apartments and high-density areas

The detailed engineering drawings for the Brazeau Lands development are expected to identify hydrants in accordance with the requirements noted above.



6 Conclusions

The hydraulic capacity and modeling analysis of Phase 1 of the Brazeau Lands development yielded the following conclusions:

- The proposed water main network can deliver all domestic flows, with service pressures expected to range between 290 kPa (42 psi) and 538 kPa (78 psi).
- The proposed water main network is able to deliver fire flows to all junctions.
- Hydraulic modeling was only completed for the existing pressure zone configuration since the boundary conditions are more conservative.

The hydraulic capacity and modeling analysis of Phases 1&2 of the Brazeau Lands development yielded the following conclusions:

- The proposed water main network can deliver all domestic flows except for junctions J-66, J-70, J-71, J-72, J-73, J-74, J-75, J-76 and J-77, with service pressures expected to range between 262 kPa (38 psi) and 538 kPa (78 psi).
- The junctions with low pressures are due to high elevations in the southern part of the Brazeau Lands development and are within 5% of the minimum allowable pressure of 276 kPa (40 psi).
- The future Zone 3C boundary conditions will provide an additional head of about seven (7) meters at each connection point, and will thus resolve the low PHD pressures at the southern part of the Brazeau Lands development.
- The proposed water main network is able to deliver fire flows to all junctions.
- Hydraulic modeling was only completed for the existing pressure zone configuration since the boundary conditions are more conservative.



Submission

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Appendix A Domestic Water Demand Calculations and Allocation



Appendix A Domestic Water Demand Calculations and Allocation

Legend

- Junction
- ⊡ Connection Point
- Water Main
- Demand Polygon

Connection #3
Dundonald Drive



GeoAdvice Engineering Inc.

Project: Hydraulic Capacity and Modeling Analysis of the Brazeau Lands
Client: David Schaeffer Engineering Ltd.
Date: June 2020
Created by: BL
Reviewed by: WdS

DISCLAIMER: GeoAdvice does not warrant in any way the accuracy and completeness of the information shown on this map. Field verification of the accuracy and completeness of the information shown on this map is the sole responsibility of the user.

Demand Allocation Phases 1&2

Figure A.1

Consumer Water Demands

Phase 1 Residential Demands

Dwelling Type	Number of Units	Population **		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	172	3.4	585	350	204,750	2.37	5.92	167*	13.03	1.18
Traditional Townhome	133	2.7	360		126,000	1.46				
Subtotal	305		945		330,750	3.83	9.57		21.05	1.91

Phases 1&2 Residential Demands

Dwelling Type	Number of Units	Population **		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	347	3.4	1,180	350	413,000	4.78	11.95	167*	26.29	2.39
Traditional Townhome	279	2.7	754		263,900	3.05				
Subtotal	626		1,934		676,900	7.83	19.59		43.09	3.92

Non Residential Demands

Property Type	Area (ha)	Average Day Demand			Max Day 1.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 1.8 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)	
		** (L/ha/d)	(L/d)	(L/s)					
Park w/ Splash Pad	1.72		28,000	48,160	0.56	0.84	250**	1.51	0.28
Subtotal	1.72			48,160	0.56	0.84		1.51	0.28

The Meadows Phases 7/8

	ADD (L/s)	MDD (L/s)	PHD (L/s)	MHD (L/s)
Total Demand:	6.20	13.50	28.50	3.10

	ADD (L/s)	MDD (L/s)	PHD (L/s)	MHD (L/s)	
Without the Meadows Phases 7/8 Demands	Phase 1	4.39	10.41	22.56	2.19
	Phases 1&2	8.39	20.42	44.59	4.20

	ADD (L/s)	MDD (L/s)	PHD (L/s)	MHD (L/s)	
With the Meadows Phases 7/8 Demands	Phase 1	10.59	23.91	51.06	5.29
	Phases 1&2	14.59	33.92	73.09	7.30

*Based on FUS fire flow calculation

**Assumed based on similar information from previously completed projects, as agreed upon with DSEL

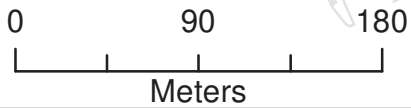


Appendix B FUS Fire Flow Calculations and Allocation

Legend

- Junction
- ☒ Connection Point
- Water Main

Connection #3
Dundonald Drive



GeoAdvice Engineering Inc.

Project: Hydraulic Capacity and Modeling Analysis of the Brazeau Lands
Client: David Schaeffer Engineering Ltd.
Date: June 2020
Created by: BL
Reviewed by: WdS

DISCLAIMER: GeoAdvice does not warrant in any way the accuracy and completeness of the information shown on this map. Field verification of the accuracy and completeness of the information shown on this map is the sole responsibility of the user.

Required Fire Flow Phases 1&2

Figure B.1

FUS Required Fire Flow Calculation

Client: David Schaeffer Engineering Ltd.

Project: 2019-091-DSE

Development: Brazeau Lands

Blocks 300-313, Single Detached

Zoning: Multi Family Residential

Date: November 6, 2019

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.



A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 1927 m²
 Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2
 Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

D. Required Fire Flow*: $F = 220C\sqrt{A}$
 C: Coefficient related to the type of construction
 A: Effective area
 The total floor area in m² in the building being considered

Note: The single detached dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 14 units is considered in this calculation.

$$C = \frac{1.5}{A = 3854 \text{ m}^2} \quad (\text{Combined area of 14 units})$$

$$F = 20,486 \text{ L/min} \quad D = 20,000 \text{ L/min}^*$$

E. Occupancy
 Occupancy content hazard: Limited Combustible
 -15 % of D -3,000 L/min $E = 17,000 \text{ L/min}$

F. Sprinkler Protection
 Automatic sprinkler protection: None
 0 % of E 0 L/min $F = 17,000 \text{ L/min}$

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	20.1 to 30 m	0-30 m-storeys	Wood Frame or Non-Combustible	8%
East	20.1 to 30 m	0-30 m-storeys	Wood Frame or Non-Combustible	8%
North	10.1 to 20 m	Over 120 m-storeys	Wood Frame or Non-Combustible	15%
South	20.1 to 30 m	Over 120 m-storeys	Wood Frame or Non-Combustible	10%
Total				41%

$$\% \text{ of E } \quad + 6,970 \text{ L/min} \quad G = 23,970 \text{ L/min}$$

H. Wood Shake Charge No 0 L/min $H = 23,970 \text{ L/min}$
 For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The single detached dwellings comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	10,000 L/min*
	167 L/s
Required Duration of Fire Flow	2 Hrs
Required Volume of Fire Flow	1,200 m³

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m ²)	3,854
Required Fire Flow (L/min)	20,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	8%
East (%)	8%
South (%)	15%
West (%)	10%
Total Exposure (%)	41%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167

FUS Required Fire Flow Calculation

Client: David Schaeffer Engineering Ltd.

Project: 2019-091-DSE

Development: Brazeau Lands

Blocks 173, Traditional Townhouse

Zoning: Multi Family Residential

Date: November 6, 2019

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.



A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 474 m²
 Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2
 Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

D. Required Fire Flow*: $F = 220C\sqrt{A}$
 C: Coefficient related to the type of construction
 A: Effective area
 The total floor area in m² in the building being considered

Note: The townhouse dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 5 units is considered in this calculation.

$$C = \frac{1.5}{A = 947 \text{ m}^2} \quad (\text{Combined area of 5 units})$$

$$F = 10,156 \text{ L/min} \quad D = 10,000 \text{ L/min}^*$$

E. Occupancy
 Occupancy content hazard: Limited Combustible
 -15 % of D -1,500 L/min $E = 8,500 \text{ L/min}$

F. Sprinkler Protection
 Automatic sprinkler protection: None
 0 % of E 0 L/min $F = 8,500 \text{ L/min}$

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
East	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
North	10.1 to 20 m	61-90 m-storeys	Wood Frame or Non-Combustible	14%
South	20.1 to 30 m	31-60 m-storeys	Wood Frame or Non-Combustible	8%
Total				56%

$$\% \text{ of E } \quad + 4,760 \text{ L/min} \quad G = 13,260 \text{ L/min}$$

H. Wood Shake Charge No 0 L/min $H = 13,260 \text{ L/min}$
 For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The townhouse dwellings comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	10,000 L/min*
	167 L/s
Required Duration of Fire Flow	2 Hrs
Required Volume of Fire Flow	1,200 m³

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m ²)	947
Required Fire Flow (L/min)	10,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	17%
East (%)	17%
South (%)	14%
West (%)	8%
Total Exposure (%)	56%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167

FUS Required Fire Flow Calculation

Client: David Schaeffer Engineering Ltd.

Project: 2019-091-DSE

Development: Brazeau Lands

Zoning: Multi Family Residential

Blocks 384, Traditional Townhouse

Date: November 6, 2019

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.



A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 380 m²
 Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2
 Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

D. Required Fire Flow*: $F = 220C\sqrt{A}$
 C: Coefficient related to the type of construction
 A: Effective area
 The total floor area in m² in the building being considered

Note: The townhouse dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 4 units is considered in this calculation.

$$C = \frac{1.5}{760 \text{ m}^2} \quad (\text{Combined area of 4 units})$$

$$F = 9,095 \text{ L/min} \quad D = 9,000 \text{ L/min}^*$$

E. Occupancy
 Occupancy content hazard: Limited Combustible
 -15 % of D -1,350 L/min $E = 7,650 \text{ L/min}$

F. Sprinkler Protection
 Automatic sprinkler protection: None
 0 % of E 0 L/min $F = 7,650 \text{ L/min}$

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	10.1 to 20 m	0-30 m-storeys	Wood Frame or Non-Combustible	12%
East	Beyond 45 m	0-30 m-storeys	Wood Frame or Non-Combustible	0%
North	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
South	20.1 to 30 m	0-30 m-storeys	Wood Frame or Non-Combustible	8%
Total				37%

$$\% \text{ of E } \quad + 2,831 \text{ L/min} \quad G = 10,481 \text{ L/min}$$

H. Wood Shake Charge No 0 L/min $H = 10,481 \text{ L/min}$
 For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The townhouse dwellings do not comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	10,000 L/min*
	167 L/s
Required Duration of Fire Flow	2 Hrs
Required Volume of Fire Flow	1,200 m³

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m ²)	760
Required Fire Flow (L/min)	9,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	12%
East (%)	0%
South (%)	17%
West (%)	8%
Total Exposure (%)	37%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167

FUS Required Fire Flow Calculation

Client: David Schaeffer Engineering Ltd.

Project: 2019-091-DSE

Development: Brazeau Lands

Zoning: Multi Family Residential

Blocks 168, Traditional Townhouse

Date: November 6, 2019

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.



A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 380 m²
 Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2
 Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

D. Required Fire Flow*: $F = 220C\sqrt{A}$
 C: Coefficient related to the type of construction
 A: Effective area
 The total floor area in m² in the building being considered

Note: The townhouse dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 4 units is considered in this calculation.

$$C = \frac{1.5}{760 \text{ m}^2} \quad (\text{Combined area of 4 units})$$

$$F = 9,095 \text{ L/min} \quad D = 9,000 \text{ L/min}^*$$

E. Occupancy
 Occupancy content hazard: Limited Combustible
 -15 % of D -1,350 L/min $E = 7,650 \text{ L/min}$

F. Sprinkler Protection
 Automatic sprinkler protection: None
 0 % of E 0 L/min $F = 7,650 \text{ L/min}$

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	30.1 to 45 m	0-30 m-storeys	Wood Frame or Non-Combustible	5%
East	10.1 to 20 m	0-30 m-storeys	Wood Frame or Non-Combustible	12%
North	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
South	Beyond 45 m	31-60 m-storeys	Wood Frame or Non-Combustible	0%
Total				34%

$$\% \text{ of E } \quad + 2,601 \text{ L/min} \quad G = 10,251 \text{ L/min}$$

H. Wood Shake Charge No 0 L/min $H = 10,251 \text{ L/min}$
 For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The townhouse dwellings do not comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	10,000 L/min*
	167 L/s
Required Duration of Fire Flow	2 Hrs
Required Volume of Fire Flow	1,200 m³

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m ²)	760
Required Fire Flow (L/min)	9,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	5%
East (%)	12%
South (%)	17%
West (%)	0%
Total Exposure (%)	34%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167



Appendix C Boundary Conditions

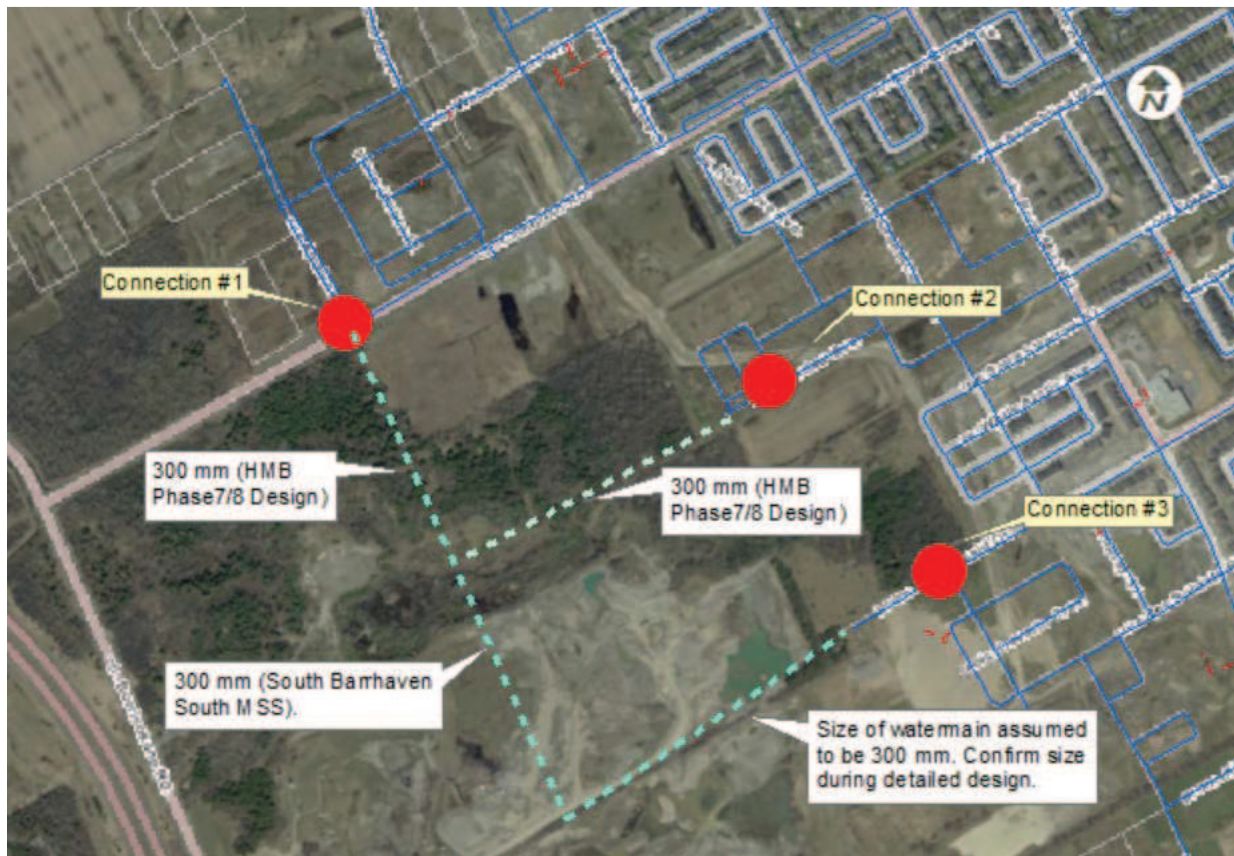
Boundary Conditions for HMB Phases 7 and 8 and Brazeau Lands

Information Provided:

Date provided: September 2019

Scenario	Demand	
	L/min	L/s
Average Daily Demand	846	14.10
Maximum Daily Demand	1961	32.69
Peak Hour	4224	70.40
Fire Flow Demand #1	10000	166.67
Fire Flow Demand #2	15000	250.00
Fire Flow Demand #3	17000	283.33

Location:



Results

Connection 1 - Cambrian Road

Demand Scenario	Existing Barrhaven PZ		Future Zone 3C	
	Head (m)	Pressure ¹ (psi)	Head (m)	Pressure ¹ (psi)
Maximum HGL	156.4	102.9	147.7	77.3
Peak Hour	135.7	60.4	142.8	70.4
Max Day plus Fire (#1)	144.0	72.2	140.0	66.4
Max Day plus Fire (#2)	135.4	59.9	134.9	59.2
Max Day plus Fire (#3)	133.7	57.4	132.5	55.7

¹ Ground Elevation = 93.3 m

Connection 2 - Brambling Way

Demand Scenario	Existing Barrhaven PZ		Future Zone 3C	
	Head (m)	Pressure ¹ (psi)	Head (m)	Pressure ¹ (psi)
Maximum HGL	156.4	100.1	147.7	74.6
Peak Hour	135.6	57.4	142.7	67.5
Max Day plus Fire (#1)	141.2	65.4	139.9	63.5
Max Day plus Fire (#2)	129.9	49.4	134.6	56.0
Max Day plus Fire (#3)	126.6	44.7	132.1	52.4

¹ Ground Elevation = 95.2 m

Connection 3 - Dundonald Drive

Demand Scenario	Existing Barrhaven PZ		Future Zone 3C	
	Head (m)	Pressure ¹ (psi)	Head (m)	Pressure ¹ (psi)
Maximum HGL	156.4	86.5	147.7	61.0
Peak Hour	135.7	43.9	142.6	53.7
Max Day plus Fire (#1)	142.0	52.9	138.6	48.1
Max Day plus Fire (#2)	131.5	38.0	132.2	38.9
Max Day plus Fire (#3)	128.7	34.0	128.9	34.3

¹ Ground Elevation = 104.8 m

Notes:

- 1) As per the Ontario Building Code in areas that may be occupied, the static pressure at any fixture shall not exceed 552 kPa (80 psi.) Pressure control measures to be considered are as follows, in order of preference:
 - a) If possible, systems to be designed to residual pressures of 345 to 552 kPa (50 to 80 psi) in all occupied areas outside of the public right-of-way without special pressure control equipment.

- b) Pressure reducing valves to be installed immediately downstream of the isolation valve in the home/ building, located downstream of the meter so it is owner maintained.
- 2) A third pump was turned on during all fire simulations under Existing Barrhaven Pressure.
 - 3) Future pipes were added to the water model as shown in the figure above.

Disclaimer

The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.



Appendix D Pipe and Junction Model Inputs

Model Inputs - Phases 1 and 2

ID	From	To	Length (m)	Diameter (mm)	Roughness ()
P-100	J-82	J-83	63.79	204	110
P-101	J-83	J-46	60.03	204	110
P-102	J-79	J-84	53.32	204	110
P-103	J-84	J-85	55.04	204	110
P-104	J-85	J-45	66.63	204	110
P-105	J-78	J-86	72.81	297	120
P-106	J-86	J-87	55.90	297	120
P-107	J-87	J-88	48.49	297	120
P-108	J-45	J-88	59.54	204	110
P-109	J-88	J-89	55.04	297	120
P-110	J-89	J-41	65.11	297	120
P-111	J-90	J-47	61.51	204	110
P-112	J-43	J-90	59.19	204	110
P-42	J-33	J-34	40.11	297	120
P-43	J-33	J-35	114.35	297	120
P-44	J-35	J-36	77.83	297	120
P-45	J-36	J-37	59.20	297	120
P-46	J-37	J-38	62.88	297	120
P-47	J-38	J-39	74.92	297	120
P-48	J-39	J-40	87.18	297	120
P-49	J-40	J-41	59.39	297	120
P-50	J-41	J-60	67.93	297	120
P-51	J-60	CONNECTION_3	138.92	297	120
P-52	J-40	J-42	58.39	204	110
P-53	J-42	J-43	83.72	204	110
P-54	J-43	J-44	72.67	204	110
P-55	J-44	J-38	58.67	204	110
P-56	J-45	J-46	59.20	204	110
P-57	J-46	J-90	81.24	204	110
P-58	J-47	J-48	84.62	204	110
P-59	J-48	J-61	59.65	297	120
P-60	J-61	J-37	60.99	297	120
P-61	J-59	J-58	94.07	297	120
P-62	J-58	J-48	82.47	297	120
P-63	J-48	J-49	63.07	204	110
P-64	J-49	J-50	57.71	204	110
P-65	J-50	J-51	84.62	204	110
P-66	J-51	J-52	106.76	204	110
P-67	J-33	J-52	62.05	204	110
P-68	J-52	J-53	60.2	204	110
P-69	J-53	J-54	112.78	204	110
P-70	J-54	J-49	90	204	110
P-71	J-49	J-57	56.32	204	110
P-72	J-57	J-56	92.28	204	110
P-73	J-53	J-55	55.27	204	110
P-74	J-55	J-56	113.38	204	110
P-75	J-56	J-62	58.69	204	110
P-76	J-62	J-63	119.4	204	110
P-77	J-63	J-64	56.35	204	110
P-78	J-64	J-65	58.6	204	110
P-79	J-65	J-66	100.76	204	110
P-80	J-66	J-70	70.42	204	110
P-81	J-70	J-71	55.7	204	110
P-82	J-71	J-69	54.8	204	110
P-83	J-64	J-67	125.85	204	110
P-84	J-67	J-69	97.99	204	110
P-85	J-62	J-68	92.12	204	110
P-86	J-68	J-69	56.42	204	110
P-87	J-69	J-59	63.46	204	110
P-88	J-59	J-72	59.77	297	120
P-89	J-72	J-73	28.67	297	120
P-90	J-72	J-74	96.85	297	120
P-91	J-74	J-75	110.13	297	120
P-92	J-75	J-76	78.16	297	120
P-93	J-77	J-76	30.34	297	120
P-94	J-76	J-78	58.2	297	120
P-95	J-78	J-79	59.97	204	110
P-96	J-79	J-80	59.39	204	110
P-97	J-80	J-81	85.15	204	110
P-98	J-81	J-59	79.25	204	110
P-99	J-80	J-82	51.74	204	110

ID	Elevation (m)	ADD (L/s)
J-33	101.29	0.18
J-34	101.41	0.00
J-35	101.33	0.16
J-36	101.25	0.16
J-37	101.64	0.06
J-38	101.46	0.14
J-39	101.83	0.20
J-40	101.96	0.14
J-41	102.65	0.04
J-42	101.87	0.16
J-43	101.72	0.18
J-44	101.59	0.16
J-45	103.27	0.06
J-46	102.38	0.08
J-47	101.77	0.12
J-48	101.83	0.06
J-49	101.74	0.14
J-50	101.40	0.12
J-51	101.41	0.18
J-52	101.35	0.20
J-53	102.22	0.20
J-54	101.87	0.20
J-55	102.52	0.20
J-56	103.00	0.20
J-57	102.46	0.12
J-58	102.95	0.06
J-59	105.68	0.64
J-60	102.80	0.00
J-61	101.51	0.06
J-62	104.21	0.00
J-63	106.39	0.20
J-64	106.74	0.20
J-65	107.17	0.20
J-66	107.78	0.18
J-67	106.62	0.20
J-68	106.00	0.22
J-69	107.07	0.14
J-70	108.43	0.14
J-71	108.62	0.16
J-72	107.85	0.12
J-73	108.47	0.16
J-74	107.68	0.00
J-75	108.00	0.24
J-76	108.27	0.16
J-77	108.93	0.08
J-78	106.17	0.00
J-79	105.57	0.06
J-80	105.54	0.18
J-81	105.54	0.18
J-82	104.30	0.28
J-83	103.10	0.12
J-84	104.73	0.20
J-85	103.68	0.12
J-86	105.81	0.20
J-87	105.51	0.08
J-88	104.78	0.08
J-89	103.69	0.04
J-90	102.07	0.08



Appendix E MHD and PHD Model Results

Legend

- Junction
- 🏠 Connection Point
- Water Main

Connection #3
Dundonald Drive



GeoAdvice Engineering Inc.

Project: Hydraulic Capacity and Modeling Analysis of the Brazeau lands
Client: David Schaeffer Engineering Ltd.
Date: June 2020
Created by: BL
Reviewed by: WdS

DISCLAIMER: GeoAdvice does not warrant in any way the accuracy and completeness of the information shown on this map. Field verification of the accuracy and completeness of the information shown on this map is the sole responsibility of the user.

MHD Pressure Results - Phase 1

Figure E.1

Minimum Hour Demand Modeling Results - Phase 1

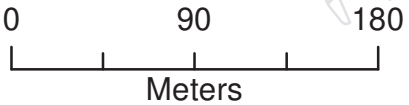
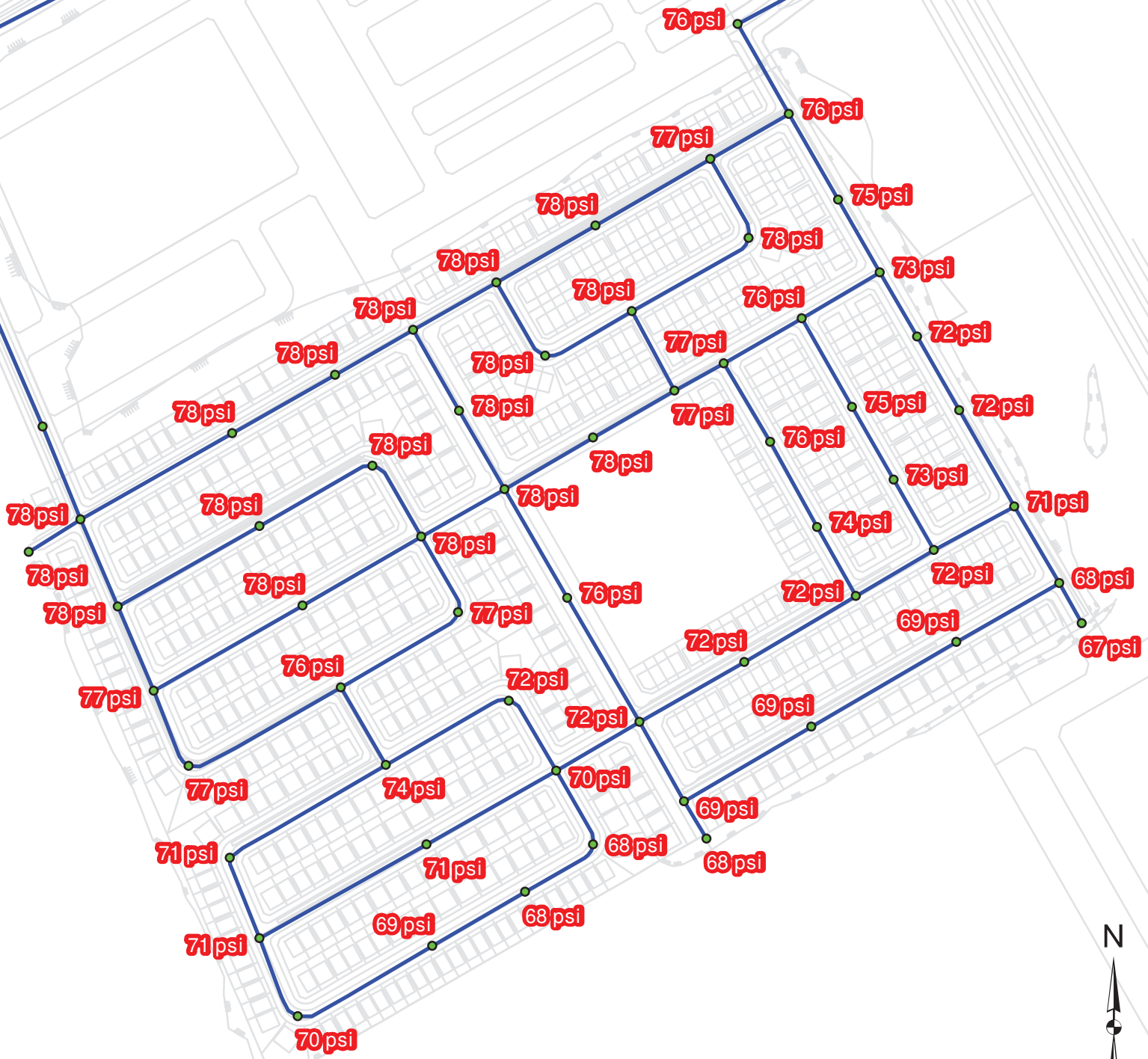
ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)
P-42	J-33	J-34	40.11	297	120	0.00	0.00	0.00	0.00
P-43	J-33	J-35	114.35	297	120	-0.09	0.00	0.00	0.00
P-44	J-35	J-36	77.83	297	120	-0.16	0.00	0.00	0.00
P-45	J-36	J-37	59.20	297	120	-0.25	0.00	0.00	0.00
P-46	J-37	J-38	62.88	297	120	-0.88	0.01	0.00	0.00
P-47	J-38	J-39	74.92	297	120	-1.05	0.02	0.00	0.00
P-48	J-39	J-40	87.18	297	120	-1.15	0.02	0.00	0.00
P-49	J-40	J-41	59.39	297	120	-1.68	0.02	0.00	0.00
P-50	J-41	J-60	67.93	297	120	-1.69	0.02	0.00	0.00
P-51	J-60	CONNECTION_3	138.92	297	120	-1.69	0.02	0.00	0.00
P-52	J-40	J-42	58.39	204	110	0.45	0.01	0.00	0.00
P-53	J-42	J-43	91.90	204	110	0.37	0.01	0.00	0.00
P-54	J-43	J-44	64.49	204	110	-0.02	0.00	0.00	0.00
P-55	J-44	J-38	58.67	204	110	-0.10	0.00	0.00	0.00
P-56	J-45	J-46	59.20	204	110	-0.03	0.00	0.00	0.00
P-57	J-46	J-90	37.06	204	110	-0.08	0.00	0.00	0.00
P-58	J-47	J-48	67.31	204	110	0.16	0.00	0.00	0.00
P-59	J-48	J-61	59.65	297	120	-0.58	0.01	0.00	0.00
P-60	J-61	J-37	60.99	297	120	-0.61	0.01	0.00	0.00
P-61	J-59	J-58	94.07	297	120	-0.32	0.00	0.00	0.00
P-62	J-58	J-48	82.47	297	120	-0.35	0.01	0.00	0.00
P-63	J-48	J-49	63.07	204	110	0.36	0.01	0.00	0.00
P-64	J-49	J-50	57.71	204	110	0.04	0.00	0.00	0.00
P-65	J-50	J-51	84.62	204	110	-0.02	0.00	0.00	0.00
P-66	J-51	J-52	106.76	204	110	-0.11	0.00	0.00	0.00
P-67	J-33	J-52	62.05	204	110	0.42	0.01	0.00	0.00
P-68	J-52	J-53	60.20	204	110	0.21	0.01	0.00	0.00
P-69	J-53	J-54	112.78	204	110	-0.01	0.00	0.00	0.00
P-70	J-54	J-49	90.00	204	110	-0.10	0.00	0.00	0.00
P-71	J-49	J-57	56.32	204	110	0.14	0.00	0.00	0.00
P-72	J-57	J-56	92.28	204	110	0.08	0.00	0.00	0.00
P-73	J-53	J-55	55.27	204	110	0.12	0.00	0.00	0.00
P-74	J-55	J-56	113.38	204	110	0.02	0.00	0.00	0.00
P-111	J-90	J-47	61.51	204	110	0.22	0.01	0.00	0.00
P-112	J-43	J-90	59.19	204	110	0.30	0.01	0.00	0.00

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-33	0.09	101.29	156	78
J-34	0.00	101.41	156	78
J-35	0.08	101.33	156	78
J-36	0.08	101.25	156	78
J-37	0.03	101.64	156	78
J-38	0.07	101.46	156	78
J-39	0.10	101.83	156	78
J-40	0.07	101.96	156	77
J-41	0.02	102.65	156	76
J-42	0.08	101.87	156	78
J-43	0.09	101.72	156	78
J-44	0.08	101.59	156	78
J-45	0.03	103.27	156	76
J-46	0.04	102.38	156	77
J-47	0.06	101.77	156	78
J-48	0.03	101.83	156	78
J-49	0.07	101.74	156	78
J-50	0.06	101.40	156	78
J-51	0.09	101.41	156	78
J-52	0.10	101.35	156	78
J-53	0.10	102.22	156	77
J-54	0.10	101.87	156	78
J-55	0.10	102.52	156	77
J-56	0.10	103.00	156	76
J-57	0.06	102.46	156	77
J-58	0.03	102.95	156	76
J-59	0.32	105.68	156	72
J-60	0.00	102.80	156	76
J-61	0.03	101.51	156	78
J-90	0.00	102.07	156	77

Legend

- Junction
- ⊡ Connection Point
- Water Main

Connection #3
Dundonald Drive



GeoAdvice Engineering Inc.

Project: Hydraulic Capacity and Modeling Analysis of the Brazeau Lands
Client: David Schaeffer Engineering Ltd.
Date: June 2020
Created by: BL
Reviewed by: WdS

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MHD Pressure Results - Phases 1&2

Figure E.2

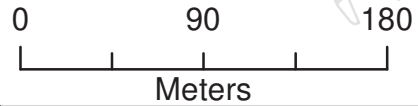
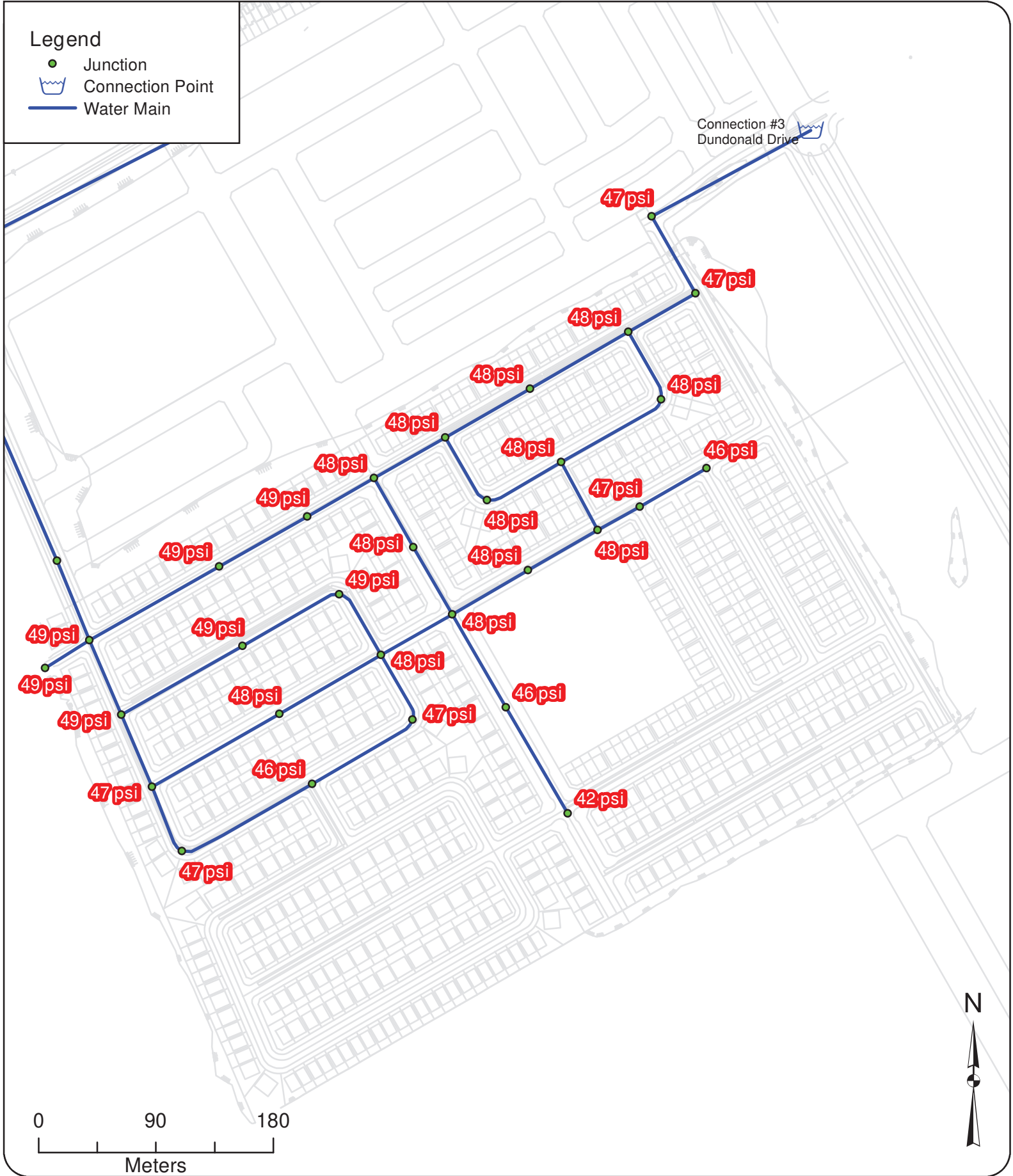
Minimum Hour Demand Modeling Results - Phases 1 and 2

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)
P-42	J-33	J-34	40.11	297	120	0.00	0.00	0.00	0.00
P-43	J-33	J-35	114.35	297	120	0.35	0.01	0.00	0.00
P-44	J-35	J-36	77.83	297	120	0.28	0.00	0.00	0.00
P-45	J-36	J-37	59.20	297	120	0.20	0.00	0.00	0.00
P-46	J-37	J-38	62.88	297	120	-0.73	0.01	0.00	0.00
P-47	J-38	J-39	74.92	297	120	-0.95	0.01	0.00	0.00
P-48	J-39	J-40	87.18	297	120	-1.05	0.02	0.00	0.00
P-49	J-40	J-41	59.39	297	120	-1.56	0.02	0.00	0.00
P-50	J-41	J-60	67.93	297	120	-3.05	0.04	0.00	0.01
P-51	J-60	CONNECTION_3	138.92	297	120	-3.05	0.04	0.00	0.01
P-52	J-40	J-42	58.39	204	110	0.44	0.01	0.00	0.00
P-53	J-42	J-43	83.72	204	110	0.35	0.01	0.00	0.00
P-54	J-43	J-44	72.67	204	110	-0.07	0.00	0.00	0.00
P-55	J-44	J-38	58.67	204	110	-0.15	0.00	0.00	0.00
P-56	J-45	J-46	59.20	204	110	0.21	0.01	0.00	0.00
P-57	J-46	J-90	81.24	204	110	-0.10	0.00	0.00	0.00
P-58	J-47	J-48	84.62	204	110	0.18	0.01	0.00	0.00
P-59	J-48	J-61	59.65	297	120	-0.87	0.01	0.00	0.00
P-60	J-61	J-37	60.99	297	120	-0.90	0.01	0.00	0.00
P-61	J-59	J-58	94.07	297	120	-0.53	0.01	0.00	0.00
P-62	J-58	J-48	82.47	297	120	-0.56	0.01	0.00	0.00
P-63	J-48	J-49	63.07	204	110	0.45	0.01	0.00	0.00
P-64	J-49	J-50	57.71	204	110	-0.03	0.00	0.00	0.00
P-65	J-50	J-51	84.62	204	110	-0.09	0.00	0.00	0.00
P-66	J-51	J-52	106.76	204	110	-0.18	0.01	0.00	0.00
P-67	J-33	J-52	62.05	204	110	0.62	0.02	0.00	0.00
P-68	J-52	J-53	60.20	204	110	0.33	0.01	0.00	0.00
P-69	J-53	J-54	112.78	204	110	-0.03	0.00	0.00	0.00
P-70	J-54	J-49	90.00	204	110	-0.13	0.00	0.00	0.00
P-71	J-49	J-57	56.32	204	110	0.28	0.01	0.00	0.00
P-72	J-57	J-56	92.28	204	110	0.22	0.01	0.00	0.00
P-73	J-53	J-55	55.27	204	110	0.26	0.01	0.00	0.00
P-74	J-55	J-56	113.38	204	110	0.17	0.01	0.00	0.00
P-111	J-90	J-47	61.51	204	110	0.24	0.01	0.00	0.00
P-112	J-43	J-90	59.19	204	110	0.33	0.01	0.00	0.00
P-75	J-56	J-62	58.69	204	110	0.29	0.01	0.00	0.00
P-76	J-62	J-63	119.4	204	110	0.19	0.01	0.00	0.00
P-77	J-63	J-64	56.35	204	110	0.10	0.00	0.00	0.00
P-78	J-64	J-65	58.6	204	110	0.09	0.00	0.00	0.00
P-79	J-65	J-66	100.76	204	110	0.00	0.00	0.00	0.00
P-80	J-66	J-70	70.42	204	110	-0.10	0.00	0.00	0.00
P-81	J-70	J-71	55.7	204	110	-0.18	0.01	0.00	0.00
P-82	J-71	J-69	54.8	204	110	-0.24	0.01	0.00	0.00
P-83	J-64	J-67	125.85	204	110	-0.09	0.00	0.00	0.00
P-84	J-67	J-69	97.99	204	110	-0.20	0.01	0.00	0.00
P-85	J-62	J-68	92.12	204	110	0.00	0.00	0.00	0.00
P-86	J-68	J-69	56.42	204	110	-0.07	0.00	0.00	0.00
P-87	J-69	J-59	63.46	204	110	-0.59	0.02	0.00	0.00
P-88	J-59	J-72	59.77	297	120	-0.29	0.00	0.00	0.00
P-89	J-72	J-73	28.67	297	120	0.00	0.00	0.00	0.00
P-90	J-72	J-74	96.85	297	120	-0.37	0.01	0.00	0.00
P-91	J-74	J-75	110.13	297	120	-0.49	0.01	0.00	0.00
P-92	J-75	J-76	78.16	297	120	-0.57	0.01	0.00	0.00
P-93	J-77	J-76	30.34	297	120	0.00	0.00	0.00	0.00
P-94	J-76	J-78	58.2	297	120	-0.61	0.01	0.00	0.00
P-95	J-78	J-79	59.97	204	110	0.21	0.01	0.00	0.00
P-96	J-79	J-80	59.39	204	110	0.22	0.01	0.00	0.00
P-97	J-80	J-81	85.15	204	110	0.23	0.01	0.00	0.00
P-98	J-81	J-59	79.25	204	110	0.09	0.00	0.00	0.00
P-99	J-80	J-82	51.74	204	110	-0.10	0.00	0.00	0.00
P-100	J-82	J-83	63.79	204	110	-0.16	0.00	0.00	0.00
P-101	J-83	J-46	60.03	204	110	-0.26	0.01	0.00	0.00
P-102	J-79	J-84	53.32	204	110	-0.09	0.00	0.00	0.00
P-103	J-84	J-85	55.04	204	110	-0.15	0.00	0.00	0.00
P-104	J-85	J-45	66.63	204	110	-0.25	0.01	0.00	0.00
P-105	J-78	J-86	72.81	297	120	-0.86	0.01	0.00	0.00
P-106	J-86	J-87	55.9	297	120	-0.89	0.01	0.00	0.00
P-107	J-87	J-88	48.49	297	120	-0.93	0.01	0.00	0.00
P-108	J-45	J-88	59.54	204	110	-0.49	0.01	0.00	0.00
P-109	J-88	J-89	55.04	297	120	-1.44	0.02	0.00	0.00
P-110	J-89	J-41	65.11	297	120	-1.48	0.02	0.00	0.00

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-33	0.09	101.29	156	78
J-34	0.00	101.41	156	78
J-35	0.08	101.33	156	78
J-36	0.08	101.25	156	78
J-37	0.03	101.64	156	78
J-38	0.07	101.46	156	78
J-39	0.10	101.83	156	78
J-40	0.07	101.96	156	77
J-41	0.02	102.65	156	76
J-42	0.08	101.87	156	78
J-43	0.09	101.72	156	78
J-44	0.08	101.59	156	78
J-45	0.03	103.27	156	76
J-46	0.04	102.38	156	77
J-47	0.06	101.77	156	78
J-48	0.03	101.83	156	78
J-49	0.07	101.74	156	78
J-50	0.06	101.40	156	78
J-51	0.09	101.41	156	78
J-52	0.10	101.35	156	78
J-53	0.10	102.22	156	77
J-54	0.10	101.87	156	78
J-55	0.10	102.52	156	77
J-56	0.10	103.00	156	76
J-57	0.06	102.46	156	77
J-58	0.03	102.95	156	76
J-59	0.32	105.68	156	72
J-60	0.00	102.80	156	76
J-61	0.03	101.51	156	78
J-62	0.00	102.07	156	77
J-63	0.10	104.21	156	74
J-64	0.10	106.39	156	71
J-65	0.10	106.74	156	71
J-66	0.09	107.17	156	70
J-67	0.10	107.78	156	69
J-68	0.11	106.62	156	71
J-69	0.07	106.00	156	72
J-70	0.07	107.07	156	70
J-71	0.08	108.43	156	68
J-72	0.06	108.62	156	68
J-73	0.08	107.85	156	69
J-74	0.00	108.47	156	68
J-75	0.12	107.68	156	69
J-76	0.08	108.00	156	69
J-77	0.04	108.27	156	68
J-78	0.00	108.93	156	67
J-79	0.03	106.17	156	71
J-80	0.09	105.57	156	72
J-81	0.09	105.54	156	72
J-82	0.06	104.30	156	74
J-83	0.10	103.10	156	76
J-84	0.06	104.73	156	73
J-85	0.10	103.68	156	75
J-86	0.04	105.81	156	72
J-87	0.04	105.51	156	72
J-88	0.02	104.78	156	73
J-89	0.04	103.69	156	75

Legend

- Junction
- Connection Point
- Water Main



GeoAdvice Engineering Inc.

Project: Hydraulic Capacity and Modeling Analysis of the Brazeau Lands
Client: David Schaeffer Engineering Ltd.
Date: June 2020
Created by: BL
Reviewed by: WdS

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PHD Pressure Results - Phase 1

Figure E.3

Peak Hour Demand Modeling Results - Phase 1

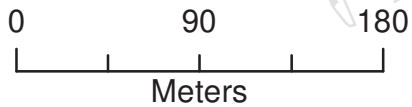
ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)
P-42	J-33	J-34	40.11	297	120	0.00	0.00	0.00	0.00
P-43	J-33	J-35	114.35	297	120	-2.53	0.04	0.00	0.01
P-44	J-35	J-36	77.83	297	120	-3.36	0.05	0.00	0.01
P-45	J-36	J-37	59.20	297	120	-4.27	0.06	0.00	0.02
P-46	J-37	J-38	62.88	297	120	-10.16	0.15	0.01	0.11
P-47	J-38	J-39	74.92	297	120	-11.85	0.17	0.01	0.15
P-48	J-39	J-40	87.18	297	120	-13.00	0.19	0.02	0.18
P-49	J-40	J-41	59.39	297	120	-18.81	0.27	0.02	0.35
P-50	J-41	J-60	67.93	297	120	-18.99	0.27	0.02	0.36
P-51	J-60	CONNECTION_3	138.92	297	120	-18.99	0.27	0.05	0.36
P-52	J-40	J-42	58.39	204	110	5.02	0.15	0.01	0.23
P-53	J-42	J-43	91.90	204	110	4.12	0.13	0.01	0.16
P-54	J-43	J-44	64.49	204	110	-0.06	0.00	0.00	0.00
P-55	J-44	J-38	58.67	204	110	-0.91	0.03	0.00	0.01
P-56	J-45	J-46	59.20	204	110	-0.36	0.01	0.00	0.00
P-57	J-46	J-90	37.06	204	110	-0.84	0.03	0.00	0.01
P-58	J-47	J-48	67.31	204	110	1.65	0.05	0.00	0.03
P-59	J-48	J-61	59.65	297	120	-5.28	0.08	0.00	0.03
P-60	J-61	J-37	60.99	297	120	-5.59	0.08	0.00	0.04
P-61	J-59	J-58	94.07	297	120	-1.96	0.03	0.00	0.01
P-62	J-58	J-48	82.47	297	120	-2.26	0.03	0.00	0.01
P-63	J-48	J-49	63.07	204	110	4.29	0.13	0.01	0.17
P-64	J-49	J-50	57.71	204	110	0.63	0.02	0.00	0.00
P-65	J-50	J-51	84.62	204	110	-0.06	0.00	0.00	0.00
P-66	J-51	J-52	106.76	204	110	-1.04	0.03	0.00	0.01
P-67	J-33	J-52	62.05	204	110	4.28	0.13	0.01	0.17
P-68	J-52	J-53	60.20	204	110	2.10	0.06	0.00	0.04
P-69	J-53	J-54	112.78	204	110	-0.21	0.01	0.00	0.00
P-70	J-54	J-49	90.00	204	110	-1.27	0.04	0.00	0.02
P-71	J-49	J-57	56.32	204	110	1.63	0.05	0.00	0.03
P-72	J-57	J-56	92.28	204	110	0.95	0.03	0.00	0.01
P-73	J-53	J-55	55.27	204	110	1.17	0.04	0.00	0.02
P-74	J-55	J-56	113.38	204	110	0.11	0.00	0.00	0.00
P-111	J-90	J-47	61.51	204	110	2.31	0.07	0.00	0.05
P-112	J-43	J-90	59.19	204	110	3.16	0.10	0.01	0.10

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-33	0.99	101.29	136	49
J-34	0.00	101.41	136	49
J-35	0.83	101.33	136	49
J-36	0.91	101.25	136	49
J-37	0.30	101.64	136	48
J-38	0.78	101.46	136	49
J-39	1.15	101.83	136	48
J-40	0.78	101.96	136	48
J-41	0.18	102.65	136	47
J-42	0.90	101.87	136	48
J-43	1.02	101.72	136	48
J-44	0.84	101.59	136	48
J-45	0.36	103.27	136	46
J-46	0.48	102.38	136	47
J-47	0.66	101.77	136	48
J-48	0.38	101.83	136	48
J-49	0.76	101.74	136	48
J-50	0.68	101.40	136	49
J-51	0.99	101.41	136	49
J-52	1.14	101.35	136	49
J-53	1.14	102.22	136	47
J-54	1.06	101.87	136	48
J-55	1.06	102.52	136	47
J-56	1.06	103.00	136	46
J-57	0.68	102.46	136	47
J-58	0.30	102.95	136	46
J-59	1.96	105.68	136	42
J-60	0.00	102.80	136	47
J-61	0.30	101.51	136	48
J-90	0.00	102.07	136	48

Legend

- Junction
- ☒ Connection Point
- Water Main

Connection #3
Dundonald Drive



GeoAdvice Engineering Inc.

Project: Hydraulic Capacity and Modeling Analysis of the Brazeau Lands

Client: David Schaeffer Engineering Ltd.

Date: June 2020

Created by: BL

Reviewed by: WdS

DISCLAIMER: GeoAdvice does not warrant in any way the accuracy and completeness of the information shown on this map. Field verification of the accuracy and completeness of the information shown on this map is the sole responsibility of the user.

PHD Pressure Results - Phases 1&2

Figure E.4

Peak Hour Demand Modeling Results - Phases 1 and 2

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)
P-42	J-33	J-34	40.11	297	120	0.00	0.00	0.00	0.00
P-43	J-33	J-35	114.35	297	120	3.16	0.05	0.00	0.01
P-44	J-35	J-36	77.83	297	120	2.33	0.03	0.00	0.01
P-45	J-36	J-37	59.20	297	120	1.42	0.02	0.00	0.00
P-46	J-37	J-38	62.88	297	120	-8.04	0.12	0.00	0.07
P-47	J-38	J-39	74.92	297	120	-10.35	0.15	0.01	0.12
P-48	J-39	J-40	87.18	297	120	-11.49	0.17	0.01	0.14
P-49	J-40	J-41	59.39	297	120	-17.00	0.25	0.02	0.29
P-50	J-41	J-60	67.93	297	120	-33.05	0.48	0.07	1.01
P-51	J-60	CONNECTION_3	138.92	297	120	-33.05	0.48	0.14	1.01
P-52	J-40	J-42	58.39	204	110	4.72	0.14	0.01	0.20
P-53	J-42	J-43	83.72	204	110	3.82	0.12	0.01	0.14
P-54	J-43	J-44	72.67	204	110	-0.68	0.02	0.00	0.01
P-55	J-44	J-38	58.67	204	110	-1.52	0.05	0.00	0.02
P-56	J-45	J-46	59.20	204	110	2.27	0.07	0.00	0.05
P-57	J-46	J-90	81.24	204	110	-0.92	0.03	0.00	0.01
P-58	J-47	J-48	84.62	204	110	1.88	0.06	0.00	0.04
P-59	J-48	J-61	59.65	297	120	-8.86	0.13	0.01	0.09
P-60	J-61	J-37	60.99	297	120	-9.16	0.13	0.01	0.09
P-61	J-59	J-58	94.07	297	120	-4.98	0.07	0.00	0.03
P-62	J-58	J-48	82.47	297	120	-5.28	0.08	0.00	0.03
P-63	J-48	J-49	63.07	204	110	5.08	0.16	0.01	0.23
P-64	J-49	J-50	57.71	204	110	-0.22	0.01	0.00	0.00
P-65	J-50	J-51	84.62	204	110	-0.90	0.03	0.00	0.01
P-66	J-51	J-52	106.76	204	110	-1.89	0.06	0.00	0.04
P-67	J-33	J-52	62.05	204	110	6.57	0.20	0.02	0.37
P-68	J-52	J-53	60.20	204	110	3.54	0.11	0.01	0.12
P-69	J-53	J-54	112.78	204	110	-0.41	0.01	0.00	0.00
P-70	J-54	J-49	90.00	204	110	-1.48	0.05	0.00	0.02
P-71	J-49	J-57	56.32	204	110	3.06	0.09	0.01	0.09
P-72	J-57	J-56	92.28	204	110	2.38	0.07	0.01	0.06
P-73	J-53	J-55	55.27	204	110	2.82	0.09	0.00	0.08
P-74	J-55	J-56	113.38	204	110	1.76	0.05	0.00	0.03
P-111	J-90	J-47	61.51	204	110	2.55	0.08	0.00	0.06
P-112	J-43	J-90	59.19	204	110	3.47	0.11	0.01	0.11
P-75	J-56	J-62	58.69	204	110	3.08	0.09	0.01	0.09
P-76	J-62	J-63	119.4	204	110	2.11	0.06	0.01	0.05
P-77	J-63	J-64	56.35	204	110	1.05	0.03	0.00	0.01
P-78	J-64	J-65	58.6	204	110	0.97	0.03	0.00	0.01
P-79	J-65	J-66	100.76	204	110	-0.01	0.00	0.00	0.00
P-80	J-66	J-70	70.42	204	110	-1.15	0.04	0.00	0.01
P-81	J-70	J-71	55.7	204	110	-2.06	0.06	0.00	0.04
P-82	J-71	J-69	54.8	204	110	-2.67	0.08	0.00	0.07
P-83	J-64	J-67	125.85	204	110	-1.06	0.03	0.00	0.01
P-84	J-67	J-69	97.99	204	110	-2.27	0.07	0.01	0.05
P-85	J-62	J-68	92.12	204	110	-0.17	0.01	0.00	0.00
P-86	J-68	J-69	56.42	204	110	-0.93	0.03	0.00	0.01
P-87	J-69	J-59	63.46	204	110	-6.63	0.20	0.02	0.38
P-88	J-59	J-72	59.77	297	120	-2.83	0.04	0.00	0.01
P-89	J-72	J-73	28.67	297	120	0.00	0.00	0.00	0.00
P-90	J-72	J-74	96.85	297	120	-3.74	0.05	0.00	0.02
P-91	J-74	J-75	110.13	297	120	-5.03	0.07	0.00	0.03
P-92	J-75	J-76	78.16	297	120	-5.93	0.09	0.00	0.04
P-93	J-77	J-76	30.34	297	120	0.00	0.00	0.00	0.00
P-94	J-76	J-78	58.2	297	120	-6.39	0.09	0.00	0.05
P-95	J-78	J-79	59.97	204	110	2.36	0.07	0.00	0.06
P-96	J-79	J-80	59.39	204	110	2.34	0.07	0.00	0.05
P-97	J-80	J-81	85.15	204	110	2.34	0.07	0.00	0.05
P-98	J-81	J-59	79.25	204	110	0.78	0.02	0.00	0.01
P-99	J-80	J-82	51.74	204	110	-0.96	0.03	0.00	0.01
P-100	J-82	J-83	63.79	204	110	-1.63	0.05	0.00	0.03
P-101	J-83	J-46	60.03	204	110	-2.71	0.08	0.00	0.07
P-102	J-79	J-84	53.32	204	110	-0.94	0.03	0.00	0.01
P-103	J-84	J-85	55.04	204	110	-1.54	0.05	0.00	0.03
P-104	J-85	J-45	66.63	204	110	-2.62	0.08	0.00	0.07
P-105	J-78	J-86	72.81	297	120	-9.11	0.13	0.01	0.09
P-106	J-86	J-87	55.9	297	120	-9.53	0.14	0.01	0.10
P-107	J-87	J-88	48.49	297	120	-9.95	0.14	0.01	0.11
P-108	J-45	J-88	59.54	204	110	-5.25	0.16	0.01	0.24
P-109	J-88	J-89	55.04	297	120	-15.45	0.22	0.01	0.25
P-110	J-89	J-41	65.11	297	120	-15.87	0.23	0.02	0.26

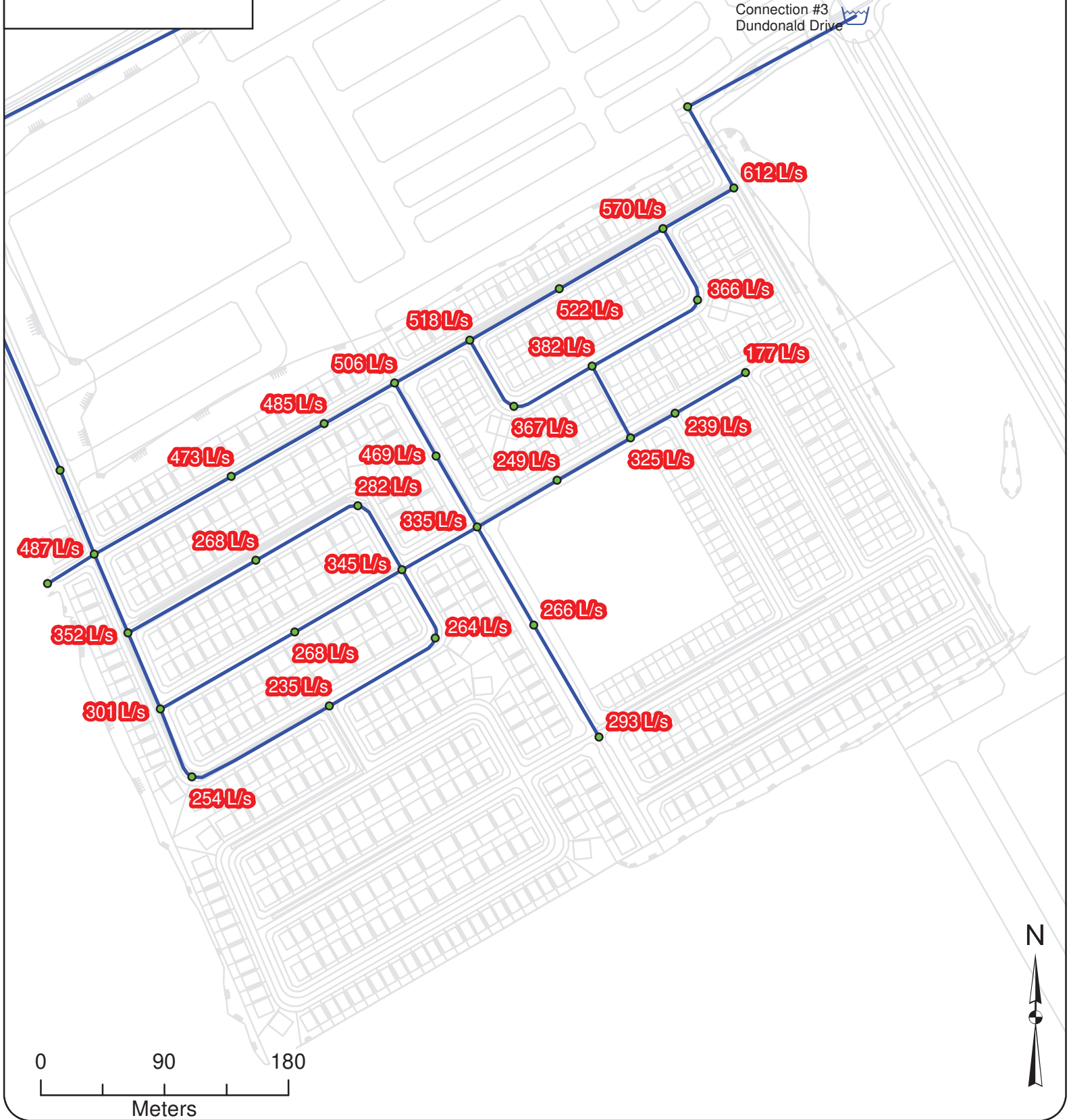
ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-33	0.99	101.29	135	49
J-34	0.00	101.41	135	48
J-35	0.83	101.33	135	49
J-36	0.91	101.25	135	49
J-37	0.30	101.64	135	48
J-38	0.78	101.46	135	48
J-39	1.15	101.83	135	48
J-40	0.78	101.96	135	48
J-41	0.18	102.65	135	47
J-42	0.90	101.87	135	48
J-43	1.02	101.72	135	48
J-44	0.84	101.59	135	48
J-45	0.36	103.27	135	46
J-46	0.48	102.38	135	47
J-47	0.66	101.77	135	48
J-48	0.38	101.83	135	48
J-49	0.76	101.74	135	48
J-50	0.68	101.40	135	48
J-51	0.99	101.41	135	48
J-52	1.14	101.35	135	48
J-53	1.14	102.22	135	47
J-54	1.06	101.87	135	48
J-55	1.06	102.52	135	47
J-56	1.06	103.00	135	46
J-57	0.68	102.46	135	47
J-58	0.30	102.95	135	46
J-59	1.96	105.68	135	42
J-60	0.00	102.80	136	47
J-61	0.30	101.51	135	48
J-60	0.00	102.07	135	47
J-62	1.14	104.21	135	44
J-63	1.06	106.39	135	41
J-64	1.14	106.74	135	41
J-65	0.98	107.17	135	40
J-66	1.14	107.78	135	39
J-67	1.21	106.62	135	41
J-68	0.76	106.00	135	42
J-69	0.76	107.07	135	40
J-70	0.91	108.43	135	38
J-71	0.61	108.62	135	38
J-72	0.91	107.85	135	39
J-73	0.00	108.47	135	38
J-74	1.29	107.68	135	39
J-75	0.91	108.00	135	39
J-76	0.45	108.27	135	39
J-77	0.00	108.93	135	38
J-78	0.36	106.17	135	42
J-79	0.96	105.57	135	42
J-80	0.96	105.54	135	43
J-81	1.56	105.54	135	42
J-82	0.66	104.30	135	44
J-83	1.08	103.10	135	46
J-84	0.60	104.73	135	44
J-85	1.08	103.68	135	45
J-86	0.42	105.81	135	42
J-87	0.42	105.51	135	43
J-88	0.24	104.78	135	44
J-89	0.42	103.69	135	45



Appendix F MDD+FF Model Results

Legend

- Junction
- ☒ Connection Point
- Water Main



Connection #3
Dundonald Drive

0 90 180
Meters



GeoAdvice Engineering Inc.

Project: Hydraulic Capacity and Modeling Analysis of the Brazeau Lands
Client: David Schaeffer Engineering Ltd.
Date: June 2020
Created by: BL
Reviewed by: WdS

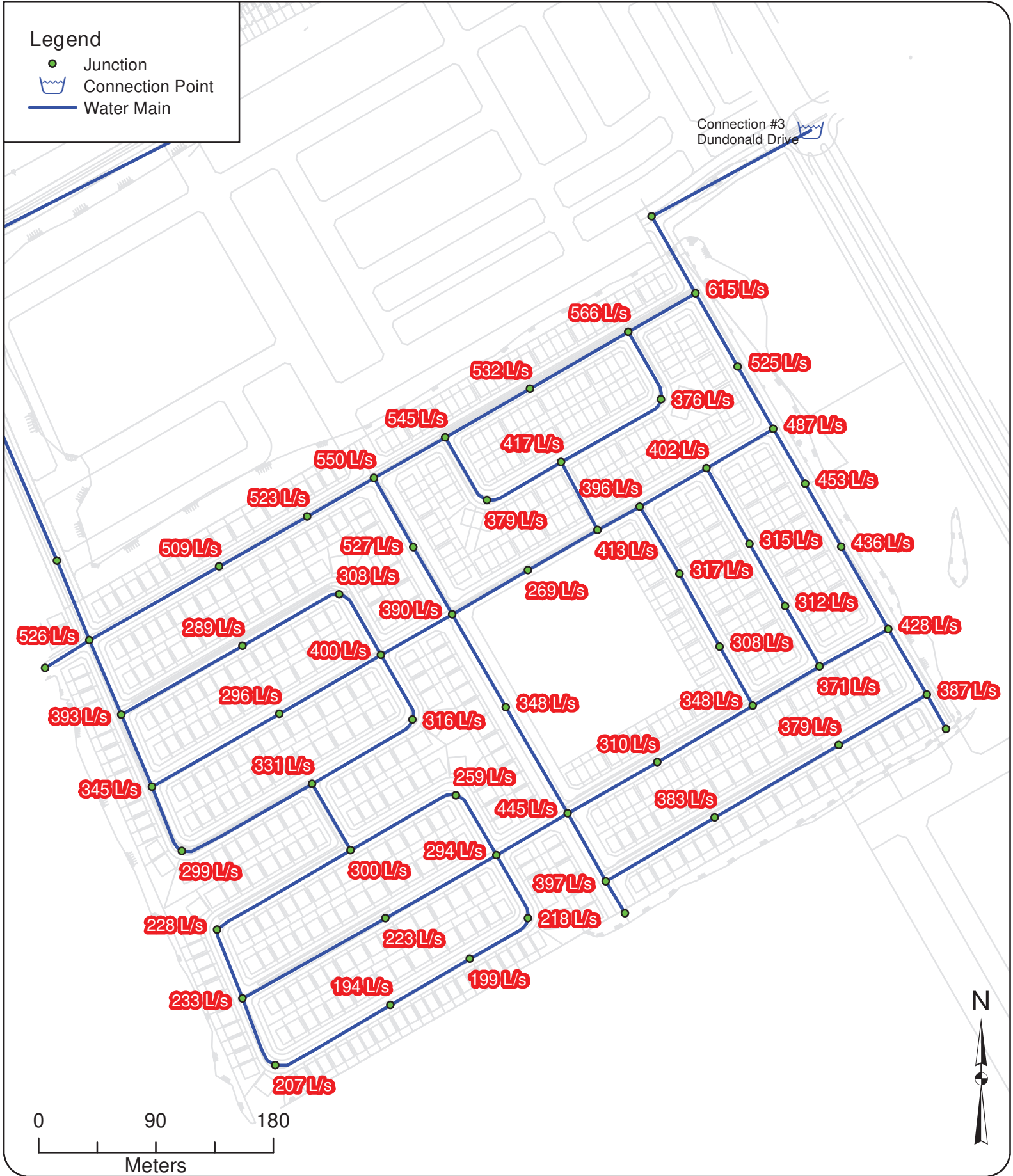
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Available Fire Flow
@ 20 psi - Phase 1

Figure F.1

Legend

- Junction
- Connection Point
- Water Main



Project: Hydraulic Capacity and Modeling Analysis of the Brazeau Lands
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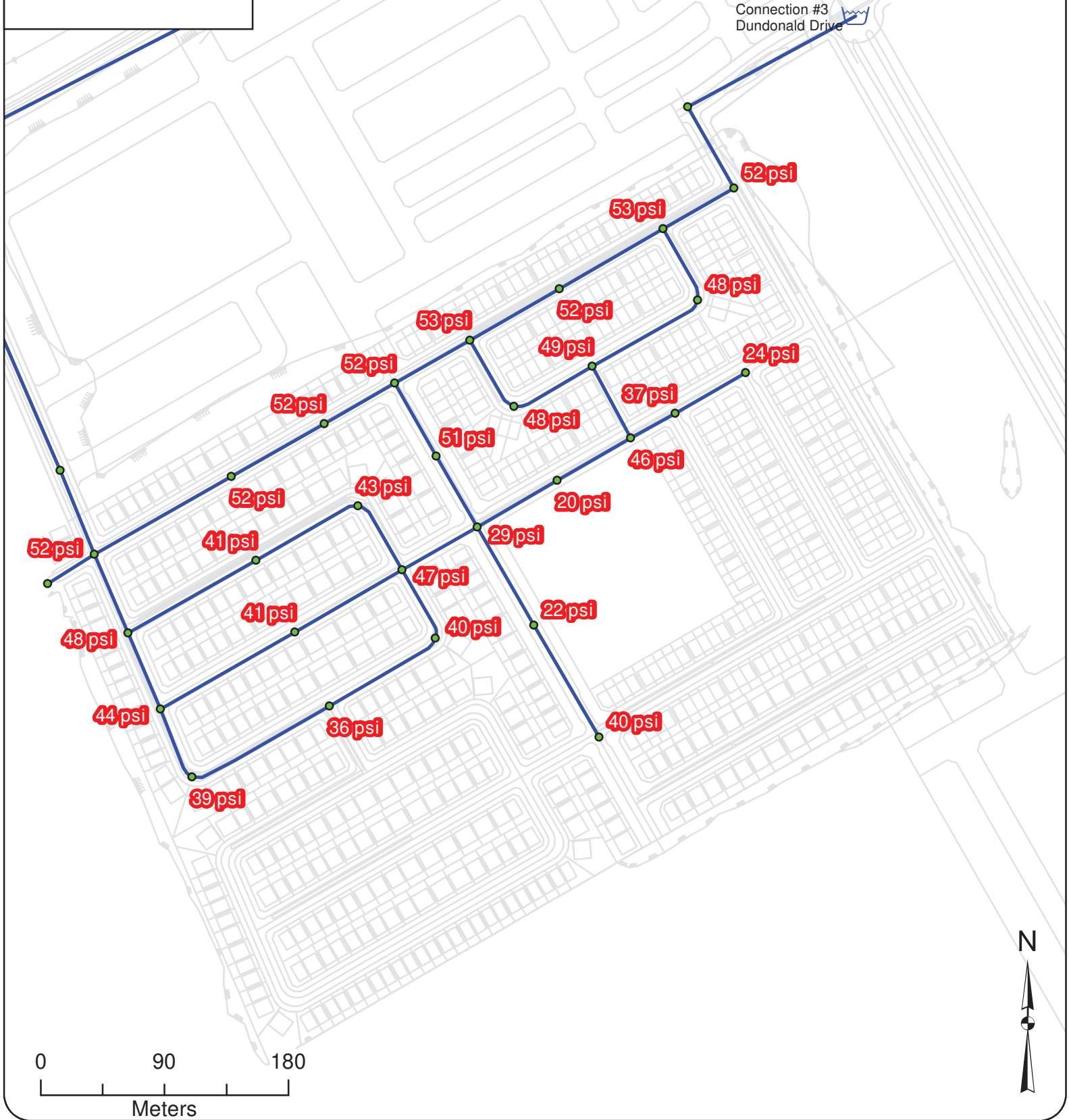
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Available Fire Flow @
 20 psi - Phases 1&2

Figure F.2

Legend

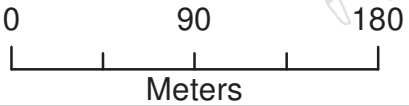
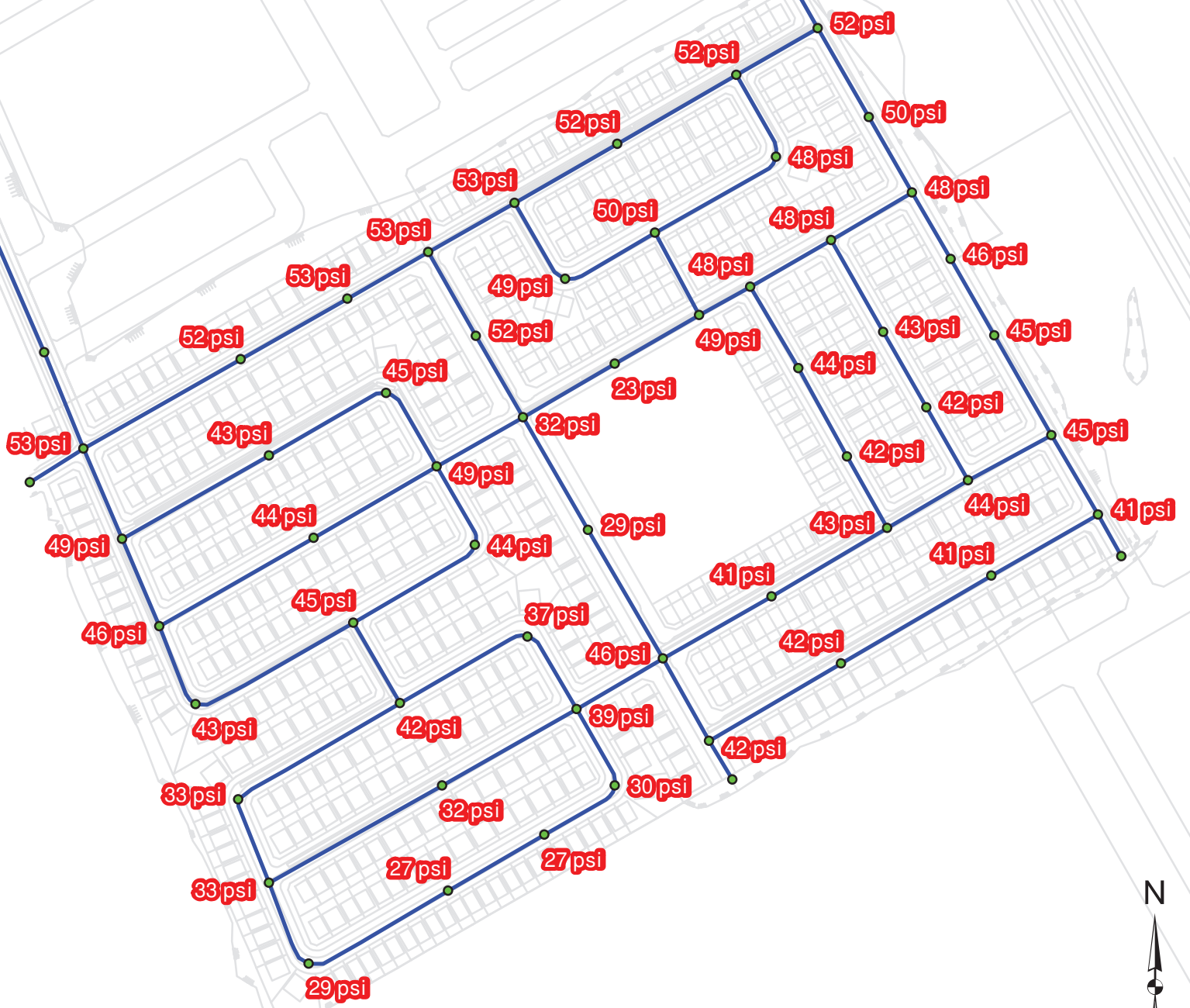
- Junction
- ⊡ Connection Point
- Water Main



Legend

- Junction
- ☒ Connection Point
- Water Main

Connection #3
Dundonald Drive



GeoAdvice Engineering Inc.

Project: Hydraulic Capacity and Modeling Analysis of the Brazeau Lands
Client: David Schaeffer Engineering Ltd.
Date: June 2020
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Reviewed by: WdS

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Residual Pressure @
Required Fire Flow -
Phases 1&2

Figure F.4

Fire Flow Modeling Results - Phase 1

ID	Static Demand (L/s)	Fire-Flow Demand (L/s)	Residual Pressure (psi)	Available Flow at Hydrant (L/s)	Available Flow Pressure (psi)
J-33	0.45	167	52	487	20
J-35	0.38	167	52	473	20
J-36	0.41	167	52	485	20
J-37	0.14	167	52	506	20
J-38	0.36	167	53	518	20
J-39	0.52	167	52	522	20
J-40	0.36	167	53	570	20
J-41	0.08	167	52	612	20
J-42	0.41	167	48	366	20
J-43	0.47	167	49	382	20
J-44	0.38	167	48	367	20
J-45	0.16	167	24	177	20
J-46	0.22	167	37	239	20
J-49	0.34	167	47	345	20
J-50	0.31	167	43	282	20
J-51	0.45	167	41	268	20
J-52	0.52	167	48	352	20
J-53	0.52	167	44	301	20
J-54	0.48	167	41	268	20
J-55	0.48	167	39	254	20
J-56	0.48	167	36	235	20
J-57	0.31	167	40	264	20
J-59	1.04	167	40	293	20
J-61	0.14	167	51	469	20
J-90	0.00	167	46	325	20
J-47	0.30	250	20	249	20
J-48	0.17	250	29	335	20
J-58	0.14	250	22	266	20

Fire Flow Modeling Results - Phases 1 and 2

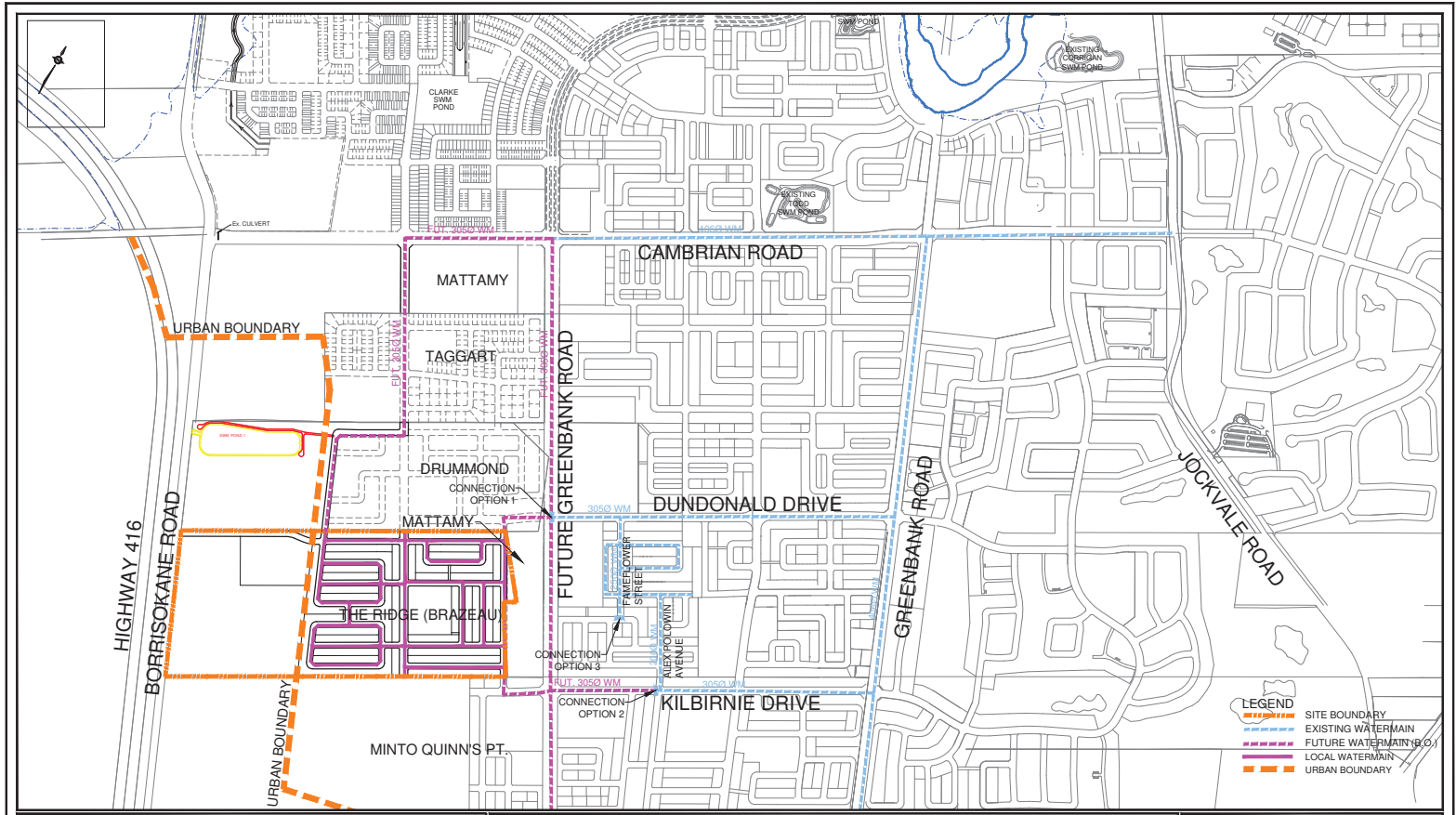
ID	Static Demand (L/s)	Fire-Flow Demand (L/s)	Residual Pressure (psi)	Available Flow at Hydrant (L/s)	Available Flow Pressure (psi)
J-33	0.45	167	53	526	20
J-35	0.38	167	52	509	20
J-36	0.41	167	53	523	20
J-37	0.14	167	53	550	20
J-38	0.36	167	53	545	20
J-39	0.52	167	52	532	20
J-40	0.36	167	52	566	20
J-41	0.08	167	52	615	20
J-42	0.41	167	48	376	20
J-43	0.47	167	50	417	20
J-44	0.38	167	49	379	20
J-45	0.16	167	48	402	20
J-46	0.22	167	48	396	20
J-49	0.34	167	49	400	20
J-50	0.31	167	45	308	20
J-51	0.45	167	43	289	20
J-52	0.52	167	49	393	20
J-53	0.52	167	46	345	20
J-54	0.48	167	44	296	20
J-55	0.48	167	43	299	20
J-56	0.48	167	45	331	20
J-57	0.31	167	44	316	20
J-59	1.04	167	46	445	20
J-61	0.14	167	52	527	20
J-62	0.52	167	42	300	20
J-63	0.48	167	33	228	20
J-64	0.52	167	33	233	20
J-65	0.45	167	29	207	20
J-66	0.52	167	27	194	20
J-67	0.55	167	32	223	20
J-68	0.34	167	37	259	20
J-69	0.34	167	39	294	20
J-70	0.41	167	27	199	20
J-71	0.28	167	30	218	20
J-72	0.41	167	42	397	20
J-74	0.58	167	42	383	20
J-75	0.41	167	41	379	20
J-76	0.21	167	41	387	20
J-78	0.16	167	45	428	20
J-79	0.44	167	44	371	20
J-80	0.44	167	43	349	20
J-81	0.71	167	41	310	20
J-82	0.30	167	42	308	20
J-83	0.49	167	44	317	20
J-84	0.27	167	42	312	20
J-85	0.49	167	43	315	20
J-86	0.19	167	45	436	20
J-87	0.19	167	46	453	20
J-88	0.11	167	48	487	20
J-89	0.19	167	50	525	20
J-90	0.00	167	49	413	20
J-47	0.30	250	23	269	20
J-48	0.17	250	32	390	20
J-58	0.14	250	29	348	20

Connection point 1:
Existing watermain
node off Haiku/
Obsidian street
intersection fronting
Block 1.



Connection point 2:
Existing watermain
node on Obsidian
street



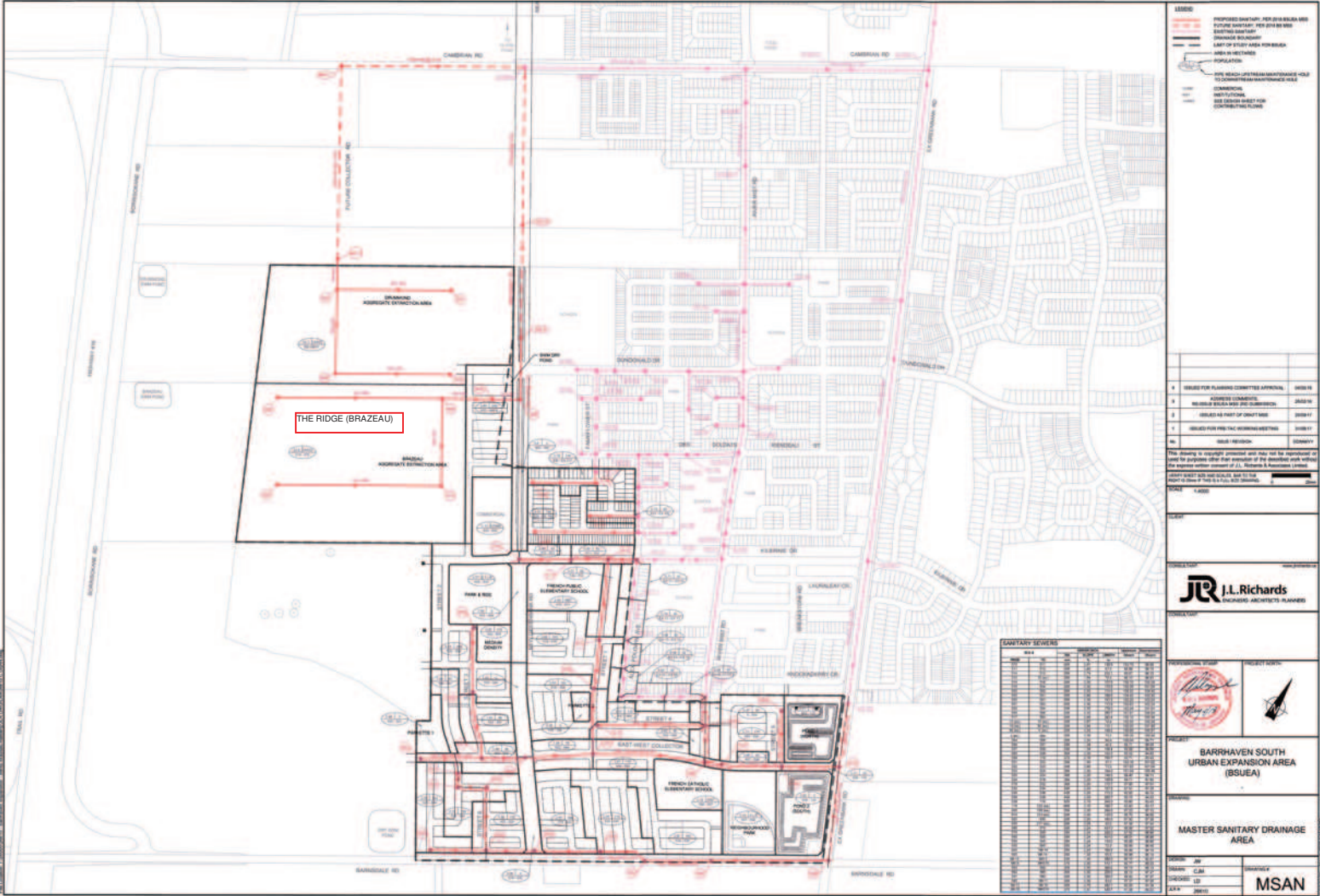


120 Iber Road, Unit 103
 Stittsville, ON K2S 1E9
 TEL: (613) 836-0856
 FAX: (613) 836-7183
 www.DSEL.ca

CAIVAN - BRAZEAU
 WATERMAIN SERVICING PLAN
 CITY OF OTTAWA

PROJECT No.:	18-1030
SCALE:	1:10,000
DATE:	APRIL 2020
FIGURE:	WAT-1

APPENDIX C



LEGEND
--- PROPOSED SANITARY PER 216 BSUEA MSN
--- EXISTING SANITARY PER 216 BSUEA MSN
--- STORM SEWER
--- EASEMENT FOR SANITARY
--- EASEMENT FOR STORM SEWER
--- AREA NOT COVERED BY SANITARY
--- AREA NOT COVERED BY STORM SEWER
--- AREA NOT COVERED BY SANITARY AND STORM SEWER
--- AREA NOT COVERED BY SANITARY AND STORM SEWER AND
 ELECTRICAL
--- SANITARY
--- STORM SEWER
--- EASEMENT FOR SANITARY
--- EASEMENT FOR STORM SEWER
--- EASEMENT FOR SANITARY AND STORM SEWER
--- EASEMENT FOR SANITARY AND STORM SEWER AND
 ELECTRICAL

1	ISSUED FOR PLANNING COMMITTEE APPROVAL	04/04/16
2	ISSUED FOR APPROVAL	04/04/16
3	ISSUED FOR APPROVAL	04/04/17
4	ISSUED FOR APPROVAL	04/04/17
5	ISSUED FOR APPROVAL	04/04/17

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 J.L. Richards & Associates Limited
 4000 West Beaver Creek Road, Suite 200
 Richmond Hill, Ontario L4B 3N2



PROJECT:
 BARRHAVEN SOUTH
 URBAN EXPANSION AREA
 (BSUEA)

TITLE:
 MASTER SANITARY DRAINAGE
 AREA

LINE NO.	START	END	LENGTH	DIAMETER	DEPTH	STATUS
1	10+00	10+50	50	12"	1.00	EXISTING
2	10+50	11+00	50	12"	1.00	EXISTING
3	11+00	11+50	50	12"	1.00	EXISTING
4	11+50	12+00	50	12"	1.00	EXISTING
5	12+00	12+50	50	12"	1.00	EXISTING
6	12+50	13+00	50	12"	1.00	EXISTING
7	13+00	13+50	50	12"	1.00	EXISTING
8	13+50	14+00	50	12"	1.00	EXISTING
9	14+00	14+50	50	12"	1.00	EXISTING
10	14+50	15+00	50	12"	1.00	EXISTING
11	15+00	15+50	50	12"	1.00	EXISTING
12	15+50	16+00	50	12"	1.00	EXISTING
13	16+00	16+50	50	12"	1.00	EXISTING
14	16+50	17+00	50	12"	1.00	EXISTING
15	17+00	17+50	50	12"	1.00	EXISTING
16	17+50	18+00	50	12"	1.00	EXISTING
17	18+00	18+50	50	12"	1.00	EXISTING
18	18+50	19+00	50	12"	1.00	EXISTING
19	19+00	19+50	50	12"	1.00	EXISTING
20	19+50	20+00	50	12"	1.00	EXISTING
21	20+00	20+50	50	12"	1.00	EXISTING
22	20+50	21+00	50	12"	1.00	EXISTING
23	21+00	21+50	50	12"	1.00	EXISTING
24	21+50	22+00	50	12"	1.00	EXISTING
25	22+00	22+50	50	12"	1.00	EXISTING
26	22+50	23+00	50	12"	1.00	EXISTING
27	23+00	23+50	50	12"	1.00	EXISTING
28	23+50	24+00	50	12"	1.00	EXISTING
29	24+00	24+50	50	12"	1.00	EXISTING
30	24+50	25+00	50	12"	1.00	EXISTING
31	25+00	25+50	50	12"	1.00	EXISTING
32	25+50	26+00	50	12"	1.00	EXISTING
33	26+00	26+50	50	12"	1.00	EXISTING
34	26+50	27+00	50	12"	1.00	EXISTING
35	27+00	27+50	50	12"	1.00	EXISTING
36	27+50	28+00	50	12"	1.00	EXISTING
37	28+00	28+50	50	12"	1.00	EXISTING
38	28+50	29+00	50	12"	1.00	EXISTING
39	29+00	29+50	50	12"	1.00	EXISTING
40	29+50	30+00	50	12"	1.00	EXISTING
41	30+00	30+50	50	12"	1.00	EXISTING
42	30+50	31+00	50	12"	1.00	EXISTING
43	31+00	31+50	50	12"	1.00	EXISTING
44	31+50	32+00	50	12"	1.00	EXISTING
45	32+00	32+50	50	12"	1.00	EXISTING
46	32+50	33+00	50	12"	1.00	EXISTING
47	33+00	33+50	50	12"	1.00	EXISTING
48	33+50	34+00	50	12"	1.00	EXISTING
49	34+00	34+50	50	12"	1.00	EXISTING
50	34+50	35+00	50	12"	1.00	EXISTING
51	35+00	35+50	50	12"	1.00	EXISTING
52	35+50	36+00	50	12"	1.00	EXISTING
53	36+00	36+50	50	12"	1.00	EXISTING
54	36+50	37+00	50	12"	1.00	EXISTING
55	37+00	37+50	50	12"	1.00	EXISTING
56	37+50	38+00	50	12"	1.00	EXISTING
57	38+00	38+50	50	12"	1.00	EXISTING
58	38+50	39+00	50	12"	1.00	EXISTING
59	39+00	39+50	50	12"	1.00	EXISTING
60	39+50	40+00	50	12"	1.00	EXISTING
61	40+00	40+50	50	12"	1.00	EXISTING
62	40+50	41+00	50	12"	1.00	EXISTING
63	41+00	41+50	50	12"	1.00	EXISTING
64	41+50	42+00	50	12"	1.00	EXISTING
65	42+00	42+50	50	12"	1.00	EXISTING
66	42+50	43+00	50	12"	1.00	EXISTING
67	43+00	43+50	50	12"	1.00	EXISTING
68	43+50	44+00	50	12"	1.00	EXISTING
69	44+00	44+50	50	12"	1.00	EXISTING
70	44+50	45+00	50	12"	1.00	EXISTING
71	45+00	45+50	50	12"	1.00	EXISTING
72	45+50	46+00	50	12"	1.00	EXISTING
73	46+00	46+50	50	12"	1.00	EXISTING
74	46+50	47+00	50	12"	1.00	EXISTING
75	47+00	47+50	50	12"	1.00	EXISTING
76	47+50	48+00	50	12"	1.00	EXISTING
77	48+00	48+50	50	12"	1.00	EXISTING
78	48+50	49+00	50	12"	1.00	EXISTING
79	49+00	49+50	50	12"	1.00	EXISTING
80	49+50	50+00	50	12"	1.00	EXISTING

DRAWN: JRP
CHECKED: CLM
DATE: 04/17/16

PROJECT: MSAN

Master Servicing Study Barrhaven South Urban Expansion Area

was assumed to have 4 washbasins that deliver 375 L/d and four (4) water closets that generate 150 L/hr for 10 hr/day resulting in a total flow of 7500 L/day.

Table 6-3: Land Use and Theoretical Wastewater Flows

Land Use	Flow Rate	Area (ha)	Units	Pop.	Average Flow (L/S)	Peak Factor	Infiltration	Total Flows (L/s)
Minto and Mattamy Lands								
Schools	28,000 L/ha/d	4.55			1.50	1.5	1.50	3.8
Park Block	4 L/s	4.39			4.0	1	1.45	5.5
Commercial	28,000 L/ha/d	2.13			0.70	1.5	0.70	1.8
Low-Medium density Residential	280 l/c/d	35.26	1080	3378	11.0	2.92	11.64	43.6
High Density Residential	280 l/c/d	0.90	120	216	0.7	3.51	0.30	2.8
Roads	-	27.00				1	8.91	8.9
Park and Ride		2.57			0.1	1	0.85	1.0
<u>Total</u>		76.8	1200	3594	17.95		25.35	67.4
Brazeau Aggregate Extraction Area								
Schools	28,000 L/ha/d	1.47			0.48	1.5	0.49	1.2
Commercial	28,000 L/ha/d	0.67			0.22	1.5	0.22	0.6
Low-Medium Density Residential	280 l/c/d	10.27	360	1126	3.65	3.21	3.39	15.1
High Density Residential	280 l/c/d	0.28	38	68	0.22	3.63	0.09	0.9
Roads	-	7.95				1	2.62	2.6
Park Block	-	1.48				1	0.49	0.5
<u>Pond Blocks</u>	-	1.78				1	0.59	0.6
<u>Total</u>		23.9		1194	4.57		7.89	21.5
Drummond Aggregate Extraction Area								
Schools	28,000 L/ha/d	1.25			0.41	1.5	0.41	1.0
Commercial	28,000 L/ha/d	0.57			0.18	1.5	0.19	0.5
Low-Medium Density Residential	280 l/c/d	8.72	288	900	2.92	3.26	2.88	12.4
High Density Residential	280 l/c/d	0.24	32	58	0.19	3.64	0.08	0.8
Roads	-	6.75				1	2.23	2.2

Master Servicing Study Barrhaven South Urban Expansion Area

Land Use	Flow Rate	Area (ha)	Units	Pop.	Average Flow (L/S)	Peak Factor	Infiltration	Total Flows (L/s)
Park Blocks	-	1.26				1	0.42	0.4
Pond Blocks	-	1.51				1	0.50	0.5
<u>Total</u>		20.3		958	3.70		6.71	17.8
Barrhaven South Urban Expansion Area Totals								
<u>Total</u>		121.0		5746	26.22		40.0	106.7

Based on the land uses presented on the Demonstration Plan (Figure 4-2), the BSUEA would generate a peak wastewater flow of approximately 106.7 L/s.

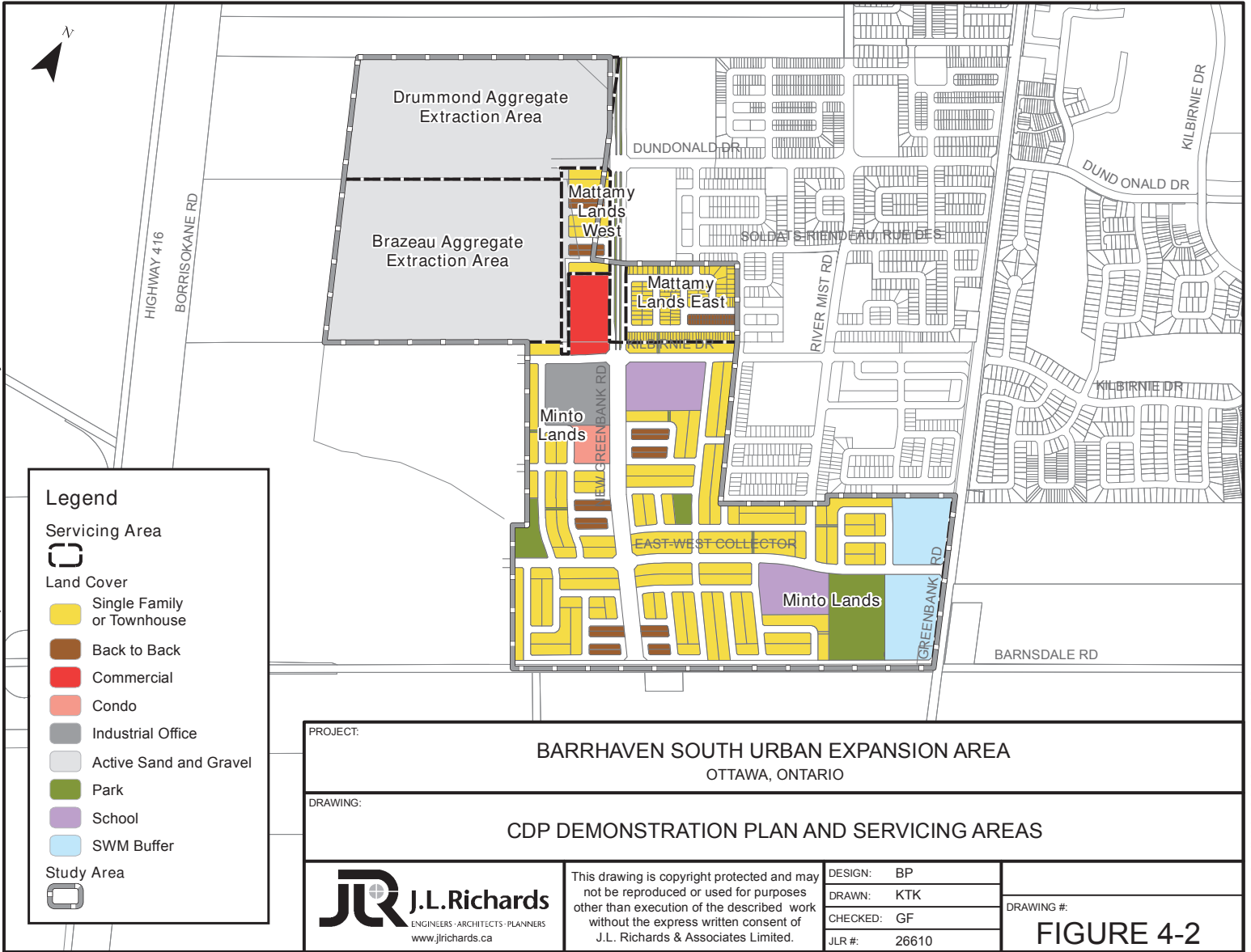
6.3 Wastewater Collection System Strategy

6.3.1 Proposed Sewer System Layout and Sizing

A trunk sanitary sewer system layout was developed based on the ROW corridors identified on the BSUEA Demonstration Plan for the purposes of demonstrating the feasibility of providing wastewater servicing for the BSUEA lands, refer to the Key Servicing Plans. Proposed trunk sanitary sewers were sized based on the aforementioned design criteria and the drainage areas depicted on the Master Sanitary Drainage Area Drawing MSAN, refer to the BSUEA Sanitary Sewer Design Sheet (Appendix J) for detailed calculations. Final configuration and sizing of the wastewater collection system will be confirmed at detailed design of each subdivision stage. At such time, refinements may be implemented.

The proposed BSUEA trunk sanitary sewers will discharge to existing/planned sanitary sewers at the following six (6) locations, as shown on Figure 6-2:

1. The Future Collector Road
2. New Greenbank Road
3. Flameflower Street
4. Alex Polowin Avenue
5. Kilbirnie Drive
6. Greenbank Road



Legend

- Servicing Area**
- Servicing Area
- Land Cover**
- Single Family or Townhouse
- Back to Back
- Commercial
- Condo
- Industrial Office
- Active Sand and Gravel
- Park
- School
- SWM Buffer
- Study Area**
- Study Area

PROJECT:	BARRHAVEN SOUTH URBAN EXPANSION AREA OTTAWA, ONTARIO	
DRAWING:	CDP DEMONSTRATION PLAN AND SERVICING AREAS	
 J.L. Richards <small>ENGINEERS - ARCHITECTS - PLANNERS</small> <small>www.jlrichards.ca</small>	This drawing is copyright protected and may not be reproduced or used for purposes other than execution of the described work without the express written consent of J.L. Richards & Associates Limited.	DESIGN: BP DRAWN: KTK CHECKED: GF JLR #: 26610
	DRAWING #: <h2 style="margin: 0;">FIGURE 4-2</h2>	

Master Servicing Study Barrhaven South Urban Expansion Area

It is noted that the residual capacity in the River Mist Road trunk sanitary sewer has in fact increased with the addition of the BSUEA peak flows. This is the result of adding a relatively small tributary area while reducing the average daily residential flow from 350 L/cap to 280 L/cap combined with diverting some existing drainage areas, located in Quinn's Pointe, away from the outlet.

Table 6-4: Residual Capacity Comparison in the BSC Trunk Sanitary Sewers

Existing Trunk Sanitary Sewer	Limiting Pipe reach	Current Minimum Residual Capacity	Proposed BSUEA Tributary Lands	Proposed BSUEA Tributary Area	Revised Minimum Residual Capacity with inclusion of BSUEA Peak Flow
Cambrian Road	MH 13A to MH15A	51.4 L/s	Drummond, Brazeau, Mattamy West (Residential only)	48 ha	52.9 L/s
River Mist Road	MH 102A to MH 17A	14.4 L/s	Mattamy East, Mattamy West (Commercial only), Northwest corner of Minto	12 ha	30.5 L/s
River Mist Road	MH 1 to MH 163	5.58 L/s	Minto	5 ha	4.63 L/s
Greenbank Road	MH 45 to MH 435A	295.4 L/s	Minto	60 ha	283.2 L/s

With the addition of the BSUEA lands, a total theoretical peak wastewater flow of 403.7 L/s was calculated at the most downstream maintenance hole in the BSC (MH 501A on Greenbank Road), as indicated in the Sanitary Sewer Design Sheet in Appendix J. This calculated theoretical peak flow is less than the 590 L/s allocated for all of the BSC in Stantec's City-wide 2013 Wastewater Collection System Assessment. In this assessment, Stantec created a hydrodynamic model of trunk sanitary sewers (450 mm in diameter and greater) which demonstrated that the existing downstream trunk system could accommodate the theoretical flow of 590 L/s generated by the BSC with no risk of surcharging or basement flooding. Consequently, Stantec concluded that system upgrades were not required to accommodate the anticipated growth in the BSC. Since the Stantec assessment considered a peak flow that was 186 L/s greater than that calculated for the BSC and the BSUEA combined, it is understood that the existing trunk sanitary sewers located downstream of the BSC can accommodate the additional flows generated by the BSUEA.

BARRHAVEN SOUTH URBAN EXPANSION (BSUEA)

BSUEA SANITARY SEWER DESIGN SHEET

CITY OF OTTAWA
MINTO COMMUNITIES INC.
J.R. NO. 26610

Designed by: A.T.
Checked by: M.S.

Date: February 2016

DESIGN PARAMETERS table with columns: Single Family, Semi-Detached Townhouse, Multi-Family, etc., and rows: Area, Peak Factor, etc.

Peak Factor = 1.5 (BSUEA contributing areas = 100%, TD (R) in contributing areas = 100%)

Main sewer design table with columns: STREET, INLET NO., NO. OF INHABITANTS, SEWER DATA, etc. Includes sections for Residential, Commercial, Institutional, and Intersecting streets.

ONLY FLOW CONTRIBUTIONS FROM BSUEA ARE SHOWN. FLOW FROM OTHER CONTRIBUTING AREAS TRIBUTARY TO CAMDEN ROAD. SEE OVERALL SANITARY SPREADSHEET.

BARRHAVEN SOUTH URBAN EXPANSION AREA (BSUEA)

CITY OF OTTAWA
MAYOR CROMBIE/ENGINEER

J.R. NO. 2648

BARRHAVEN SOUTH SANITARY SEWER DESIGN SHEET

Designed by: AT
Checked by: RM

PROPOSED AND BASE DESIGN PARAMETERS table with columns for item, description, and value. Includes parameters like 6", 8", 10", 12", 15", 20", 24", 30", 36", 42", 48", 54", 60", 66", 72", 78", 84", 90", 96", 102", 108", 114", 120", 126", 132", 138", 144", 150", 156", 162", 168", 174", 180, 186, 192, 198, 204, 210, 216, 222, 228, 234, 240, 246, 252, 258, 264, 270, 276, 282, 288, 294, 300, 306, 312, 318, 324, 330, 336, 342, 348, 354, 360, 366, 372, 378, 384, 390, 396, 402, 408, 414, 420, 426, 432, 438, 444, 450, 456, 462, 468, 474, 480, 486, 492, 498, 504, 510, 516, 522, 528, 534, 540, 546, 552, 558, 564, 570, 576, 582, 588, 594, 600, 606, 612, 618, 624, 630, 636, 642, 648, 654, 660, 666, 672, 678, 684, 690, 696, 702, 708, 714, 720, 726, 732, 738, 744, 750, 756, 762, 768, 774, 780, 786, 792, 798, 804, 810, 816, 822, 828, 834, 840, 846, 852, 858, 864, 870, 876, 882, 888, 894, 900, 906, 912, 918, 924, 930, 936, 942, 948, 954, 960, 966, 972, 978, 984, 990, 996, 1002, 1008, 1014, 1020, 1026, 1032, 1038, 1044, 1050, 1056, 1062, 1068, 1074, 1080, 1086, 1092, 1098, 1104, 1110, 1116, 1122, 1128, 1134, 1140, 1146, 1152, 1158, 1164, 1170, 1176, 1182, 1188, 1194, 1200, 1206, 1212, 1218, 1224, 1230, 1236, 1242, 1248, 1254, 1260, 1266, 1272, 1278, 1284, 1290, 1296, 1302, 1308, 1314, 1320, 1326, 1332, 1338, 1344, 1350, 1356, 1362, 1368, 1374, 1380, 1386, 1392, 1398, 1404, 1410, 1416, 1422, 1428, 1434, 1440, 1446, 1452, 1458, 1464, 1470, 1476, 1482, 1488, 1494, 1500, 1506, 1512, 1518, 1524, 1530, 1536, 1542, 1548, 1554, 1560, 1566, 1572, 1578, 1584, 1590, 1596, 1602, 1608, 1614, 1620, 1626, 1632, 1638, 1644, 1650, 1656, 1662, 1668, 1674, 1680, 1686, 1692, 1698, 1704, 1710, 1716, 1722, 1728, 1734, 1740, 1746, 1752, 1758, 1764, 1770, 1776, 1782, 1788, 1794, 1800, 1806, 1812, 1818, 1824, 1830, 1836, 1842, 1848, 1854, 1860, 1866, 1872, 1878, 1884, 1890, 1896, 1902, 1908, 1914, 1920, 1926, 1932, 1938, 1944, 1950, 1956, 1962, 1968, 1974, 1980, 1986, 1992, 1998, 2004, 2010, 2016, 2022, 2028, 2034, 2040, 2046, 2052, 2058, 2064, 2070, 2076, 2082, 2088, 2094, 2100, 2106, 2112, 2118, 2124, 2130, 2136, 2142, 2148, 2154, 2160, 2166, 2172, 2178, 2184, 2190, 2196, 2202, 2208, 2214, 2220, 2226, 2232, 2238, 2244, 2250, 2256, 2262, 2268, 2274, 2280, 2286, 2292, 2298, 2304, 2310, 2316, 2322, 2328, 2334, 2340, 2346, 2352, 2358, 2364, 2370, 2376, 2382, 2388, 2394, 2400, 2406, 2412, 2418, 2424, 2430, 2436, 2442, 2448, 2454, 2460, 2466, 2472, 2478, 2484, 2490, 2496, 2502, 2508, 2514, 2520, 2526, 2532, 2538, 2544, 2550, 2556, 2562, 2568, 2574, 2580, 2586, 2592, 2598, 2604, 2610, 2616, 2622, 2628, 2634, 2640, 2646, 2652, 2658, 2664, 2670, 2676, 2682, 2688, 2694, 2700, 2706, 2712, 2718, 2724, 2730, 2736, 2742, 2748, 2754, 2760, 2766, 2772, 2778, 2784, 2790, 2796, 2802, 2808, 2814, 2820, 2826, 2832, 2838, 2844, 2850, 2856, 2862, 2868, 2874, 2880, 2886, 2892, 2898, 2904, 2910, 2916, 2922, 2928, 2934, 2940, 2946, 2952, 2958, 2964, 2970, 2976, 2982, 2988, 2994, 3000.

- Source: Half Moon Bay South Subdivision - Phase 4 - Excluding Antenna- Sanitary sewer design sheet prepared by Stantec (2015)
- Quinn's Point - Excluding Antenna- Sanitary sewer design sheet prepared by J.L. Roberts (2015)
- Barrhaven South Master Servicing Study Appendix - Sanitary sewer design sheet prepared Stantec (2014)

Legend: Proposed (Yellow), Proposed by Others (Blue), Existing (Green)

TOTAL PEAK FLOW TO MH57A = 112.80 L/s
(USING CUMULATIVE AREAS,
POPULATIONS AND PEAK FACTORS)

Date: February 2018

Main data table with columns: STREET, SOURCE, MAJ.# FROM TO, NUMBER OF DINTS (INT, MFL, AD, TOT), AREA (TOTAL, POPUL, CUMULATIVE), PEAKING FACTOR, POPUL. FLOW, COMMERCIAL, INSTITUTIONAL, GREENHOUSE, PEAK EXTR., PUMP, PEAK DIA., DIA. SLOPE, R/SW DATA (SLOPE, VELA, LENGTH), RESIDUAL CAP., and PEAK FLOW FACTOR. The table is divided into sections: COMMON HOME OUTLET, BRANCHED OUTLET, COMMON POINTS OUTLET, and DINTS TO MH7A INVERTED ROAD OUTLETS VIA CAMBRIDGE ROAD.

BARRHAVEN SOUTH URBAN EXPANSION AREA (BSUEA)

CITY OF OTTAWA
MINTO CONSULTING INC.
J.R. NO. 2648

BARRHAVEN SOUTH SANITARY SEWER DESIGN SHEET

Designed by: AT
Checked by: RM

PROPOSED AND BSUEA DESIGN PARAMETERS			
Single Family	3.4	pers/unit	8" x 280 L/ha/day
Semi-Detached/Townhouse (row)	2.7	pers/unit	1" x 8,330 L/ha/day
Apartment	1.8	pers/unit	1" x 2800 L/ha/day
Manning's Coeff. (N)	0.213		0.213

Notes: 1. 2.5 ICI in contributing area is >20%, 1.0 ICI in contributing area is <20%
 2. Half Moon Bay South Subdivision - Phase 4 - Excluding Aerials - Sanitary sewer design sheet prepared by Statoc (2015)
 3. Quinn's Point - Excluding Aerials - Sanitary sewer design sheet prepared by J.L. Roberts (2015)
 4. Barrhaven South Master Services Study Appendix - Sanitary sewer design sheet prepared Statoc (2014)

Legend	Proposed	Proposed by Others	Existing

Date: February 19, 2018

STREET	SOURCE	MAL #	NUMBER OF DINTS				AREA TOTAL ha	POPULATION TOTAL	POPUL. DENSITY	PEAKING FACTOR	POPUL. FLOW l/s	COMMERCIAL		INDUSTRIAL		GREENHOUSE		PEAK EXTR. FLOW l/s	PLOG FLOW l/s	PEAK DIET. FLOW l/s	SEWER DATA				REINFORC. DIA. mm	REINFORC. LENGTH m	REINFORC. COST \$	EST. FACTOR	
			IN		OUT							AREA ha	INST. FLOW l/s	AREA ha	INST. FLOW l/s	AREA ha	INST. FLOW l/s				SLOPE %	CAPACITY l/s	VELOCITY m/s	LENGTH m					
			IN	OUT	IN	OUT																							
Greenbank Road		EX122	EX122R			0.45	0	340	0.04	2.90	36.16	0.00	0.00	0.00	0.00	0.00	0.00	22.79		63.20	600	0.21	291.1	1.00	121.02	227.00	0.10	1.00	
Essement		EX44	EX122R			0.00	0	250	2.02	3.45	2.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.79	300	0.35	59.9	0.82	16.00	56.12	0.00	1.00	
Greenbank Road		EX122R	MH200A			0.43	0	3869	65.49	2.87	38.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.80		66.37	600	0.25	318.2	1.00	120.40	252.88	0.20	1.00
Kilbuck Drive	JLR (2016)	EX24	MH200A		3	0.11	0	224	2.15	3.50	2.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71		3.25	200	0.71	25.8	0.88	28.70	25.80	0.00	1.00
Existing Greenbank Road		MH200A	EX88A			0	0	4123	67.64	2.86	38.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.51		73.94	600	0.25	320.3	1.10	126.20	245.34	0.20	1.00
EXISTING GREENBANK RD FROM MH36A TO MH36A																													
Existing Greenbank Road		III	EX88A	MH96A		0.00	0	4123	67.64	2.86	38.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.51		73.94	600	0.25	320.3	1.10	126.20	245.34	0.20	1.00
Existing Greenbank Road		III	MH96A	MH100A		0.00	0	4123	67.64	2.86	38.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.51		73.94	600	0.25	320.3	1.10	126.20	245.34	0.20	1.00
Existing Greenbank Road		III	MH100A	MH200A		0.00	0	4123	67.64	2.86	38.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.51		73.94	600	0.25	320.3	1.10	126.20	245.34	0.20	1.00
Existing Greenbank Road		III	MH200A	MH17A		0.00	0	4123	67.64	2.86	38.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.51		73.94	600	0.25	320.3	1.10	126.20	245.34	0.20	1.00
Existing Greenbank Road		III	MH17A	MH96A		18.95	1631	97.64	67.58	2.75	31.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71		93.00	600	0.30	350.8	1.00	100.00	254.95	0.07	1.00
Existing Greenbank Road		III	MH96A	MH96A		0.00	0	3164	67.58	2.75	31.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71		93.00	600	0.30	350.8	1.00	100.00	254.95	0.07	1.00
Existing Greenbank Road		III	MH96A	MH201A		12.13	787	65.41	66.72	2.71	37.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81		104.01	600	0.30	350.8	1.00	100.00	248.83	0.06	1.00
Existing Greenbank Road		III	MH201A	MH200A		0.00	0	6541	99.72	2.71	37.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81		104.01	600	0.30	350.8	1.00	100.00	248.83	0.06	1.00
Existing Greenbank Road		III	MH200A	MH200C		0.00	0	6541	99.72	2.71	37.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81		104.01	600	0.30	350.8	1.00	100.00	248.83	0.06	1.00
Existing Greenbank Road		III	MH200C	MH40		0.00	0	6541	99.72	2.71	37.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81		104.01	600	0.30	350.8	1.00	100.00	248.83	0.06	1.00
Existing Greenbank Road	Statoc (2014)	MH40	MH420A			5.12	548	103.00	301.38	2.27	171.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81		104.01	600	0.30	350.8	1.00	100.00	248.83	0.06	1.00
North		MA0	MA0			22.23	2378	107.00	22.23	3.20	23.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81		35.37	450	0.11	96.4	0.82	507.20	63.03	0.07	1.00
North		MA0	MA0			2.88	309	107.00	2.88	2.99	23.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81		35.37	450	0.11	96.4	0.82	507.20	63.03	0.07	1.00
North		MA7	MA6			18.50	1979	107.00	18.50	2.82	42.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81		62.01	450	0.11	96.4	0.82	507.20	63.03	0.07	1.00
Redeveloped Greenbank Road		MA0	MA0			21.68	2300	107.00	21.68	2.99	60.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81		67.36	525	0.10	140.5	0.82	473.20	53.14	0.05	1.00
Redeveloped Greenbank Road		MA0	MA4			0.53	1000	1800.00	74.52	2.24	68.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81		68.19	525	0.10	140.5	0.82	438.40	42.31	0.03	1.00
Redeveloped Greenbank Road		MA1	MH200A			0.07	863	1220.00	32.89	2.61	74.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81		100.03	525	0.10	140.5	0.82	430.70	32.47	0.02	1.00
Redeveloped Greenbank Road		MH201A	MH200A			3.80	291	3000.00	96.89	2.60	76.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81		110.88	600	0.10	201.5	0.82	49.00	10.22	0.02	1.00
Redeveloped Greenbank Road		MH202A	MH430A			0.00	0	9099	88.69	2.60	76.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81		110.88	600	0.10	201.5	0.82	11.10	90.22	0.02	1.00
Redeveloped Greenbank Road		MH430A	MH501A			0.00	0	32409	357.69	2.16	226.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81		400.67	900	0.10	597.0	1.10	13.20	167.43	0.10	1.00

Sanitary design calculation for the proposed HMB phase 8 site by DSEL (2020)

SANITARY SEWER CALCULATION SHEET																						Ottawa								
Manning's n=0.013																														
STREET	LOCATION	FROM M.H.	TO M.H.	AREA (ha)	UNITS	RESIDENTIAL AREA AND POPULATION				CUMULATIVE		PEAK		COMM		RESID		PARK		CWH		INFILTRATION		DIBT (m)	DA (mm)	SLOPE (%)	PIPE DFP (FULL) (ft/s)	RATIO Q at 10 deg	VEL (FULL) (m/s)	VEL (ACT) (m/s)
						SINGLE	TOWNHOUSE	POP	POP	PEAK FACT	PEAK FLOW (l/s)	AREA (ha)	AREA (ha)	AREA (ha)	AREA (ha)	AREA (ha)	AREA (ha)	TOTAL AREA (ha)	ACCU AREA (ha)	INFLT FLOW (l/s)	TOTAL FLOW (l/s)									
Drummond Future Road	Plug	305A		0.89				67	0.89	67	3.63	0.79	0.00	0.00	0.00	0.89	0.89	0.29	1.08	8.0	200	0.35	19.40	0.06	0.62	0.33				
To Expansion Road, Pipe 305A - 308A									0.89	67			0.00	0.00	0.00															
Future Residential	Ctrf 3A	109A		1.90				162	1.90	162	3.54	1.86	0.00	0.00	0.00	1.90	1.90	0.63	2.49	11.0	200	0.35	19.40	0.13	0.62	0.42				
To Obadian Street, Pipe 109A - 400A									1.90	162			0.00	0.00	0.00															
Focality Crescent		107A	108A	0.14	3		3	9	0.14	9	3.74	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.14	0.05	0.16	12.5	200	2.45	51.34	0.60	1.63	0.36	
To Haidu Street, Pipe 110A - 1100A		108A	110A	0.17	5		5	14	0.31	23	3.70	0.28	0.00	0.00	0.00	0.00	0.17	0.31	0.10	0.38	50.5	200	0.35	19.40	0.02	0.62	0.24			
		107A	112A	0.45	18		18	49	0.45	49	3.65	0.58	0.00	0.00	0.00	0.00	0.45	0.45	0.15	0.73	73.5	200	0.70	27.44	0.03	0.87	0.37			
		112A	113A	0.43	16		16	44	0.88	93	3.60	1.00	0.00	0.00	0.00	0.43	0.68	0.29	1.38	70.5	200	0.35	19.40	0.07	0.62	0.36				
		113A	114A	0.12	3		3	9	1.00	102	3.59	1.19	0.00	0.00	0.00	0.00	0.12	1.00	0.33	1.52	12.5	200	0.35	19.40	0.08	0.62	0.36			
		114A	115A	0.18	5		5	14	1.18	116	3.58	1.35	0.00	0.00	0.00	0.00	0.18	1.18	0.39	1.74	50.5	200	0.40	20.74	0.08	0.66	0.40			
To Haidu Street, Pipe 115A - 111A									1.18	116			0.00	0.00	0.00															
Sturndae Street		124A	125A	0.60	18	18		62	0.60	62	3.64	0.73	0.00	0.00	0.00	0.60	0.60	0.20	0.93	101.0	200	0.65	26.44	0.04	0.84	0.39				
		125A	126A	0.50	12	12		41	1.10	103	3.59	1.20	0.00	0.00	0.00	0.50	1.10	0.36	1.56	91.0	200	0.35	19.40	0.08	0.62	0.37				
Contribution From Montology Way, Pipe 123A - 126A									0.81	63			0.00	0.00	0.00				0.81	1.91										
		126A	106A						1.91	166	3.54	1.91	0.00	0.00	0.00	0.00	1.91	0.63	2.54	63.0	200	0.35	19.40	0.13	0.62	0.42				
To Elevation Road, Pipe 106A - 116A									1.91	166			0.00	0.00	0.00				1.91											
Park		Ctrf 4A	104A						0.00				0.00	0.00	1.72	1.72	0.19	1.72	1.72	0.57	0.75	10.5	200	0.35	19.40	0.04	0.62	0.29		
To Chillerton Drive, Pipe 104A - 106A									0.00	0			0.00	0.00					1.72											
Canadensis Lane		229A	230A	0.42	15		15	41	0.42	41	3.67	0.49	0.00	0.00	0.00	0.42	0.42	0.14	0.63	73.5	200	2.00	46.38	0.01	1.48	0.51				
		230A	103A	0.48	18		18	49	0.90	90	3.60	1.05	0.00	0.00	0.00	0.48	0.90	0.30	1.35	90.0	200	3.00	56.81	0.02	1.81	0.75				
To Chillerton Drive, Pipe 103A - 104A									0.90	90			0.00	0.00	0.00				0.90											
Surface Lane		227A	228A	0.47	18		18	49	0.47	49	3.65	0.58	0.00	0.00	0.00	0.00	0.47	0.47	0.16	0.74	72.5	200	2.00	46.38	0.02	1.48	0.53			
		228A	102A	0.48	18		18	49	0.95	98	3.60	1.14	0.00	0.00	0.00	0.48	0.95	0.31	1.48	60.0	200	0.85	30.24	0.05	0.96	0.49				
To Chillerton Drive, Pipe 102A - 103A									0.95	98			0.00	0.00	0.00				0.95											
Chillerton Drive		101A	102A	0.14	3		3	9	0.14	9	3.74	0.11	0.00	0.00	0.00	0.00	0.00	0.14	0.14	0.05	0.16	25.5	200	2.60	52.89	0.60	1.68	0.34		
Contribution From Surface Lane, Pipe 228A - 102A									0.95	98			0.00	0.00	0.00				0.95	1.09										
		102A	103A	0.22	7		7	19	1.31	126	3.57	1.46	0.00	0.00	0.00	0.00	0.22	1.31	0.43	1.89	59.0	200	1.70	42.76	0.04	1.36	0.67			
Contribution From Canadensis Lane, Pipe 230A - 103A									0.90	90			0.00	0.00	0.00				0.90	2.21										
		103A	104A	0.46	14		14	38	2.67	254	3.49	2.87	0.00	0.00	0.00	0.46	2.67	0.88	3.75	120.0	200	0.50	23.19	0.16	0.74	0.54				
Contribution From Park, Pipe 4A - 104A									0.00	0			0.00	0.00	1.72				1.72	4.39										
		104A	106A	0.08	1		1	3	2.75	257	3.49	2.90	0.00	0.00	1.72	0.19	0.08	4.47	1.48	4.56	45.5	200	0.35	19.40	0.24	0.62	0.50			
To Elevation Road, Pipe 106A - 116A									2.75	257			0.00	0.00	1.72				4.47											
DESIGN PARAMETERS																														
Park Flow = 9300 l/h/d										Industrial Peak Factor = as per MOC Graph										PROJECT:										
Average Daily Flow = 280 l/h/d										Entrance Flow = 0.339 l/s/h										City of Ottawa										
Committed Flow = 26000 l/h/d										Minimum Velocity = 0.600 m/s										City of Ottawa										
Industrial Flow = 35000 l/h/d										Manning's n = (Conc) 0.013 (Pvc) 0.013										City of Ottawa										
Max Res. Peak Factor = 3.80										Townhouse coeff = 2.7										City of Ottawa										
Commercial/Inst. Park Peak Factor = 1.00										Single house coeff = 3.4										City of Ottawa										
Institutional = 0.32 l/s/h																				City of Ottawa										
Checked: ASJ																														
Project: Clavan Communities - Brazeau Phase 1																														
City of Ottawa																														
Date: 27 Jul 2020																														
Sheet No. 1																														
of 6																														

SANITARY SEWER CALCULATION SHEET



Manning's n=0.013

STREET	LOCATION	FROM M.H.	TO M.H.	RESIDENTIAL AREA AND POPULATION				CUMULATIVE		PEAK FLOW		CONN.		NETT		PARK		DHW		INFILTRATION		DIST (m)	DIA (mm)	SLOPE (%)	PIPE		RATIO	VEL.	
				AREA (ha)	UNITS	UNITS	POP.	AREA (ha)	POP.	FACT.	FLOW (l/s)	AREA (ha)	AREA (ha)	AREA (ha)	AREA (ha)	AREA (ha)	AREA (ha)	AREA (ha)	AREA (ha)	AREA (ha)	AREA (ha)				AREA (ha)	AREA (ha)		AREA (ha)	AREA (ha)
Epoch Street																													
		220A	221A	0.42	10	10	27	0.42	27	3.69	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.42	0.14	0.46	77.5	200	0.95	31.97	0.01	1.02	0.35
		221A	222A	0.49	18	18	49	0.91	76	3.62	0.89	0.00	0.00	0.00	0.00	0.49	0.91	0.30	1.19	93.0	200	0.35	19.40	0.06	0.62	0.34			
		222A	223A	0.52	20	20	54	1.43	130	3.57	1.90	0.00	0.00	0.00	0.00	0.52	1.43	0.47	1.98	100.5	200	0.35	19.40	0.10	0.62	0.40			
To Elevation Road, Pipe 223A - 105A																													
Eminence Street																													
		215A	216A	0.49	12	12	41	0.49	41	3.67	0.49	0.00	0.00	0.00	0.00	0.49	0.49	0.16	0.65	75.5	200	0.85	30.24	0.02	0.96	0.39			
		216A	217A	0.72	17	17	58	1.21	99	3.60	1.15	0.00	0.00	0.00	0.00	0.72	1.21	0.40	1.55	113.5	200	0.35	19.40	0.08	0.62	0.37			
		217A	218A	0.45	12	12	41	1.66	140	3.56	1.62	0.00	0.00	0.00	0.00	0.45	1.66	0.55	2.16	83.5	200	0.35	19.40	0.11	0.62	0.41			
To Elevation Road, Pipe 219A - 223A																													
Elevation Road																													
		218A	219A	0.13	2	2	7	0.13	7	3.74	0.08	0.00	0.00	0.00	0.00	0.13	0.13	0.04	0.13	24.0	200	2.65	53.39	0.00	1.70	0.35			
Contribution From Eminence Street, Pipe 217A - 219A																													
		219A	223A	0.23	4	4	14	2.02	161	3.54	1.85	0.00	0.00	0.00	0.00	0.23	2.02	0.67	2.52	59.0	200	0.85	30.24	0.08	0.96	0.58			
Contribution From Epoch Street, Pipe 222A - 223A																													
		223A	105A	0.42	6	6	21	3.97	312	3.46	3.50	0.00	0.00	0.00	0.42	3.67	1.28	4.77	82.5	200	0.70	27.44	0.17	0.87	0.66				
		105A	106A	0.42	7	7	24	4.29	336	3.45	3.75	0.00	0.00	0.00	0.00	0.42	4.29	1.42	5.17	94.0	200	1.30	37.40	0.14	1.19	0.83			
Contribution From Chillerton Drive, Pipe 104A - 106A																													
								2.75	257			0.00	0.00	1.72	4.47	8.76													
Contribution From Stumidae Street, Pipe 126A - 106A																													
								1.91	166			0.00	0.00	0.00	1.91	10.67													
		106A	116A	0.35	8	8	28	9.30	769			0.00	0.00	1.72	0.19	0.35	11.37	3.75	12.63	118.0	200	0.35	19.40	0.65	0.62	0.66			
To Haku Street, Pipe 116A - 1160A																													
								9.65	817			0.00	0.00	1.72															
								1.57	118			0.00	0.00	0.00	1.57	1.57													
To Expansion Road, Pipe 310A - 1311A																													
		309A	310A	5.67			595	7.24	713	3.31	7.65	0.00	0.00	0.00	0.00	5.67	7.24	2.39	10.04	15.0	250	0.25	29.73	0.34	0.61	0.55			
Drummond Future Road																													
		301A	302A	1.27			95	1.27	95	3.60	1.11	0.00	0.00	0.00	0.00	1.27	1.27	0.42	1.53	94.5	200	0.35	19.40	0.08	0.62	0.36			
To Expansion Road, Pipe 302A - 1180A																													
Drummond Future Road																													
								2.22	23			0.00	0.00	1.45	1.45	1.67	1.67												
		1303A	3031A	0.61			46	0.83	69	3.63	0.81	0.00	0.00	1.45	0.16	0.61	2.28	0.75	1.72	108.0	200	0.35	19.40	0.09	0.62	0.38			
To Expansion Road, Pipe 3031A - 302A																													
Expansion Road																													
								0.16	17			0.00	0.00	0.00	0.16	0.16													
		303A	3031A	0.19			14	0.35	31	3.68	0.37	0.00	0.00	0.00	0.19	0.35	0.12	0.49	65.0	200	0.65	26.44	0.02	0.84	0.32				
Contribution From Drummond Future Road, Pipe 1303A - 3031A																													
		3031A	302A	0.22			17	1.40	117	3.58	1.36	0.00	0.00	1.45	0.16	0.22	2.85	0.94	2.45	59.0	200	0.35	19.40	0.13	0.62	0.42			
Contribution From Expansion Road, Pipe 301A - 302A																													
		302A	1180A	0.20			15	2.87	227	3.50	2.58	0.00	0.00	1.45	0.16	0.20	4.32	1.43	4.16	49.5	200	0.35	19.40	0.21	0.62	0.49			
To Haku Street, Pipe 118A - 117A																													
		1180A	118A					2.87	227			0.00	0.00	1.45	0.16	0.00	4.32	1.43	4.16	11.0	200	0.35	19.40	0.21	0.62	0.49			

DESIGN PARAMETERS												PROJECT											
Park Flow = 9300 L/ha/ds 0.10764 l/s/ha Average Daily Flow = 280 lpd/day Commitment Flow = 28000 L/ha/ds 0.3241 l/s/ha Industrial Flow = 35000 L/ha/ds 0.40509 l/s/ha Max Res. Peak Factor = 3.80 Commercial/Inst./Park Peak Factor = 1.00 Institutional = 0.32 l/s/ha												Industrial Peak Factor = as per MOE Graph Extraneous Flow = 0.330 L/s/ha Minimum Velocity = 0.600 m/s Manning's n = (Conc) 0.013 (Pvc) 0.015 Townhouse coeff = 2.7 Single house coeff = 3.4											
Checked: _____ Dwg. Reference: Sanitary Drainage Plan, Dwg. No. 80-83												Designed: _____ PROJECT: Clavan Communities - Brazeau Phase 1 LOCATION: City of Ottawa File Ref: 16-1030 Date: 27 Jul 2020 Sheet No: 2 of 6											

SANITARY SEWER CALCULATION SHEET



Manning's n=0.013

STREET	LOCATION	FROM M.H.	TO M.H.	RESIDENTIAL AREA AND POPULATION				CUMULATIVE		PEAK FLOW (l/s)	PEAK FLOW (l/s)	CONN.		NETT		PARK	DHW	INFILTRATION		DIST (m)	DIA (mm)	SLOPE (%)	PIPE		RATIO Q _{act} /Q _{cap}	VEL.									
				AREA (ha)	UNITS	UNITS	UNITS	POP	AREA (ha)			POP	AREA (ha)	AREA (ha)	ACCU. AREA (ha)			ACCU. AREA (ha)	ACCU. AREA (ha)				ACCU. AREA (ha)	INFILT. FLOW (l/s)		INFILT. FLOW (l/s)	Q _{cap} (l/s)	Q _{act} (l/s)	(FULL) (m/s)	(ACT.) (m/s)					
Haiku Street - Local Sewer																																			
To Haiku Street, Pipe 1100A - 109A		109A	1100A	0.20	6	6	17	0.20	17	3.71	0.20	0.00	0.00	0.00	0.00	0.00	0.20	0.20	0.07	0.27	55.5	200	1.00	32.80	0.01	1.04	0.30								
To Haiku Street, Pipe 1160A - 115A		1150A	1160A	0.24	6	6	17	0.24	17	3.71	0.20	0.00	0.00	0.00	0.00	0.00	0.24	0.24	0.08	0.28	41.5	200	0.65	26.44	0.01	0.84	0.27								
To Haiku Street, Pipe 111A - 110A		110A	111A	0.41	16	16	44	0.41	44	3.66	0.52	0.00	0.00	0.00	0.00	0.00	0.41	0.41	0.14	0.66	74.5	200	0.65	26.44	0.02	0.84	0.35								
To Haiku Street, Pipe 115A - 111A		111A	115A	0.49	19	19	52	0.49	52	3.65	0.61	0.00	0.00	0.00	0.00	0.00	0.49	0.49	0.16	0.78	87.5	200	0.65	26.44	0.03	0.84	0.37								
To Haiku Street, Pipe 117A - 116A		116A	117A	0.70	19	19	65	0.70	65	3.63	0.77	0.00	0.00	0.00	0.00	0.00	0.70	0.70	0.23	1.00	119.0	200	0.65	26.44	0.04	0.84	0.40								
To Haiku Street, Pipe 116A - 1160A		117A	116A	0.67	15	15	51	0.67	51	3.65	0.60	0.00	0.00	0.00	0.00	0.00	0.67	0.67	0.22	0.82	125.5	200	0.65	26.44	0.03	0.84	0.38								
Haiku Street																																			
Contribution From Haiku Street, Pipe 116A - 1160A								22.60	1828			21.23	0.00	3.17	42.68	42.68																			
Contribution From Haiku Street - Local Sewer, Pipe 1150A - 1160A								0.24	17.00			0.00	0.00	0.00	0.24																				
1160A 1150A								22.84	1845	3.09	18.48	21.23	0.00	3.17	7.22	0.00	42.92	14.16	39.86	41.5	375	0.15	67.91	0.59	0.61	0.64									
1150A 115A								22.84	1845	3.09	18.48	21.23	0.00	3.17	7.22	0.00	42.92	14.16	39.86	4.5	375	0.15	67.91	0.59	0.61	0.64									
Contribution From Focality Crescent, Pipe 114A - 115A								1.18	115			0.00	0.00	0.00	1.18	44.10																			
Contribution From Haiku Street - Local Sewer, Pipe 111A - 115A								0.67	51.00			0.00	0.00	0.00	0.67																				
115A 111A								24.69	2012	3.07	20.00	21.23	0.00	3.17	7.22	0.00	44.77	14.77	41.99	87.5	375	0.15	67.91	0.62	0.61	0.65									
Contribution From Haiku Street - Local Sewer, Pipe 10A - 111A								0.70	65.50			0.00	0.00	0.00	0.70																				
111A 110A								25.39	2077	3.06	20.59	21.23	0.00	3.17	7.22	0.00	45.47	15.01	42.81	74.5	375	0.15	67.91	0.63	0.61	0.65									
Contribution From Focality Crescent, Pipe 106A - 110A								0.31	23			0.00	0.00	0.00	0.31	45.78																			
110A 1100A								25.70	2100	3.06	20.79	21.23	0.00	3.17	7.22	0.00	45.78	15.11	43.12	4.0	375	0.15	67.91	0.64	0.61	0.65									
Contribution From Haiku Street - Local Sewer, Pipe 109A - 1100A								0.20	17.00			0.00	0.00	0.00	0.20																				
1100A 109A								25.90	2117	3.05	20.95	21.23	0.00	3.17	7.22	0.00	45.98	15.17	43.34	55.5	375	0.15	67.91	0.64	0.61	0.65									
To Obsidian Street, Pipe 109A - 400A								25.90	2117			21.23	0.00	3.17																					
Future Commercial																																			
2A 2250A								0.00				2.99	2.99	0.00	0.00	0.97	2.99	2.99	0.99	1.96	11.0	200	0.35	19.40	0.10	0.62	0.39								
To Obsidian Street, Pipe 2250A - 226A								0.00	0			2.99	0.00	0.00	0.00	2.99																			
Obsidian Street																																			
224A 225A								0.33	9	9	25	0.33	25	3.69	0.30	0.00	0.00	0.00	0.33	0.33	0.11	0.41	75.0	200	0.65	26.44	0.02	0.84	0.30						
225A 2250A								0.27	8	8	22	0.60	47	3.66	0.56	0.00	0.00	0.00	0.27	0.60	0.20	0.75	67.5	200	0.90	31.12	0.02	0.99	0.41						
Contribution From Future Commercial, Pipe 2A - 2250A								0.00	0			0.00	0	2.99	0.00	2.99	3.59																		
2250A 226A								0.15	3	3	9	0.75	56	3.64	0.66	2.99	0.00	0.00	0.97	1.15	3.74	1.23	2.86	46.0	200	1.40	38.81	0.07	1.24	0.71					
226A 108A								0.34	9	9	25	1.09	81	3.61	0.95	2.99	0.00	0.00	0.97	1.15	4.08	1.35	3.26	92.0	200	1.60	41.49	0.08	1.32	0.78					
Contribution From Haiku Street, Pipe 1100A - 109A								25.90	2117			21.23	0.00	3.17																					
109A 400A								1.90	162			0.00	0.00	0.00	1.90	51.99																			
To Drummond Future Road, Pipe 400A - 401A								28.98	2360			24.22	0.00	3.17	8.19	0.09	52.05	17.18	48.49	63.0	375	0.15	67.91	0.71	0.61	0.67									

DESIGN PARAMETERS			
Park Flow =	9000	L/ha/d	0.10764
Average Daily Flow =	280	l/day	
Committed Flow =	28000	L/ha/d	0.3241
Industrial Flow =	35000	L/ha/d	0.40509
Max Res. Peak Factor =	3.80		
Commercial/Inst./Park Peak Factor =	1.00		
Institutional =	0.32	l/ha	

DESIGNED		PROJECT	
Checked:	SLM	LOCATION:	Clavan Communities - Brazeau Phase 1
	ADF		City of Ottawa
Dwg. Reference:	Sanitary Drainage Plan, Dwg. No. 80-83	File Ref:	16-1038
Date:	27 Jul 2020	Sheet No.:	5 of 6

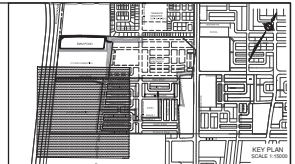
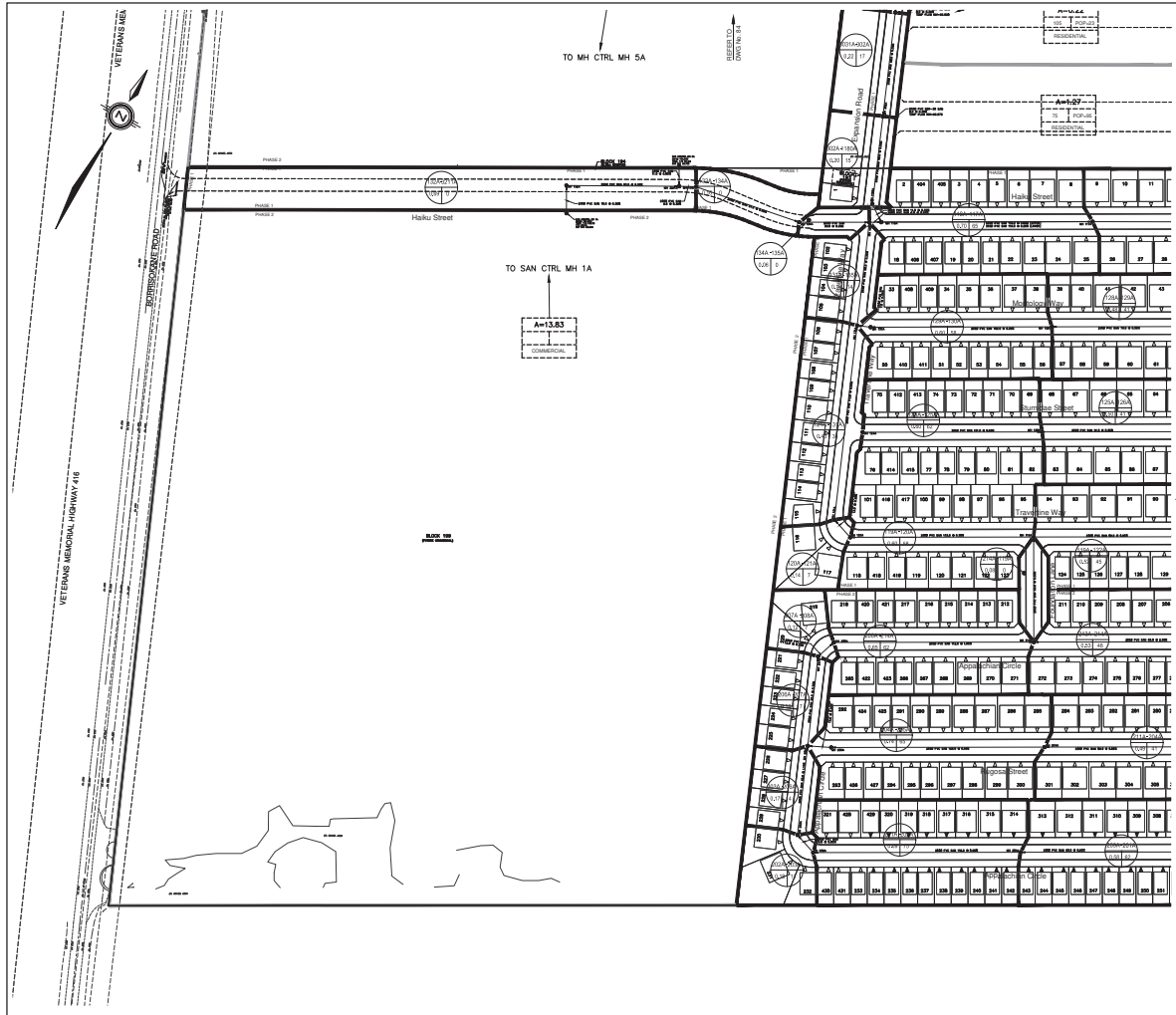
SANITARY SEWER CALCULATION SHEET



Manning's n=0.013

STREET	LOCATION		RESIDENTIAL AREA AND POPULATION				COMM.		INDUST.		PARK		DHW		INFILTRATION				PIPE		VEL.						
	FROM M.H.	TO M.H.	AREA (ha)	UNITS	UNITS	POP.	AREA (ha)	POP.	PEAK FLOW (l/s)	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DI (mm)	SLOPE (%)	PIPE CAP (l/s)	RATIO Q act/Q cap	(FULL) (m/s)	(ACT.) (m/s)	
Drummond Future Road																											
Contribution From Obsidian Street, Pipe 109A - 400A																											
	400A	401A	0.24			25	29.22	2385	3.02	23.34	24.22	0.00		3.17	8.19	0.24	52.29	17.26	48.79	72.5	375	0.15	67.91	0.72	0.61	0.67	
	401A	402A	0.14			15	29.36	2400	3.02	23.48	24.22	0.00		3.17	8.19	0.14	52.43	17.30	48.97	62.0	375	0.15	67.91	0.72	0.61	0.67	
To future Greenbank Road, Pipe 402A - 403A																											
							29.36	2400			24.22	0.00		3.17			52.43										
Future Greenbank Road																											
Contribution From Drummond Future Road, Pipe 401A - 402A																											
	402A	403A	0.38			0	29.74	2400	3.02	23.48	24.22	0.00		3.17	8.19	0.38	52.81	17.43	49.09	80.0	375	0.15	67.91	0.72	0.61	0.67	
	403A	404A	0.33			0	30.07	2400	3.02	23.48	24.22	0.00		3.17	8.19	0.33	53.14	17.54	49.20	80.0	375	0.15	67.91	0.72	0.61	0.67	
	404A	405A	0.33			0	30.40	2400	3.02	23.48	24.22	0.00		3.17	8.19	0.33	53.47	17.65	49.31	81.0	375	0.15	67.91	0.73	0.61	0.67	
Contribution From Expansion Road, Pipe 1313A - 405A																											
						0	15.39	1492			0.00	0.00	0.00	0.00			15.39										
	405A	406A	0.25			0	46.04	3892	2.88	36.26	24.22	0.00		3.17	8.19	0.25	69.11	22.81	67.26	59.5	375	0.25	87.67	0.77	0.79	0.87	
	406A	407A	0.35			0	46.39	3892	2.88	36.26	24.22	6.06	6.06	3.17	10.15	0.41	75.92	24.92	71.34	63.5	375	0.30	96.03	0.74	0.87	0.95	
	407A	408A	0.46			0	46.85	3892	2.88	36.26	24.22	6.06	6.06	3.17	10.15	0.46	75.98	25.07	71.49	110.0	375	0.30	96.03	0.74	0.87	0.95	
	408A	409A	0.40			0	47.25	3892	2.88	36.26	24.22	6.06	6.06	3.17	10.15	0.40	76.38	25.21	71.62	96.5	375	0.30	96.03	0.75	0.87	0.95	
	409A	410A	0.51			0	47.76	3892	2.88	36.26	24.22	6.06	6.06	3.17	10.15	0.51	76.89	25.37	71.79	120.0	375	0.30	96.03	0.75	0.87	0.95	
	410A	570A	0.30			0	48.06	3892	2.88	36.26	24.22	6.06	6.06	3.17	10.15	0.30	77.19	25.47	71.89	63.0	375	0.30	96.03	0.75	0.87	0.95	
	570A	57A					48.06	3892	2.88	36.26	24.22	6.06	6.06	3.17	10.15	0.00	77.19	25.47	71.89	15.0	375	0.50	123.98	0.58	1.12	1.16	

DESIGN PARAMETERS										PROJECT: Clavan Communities - Brazeau Phase 1																
Park Flow =	9300	L/ha/day	0.10764	l/s/ha						Designed:	SLM															
Average Daily Flow =	280	l/day								Checked:	ADP															
Commercial Flow =	28000	L/ha/day	0.3241	l/s/ha	Industrial Peak Factor = as per MOE Graph					LOCATION:	City of Ottawa															
Industrial Flow =	35000	L/ha/day	0.40509	l/s/ha	Extraneous Flow =	0.330	L/ha																			
Max Res. Peak Factor =	3.80				Minimum Velocity =	0.600	m/s																			
Commercial/Inst./Park Peak Factor =	1.00				Manning's n =	0.013	(PVC)																			
Institutional =	0.32	l/s/ha			Townhouse coeff =	2.7																				
					Single house coeff =	3.4																				



LEGEND

- SANITARY DRAINAGE BOUNDARY
- SANITARY SUB-DRAINAGE BOUNDARY
- SANITARY DRAINAGE BOUNDARY (OTHER PHASES)
- UPSTREAM MH TO DOWNTHEM MH
- AREA IN HECTARES
- POPULATION
- UPSTREAM MH TO DOWNTHEM MH
- AREA IN HECTARES (OTHER PHASES)
- POPULATION (OTHER PHASES)
- EXTERNAL AREA IN HECTARES
- EXTERNAL POPULATION
- DENSITY (PERSONS/HECTARE)
- EXTERNAL LAND USE
- MAINTENANCE HOLE
- CAP

NOT FOR CONSTRUCTION

1	A.S.F.	20-21-27th SUBMISSION
2	A.S.F.	20-22-28th SUBMISSION
3	A.S.F.	20-23-29th SUBMISSION
4	A.S.F.	20-24-30th SUBMISSION
5	A.S.F.	19-25-31st SUBMISSION
6	A.S.F.	19-26-32nd SUBMISSION
7	A.S.F.	19-27-33rd SUBMISSION
8	A.S.F.	19-28-34th SUBMISSION
9	A.S.F.	19-29-35th SUBMISSION
10	A.S.F.	19-30-36th SUBMISSION
11	A.S.F.	19-31-37th SUBMISSION
12	A.S.F.	19-32-38th SUBMISSION
13	A.S.F.	19-33-39th SUBMISSION
14	A.S.F.	19-34-40th SUBMISSION
15	A.S.F.	19-35-41st SUBMISSION
16	A.S.F.	19-36-42nd SUBMISSION
17	A.S.F.	19-37-43rd SUBMISSION
18	A.S.F.	19-38-44th SUBMISSION
19	A.S.F.	19-39-45th SUBMISSION
20	A.S.F.	19-40-46th SUBMISSION
21	A.S.F.	19-41-47th SUBMISSION
22	A.S.F.	19-42-48th SUBMISSION
23	A.S.F.	19-43-49th SUBMISSION
24	A.S.F.	19-44-50th SUBMISSION
25	A.S.F.	19-45-51st SUBMISSION
26	A.S.F.	19-46-52nd SUBMISSION
27	A.S.F.	19-47-53rd SUBMISSION
28	A.S.F.	19-48-54th SUBMISSION
29	A.S.F.	19-49-55th SUBMISSION
30	A.S.F.	19-50-56th SUBMISSION
31	A.S.F.	19-51-57th SUBMISSION
32	A.S.F.	19-52-58th SUBMISSION
33	A.S.F.	19-53-59th SUBMISSION
34	A.S.F.	19-54-60th SUBMISSION
35	A.S.F.	19-55-61st SUBMISSION
36	A.S.F.	19-56-62nd SUBMISSION
37	A.S.F.	19-57-63rd SUBMISSION
38	A.S.F.	19-58-64th SUBMISSION
39	A.S.F.	19-59-65th SUBMISSION
40	A.S.F.	19-60-66th SUBMISSION
41	A.S.F.	19-61-67th SUBMISSION
42	A.S.F.	19-62-68th SUBMISSION
43	A.S.F.	19-63-69th SUBMISSION
44	A.S.F.	19-64-70th SUBMISSION
45	A.S.F.	19-65-71st SUBMISSION
46	A.S.F.	19-66-72nd SUBMISSION
47	A.S.F.	19-67-73rd SUBMISSION
48	A.S.F.	19-68-74th SUBMISSION
49	A.S.F.	19-69-75th SUBMISSION
50	A.S.F.	19-70-76th SUBMISSION
51	A.S.F.	19-71-77th SUBMISSION
52	A.S.F.	19-72-78th SUBMISSION
53	A.S.F.	19-73-79th SUBMISSION
54	A.S.F.	19-74-80th SUBMISSION
55	A.S.F.	19-75-81st SUBMISSION
56	A.S.F.	19-76-82nd SUBMISSION
57	A.S.F.	19-77-83rd SUBMISSION
58	A.S.F.	19-78-84th SUBMISSION
59	A.S.F.	19-79-85th SUBMISSION
60	A.S.F.	19-80-86th SUBMISSION
61	A.S.F.	19-81-87th SUBMISSION
62	A.S.F.	19-82-88th SUBMISSION
63	A.S.F.	19-83-89th SUBMISSION
64	A.S.F.	19-84-90th SUBMISSION
65	A.S.F.	19-85-91st SUBMISSION
66	A.S.F.	19-86-92nd SUBMISSION
67	A.S.F.	19-87-93rd SUBMISSION
68	A.S.F.	19-88-94th SUBMISSION
69	A.S.F.	19-89-95th SUBMISSION
70	A.S.F.	19-90-96th SUBMISSION
71	A.S.F.	19-91-97th SUBMISSION
72	A.S.F.	19-92-98th SUBMISSION
73	A.S.F.	19-93-99th SUBMISSION
74	A.S.F.	19-94-100th SUBMISSION
75	A.S.F.	19-95-101st SUBMISSION
76	A.S.F.	19-96-102nd SUBMISSION
77	A.S.F.	19-97-103rd SUBMISSION
78	A.S.F.	19-98-104th SUBMISSION
79	A.S.F.	19-99-105th SUBMISSION
80	A.S.F.	19-100-106th SUBMISSION
81	A.S.F.	19-101-107th SUBMISSION
82	A.S.F.	19-102-108th SUBMISSION
83	A.S.F.	19-103-109th SUBMISSION
84	A.S.F.	19-104-110th SUBMISSION
85	A.S.F.	19-105-111th SUBMISSION
86	A.S.F.	19-106-112th SUBMISSION
87	A.S.F.	19-107-113th SUBMISSION
88	A.S.F.	19-108-114th SUBMISSION
89	A.S.F.	19-109-115th SUBMISSION
90	A.S.F.	19-110-116th SUBMISSION
91	A.S.F.	19-111-117th SUBMISSION
92	A.S.F.	19-112-118th SUBMISSION
93	A.S.F.	19-113-119th SUBMISSION
94	A.S.F.	19-114-120th SUBMISSION
95	A.S.F.	19-115-121st SUBMISSION
96	A.S.F.	19-116-122nd SUBMISSION
97	A.S.F.	19-117-123rd SUBMISSION
98	A.S.F.	19-118-124th SUBMISSION
99	A.S.F.	19-119-125th SUBMISSION
100	A.S.F.	19-120-126th SUBMISSION

TOPOGRAPHIC INFORMATION
 20 BARNEYS LIMITED PROJECT NUMBER 18-10-145-00 SURVEY DATED JULY 26, 2019
LEGAL INFORMATION
 CALCULATED BY CAR PROVIDED BY J.D. BARNES LTD. PROJECT 18-10-145-00, DATED APRIL 4, 2020
 GEOTECH MARK No. 00196403710
 ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GEOTECH DATA AND ARE DERIVED FROM THE MUNICIPALITY OF OTTAWA'S OPERATIONAL NUMBER 2 PARCELS ELEVATION OF 67.76 METERS

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL
 120 Bay Road Unit 102
 Ottawa, Ontario K2H 1G2
 Tel: (613) 838-9522
 Fax: (613) 838-7165
 www.DSEL.ca

A.S.F. ENGINEERS
 120 Bay Road Unit 102
 Ottawa, Ontario K2H 1G2
 Tel: (613) 838-9522
 Fax: (613) 838-7165
 www.ASF.ca

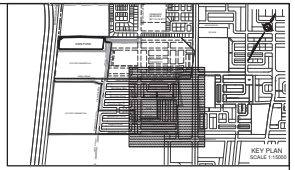
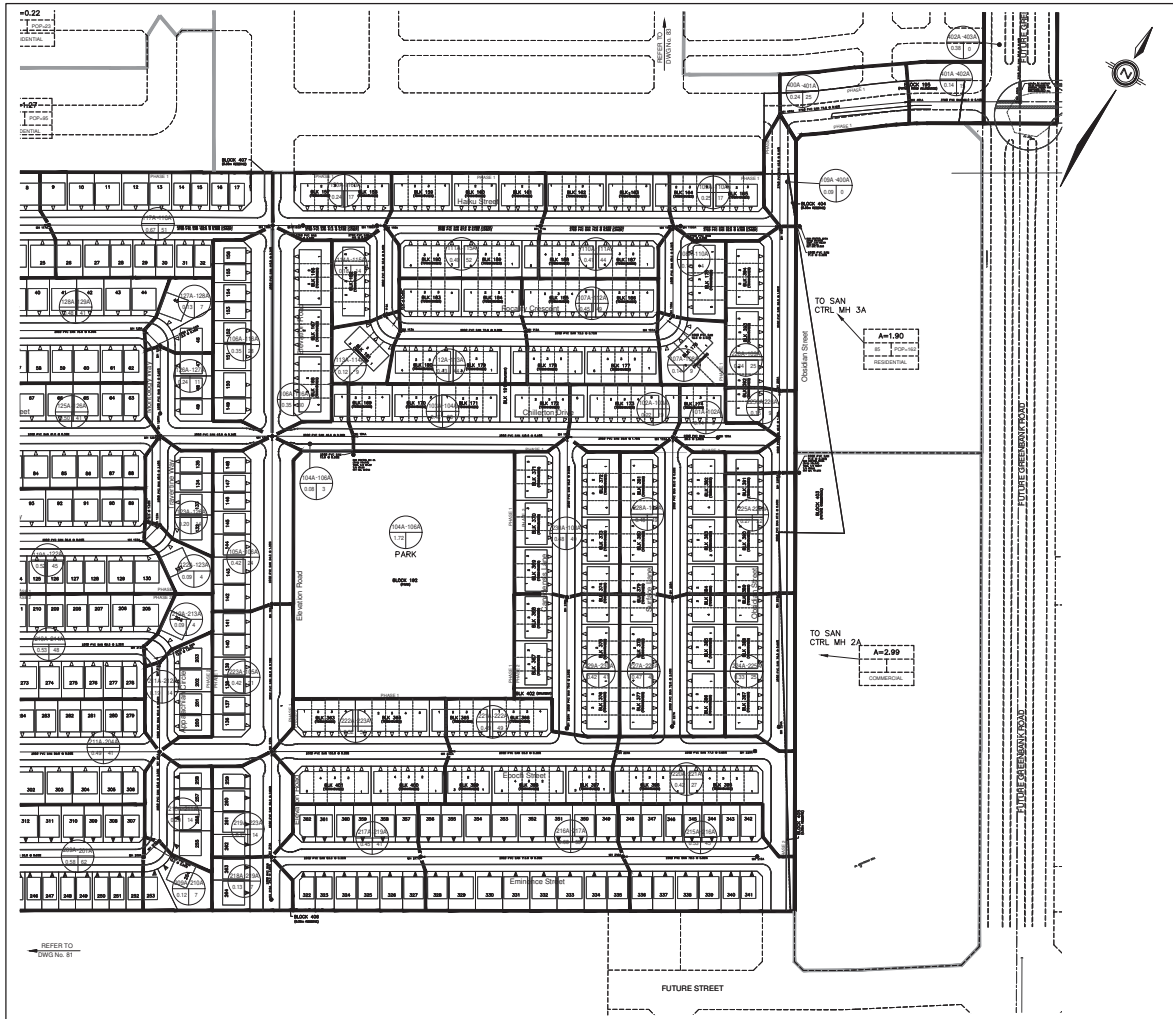
Ottawa CITY OF OTTAWA

SANITARY DRAINAGE PLAN

DRAWN BY: G.S.S. CHECKED BY: A.S.F. PROJECT No. 18-1030
 DESIGNED BY: G.S.S. CHECKED BY: A.S.F. SHEET No. 81
 SCALE: 1:1000

HORIZ. 1:1000 0 10 20 30 40

CITY FILE No. 007-16-19-0005 CITY PLAN No. 172033



LEGEND

- SANITARY DRAINAGE BOUNDARY
- SANITARY SUB-DRAINAGE BOUNDARY
- SANITARY DRAINAGE BOUNDARY (OTHER PHASES)
- UPSTREAM MH TO DOWNSTREAM MH
- AREA IN HECTARES
- EXTERNAL POPULATION
- DENSITY (PERSONS/HECTARE)
- EXTERNAL LAND USE
- MAINTENANCE HOLE
- CAP

NOT FOR CONSTRUCTION

4.1 A.S.F. 20-27-27 6TH SUBMISSION
 4.2 A.S.F. 20-28-28 6TH SUBMISSION
 4.3 A.S.F. 20-29-29 6TH SUBMISSION
 4.4 A.S.F. 20-30-30 6TH SUBMISSION
 4.5 A.S.F. 20-31-31 6TH SUBMISSION
 4.6 A.S.F. 20-32-32 6TH SUBMISSION
 4.7 A.S.F. 20-33-33 6TH SUBMISSION
 4.8 A.S.F. 20-34-34 6TH SUBMISSION
 4.9 A.S.F. 20-35-35 6TH SUBMISSION
 4.10 A.S.F. 20-36-36 6TH SUBMISSION
 4.11 A.S.F. 20-37-37 6TH SUBMISSION
 4.12 A.S.F. 20-38-38 6TH SUBMISSION
 4.13 A.S.F. 20-39-39 6TH SUBMISSION
 4.14 A.S.F. 20-40-40 6TH SUBMISSION
 4.15 A.S.F. 20-41-41 6TH SUBMISSION
 4.16 A.S.F. 20-42-42 6TH SUBMISSION
 4.17 A.S.F. 20-43-43 6TH SUBMISSION
 4.18 A.S.F. 20-44-44 6TH SUBMISSION
 4.19 A.S.F. 20-45-45 6TH SUBMISSION
 4.20 A.S.F. 20-46-46 6TH SUBMISSION
 4.21 A.S.F. 20-47-47 6TH SUBMISSION
 4.22 A.S.F. 20-48-48 6TH SUBMISSION
 4.23 A.S.F. 20-49-49 6TH SUBMISSION
 4.24 A.S.F. 20-50-50 6TH SUBMISSION
 4.25 A.S.F. 20-51-51 6TH SUBMISSION
 4.26 A.S.F. 20-52-52 6TH SUBMISSION
 4.27 A.S.F. 20-53-53 6TH SUBMISSION
 4.28 A.S.F. 20-54-54 6TH SUBMISSION
 4.29 A.S.F. 20-55-55 6TH SUBMISSION
 4.30 A.S.F. 20-56-56 6TH SUBMISSION
 4.31 A.S.F. 20-57-57 6TH SUBMISSION
 4.32 A.S.F. 20-58-58 6TH SUBMISSION
 4.33 A.S.F. 20-59-59 6TH SUBMISSION
 4.34 A.S.F. 20-60-60 6TH SUBMISSION
 4.35 A.S.F. 20-61-61 6TH SUBMISSION
 4.36 A.S.F. 20-62-62 6TH SUBMISSION
 4.37 A.S.F. 20-63-63 6TH SUBMISSION
 4.38 A.S.F. 20-64-64 6TH SUBMISSION
 4.39 A.S.F. 20-65-65 6TH SUBMISSION
 4.40 A.S.F. 20-66-66 6TH SUBMISSION
 4.41 A.S.F. 20-67-67 6TH SUBMISSION
 4.42 A.S.F. 20-68-68 6TH SUBMISSION
 4.43 A.S.F. 20-69-69 6TH SUBMISSION
 4.44 A.S.F. 20-70-70 6TH SUBMISSION
 4.45 A.S.F. 20-71-71 6TH SUBMISSION
 4.46 A.S.F. 20-72-72 6TH SUBMISSION
 4.47 A.S.F. 20-73-73 6TH SUBMISSION
 4.48 A.S.F. 20-74-74 6TH SUBMISSION
 4.49 A.S.F. 20-75-75 6TH SUBMISSION
 4.50 A.S.F. 20-76-76 6TH SUBMISSION
 4.51 A.S.F. 20-77-77 6TH SUBMISSION
 4.52 A.S.F. 20-78-78 6TH SUBMISSION
 4.53 A.S.F. 20-79-79 6TH SUBMISSION
 4.54 A.S.F. 20-80-80 6TH SUBMISSION
 4.55 A.S.F. 20-81-81 6TH SUBMISSION
 4.56 A.S.F. 20-82-82 6TH SUBMISSION
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 4.63 A.S.F. 20-89-89 6TH SUBMISSION
 4.64 A.S.F. 20-90-90 6TH SUBMISSION
 4.65 A.S.F. 20-91-91 6TH SUBMISSION
 4.66 A.S.F. 20-92-92 6TH SUBMISSION
 4.67 A.S.F. 20-93-93 6TH SUBMISSION
 4.68 A.S.F. 20-94-94 6TH SUBMISSION
 4.69 A.S.F. 20-95-95 6TH SUBMISSION
 4.70 A.S.F. 20-96-96 6TH SUBMISSION
 4.71 A.S.F. 20-97-97 6TH SUBMISSION
 4.72 A.S.F. 20-98-98 6TH SUBMISSION
 4.73 A.S.F. 20-99-99 6TH SUBMISSION
 4.74 A.S.F. 20-100-100 6TH SUBMISSION

TOPOGRAPHIC INFORMATION
 2D BARRIS LIMITED PROJECT NUMBER 18-10-100 SURVEY DATED JULY 26, 2019
 LEGAL INFORMATION
 CALCULATED BY: BARRIS PROVIDED BY: BARRIS LTD. PROJECT 18-10-100-DL DATED
 APRIL 5, 2020
 BENCH MARK No. 001196403710
 ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GDS20 DATUM AND ARE DERIVED FROM THE MUNICIPALITY
 ENGINEERING DEPARTMENT RECORDS. A FURTHER LISTING OF BENCH MARKS

CAIVAN COMMUNITIES THE RIDGE PHASE 1

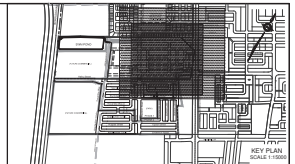
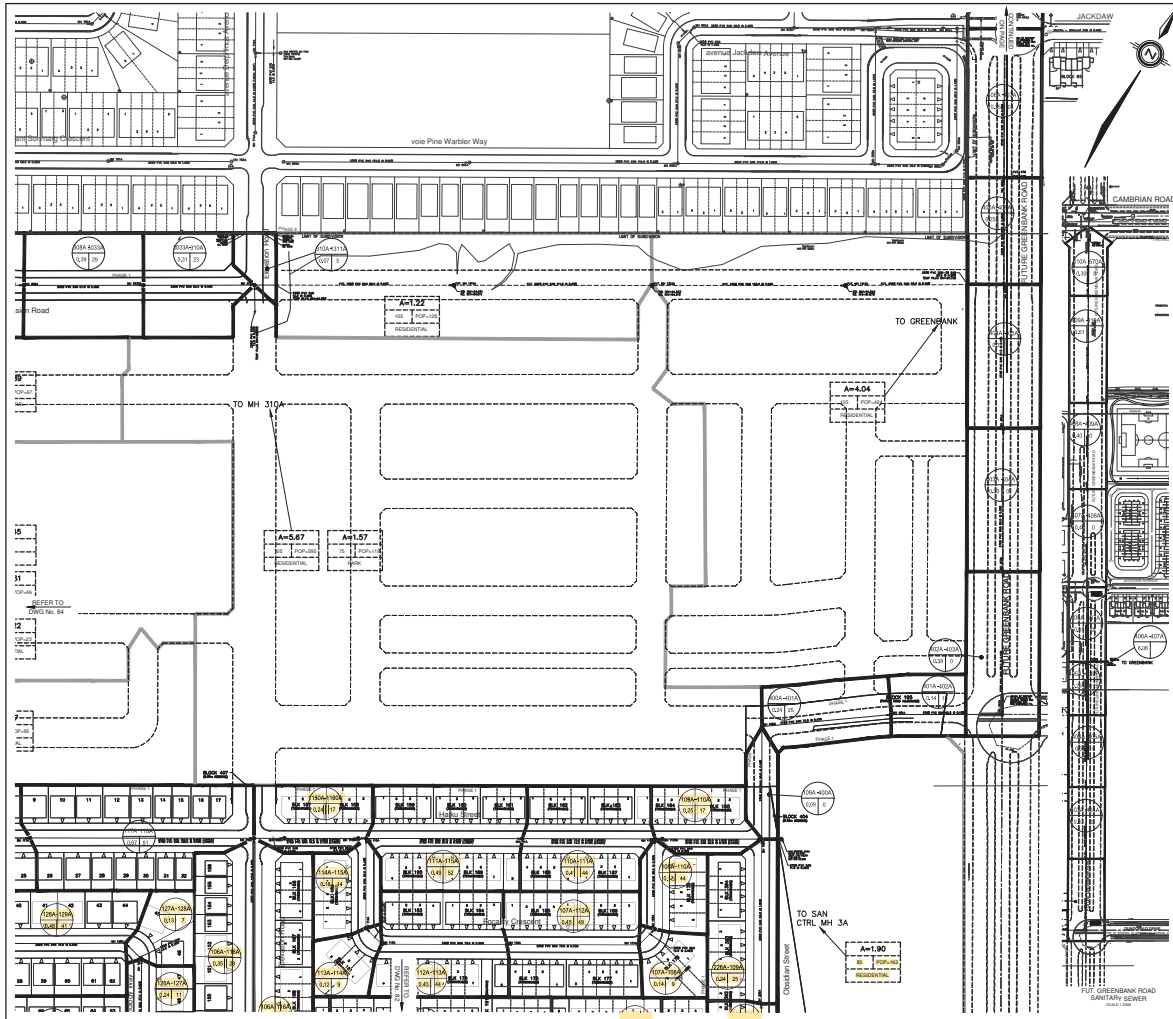
DSEL
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 Ottawa, Ontario K2H 1Z9
 Tel: (613) 836-8888
 Fax: (613) 836-1185
 www.DSEL.ca

Ottawa CITY OF OTTAWA

SANITARY DRAINAGE PLAN

DRAWN BY: G.S.D. CHECKED BY: A.D.F. PROJECT No. 18-1030
 DESIGNED BY: C.M.C. CHECKED BY: A.D.F. SHEET No. 82
 SCALE: 1:1000
 HORIZ. 1:1000 0 10 20 30 40

CITY PLAN No. 17503
 CITY FILE No. D07-16-19-0005



LEGEND

- SANITARY DRAINAGE BOUNDARY
- SANITARY SUB-DRAINAGE BOUNDARY
- SANITARY DRAINAGE BOUNDARY (OTHER PHASES)
- UPSTREAM MH TO DOWNSTREAM MH
- AREA IN HECTARES
- DENSITY PER HECTARE
- POPULATION
- UPSTREAM MH TO DOWNSTREAM MH
- AREA IN HECTARES (OTHER PHASES)
- POPULATION (OTHER PHASES)
- EXTERNAL AREA IN HECTARES
- EXTERNAL POPULATION
- DENSITY (PERSONS/HECTARE)
- EXTERNAL LAND USE
- MAINTENANCE HOLE
- CAP

NOT FOR CONSTRUCTION

1. A.D.F. 20-21-22 5th SUBMISSION
2. A.D.F. 20-22-23 4th SUBMISSION
3. A.D.F. 20-24-24 3rd SUBMISSION
4. A.D.F. 19-13-23 2nd SUBMISSION
5. A.D.F. 19-13-24 1ST SUBMISSION
6. S.D. DESCRIPTION

TOPOGRAPHIC INFORMATION
 20 BARNES LIMITED PROJECT NUMBER 18-10-146-00 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
 PREPARED BY: CAVAL COMMUNITIES LTD. PROJECT 18-10-146-00, DATED APRIL 5, 2018

BENCH MARK No. 001196403710
 CLEANING WORK ON THIS PLAN ARE RELATED TO EXISTING DATA AND ARE DERIVED FROM THE MUNICIPALITY PROVIDED THE SURVEYING NUMBER A FURNISHED LOCATION OF 6/28 METERS

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL CONSULTING ENGINEERS LTD. A 30 FOREST SERVICES

120 Bay Road Unit 103
 Ottawa, Ontario K2E 1Z9
 Tel: (613) 836-8866
 Fax: (613) 836-1165
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Ottawa CITY OF OTTAWA

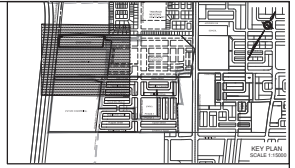
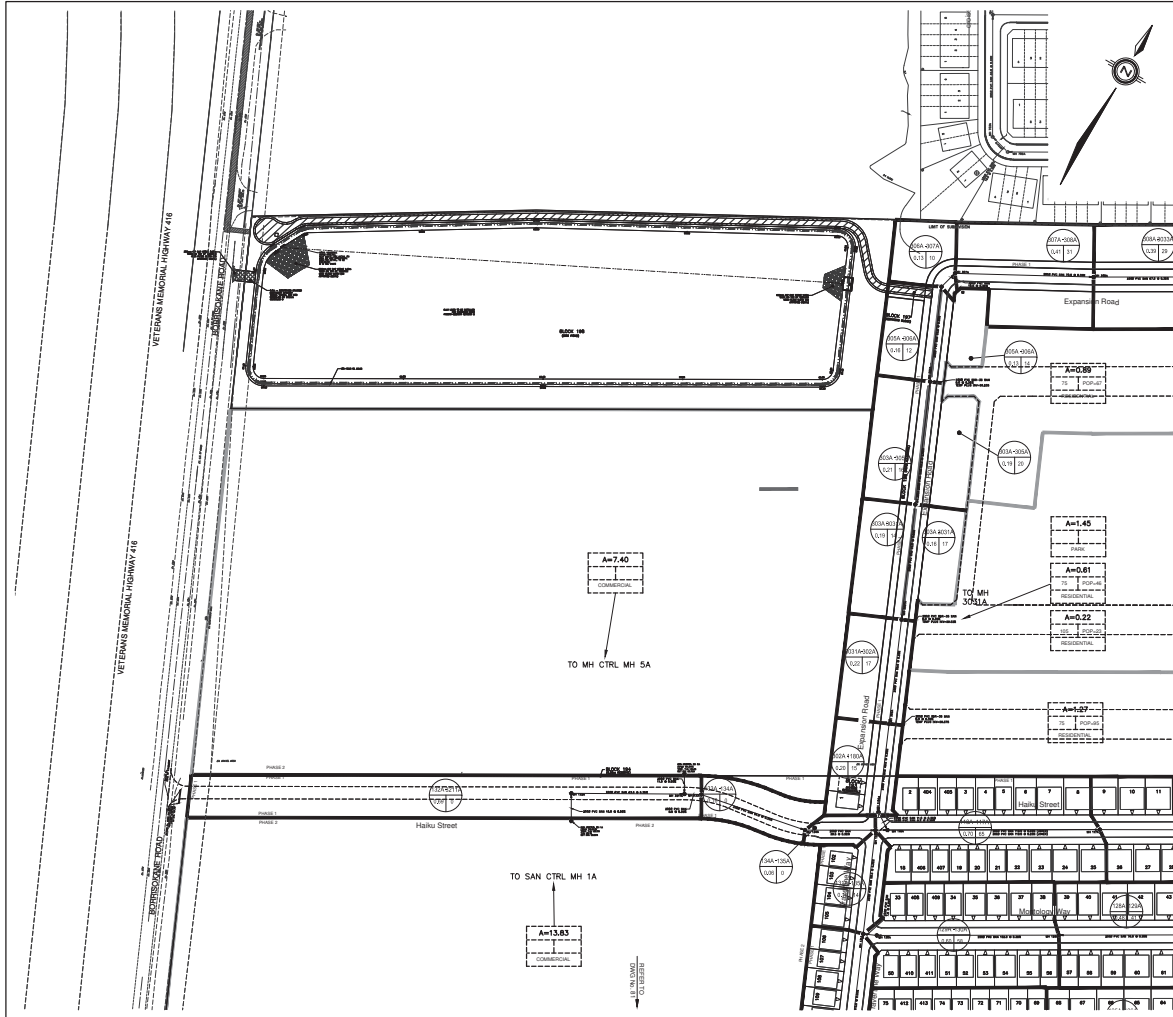
SANITARY DRAINAGE PLAN

DRAWN BY: G.S.G. CHECKED BY: A.D.F. PROJECT No. 18-1030
 DESIGNED BY: C.M.A. CHECKED BY: A.D.F. SHEET No. 83

SCALE: 1:1000

HORIZ. 1:1000 0 10 20 30 40

CITY PLAN No. 17503
 CITY FILE No. D07-16-0005



LEGEND

- SANITARY DRAINAGE BOUNDARY ————
- SANITARY SUB-DRAINAGE BOUNDARY ————
- SANITARY DRAINAGE BOUNDARY (OTHER PHASES) ————
- UPSTREAM MH TO DOWNSTREAM MH:
 - AREA IN HECTARES: $\frac{A=1.45}{1000}$
 - POPULATION: $\frac{P=100}{1000}$
- UPSTREAM MH TO DOWNSTREAM MH (OTHER PHASES):
 - AREA IN HECTARES (OTHER PHASES): $\frac{A=55.63}{1000}$
 - POPULATION (OTHER PHASES): $\frac{P=2000}{1000}$
- EXTERNAL AREA IN HECTARES: $\frac{A=55.63}{1000}$
- EXTERNAL POPULATION: $\frac{P=2000}{1000}$
- DENSITY (PERSONS/HECTARE): $\frac{P}{A}$
- EXTERNAL LAND USE: $\frac{L}{1000}$
- MAINTENANCE HOLE: $\frac{M}{1000}$
- CAP: $\frac{C}{1000}$

REFER TO DWG NO. 18

NOT FOR CONSTRUCTION

4	A.S.F.	30-37	3RD SUBMISSION
5	A.S.F.	30-38	3RD SUBMISSION
4	A.S.F.	30-39	3RD SUBMISSION
3	A.S.F.	30-40	3RD SUBMISSION
2	A.S.F.	30-41	3RD SUBMISSION
2	A.S.F.	30-42	3RD SUBMISSION
2	A.S.F.	30-43	3RD SUBMISSION
2	A.S.F.	30-44	3RD SUBMISSION
2	A.S.F.	30-45	3RD SUBMISSION
2	A.S.F.	30-46	3RD SUBMISSION
2	A.S.F.	30-47	3RD SUBMISSION
2	A.S.F.	30-48	3RD SUBMISSION
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2	A.S.F.	30-51	3RD SUBMISSION
2	A.S.F.	30-52	3RD SUBMISSION
2	A.S.F.	30-53	3RD SUBMISSION
2	A.S.F.	30-54	3RD SUBMISSION
2	A.S.F.	30-55	3RD SUBMISSION
2	A.S.F.	30-56	3RD SUBMISSION
2	A.S.F.	30-57	3RD SUBMISSION
2	A.S.F.	30-58	3RD SUBMISSION
2	A.S.F.	30-59	3RD SUBMISSION
2	A.S.F.	30-60	3RD SUBMISSION

TOPOGRAPHIC INFORMATION
 2D BARRIS LIMITED PROJECT NUMBER 18-10-140-00 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
 EXCLUDED BY-LAW PROVIDED BY JD BARRIS LTD. PROJECT 18-10-140-00 DATED APRIL 5, 2019

BENCH MARK NO. 001196403710
 ELEVATION SHOWN ON THIS PLAN ARE RELATED TO GROUND DATUM AND ARE DERIVED FROM THE MUNICIPALITY BENCH MARK SYSTEM WITH A TYPICAL ELEVATION OF 61.28 METERS

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL
 120 Bar Road Unit 103
 Ottawa, Ontario K2H 1Z9
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 Fax: (613) 836-1165
 www.dsel.ca

A-B FOREST
 1000
 1000

Ottawa CITY OF OTTAWA

SANITARY DRAINAGE PLAN

DRAWN BY: G.S.G. CHECKED BY: A.S.F. PROJECT NO.: 18-1030
 DESIGNED BY: C.M.A. CHECKED BY: A.S.F. SHEET NO.: 84
 SCALE: 1:1000

CITY PLAN No. 17503
 CITY FILE No. D07-16-19-0005

6.3.1.1 Future Collector Road (west of new Greenbank Road) Outlet

The Drummond Aggregate Extraction Area will be serviced by a connection (at MA11) to the planned trunk sanitary sewer on the Future Collector Road. This planned trunk sanitary sewer will outlet to the planned Cambrian Road trunk sanitary sewer, located west of New Greenbank Road, as identified in the 2014 BSMSSA. The proposed BSUEA sanitary sewer system within the Drummond property was conceptually sized to be 200 mm in diameter with a slope of 0.35% assuming that the development of the Aggregate Extraction Area would generally consists of a residential land usage. Although a demonstration plan is not currently available for this area, a high level trunk sanitary sewer layout was developed for the property.

Per the Draft 2014 BSMSSA, the specified obvert elevation of 95.00 m at maintenance hole MA11, which is located at the northern limit of the BSUEA, is proposed to be respected. Based on this outlet obvert elevation and based on a high level sewer layout concept, which would cross above the future storm sewer system, an upstream obvert elevation of 99.20 m would result at MH 593 within the southeastern corner of the Drummond Aggregate Extraction Area. As discussed in Section 5.7.5, the existing Drummond Aggregate Extraction Area must be reinstated to a minimum elevation of 104.0 m. Allowing for a 3.0m cover over the sanitary sewer system, would require a reinstated elevation of approximately 102.2m, which would still be within the minimum required reinstatement elevation of 104.0 m.

6.3.1.2 New Greenbank Road Outlet

The Brazeau Aggregate Extraction Area will be serviced by a connection (at MA14) to the planned trunk sanitary sewer on the New Greenbank Road. This planned trunk sanitary sewer will outlet to the existing Cambrian Road trunk sanitary sewer, located east of New Greenbank Road, as identified in the 2014 BSMSSA.

The proposed BSUEA sanitary sewer system within the Brazeau property was conceptually sized to be 250 mm in diameter with a slope of 0.24% assuming that the development of the Aggregate Extraction Area would generally consists of a residential land usage. Although a demonstration plan is not currently available for this area, a high level sanitary sewer layout was developed for the property.

Per the Draft 2014 BSMSSA, the specified obvert elevation of 96.10 m at maintenance hole MA14, which is located at the northern limit of the BSUEA, is proposed to be respected. Based on this outlet obvert elevation and based on the high level sewer layout developed for the site, an upstream sanitary sewer obvert elevation of 98.55 m would result at MH 585 within the southwest corner of the Brazeau Aggregate Extraction Area.

As discussed in Section 5.7.5, the existing Brazeau Aggregate Extraction Area must be reinstated to a minimum elevation of 97.0 m. However, when accounting for a 3.0 m cover over the sanitary sewers in the westerly half of the property, a minimum reinstated elevation of approximately 101.55 m would be required. Similarly, when accounting for a 3.0 m cover over the storm sewer system (as

described in Section 5.7.5) in the easterly half of the site, a minimum reinstated elevation of approximately 102.5 m would be required. Per the available existing topography of the Brazeau lands, the lowest topography appears to be approximately 98.0 m. Consequently, to service the Brazeau Aggregate Extraction Area with gravity sewers, with an allowable 3.0 m cover, it is anticipated that some areas may require as much as 4.5 m of fill.

Wastewater generated by Mattamy Lands West, will outlet to the planned 250 mm diameter sanitary sewer on New Greenbank Road at MA14. The planned New Greenbank Road sanitary sewer will discharge to the Cambrian Road trunk sanitary sewer as per the Draft 2014 BSMSSA.

A southerly extension of the 250 mm diameter New Greenbank Road trunk sanitary sewer will be required to service the proposed BSUEA tributary area. A new trunk sanitary sewer segment is proposed from MH 900 to MA14, as shown on the Key Servicing Plan. This proposed sewer segment is much shallower than the planned portion of the trunk downstream of MA 14 where cover depth is in the range of 6.9 m. The proposed sewer segment will have a proposed cover depth of 7.43 m.

6.3.1.3 Flameflower Street Outlet

The 2 ha commercial block located west of New Greenbank Road as well as a 2 ha portion of Mattamy Lands East will be serviced by a connection to the existing 200 mm diameter sanitary sewer located on Flameflower Street at MH EX 217. The existing Flameflower street sewer conveys wastewater to the Dundonald Drive sanitary sewer which ultimately outlets to the existing River Mist Road trunk sanitary sewer.

A 200 mm diameter local sanitary sewer is proposed to service the residential and commercial development. A drop maintenance hole is expected at MH 920 due to the relatively high elevation of the commercial block and New Greenbank Road compared to the residential development, as shown on the Master Grading Plan, Drawing MG1.

6.3.1.4 Alex Polowin Avenue Outlet

Wastewater generated by 5 ha of Mattamy Lands East will be conveyed to the existing 200 mm diameter sanitary sewer on Alex Polowin via two (2) connection points: MH EX153 and MH EX158. The existing Alex Polowin sewer will convey wastewater northerly to the Des Soldats Reindeau Street sanitary sewer which ultimately outlets to the River Mist Road trunk sanitary sewer.

Two (2) parallel local 200 mm diameter sanitary sewers are proposed to convey wastewater generated in the BSUEA tributary area to the proposed outlet locations.

6.3.1.5 Kilbirnie Drive Outlet

Residential development and the school fronting the Kilbirnie Drive extension as well as the northern portions of Alex Polowin (south of Kilbirnie) and Street 1, in the Minto Lands, will be serviced by a connection at MH 10 to the existing 200 mm

ANY EXISTING AREA DURING CONSTRUCTION TO BE RESTORED TO ITS ORIGINAL CONDITION OR BETTER TO THE SATISFACTION OF THE AUTHORITY HAVING JURISDICTION.

CONTRACTOR TO VERIFY THE EXISTING LOCATIONS AND HORIZONTAL ELEVATIONS OF EX UNDERGROUND SERVICES AND TO NOTIFY PRIOR TO STARTING CONSTRUCTION.

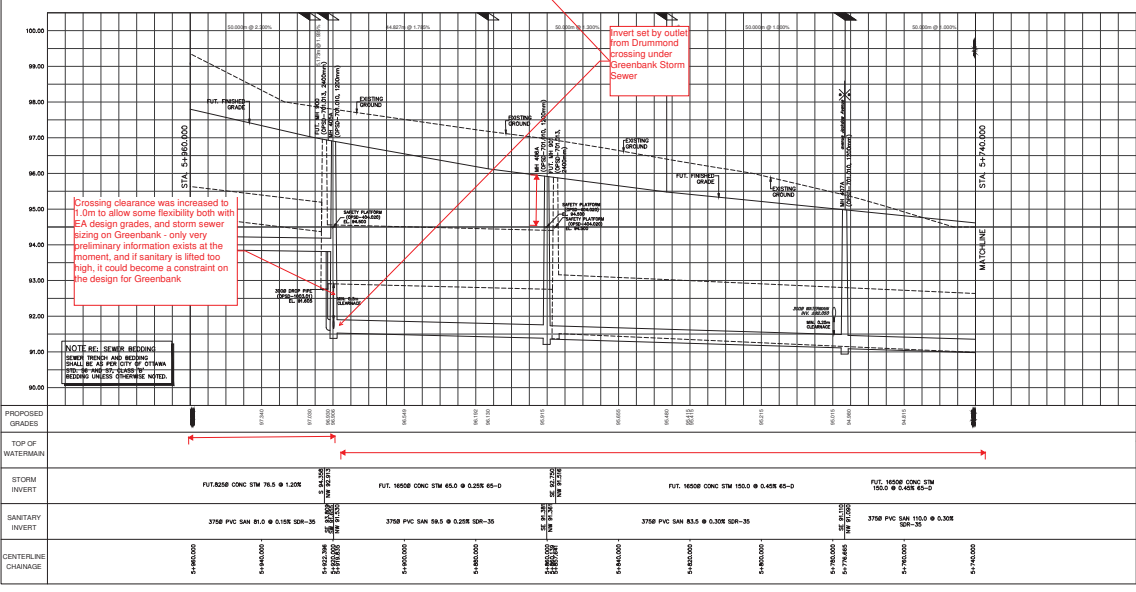
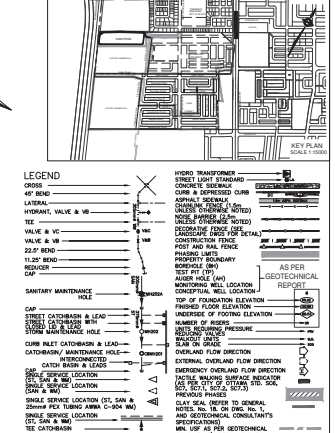
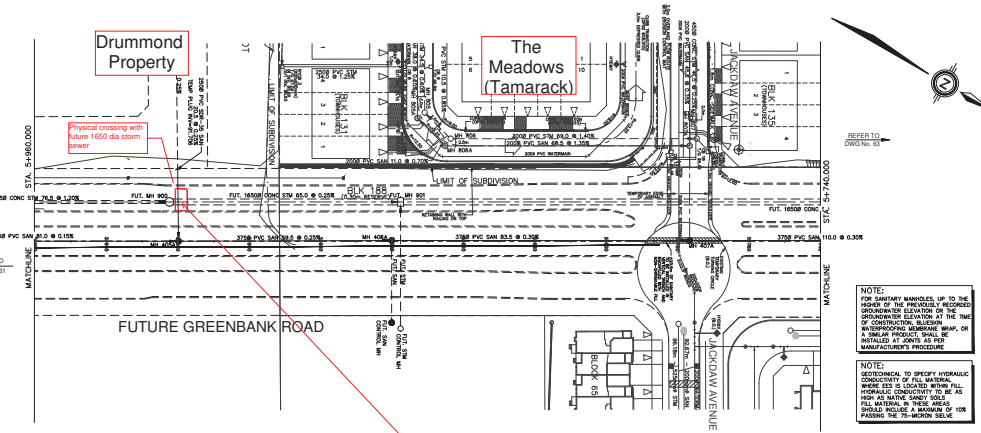
NOTE: ALL EXISTING PIPES, STRUCTS ETC. WHEN LOCATED, BLOCKED AND RIGID TO BE REPAIRED, REPLACED OR REMOVED AS NOTED.

PERMISSION REQUIRED FOR WORK ON ADJACENT LANDS.

NOTE: FOR WATERMAIN STRES, 2.5m MIN. COVER TO BE PROVIDED.

NOTE: ICID FOR USE APPLICATOR, REFER TO DRAWING NO. 3 FOR DETAIL.

NOTE: SEE TEST PIT/ADDSHOLE ANY EXISTING MATERIALS ENCOUNTERED BELOW THE SERVICE TRENCH WITH BUILDING FOOTPRINT TO BE SUB-ELEVATED AND ISOLATED WITH COMPACTED FURNISHED FILL AS PER GEOTECHNICAL ENGINEERS RECOMMENDATION.



NOT FOR CONSTRUCTION

ADJ. 30-31-23RD SUBMISSION
 1 ADJ. 30-36-15TH SUBMISSION
 4 ADJ. 30-36-24RD SUBMISSION
 3 ADJ. 30-32-23RD SUBMISSION
 1 ADJ. 30-30-1ST SUBMISSION
 1 ADJ. 30-28-19 GATED FOR CLIENT REVIEW

TOPOGRAPHIC INFORMATION
 JD BARNES LIMITED PROJECT NUMBER 18-10-145-00 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
 CALCULATED BY PLAN PROVIDED BY JD BARNES LTD, PROJECT 18-10-145-00, DATED FEBRUARY 15, 2022
 BENCH MARK No. 00196403710
 BEARING TO BE OBTAINED AND HAVING A FINISHED ELEVATION OF 91.70M DERIVED FROM THE MANORSHIP

CAIVAN COMMUNITIES THE RIDGE PHASE 1

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 Oshawa, Ontario K2H 1Z9
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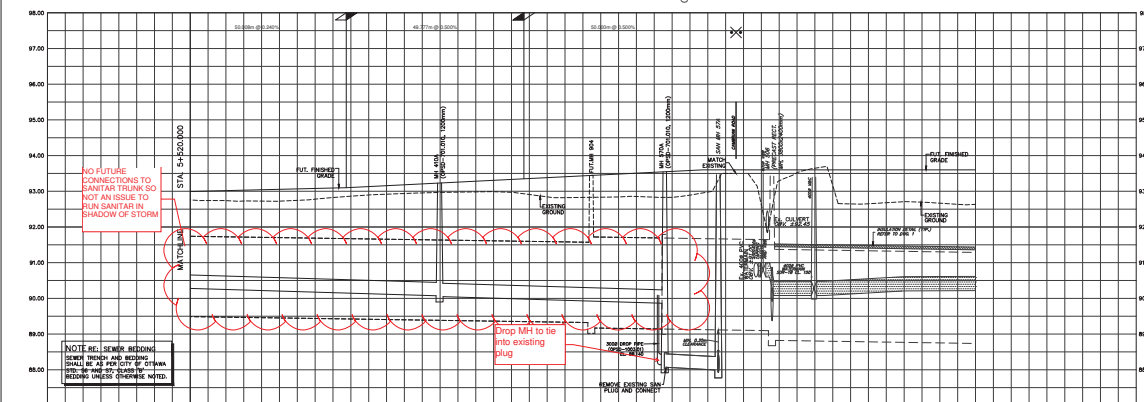
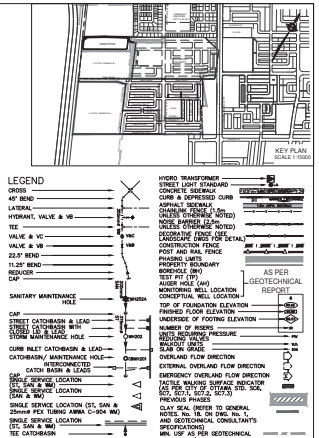
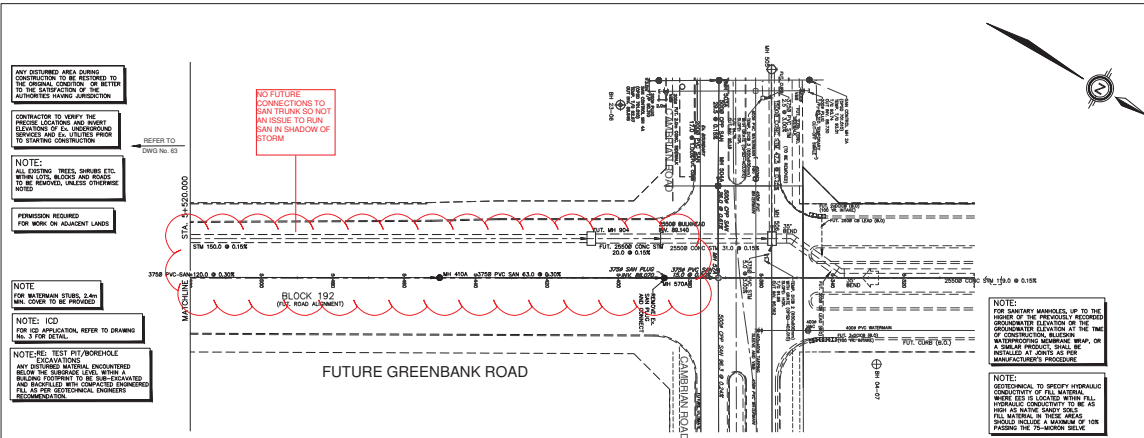
Ottawa CITY OF OTTAWA

PLAN AND PROFILE OF Greenbank Road (STA. 5+960.000 TO STA. 5+740.000)

STORM INVERT: []
 SANITARY INVERT: []

SCALE: HORIZ. 1:500 VERT. 1:500

PROJECT NO. 18-1030
 SHEET NO. 62



NOT FOR CONSTRUCTION

4 A.D.F. 20-21-23RD SUBMISSION
 1 A.D.F. 20-26-18TH SUBMISSION
 4 A.D.F. 20-28-18TH SUBMISSION
 3 A.D.F. 19-12-23RD SUBMISSION
 1 A.D.F. 19-20-18TH SUBMISSION
 1 A.D.F. 19-28-18TH SUBMISSION

TOPOGRAPHIC INFORMATION
 JO BARNES LIMITED PROJECT NUMBER 18-10-145-00 SURVEY DATED JULY 26, 2019
LEGAL INFORMATION
 CALCULATED BY PLAN PROVIDED BY JO BARNES LTD, PROJECT 18-10-145-00, DATED FEB. 1, 2020
 BENCH MARK No. 001196403710
 BOUNDARY TO BE SHOWN ON PLANS AT THE DISCRETION OF THE CONSULTANT'S RECOMMENDATION

CAIVAN COMMUNITIES THE RIDGE PHASE 1

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 Cambridge, Ontario N2H 1Z9
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PROPOSED GRADES	91+00.00	91+10.00	91+20.00	91+30.00	91+40.00	91+50.00	91+60.00	91+70.00	91+80.00	91+90.00	92+00.00
TOP OF WATERMAN											
STORM INVERT	FUT. 2500B CONC STM 150.0 @ 0.15%										
SANITARY INVERT	3788 PVC SAN 120.0 @ 0.30% SDR-35			3788 PVC SAN 43.0 @ 0.30% SDR-35							
CENTRELINE CHARGE	91+00.00	91+10.00	91+20.00	91+30.00	91+40.00	91+50.00	91+60.00	91+70.00	91+80.00	91+90.00	92+00.00

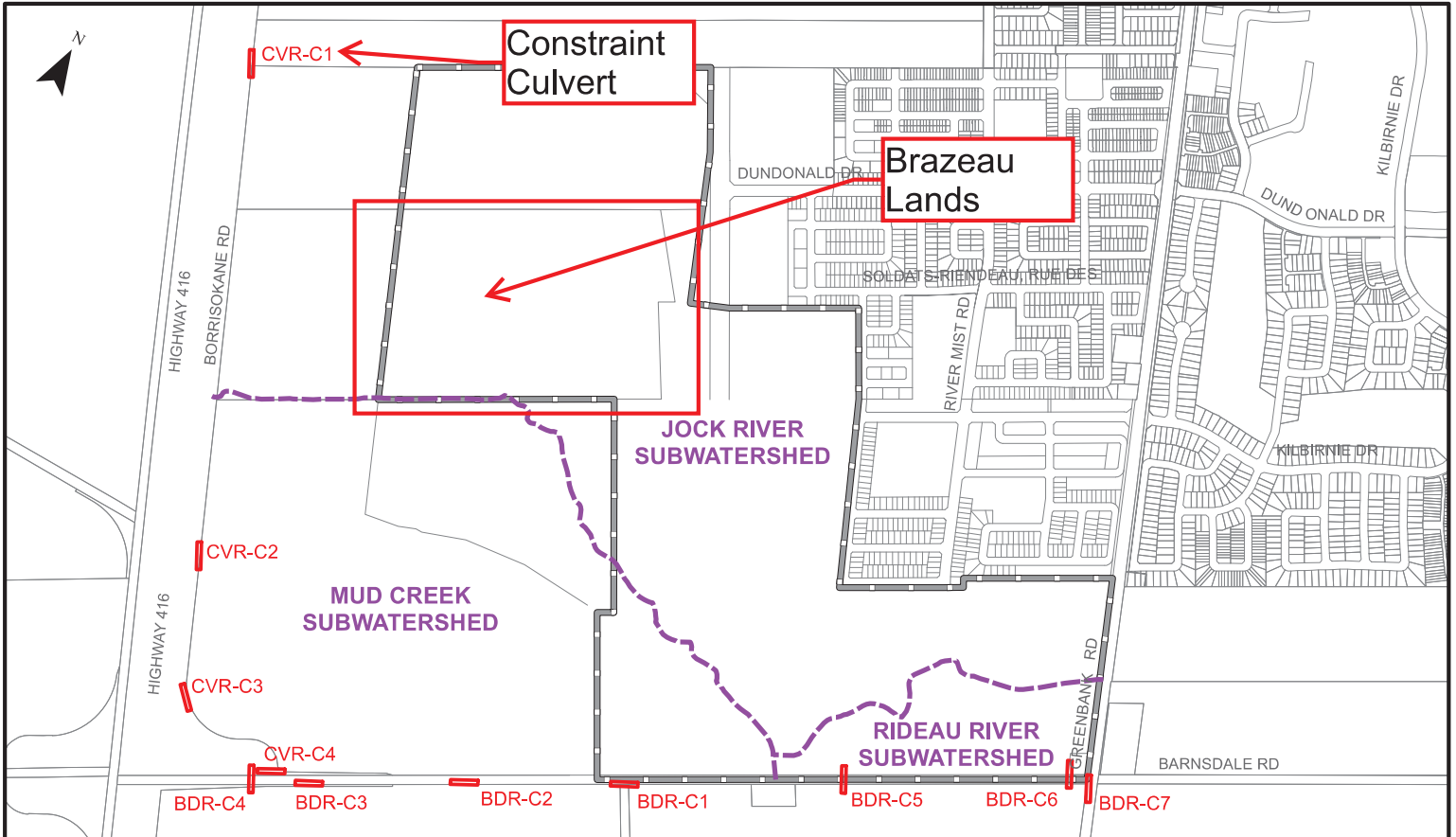
Ottawa CITY OF OTTAWA

PLAN AND PROFILE OF
Greenbank Road
 (STA. 5+520.000 TO STA. 5+300.000)

DRAWN BY: G.S.S. CHECKED BY: A.D.F. PROJECT NO.: 18-1030
 DESIGNED BY: G.S.S. PROJECT NO.: 18-1030
 SCALE: HORIZ. 1:500 VERT. 1:10 SHEET NO.: 64

CITY PLAN No. 17503
 CITY FILE No. D07-16-19-0005


APPENDIX D



Legend

- Culvert
- - - Subwatershed Limits

Study Area



PROJECT: **BARRHAVEN SOUTH URBAN EXPANSION AREA**
OTTAWA, ONTARIO

DRAWING: **BSUEA EXTENTS, DRAINAGE DIVIDE AND CULVERTS**



J.L. Richards
ENGINEERS - ARCHITECTS - PLANNERS
www.jrichards.ca

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DESIGN:	BP
DRAWN:	KTK
CHECKED:	GF
JLR #:	26610

DRAWING #:
FIGURE 3-1

Table 5-1: Inventory of Model Boundary Water Crossings

Culvert ID	Location	Type	Size (mm)
CR-C1	On Cambrian Road, 910 m east of Borrisokane Road, carries Clarke West Municipal Drain	Circ. CSP	1650
CR-C2	On Cambrian Road at Borrisokane Road	Circ. CSP	N/A
BDR-C4	On Barnsdale Road, 50 m west of Borrisokane Road	Circ. CSP	1200
BDR-C5	On Barnsdale Road, 500 m west of the existing Greenbank Road	Circ. CSP	500
BDR-C6	On Barnsdale Road, 60 m west of the existing Greenbank Road	Circ. CSP	400

It should be noted that culvert CR-C2 was not included as part of the topographical survey and size is currently unknown.

The 2014 Barrhaven South Master Servicing Study Draft Addendum (Draft 2014 BSMSSA) prepared by Stantec, notes that water crossing CR-C1 is to be replaced with storm sewers when the Clarke West Municipal Drain is enclosed as part of the adjacent development and the Clarke Stormwater Management Facility is constructed. The Draft 2014 BSMSSA also indicated that culvert CR-C2 is to be maintained, and will accommodate flows from the existing catchment area south of Cambrian Road up to the 1:100 year event. Should future development occur south of the woodlot draining to CR-C2, grading and servicing from the future development area in the vicinity of the woodlot should be developed to maximize overland sheet flow drainage (not channelized) towards the woodlot.

Table 5-2: Inventory of Model Water Crossings (Internal)

Culvert ID	Location	Type	Size (mm)
CVR-C1	East of Borrisokane Road along the north corner of the BSUEA	Circ. CSP	500
CVR-C2	East of Borrisokane Road at Field Entrance	Circ. CSP	450
CVR-C3	East of Borrisokane Road at Field Entrance	Circ. CSP	400
CVR-C4	Borrisokane Road Crossing north of Barnsdale Road	Circ. CSP	1200
BDR-C1	Viewbank Road Crossing	Circ. CSP	400
BDR-C2	Field Entrance Crossing South of Barnsdale Road	Circ. CSP	400
BDR-C3	Field Entrance Crossing South of Barnsdale Road	Circ. CSP	500
BDR-C7	Barnsdale Road Crossing close to the existing Greenbank Road Intersection	Circ. CSP	500

Table 5-2, above, summarizes the various culvert crossings within the BSUEA. As shown above, all the culverts are 500 mm in diameter or less with the exception of CVR-C4, which is 1200 mm in diameter.

B5.5.1 Storm Distribution

The hydrological response of the BSUEA and abutting lands was simulated under a 6 hour, 12 hour and 24 hour SCS Type II storm distribution. The SCS Type II storm distribution was developed by the American Soil Conservation Service and is generally used for estimating flows in rural areas. The critical storm event under pre-development conditions, with the highest peak runoff, was found to occur under the 12 hour SCS Type II storm distribution.

B5.6 Modeling Results

The pre-development SWMHYMO simulation results, predicting flows at each of the culverts for the critical storm event, are shown in Table 5-5, below. The estimated capacity and level of service of each culvert is also provided. The details of culvert CR-C2, crossing Cambrian Road at Borrisokane Road, could not be obtained in the field due to obstructions and/or structural failure. Hence, the capacity and level of service at this culvert could not be confirmed.

Table 5-5: Hydrological Simulation Results at Culvert Locations
(12 hour SCS Type II storm)

Culvert ID	Flow (m ³ /s) at culvert location for return period (recurrence)						Estimated Culvert Capacity (m ³ /s)	Estimated Level of Service (years)
	1:2 yr	1:5 yr	1:10 yr	1:25 yr	1:50 yr	1:100 yr		
CR-C1	0.3	0.7	1.0	1.6	2.0	2.5	5.5	1:100
CR-C2	0.2	0.4	0.7	1.0	1.3	1.6	N/A	N/A
CVR-C1	0.1	0.3	0.5	0.8	1.0	1.3	0.4	1:5
CVR-C2	0.0	0.1	0.1	0.2	0.2	0.3	0.2	1:25
CVR-C3	0.0	0.1	0.2	0.2	0.3	0.4	0.3	1:50
CVR-C4	0.2	0.4	0.6	0.9	1.1	1.4	2.6	1:100
BDR-C1	0.0	0.0	0.1	0.1	0.1	0.2	0.2	1:100
BDR-C2	0.0	0.1	0.1	0.1	0.2	0.2	0.2	1:50
BDR-C3	0.1	0.1	0.1	0.2	0.2	0.3	0.5	1:100
BDR-C4	0.2	0.4	0.6	0.9	1.2	1.5	2.6	1:100
BDR-C5	0.0	0.0	0.0	0.0	0.0	0.1	0.3	1:100
BDR-C6	0.0	0.0	0.1	0.1	0.2	0.2	0.2	1:100
BDR-C7	0.1	0.1	0.1	0.2	0.3	0.4	0.3	1:50
Total Flow to Thomas Baxter Municipal Drain	0.2	0.5	0.7	1.1	1.3	1.6	N/A	N/A

OUTLET TRUNK STORM SEWER TO JACK RIVER
 DISTANCE FROM ROAD TO JACK RIVER TO BE FLOOD PLAN LIMIT
 AS APPROXIMATELY 650'
 INVERT AT ROAD = 81.0 M
 INVERT AT JACK RIVER TO BE FLOOD PLAN = APPROXIMATELY 81.0 M
 OUTLET SLOPE = 0.005 M/S @ 1.5%

- LEGEND
- EXISTING STORM SEWER SYSTEM PER 2010
 - PROPOSED STORM SEWER SYSTEM PER 2010 FLOOD PLAN
 - FUTURE STORM SEWER PER 2010 AS SHOWN
 - DRAINAGE BOUNDARY
 - LIMIT OF STUDY AREA FOR SUBURBAN WATERSHED DRAINAGE ANALYSIS
 - AREA IN WETLAND
 - ROAD CENTERLINE
 - OVERLAP OF PROPERTY BOUNDARIES WITH TO CORRESPONDING WATERSHED AREA
- * IF NEW AREAS DRAINAGE IS CONSIDERED, SPECIFY ON PLAN

NOTE:
 ROADWAYS WITHIN A DRAINAGE AREA WHICH IS TRIBUTARY TO AN EES SEWER, ARE TO BE DESIGNED WITH EES SEWERS. CONVERSELY, ROADWAYS WITHIN A DRAINAGE AREA WHICH IS TRIBUTARY TO A CONVENTIONAL SEWER, ARE TO BE DESIGNED WITH CONVENTIONAL SEWERS.

- 4. ISSUED FOR PLANNING COMMITTEE APPROVAL 02/2019
- 5. ADDRESS COMMENTS 02/2019
- 6. ISSUED AS PART OF GRANT NO. 020017
- 7. ISSUED FOR PRE-SALE MARKETING MATERIALS 03/2017
- NO. ISSUE REVISION 02/2017

This drawing is copyright property and may not be reproduced or used for any other project without the written consent of J.L. Richards & Associates, Inc.
 APPROVED AND AUTHORIZED FOR THE PROJECT: [Signature]

SCALE: 1"=60'

ETOHIBOONE COOPERATION SYSTEM STORM SEWERS

NO.	DESCRIPTION	DATE	BY	CHKD
1	ISSUED FOR PRE-SALE MARKETING MATERIALS	03/2017
2	ISSUED AS PART OF GRANT NO.	020017
3	ADDRESS COMMENTS	02/2019
4	ISSUED FOR PLANNING COMMITTEE APPROVAL	02/2019



BARRHAVEN SOUTH URBAN EXPANSION AREA (BSUEA)

MASTER STORM DRAINAGE PLAN EES

DATE: JAN 2019
 DRAWN BY: CAM
 CHECKED BY: JLN
 APPR: JLN
 PROJECT NO.: MST-2

re: Groundwater Infiltration Review
Proposed Residential Development
Brazeau Pit and Drummonds Pit- Borrisokane Road - Ottawa

to: Caivan Communities - **Mr. Andrew Finnson** - afinnson@caivan.com

date: August 30, 2019

file: PG4504-MEMO.06 Revision 1

Paterson Group (Paterson) has prepared the current memorandum report to provide a review of the hydrogeological characteristics in support of groundwater infiltration recommendations for the aforementioned site.

Background Information

It is currently understood that the proposed residential development consists of a mixture of single family and townhouse style residential dwellings. It is also understood that the development will be serviced by municipal infrastructure that outlets to a stormwater management pond.

The field program for the geotechnical investigation at the Brazeau Pit was completed between November 16, 2018 and April 10, 2019. At that time, a total of 12 boreholes and 15 test pits were advanced to a maximum depth of 5.9 m below existing grade. The results of the investigation indicated that, in general, the subsurface profile consisted of a thin layer of fill material overlying a deposit of silty sand/sand with varying amounts of gravel and cobbles. A thick layer of fill material was encountered within the southeast portion of the subject site and primarily consisted of silty sand with varying amounts of clay, gravel, cobbles, organics and construction debris. This was typically underlain by a till deposit composed of a silty sand matrix with gravel, cobbles and boulders. A very stiff to stiff silty clay layer was noted between the silty sand/sand and till deposits at select boreholes within the western portion of the property. A DCPT test was completed at one borehole location and encountered practical refusal at a depth of 23.5 m. However, bedrock was not conclusively encountered as part of the geotechnical investigations for the proposed development.

The field program for the geotechnical investigation at the Drummonds Pit was completed between July 22 and July 26, 2019. At that time, a total of 8 boreholes and 14 test pits were advanced to a maximum depth of 11.3 m below existing grade. The results of the investigation indicated that, in general, the subsurface profile consisted of a fill material comprised of silty sand to sand and/or silty clay with varying amounts of gravel, cobbles and boulders. Depending on the depth of excavation during the extraction of the aggregate material, the above noted fill material is underlain by either silty sand/sand with varying amounts of gravel, cobbles and boulders or a glacial till deposit composed of a silty sand to silty clay matrix with varying amounts of gravel, cobbles and boulders. A very stiff to stiff silty clay layer was noted underlying the silty sand/sand or fill material at select test holes. A DCPT test was completed at one borehole location and encountered practical refusal at a depth of 11.6 m.

Bedrock was not conclusively encountered as part of the geotechnical investigations for the proposed development. However, based on available mapping, the site is located in an area where bedrock consists of dolomite of the Oxford formation, with overburden thickness ranging from 15 to 25 m.

Hydrogeological Setting

The subject site is located primarily within the Jock Downstream Reach subwatershed of the Jock watershed, with a negligible percentage of the property being located within the Mud Creek subwatershed of the Lower Rideau watershed.

Hydraulic Conductivity and Infiltration Values

Hydraulic conductivity testing was not completed as part of the geotechnical investigations for the proposed development. However, testing completed directly south of the subject site as part of the Community Development Plan (CDP) determined that the hydraulic conductivity of the silty sand/sand deposit ranged from 3.0×10^{-6} to 4.8×10^{-4} m/sec. The hydraulic conductivity values obtained from within the till deposit were slightly lower, and ranged from 5.0×10^{-7} to 7.6×10^{-5} m/sec. The values obtained from the field testing to the south are consistent with published values, and are considered applicable to the materials encountered at the subject site. With regards to the silty clay layer noted underlying the silty sand/sand deposit, hydraulic conductivity values were anticipated to range from 1.0×10^{-9} to 1.0×10^{-7} m/sec, and were based on published values. Due to the variability in the fill material noted on site, hydraulic conductivity values are anticipated to range from 1.0×10^{-7} to 1.0×10^{-4} m/sec and is dependant on the ratio of silty sand/sand to silty clay within the material. **For infiltration system design purposes, it is recommended to use an infiltration rate of 75 mm/hr for the Brazeau Pit site and an infiltration rate of 50 mm/hr for the Drummond Pit site.**

Based on discussions with David Schaeffer Engineering Ltd., it is understood that a version of the Etobicoke exfiltration system is being proposed for the development in order to ensure infiltration volumes to the underlying aquifer systems be maintained. The exfiltration system is proposed to be installed below the curb lines of the development and placed over native silty sand/sand, free-draining sand material 1.5 m in thickness or a silty sand/sand to silty clay fill material. **It is understood that the subject area is required to meet post-development infiltration levels of 40% of the area precipitation. It is further understood that the annual precipitation for the area is 844 mm, so a post-development infiltration level of 40% would require that a minimum infiltration of 338 mm be achieved for the subject site.**

Water Levels and Flow Directions

Water levels obtained at the time of the geotechnical investigations ranged from 0 to 9.1 m depth below existing grade. Based on the recovered water levels, it is expected that the local groundwater flow direction trends to the north towards the Jock River, located approximately 1.4 km north from the north property boundary of the Drummonds Pit. This is corroborated by the groundwater divide separating the Jock Downstream Reach subwatershed and the Mud Creek subwatershed located at the southern boundary of the Brazeau Pit. Its location at the southern edge of the property would suggest that groundwater flows north, away from the divide.

Groundwater Recharge and Discharge

The presence of overburden soils with moderate to high hydraulic conductivity overlying the bedrock aquifer units are considered to provide the potential for significant groundwater recharge within the study area. The Kars esker is considered to transmit large quantities of water that are recharged through the infiltration of precipitation within the non-cohesive material comprising the original overburden materials in the area. The subject site represents a small portion of the existing zone identified by the Mississippi-Rideau Source Protection Region (MRSPR) as a zone of significant groundwater recharge.

Recommendations

As previously discussed, existing conditions at the subject site currently allow for significant volumes of recharge to occur. As such, it is recommended that measures be taken as part of the proposed development to ensure that infiltration volumes to the underlying aquifer systems be maintained. In accomplishing this, the following are some of the potential measures that could be implemented at the subject site:

- Transport the water using a modified version of the Etobicoke exfiltration system for the development with a minimum 1 m vertical separation between the base of the system and the seasonally high water table to allow for adequate infiltration.
- Allocate land for City parks, providing opportunities to allow clean water to infiltrate into the overburden aquifer system.
- Promote infiltration of clean water from rooftops by directing stormwater to grassed areas as opposed to driveways and/or municipal infrastructure.
- Implement Low Impact Development (LID) measures in conjunction with BMP for stormwater quality and quantity control to assist in infiltrating clean water, treating salt impacted water where required or redirecting salt impacted water away from infiltration locations.

It is important to note that not all of the above may necessarily need to be employed at the subject site, and that the measures required to maintain existing infiltration will be dependant on the final design of the proposed development.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.



Mike Killam, P.Eng.



David J. Gilbert, P.Eng.

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July 29, 2020

Project Number: P1800

David Schaeffer Engineering Limited
120 Iber Road, Unit 103
Stittsville, ON
K2S 1E9

Attention: Mr. Kevin Murphy, P.Eng.

Subject: The Ridge (Brazeau):
Low Impact Development (LID) Design

Introduction

As a part of the detailed design of the Ridge (Brazeau) subdivision, located in Barrhaven within the City of Ottawa, J.F. Sabourin and Associates Inc. (JFSA) were commissioned to complete an in-depth analysis of the proposed development and its Low Impact Development (LID) measures to ensure that the site's infiltration targets will be met post-development. The detailed study area consists of 28.78 ha, which includes 27.06 ha of the Ridge residential development and 1.72 ha of parklands surrounded by the residential development, lands external to the site have not been considered in this LID analysis. Ultimately, this stormwater infrastructure will service a total drainage area of 71.75 ha. A detailed PCSWMM hydrologic/hydraulic model was developed to replicate the proposed developments water budget using historical rainfall data. The following memo outlines the proposed developments water budget and the aquifer recharge benefits that the LID's provide.

Site Infiltration Targets

As a part of the Master Servicing Study Barrhaven South Urban Expansion Area report completed by J.L. Richards in May 2018, it was determined that pre-development aquifer recharge within the study area accounted for 40% of the overall sites water budget. The City and RVCA determined that pre-development aquifer recharge levels should be maintained under post-development conditions and that the infiltration should be provided across the development and not simply concentrated to one or two locations. The City and RVCA determined that the preferred infiltration servicing strategy for this area would be Etobicoke Exfiltration Systems (EES) and that these systems should be limited only to local roads and their respective catchments, with the intent to prohibit any infiltration of roadway runoff from either collector or arterial roads due to the salting practices applied at those locations.

Etobicoke Exfiltration System (EES) Design

Within the Ridge development, there will be a total of 24 EESs implemented, to meet the aquifer recharge requirements outlined above. The EES units will be installed underneath storm sewers within the right-of-way (ROW) in specific areas as determined by David Schaeffer Engineering (DSEL) as a part of the developments detailed design. Each system will consist of one 250 mm diameter perforated pipes surrounded by a 0.85 m deep by 1.20 m wide clear stone trench. Detailed drawings of the proposed EES units are provided in Figure 1. The location of each EES and its respective design geometries are indicated in Figure 2. Figure 3 outlines the total drainage area to each of the units and the respective runoff coefficients. Based on the areas provided in Figure 3 the EES units will service a total drainage area of 18.49 ha (64.2% of the total development).

Table A1 to A3 in Attachment A provides a full summary of the design parameters for each EES. Note that there are no LID measures proposed on private property (residential rear yards) or within the parklands.

Modelling Approach

The model used for this water budget analysis builds on the existing detailed PCSWMM model of the Ridge (Brazeau) development, which was created as a part of the stormwater management analysis. All components of this model remain unaltered, such as subcatchment parameters, SWM pond configuration, catch basins and the major and minor systems, with the only exception being the removal of the large undetailed external lands that were simulated using SWMHYMO, that were included in the SWM analysis to ensure the ultimate SWM design is sufficient. For details regarding all model's parameters, refer to JFSA's "Stormwater Management Report for The Ridge (Brazeau) Subdivision", July 2020.

The storage provided by each of the EESs has been represented in the model as storage nodes, with appropriate depth/area curves assigned to each EES based on the detailed design parameters. A porosity of 0.4 has been assumed for all EES, and as all units will contain a perforated PVC pipe to help disperse the runoff throughout the entire system, the storage volume provided by these pipes has also been accounted for in the EES storage volume curves.

The soil infiltration rate for the site, determined by Paterson Group (see below), was reduced by a factor of safety of 2.5 as per the guidance from Credit Valley and Toronto and Region Conservation Authorities on Low Impact Development. A specific outlet curve (depth/flow relationship) was developed for each EES, based on its respective geometry. Note that this analysis only considered infiltration through the bottom of the EES, resulting in a conservative estimate for the total infiltration benefits provided by each EES. The total flow through each outlet curve was then used to determine the total aquifer recharge provided by each EES.

The proposed EESs were connected to their respective maintenance holes in the model through an orifice of 250 mm with a discharge coefficient of 0.82 (short pipe) to reflect any restriction that the proposed perforated pipe could have on conveying flow from the maintenance hole to the EES. Each perforated pipe has been reviewed for the more frequent events to ensure that the pipe inlet is not obstructing flows from getting into the system. Note that all EESs are named after the maintenance hole that they are connected to.

Soil Infiltration Rate

Paterson Group conducted soil infiltration testing within the vicinity of the proposed EES measures, which determined a soil infiltration rate of 75 mm/hr for the Ridge (Brazeau) site. Email correspondence indicating the infiltration rate obtained by Paterson for the subject site has been included in Attachment A. For the subcatchments within the development, default Hortons infiltration values have been applied as per the City of Ottawa Sewer Design Guidelines (2012).

Evaporation & Evapotranspiration Parameters

To ensure that the depression storage within the models subcatchments can regenerate after the first rainfall event, monthly evaporation rates have been applied. The Master Servicing Study provided no documentation on the surface evaporation rates used in that analysis, and as such monthly evaporation rates applied in this model are as per those specified in the City of Ottawa's PCSWMM Carp River model documentation. A summary of these monthly values can be found in Attachment A Table A4.

To ensure that evapotranspiration is appropriately accounted for in the continuous simulation water budget, the groundwater routine within the model's hydrologic algorithm has been activated. Groundwater parameters have been applied as specified for type A soils in the J L Richards Master Servicing Study. Excerpts from this report regarding the groundwater parameters have been provided in Attachment A.

EES Drawdown Times

As indicated above all EES units will have a maximum depth of 850 mm with an assumed porosity of 0.4. Based on the site soil infiltration rate of 75 mm/hr, determined by Paterson in the field, and assuming only bottom infiltration, this equates to a full EES having a drawdown time of approximately 4.5 hours. Applying a safety factor of 2.5 to the site infiltration rate, the draw downtime is 11.3 hours, with both values being substantially less than 24 - 48-hour maximum drawdown times generally permitted.

Continuous Simulations

The detailed PCSWMM model was run for 39 years, from 1967 to 2007, using hourly rainfall data from Environment Canada's Ottawa International Airport station. Note that there was no data available for the years 2001 and 2005 in this data set. The hourly rainfall data used in this analysis is a heavily reviewed and vetted product sold by Environment Canada, and only includes rainfall data and does not include any snowfall that occurred during this window. The yearly operational window for this rain gauge consistently started on April 1st, but the end of operation varied from year to year and was either the last day of October or November. For consistency, all simulations were run from April 1st to December 2nd, note an additional 2 days were added to the simulation to ensure any volume still contained within the EESs was able to infiltrate out of the system.

Table A5 in Attachment A provides a full summary of the rainfall data used in this analysis. From this rainfall data, it is seen that the average yearly simulated rainfall for this window is 552.0 mm. Based on Environment Canada normals data for the Ottawa MacDonal Cartier International Airport, the annual average rainfall is 758.2 mm. Reducing this window to include only the months of April to October, the average total rainfall is 585.6 mm, see Table A6 in Attachment A for full details. Note that this normals analysis was completed for the years 1981 to 2010, The discrepancy between the hourly rainfall data and the normals summary may be simply in part due to the difference in years analyzed. As specified by the Master Servicing Study, the proposed development should infiltrate 40% of the annual runoff. As the hourly rainfall data used in this simulation does not extend the full year, the infiltration target for this analysis has been assumed to be 40% of the average simulated rainfall volume (552.0 mm), which is calculated to be 220.8 mm or 63,564 m³ based on the 28.78 ha study area.

Simulation Results

Table 1 outlines the average simulated infiltration volumes for each of the proposed EESs contained within the development, as per the model simulations from 1967 - 2007. From this analysis, it was found that on average each EES will infiltrate approximately 1,132 m³ / 3.9 mm, and all EESs on average will infiltrate 27,180 m³ / 94.4 mm per year, based on the simulated window (April- Nov). Infiltration volumes for each EES for each year have been provided in Tables B1 in Attachment B. Also provided in Attachment B are full summaries of the surface runoff, surface evaporation, surface infiltration and groundwater evapotranspiration for each of the subcatchments within the model for each simulated year. Note that the surface infiltration volumes have not been considered as "truly infiltrated" in this water budget analysis, as these volumes are simply an indicator of the rainfall volume that is passed to the groundwater module. This volume will then either evapotranspire or infiltrate into the groundwater aquifer, based on the program's groundwater algorithms.

Table 1: EES Infiltration Summary (April - November)

EES ID	Average Infiltration (m ³)
ESS_MH_102	1,057
ESS_MH_103	1,915
ESS_MH_104	1,068
ESS_MH_108	25
ESS_MH_109	725
ESS_MH_110	852
ESS_MH_111	1,398
ESS_MH_114	966
ESS_MH_119	2,036
ESS_MH_120	329
ESS_MH_121	1,241
ESS_MH_125	995
ESS_MH_127	1,246
ESS_MH_128	250
ESS_MH_129	1,304
ESS_MH_130	797
ESS_MH_204	1,554
ESS_MH_208	1,769
ESS_MH_215	1,336
ESS_MH_217	2,329
ESS_MH_218	884
ESS_MH_222	1,779
ESS_MH_223	537
ESS_MH_227	787
Average Total	1,132
Total* (mm)	147

*Based on the 18.49 ha serviced by the EES units

Table 1 above outlines that the proposed EESs within the development will on average infiltrate 27,180 m³ / 147 mm (26.6% the total precipitation) for the 18.49 ha area serviced by the EES units. Table 2 outlines the water budget breakdown of the development based on the 39 years of simulations, this includes evaporation, evapotranspiration, infiltration, and runoff from the various components within the development.

From this analysis, the pervious surfaces within the development will infiltrate 38,375 m³ / 133.3 mm (24.1% of the total precipitation) for the full development area of 28.78 ha. As stated above 64.2% of the development (18.49 ha) will be serviced by EES units and also have infiltration from the pervious lands, while the remaining 35.8% (10.29 ha) will only have infiltration from the previous lands. Below is a simplified calculation of the sites total infiltration percentage based on the average model results:

$$\begin{aligned} & [(\%EES_{infil} + \%Natural_{infil}) \times \%Area\ with\ EES] + [\%Natural_{infil} \times \%Area\ without\ EES] \\ & [(26.6\% + 24.1\%) \times 64.2\%] + [24.1\% * 35.8\%] = 41.1\% \end{aligned}$$

In a more detailed approach adding the average infiltration volumes provided by the EESs and the pervious surfaces results in the average total infiltration for the site to be 65,554 m³ / 227.8 mm (41.3% of the total precipitation). This exceeds the 40% infiltration requirement set out by the Master Servicing study by 2,010 m³ / 7mm (1.3% of the total precipitation).

The development subcatchments have an average annual runoff volume of 55,977m³ with 64.2% of this area serviced by EES units, simply assuming the runoff from the site is uniform this results in 35,937 m³ reaching the EES units. From this analysis it was found that the EES units will on average infiltrate 27,180 m³, meaning that the EES units will infiltrate approximately 75% of the runoff from the areas that they service.

Table 2: The Ridge Development - Water Budget Summary

Year	Rainfall		Subcatchments			Ground water		EES	Water Budget Summary											
	[1] (mm)	[2] (m ³)	[3] Surface Runoff	[4] Surface Evaporation	[5] Surface Infiltration	[6] Evapotranspiration	[5]-[6] Subsurface	[7] EES Infiltration	[3]-[7] Total Runoff	[4]-[6] Total Evaporation	[5]-[6]-[7] Total Aquifer									
1967	373	107,340	40,265	38%	10,454	10%	56,869	53%	20,729	19%	36,139	34%	19,179	18%	21,086	20%	31,183	29%	55,318	52%
1968	520.6	149,816	53,338	36%	21,952	15%	76,422	51%	45,033	30%	31,388	21%	25,347	17%	27,991	19%	66,985	45%	56,735	38%
1969	499	143,600	49,386	34%	20,908	15%	73,745	51%	44,954	31%	28,791	20%	26,413	18%	22,973	16%	65,862	46%	55,204	38%
1970	538.1	154,852	56,100	36%	23,784	15%	76,492	49%	42,804	28%	33,687	22%	26,199	17%	29,901	19%	66,589	43%	59,886	39%
1971	491	141,298	46,149	33%	24,923	18%	71,390	51%	42,667	30%	28,723	20%	23,859	17%	22,290	16%	67,590	48%	52,582	37%
1972	764.1	219,889	82,866	38%	30,572	14%	108,956	50%	41,313	19%	67,642	31%	36,460	17%	46,406	21%	71,885	33%	104,102	47%
1973	670.1	192,838	70,759	37%	25,134	13%	97,932	51%	43,946	23%	53,986	28%	32,889	17%	37,870	20%	69,080	36%	86,875	45%
1974	332.1	95,570	30,368	32%	17,808	19%	48,763	51%	44,506	47%	4,257	4%	16,829	18%	13,539	14%	62,314	65%	21,086	22%
1975	497.7	143,226	52,486	37%	18,873	13%	72,803	51%	42,106	29%	30,697	21%	24,106	17%	28,380	20%	60,979	43%	54,803	38%
1976	467.5	134,535	43,633	32%	23,144	17%	69,601	52%	43,872	33%	25,729	19%	24,113	18%	19,520	15%	67,017	50%	49,842	37%
1977	587.6	169,097	59,672	35%	23,955	14%	87,052	51%	43,783	26%	43,268	26%	30,955	18%	28,717	17%	67,738	40%	74,223	44%
1978	558.2	160,636	55,528	35%	25,001	16%	81,849	51%	43,755	27%	38,094	24%	27,382	17%	28,146	18%	68,756	43%	65,476	41%
1979	753.6	216,867	81,846	38%	26,018	12%	110,150	51%	44,303	20%	65,846	30%	33,426	15%	48,420	22%	70,322	32%	99,272	46%
1980	555	159,715	53,735	34%	24,744	15%	83,133	52%	43,662	27%	39,471	25%	28,304	18%	25,431	16%	68,407	43%	67,775	42%
1981	840.9	241,990	94,132	39%	32,336	13%	117,734	49%	41,352	17%	76,382	32%	36,938	15%	57,194	24%	73,688	30%	113,320	47%
1982	542.6	156,147	53,734	34%	21,748	14%	81,131	52%	44,145	28%	36,986	24%	28,768	18%	24,966	16%	65,892	42%	65,754	42%
1983	537	154,535	52,092	34%	23,333	15%	80,591	52%	43,903	28%	36,689	24%	28,624	19%	23,468	15%	67,236	44%	65,313	42%
1984	416.2	119,772	42,213	35%	14,107	12%	63,276	53%	42,761	36%	20,515	17%	21,782	18%	20,431	17%	56,867	47%	42,297	35%
1985	456	131,226	45,258	34%	20,781	16%	67,467	51%	44,655	34%	22,812	17%	21,710	17%	23,548	18%	65,436	50%	44,522	34%
1986	814	234,249	84,342	36%	29,981	13%	122,192	52%	42,294	18%	79,899	34%	38,383	16%	45,959	20%	72,275	31%	118,282	50%
1987	602.9	173,500	59,880	35%	25,558	15%	89,563	52%	43,429	25%	46,134	27%	30,087	17%	29,793	17%	68,987	40%	76,221	44%
1988	610.2	175,600	63,539	36%	25,595	15%	87,953	50%	43,380	25%	44,573	25%	30,450	17%	33,089	19%	68,976	39%	75,023	43%
1989	512.8	147,571	49,875	34%	22,284	15%	75,953	51%	44,145	30%	31,809	22%	26,088	18%	23,787	16%	66,428	45%	57,897	39%
1990	651.2	187,399	63,580	34%	28,129	15%	96,309	51%	41,296	22%	55,013	29%	32,552	17%	31,028	17%	69,425	37%	87,565	47%
1991	520.4	149,758	50,115	33%	21,662	14%	78,522	52%	44,408	30%	34,115	23%	27,819	19%	22,296	15%	66,070	44%	61,934	41%
1992	621.2	178,766	64,452	36%	26,027	15%	89,086	50%	42,112	24%	46,973	26%	30,907	17%	33,545	19%	68,140	38%	77,880	44%
1993	643.5	185,183	61,607	33%	27,758	15%	96,182	52%	41,821	23%	54,361	29%	33,872	18%	27,735	15%	69,579	38%	88,233	48%
1994	514.5	148,060	51,997	35%	21,793	15%	76,544	52%	45,331	31%	31,213	21%	24,170	16%	27,827	19%	67,124	45%	55,383	37%
1995	443.6	127,657	48,088	38%	13,357	10%	66,651	52%	45,166	35%	21,485	17%	17,640	14%	30,448	24%	58,523	46%	39,125	31%
1996	476.8	137,211	46,882	34%	20,284	15%	70,721	52%	44,614	33%	26,106	19%	24,902	18%	21,980	16%	64,898	47%	51,008	37%
1997	363.6	104,635	34,658	33%	16,197	15%	54,460	52%	44,375	42%	10,085	10%	20,046	19%	14,612	14%	60,572	58%	30,131	29%
1998	440.3	126,707	41,297	33%	22,506	18%	65,344	52%	42,749	34%	22,595	18%	22,234	18%	19,063	15%	65,255	52%	44,829	35%
1999	424.4	122,132	41,317	34%	19,163	16%	63,818	52%	44,162	36%	19,656	16%	20,691	17%	20,626	17%	63,325	52%	40,347	33%
2000	535.9	154,219	50,446	33%	25,837	17%	79,800	52%	41,901	27%	37,900	25%	25,665	17%	24,781	16%	67,738	44%	63,565	41%
2001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2002	551.5	158,708	61,050	38%	19,621	12%	79,923	50%	46,159	29%	33,764	21%	26,040	16%	35,010	22%	65,779	41%	59,804	38%
2003	554.6	159,600	54,033	34%	24,069	15%	83,542	52%	42,697	27%	40,846	26%	27,547	17%	26,486	17%	66,766	42%	68,393	43%
2004	573.3	164,982	65,130	39%	24,295	15%	77,742	47%	43,942	27%	33,801	20%	22,565	14%	42,565	26%	68,237	41%	56,366	34%
2005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2006	723.4	208,177	73,841	35%	28,434	14%	108,758	52%	42,536	20%	66,222	32%	37,829	18%	36,012	17%	70,970	34%	104,051	50%
2007	550.7	158,478	53,395	34%	25,838	16%	81,708	52%	42,752	27%	38,957	25%	27,239	17%	26,156	17%	68,590	43%	66,196	42%
Average	552.0	158,860	55,977	35.1%	23,025	14.6%	81,285	51.3%	42,911	28.1%	38,375	23.1%	27,180	17.2%	28,797	17.9%	65,935	42.7%	65,554	40.3%

Notes:

Total drainage area 28.78 ha

Surface Infiltration not considered as a part of the total aquifer recharge, as this value is simply the volume that is passed to the groundwater component

Erosion & Sediment Control During & After Construction

Silt and erosion control strategies shall be implemented during construction activities to optimize the operations of the LID once implemented and minimize the siltation of the systems during construction. The following measures should be implemented:

- Prior to site works, locations of the LIDs should be marked and vehicles to avoid this area other than during the installation of the LID drainage not to be directed to LID.
- Prior to the completion of landscape works, catch basins not connected to the LID practices can be used during construction for drainage.
- Heavy equipment and traffic should avoid travelling over the proposed location of the facility to minimize the compaction of the soil.
- To minimize siltation during construction, the EES units should be constructed with upstream and downstream plugs. During construction, these plugs will be implanted preventing sediments from entering the units. Once an occupancy of 80% is achieved, the upstream plug will then be removed and the EES units allow to operate as intended.
- Facilities should be kept “off-line” until construction is complete. They should never serve as a sediment control device during site construction. Sediment should be prevented from entering the infiltration facility using super silt fence, diversion berms or other means.
- Upland drainage areas need to be properly stabilized with a thick layer of vegetation, particularly immediately following construction, to reduce sediment loads.
- The facility should be excavated to design dimensions from the side using a backhoe or excavator. The base of the facility should be level or nearly level.
- The bottom of the facility should be scarified to improve infiltration. An optional 150 mm of sand could be spread for the bottom filter layer. The monitoring well should be anchored and stone should be added to the facility in 0.3-metre lifts.
- Geotextile fabric should be correctly installed in the soakaway or infiltration trench excavation. Large tree roots should be trimmed flush with the sides of the facility to prevent puncturing or tearing of the fabric during subsequent installation procedures. When laying out the geotextile, the width should include sufficient material to compensate for perimeter irregularities in the facility and for a 150 mm minimum top overlap. Voids may occur between the fabric and the excavated sides of the facility. Natural soils should be placed in any voids to ensure fabric conformity to the excavation sides

Conclusion

In summary, the detailed PCSWMM model of the proposed Ridge (Brazeau) development has been updated to include the EES measures proposed within the site. Continuous simulations using 39 years of historical rainfall data determined that the proposed water budget for the Ridge subdivision would be 18% surface runoff, 42% evaporation and 40% infiltration. From this analysis, it was found that the proposed EESs within the development will on average infiltrate 27180 m³ / 94.4 mm (17% of the total precipitation) while the pervious surfaces within the development will infiltrate 38,375 m³ / 133.3 mm (23% of the total precipitation). Adding the infiltration provided by the EESs and the pervious surfaces yearly results in the average total infiltration for the site to be 65,554 m³ / 227.8 mm (41.3% of the total precipitation). This exceeds the 40% infiltration requirement set out by the Master Servicing study by 2010 m³ / 7mm (1.3% of the total precipitation), confirming that the proposed development will not adversely affect the existing groundwater recharge and existing infiltration budget.

Yours truly,
J.F Sabourin and Associates Inc.



Jonathon Burnett, B.Eng, P.Eng
Water Resources Engineer



cc: J.F Sabourin, M.Eng, P.Eng
Director of Water Resources Projects

Figures

- Figure 1: Exfiltration System Details
- Figure 2: Exfiltration System Locations
- Figure 3: Exfiltration System Drainage Areas

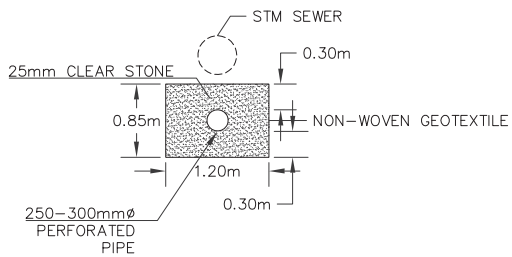
Tables

- Table 1: EES Infiltration Summary (April - November)
- Table 2: Water Budget Summary

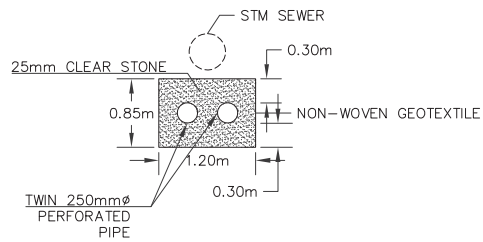
Attachments

- Attachment A: Continuous Simulation Parameters & Background Information
- Attachment B: Continuous Simulation Results

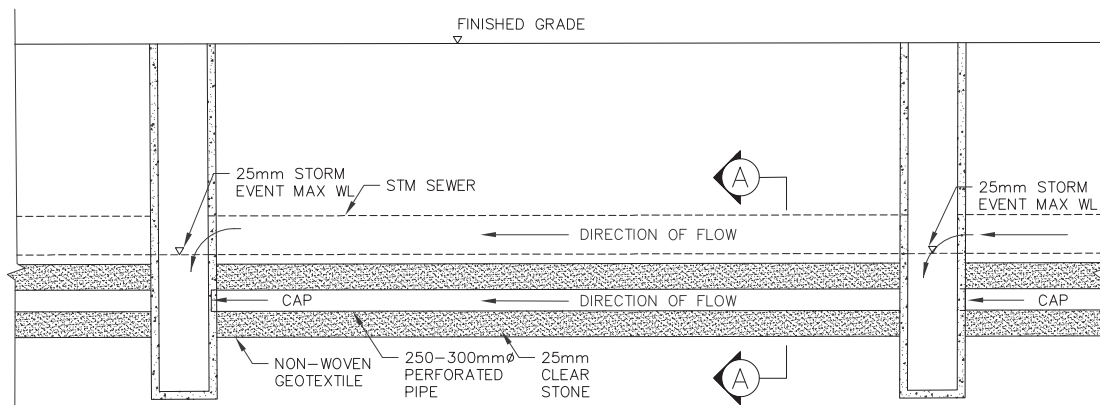
EXFILTRATION TRENCH – ROADS



SECTION DETAIL A
SCALE: N.T.S.



SECTION DETAIL A
SCALE: N.T.S.



PROFILE
SCALE: N.T.S.

SCALE: NTS

J.F. Sabourin & Associates Inc.
WATER RESOURCES AND ENVIRONMENTAL CONSULTANTS
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CLIENT: DAVID SCHAEFFER ENGINEERING LTD.

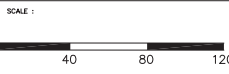
PROJECT: THE RIDGE PHASE 1 SUBDIVISION

BY	DATE	DESCRIPTION	BY

EXFILTRATION SYSTEM DETAILS

FIGURE 1	DESIGNED: BL	
	DRAWN: JFS	
	VERIFIED: JFS	
	APPROVED: JFS	
DRAWING REF: 1800-19_202001_L10 Subm3 Design/CAD/ Figure 1 & 2.dwg	DATE: APRIL 2020	PROJECT No: 1800

LEGEND:
 Etobicoke Exfiltration System



 J.F. Sabourin & Associates Inc.
 WATER RESOURCES AND ENVIRONMENTAL CONSULTANTS
 OTTAWA (613) 836-3886
 GATINEAU (819) 243-6858

CLIENT : DAVID SCHAEFFER ENGINEERING LTD.

PROJECT : THE RIDGE PHASE 1 SUBDIVISION

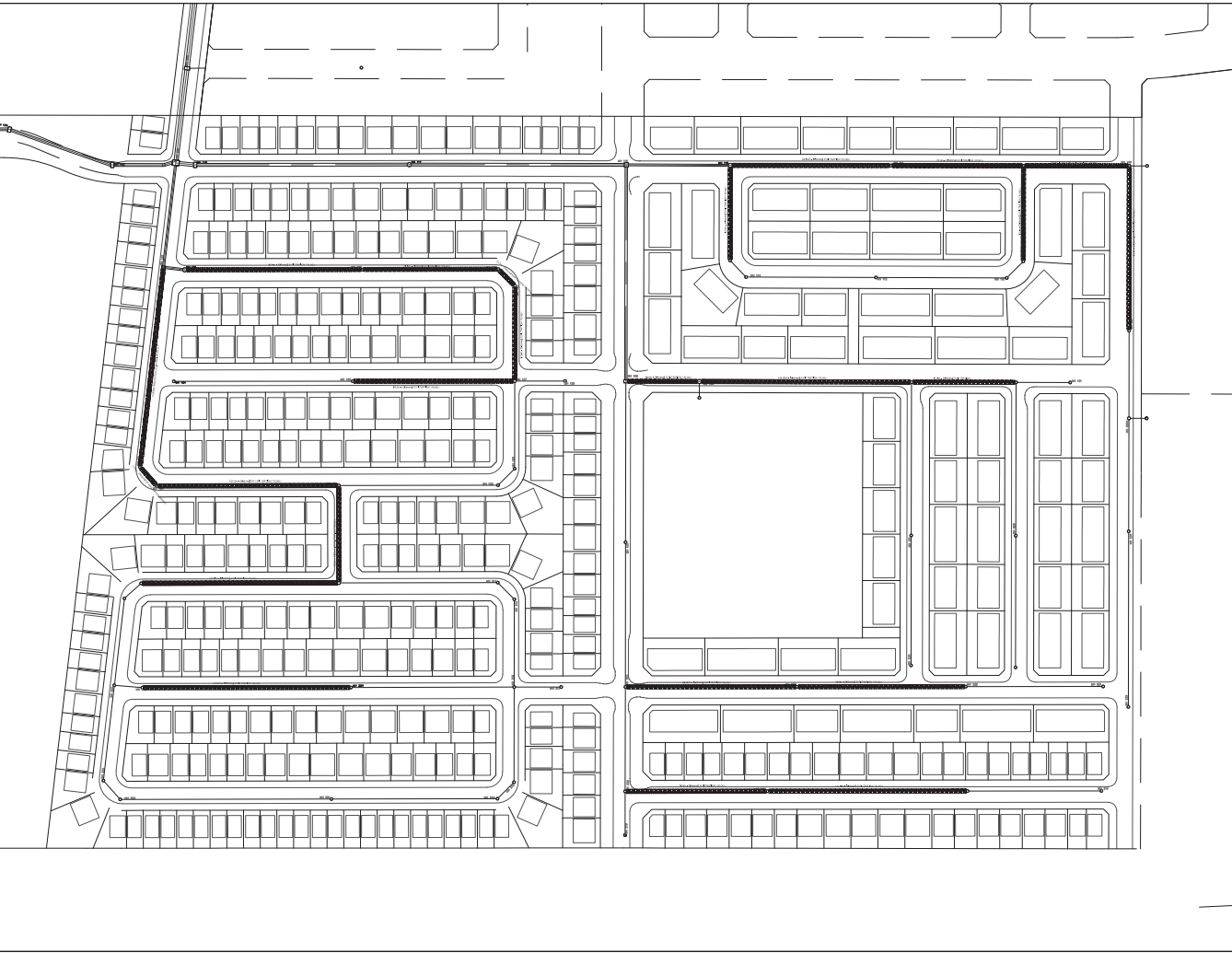
BY	DATE	DESCRIPTION	BY

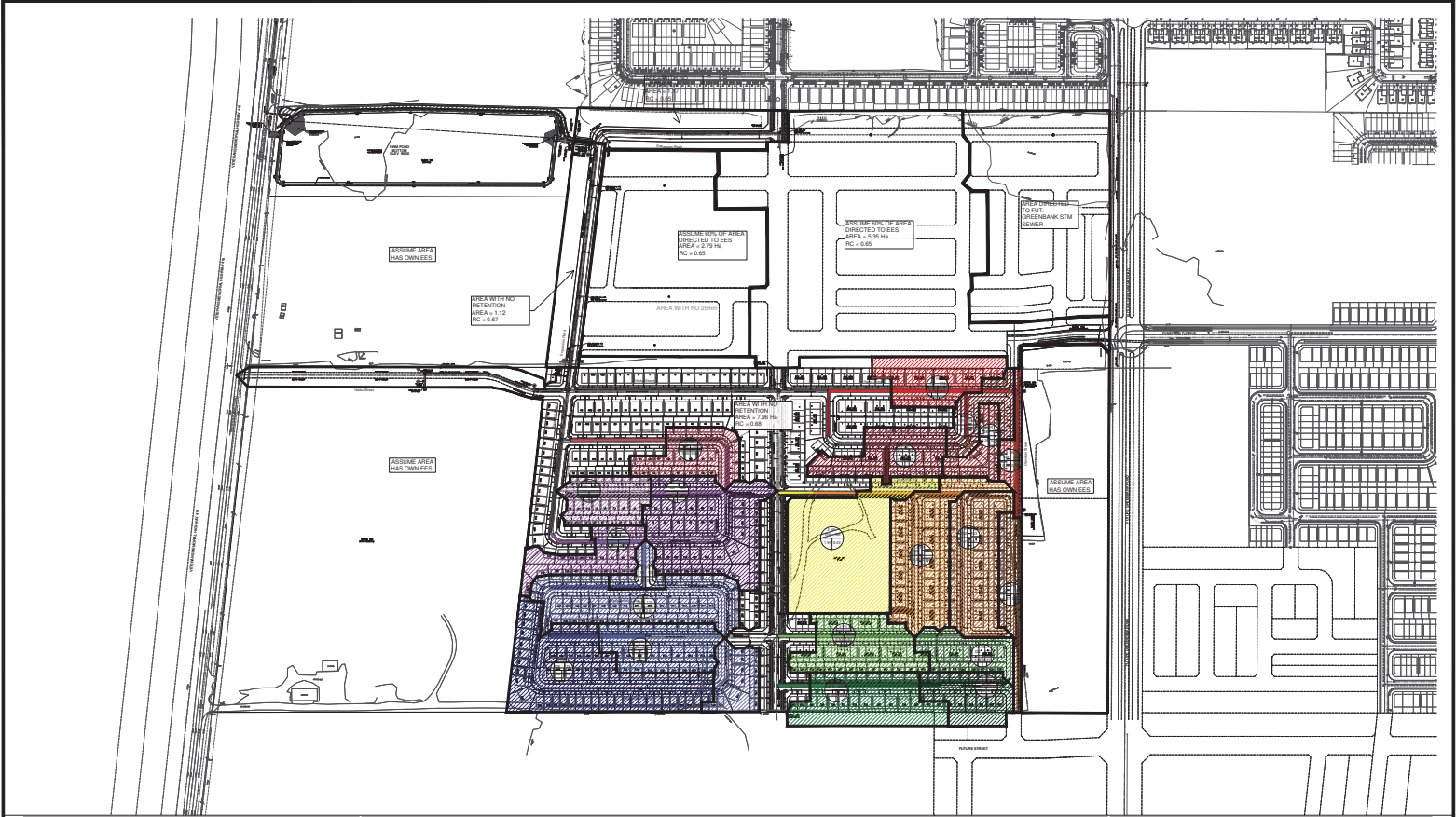
EXFILTRATION SYSTEM LOCATIONS

FIGURE 2

DESIGNED:	
DRAWN:	BL
VERIFIED:	JB
APPROVED:	JB
DATE:	JULY 2020
PROJECT No.	1800

DRAWING REF.: 1800-19-202001 L10 Subm3\ Design\CAO\Figure 1 & 2.dwg





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 Fax. (613) 836-7183
 www.DSEL.ca

CAIVAN COMMUNITIES - THE RIDGE PHASE 1
 CITY OF OTTAWA

EES DRAINAGE FIGURE

SCALE:	1:2000	PROJECT No.:	18-1030
DATE:	JULY 2020	FIGURE:	3



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Ottawa, ON
Paris, ON
Gatineau, QC
Montréal, QC
Québec, QC

Attachment A

Continuous Simulation Parameters & Background Information

Table A4 - Monthly Evaporation

Month	Evaporation Rate (mm/Day)
January	0.0000
February	0.0000
March	0.0000
April	1.1330
May	2.5160
June	3.9330
July	4.5160
August	3.8710
September	2.3670
October	1.3870
November	0.2000
December	0.0000

Source:

Table 10- Evaporation Rate (mm/Day) - Appendices, City of Ottawa (Feb 2014)

**Table A5 - Historical Rainfall Data
Summary:
Ottawa International Airport**

Year	Rainfall Volume (mm)
1967	373.0
1968	520.6
1969	499.0
1970	538.1
1971	491.0
1972	764.1
1973	670.1
1974	332.1
1975	497.7
1976	467.5
1977	587.6
1978	558.2
1979	753.6
1980	555.0
1981	840.9
1982	542.6
1983	537.0
1984	416.2
1985	456.0
1986	814.0
1987	602.9
1988	610.2
1989	512.8
1990	651.2
1991	520.4
1992	621.2
1993	643.5
1994	514.5
1995	443.6
1996	476.8
1997	363.6
1998	440.3
1999	424.4
2000	535.9
2001	
2002	551.5
2003	554.6
2004	573.3
2005	
2006	723.4
2007	550.7
Average	552.0
Total	21529.1

No data Available

Ottawa International Airport
1981 to 2010 Canadian Climate Normals Station Data

Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rainfall (mm)	25.0	18.7	31.1	63.0	80.1	92.8	91.9	85.5	90.1	82.2	64.5	33.5	758.2
Snowfall (cm)	53.9	43.3	38.3	11.3	0.2	0.0	0.0	0.0	0.0	3.7	20.2	52.5	223.5
Precipitation (mm)	65.4	54.3	64.4	74.5	80.3	92.8	91.9	85.5	90.1	86.1	81.9	76.4	943.4

Source:

https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnName&stnName=ottawa&searchMethod=contains&tt=entire&in=0&tt=entire&atSec=0&tt=entire&ong=0&stn=4337&disp=ac=0&station-metadata

From: David Gilbert <DGilbert@Patersongroup.ca>

Sent: August 29, 2019 5:30 PM

To: Susan Murphy <susan.murphy@caivan.com>; Steve Pichette <SPichette@dsel.ca>

Cc: Michael Killam <MKillam@Patersongroup.ca>

Subject: Drummonds and Brazeau Pit - Infiltration information

Hi guys,

I spoke with Bobby Pettigrew at JL Richards and he used 40% of area precipitation to be infiltrated over a 30 year period using the infiltration system. Annual precipitation in water budget was noted to be 844 mm, so infiltration of 40% would be 338 mm. He noted that this amount was equivalent to full infiltration of a 22 mm rain event. The infiltration rate for system design for Brazeau Pit is 75 mm/hour and for Drummond Pit is 50 mm/hour. We are working on the groundwater contour plan based on our current groundwater observations for both sites. This drawing should be ready tomorrow.

Dave

David Gilbert, P.Eng.

Senior Geotechnical Engineer

patersongroup

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Ottawa, Ontario, K2E 7J5

Tel: (613) 226-7381 Ext. 205

3.0 GROUNDWATER

3.1 Groundwater Parameters

Parameter	Units	Description																				
Aquifer Name	-	Name of the aquifer representing soil conditions. Four Aquifers were created based on different soil conditions from OSG mapping. Only two of the aquifers are used within the study area. <table border="1"> <thead> <tr> <th>Aquifer</th> <th>Description</th> <th>Clay content (%)</th> <th>Sand content (%)</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>Sand</td> <td>5</td> <td>92</td> </tr> <tr> <td>B</td> <td>Sandy Loam</td> <td>10</td> <td>65</td> </tr> <tr> <td>C (not used)</td> <td>Sandy Clay Loam</td> <td>28</td> <td>60</td> </tr> <tr> <td>D (not used)</td> <td>Clay Loam</td> <td>34</td> <td>33</td> </tr> </tbody> </table>	Aquifer	Description	Clay content (%)	Sand content (%)	A	Sand	5	92	B	Sandy Loam	10	65	C (not used)	Sandy Clay Loam	28	60	D (not used)	Clay Loam	34	33
Aquifer	Description	Clay content (%)	Sand content (%)																			
A	Sand	5	92																			
B	Sandy Loam	10	65																			
C (not used)	Sandy Clay Loam	28	60																			
D (not used)	Clay Loam	34	33																			
Receiving Node	-	Name of the receiving node for groundwater outflow to baseflow. This is based on the groundwater subwatershed delineation.																				
Surface Elevation	m	Elevation of the ground surface for the subcatchment was averaged from the Patterson report. Value: 107																				
Coefficients		The coefficients were set for the saturated groundwater zone to represent a storage reservoir where outflow is linear proportional to the water table depth without surface water interaction. It was considered that the nearest open water channels were sufficiently far to have negligible impact on groundwater levels. The groundwater equation used is: $f_G = A1 (d_L - h_{sw})$ Where: f_G = groundwater flow d_L = depth of the lower saturated subsurface zone h_{sw} = height of surface water above the bottom of the groundwater zone $A1$ = Calibration factor (estimated at 0.05) Value: 0.05																				
Surface Water Depth	m	Set as 0.5 metres to allow flow from the water table to surrounding watercourses. Value: 0.5																				

Parameter	Units	Description
Initial Elevation	m	Initial elevation of the water table Value: 95.5
		All other parameters used as per the receiving node or aquifer

3.2 Aquifer Parameters

Parameter	Units	Description / Values										
Porosity	Fraction	<p>The following values were used for the volumetric water content of the soil at saturation (i.e. volume of water per total volume):</p> <table border="1"> <thead> <tr> <th>Soil Group</th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> </tr> </thead> <tbody> <tr> <td>Porosity</td> <td>0.436</td> <td>0.450</td> <td>0.432</td> <td>0.472</td> </tr> </tbody> </table> <p>(Source: SPAW Calculator)</p>	Soil Group	A	B	C	D	Porosity	0.436	0.450	0.432	0.472
Soil Group	A	B	C	D								
Porosity	0.436	0.450	0.432	0.472								
Wilting Point	Fraction	<p>This is soil moisture contact at which plants cannot obtain sufficient moisture from the soil to meet transpiration requirements and they will die. It is roughly equivalent to the moisture content of soil at 15 atmospheres. The following values were used:</p> <table border="1"> <thead> <tr> <th>Soil Group</th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> </tr> </thead> <tbody> <tr> <td>Wilting Point</td> <td>0.050</td> <td>0.081</td> <td>0.183</td> <td>0.213</td> </tr> </tbody> </table> <p>(Source: SPAW Calculator)</p>	Soil Group	A	B	C	D	Wilting Point	0.050	0.081	0.183	0.213
Soil Group	A	B	C	D								
Wilting Point	0.050	0.081	0.183	0.213								
Field Capacity	Fraction	<p>Considered to be the amount of water a well-drained soil holds after free water has drained off. The following values were used:</p> <table border="1"> <thead> <tr> <th>Soil Group</th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> </tr> </thead> <tbody> <tr> <td>Field Capacity</td> <td>0.094</td> <td>0.179</td> <td>0.283</td> <td>0.350</td> </tr> </tbody> </table> <p>(Source: SPAW Calculator)</p>	Soil Group	A	B	C	D	Field Capacity	0.094	0.179	0.283	0.350
Soil Group	A	B	C	D								
Field Capacity	0.094	0.179	0.283	0.350								
Conductivity	mm/hr	<p>Within the Aquifer Parameters, the soil saturated conductivity is a governing parameter of the percolation rate between the upper unsaturated soil layer and the lower saturated soil layer. This is not the same as any hydraulic conductivity used for the surface infiltration. The values have been selected from the SPAW calculator and are:</p> <table border="1"> <thead> <tr> <th>Soil Group</th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> </tr> </thead> <tbody> <tr> <td>Conductivity (mm/hr)</td> <td>114</td> <td>50.3</td> <td>7.8</td> <td>4.6</td> </tr> </tbody> </table> <p>(Source: SPAW Calculator)</p>	Soil Group	A	B	C	D	Conductivity (mm/hr)	114	50.3	7.8	4.6
Soil Group	A	B	C	D								
Conductivity (mm/hr)	114	50.3	7.8	4.6								

Parameter	Units	Description / Values										
Conductivity Slope	-	<p>Conductivity slope measures the rate at which a soil's hydraulic conductivity decreases with decreasing moisture content. Regression analysis has shown it can be estimated with the following relationship:</p> <p>Conductivity Slope = 0.48(% Sand) + 0.85(% Clay)</p> <p>Based on this relationship the following values were used:</p> <table border="1"> <thead> <tr> <th>Soil Group</th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> </tr> </thead> <tbody> <tr> <td>Conductivity Slope</td> <td>48</td> <td>40</td> <td>53</td> <td>45</td> </tr> </tbody> </table>	Soil Group	A	B	C	D	Conductivity Slope	48	40	53	45
Soil Group	A	B	C	D								
Conductivity Slope	48	40	53	45								
Tension Slope		Used for backward compatibility in the software and not used in this model										
Upper Evaporation Factor	Fraction	<p>This factor determines the fraction of available subsurface evaporation rate used in the upper subsurface zone (compared to the lower subsurface zone). A higher evaporation rate is associated with looser soils, lower water table elevations and shallow root zones. It was assumed that in all soils 80% of the available subsurface evaporation would be used in the upper zone due to the depth of the water table.</p> <p>Value: 0.8</p>										
Lower Evaporative Depth	m	<p>The depth of the lower subsurface zone which can be used for evapotranspiration should be approximate to the expected average depth of root penetration. The following values were used:</p> <table border="1"> <thead> <tr> <th>Soil Group</th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> </tr> </thead> <tbody> <tr> <td>Evaporative Depth (m)</td> <td>1.5</td> <td>2.4</td> <td>3.0</td> <td>5.2</td> </tr> </tbody> </table> <p><i>(Source: Shah et al 2007 from EPA 2015)</i></p>	Soil Group	A	B	C	D	Evaporative Depth (m)	1.5	2.4	3.0	5.2
Soil Group	A	B	C	D								
Evaporative Depth (m)	1.5	2.4	3.0	5.2								
Lower Groundwater Loss Rate	mm/hr	<p>This is the rate of percolation from the lower subsurface zone to a deep aquifer and is approximate to the rate at which the water table elevation will drop over a prolonged dry period. The saturated hydraulic conductivity of a compacted clay soil was used in all cases.</p> <p>Value: 0.004</p>										
Bottom Elevation	m	<p>The elevation of the bedrock as averaged from the Patterson 2016 report.</p> <p>Value: 85</p>										

Parameter	Units	Description / Values				
Unsaturated Zone Moisture		The moisture content of the unsaturated upper subsurface zone at the start of the simulation. Cannot be less than the wilting point and cannot be more than porosity. Assumed to be an approximate value between the wilting point and porosity fractions.				
		Soil Group	A	B	C	D
		Evaporative Depth (m)	0.25	0.22	0.32	0.35

Attachment B

Continuous Simulation Results

Table B1 - Yearly Precipitation

Year	Rainfall	
	(mm)	(m ³)
1967	373	107,340
1968	520.6	149,816
1969	499	143,600
1970	538.1	154,852
1971	491	141,298
1972	764.1	219,889
1973	670.1	192,838
1974	332.1	95,570
1975	497.7	143,226
1976	467.5	134,535
1977	587.6	169,097
1978	558.2	160,636
1979	753.6	216,867
1980	555	159,715
1981	840.9	241,990
1982	542.6	156,147
1983	537	154,535
1984	416.2	119,772
1985	456	131,226
1986	814	234,249
1987	602.9	173,500
1988	610.2	175,600
1989	512.8	147,571
1990	651.2	187,399
1991	520.4	149,758
1992	621.2	178,766
1993	643.5	185,183
1994	514.5	148,060
1995	443.6	127,657
1996	476.8	137,211
1997	363.6	104,635
1998	440.3	126,707
1999	424.4	122,132
2000	535.9	154,219
2001	-	-
2002	551.5	158,708
2003	554.6	159,600
2004	573.3	164,982
2005	-	-
2006	723.4	208,177
2007	550.7	158,478
Average	552.0	158,860

Notes:

Total drainage area 28.78 ha

Table 01. Suburbs/Urban
Yearly Rainfall Volume (in)

Table with columns: Sub Area, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, Average.

Table 61. Suburbanities
Wardly Percentages

Table with columns: Ward, Area, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, Average.

Table 84. Subcatchments

Node	Area	Yearly Surface Runoff Volume (m³)																												Average													
		1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AD03E_3	0.030	15	27	29	31	32	37	32	26	26	32	31	34	32	39	28	31	20	27	30	33	32	30	38	30	33	38	28	17	27	22	20	26	26	24	23	20	24	23	20			
AD04NE	0.111	46	73	79	83	89	100	87	69	71	86	83	93	87	87	166	77	84	55	72	86	89	86	82	97	82	89	103	76	40	72	61	82	71	86	-	86	89	82	-	91	87	81
AD04N	0.168	56	103	111	118	128	141	122	98	100	121	117	132	122	154	150	109	118	78	102	138	126	122	116	137	116	125	145	107	64	102	86	116	101	136	-	93	128	116	-	129	128	115
AD04W2	0.127	30	54	59	62	67	75	65	52	53	64	62	70	65	65	79	57	62	41	54	73	67	64	61	72	61	66	77	57	34	54	45	61	53	72	-	49	66	61	-	66	66	63
AD04WE	0.051	13	24	26	28	30	34	29	23	24	29	28	31	29	29	36	26	28	18	24	33	30	29	28	33	28	30	35	25	15	24	20	28	24	32	-	22	30	28	-	31	30	27
AD04E1	0.061	13	24	26	28	30	34	29	23	24	29	28	31	29	29	36	26	28	18	24	33	30	29	28	33	28	30	35	25	15	24	20	28	24	32	-	22	30	28	-	31	30	27
AD04E	0.061	13	24	26	28	30	34	29	23	24	29	28	31	29	29	36	26	28	18	24	33	30	29	28	33	28	30	35	25	15	24	20	28	24	32	-	22	30	28	-	31	30	27
AD04E1	0.064	24	44	48	50	54	61	53	42	43	52	50	57	52	53	64	47	51	33	44	59	54	52	50	59	50	53	62	46	28	44	37	50	43	58	-	40	54	50	-	55	55	49
AD04NE	0.043	15	28	30	32	35	39	34	27	27	33	32	36	34	34	41	30	32	21	28	38	35	33	32	38	32	34	40	29	18	28	24	32	28	37	-	26	35	32	-	35	35	32
AD04NE1	0.028	10	18	20	21	22	25	22	17	18	22	21	23	22	22	27	19	21	14	18	26	23	22	21	24	21	22	26	19	11	18	15	21	16	24	-	17	22	21	-	23	23	20
AD04N1	0.054	19	35	38	41	43	49	42	34	34	42	40	46	42	43	52	38	41	27	35	48	44	42	40	47	40	43	50	37	22	35	30	40	35	47	-	32	43	40	-	45	44	40
AD04W1	0.044	10	19	20	22	23	26	22	18	18	22	21	24	22	23	27	20	22	14	19	25	23	22	21	25	21	23	27	20	12	19	16	21	18	25	-	17	23	21	-	24	23	21
AD04WE	0.024	12	22	24	25	27	31	27	21	22	26	25	29	26	27	32	24	26	17	22	30	27	26	25	30	25	27	31	23	14	22	19	25	22	29	-	20	27	25	-	28	28	25
AD04E2	0.054	19	35	38	41	43	49	42	34	34	42	40	46	42	43	52	38	41	27	35	48	44	42	40	47	40	43	50	37	22	35	30	40	35	47	-	32	43	40	-	45	44	40
AD04NE2	0.12	43	78	85	90	96	108	94	75	78	93	89	103	94	94	114	83	90	59	78	103	97	93	89	105	89	95	111	82	43	78	65	89	77	104	-	71	95	89	-	99	98	88
AD04N1	0.067	24	44	48	50	54	61	52	42	43	52	50	57	52	53	64	47	51	33	44	59	54	52	50	59	50	53	62	46	27	44	37	50	43	58	-	40	54	50	-	55	55	49
AD04NE1	0.107	25	46	49	52	56	63	55	44	45	54	52	59	55	55	67	48	53	35	45	62	56	54	58	61	55	56	65	48	29	45	38	52	45	60	-	41	56	51	-	58	57	53
AD04NE2	0.119	43	78	84	89	96	108	93	74	78	92	89	103	93	94	114	83	90	59	78	103	96	93	89	104	89	95	110	81	43	78	65	89	77	103	-	71	96	89	-	99	97	87
AD04E1	0.067	24	44	48	50	54	61	52	42	43	52	50	57	52	53	64	47	51	33	44	59	54	52	50	59	50	53	62	46	27	44	37	50	43	58	-	40	54	50	-	55	55	49
A_N_2	0.019	5	9	10	11	12	13	11	9	9	11	11	12	11	11	14	10	11	7	9	13	12	11	11	13	11	12	13	10	6	9	8	11	9	13	-	9	12	11	-	12	11	11
A04	1.72	2,891	7,753	5,555	7,518	7,489	11,040	8,186	4,273	5,079	8,406	7,785	8,756	9,096	7,677	11,658	6,884	6,988	3,373	6,661	10,874	8,073	8,703	6,257	9,203	5,587	8,778	7,672	6,880	4,484	6,157	4,359	6,452	5,203	7,034	-	6,740	6,687	8,299	-	10,094	8,173	2,695
Total	28,778	156,684	174,912	180,908	173,784	184,833	180,372	151,134	137,888	148,875	183,244	183,895	192,081	182,618	204,784	132,336	121,768	73,333	104,387	205,781	195,081	195,108	195,205	212,284	184,319	174,642	190,617	137,708	112,769	102,517	130,284	104,197	121,006	103,168	125,817	-	138,121	142,669	142,395	-	184,834	152,818	14,159

Table 48 - Expenditures
Yearly (actual information) in billion JPY

Table with 30 columns (Year 1980-2008) and multiple rows of data. Columns include 'Year' and 'Expenditure' for various categories. Data is presented in a grid format with values in billion JPY. Some cells contain numerical values, while others are blank.

Tab. 66 - Subvenções

Valor: Lucro líquido (milhões de reais)

Atividade	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	Average															
AD35 3 0.050	33	47	45	48	44	47	60	30	45	42	53	50	67	50	73	49	48	37	41	73	54	55	46	58	47	55	58	46	40	43	33	39	38	48	47	50	49	65	49	48		
AD36NE 0.111	112	136	150	139	147	204	200	100	149	140	176	166	224	189	243	185	181	126	137	244	181	180	154	136	159	184	183	154	133	143	139	132	127	181	-	138	186	188	-	217	185	364
AD36N 0.150	117	219	210	224	207	315	281	140	209	197	247	233	314	254	342	259	259	175	192	343	254	257	216	274	219	258	271	217	187	201	153	185	179	226	-	223	234	233	-	355	232	331
AD36P2 0.127	401	591	564	580	548	834	743	368	546	538	674	626	837	648	887	633	629	484	518	948	691	670	584	747	604	686	749	584	503	547	422	506	488	613	-	616	642	571	-	851	633	624
AD36E 0.051	88	132	117	125	115	175	156	78	116	110	138	130	175	130	190	127	126	98	107	191	141	143	120	153	122	144	151	121	104	112	85	103	100	126	-	124	130	130	-	170	129	329
AD36S 1 0.064	55	79	73	78	72	110	98	49	73	69	86	82	110	82	119	80	79	61	67	120	89	90	75	96	77	90	95	78	65	70	54	65	62	79	-	78	82	81	-	108	81	83
AD36NE 0.043	43	60	58	62	57	87	77	39	58	54	68	64	87	64	94	63	62	48	53	95	70	71	60	76	60	71	75	60	52	56	42	51	49	62	-	61	64	64	-	84	64	64
AD36NE1 0.028	29	39	38	40	37	56	55	29	38	35	44	42	58	42	61	41	41	31	34	65	46	48	39	48	39	46	48	39	34	36	27	33	32	41	-	40	42	42	-	55	42	41
AD36N 0.054	54	78	73	78	72	109	97	48	72	68	88	81	109	81	118	79	78	61	68	119	88	89	75	95	75	89	94	75	65	70	53	64	62	78	-	77	81	81	-	105	80	88
AD36P1 0.044	149	205	196	201	190	289	257	127	189	186	233	217	290	254	307	219	218	188	179	328	240	232	203	259	209	238	259	202	174	190	146	175	169	212	-	213	222	198	-	295	219	238
AD36E 0.024	34	48	46	49	45	69	61	30	46	43	54	51	69	51	74	52	49	38	42	75	55	56	47	60	45	58	59	47	41	44	33	40	39	49	-	49	51	51	-	68	51	60
AD36S 0.054	54	78	73	78	72	109	97	48	72	68	88	81	109	81	118	79	78	61	68	119	88	89	75	95	75	89	94	75	65	70	53	64	62	78	-	77	81	81	-	105	80	88
AD36NE 0.12	121	168	162	172	159	242	216	108	161	151	190	179	242	189	263	178	174	135	140	264	195	198	168	211	169	199	209	167	144	154	118	143	138	134	-	131	160	139	-	224	159	238
AD36N 0.037	67	94	90	96	89	132	121	60	90	85	106	100	132	100	147	98	97	75	82	147	109	110	93	118	94	111	118	93	80	88	68	80	77	97	-	96	100	100	-	131	100	99
AD36P1 0.107	363	498	478	488	462	703	626	310	459	453	588	507	708	546	746	533	530	408	437	788	582	594	462	628	508	578	631	462	423	461	352	428	411	516	-	519	541	481	-	717	582	526
AD36E 0.119	120	167	160	171	158	240	214	107	160	150	189	178	240	178	281	174	173	134	147	262	194	196	165	209	167	197	207	165	143	153	117	141	136	172	-	170	178	178	-	252	177	236
AD36S 0.037	67	94	90	96	89	132	121	60	90	85	106	100	132	100	147	98	97	75	82	147	109	110	93	118	94	111	118	93	80	88	68	80	77	97	-	96	100	100	-	131	100	99
A. N. 2 0.019	31	43	42	44	41	62	56	28	42	39	49	46	62	46	68	45	45	35	38	68	50	51	43	54	44	51	54	43	37	40	37	35	45	-	44	48	48	-	60	48	48	
A.04	1.72	1.398	672	1.114	473	950	1.883	890	1.584	1.087	940	1.430	1.672	1.122	1.649	851	1.115	1.812	814	1.889	1.121	548	1.116	805	1.855	493	1.302	1.281	1.816	806	931	788	1.405	1.403	-	1.873	1.957	1.072	-	1.289	887	1.204
Total	38.778	56.889	78.432	78.746	76.481	128.286	123.821	60.763	128.699	109.681	137.633	128.499	188.139	133.234	181.131	180.021	131.276	87.487	133.119	181.033	131.633	78.033	96.389	78.113	89.089	96.183	76.544	64.651	76.211	54.469	63.344	63.618	79.808	-	79.033	89.343	77.242	-	208.198	181.708	81.295	

		Table C - Coordinates																																										
		Years Sub-Surface Infiltration Volume (m³)																																										
Node	Area	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	Average	
AD03B	0.039	11	34	34	27	31	30	33	30	23	33	32	33	33	30	31	32	21	32	31	32	32	33	30	31	31	32	34	22	33	26	29	29	30	-	34	30	32	-	31	32	30		
AD03C	0.111	38	114	113	91	103	103	103	100	77	111	107	109	110	109	101	104	106	79	106	103	108	108	111	100	110	105	102	114	73	110	87	97	97	100	-	114	100	108	-	105	107	101	
AD03N	0.156	83	160	159	128	145	141	154	140	108	155	150	153	155	142	146	149	98	149	145	150	152	156	140	155	147	142	160	103	154	122	136	136	140	-	161	140	152	-	147	150	142		
AD03R	0.127	104	261	259	237	248	237	249	204	264	201	254	248	251	250	232	258	254	278	203	238	248	250	254	238	253	244	238	209	285	261	271	235	265	240	-	265	246	253	-	242	244	230	
AD05E	0.051	30	60	69	72	81	79	86	78	61	87	84	86	87	86	80	82	83	55	83	82	85	85	86	78	87	83	80	90	57	86	68	77	76	79	-	90	79	86	-	83	85	80	
AD05I	0.064	19	56	56	45	51	49	54	49	38	54	54	52	53	54	50	51	52	34	52	51	53	53	55	49	54	51	50	56	36	54	43	48	47	49	-	56	49	53	-	52	53	50	
AD05N	0.043	15	44	44	35	40	39	42	39	30	43	41	42	43	42	39	40	41	27	41	40	42	42	43	39	43	41	39	44	28	43	34	38	37	39	-	44	39	42	-	41	41	39	
AD05R	0.028	10	29	29	23	26	25	26	25	19	28	27	28	28	26	26	26	27	18	27	26	27	27	27	28	25	28	26	26	20	19	28	22	24	24	25	-	29	25	27	-	26	27	25
AD05N	0.054	18	55	55	44	50	49	53	49	37	54	52	53	54	53	49	51	51	34	52	50	52	53	54	49	54	51	49	56	36	53	42	47	47	49	-	56	49	53	-	51	52	49	
AD05R	0.034	12	35	35	28	32	31	34	31	24	34	33	33	34	33	31	32	32	21	33	32	33	33	34	31	34	32	31	35	22	34	27	30	30	31	-	35	31	33	-	32	33	31	
AD05B	0.054	18	55	55	44	50	49	53	49	37	54	52	53	54	53	49	51	51	34	52	50	52	53	54	49	54	51	49	56	36	53	42	47	47	49	-	56	49	53	-	51	52	49	
AD05C	0.12	41	122	122	99	112	108	110	108	83	120	115	118	119	119	109	112	114	76	115	112	117	117	120	108	119	113	110	123	79	119	94	105	105	108	-	124	108	117	-	113	116	109	
AD05N	0.067	23	69	68	55	62	60	66	60	47	67	64	66	66	61	63	64	42	64	62	65	65	67	60	67	63	61	69	44	66	53	58	58	60	-	69	60	65	-	63	65	61		
AD05R	0.107	64	220	216	213	208	193	209	222	167	212	213	209	211	209	195	216	213	157	213	199	207	210	213	200	211	201	196	217	204	214	206	196	197	193	-	217	192	207	-	201	205	209	
AD05C	0.139	40	122	121	98	111	107	117	107	83	119	114	117	118	117	108	111	113	75	114	111	116	116	119	107	118	112	109	122	79	118	90	104	104	107	-	123	107	116	-	112	115	108	
AD05B	0.067	23	69	68	55	62	60	66	60	47	67	64	66	66	61	63	64	42	64	62	65	65	67	60	67	63	61	69	44	66	53	58	58	60	-	69	60	65	-	63	65	61		
A - N Z	0.019	11	32	32	26	29	28	31	28	22	30	30	31	31	31	29	29	30	20	30	29	30	30	31	28	31	29	29	32	30	31	24	27	27	28	-	32	28	30	-	29	30	28	
A104	1.72	1,023	302	308	250	275	501	888	523	856	579	497	739	893	592	871	449	589	956	430	867	592	288	599	425	979	260	688	678	959	426	491	406	742	788	-	989	1,033	596	-	670	468	636	
Total	38,778	30,729	40,039	44,354	42,884	42,667	41,313	43,346	44,036	42,106	43,811	43,763	43,755	44,363	43,661	43,302	44,243	43,893	42,761	44,633	43,234	43,423	43,380	44,440	43,236	44,408	43,112	43,831	45,331	45,166	44,624	44,571	42,749	44,543	43,961	-	46,739	42,697	43,543	-	41,536	42,731	42,511	

Kevin Murphy

From: Shillington, Jeffrey <jeff.shillington@ottawa.ca>
Sent: Monday, June 22, 2020 3:50 PM
To: Kevin Murphy
Cc: Steve Pichette; Zeyad Hassan; Bougadis, John; Zaknoun, Hasnaa
Subject: RE: Information on Smart Covers

Kevin,

Thanks for the Figure showing proposed locations for the smart covers. The proposed locations are acceptable, subject to final locations of the EES system itself.

Regards,

Jeff Shillington, P.Eng.
Senior Project Manager, Development Review, South Branch
Planning, Infrastructure and Economic Development
City of Ottawa
tel: 580-2424 x 16960
email: jeff.shillington@ottawa.ca

From: Kevin Murphy <KMurphy@dsel.ca>
Sent: June 10, 2020 9:27 AM
To: Shillington, Jeffrey <jeff.shillington@ottawa.ca>
Cc: Steve Pichette <SPichette@dsel.ca>; Zeyad Hassan <zeyad.hassan@caivan.com>
Subject: RE: Information on Smart Covers

CAUTION: This email originated from an External Sender. Please do not click links or open attachments unless you recognize the source.

ATTENTION : Ce courriel provient d'un expéditeur externe. Ne cliquez sur aucun lien et n'ouvrez pas de pièce jointe, excepté si vous connaissez l'expéditeur.

Good morning Jeff,

Please see the attached Figure for the identification of proposed future monitoring locations for the EES system within The Ridge development.

The proposed locations are indicated on the 'Figure 2' from the JFSA LID report.

Based on the text from the MSS it appears that the monitoring systems are to be spread throughout the development as much as possible to capture any differences in soil infiltration throughout the site. In alignment with the MSS, we have selected two (2) EES locations in the upstream portion of the development two (2) at the downstream extent and one midway. Unlike to Minto development, there were no precise details in the MSS of where to locate the monitoring locations within The Ridge development area.

Can you please advise if the locations are acceptable?

Kevin

DSEL

david schaeffer engineering ltd.

phone: (613) 836-0856 ext.563

cell: (613) 324-8361

email: kmurphy@DSEL.ca

From: Matthew Nicolak [<mailto:matthew@linkut.ca>]

Sent: Friday, May 22, 2020 1:22 PM

To: Shillington, Jeffrey <jeff.shillington@ottawa.ca>

Cc: Kevin Murphy <KMurphy@dsel.ca>

Subject: RE: Information on Smart Covers

No problem Jeff.

I'm not sure that we have done anything for Quinn's Pointe Subdivision (unless it is named something different for us). We did install 4 systems this week in Stittsville for J.L. Richards as a capacity analysis downstream of a new sewage pump station. It is for a developer as well. Could that be the one?

Matthew

From: Shillington, Jeffrey <jeff.shillington@ottawa.ca>

Sent: May 22, 2020 1:00 PM

To: Matthew Nicolak <matthew@linkut.ca>

Cc: Kevin Murphy <kmurphy@dsel.ca>

Subject: RE: Information on Smart Covers

Thanks for the quick response and info Matthew!

Can you advise what you are providing the City of Ottawa on the Quinn's Pointe Subdivision, let me know if you need more information.

The proposed subdivision is just northwest of Quinn's Pointe and we would be looking for the same type of information.

Jeff Shillington, P.Eng.

Senior Project Manager, Development Review, South Branch

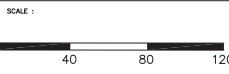
Planning, Infrastructure and Economic Development


City of Ottawa

tel: 580-2424 x 16960

email: jeff.shillington@ottawa.ca

LEGEND:
 Etobicoke Exfiltration System
 Potential EES monitoring Locations



 J.F. Sabourin & Associates Inc.
 WATER RESOURCES AND ENVIRONMENTAL CONSULTANTS
 OTTAWA (613) 836-3884
 GATINEAU (819) 243-6558

CLIENT : DAVID SCHAEFFER ENGINEERING LTD.

PROJECT : THE RIDGE PHASE 1 SUBDIVISION

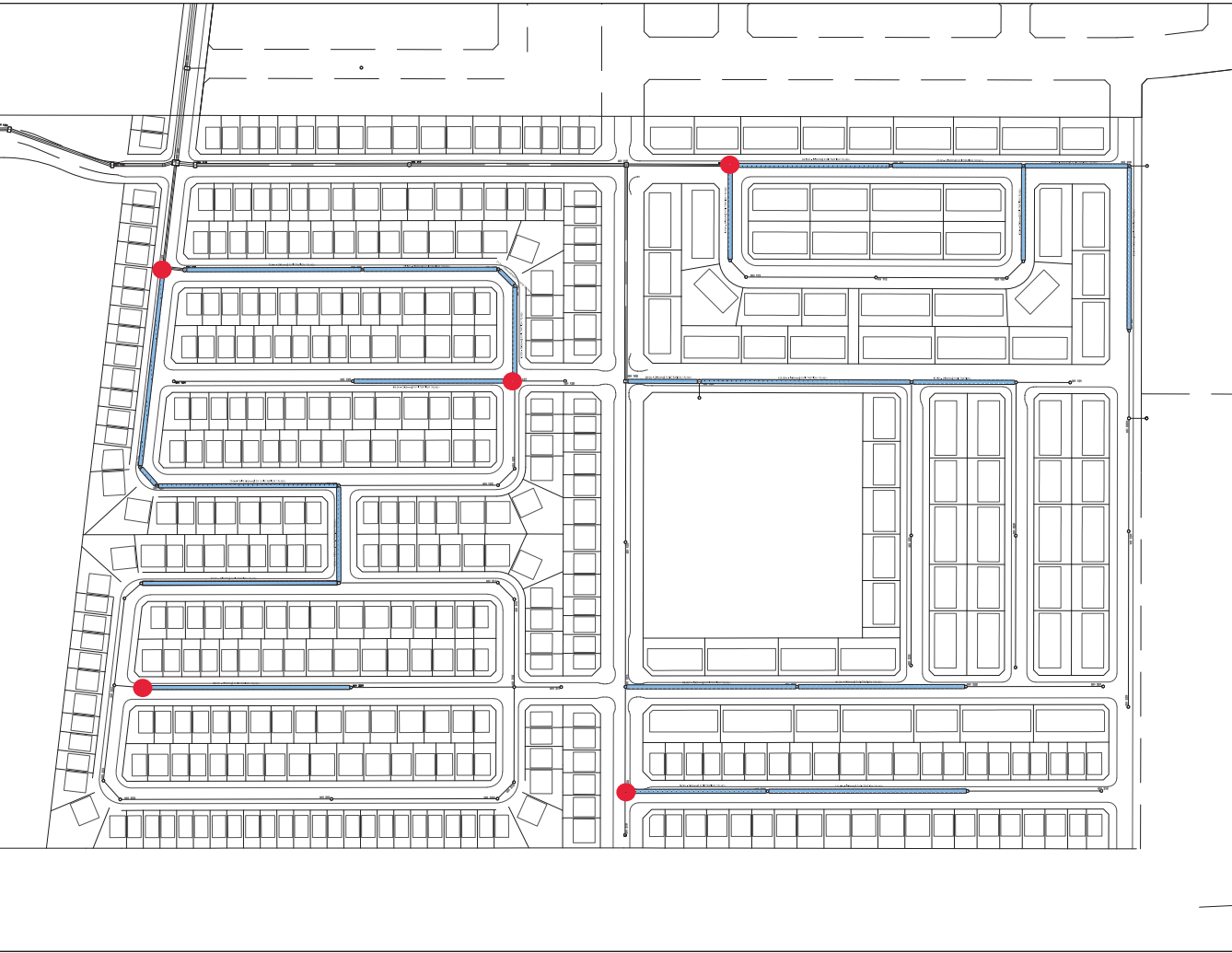
BY	DATE	DESCRIPTION	BY

EXFILTRATION SYSTEM LOCATIONS

FIGURE 2

DESIGNED:	PROJECT No.
BL	1800
VERIFIED: JFS	
APPROVED: JFS	
DATE	
JAN 2020	

DRAWING REF.: 1800-19-202001 L10 Subm3\ Design\CAO\Figure 1 & 2.dwg



STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
 Collector Roads Return Frequency = 5 years
 Arterial Roads Return Frequency = 10 years



LOCATION		AREA (Ha)												FLOW					SEWER DATA													
Location	From Node	To Node	2 YEAR		5 YEAR		10 YEAR		100 YEAR		Time of Conc.	Intensity 2 Year	Intensity 5 Year	Intensity 10 Year	Intensity 100 Year	Peak Flow Q (l/s)	DIA (mm) (actual)	DIA (mm) (nominal)	TYPE	SLOPE (%)	LENGTH (m)	CAPACITY (l/s)	VELOCITY (m/s)	TIME OF TRAVEL (min)	RATIO Q/Q Full							
			AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC														
	205	206	0.25	0.71	0.49	2.22			0.00	0.00					0.00	0.00	13.78	64.80	87.71	102.74	150.07	144	525	525	CONC	0.20	16.0	192.3	0.89	0.30	0.75	
To Appalachian Circle, Pipe 206 - 207																																
Appalachian Circle																																
	209	210			0.00	0.00			0.00	0.00					0.00	0.00	10.00	76.81	104.19	122.14	178.56	0	300	300	PVC	2.40	13.0	149.8	2.12	0.10	0.00	
	210	212	0.20	0.71	0.39	0.39			0.00	0.00					0.00	0.00	10.10	76.41	103.66	121.51	177.63	30	300	300	PVC	3.90	54.0	188.5	2.67	0.34	0.16	
Contribution From Rugosa Street, Pipe 211 - 212																																
	212	213			0.00	0.79			0.00	0.00					0.00	0.00	10.55	74.77	101.40	118.85	173.72	59	375	375	PVC	0.45	49.5	117.6	1.06	0.77	0.50	
	213	214	0.12	0.71	0.24	1.02			0.00	0.00					0.00	0.00	11.32	72.06	97.70	114.49	167.53	74	375	375	PVC	1.00	13.5	175.3	1.59	0.14	0.42	
	214	215	0.44	0.71	0.87	2.43			0.00	0.00					0.00	0.00	11.46	71.61	97.06	113.74	166.21	174	375	375	PVC	2.35	90.0	268.8	2.43	0.62	0.65	
To Foundation Lane, Pipe 215 - 119																																
	209	201			0.07	0.54	0.11	0.11		0.00	0.00				0.00	0.00	10.00	76.81	104.19	122.14	178.56	46	300	300	PVC	0.55	94.0	71.7	1.01	1.54	0.64	
	201	202	0.37	0.71	0.73	1.48			0.00	0.00					0.00	0.00	11.54	71.34	96.69	113.30	165.58	106	375	375	PVC	0.90	119.5	166.3	1.51	1.32	0.63	
	202	203			0.00	1.48			0.00	0.00					0.00	0.00	12.87	67.31	91.15	106.78	156.00	100	450	450	CONC	0.20	14.0	127.5	0.80	0.29	0.78	
	203	206	0.20	0.71	0.39	2.17			0.00	0.00					0.00	0.00	13.16	66.49	90.02	105.46	154.06	145	450	450	CONC	0.45	54.5	191.3	1.20	0.76	0.76	
Contribution From Rugosa Street, Pipe 205 - 206																																
	206	207	0.08	0.54	0.12	4.51			0.00	0.00					0.00	0.00	14.08	64.03	86.65	101.49	148.23	306	600	600	CONC	0.40	49.5	388.3	1.37	0.60	0.79	
	207	208	0.14	0.71	0.28	4.79			0.00	0.00					0.00	0.00	14.68	62.53	84.60	99.08	144.69	299	600	600	CONC	1.90	12.5	846.4	2.99	0.07	0.35	
	208	215	0.12	0.54	0.18	4.97			0.00	0.00					0.00	0.00	14.75	62.36	84.37	98.81	144.30	349	600	600	CONC	1.90	112.0	846.4	2.99	0.62	0.41	
To Foundation Lane, Pipe 215 - 119																																
Foundation Lane																																
	Contribution From Appalachian Circle, Pipe 208 - 215				5.60				0.00	0.00					0.00	0.00	15.37															
	Contribution From Appalachian Circle, Pipe 214 - 215				2.43				0.00	0.00					0.00	0.00	12.08															
	215	119	0.20	0.71	0.39	8.42			0.00	0.00					0.00	0.00	15.37	60.90	82.37	96.45	140.84	513	675	675	CONC	1.60	55.0	1063.3	2.97	0.31	0.48	
To Travertine Way, Pipe 119 - 120																																
Travertine Way																																
	119	122	0.15	0.54	0.23	0.23			0.00	0.00					0.00	0.00	10.00	76.81	104.19	122.14	178.56	49	300	300	PVC	0.55	90.0	71.7	1.01	1.48	0.69	
	122	123	0.29	0.54	0.44	1.33			0.00	0.00					0.00	0.00	11.48	71.56	96.98	113.65	166.09	95	300	300	PVC	1.55	13.0	120.4	1.70	0.13	0.79	
	123	127			0.00	1.33			0.00	0.00					0.00	0.00	11.61	71.14	96.41	112.98	165.10	95	300	300	PVC	1.60	49.5	122.3	1.73	0.46	0.77	
To Montology Way, Pipe 127 - 128																																
Contribution From Foundation Lane, Pipe 215 - 119																																
	119	120	0.21	0.71	0.41	8.64			0.00	0.00					0.00	0.00	15.68	60.20	81.41	95.33	139.19	567	900	900	CONC	0.20	103.0	899.6	1.27	1.35	0.70	
	120	121			0.00	9.42			0.00	0.00					0.00	0.00	17.03	57.35	77.52	90.75	132.48	540	900	900	CONC	0.20	14.0	899.6	1.27	0.18	0.67	
	121	132	0.21	0.54	0.32	9.74			0.00	0.00					0.00	0.00	17.22	56.99	77.02	90.17	131.62	613	900	900	CONC	1.10	114.0	1898.7	2.98	0.64	0.32	
Contribution From Montology Way, Pipe 131 - 132																																
	132	136	0.52	0.71	1.03	10.77			0.00	0.06					0.00	0.00	17.15															
	136	138	0.42	0.54	0.63	17.85			0.00	0.06					0.00	0.00	17.85	55.76	75.35	88.20	128.73	1000	1200	1200	CONC	0.20	59.5	1743.6	1.54	0.64	0.57	
To Expansion Road, Pipe 138 - 302																																
Focally Crescent																																
	107	108			0.00	0.00			0.00	0.00					0.00	0.00	10.00	76.81	104.19	122.14	178.56	0	300	300	PVC	0.65	13.0	78.0	1.10	0.20	0.00	
	108	110	0.34	0.58	0.55	1.11			0.00	0.00					0.00	0.00	10.20	76.06	103.17	120.93	178.78	84	450	450	CONC	0.20	54.0	127.5	0.80	1.12	0.66	
To Halku Street, Pipe 110 - 111																																

Definitions:
 Q = 2.78 AIR, where
 Q = Peak Flow in Litres per second (L/s)
 A = Areas in hectares (ha)
 I = Rainfall Intensity (mm/h)
 R = Runoff Coefficient

Notes:
 1) Ottawa Rainfall-Intensity Curve
 2) Min. Velocity = 0.80 m/s

Designed: SLM
 Checked: ADF
 Dwg. Reference: Storm Drainage Plan 83-86

PROJECT: Cavan Communities - Brazeau Phase 1
 LOCATION: City of Ottawa
 File Ref: 18-1010 Date: 27-Jul-20 Sheet No: 2 OF 6



STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Arterial Roads Return Frequency = 10 years

Table with columns for LOCATION, AREA (Ha), FLOW (Intensity, Peak Flow, Q), and SEWER DATA (DIA, SLOPE, LENGTH, CAPACITY, VELOCITY, TIME OF RATIO). Rows include Surface Lane, Chilterton Drive, Epoch Street, and Elevation Road.

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Area in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Velocity = 0.80 m/s

Design: SLM
Checked: ADF
Proj. Reference: Storm Drainage Plan 83-86
PROJECT: Clavan Communities - Brazeau Phase 1
LOCATION: City of Ottawa
File Ref: 18-1010
Date: 27-Jul-20
Sheet No: 4 OF 6

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
 Collector Roads Return Frequency = 5 years
 Arterial Roads Return Frequency = 10 years



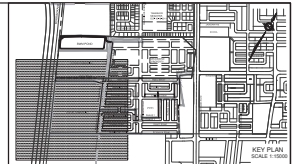
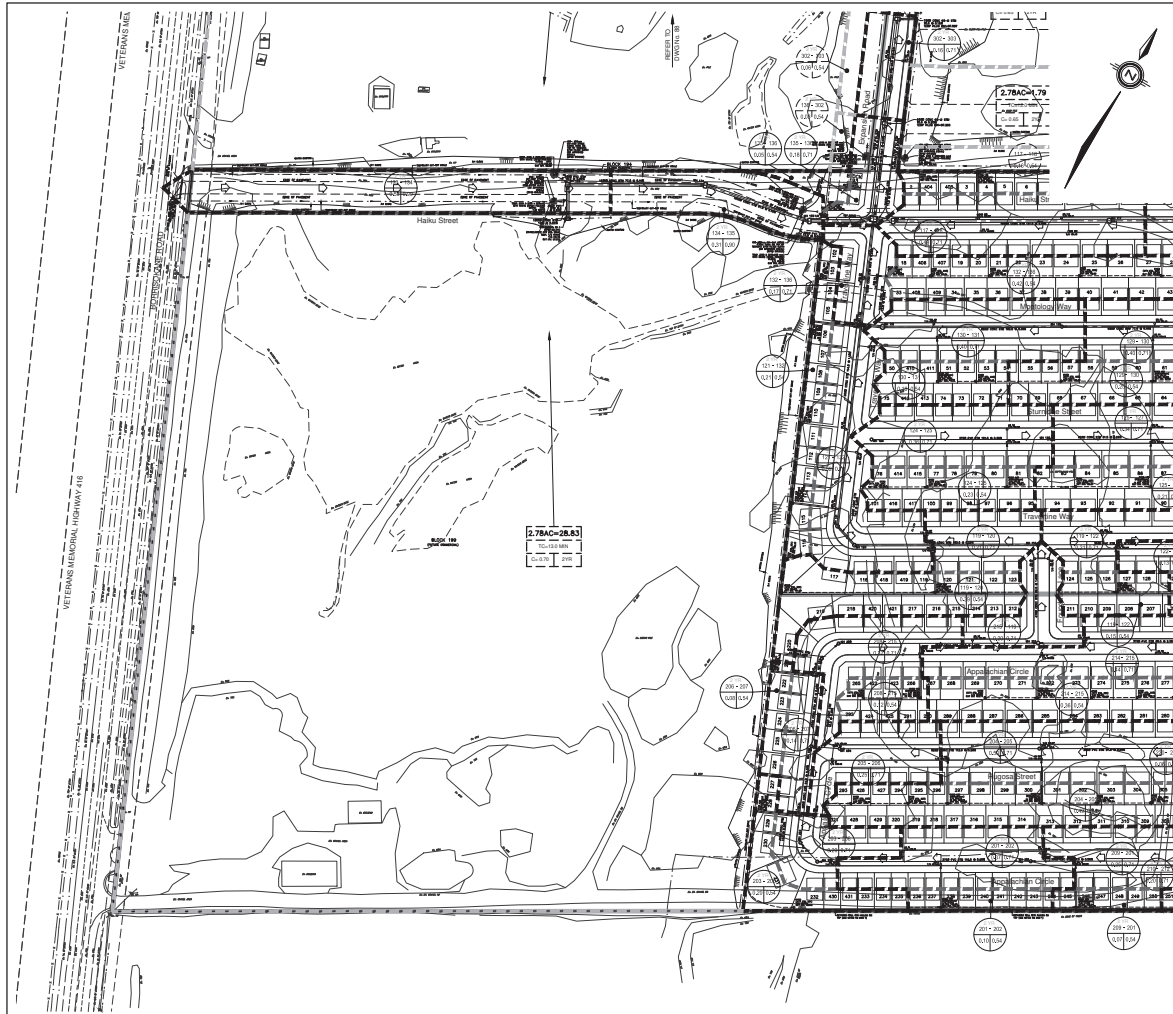
LOCATION		AREA (Ha)												FLOW					SEWER DATA											
Location	From Node	To Node	2 YEAR				5 YEAR				10 YEAR				Time of Conc. (min)	Intensity 2 Year (mm/h)	Intensity 5 Year (mm/h)	Intensity 10 Year (mm/h)	Intensity 100 Year (mm/h)	Peak Flow Q (l/s)	DIA. (mm) (actual)	DIA. (mm) (nominal)	TYPE	SLOPE (%)	LENGTH (m)	CAPACITY (l/s)	VELOCITY (m/s)	TIME OF FLOW (min)	RATIO	
			AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC																AREA (Ha)
Contribution From Expansion Road, Pipe 306TEE - 306TEE																														
	306TEE	307	0.18	0.71	0.36	89.08			0.00	6.21			0.00	0.00	0.00	23.16	47.45	64.01	74.88	109.20	4624	2250	2250	CONC	0.10	13.0	6590.6	1.66	0.13	0.70
	307	400			0.00	89.08			0.00	6.21			0.00	0.00	0.00	23.29	47.28	63.78	74.61	108.80	4608	2250	2250	CONC	0.10	23.5	6590.6	1.66	0.24	0.70
ABIC PROPERTY																														
	400	HW401			0.00	89.08			0.00	6.21			0.00	0.00	0.00	23.52	46.98	63.36	74.12	108.09	4788	2250	2250	CONC	0.10	15.5	6590.6	1.66	0.16	0.73
POND OUTLET - CONSTANT FLOW RATE 1300 L/S																														
	HW OUT	1002	0.00	0.00	0.00	0.00			0.00	0.00			0.00	0.00	0.00	10.00	76.81	104.19	122.14	178.58	1300	900	900	CONC	0.60	7.5	1402.3	2.20	0.08	0.93
	1002	1003			0.00	0.00			0.00	0.00			0.00	0.00	0.00	10.06	76.59	103.89	121.79	178.04	1300	900	900	CONC	0.60	28.0	1402.3	2.20	0.21	0.93
To BORRISOKANE - 190, Pipe 1003 - 1004																														
BORRISOKANE ROAD - CONSTANT FLOW RATE 1300 L/S																														
Contribution From POND OUTLET - 192, Pipe 1002 - 1003																														
	1003	1004			0.00	0.00			0.00	0.00			0.00	0.00	0.00	10.27	75.79	102.80	120.50	176.14	1300	900	900	CONC	0.60	108.5	1402.3	2.20	0.82	0.93
	1004	1005			0.00	0.00			0.00	0.00			0.00	0.00	0.00	11.09	72.86	98.77	115.76	169.18	1300	975	975	CONC	0.40	106.0	1417.4	1.90	0.83	0.92
	1005	1006			0.00	0.00			0.00	0.00			0.00	0.00	0.00	12.02	69.83	94.61	110.86	161.99	1300	1200	1200	CONC	0.20	106.0	1743.6	1.54	1.15	0.75
	1006	1007			0.00	0.00			0.00	0.00			0.00	0.00	0.00	13.17	66.47	89.99	105.42	154.01	1300	1200	1200	CONC	0.20	106.0	1743.6	1.54	1.15	0.75
	1007	1008			0.00	0.00			0.00	0.00			0.00	0.00	0.00	14.31	63.44	85.85	100.55	146.85	1300	1200	1200	CONC	0.20	88.0	1743.6	1.54	0.95	0.75
	1008	HW1009			0.00	0.00			0.00	0.00			0.00	0.00	0.00	15.26	61.15	82.72	96.68	141.48	1300	1200	1200	CONC	0.20	14.6	1743.6	1.54	0.16	0.75

Definitions:
 Q = 2.78 AIR, where
 Q = Peak Flow in Litres per second (L/s)
 A = Areas in hectares (ha)
 I = Rainfall Intensity (mm/h)
 R = Runoff Coefficient

Notes:
 1) Ottawa Rainfall-Intensity Curve
 2) Mn. Velocity = 0.80 m/s

Design: SLM
 Checked: ADF
 Dwg. Reference: Storm Drainage Plan 83-86

PROJECT: Clavan Communities - Brazeau Phase 1
 LOCATION: City of Ottawa
 File Ref: 18-1010 Date: 27-Jul-20 Sheet No. 6 OF 6



LEGEND

STORM DRAINAGE BOUNDARY	---
STORM DRAINAGE BOUNDARY (OTHER PHASE)	---
STORM FREQUENCY	---
UPSTREAM MH TO DOWNSTREAM MH	---
AREA IN HECTARES	---
RUNOFF COEFFICIENT	---
EXTERNAL 2/8AC =	2.78AC=14.40
EXTERNAL TIME OF CONCENTRATION	---
EXTERNAL STORM FREQUENCY	---
STORM FREQUENCY (OTHER PHASE)	---
UPSTREAM MH TO DOWNSTREAM MH (OTHER PHASE)	---
AREA IN HECTARES (OTHER PHASE)	---
RUNOFF COEFFICIENT (OTHER PHASE)	---
STREET CATCHBAIN & LEAD	---
STREET CATCHBAIN WITH MAINTENANCE HOLE	---
CURB INLET CATCHBAIN & LEAD	---
CATCHBAIN MAINTENANCE HOLE	---
INTERCONNECTED CATCH BAIN & LEADS	---
CON	---
OVERLAND FLOW DIRECTION	---
EXTERNAL OVERLAND FLOW DIRECTION	---
EMERGENCY OVERLAND FLOW DIRECTION	---

NOT FOR CONSTRUCTION

1	A.S.F.	20-21-27th SUBMISSION
2	A.S.F.	20-22-28th SUBMISSION
3	A.S.F.	20-24-29th SUBMISSION
4	A.S.F.	19-23-23rd SUBMISSION
5	A.S.F.	19-24-24th SUBMISSION
6	A.S.F.	19-25-25th SUBMISSION
7	A.S.F.	19-26-26th SUBMISSION
8	A.S.F.	19-27-27th SUBMISSION
9	A.S.F.	19-28-28th SUBMISSION
10	A.S.F.	19-29-29th SUBMISSION
11	A.S.F.	19-30-30th SUBMISSION
12	A.S.F.	19-31-31st SUBMISSION
13	A.S.F.	19-32-32nd SUBMISSION
14	A.S.F.	19-33-33rd SUBMISSION
15	A.S.F.	19-34-34th SUBMISSION
16	A.S.F.	19-35-35th SUBMISSION
17	A.S.F.	19-36-36th SUBMISSION
18	A.S.F.	19-37-37th SUBMISSION
19	A.S.F.	19-38-38th SUBMISSION
20	A.S.F.	19-39-39th SUBMISSION
21	A.S.F.	19-40-40th SUBMISSION
22	A.S.F.	19-41-41st SUBMISSION
23	A.S.F.	19-42-42nd SUBMISSION
24	A.S.F.	19-43-43rd SUBMISSION
25	A.S.F.	19-44-44th SUBMISSION
26	A.S.F.	19-45-45th SUBMISSION
27	A.S.F.	19-46-46th SUBMISSION
28	A.S.F.	19-47-47th SUBMISSION
29	A.S.F.	19-48-48th SUBMISSION
30	A.S.F.	19-49-49th SUBMISSION
31	A.S.F.	19-50-50th SUBMISSION
32	A.S.F.	19-51-51st SUBMISSION
33	A.S.F.	19-52-52nd SUBMISSION
34	A.S.F.	19-53-53rd SUBMISSION
35	A.S.F.	19-54-54th SUBMISSION
36	A.S.F.	19-55-55th SUBMISSION
37	A.S.F.	19-56-56th SUBMISSION
38	A.S.F.	19-57-57th SUBMISSION
39	A.S.F.	19-58-58th SUBMISSION
40	A.S.F.	19-59-59th SUBMISSION
41	A.S.F.	19-60-60th SUBMISSION
42	A.S.F.	19-61-61st SUBMISSION
43	A.S.F.	19-62-62nd SUBMISSION
44	A.S.F.	19-63-63rd SUBMISSION
45	A.S.F.	19-64-64th SUBMISSION
46	A.S.F.	19-65-65th SUBMISSION
47	A.S.F.	19-66-66th SUBMISSION
48	A.S.F.	19-67-67th SUBMISSION
49	A.S.F.	19-68-68th SUBMISSION
50	A.S.F.	19-69-69th SUBMISSION
51	A.S.F.	19-70-70th SUBMISSION
52	A.S.F.	19-71-71st SUBMISSION
53	A.S.F.	19-72-72nd SUBMISSION
54	A.S.F.	19-73-73rd SUBMISSION
55	A.S.F.	19-74-74th SUBMISSION
56	A.S.F.	19-75-75th SUBMISSION
57	A.S.F.	19-76-76th SUBMISSION
58	A.S.F.	19-77-77th SUBMISSION
59	A.S.F.	19-78-78th SUBMISSION
60	A.S.F.	19-79-79th SUBMISSION
61	A.S.F.	19-80-80th SUBMISSION
62	A.S.F.	19-81-81st SUBMISSION
63	A.S.F.	19-82-82nd SUBMISSION
64	A.S.F.	19-83-83rd SUBMISSION
65	A.S.F.	19-84-84th SUBMISSION
66	A.S.F.	19-85-85th SUBMISSION
67	A.S.F.	19-86-86th SUBMISSION
68	A.S.F.	19-87-87th SUBMISSION
69	A.S.F.	19-88-88th SUBMISSION
70	A.S.F.	19-89-89th SUBMISSION
71	A.S.F.	19-90-90th SUBMISSION
72	A.S.F.	19-91-91st SUBMISSION
73	A.S.F.	19-92-92nd SUBMISSION
74	A.S.F.	19-93-93rd SUBMISSION
75	A.S.F.	19-94-94th SUBMISSION
76	A.S.F.	19-95-95th SUBMISSION
77	A.S.F.	19-96-96th SUBMISSION
78	A.S.F.	19-97-97th SUBMISSION
79	A.S.F.	19-98-98th SUBMISSION
80	A.S.F.	19-99-99th SUBMISSION
81	A.S.F.	19-100-100th SUBMISSION

TOPOGRAPHIC INFORMATION
 JO BARNES LIMITED PROJECT NUMBER 18-10-145-00 SURVEY DATED JULY 26, 2019
LEGAL INFORMATION
 CALCULATED BY CAR PROVIDED BY JO BARNES LTD. PROJECT 18-10-145-00, DATED APRIL 4, 2020
 DESIGN MARK No. 00196403710
 GEOMATIC SOFTWARE, THIS PLAN AND ANY RELATED TO BEHOLDERS AND ARE DERIVED FROM THE MUNICIPALITY OF OTTAWA'S INFORMATION SYSTEMS & BUREAU OF RECORDS DIVISION OF 6/26/2019

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL 120 River Road Unit 102
 Ottawa, Ontario K2H 1G2
 Tel: (613) 838-0822
 Fax: (613) 838-7165
 www.DSEL.ca

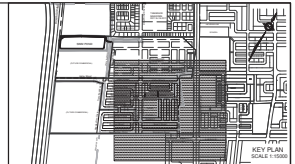
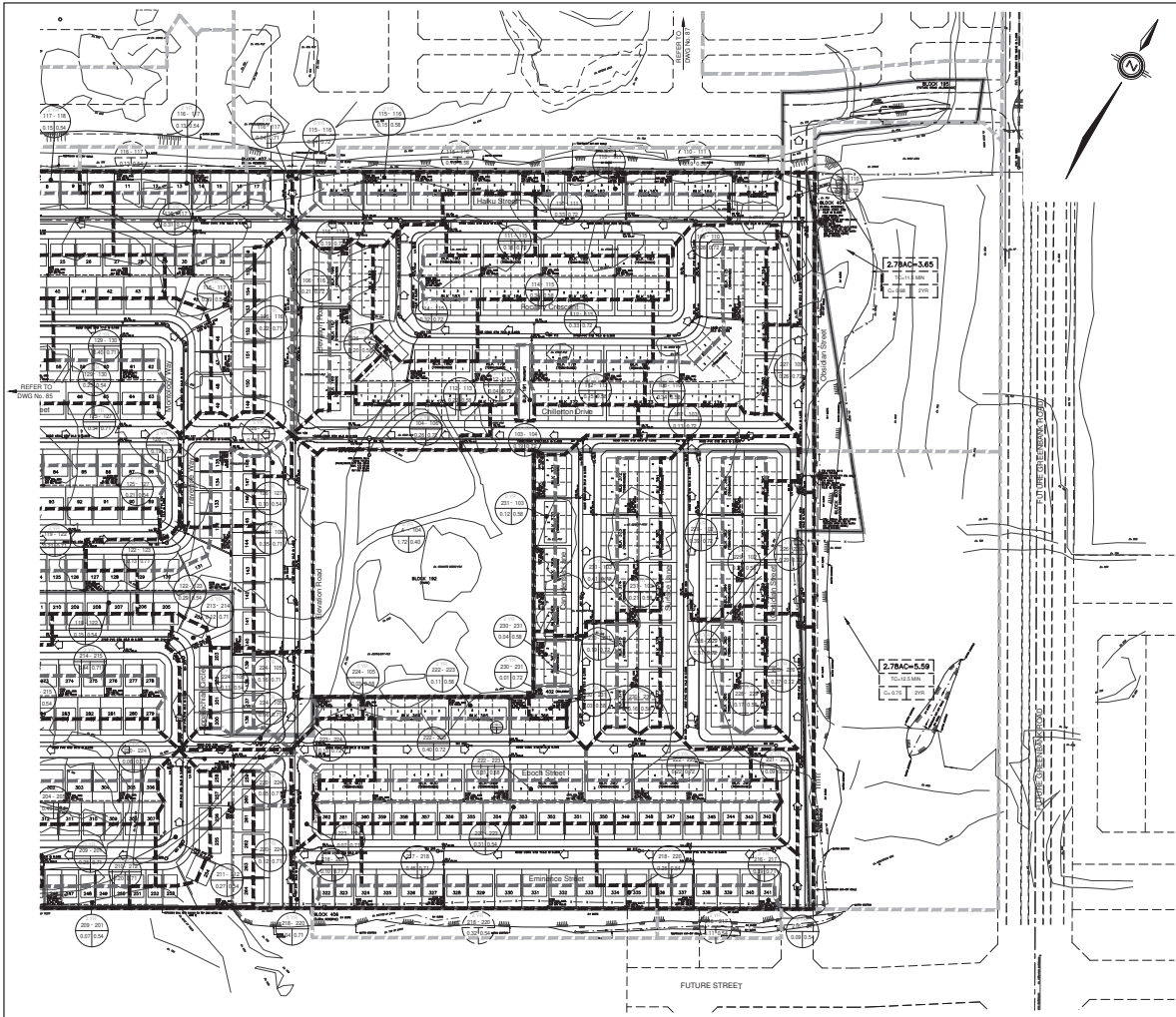
A.S.F. ENGINEERS

Ottawa CITY OF OTTAWA

STORM DRAINAGE PLAN

DRAWN BY: G.S.S.	CHECKED BY: A.S.F.	PROJECT No. 18-1030
DESIGNED BY: C.M.K.	CHECKED BY: A.S.F.	SHEET No. 85
SCALE:		
HORIZ: 1:1000		

CITY FILE No. 007-16-19-0005 CITY PLAN No. 178203



LEGEND

STORM DRAINAGE BOUNDARY	---
STORM DRAINAGE BOUNDARY (OTHER PHASE)	---
STORM FREQUENCY	---
UPSTREAM MH TO DOWNSTREAM MH	4.5' x 4.5'
AREA IN HECTARES	1:100
RAINFALL COEFFICIENT	---
EXTERNAL 2/8AC =	2.78AC=14.40
EXTERNAL TIME OF CONCENTRATION	---
EXTERNAL BUDGETED RAINFALL COEFFICIENT	---
EXTERNAL STORM FREQUENCY	---
STORM FREQUENCY (OTHER PHASE)	---
UPSTREAM MH TO DOWNSTREAM MH (OTHER PHASE)	---
AREA IN HECTARES (OTHER PHASE)	---
RAINFALL COEFFICIENT (OTHER PHASE)	---
STREET CATCHBAIN & LEAD	---
STREET CATCHBAIN WITH MAINTENANCE HOLE	---
CURB INLET CATCHBAIN & LEAD	---
CATCHBAIN MAINTENANCE HOLE	---
INTERCONNECTED CATCH BAIN & LEADS	---
CAW	---
OVERLAND FLOW DIRECTION	---
EXTERNAL OVERLAND FLOW DIRECTION	---
EMERGENCY OVERLAND FLOW DIRECTION	---

NOT FOR CONSTRUCTION

1 A.S.F. 20-27-27th SUBMISSION
 2 A.S.F. 20-28-28th SUBMISSION
 3 A.S.F. 20-29-29th SUBMISSION
 4 A.S.F. 20-30-30th SUBMISSION
 5 A.S.F. 20-31-31st SUBMISSION
 6 A.S.F. 20-32-32nd SUBMISSION
 7 A.S.F. 20-33-33rd SUBMISSION
 8 A.S.F. 20-34-34th SUBMISSION
 9 A.S.F. 20-35-35th SUBMISSION
 10 A.S.F. 20-36-36th SUBMISSION
 11 A.S.F. 20-37-37th SUBMISSION
 12 A.S.F. 20-38-38th SUBMISSION
 13 A.S.F. 20-39-39th SUBMISSION
 14 A.S.F. 20-40-40th SUBMISSION
 15 A.S.F. 20-41-41st SUBMISSION
 16 A.S.F. 20-42-42nd SUBMISSION
 17 A.S.F. 20-43-43rd SUBMISSION
 18 A.S.F. 20-44-44th SUBMISSION
 19 A.S.F. 20-45-45th SUBMISSION
 20 A.S.F. 20-46-46th SUBMISSION
 21 A.S.F. 20-47-47th SUBMISSION
 22 A.S.F. 20-48-48th SUBMISSION
 23 A.S.F. 20-49-49th SUBMISSION
 24 A.S.F. 20-50-50th SUBMISSION
 25 A.S.F. 20-51-51st SUBMISSION
 26 A.S.F. 20-52-52nd SUBMISSION
 27 A.S.F. 20-53-53rd SUBMISSION
 28 A.S.F. 20-54-54th SUBMISSION
 29 A.S.F. 20-55-55th SUBMISSION
 30 A.S.F. 20-56-56th SUBMISSION
 31 A.S.F. 20-57-57th SUBMISSION
 32 A.S.F. 20-58-58th SUBMISSION
 33 A.S.F. 20-59-59th SUBMISSION
 34 A.S.F. 20-60-60th SUBMISSION
 35 A.S.F. 20-61-61st SUBMISSION
 36 A.S.F. 20-62-62nd SUBMISSION
 37 A.S.F. 20-63-63rd SUBMISSION
 38 A.S.F. 20-64-64th SUBMISSION
 39 A.S.F. 20-65-65th SUBMISSION
 40 A.S.F. 20-66-66th SUBMISSION
 41 A.S.F. 20-67-67th SUBMISSION
 42 A.S.F. 20-68-68th SUBMISSION
 43 A.S.F. 20-69-69th SUBMISSION
 44 A.S.F. 20-70-70th SUBMISSION
 45 A.S.F. 20-71-71st SUBMISSION
 46 A.S.F. 20-72-72nd SUBMISSION
 47 A.S.F. 20-73-73rd SUBMISSION
 48 A.S.F. 20-74-74th SUBMISSION
 49 A.S.F. 20-75-75th SUBMISSION
 50 A.S.F. 20-76-76th SUBMISSION
 51 A.S.F. 20-77-77th SUBMISSION
 52 A.S.F. 20-78-78th SUBMISSION
 53 A.S.F. 20-79-79th SUBMISSION
 54 A.S.F. 20-80-80th SUBMISSION
 55 A.S.F. 20-81-81st SUBMISSION
 56 A.S.F. 20-82-82nd SUBMISSION
 57 A.S.F. 20-83-83rd SUBMISSION
 58 A.S.F. 20-84-84th SUBMISSION
 59 A.S.F. 20-85-85th SUBMISSION
 60 A.S.F. 20-86-86th SUBMISSION
 61 A.S.F. 20-87-87th SUBMISSION
 62 A.S.F. 20-88-88th SUBMISSION
 63 A.S.F. 20-89-89th SUBMISSION
 64 A.S.F. 20-90-90th SUBMISSION
 65 A.S.F. 20-91-91st SUBMISSION
 66 A.S.F. 20-92-92nd SUBMISSION
 67 A.S.F. 20-93-93rd SUBMISSION
 68 A.S.F. 20-94-94th SUBMISSION
 69 A.S.F. 20-95-95th SUBMISSION
 70 A.S.F. 20-96-96th SUBMISSION
 71 A.S.F. 20-97-97th SUBMISSION
 72 A.S.F. 20-98-98th SUBMISSION
 73 A.S.F. 20-99-99th SUBMISSION
 74 A.S.F. 20-100-100th SUBMISSION

TOPOGRAPHIC INFORMATION
 JD BARNES LIMITED PROJECT NUMBER 18-10-145-00 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
 CALCULATED BY CAW PROVIDED BY JD BARNES LTD. PROJECT 18-10-145-00, DATED APRIL 4, 2020

GENCO MARK No. 00196403710
 GENERATION NUMBER 18-10-145-00 AND ARE RELATED TO GENCO BATH AND ARE OWNED BY THE MUNICIPALITY OF OTTAWA. INFORMATION NUMBER 2 NUMBER GENERATED BY 6/10 16/20

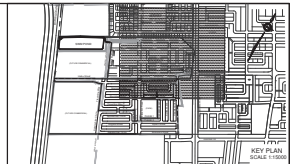
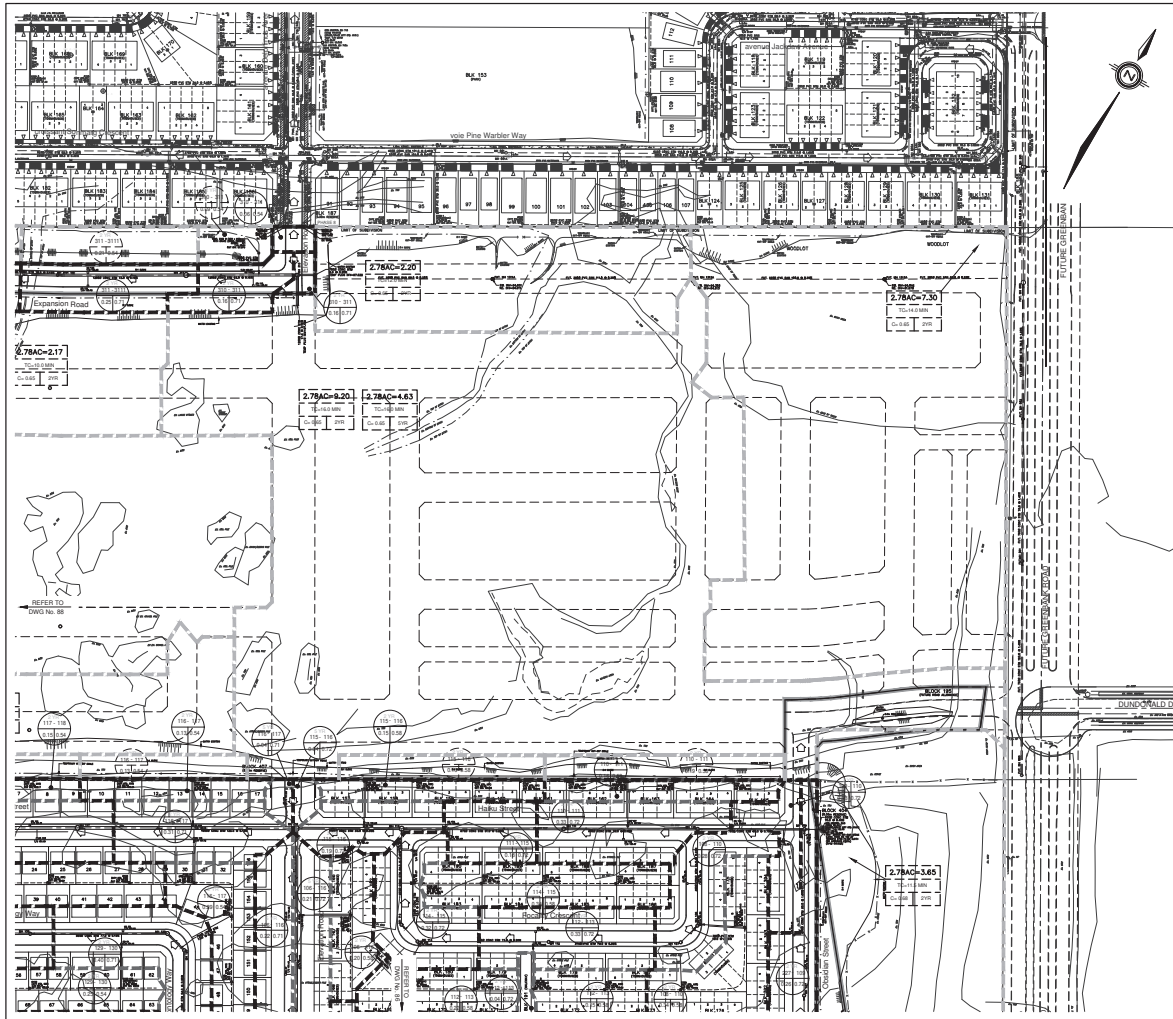
CAIVAN COMMUNITIES THE RIDGE PHASE 1
DSEL 120 Bay Road Unit 102
 Ottawa, Ontario K2G 1G2
 Tel: (613) 838-0822
 Fax: (613) 838-7182
 www.DSEL.ca
A & F FISHER ENGINEERS
 120 Bay Road Unit 102
 Ottawa, Ontario K2G 1G2
 Tel: (613) 838-0822
 Fax: (613) 838-7182
 www.AandF.ca

Ottawa CITY OF OTTAWA

STORM DRAINAGE PLAN

DRAWN BY: G.S.S.	CHECKED BY: A.S.F.	PROJECT No.:	18-1030
DESIGNED BY: G.S.S.	CHECKED BY: A.S.F.	SCALE:	1:1000
HORIZ. 1:1000			SHEET No.:
0 10 20 30 40			86

CITY FILE No. 007-16-19-0005 CITY PLANNING No. 178203



LEGEND

STORM DRAINAGE BOUNDARY	---
STORM DRAINAGE BOUNDARY (OTHER PHASES)	---
STORM FREQUENCY	---
UPSTREAM MH TO DOWNSTREAM MH	432-42
AREA IN HECTARES	---
EXTERNAL 2/3RAC =	2.78AC=14.40
EXTERNAL TIME OF CONCENTRATION	---
EXTERNAL BLENDED RUNOFF COEFFICIENT	---
EXTERNAL STORM FREQUENCY (OTHER PHASES)	---
STORM FREQUENCY (OTHER PHASES)	---
UPSTREAM MH TO DOWNSTREAM MH (OTHER PHASES)	---
AREA IN HECTARES (OTHER PHASES)	---
RUNOFF COEFFICIENT (OTHER PHASES)	---
STREET CATCHBASIN & LEAD	---
STREET CATCHBASIN WITH	---
MANHOLE & LEAD	---
CURB INLET CATCHBASIN & LEAD	---
CATCHBASIN MAINTENANCE HOLE	---
INTERCONNECTED CATCH BASIN & LEADS	---
CAN	---
OVERLAND FLOW DIRECTION	---
EXTERNAL OVERLAND FLOW DIRECTION	---
EMERGENCY OVERLAND FLOW DIRECTION	---

NOT FOR CONSTRUCTION

1	AS.F.	20-01-27 6th SUBMISSION
2	AS.F.	20-02-10 4th SUBMISSION
3	AS.F.	20-04-24 3rd SUBMISSION
4	AS.F.	19-11-20 2nd SUBMISSION
5	AS.F.	19-10-24 1ST SUBMISSION
6	DATE	DESCRIPTION

TOPOGRAPHIC INFORMATION
 JD BARNES LIMITED PROJECT NUMBER 18-10-146-00 SURVEY DATED JULY 26, 2019
LEGAL INFORMATION
 CALCULATED BY: JDB PROVIDED BY: JD BARNES LTD. PROJECT 18-10-146-00, DATED APRIL 5, 2020
 BENCH MARK No. 001196403710
 ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GCS85 DATUM AND ARE CORRECT FROM THE MUNICIPALITY OF OTTAWA'S SURVEYING DATA & PLANNING DIVISION OF 6/26/2019

CAIVAN COMMUNITIES THE RIDGE PHASE 1

120 Rue Forest Lane 103
 Ottawa, Ontario K2H 1G9
 Tel: (613) 838-0855
 Fax: (613) 838-1165
 www.DSEL.ca

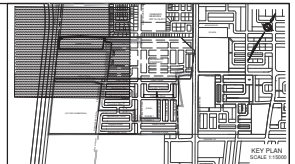
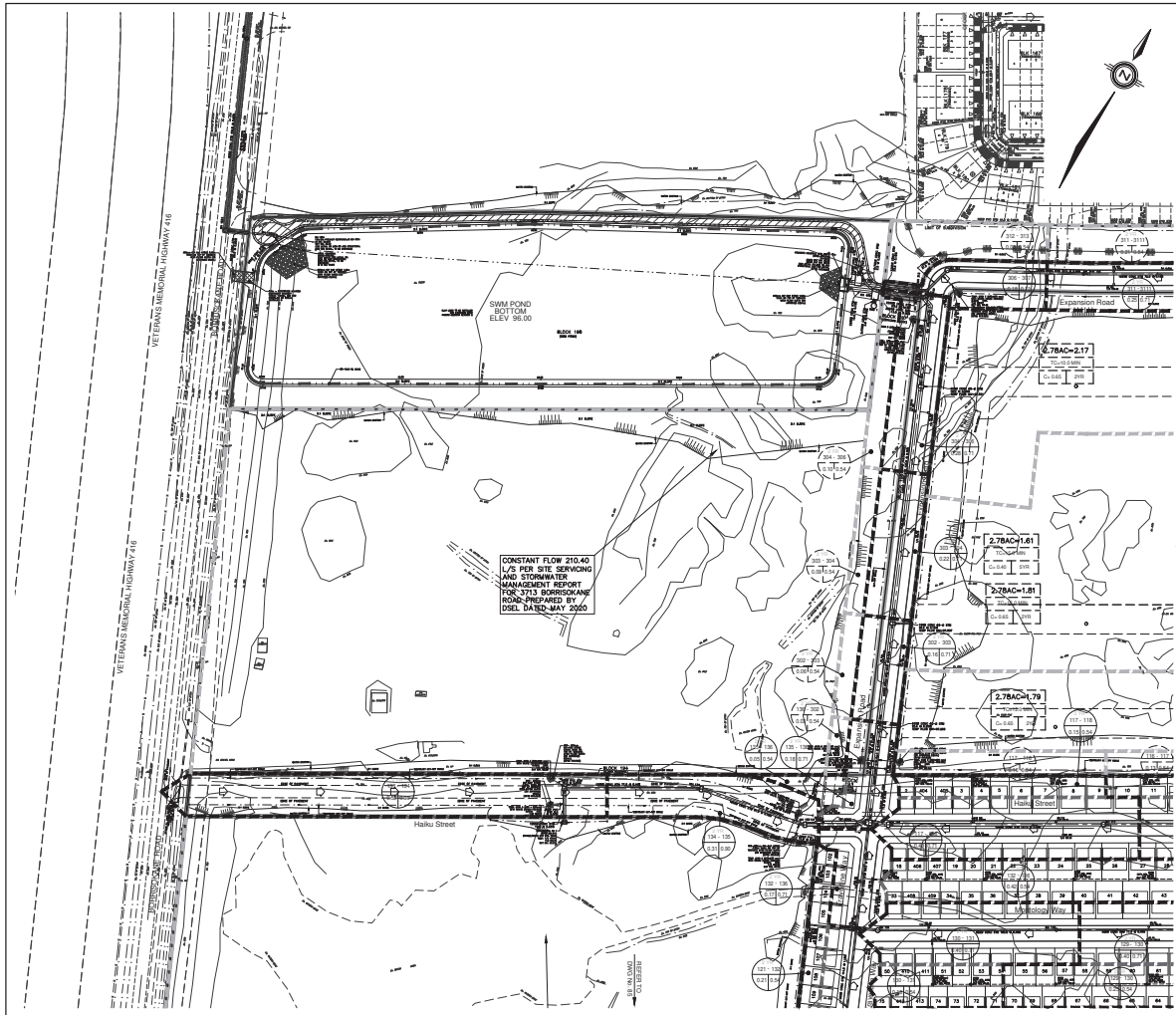
Ottawa CITY OF OTTAWA

STORM DRAINAGE PLAN

DRAWN BY: G.S.G.	CHECKED BY: A.Z.F.	PROJECT No.:
DESIGNED BY: C.M.A.	CHECKED BY: A.Z.F.	18-1030
SCALE:		SHEET No.:
		87

HORIZ. 1:1000 0 10 20 30 40

CITY PLAN No. 175933
 CITY FILE No. D07-16-19-0005



LEGEND

STORM DRAINAGE BOUNDARY	---
STORM DRAINAGE BOUNDARY (OTHER PHASES)	---
STORM FREQUENCY	---
UPSTREAM MH TO DOWNSTREAM MH	432.42
AREA IN HECTARES	2.78AC=14.40
EXTERNAL 2/3RAC =	2.78AC=14.40
EXTERNAL TIME OF CONCENTRATION	10.0
EXTERNAL BLENDED RUNOFF COEFFICIENT	0.75
EXTERNAL STORM FREQUENCY (OTHER PHASES)	10.0
STORM FREQUENCY (OTHER PHASES)	10.0
UPSTREAM MH TO DOWNSTREAM MH (OTHER PHASES)	10.0
AREA IN HECTARES (OTHER PHASES)	10.0
RUNOFF COEFFICIENT (OTHER PHASES)	0.75
STREET CATCHBASIN & LEAD	---
STREET CATCHBASIN WITH	---
MANHOLE & LEAD	---
CURB INLET CATCHBASIN & LEAD	---
CATCHBASIN MAINTENANCE TIE	---
INTERCONNECTED CATCH BASIN & LEADS	---
MANHOLE	---
OVERLAND FLOW DIRECTION	---
EXTERNAL OVERLAND FLOW DIRECTION	---
EMERGENCY OVERLAND FLOW DIRECTION	---

CONSTANT FLOW 210.40 L/S FOR SITE SERVING AND STORMWATER MANAGEMENT REPORT FOR 3713 BARRISCHANG ROAD - PREPARED BY DSEL DATED MAY 2000

REFER TO D003 TO 35

NOT FOR CONSTRUCTION

4	A.S.F.	20-21-27th SUBMISSION
5	A.S.F.	20-22-28th SUBMISSION
4	A.S.F.	20-24-24th SUBMISSION
3	A.S.F.	19-10-10th SUBMISSION
2	A.S.F.	19-10-24th SUBMISSION
NO	ST	D.S.E. DESCRIPTION

TOPOGRAPHIC INFORMATION
 D. BARNES LTD. PROJECT NUMBER 18-10-146-00 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
 DATED 18-10-146-00 SURVEY DATED JULY 26, 2019

BENCH MARK No. 001196403710
 ELEVATION SHOWN ON THIS PLAN ARE RELATED TO GROUND DATUM AND ARE DERIVED FROM THE MUNICIPALITY OF OTTAWA'S SPATIAL DATA MANAGEMENT SYSTEM (SDMS) DATUM.

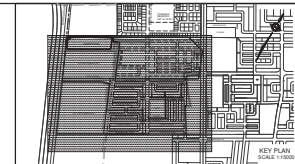
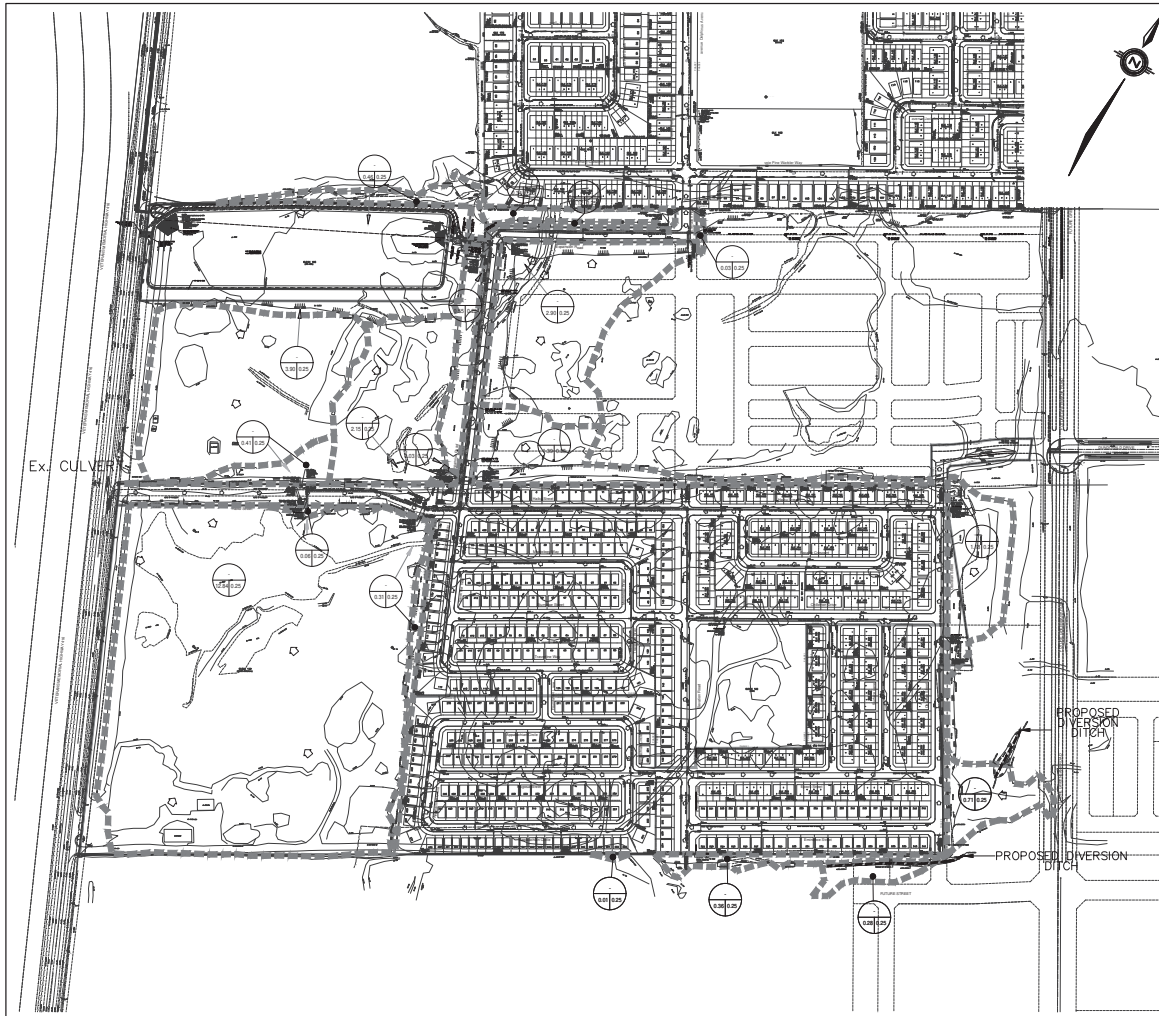
CAIVAN COMMUNITIES	THE RIDGE PHASE 1
DSEL 120 Sun Road, Unit 103 Ottawa, Ontario K2H 1S2 Tel: (613) 834-0855 Fax: (613) 834-1165 www.DSEL.ca	

Ottawa CITY OF OTTAWA

STORM DRAINAGE PLAN

DRAWN BY: G.S.G.	CHECKED BY: A.S.F.	PROJECT NO. 18-10-30
DESIGNED BY: C.M.A.	CHECKED BY: A.S.F.	SHEET NO. 88
SCALE:		
HORIZ. 1:1000		

CITY PLAN No. 175933
 CITY FILE No. D077-16-19-0005



LEGEND

EXISTING DRAINAGE BOUNDARY

AREA IN METRES

RADIIUS COEFFICIENT

EXISTING OVERLAND FLOW DIRECTION

NOT FOR CONSTRUCTION

4 A.S.F. 20-21-22 6TH SUBMISSION
 4 A.S.F. 20-23-24 4TH SUBMISSION
 4 A.S.F. 20-24-24 3RD SUBMISSION
 4 A.S.F. 19-13-23 2ND SUBMISSION
 2 A.S.F. 19-13-24 1ST SUBMISSION
 N/A 21 2016 DESCRIPTION

TOPOGRAPHIC INFORMATION
 J.D. BARNES LIMITED PROJECT NUMBER 18-10-145-00 SURVEY DATED JULY 26, 2019
LEGAL INFORMATION
 CONSULTED 18-10-145 PROVIDED BY J.D. BARNES LTD. PROJECT 18-10-145-00, DATED APRIL 6, 2020
 BENCH MARK No. 001196403710
 ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GROUND DATUM AND ARE DERIVED FROM THE MUNICIPALITY RECORDING AND SURVEYING BOARD'S FURNISHED ELEVATION OF 61.75M REVER.

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL

120 Bay Road, Unit 103
 Ottawa, Ontario K2H 1Z9
 Tel: (613) 834-0855
 Fax: (613) 834-1165
 www.DSEL.ca

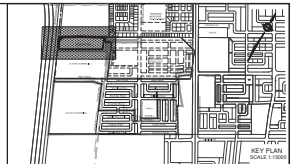
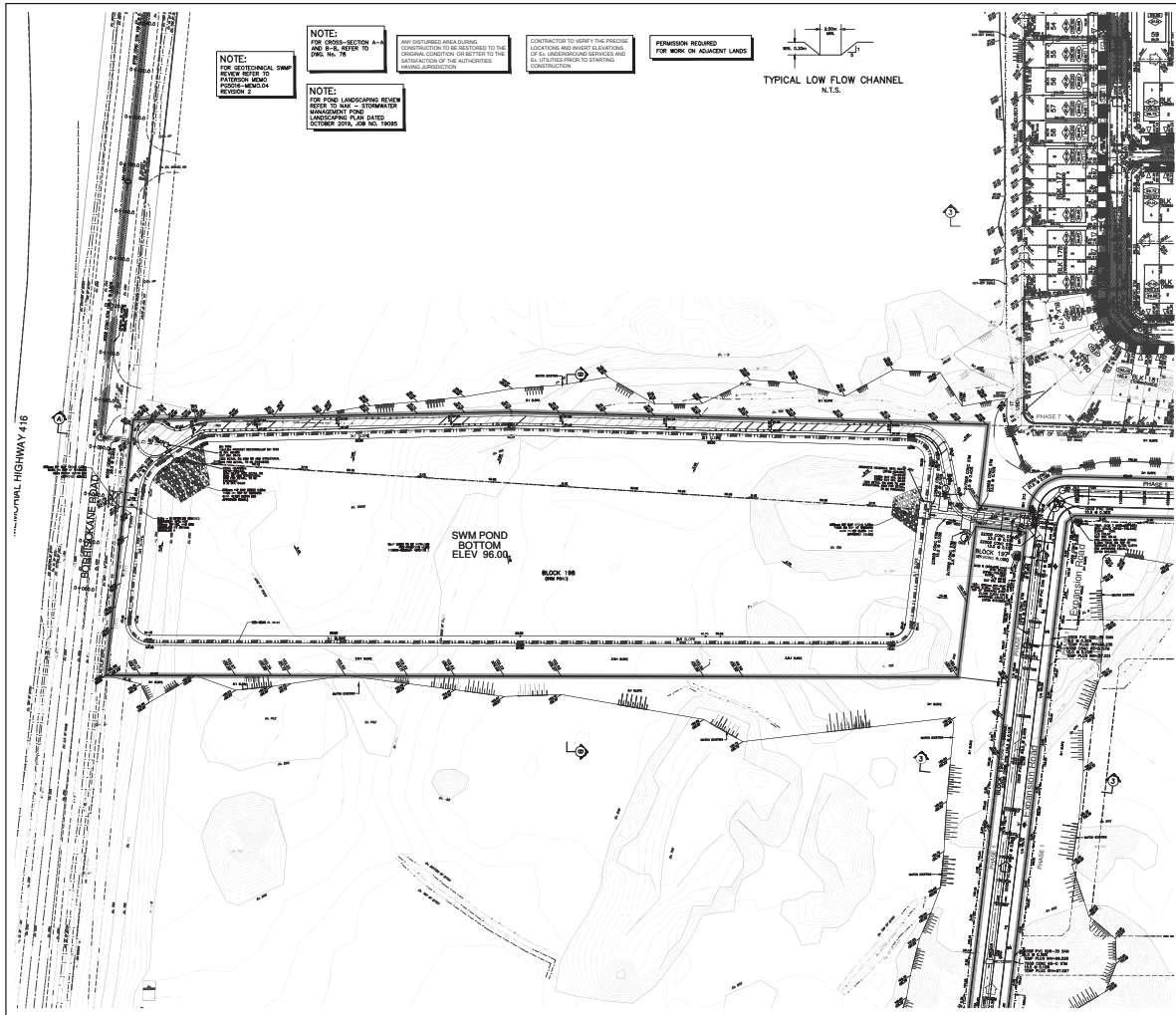
Ottawa CITY OF OTTAWA

EXTERNAL PRE-DEVELOPMENT STORM DRAINAGE PLAN

DRAWN BY: G.S.S.	CHECKED BY: A.Z.F.	PROJECT No.:
DESIGNED BY: C.M.A.	CHECKED BY: A.Z.F.	18-1030
SCALE:		SHEET No.:
		89

HORIZ. 1:2000

CITY PLAN No. 17503
 CITY FILE No. D077-16-19-0005



- LEGEND:**
- 8.0m ASPHALT ACCESS ROAD (SEE DETAIL ON DWG. 79 - SWM POND DETAILS)
 - REINFORCED GRASSED EMERGENCY WEIRWAY (100mm TOPSOIL & 500 UNDERLAY BY 300mm SPREADLIM)
 - PROPOSED ELEVATION
 - PROPOSED ELEVATION
 - EXISTING ELEVATION
 - EXISTING CONTOUR
 - ELEVATION
 - OVERLAND FLOW DIRECTION
 - 3:1 SLOPE UNLESS OTHERWISE INDICATED
 - 100 YEAR WATER LEVEL 96.92
 - RP RAP AS SPECIFIED
 - PHASE LINE
 - RETAINING WALL

NOT FOR CONSTRUCTION

1	AD.P.	20-01-27	5th SUBMISSION
2	AD.P.	20-02-10	6th SUBMISSION
3	AD.P.	20-04-24	8th SUBMISSION
4	AD.P.	19-10-23	3RD SUBMISSION
5	AD.P.	19-10-24	1ST SUBMISSION
6	ST.	20.01	DESCRIPTION

TOPOGRAPHIC INFORMATION
 2D BARNES LIMITED PROJECT NUMBER 18-10-145-00 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
 PREPARED BY: DSEL PROVIDED BY: D BARNES LTD. PROJECT 18-10-145-00, DATED APRIL 5, 2020

BENCH MARK No. 001196403710
 ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GCS85 DATUM AND ARE DERIVED FROM THE MUNICIPALITY PROVIDED THE SURVEYOR HAS A VALID QUALIFICATION OF 6th LEVEL

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL
 120 Sun Road Unit 103
 Ottawa, Ontario K2H 8J9
 Tel: (613) 836-2656
 Fax: (613) 836-1165
 www.DSEL.ca

A & B FOREST SERVICES

Ottawa CITY OF OTTAWA

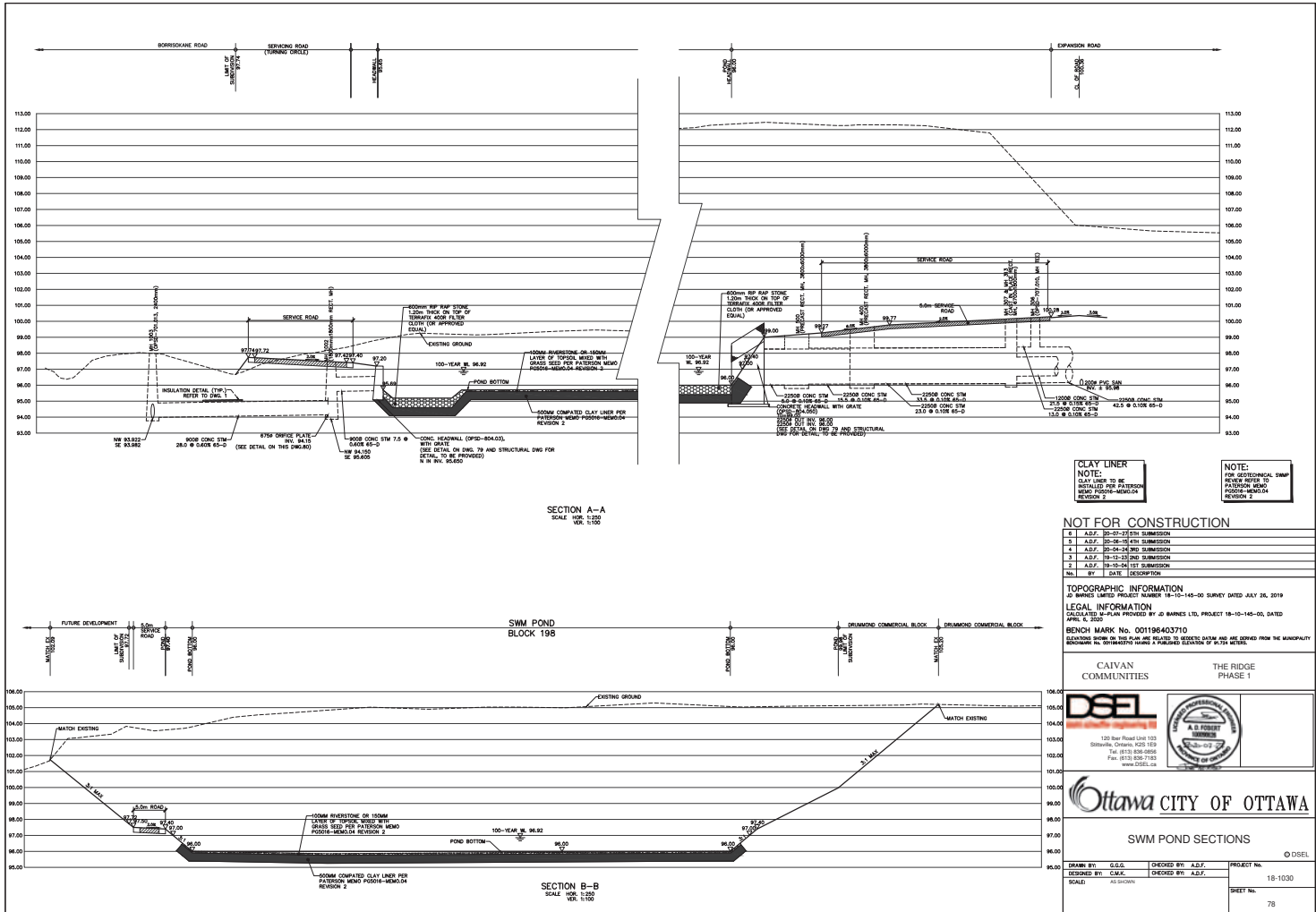
SWAMP POND

DRAWN BY: G.S.G.	CHECKED BY: A.D.F.	PROJECT No.	18-1030
DESIGNED BY: C.M.A.	CHECKED BY: A.D.F.	SHEET No.	77

SCALE: 1:750

HORIZ. 1:750

CITY PLAN No. 17503
 CITY FILE No. D07-16-19-0005



SECTION A-A
SCALE: HORIZ. 1:200
VERT. 1:100

SECTION B-B
SCALE: HORIZ. 1:500
VERT. 1:100

CLAY LINER
NOTE:
CLAY LINER TO BE
INSTALLED PER PATRIUM
MEMO P0004-MEMO.04
REVISION 2

NOTE:
FOR GEOTECHNICAL SWMP
REVIEW REFER TO
PATRIUM MEMO
P0004-MEMO.04
REVISION 2

NOT FOR CONSTRUCTION

1	ADP	20-07-17 5th SUBMISSION
2	ADP	20-08-10 6th SUBMISSION
3	ADP	20-04-24 3RD SUBMISSION
4	ADP	19-10-23 2ND SUBMISSION
5	ADP	19-10-24 1ST SUBMISSION
6	ADP	DESCRIPTION

LEGAL INFORMATION
DRAFTED BY: J. BARNES LTD. PROJECT 18-10-145-00, DATED
APRIL 5, 2020

CAIVAN COMMUNITIES THE RIDGE PHASE 1

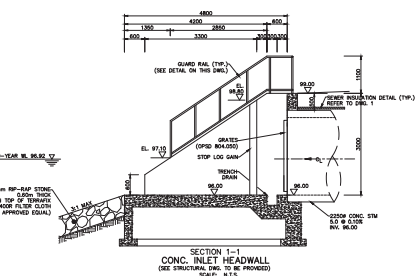
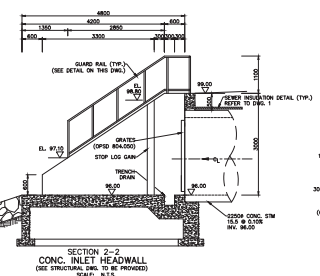
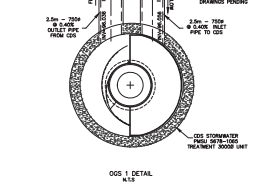
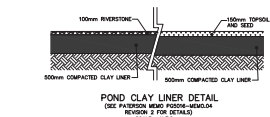
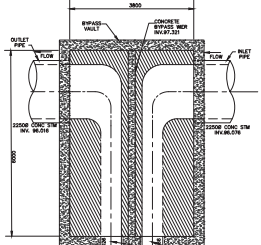
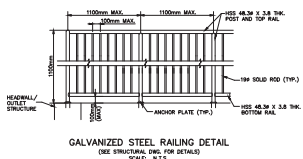
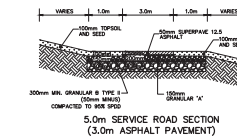
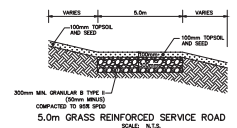
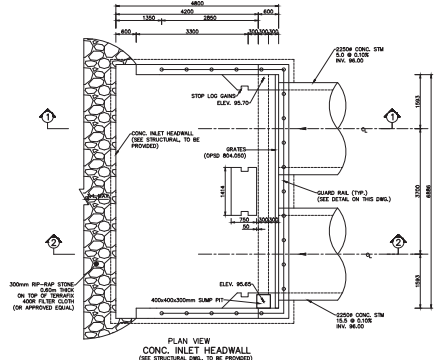
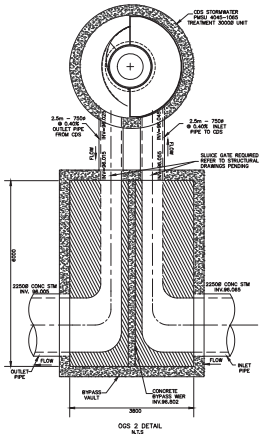
DSEL
120 Burr Road Unit 103
Ottawa, Ontario K2G 1G9
Tel: (613) 836-2656
Fax: (613) 836-1165
www.DSEL.ca

A & FOREST
SUSTAINABLE
CONSTRUCTION

Ottawa CITY OF OTTAWA

SWM POND SECTIONS

DRAWN BY: G.S.G.	CHECKED BY: A.D.F.	PROJECT No.:
DESIGNED BY: C.M.K.	CHECKED BY: A.D.F.	18-1030
SCALE:		SHEET No.:
		78



NOTE:
FOR GEOTECHNICAL SWP
PLEASE REFER TO
FOUNDATION WORK
REVISION 2

NOT FOR CONSTRUCTION

1	A.S.F.	20-21-22 5th SUBMISSION
2	A.S.F.	20-22-23 6th SUBMISSION
3	A.S.F.	20-24-24 3RD SUBMISSION
4	A.S.F.	19-10-20 2ND SUBMISSION
5	A.S.F.	19-10-24 1ST SUBMISSION
6	ST	2016 DESCRIPTION

TOPOGRAPHIC INFORMATION
J.J. BARNES PROJECT NUMBER 18-10-146-00 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
CALCULATED BY: J.J. BARNES LTD. PROJECT 18-10-146-00, DATED APRIL 6, 2020

BENCH MARK No. 001196403710
CLEANING SURVEY ON THIS PLAN IS RELATED TO EXISTING DATA AND ARE DERIVED FROM THE MUNICIPALITY ARCHIVES OR SURVEYORS USING A FORECAST LOCATION OF BENCH MARK.

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL 120 Sun Road Unit 103
Ottawa, Ontario K2E 6Z6
Tel: (613) 834-0852
Fax: (613) 834-1165
www.DSEL.ca

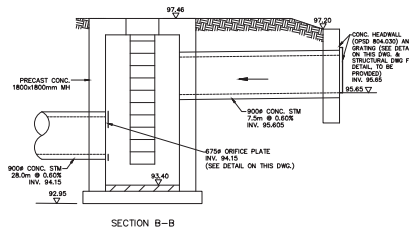
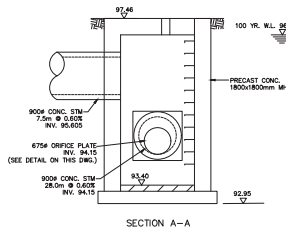
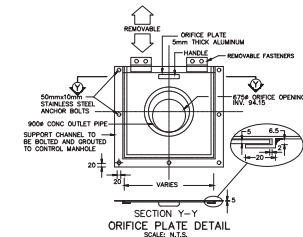
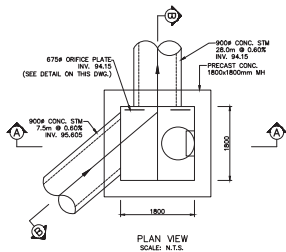
Ottawa CITY OF OTTAWA

SWM POND DETAILS

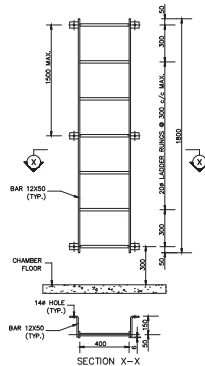
DRAWN BY: G.S.S.	CHECKED BY: A.Z.F.	PROJECT No.
DESIGNED BY: G.M.K.	CHECKED BY: A.Z.F.	18-1030
SCALE: AS SHOWN		SHEET No.
		79

© DSEL

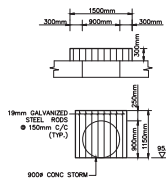
CITY PLAN No. 17503
CITY FILE No. 1007-16-19-0005



OUTLET STRUCTURE DETAIL
(SEE STRUCTURAL DRAWING FOR DETAILS, TO BE PROVIDED)
SCALE: N.T.S.



ACCESS LADDER DETAIL
(SEE STRUCTURAL DRAWING FOR DETAILS, TO BE PROVIDED)
SCALE: N.T.S.



NOTE:
FOR GEOTECHNICAL SWP
PLEASE REFER TO
PATTERN MISC
P0000-REV004
REVISION 2

NOT FOR CONSTRUCTION

4	ADP	20-07-27 5th SUBMISSION
3	ADP	20-06-19 4th SUBMISSION
4	ADP	20-04-24 3rd SUBMISSION
3	ADP	19-11-20 2nd SUBMISSION
2	ADP	19-10-24 1st SUBMISSION
1	SP	DESCRIPTION

TOPOGRAPHIC INFORMATION
CAIVAN LIMITED PROJECT NUMBER 18-10-140-00 SURVEY DATED JULY 26, 2019
LEGAL INFORMATION
CALCULATED BY: [REDACTED] PROVIDED BY: G.D. BARNES LTD, PROJECT 18-10-140-00, DATED APRIL 5, 2020
BENCH MARK No. 001196403710
CLEANING SWP ON THIS PLAN ARE RELATED TO EXISTING DATA AND ARE DERIVED FROM THE MUNICIPALITY RECORDS AND CONTRACTORS HAVE A FURTHER EVALUATION OF SUCH RECORDS

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL **A & FOREST SERVICES**

120 Bar Road Unit 103
Ottawa, Ontario K2H 1Z9
Tel: (613) 836-2656
Fax: (613) 836-1165
www.DSEL.ca

Ottawa CITY OF OTTAWA

SWM POND DETAILS

DRAWN BY: G.S.G. CHECKED BY: A.Z.F. PROJECT No. 18-1030
DESIGNED BY: G.S.G. CHECKED BY: A.Z.F. SCALE: AS SHOWN SHEET No. 80



July 29, 2020

David Schaeffer Engineering Ltd.
120 Iber Road, Unit 103
Stittsville, ON
K2S 1E9

Attention: Mr. Steve Merrick, P.Eng.

RE: CDS Oil/Grit Separator for Brazeau Subdivision, Ottawa

Site Specific Data

The proposed CDS design is based on site-specific data provided by David Schaeffer Engineering Ltd. Please note the upstream external areas were not accounted for in terms of sediment loading as it is clean water, however, the additional flow generated from these external areas are accounted for in the sizing of the OGS' as the 22mm and 100-year flows. The following table provides a summary of the hydrologic parameters specific to the application.

Design Parameters	OGS 1	OGS 2
Total Drainage Area (ha):	18.38	16.62
Site Imperviousness:	67%	67%
Particle Size Distribution:	FINE	FINE
Level of Protection Required:	Enhanced (MOE Level 1)	Enhanced (MOE Level 1)
Estimated Peak Flowrate, Q ₁₀₀ :	5575 L/s	4585 L/s

Selected CDS Model

The selected CDS model and its standard capacities are summarized in the table below:

	OGS 1	OGS 2
CDS Model:	PMSU5668_10	PMSU5668_10
Sump Capacity (L):	8,896	8,896
Total Holding Capacity (L):	25,960	25,960
Oil Capacity (L):	4,435	4,435

- Att: A) CDS TSS Calculations
B) CDS General Cut Sheet Drawings
C) MOE NETE Approval Certificate

Appendix A

CDS TSS Calculations



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



Project Name:	Brazeau Subdivision	Engineer:	DSEL
Location:	Ottawa, ON	Contact:	Steve Merrick, P.Eng.
OGS #:	1	Report Date:	29-Jul-20
Area	18.380 ha	Rainfall Station #	215
Weighted C	0.69	Particle Size Distribution	FINE
CDS Model	5668 (OFFLINE)	CDS Treatment Capacity	538 l/s

<u>Rainfall Intensity¹</u> <u>(mm/hr)</u>	<u>Percent Rainfall Volume¹</u>	<u>Cumulative Rainfall Volume</u>	<u>Total Flowrate (l/s)</u>	<u>Treated Flowrate (l/s)</u>	<u>Operating Rate (%)</u>	<u>Removal Efficiency (%)</u>	<u>Incremental Removal (%)</u>
1.0	10.6%	19.8%	35.0	35.0	6.5	97.0	10.3
1.5	9.9%	29.7%	52.5	52.5	9.8	96.1	9.5
2.0	8.4%	38.1%	70.0	70.0	13.0	95.1	8.0
2.5	7.7%	45.8%	87.5	87.5	16.3	94.2	7.2
3.0	5.9%	51.7%	105.0	105.0	19.5	93.3	5.5
3.5	4.4%	56.1%	122.5	122.5	22.8	92.3	4.0
4.0	4.7%	60.7%	140.0	140.0	26.0	91.4	4.3
4.5	3.3%	64.0%	157.5	157.5	29.3	90.5	3.0
5.0	3.0%	67.1%	175.0	175.0	32.5	89.5	2.7
6.0	5.4%	72.4%	210.0	210.0	39.0	87.7	4.7
7.0	4.4%	76.8%	245.0	245.0	45.5	85.8	3.7
8.0	3.5%	80.3%	280.0	280.0	52.0	83.9	3.0
9.0	2.8%	83.2%	315.0	315.0	58.5	82.1	2.3
10.0	2.2%	85.3%	350.0	350.0	65.0	80.2	1.8
15.0	7.0%	92.3%	525.0	525.0	97.6	70.9	5.0
20.0	4.5%	96.9%	700.0	538.1	100.0	54.0	2.5
25.0	1.4%	98.3%	875.0	538.1	100.0	43.2	0.6
30.0	0.7%	99.0%	1050.0	538.1	100.0	36.0	0.2
35.0	0.5%	99.5%	1225.0	538.1	100.0	30.8	0.1
40.0	0.5%	100.0%	1400.0	538.1	100.0	27.0	0.1
45.0	0.0%	100.0%	1575.0	538.1	100.0	24.0	0.0
50.0	0.0%	100.0%	1750.1	538.1	100.0	21.6	0.0
							87.6

Removal Efficiency Adjustment ² =	6.5%
Predicted Net Annual Load Removal Efficiency =	81.1%
Predicted Annual Rainfall Treated =	97.5%

1 - Based on 42 years of hourly rainfall data from Canadian Station 6105976, Ottawa ON
 2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.
 3 - CDS Efficiency based on testing conducted at the University of Central Florida
 4 - CDS design flowrate and scaling based on standard manufacturer model & product specifications



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



Project Name: Brazeau Subdivision	Engineer: DSEL
Location: Ottawa, ON	Contact: Steve Merrick, P.Eng.
OGS #: 2	Report Date: 29-Jul-20
Area 16.620 ha	Rainfall Station # 215
Weighted C 0.69	Particle Size Distribution FINE
CDS Model 5668 (OFFLINE)	CDS Treatment Capacity 538 l/s

<u>Rainfall Intensity¹</u> (mm/hr)	<u>Percent Rainfall Volume¹</u>	<u>Cumulative Rainfall Volume</u>	<u>Total Flowrate (l/s)</u>	<u>Treated Flowrate (l/s)</u>	<u>Operating Rate (%)</u>	<u>Removal Efficiency (%)</u>	<u>Incremental Removal (%)</u>
1.0	10.6%	19.8%	31.6	31.6	5.9	97.2	10.3
1.5	9.9%	29.7%	47.5	47.5	8.8	96.3	9.5
2.0	8.4%	38.1%	63.3	63.3	11.8	95.5	8.0
2.5	7.7%	45.8%	79.1	79.1	14.7	94.6	7.3
3.0	5.9%	51.7%	94.9	94.9	17.6	93.8	5.6
3.5	4.4%	56.1%	110.8	110.8	20.6	93.0	4.0
4.0	4.7%	60.7%	126.6	126.6	23.5	92.1	4.3
4.5	3.3%	64.0%	142.4	142.4	26.5	91.3	3.0
5.0	3.0%	67.1%	158.2	158.2	29.4	90.4	2.7
6.0	5.4%	72.4%	189.9	189.9	35.3	88.7	4.8
7.0	4.4%	76.8%	221.5	221.5	41.2	87.1	3.8
8.0	3.5%	80.3%	253.2	253.2	47.1	85.4	3.0
9.0	2.8%	83.2%	284.8	284.8	52.9	83.7	2.4
10.0	2.2%	85.3%	316.5	316.5	58.8	82.0	1.8
15.0	7.0%	92.3%	474.7	474.7	88.2	73.6	5.1
20.0	4.5%	96.9%	633.0	538.1	100.0	59.7	2.7
25.0	1.4%	98.3%	791.2	538.1	100.0	47.7	0.7
30.0	0.7%	99.0%	949.5	538.1	100.0	39.8	0.3
35.0	0.5%	99.5%	1107.7	538.1	100.0	34.1	0.2
40.0	0.5%	100.0%	1266.0	538.1	100.0	29.8	0.2
45.0	0.0%	100.0%	1424.2	538.1	100.0	26.5	0.0
50.0	0.0%	100.0%	1582.5	538.1	100.0	23.9	0.0
							88.7

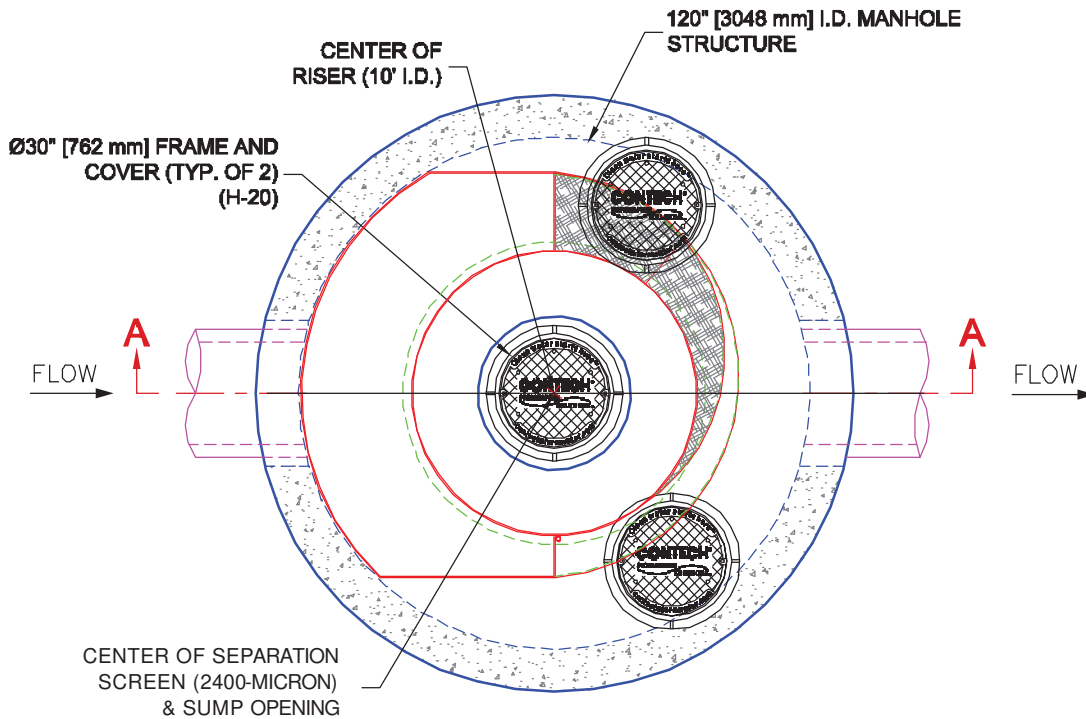
Removal Efficiency Adjustment ² =	6.5%
Predicted Net Annual Load Removal Efficiency =	82.2%
Predicted Annual Rainfall Treated =	98.0%

1 - Based on 42 years of hourly rainfall data from Canadian Station 6105976, Ottawa ON
 2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.
 3 - CDS Efficiency based on testing conducted at the University of Central Florida
 4 - CDS design flowrate and scaling based on standard manufacturer model & product specifications

Appendix B
CDS General Cut Sheet Drawings



PLAN VIEW

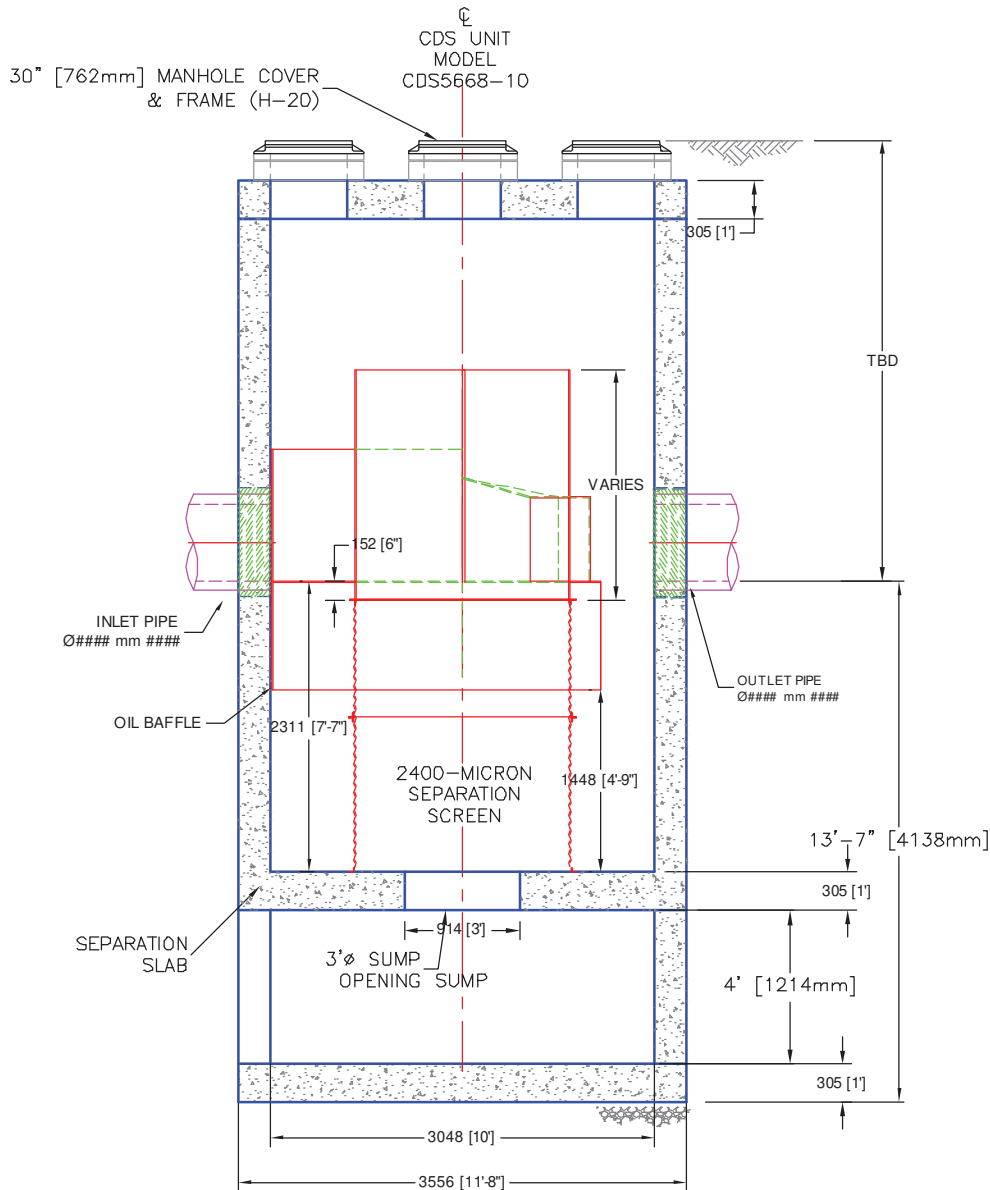


CDS MODEL PMSU56_68_10, 538 L/S TREATMENT CAPACITY
STORM WATER TREATMENT UNIT

	<p>PROJECT NAME</p> <p>CITY, STATE</p>	JOB#	###/##-##-###	SCALE	1" = 5'
		DATE	##/##/##	SHEET	1
		DRAWN	INITIALS		
		APPROV.			



SECTION A-A VIEW



CDS MODEL PMSU56_68_10, 538 L/S TREATMENT CAPACITY STORM WATER TREATMENT UNIT

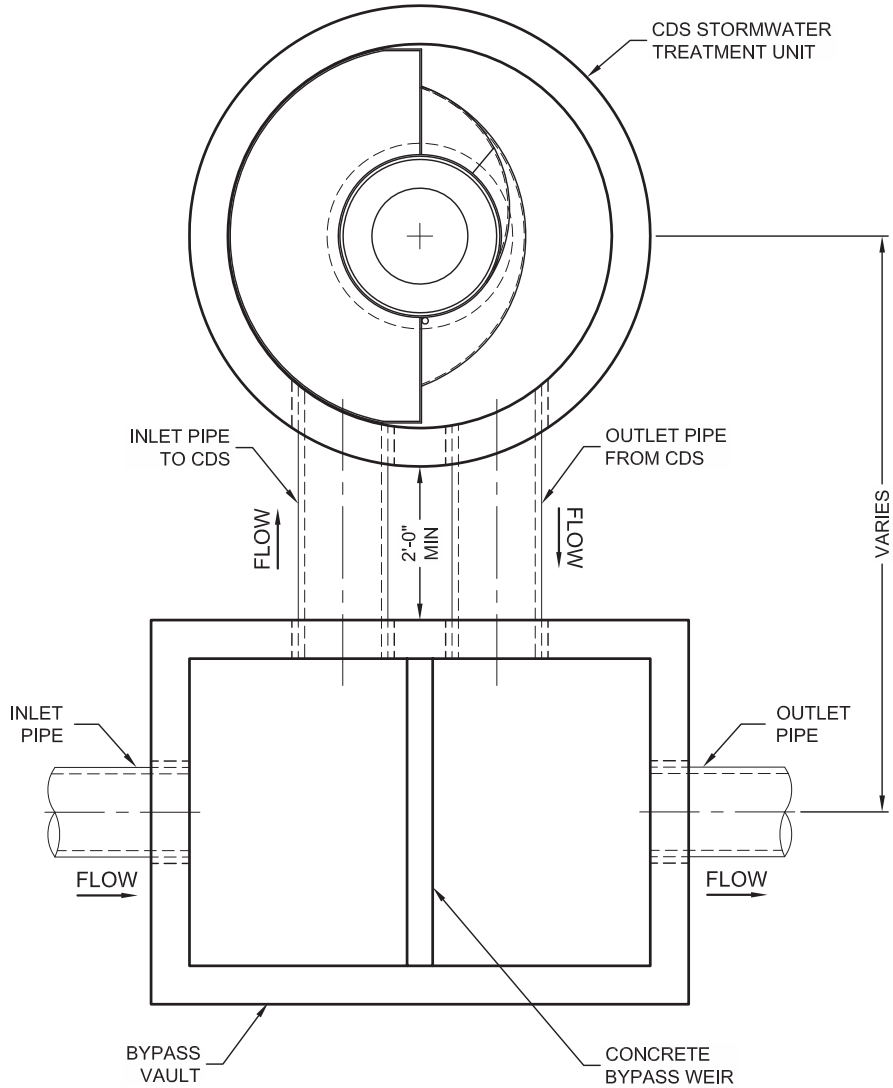


PROJECT NAME
CITY, STATE

JOB# ###/##-##-###
DATE ##/##/##
DRAWN INITIALS
APPROV.

SCALE
1" = 6'
SHEET
2

I:\STORMWATER\COM\WOPS\22 CDS\40 STANDARD DRAWINGS\OFFLINE LAYOUTS DWG\OFFLINE CDS-C LAYOUT BYPASS VAULT STRUCTURE.DWG 3/12/2013 3:35 PM



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

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800-338-1122 513-645-7000 513-645-7993 FAX

CDS STORMWATER TREATMENT SYSTEM
TYPICAL OFFLINE LAYOUT
WITH BYPASS VAULT STRUCTURE

DATE:03/12/13

SCALE: NONE

PROJECT No.: N/A

SEQ. No.: N/A

DRAWN: N/A

CHECKED: N/A

Appendix C
MOE NETE Approval Certificate

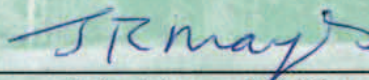
CERTIFICATE

OF TECHNOLOGY ASSESSMENT

CDS™ Technologies

The Ontario Ministry of the Environment has reviewed the solid/liquid separation system developed by CDS™ Technologies. Based on the review of the documentation submitted by the company (see the Notable Aspects section and Appendix), and data from pilot-scale testing and full-scale operations conducted by various agencies, the Ministry concludes that the continuous deflection separation (CDS™) system can provide useful removal of solids and floatables as part of a stormwater management system.

The CDS™ Technologies may be able to provide "basic to advanced" level of protection when used alone, maintained for effective operation, and when appropriately designed for the development area to be serviced. CDS™ units may also be used for pretreatment in combination with other non-proprietary technologies such as man-made wetlands, treatment ponds and infiltration basins.



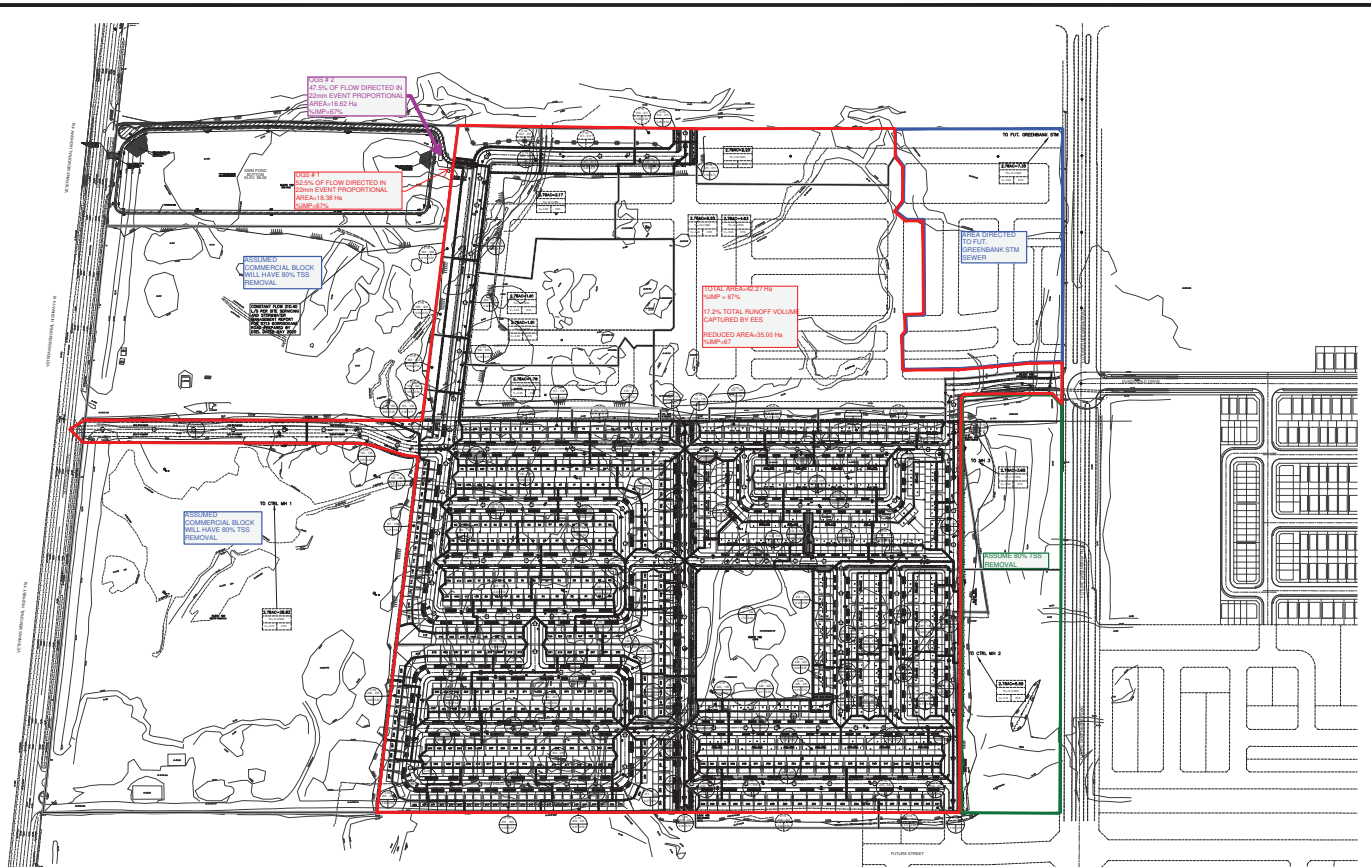
John Mayes, (A) Director
Standards Development Branch
Ministry of the Environment
(September 2006)

New Environmental Technology Evaluation Program

Promoting the development and application of new environmental technologies



Ontario



120 Iker Road, Unit 103
 Stittsville, Ontario, K2S 1E9
 Tel: (613) 836-0856
 Fax: (613) 836-7183
 www.DSEL.ca

CAIVAN COMMUNITIES - THE RIDGE PHASE 1
 CITY OF OTTAWA

OGS DRAINAGE AREA FIGURE

SCALE:	1:4000	PROJECT No.:	18-1030
DATE:	JULY 2020	FIGURE:	1 of 1

Master Servicing Study Barrhaven South Urban Expansion Area

5.8 Analysis of EES Results

5.8.1 BSUEA Site Wide Infiltration with EES

A water budget analysis was carried out as part of the Existing Condition Report (Section B6, Appendix B). This analysis revealed that pre-development infiltration across the BSUEA accounted for 40% of the total precipitation based on long-term simulations. Based on the post-development simulation results, the water budget for the overall BSUEA lands is shown in Table 5-8 below and compared in the table with the existing conditions water budget. The use of the EES along the local road network within the BSUEA lands achieves an infiltration of 44% which is greater than under existing conditions, which shows that infiltration within $\pm 10\%$ of existing is achievable. It should be noted that this analysis has excluded the Brazeau and Drummond properties which have been assumed to integrate measures to promote infiltration and preserve pre-infiltration rates along both properties separately from the remaining BSUEA. Further refinements to the high level infiltration concept, including sizing of the EES, can be investigated during detailed design.

Table 5-8: BSUEA EES Water Budget Results

Water Budget Component	Annual Average Depth (mm)	Budget (%)	Existing Condition Budget (%)
Precipitation	844	100%	100%
Evapotranspiration	231	27%	60%
Infiltration	377	44%	40%
Surface Runoff	225	27%	0%

5.8.2 Minto Lands

5.8.2.1 Major System Cascading and Ponding Levels

The simulated elevations along the major overland system nodes are shown in Table 5-9 and Table 5-10. There is no ponding during the 1:5 year event or 1:10 year event for local/collector roads and arterial roads, while the depth of flow along the major system is maintained to or below 350 mm during the 1:100 year event.

Table 5-9: Minto EES Local and Collector Road Major Node Depths

Major System Node	3 hr Chi 1:5 yr Ponding Depth (mm)	24 hr SCS 1:5 yr Ponding Depth (mm)	3 hr Chi 1:100 yr Ponding Depth (mm)	24 hr SCS 1:100 yr Ponding Depth (mm)
S_110-111	10	10	350	210
S_111-112	10	10	250	30
S_150-152	10	10	210	160
S_152-154	10	10	80	70

5.4.3 Stormwater Management Facilities (SWMFs)

The SWMFs, either wet ponds or dry ponds, should be designed in accordance with Section 8 of the OSDG and MOE's publication entitled "SWM Planning and Design Manual, 2003".

The normal water level in the wet ponds should be above the highest elevation of either: (i) the free flowing water level in the downstream storm sewer during the 1:2 year event; or (ii) the elevation of the underlying groundwater table.

For safety reasons, the live storage in dry ponds should be kept to 1.5 m (OSDG) to 2.0 m deep (MOE). A minimum 300 mm freeboard should be provided between the 1:100 year water surface elevation and the overflow elevation.

SWMFs should be integrated into the community through the use of pathways or other linkages.

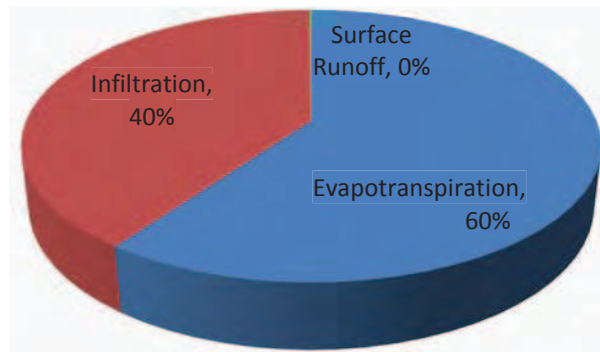
5.4.4 Water Balance

The Hydrogeological Existing Conditions Report (Paterson Group Inc., 2017) recommended that infiltration measures be incorporated into the BSUEA's storm servicing design, as the subject area contributes to groundwater recharge of the esker, which should be preserved. The Paterson Group Inc. (Paterson) Report recommended that:

- Distributed infiltration be achieved to promote recharge of overburden aquifer and preserve the pre-infiltration condition for the three (3) subwatersheds; and,
- Only captured runoff that is relatively free of roadway salts be infiltrated to minimize adverse impacts on the esker.

An analysis (using the PCSWMM software platform) was carried out and is summarized in the Existing Condition Report (Appendix B) to determine the various contributions of the water budget based on long-term simulations. To simulate the infiltration, the analysis utilized measured data compiled as part of Paterson's field program. Infiltration to groundwater recharge zones was simulated based on measured saturated field hydraulic conductivity, which was translated to infiltration rates (refer to Section B6.1.1 of Appendix B). The analysis revealed that overall pre-development infiltration from the subject site (excluding the aggregate extraction areas) accounted for 40% of the overall water budget (Figure 5-2). The City and RVCA have agreed with Paterson's recommendation that pre-development infiltration levels should be maintained and distributed infiltration be achieved across the site, and should not be concentrated at one or two location(s).

Figure 5-2: Existing Water Budget Breakdown



5.5 Storm Servicing Strategy

Based on the storm drainage connections and criteria set out in Sections 5.2 and 5.4 respectively, a stormwater management strategy has been developed. The strategy strives to preserve pre-development infiltration across the BSUEA, which in turn, impacts the individual stormwater management strategies developed for each of the servicing areas depicted in Figure 4-2. Sub-section 5.4 presents the rationale in developing storm servicing strategies, Sub-section 5.5.5 the storm drainage and design methodology, Sub-sections 5.7 5.8, and 5.9 present the analyses carried out for the conventional, EES and infiltration gallery servicing strategies, respectively while Sub-section 5.10.2 summarizes the impact of the strategies on the municipal drains.

5.5.1 EES Infiltration Strategy

5.5.1.1 Background

During the preparation of the Existing Condition Report, it became evident that storm servicing for the BSUEA would need to incorporate measures to recharge the overburden aquifer. As a result of extensive work and consultation with the both the City and RVCA over a nine (9) month period, the preferred infiltration servicing strategy has been identified as the Etobicoke Exfiltration System (EES). During this nine (9) month period, a number of Memoranda were prepared to support the selection process. All documents and work undertaken (Memoranda and Presentation) are described below (Sections 5.5.1.1 to 5.5.1.6) and included in Appendix E.

In September 2016, a Memorandum to the City outlined potential infiltration measures that could be considered for the BSUEA. The Memorandum outlined general considerations related to infiltration and nine (9) specific infiltration measures, which ranged from reduced lot grading to infiltration galleries and bio-retention cells. The advice from the City and RVCA following submission of the Memorandum is that infiltration measures should be spread across the site so as to mimic current infiltration patterns and should not rely on infrastructure on private properties. After further review and discussions, the EES was selected as the preferred measure to preserve the water budget and carried forward for further sizing and analysis.

Master Servicing Study

Barrhaven South Urban Expansion Area

Table 5-13: Minto EES Pond Parameters and Results

Pond Parameter	Dry Pond 1	Dry Pond 2	Western Spill-over Pond
Water Quality	Not Required	Not Required	Not Required
Simulated Release Rate (m ³ /s)	1.7	0.5	0.33
Pond Invert (m)	95	95.6	100
Pond Top of Bank (m)	95.75	96.8	100.7
Active Storage Depth (m)	0.75	1.2	1.1
Freeboard (m)	>0.3	>0.3	>0.3
Outlet Elevation (m)	95	95.6	100
Outlet Diameter (m)	0.675	0.375	0.4
Drawdown Time (hrs)	6	12	6
Surface Area (ha)	1.5	1.7	1.2

5.8.3 Mattamy Lands East and Mattamy Lands West

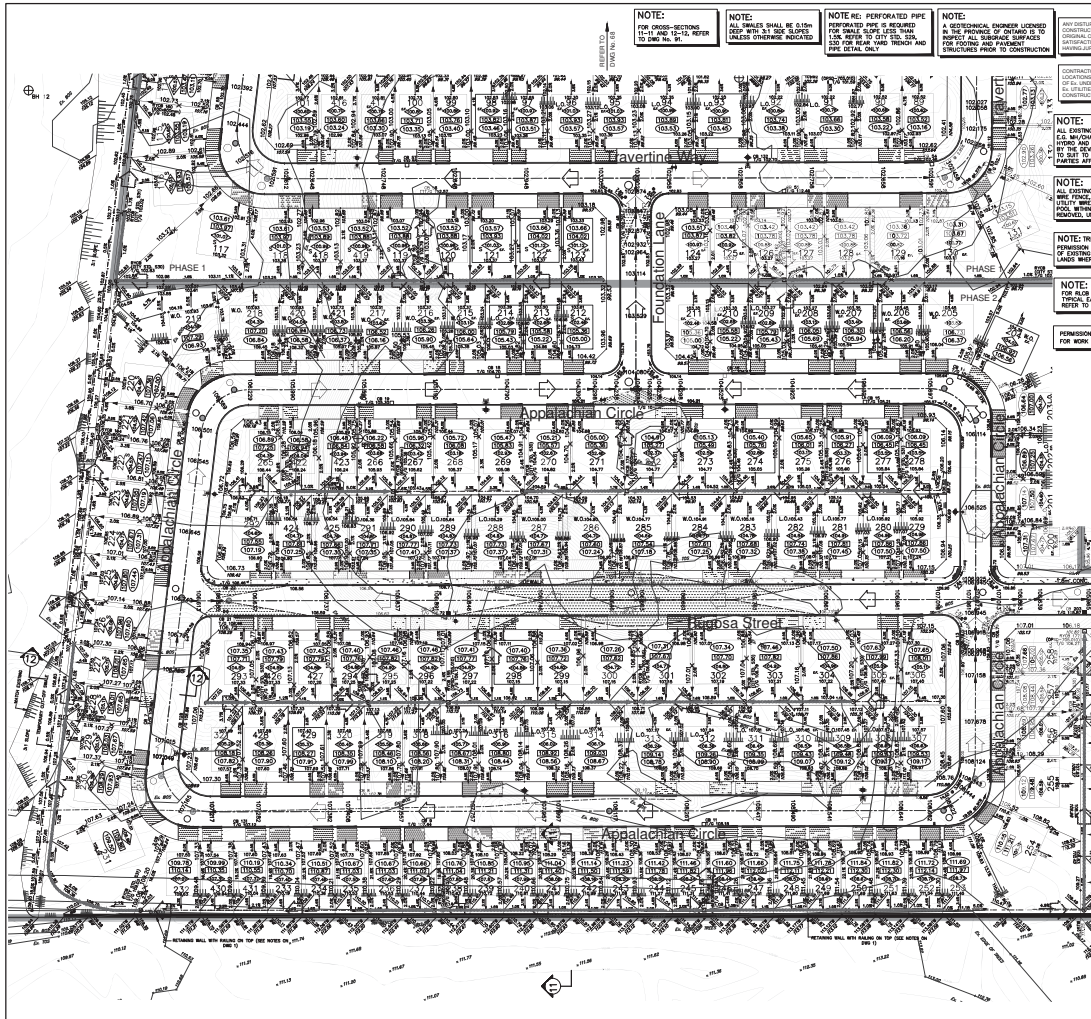
The Mattamy Lands East was modelled at the conceptual level as part of the Half Moon Bay South – Phase 4 Stormwater Management Report (Stantec, 2015) while the minor system of Mattamy Lands West was included in the Draft BSMSSA, Stantec, 2014. Neither of these Reports included an assessment of EES within the storm minor system.

Including the EES within these areas would not alter the stormwater management approach as neither of the Mattamy Lands requires additional water quality control and the MSS designs do not affect major system storage requirements. The use of EES in Mattamy Lands East, however, may improve the downstream HGLs in the Half Moon Bay South subdivision and areas draining to the Todd Pond as exfiltration of clean runoff into the underlying groundwater and esker would be promoted resulting in a reduction in the flow and increase in available capacity in the conventional sewers.

5.8.4 Brazeau and Drummond Aggregate Extraction Areas

The EES has been identified as a suitable strategy on urban development in the BSUEA to achieve distributed infiltration as per the recommendations of Paterson's Existing Conditions Report. Assuming that both aggregate extraction areas are developed as residential, infiltrating clean runoff from local roads can achieve the required infiltration. Alternatively, infiltration galleries could also supplement or replace part of an EES. At detailed design of these properties, the strategy to preserve pre-development infiltration rates will need to be reviewed in consultation with the Geotechnical Engineer once it is known what type of fill material was used to meet the minimum rehabilitation elevations.

APPENDIX E



NOTE: FOR CROSS-SECTION SEE PLAN 18-10-14-00-01

NOTE: ALL SLOPES SHALL BE 0.5% UNLESS OTHERWISE NOTED

NOTE: PERFORATED PIPE FOR DRAINAGE SHALL BE 150mm DIA. UNLESS OTHERWISE NOTED

NOTE: A GEOTECHNICAL ENGINEER LICENSED IN THE PROVINCE OF ONTARIO IS THE PROVIDER OF RECORD TO VERIFY ALL SOILS SURFACE SURFACES FOR FOOTING AND FOUNDATION STRUCTURES PRIOR TO CONSTRUCTION

NOTE: ANY DISTURBED AREA DURING CONSTRUCTION TO BE RESTORED TO THE ORIGINAL CONDITION, OR BETTER TO THE SATISFACTION OF THE ADJACENT PROPERTY OWNERS

NOTE: CONTRACTOR TO KEEP THE PRECISE LOCATION AND POINT ELEVATIONS OF ALL MEASUREMENTS SHOWN AND BE AVAILABLE PRIOR TO STARTING CONSTRUCTION

NOTE: ALL EXISTING ABOVE GROUND FEATURES (E.G. MANHOLE COVERS, FENCEPOSTS, TAPPING AND JOINT PIPES) TO BE RELOCATED BY THE DEVELOPER TO BE ADJUSTED TO FIT TO THE SUBMISSION OF PHASES AFFICED

NOTE: ALL EXISTING BUILDING, SHED, POST & RAIL FENCE, CHAIN LINK FENCE, TREE, FENCE, WALL, TREE, CONCRETE PILING, TO BE REMOVED UNLESS OTHERWISE NOTED

NOTE: TREE REMOVAL PERMISSION REQUIRED FOR REMOVAL OF EXISTING TREES ON EXTERNAL LANDS WHERE APPLICABLE

NOTE: PERMITS REQUIRED FOR WORK ON ADJACENT LANDS

LEGEND

- PROPOSED ELEVATION: 103.45
- EXISTING ELEVATION: 102.27
- FUTURE ELEVATION: (10.00)
- PROPOSED SLOPE GRADE: 1.0%
- HIGH POINT: 102.18
- STREET CATCHBASIN: 102.18
- EXISTING CATCHBASIN WITH: 102.18
- CATCHBASIN: 102.18
- TELE CATCHBASIN: 102.18
- ELDER CATCHBASIN: 102.18
- HYDRANT, VALVE & IS: 102.18
- VALVE & IS: 102.18
- BASELINE ELEVATION: 102.18
- TOP OF FOUNDATION (TOP): 102.18
- PROPOSED FLOOR ELEVATION: 102.18
- FINISH OF FOOTING: 102.18
- ELEVATION (TOP): 102.18
- PAVE, ASPHALT AND VALUES: 102.18
- MAINTENANCE: 102.18
- SLAB ON GRADE: 102.18
- HYDRO SWITCHGEAR: 102.18
- HYDRO TRANSFORMER: 102.18
- STREET LIGHT STANDARDS: 102.18
- TACTILE WALKING SURFACE: 102.18
- PROPOSED (AS SHOWN): 102.18
- PERMITS PHASES / PHASES NOT PART OF CURRENT GRADING APPROVAL: 102.18
- OVERLAND FLOW DIRECTION: 102.18
- EXTERNAL OVERLAND FLOW DIRECTION: 102.18
- PROPERTY BOUNDARY: 102.18
- RETAINING WALL AND ELEVATION: 102.18
- PROPERTY BOUNDARY: 102.18
- 1:1 TERRACING MAXIMUM SLOPE: 102.18
- FOREGOING AREA WITH SHELTER: 102.18
- MINIMUM PERCENTAGE SLOPE: 102.18
- MINIMUM CITY USE SLOPE: 102.18
- MINIMUM CITY USE SLOPE: 102.18
- SLOPE LESS THAN 1:10: 102.18
- CLAY SOIL, REFER TO GEOTECHNICAL CONSULTANT'S SPECIFICATIONS: 102.18

NOT FOR CONSTRUCTION

4 - A.D.F. 20-21-27 5th SUBMISSION

1 - I.I. 20-24-28 4th SUBMISSION

4 - A.D.F. 20-24-28 4th SUBMISSION

1 - I.I. 20-24-28 4th SUBMISSION

1 - A.D.F. 19-10-24 1st SUBMISSION

1 - I.I. 19-10-24 1st SUBMISSION

1 - I.I. 19-10-24 1st SUBMISSION

1 - I.I. 19-10-24 1st SUBMISSION

1 - I.I. 19-10-24 1st SUBMISSION

TOPOGRAPHIC INFORMATION
 20 BARRIS LIMITED PROJECT NUMBER 18-10-14-00-00 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
 STREET LIGHT STANDARDS PROVIDED BY JD BARRIS LTD. PROJECT 18-10-14-00-00, DATED APRIL 8, 2019

GENCO MARK No. 001196403710
 GEOTECHNICAL DATA ON THIS PLAN ARE RELATED TO GEOTECHNICAL DATA AND ARE DERIVED FROM THE MUNICIPALITY OF OTTAWA'S GEOTECHNICAL DATA. A FURTHER EXPLANATION OF SUCH DATA IS AVAILABLE.

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL
 120 Bay Road Unit 103
 Ottawa, Ontario K2H 1S9
 Tel: (613) 836-8888
 Fax: (613) 836-1185
 www.DSEL.ca

A 3 FOREST SERVICES

Ottawa CITY OF OTTAWA

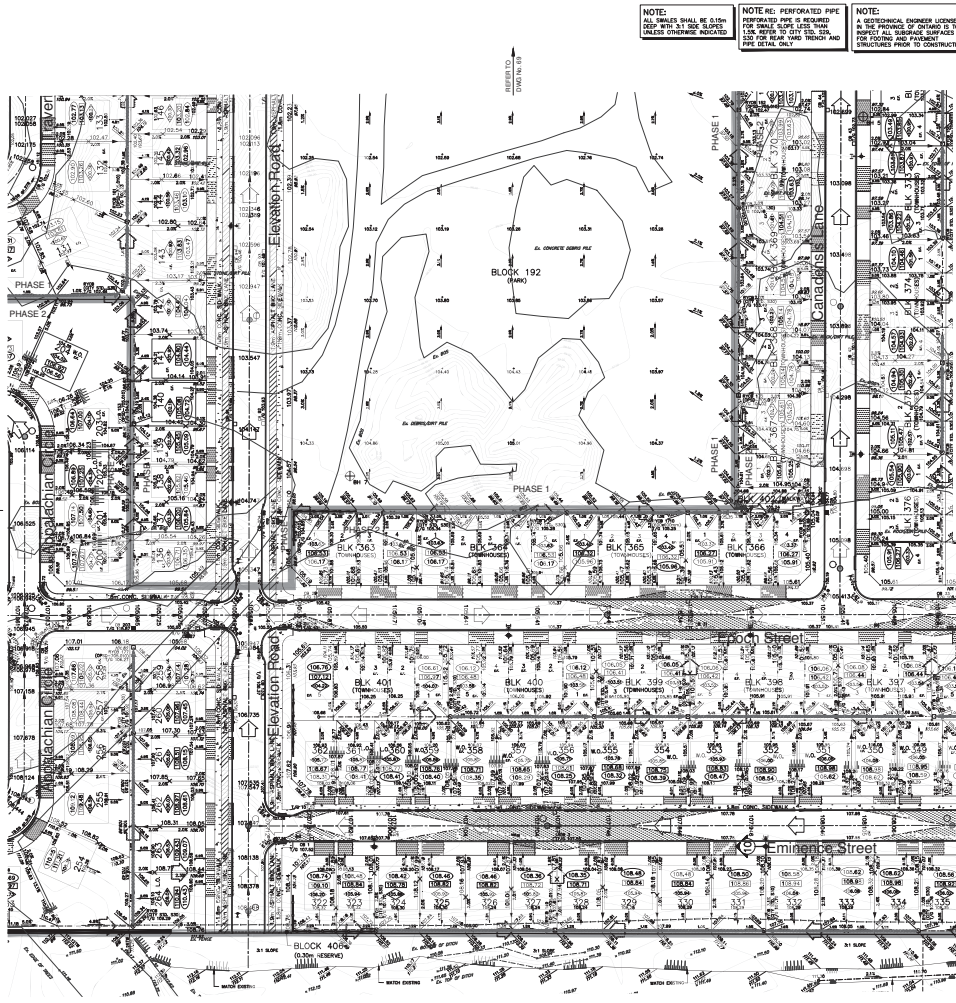
GRADING PLAN

PROJECT No. 18-1030

SHEET No. 65

SCALE: HORIZ. 1:500

CITY PLAN No. 17503
 CITY FILE No. D07-16-19-0005



NOTE:
ALL GRADES SHALL BE 0.1% TO 0.5% WITH A MIN. SLOPE UNLESS OTHERWISE INDICATED.

NOTE: RE-PERFORATED PIPE
RE-PERFORATED PIPE IS REQUIRED FOR SLOPE SITES LESS THAN 1% UNLESS OTHERWISE INDICATED. REFER TO CITY OF OTTAWA STANDARD SPECIFICATIONS FOR RE-PERFORATED PIPE.

NOTE:
A GEOTECHNICAL ENGINEER LICENSED IN THE PROVINCE OF ONTARIO IS TO BE CONSULTED TO VERIFY ALL EXISTING AND PROPOSED FOUNDATION CONDITIONS AND TO BE CONSULTED TO VERIFY ALL EXISTING AND PROPOSED FOUNDATION CONDITIONS AND TO BE CONSULTED TO VERIFY ALL EXISTING AND PROPOSED FOUNDATION CONDITIONS.

CONTRACTOR TO VERIFY THE PRECISE LOCATION AND ELEVATION OF ALL EXISTING UTILITIES AND TO BE CONSULTED TO VERIFY ALL EXISTING AND PROPOSED FOUNDATION CONDITIONS.



NOTE:
ALL EXISTING ABOVE GROUND FEATURES (E.G. MANHOLE COVERS, PERESTALS, ETC.) SHALL BE PRESERVED AND REMOVED UNLESS OTHERWISE NOTED.

NOTE:
REMOVAL OF EXISTING TREE OR TREES ON ADJACENT LANDS WHERE APPLICABLE.

NOTE:
FOR TREE REMOVAL, PERMISSION REQUIRED FOR REMOVAL OF EXISTING TREES ON EXTERNAL LANDS WHERE APPLICABLE.

NOTE:
FOR TREE LAYOUT, TREE SPECIES, TREE HEIGHT, TREE CANOPY, TREE AGE, TREE CONDITION, TREE REMOVAL, TREE PRESERVATION, TREE PROTECTION, TREE REPLACEMENT, TREE SPECIFICATIONS, TREE SCHEDULE, TREE SURVEY, TREE VALUATION, TREE MANAGEMENT, TREE MAINTENANCE, TREE MONITORING, TREE RESEARCH, TREE EDUCATION, TREE PROMOTION, TREE POLICY, TREE STRATEGY, TREE ACTION PLAN, TREE REPORT, TREE STUDY, TREE ASSESSMENT, TREE AUDIT, TREE INVENTORY, TREE SURVEY, TREE MAPPING, TREE DATA, TREE ANALYSIS, TREE SYNTHESIS, TREE COMMUNICATION, TREE COORDINATION, TREE COLLABORATION, TREE PARTNERSHIP, TREE ALLIANCE, TREE NETWORK, TREE FORUM, TREE CONFERENCE, TREE MEETING, TREE WORKSHOP, TREE SEMINAR, TREE SYMPOSIUM, TREE CONGRESS, TREE EXHIBITION, TREE FAIR, TREE FESTIVAL, TREE CELEBRATION, TREE CEREMONY, TREE SERVICE, TREE SUPPORT, TREE ASSISTANCE, TREE GUIDANCE, TREE COUNSEL, TREE ADVICE, TREE RECOMMENDATION, TREE OPINION, TREE CONCLUSION, TREE SUMMARY, TREE RECOMMENDATION, TREE ACTION PLAN, TREE REPORT, TREE STUDY, TREE ASSESSMENT, TREE AUDIT, TREE INVENTORY, TREE SURVEY, TREE MAPPING, TREE DATA, TREE ANALYSIS, TREE SYNTHESIS, TREE COMMUNICATION, TREE COORDINATION, TREE COLLABORATION, TREE PARTNERSHIP, TREE ALLIANCE, TREE NETWORK, TREE FORUM, TREE CONFERENCE, TREE MEETING, TREE WORKSHOP, TREE SEMINAR, TREE SYMPOSIUM, TREE CONGRESS, TREE EXHIBITION, TREE FAIR, TREE FESTIVAL, TREE CELEBRATION, TREE CEREMONY, TREE SERVICE, TREE SUPPORT, TREE ASSISTANCE, TREE GUIDANCE, TREE COUNSEL, TREE ADVICE, TREE RECOMMENDATION, TREE OPINION, TREE CONCLUSION, TREE SUMMARY.

NOTE:
FOR CROSS-SECTION, REFER TO DWG. NO. 67.



- LEGEND**
- 103.45 OVERLAND FLOW DIRECTION
 - 103.27 EXISTING ELEVATION
 - 103.00 FUTURE ELEVATION
 - 102.80 PROPOSED WALKWAY GRADE
 - 102.18 HIGH POINT
 - 102.00 STREET CATCHBASIN
 - 102.00 EXISTING MANHOLE
 - 102.00 TELE CATCHBASIN
 - 102.00 EXISTING CATCHBASIN
 - 102.00 HYDRAULIC VALVE & IS
 - 102.00 VALVE & IS
 - 102.00 BUILDING FLOOR ELEVATION
 - 102.00 TOP OF FOUNDATION (TOP)
 - 102.00 PROPOSED FLOOR ELEVATION
 - 102.00 FINISH FLOOR ELEVATION (FF)
 - 102.00 ELEVATION (FF)
 - 102.00 UNITS: SEWERING & WASTEWATER WALKOUT UNITS
 - 102.00 SLOPE ON GRADE
 - 102.00 HYDRO SWITCHGEAR
 - 102.00 HYDRO TRANSFORMER
 - 102.00 STREET LIGHT STANDAARD
 - 102.00 TACTILE WALKWAY SURFACE
 - 102.00 PROPOSED UTILITY
 - 102.00 EXISTING UTILITY
 - 102.00 EXISTING PHASES / PHASES NOT PART OF CURRENT GRADING APPROVAL
 - 103.45 OVERLAND FLOW DIRECTION
 - 103.27 EXISTING ELEVATION
 - 103.00 FUTURE ELEVATION
 - 102.80 PROPOSED WALKWAY GRADE
 - 102.18 HIGH POINT
 - 102.00 STREET CATCHBASIN
 - 102.00 EXISTING MANHOLE
 - 102.00 TELE CATCHBASIN
 - 102.00 EXISTING CATCHBASIN
 - 102.00 HYDRAULIC VALVE & IS
 - 102.00 VALVE & IS
 - 102.00 BUILDING FLOOR ELEVATION
 - 102.00 TOP OF FOUNDATION (TOP)
 - 102.00 PROPOSED FLOOR ELEVATION
 - 102.00 FINISH FLOOR ELEVATION (FF)
 - 102.00 ELEVATION (FF)
 - 102.00 UNITS: SEWERING & WASTEWATER WALKOUT UNITS
 - 102.00 SLOPE ON GRADE
 - 102.00 HYDRO SWITCHGEAR
 - 102.00 HYDRO TRANSFORMER
 - 102.00 STREET LIGHT STANDAARD
 - 102.00 TACTILE WALKWAY SURFACE
 - 102.00 PROPOSED UTILITY
 - 102.00 EXISTING UTILITY
 - 102.00 EXISTING PHASES / PHASES NOT PART OF CURRENT GRADING APPROVAL

NOT FOR CONSTRUCTION

4	ADP	20-01-27 5th SUBMISSION
1	ADP	20-02-19 4th SUBMISSION
4	ADP	20-04-24 3RD SUBMISSION
1	ADP	19-10-23 2ND SUBMISSION
1	ADP	19-10-24 1ST SUBMISSION
1	ADP	18-11-16 PRELIMINARY

TOPOGRAPHIC INFORMATION
D. J. BARNES LIMITED PROJECT NUMBER 18-10-146-00 SURVEY DATED JUNE 26, 2019

LEGAL INFORMATION
PREPARED BY: BARNES LTD. PROJECT 18-10-146-00 DATED APRIL 5, 2020

RECORD MARK No. 001196403710
GRADING SHOWN ON THIS PLAN ARE RELATED TO EXISTING DATA AND ARE DERIVED FROM THE MUNICIPALITY OF OTTAWA'S SPATIAL DATA. A FURTHER EXPLANATION OF DATA SOURCES IS AVAILABLE AT: WWW.CITYOFOTTAWA.CA

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL
Design Services Ltd.
120 Bay Road Unit 103
Ottawa, Ontario K2H 1S9
Tel: (613) 836-8888
Fax: (613) 836-1125
www.dsel.ca

A-8 FOREST SERVICES
A-8 FOREST SERVICES
120 Bay Road Unit 103
Ottawa, Ontario K2H 1S9
Tel: (613) 836-8888
Fax: (613) 836-1125
www.a8forest.com

Ottawa CITY OF OTTAWA

GRADING PLAN

PROJECT No. 18-10-146-00 SHEET No. 66

SCALE: HORIZ. 1:500

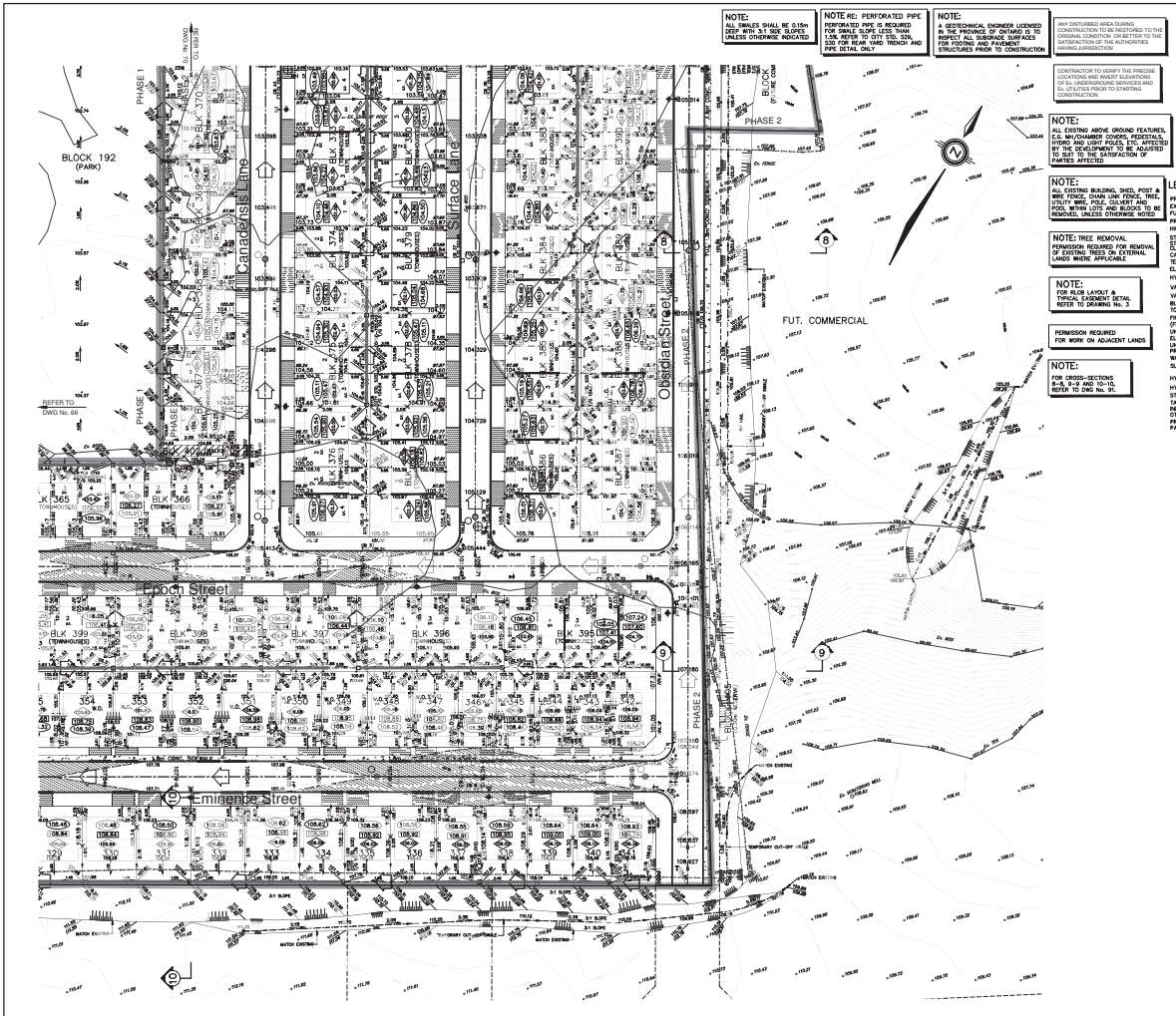
DATE: 18-10-20

PROJECT No. 18-10-146-00 SHEET No. 66

SCALE: HORIZ. 1:500

DATE: 18-10-20

CITY PLAN No. 175933
CITY FILE No. D07-16-19-0005



NOTE: ALL SIZES SHALL BE 0.5m FOR 1:500 UNLESS OTHERWISE INDICATED.

NOTE: REPERFORATED PIPE: REPERFORATED PIPE IS REQUIRED FOR SLOPE LESS THAN 1% REFER TO CITY TEL. 333-3333 FOR REPERFORATION AND PIPE DETAIL ONLY.

NOTE: A GEOTECHNICAL ENGINEER LICENSED IN THE PROVINCE OF ONTARIO IS TO VERIFY ALL SUBGRADE SURFACES FOR FOOTING AND FOUNDATION STRUCTURES PRIOR TO CONSTRUCTION.

NOTE: ALL EXISTING ABOVE GROUND FEATURES (E.G. MANHOLE COVERS, PESTICIDE HOLES AND HOSE PIPES) TO BE ADJUSTED TO FIT TO THE SUBGRADE OF PHASES AFFECTED.

NOTE: ANY DISTURBED AREA DURING CONSTRUCTION TO BE RESTORED TO ORIGINAL CONDITION OR BETTER TO THE SATISFACTION OF THE APPROVED CONTRACTOR.

CONTRACTOR TO KEEP THE PRECISE LOCATION AND HEIGHT ELEVATIONS OF ALL MEASUREMENT SERVICES AND BE UTILIZED PRIOR TO STARTING ANY CONSTRUCTION.

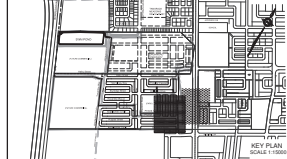
NOTE: ALL EXISTING ABOVE GROUND FEATURES (E.G. MANHOLE COVERS, PESTICIDE HOLES AND HOSE PIPES) TO BE ADJUSTED TO FIT TO THE SUBGRADE OF PHASES AFFECTED.

NOTE: TREE REMOVAL: PERMISSION REQUIRED FOR REMOVAL OF EXISTING TREES ON EXTERNAL LANDS WHERE APPLICABLE.

NOTE: FOR PILES LAYOUT & TYPICAL ELEMENTS REFER TO DRAWING No. 2.

PERMISSION REQUIRED FOR WORK ON ADJACENT LANDS

NOTE: FOR CROSS-SECTIONS REFER TO ENG No. 31.



- LEGEND**
- PROPOSED ELEVATION ——— 103.45
 - EXISTING ELEVATION ——— 102.22
 - FUTURE ELEVATION ——— (143.00)
 - PROPOSED GRADE ——— 1.00
 - HIGH POINT ——— 103.16
 - STREET CATCHBASIN ——— 103.00
 - EXISTING MANHOLE ——— 103.00
 - NEW CATCHBASIN ——— 103.00
 - ELDER CATCHBASIN ——— 103.00
 - HYDRANT, VALVE & IS ——— 103.00
 - VALVE & IS ——— 103.00
 - BASELINE ELEVATION ——— 103.00
 - TOP OF FOUNDATION (TOF) ——— 103.00
 - PERMISSIBLE FLOOR ELEVATION (PFE) ——— 103.00
 - PERMISSIBLE FLOOR ELEVATION (PFE) ——— 103.00
 - UNITS: 1000 (NO UNITS) ——— 103.00
 - SLAB ON GRADE ——— 103.00
 - HYDRO SWITCHGEAR ——— 103.00
 - HYDRO TRANSFORMER ——— 103.00
 - STREET LIGHT STANDARD ——— 103.00
 - TACTILE WARNING SURFACE ——— 103.00
 - INDICATOR LIGHTS ——— 103.00
 - PERVIOUS PHASES / PHASES NOT PART OF CURRENT GRADING APPROVAL
- LEGEND**
- 103.45 OVERLAND FLOW DIRECTION
 - 102.22 FLOW DIRECTION
 - 1.00 EXTERNAL OVERLAND FLOW DIRECTION
 - 103.16 PROPERTY OVERLAND FLOW DIRECTION
 - 103.00 RETAINING WALL AND ELEVATIONS
 - 103.00 MINIMUM FINISH (LOW ON LOTS OTHERWISE NOTED)
 - 103.00 HOSE RANGES (SEE LANDSCAPE DWGS FOR DETAIL)
 - 103.00 CONSTRUCTION FENCE
 - 103.00 PROPERTY BOUNDARY
 - 103.00 1:1 TERRACE MAXIMUM SLOPE
 - 103.00 FORMING AREA WITH SPILLWAY ELEVATION (MINIMUM 0.30%)
 - 103.00 200K PIPES PERFORATED PIPES (REFER TO CITY TEL 333-3333 FOR DETAILS ONLY)
 - 103.00 SLOPE LESS THAN 1:10
 - 103.00 CLAY SEAL REFER TO GENERAL NOTES, TABLE DSG, NO. 1.

NOT FOR CONSTRUCTION

4	ADP	20-07-27th SUBMISSION
1	ADP	20-26-19th SUBMISSION
4	ADP	20-24-24th SUBMISSION
1	ADP	19-13-23rd SUBMISSION
2	ADP	19-13-24th SUBMISSION
1	ADP	19-13-21st SUBMISSION
1	ADP	19-13-20th SUBMISSION

TOPOGRAPHIC INFORMATION
 2D BARRIS LIMITED PROJECT NUMBER 18-10-140-00 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
 2D BARRIS LIMITED PROJECT NUMBER 18-10-140-00, DATED APRIL 5, 2019.

BENCH MARK No. 001195403710
 ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GROUND DATA AND ARE DERIVED FROM THE MUNICIPALITY OF OTTAWA'S SPATIAL DATA FRAMEWORK (SDWF) DATUM.

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL
 CONSULTING INC.
 120 Bay Road Unit 103
 Ottawa, Ontario K2H 1G9
 Tel: (613) 836-2888
 Fax: (613) 836-1165
 www.dsel.ca

Ottawa CITY OF OTTAWA

GRADING PLAN

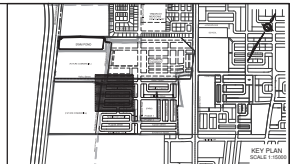
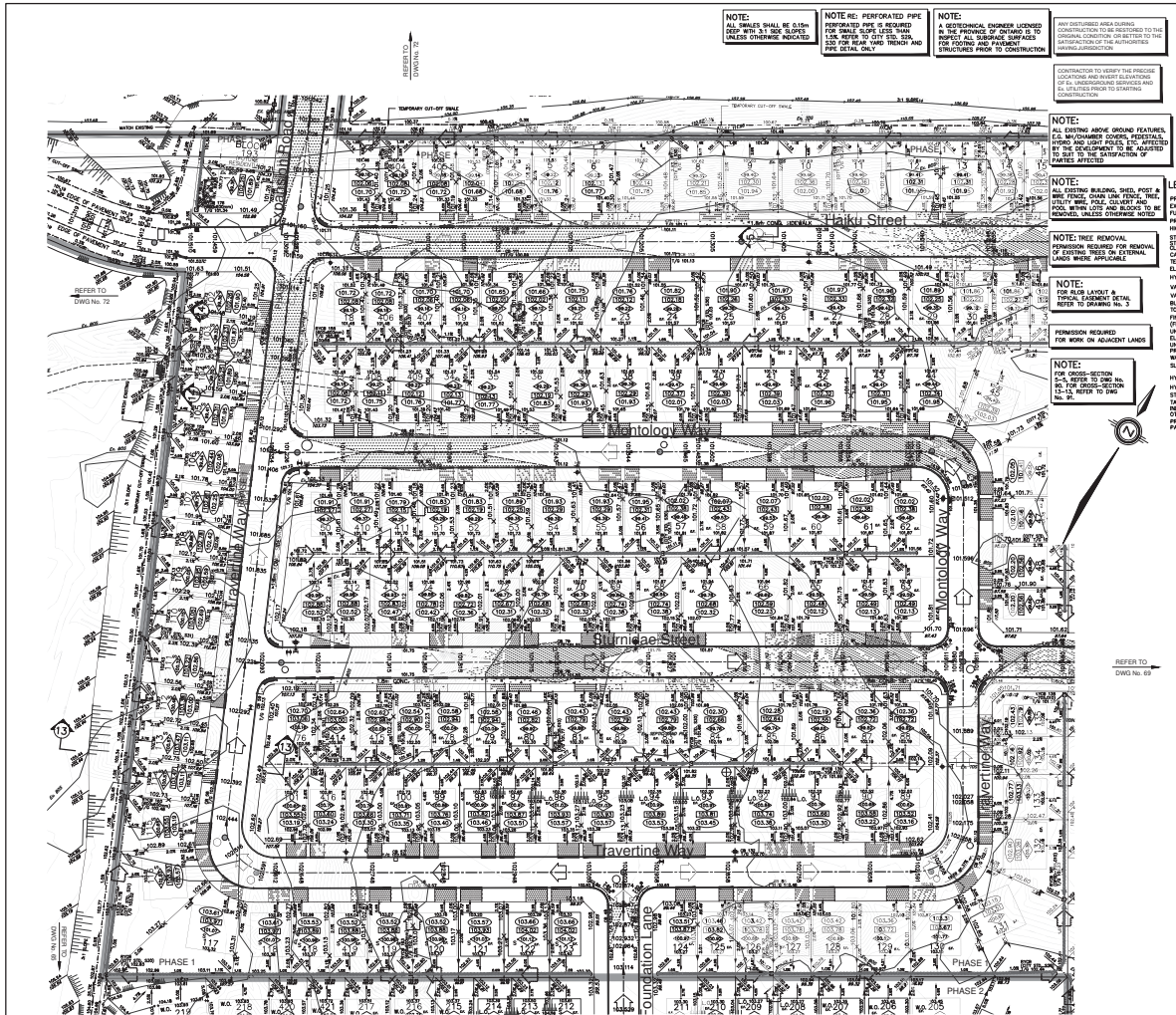
CAIVAN COMMUNITIES THE RIDGE PHASE 1

PROJECT No. 18-1030

SHEET No. 67

HORIZ. SCALE 1:500

DATE: APRIL 5, 2019



LEGEND

103.45	OVERLAND FLOW DIRECTION	→
102.22	PROPOSED ELEVATION	—
103.000	EXISTING ELEVATION	—
102.00	FUTURE ELEVATION	—
1.00	PROPOSED SLOPE GRADE	—
102.16	EXTERNAL OVERLAND FLOW DIRECTION	→
102.16	INTERNAL OVERLAND FLOW DIRECTION	→
102.16	INDICATED OVERLAND FLOW DIRECTION	→
102.16	RETAINING WALL AND ELEVATION	—
102.16	MINIMUM FINISH (LOW POINT UNLESS OTHERWISE NOTED)	—
102.16	MOISTURE BARRIER (SEE LANDSCAPE DWGS FOR DETAIL)	—
102.16	CONSTRUCTION FENCE	—
102.16	PROPERTY BOUNDARY	—
102.16	1:1 TERRACING MAXIMUM SLOPE	—
102.16	FORMING AREA WITH SLOPE ELEVATION (MINIMUM 0.300%)	—
102.16	200# PIP PERFORATED PIPE (SEE LANDSCAPE DWGS FOR DETAIL)	—
102.16	2" SLOPE TRENCH AND PIPE DETAILS ONLY (CONCRETE APPLIED TO SLOPE LESS THAN 1:10)	—
102.16	CLAY SEAL REFER TO GENERAL NOTES, TABLE 10.1.1	—
102.16	PERFORATED PHASES / PHASES NOT PART OF CURRENT GRADING APPROVAL	—

NOT FOR CONSTRUCTION

1	ADJ. 20-21-22 5th SUBMISSION
2	ADJ. 20-22-23 4th SUBMISSION
3	ADJ. 20-24-24 3rd SUBMISSION
4	ADJ. 19-10-24 3RD SUBMISSION
5	ADJ. 19-10-24 1ST SUBMISSION
6	ADJ. 18-10-24 1ST SUBMISSION

TOPOGRAPHIC INFORMATION
 2D BANNES LIMITED PROJECT NUMBER 18-10-140-00 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
 PREPARED BY: CAIVAN COMMUNITIES LTD. PROJECT 18-10-140-00, DATED APRIL 5, 2019

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL
 120 Sun Road Unit 103
 Cambridge, Ontario N2H 2T9
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 Fax: (613) 836-1182
 www.DSEL.ca

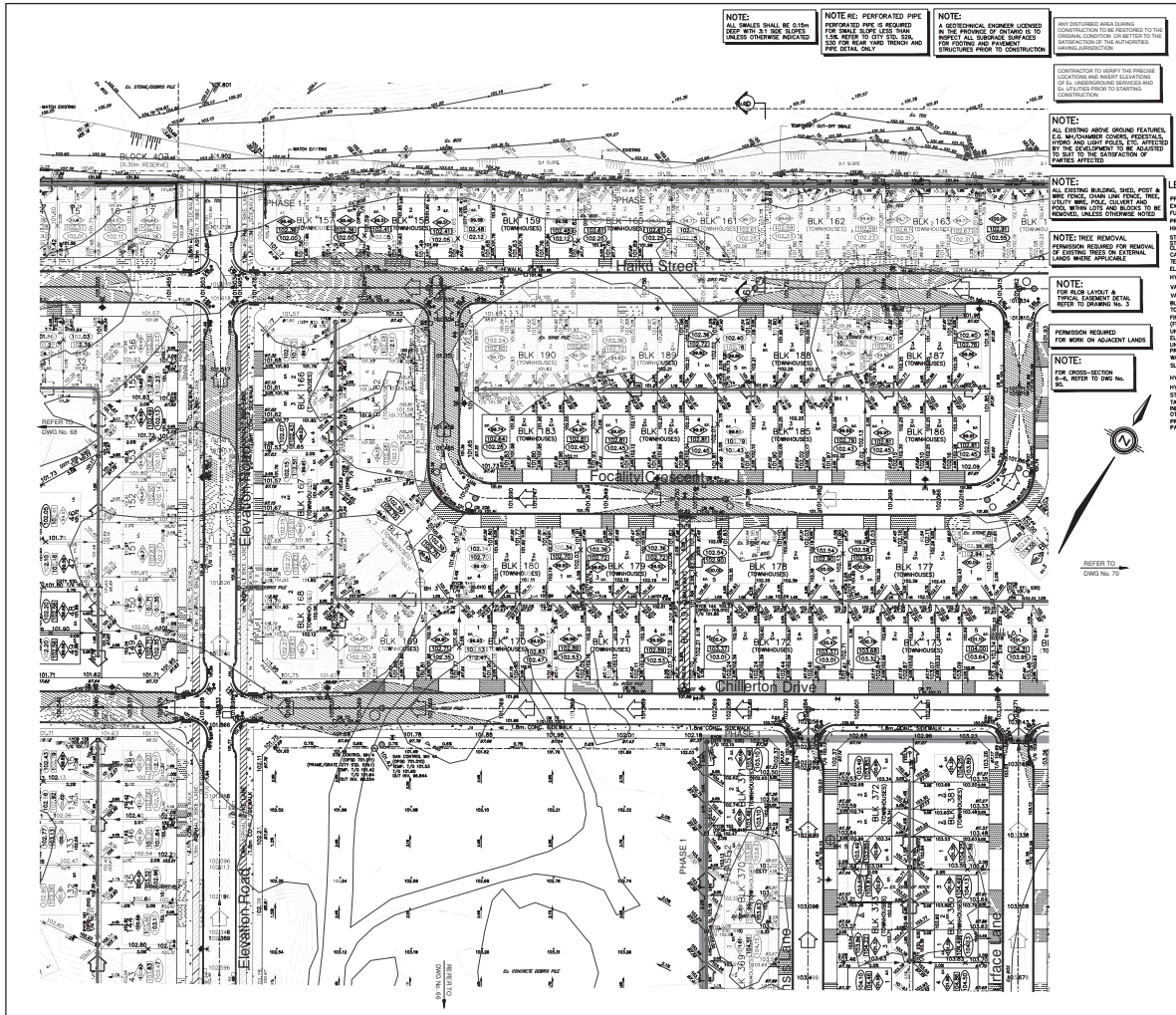
A 3 FOREST
 1000 Highway 7
 Cambridge, Ontario N2H 2T9
 Tel: (613) 836-8888
 Fax: (613) 836-1182
 www.A3FOREST.ca

Ottawa CITY OF OTTAWA

GRADING PLAN

PROJECT NO. 18-1030 SHEET NO. 68

SCALE: HORIZ. 1:500



NOTE:
ALL SIZES SHALL BE 0.15m-0.20m WITH 1% SLOPE UNLESS OTHERWISE INDICATED.

NOTE: PERFORATED PIPE FOR DRAINAGE SHALL BE 150mm DIA. UNLESS OTHERWISE INDICATED.

NOTE: A GEOTECHNICAL ENGINEER LICENSED IN THE PROVINCE OF ONTARIO IS TO BE CONSULTED TO VERIFY ALL FOUNDATION SURFACES FOR FOOTING AND FOUNDATION STRUCTURES PRIOR TO CONSTRUCTION.

ALL EXISTING ABOVE GROUND FEATURES (E.G. MANHOLE COVERS, FENCEPOSTS, HOLES AND HOLES) SHALL BE ADJUSTED TO SUIT TO THE SURVEY OF THE PLANES AFFECTED.

CONTRACTOR TO KEEP THE PRECISE LOCATION AND POINT ELEVATIONS OF ALL MEASUREMENT SERVICES AND UTILITIES PRIOR TO STARTING CONSTRUCTION.



NOTE:
ALL EXISTING ABOVE GROUND FEATURES (E.G. MANHOLE COVERS, FENCEPOSTS, HOLES AND HOLES) SHALL BE ADJUSTED TO SUIT TO THE SURVEY OF THE PLANES AFFECTED.

NOTE:
TREES TO BE REMOVED FOR RENOVATION OF EXISTING TREES ON EXTERNAL LANDS WHERE APPLICABLE.

NOTE:
PERMISSION REQUIRED FOR WORK ON ADJACENT LANDS FOR CROSS-SECTION REFER TO DRAWING No. 2.

NOTE:
FOR CROSS-SECTION REFER TO DRAWING No. 2.

LEGEND

102.45	OVERLAND FLOW DIRECTION	→
102.22	PROPOSED ELEVATION	—
(14.00)	FUTURE ELEVATION	—
—	PROPOSED GRADE	—
102.18	HIGH POINT	○
102.18	STREET CATCHBASIN	○
102.18	EXISTING CATCHBASIN	○
102.18	NEW CATCHBASIN	○
102.18	TELEPHONE CATCHBASIN	○
102.18	TELEPHONE CATCHBASIN	○
102.18	HYDRAULIC VALVE & IS	○
102.18	VALVE & IS	○
102.18	BASELINE ELEVATION	○
102.18	TOP OF FOUNDATION (FOF)	○
102.18	PROPOSED FLOOR ELEVATION	○
102.18	EXISTENCE OF FOOTING	○
102.18	ELEVATION (FOF)	○
102.18	UNITED STATES WATER	○
102.18	WALDOUT UNITS	○
102.18	SLAB ON GRADE	○
102.18	HYDRO TRANSFORMER	○
102.18	STREET LIGHT STANDARDS	○
102.18	TACTILE WARNING SURFACE	○
102.18	INDICATING (L.S. 10)	○
102.18	PROPOSED PHASES / PHASES NOT PART OF CURRENT GRADING APPROVAL	○

NOT FOR CONSTRUCTION

1	ADJ. 20-21-22 5th SUBMISSION
2	ADJ. 20-22-23 4th SUBMISSION
3	ADJ. 20-24-24 3rd SUBMISSION
4	ADJ. 19-23-23 2nd SUBMISSION
5	ADJ. 19-23-24 1st SUBMISSION

TOPOGRAPHIC INFORMATION
 20' BENCH LIMITED PROJECT NUMBER 18-10-10-00 SURVEY DATED JULY 26, 2019
 LEGAL INFORMATION
 CONSULTED: 18-10-10-00 SURVEY DATED JULY 26, 2019
 APRIL 8, 2020
 BENCH MARK: No. 001198403710
 GRADING SHALL BE THE 0.15m AND RELATED TO GROUND DATA AND BE DERIVED FROM THE MUNICIPALITY PROVIDED AND SUPERSEDES ANY PREVIOUS GRADING OF THIS AREA.

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL
 120 Sun Road Unit 103
 Cambridge, Ontario N2H 2E9
 Tel: (519) 836-8888
 Fax: (519) 836-1182
 www.DSEL.ca

A-1 FOREST SERVICES

Ottawa CITY OF OTTAWA

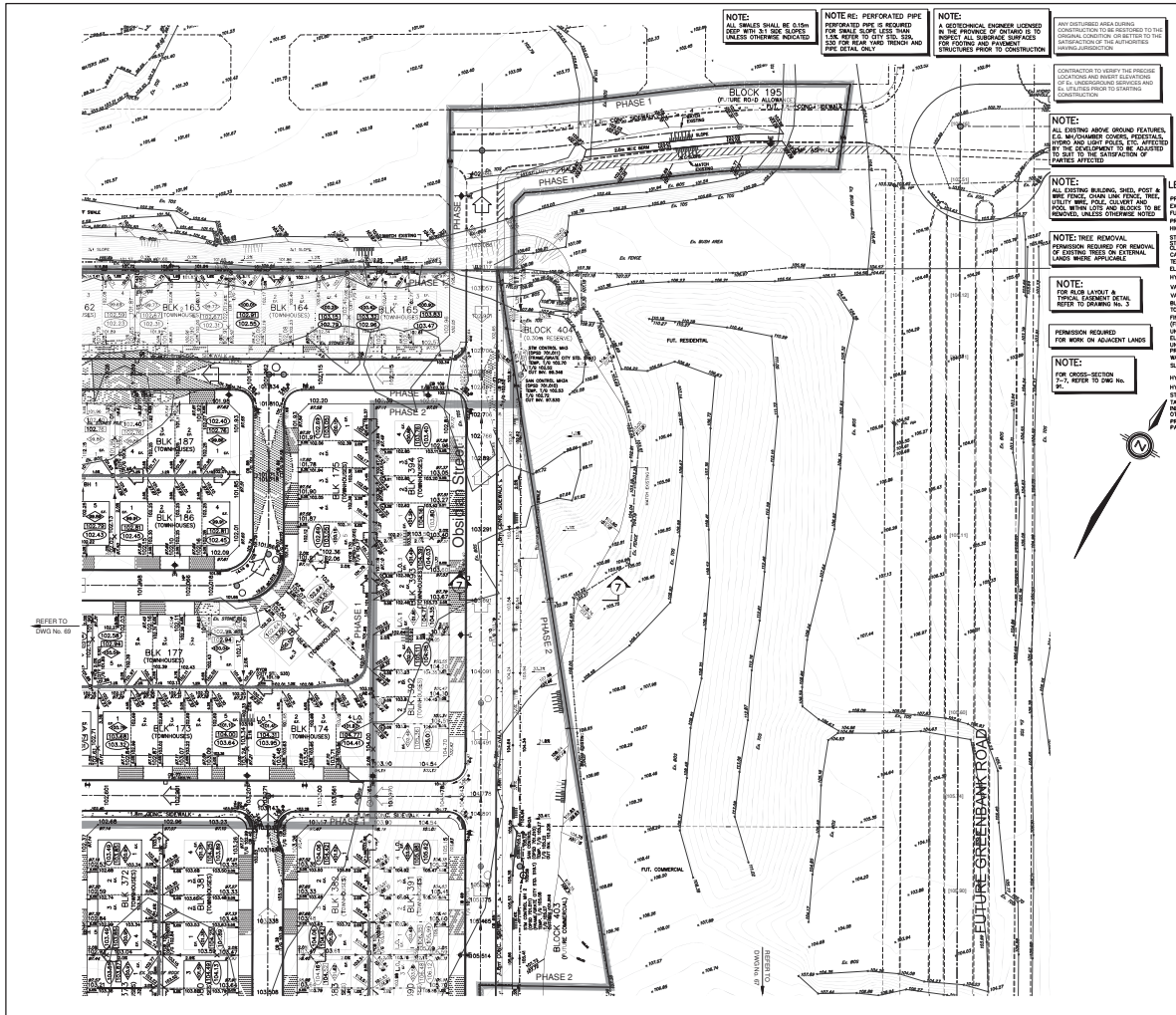
GRADING PLAN

PROJECT No. 18-10-30 SHEET No. 69

SCALE: HORIZ. 1:500

DATE: 18-10-30

DESIGNED BY: G.S.G. CHECKED BY: A.D.F. PROJECT No. 18-10-30
 DRAWN BY: C.M.A. CHECKED BY: A.D.F. SHEET No. 69



NOTE:
ALL SLOPES SHALL BE 0.5% UNLESS OTHERWISE INDICATED.

NOTE: PERFORATED PIPE IS REQUIRED FOR SLOPE SLOPE LESS THAN 1.0% REFER TO CITY TSS 330 FOR HEAD OVER FLOW AND PIPE DETAIL ONLY.

NOTE: A GEOTECHNICAL ENGINEER LICENSED IN THE PROVINCE OF ONTARIO IS TO VERIFY ALL SURFACE SURFACES FOR FOOTING AND FOUNDATION STRUCTURES PRIOR TO CONSTRUCTION.

Any disturbed area during construction to be restored to the original condition, or better to that condition than the adjacent area.

CONTRIBUTOR TO KEEP THE PRECISE LOCATION OF ANY EXISTING UTILITIES OF ALL UNDERGROUND SERVICES AND BE UTILITIES PRIOR TO STARTING CONSTRUCTION.

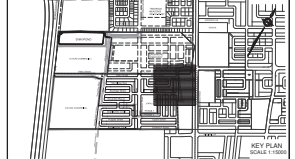
NOTE:
ALL EXISTING ABOVE GROUND FEATURES (E.G. MANHOLE COVERS, PERESTALS, SIGNS AND LIGHT FIXTURES) TO BE REMOVED UNLESS OTHERWISE NOTED.

NOTE: TREE REMOVAL PERMISSION REQUIRED FOR REMOVAL OF EXISTING TREES ON EXTERNAL LANDS WHERE APPLICABLE.

NOTE: FOR PILES LAYOUT A TYPICAL EXEMPT DETAIL REFER TO DRAWING No. 2.

NOTE: PERMISSION REQUIRED FOR WORK ON ADJACENT LANDS.

NOTE: FOR CROSS-SECTION REFER TO DRAWING No. 2.



LEGEND

PROPOSED ELEVATION	103.45	OVERLAND FLOW DIRECTION	
EXISTING ELEVATION	102.27	EXTERNAL OVERLAND FLOW DIRECTION	
FUTURE ELEVATION	(14.00)	IMMEDIATE OVERLAND FLOW DIRECTION	
PROPOSED GRADE	1.00	RETAINING WALL AND ELEVATION	
HIGH POINT	102.16	PROPERTY BOUNDARY	
STREET CATCHBASIN	102.16	1% TYPICAL MAXIMUM SLOPE	
CUSTOMER MANHOLE	102.16	FOOTING AREA WITH SILLARY ELEVATION (MINIMUM 0.300)	
TELE CATCHBASIN	102.16	200% P.C. PERFORATED PIPE (SEE LANDSCAPE DWGS FOR DETAIL)	
ELDER CATCHBASIN	102.16	CONSTRUCTION FENCE	
HYDRANT, VALVE & IS	102.16	CONSTRUCTION FENCE	
VALVE & IS	102.16	CONSTRUCTION FENCE	
BASELINE ELEVATION	102.16	CONSTRUCTION FENCE	
TOP OF FOUNDATION (TOP)	102.16	CONSTRUCTION FENCE	
PROPOSED FLOOR ELEVATION	102.16	CONSTRUCTION FENCE	
PERMITS OF FOOTING ELEVATION (TOP)	102.16	CONSTRUCTION FENCE	
UNITS: MILLIMETERS	102.16	CONSTRUCTION FENCE	
WALKOUT UNITS	102.16	CONSTRUCTION FENCE	
SLAB ON GRADE	102.16	CONSTRUCTION FENCE	
HYDRO SWITCHGEAR	102.16	CONSTRUCTION FENCE	
HYDRO TRANSFORMER	102.16	CONSTRUCTION FENCE	
STREET LIGHT STANDARDS	102.16	CONSTRUCTION FENCE	
PAVING SURFACE	102.16	CONSTRUCTION FENCE	
CONCRETE	102.16	CONSTRUCTION FENCE	
PERFORATED PIPE	102.16	CONSTRUCTION FENCE	
PERFORATED PHASES / PHASES NOT PART OF CURRENT GRADING APPROVAL	102.16	CONSTRUCTION FENCE	

NOT FOR CONSTRUCTION

1	ADJ. 20-21-22 5th SUBMISSION
2	ADJ. 20-22-23 4th SUBMISSION
3	ADJ. 20-23-24 3rd SUBMISSION
4	ADJ. 20-24-25 2nd SUBMISSION
5	ADJ. 20-25-26 1st SUBMISSION
6	ADJ. 20-26-27 1st SUBMISSION

TOPOGRAPHIC INFORMATION
 20 BARRIS LIMITED PROJECT NUMBER 18-10-140-00 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
 PREPARED BY: DSEL PROVIDED BY: JD BARRIS LTD. PROJECT 18-10-140-00, DATED APRIL 5, 2019

REVISION MARK No. 001196403710
 GEOTECHNICAL DATA ON THIS PLAN ARE RELATED TO GEOTECHNICAL DATA AND ARE DERIVED FROM THE MUNICIPALITY OF OTTAWA. THE CITY OF OTTAWA IS NOT RESPONSIBLE FOR THE ACCURACY OF THE DATA.

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL
 120 Sun Road Unit 103
 Ottawa, Ontario K2H 1S9
 Tel: (613) 836-8888
 Fax: (613) 836-1183
 www.dsel.ca

A-1 FOREST SERVICES

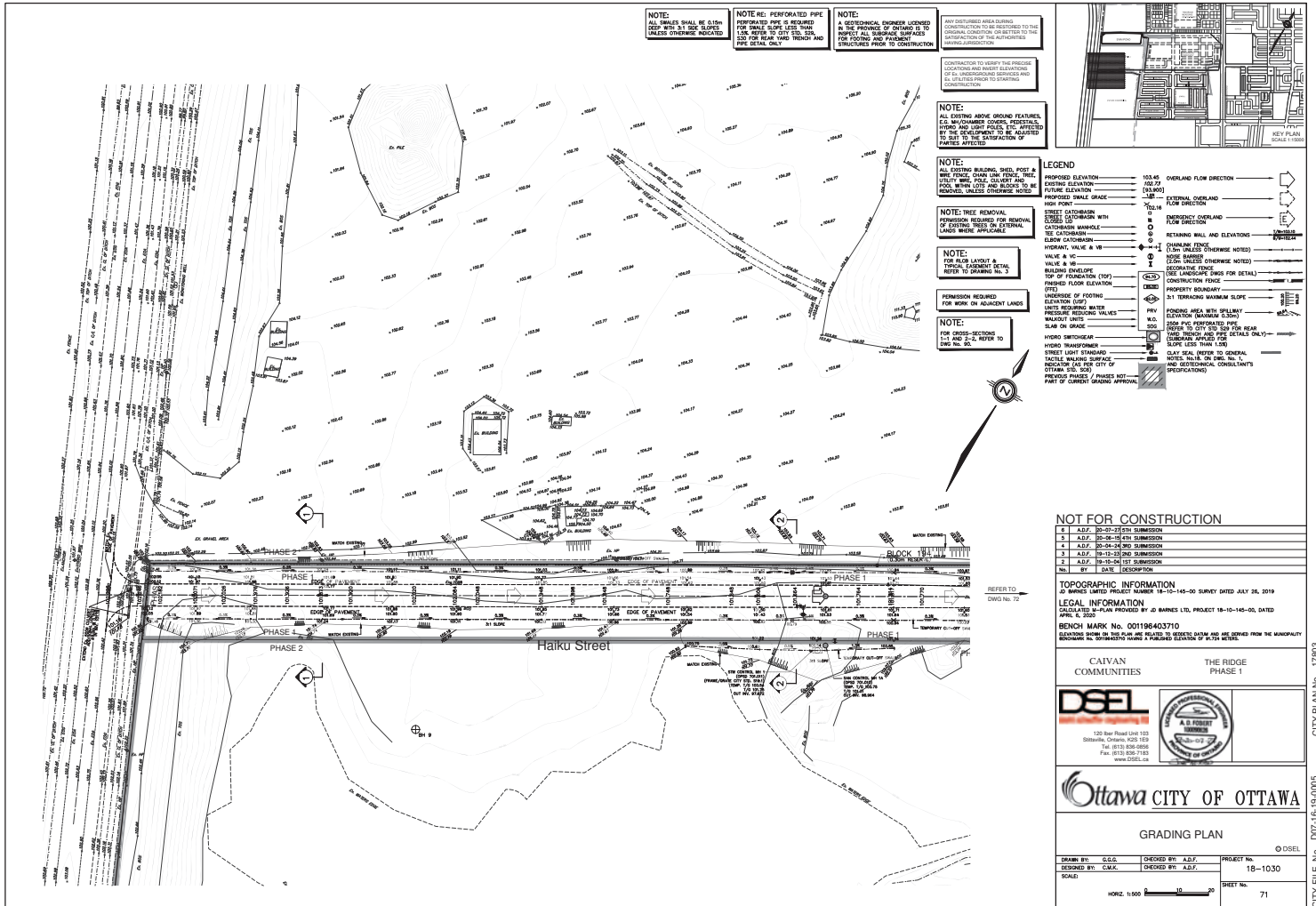
Ottawa CITY OF OTTAWA

GRADING PLAN

PROJECT No. 18-1030
 SHEET No. 70

SCALE: HORIZ. 1:500

CITY PLAN No. 17503
 CITY FILE No. D07-16-19-0005

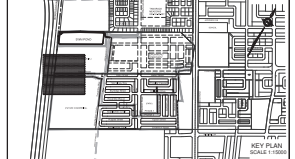


NOTE:
ALL SLOPES SHALL BE 0.5%
UNLESS OTHERWISE INDICATED.

NOTE: RE: PERFORATED PIPE
PERFORATED PIPE IS REQUIRED
FOR SLOPE LESS THAN
1.0% REFER TO CITY TRM
300 FOR HEAD, SPACING AND
PIPE DETAIL ONLY.

NOTE:
A GEOTECHNICAL ENGINEER LICENSED
IN THE PROVINCE OF ONTARIO IS TO
VERIFY ALL SUBGRADE SURFACES
FOR FOOTING AND FOUNDATION
STRUCTURES PRIOR TO CONSTRUCTION.

CONTRACTOR TO KEEP THE PRECISE
LOCATION AND POINT ELEVATIONS
OF ALL INTERFERING SERVICES AND
BE UTILIZED PRIOR TO STARTING
CONSTRUCTION.



NOTE:
ALL EXISTING ABOVE GROUND FEATURES
E.G. MANHOLE COVERS, PERESTALS,
SIGNS AND LIGHT FIXTURES, ETC. NOTICED
BY THE DEVELOPER TO BE ADJUSTED
TO FIT TO THE SUBGRADE OF
PHASES AFFECTED.

NOTE:
ALL EXISTING BUILDING, SHED, POST &
RAIL FENCE, CHAIN LINK FENCE, TREE,
UTILITY WIRE, TREE, CONCRETE PILING, TO
BE REMOVED UNLESS OTHERWISE NOTED.

NOTE: TREE REMOVAL
PERMISSION REQUIRED FOR REMOVAL
OF EXISTING TREES ON EXTERNAL
LANDS WHERE APPLICABLE.

NOTE:
FOR PILE LAYOUT &
TYPICAL ELEMENT DETAIL
REFER TO DRAWING No. 2.

PERMISSION REQUIRED
FOR WORK ON ADJACENT LANDS

NOTE:
FOR CROSS-SECTION
1-1 AND 2-2 REFER TO
DWG No. 90.

LEGEND

PROPOSED ELEVATION	102.45	OVERLAND FLOW DIRECTION	→
EXISTING ELEVATION	102.27	EXTERNAL OVERLAND FLOW DIRECTION	→
FUTURE ELEVATION	(N/A)	IMMEDIATE OVERLAND FLOW DIRECTION	→
PROPOSED GRADE	102.00	RETAINING WALL AND ELEVATION	—
HIGH POINT	102.18	PROPERTY BOUNDARY	—
STREET CATCHBASIN	102.00	1:1 TERRACING MAXIMUM SLOPE	1:1
CATCHBASIN MANHOLE	102.00	FOOTING AREA WITH SLOPE	—
TELE CATCHBASIN	102.00	W.O. (SEE LANDSCAPE DWGS FOR DETAIL)	—
ELDER CATCHBASIN	102.00	CONSTRUCTION FENCE	—
HYDRANT, VALVE & IS	102.00	PERFORATED PIPE	—
VALVE & IS	102.00	PERFORATED PIPE	—
VALVE & IS	102.00	PERFORATED PIPE	—
TOP OF FOUNDATION (TOF)	102.00	PERFORATED PIPE	—
PROPOSED FLOOR ELEVATION	102.00	PERFORATED PIPE	—
(FTE)	102.00	PERFORATED PIPE	—
PERIMETER OF FOOTING	102.00	PERFORATED PIPE	—
ELEVATION (EFT)	102.00	PERFORATED PIPE	—
UNITS: DIMENSIONS IN METERS	102.00	PERFORATED PIPE	—
WALKOUT UNITS	102.00	PERFORATED PIPE	—
SLAB ON GRADE	102.00	PERFORATED PIPE	—
HYDRO TRANSFORMER	102.00	PERFORATED PIPE	—
STREET LIGHT STANDARDS	102.00	PERFORATED PIPE	—
TACTILE WALKING SURFACE	102.00	PERFORATED PIPE	—
INDICATED (AS PER CITY OF	102.00	PERFORATED PIPE	—
OTTAWA)	102.00	PERFORATED PIPE	—
PERFORATED PHASES / PHASES NOT	102.00	PERFORATED PIPE	—
PART OF CURRENT GRADING APPROVAL	102.00	PERFORATED PIPE	—

NOT FOR CONSTRUCTION

1	ADJ. 20-21-22 5th SUBMISSION
2	ADJ. 20-22-23 4th SUBMISSION
3	ADJ. 20-24-24 3rd SUBMISSION
4	ADJ. 19-13-13 2nd SUBMISSION
5	ADJ. 19-13-24 1st SUBMISSION
6	ADJ. 18-10-10 1st SUBMISSION

TOPOGRAPHIC INFORMATION
BY BARNES LTD. PROJECT NUMBER 18-10-10-001 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
PREPARED BY BARNES LTD. PROJECT 18-10-10-001 DATED APRIL 5, 2020

RECORD MARK No. 001196403710
DRAWINGS SHOWN ON THIS PLAN ARE RELATED TO OTHER DATA AND ARE DERIVED FROM THE MUNICIPALITY OF OTTAWA. THE CITY OF OTTAWA IS NOT RESPONSIBLE FOR THE ACCURACY OF THE DATA.

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL
120 Bay Road Unit 103
Ottawa, Ontario K2H 1S9
Tel: (613) 836-8888
Fax: (613) 836-1125
www.DSEL.ca

A & F FOREST SERVICES

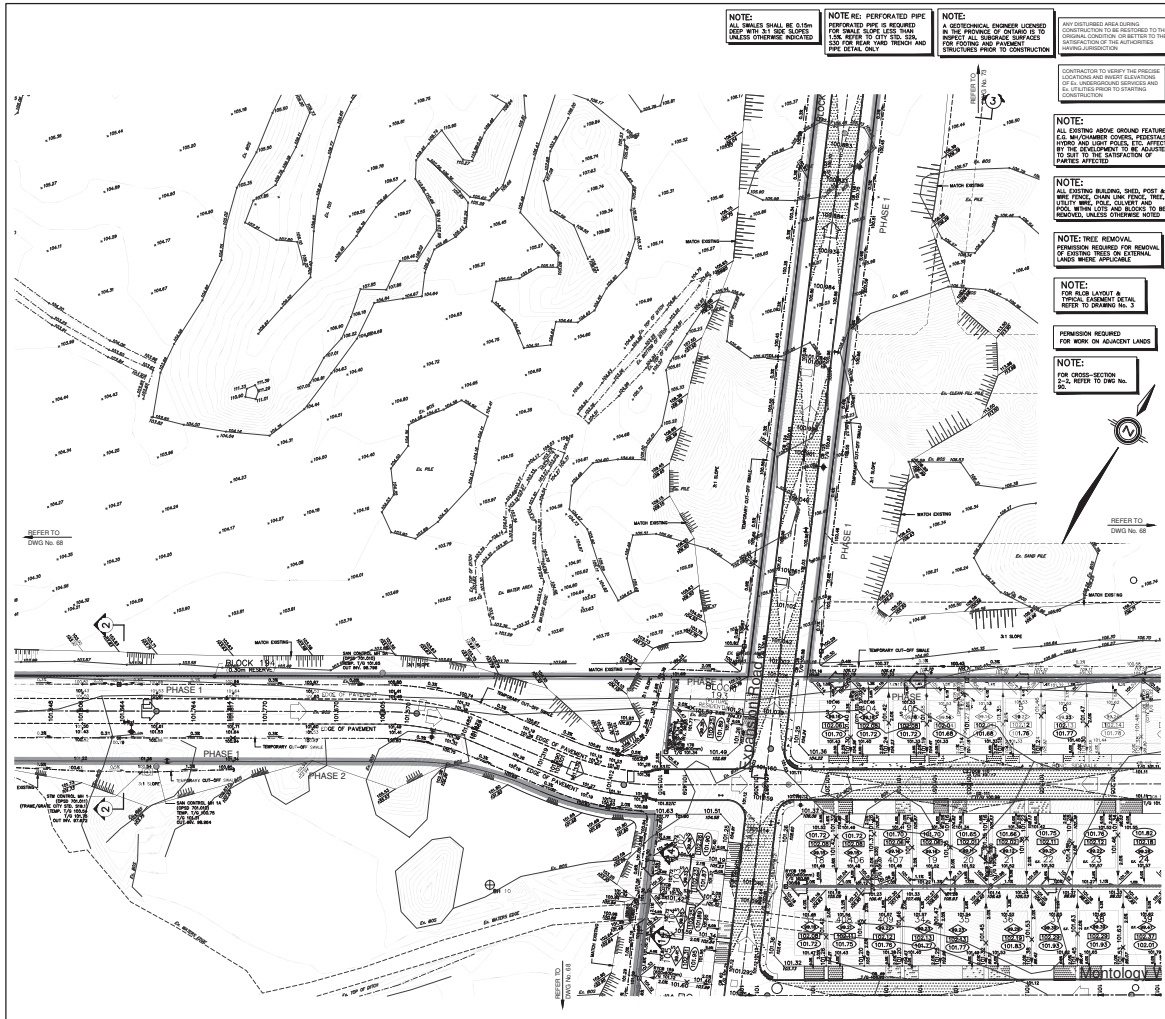
Ottawa CITY OF OTTAWA

GRADING PLAN

PROJECT No. 18-10-10-001
SHEET No. 71

SCALE: HORIZ 1:500

CITY PLAN No. 17503
CITY FILE No. D07-16-19-0005



NOTE:
ALL SLOPES SHALL BE 0.5% UNLESS OTHERWISE INDICATED.

NOTE: PERFORATED PIPE FOR DRAINAGE SHALL BE 150mm DIA. PERFORATED PIPE IS TO BE INSTALLED AT THE POINTS OF DRAINAGE TO PROTECT ALL SURFACE SURFACES FOR FOOTING AND FOUNDATION STRUCTURES PRIOR TO CONSTRUCTION.

NOTE: ALL EXISTING ABOVE GROUND FEATURES (E.G. MANHOLE COVERS, PESTICIDES, HOLES AND HOIST PITS, ETC.) MUST BE REMOVED PRIOR TO STARTING CONSTRUCTION.

NOTE: ANY DISTURBED AREA DURING CONSTRUCTION TO BE RESTORED TO THE ORIGINAL CONDITION OR BETTER TO THE SATISFACTION OF THE APPROVED PROFESSIONAL ENGINEER.

NOTE: CONTRACTOR TO KEEP THE PRECISE LOCATION AND POINT ELEVATIONS OF ALL MEASUREMENTS SERVICES AND BE UTILIZED PRIOR TO STARTING CONSTRUCTION.

NOTE: ALL EXISTING ABOVE GROUND FEATURES (E.G. MANHOLE COVERS, PESTICIDES, HOLES AND HOIST PITS, ETC.) MUST BE REMOVED PRIOR TO STARTING CONSTRUCTION.

NOTE: PERFORATED PIPE FOR DRAINAGE SHALL BE 150mm DIA. PERFORATED PIPE IS TO BE INSTALLED AT THE POINTS OF DRAINAGE TO PROTECT ALL SURFACE SURFACES FOR FOOTING AND FOUNDATION STRUCTURES PRIOR TO CONSTRUCTION.

NOTE: ALL EXISTING ABOVE GROUND FEATURES (E.G. MANHOLE COVERS, PESTICIDES, HOLES AND HOIST PITS, ETC.) MUST BE REMOVED PRIOR TO STARTING CONSTRUCTION.

NOTE: ANY DISTURBED AREA DURING CONSTRUCTION TO BE RESTORED TO THE ORIGINAL CONDITION OR BETTER TO THE SATISFACTION OF THE APPROVED PROFESSIONAL ENGINEER.

NOTE: CONTRACTOR TO KEEP THE PRECISE LOCATION AND POINT ELEVATIONS OF ALL MEASUREMENTS SERVICES AND BE UTILIZED PRIOR TO STARTING CONSTRUCTION.

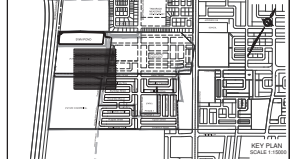
NOTE: ALL EXISTING ABOVE GROUND FEATURES (E.G. MANHOLE COVERS, PESTICIDES, HOLES AND HOIST PITS, ETC.) MUST BE REMOVED PRIOR TO STARTING CONSTRUCTION.

NOTE: PERFORATED PIPE FOR DRAINAGE SHALL BE 150mm DIA. PERFORATED PIPE IS TO BE INSTALLED AT THE POINTS OF DRAINAGE TO PROTECT ALL SURFACE SURFACES FOR FOOTING AND FOUNDATION STRUCTURES PRIOR TO CONSTRUCTION.

NOTE: ALL EXISTING ABOVE GROUND FEATURES (E.G. MANHOLE COVERS, PESTICIDES, HOLES AND HOIST PITS, ETC.) MUST BE REMOVED PRIOR TO STARTING CONSTRUCTION.

NOTE: ANY DISTURBED AREA DURING CONSTRUCTION TO BE RESTORED TO THE ORIGINAL CONDITION OR BETTER TO THE SATISFACTION OF THE APPROVED PROFESSIONAL ENGINEER.

NOTE: CONTRACTOR TO KEEP THE PRECISE LOCATION AND POINT ELEVATIONS OF ALL MEASUREMENTS SERVICES AND BE UTILIZED PRIOR TO STARTING CONSTRUCTION.



LEGEND

PROPOSED ELEVATION	103.45	OVERLAND FLOW DIRECTION	→
EXISTING ELEVATION	102.22	EXTERNAL OVERLAND FLOW DIRECTION	→
FUTURE ELEVATION	[ELEVATION]	PROPERTY OVERLAP	→
PROPOSED GRADE	102.00	CONSTRUCTION FENCE	→
HIGH POINT	102.16	RETAINING WALL AND ELEVATION	→
STREET CATCHBASIN	→	PERMANENT FENCE (CONTRACTOR TO BE NOTED)	→
CUSTOMER SERVICE	→	HOSE BARREL (CONTRACTOR TO BE NOTED)	→
TELEPHONE CATCHBASIN	→	CONSTRUCTION FENCE (SEE LANDSCAPE DWG FOR DETAIL)	→
ELDER CATCHBASIN	→	PROPERTY BOUNDARY	→
HYDRANT, VALVE & IS	→	1% TYPICAL MINIMUM SLOPE	→
VALVE & IS	→	FOODING AREA WITH SPILLWAY ELEVATION (MINIMUM 0.300)	→
VALVE & IS	→	200mm PVC PERFORATED PIPE CONSTRUCTION FENCE	→
BASELINE ELEVATION	→	SEE CITY 103 FOR SIGN SPECIFICATIONS	→
TOP OF FOUNDATION (TOP)	→	PERFORATED PIPE DETAILS ONLY (CONTRACTOR TO BE NOTED)	→
PROPOSED FLOOR ELEVATION	→	PERFORATED PIPE DETAILS ONLY (CONTRACTOR TO BE NOTED)	→
PERCENTAGE OF FOOTING ELEVATION (TOP)	→	PERFORATED PIPE DETAILS ONLY (CONTRACTOR TO BE NOTED)	→
UNITS: MILLIMETERS AND VALUES	→	PERFORATED PIPE DETAILS ONLY (CONTRACTOR TO BE NOTED)	→
WALKOUT UNITS	→	PERFORATED PIPE DETAILS ONLY (CONTRACTOR TO BE NOTED)	→
SLAB ON GRADE	→	PERFORATED PIPE DETAILS ONLY (CONTRACTOR TO BE NOTED)	→
HYDRO SWITCHGEAR	→	PERFORATED PIPE DETAILS ONLY (CONTRACTOR TO BE NOTED)	→
HYDRO TRANSFORMER	→	PERFORATED PIPE DETAILS ONLY (CONTRACTOR TO BE NOTED)	→
STREET LIGHT STANDARDS	→	PERFORATED PIPE DETAILS ONLY (CONTRACTOR TO BE NOTED)	→
TACTILE WALKING SURFACE	→	PERFORATED PIPE DETAILS ONLY (CONTRACTOR TO BE NOTED)	→
INDICATED (SEE CITY OF OTTAWA SPECIFICATIONS)	→	PERFORATED PIPE DETAILS ONLY (CONTRACTOR TO BE NOTED)	→
PERFORATED PIPE / PHASES NOT PART OF CURRENT GRADING APPROVAL	→	PERFORATED PIPE DETAILS ONLY (CONTRACTOR TO BE NOTED)	→

NOT FOR CONSTRUCTION

1	ADJ. 20-21-22 5th SUBMISSION
2	ADJ. 20-22-23 4th SUBMISSION
3	ADJ. 20-24-24 3rd SUBMISSION
4	ADJ. 19-10-20 2nd SUBMISSION
5	ADJ. 19-10-24 1st SUBMISSION
6	ADJ. 18-10-24 1st SUBMISSION

TOPOGRAPHIC INFORMATION
 20 BARRIS LIMITED PROJECT NUMBER 18-10-140-00 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
 PREPARED BY: CAIVAN COMMUNITIES LTD. PROJECT 18-10-140-00, DATED APRIL 5, 2019

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL
 120 Burr Road Unit 103
 Cambridge, Ontario N3H 5T9
 Tel: (519) 836-8888
 Fax: (519) 836-1182
 www.dsel.ca

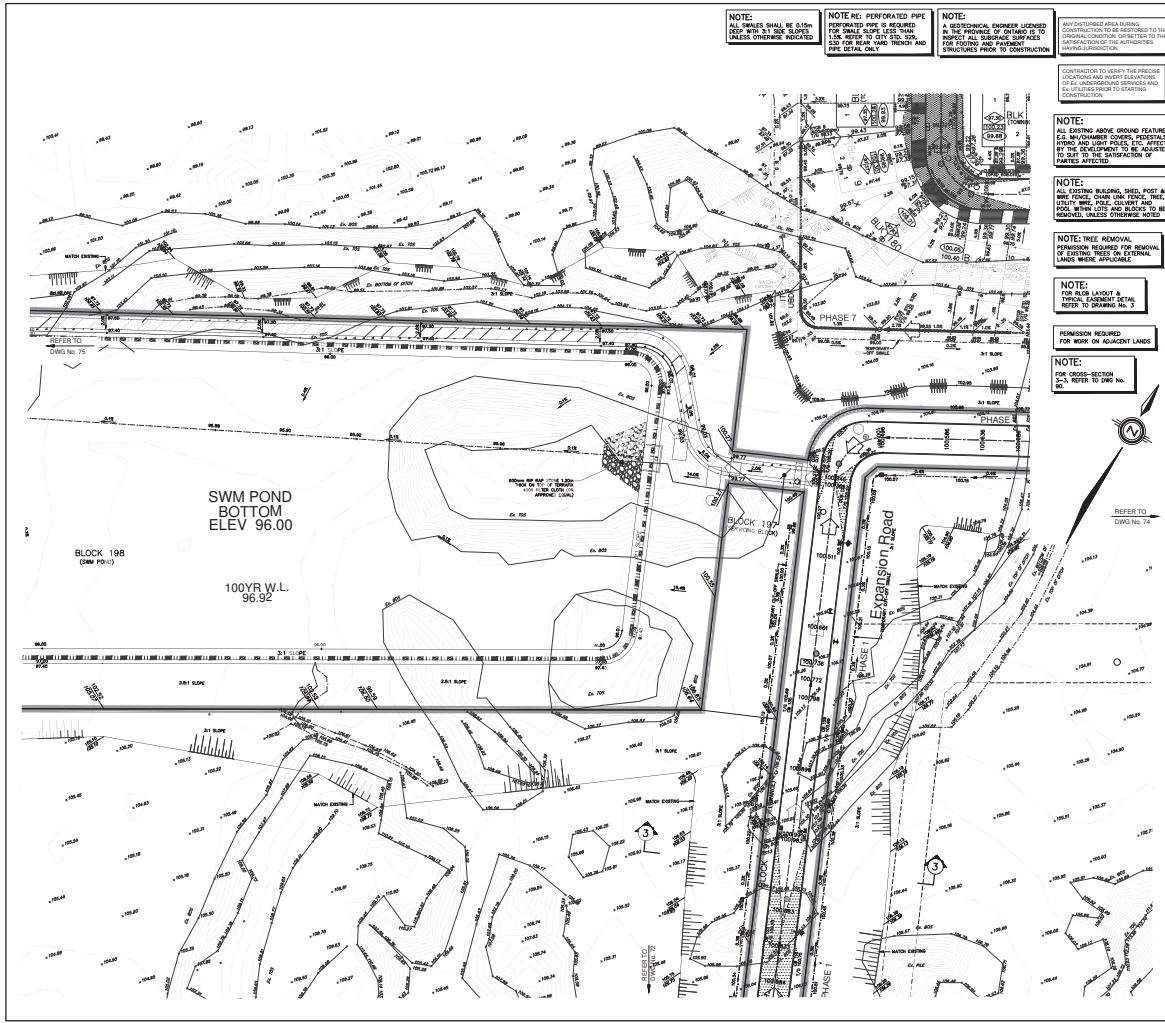
Ottawa CITY OF OTTAWA

GRADING PLAN

SCALE: HORIZ 1:500

PROJECT NO. 18-1030
 SHEET NO. 72

CITY PLAN No. 17503
 CITY FILE No. D07-16-19-0005

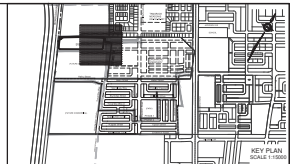


NOTE: ALL EXISTING ABOVE GROUND FEATURES (E.G. MANHOLE COVERS, PESTICIDE, HOLES AND HOIST PILES, ETC.) MUST BE REMOVED UNLESS OTHERWISE NOTED.

NOTE: PERFORATED PIPE IS REQUIRED FOR SLOPE LESS THAN 1% UNLESS OTHERWISE INDICATED.

NOTE: PERFORATED PIPE IS REQUIRED FOR SLOPE LESS THAN 1% UNLESS OTHERWISE INDICATED.

NOTE: A GEOTECHNICAL ENGINEER LICENSED IN THE PROVINCE OF ONTARIO IS TO VERIFY ALL SUBGRADE SURFACES FOR FOOTING AND FOUNDATION STRUCTURES PRIOR TO CONSTRUCTION.



NOTE: ALL EXISTING ABOVE GROUND FEATURES (E.G. MANHOLE COVERS, PESTICIDE, HOLES AND HOIST PILES, ETC.) MUST BE REMOVED UNLESS OTHERWISE NOTED.

NOTE: TREE REMOVAL PERMITS ARE REQUIRED FOR REMOVAL OF EXISTING TREES ON EXTERNAL LANDS WHERE APPLICABLE.

NOTE: PERMISSION REQUIRED FOR WORK ON ADJACENT LANDS.

NOTE: FOR CROSS-SECTION REFER TO DWG No. 10.

LEGEND

- PROPOSED ELEVATION
- EXISTING ELEVATION
- FUTURE ELEVATION
- PROPOSED SLOPE GRADE
- HIGH POINT
- STREET CATCHBASIN
- ELDER CATCHBASIN
- VALVE & HYDRANT
- VALVE & HYDRANT
- TOP OF FOUNDATION (TOP)
- PROPOSED FLOOR ELEVATION (FFE)
- PERMISE OF FOOTING ELEVATION (PFE)
- UNITS: MILLIMETER AND MILLIMETER
- WALKOUT UNITS
- SLAB ON GRADE
- HYDRO SWITCHGEAR
- HYDRO TRANSFORMER
- STREET LIGHT STANDARDS
- TACTILE WALKING SURFACE INDICATOR (AS PER CITY OF OTTAWA)
- PERFORATED PHASES / PHASES NOT PART OF CURRENT GRADING APPROVAL
- OVERLAND FLOW DIRECTION
- EXTERNAL OVERLAND FLOW DIRECTION
- IMMEDIATE OVERLAND FLOW DIRECTION
- RETAINING WALL AND ELEVATION
- PROPERTY BOUNDARY
- 1:1 TERRACING MAXIMUM SLOPE
- FOOTING AREA WITH SLEEBY ELEVATION (MINIMUM 0.300)
- 200K P.C. PERFORATED PIPE (CONFORM TO CITY OF OTTAWA SPECIFICATIONS)
- 100K P.C. PERFORATED PIPE (CONFORM TO CITY OF OTTAWA SPECIFICATIONS)
- SLOPE LESS THAN 1:100
- CLAY SEAL REFER TO GENERAL NOTES, B.L. 18.10.04.01, 1.1.01

NOT FOR CONSTRUCTION

1	ADJ.	20-01-27 5th SUBMISSION	
1	1	ADJ.	20-02-19 4th SUBMISSION
4	ADJ.	20-04-24 3rd SUBMISSION	
1	1	ADJ.	19-12-18 2nd SUBMISSION
2	ADJ.	19-12-24 1ST SUBMISSION	
10	0	0	0

TOPOGRAPHIC INFORMATION
 20 BANNES LIMITED PROJECT NUMBER 18-10-10-00 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
 PREPARED BY: CAIVAN COMMUNITIES LTD. PROJECT 18-10-10-00 DATED APRIL 5, 2019

RECORD MARK: No. 001196403710
 GEOTECHNICAL DATA AND TESTS OBTAINED FROM THE MUNICIPALITY OF OTTAWA. THE DATA IS PROVIDED TO THE CLIENT AS IS. THE CLIENT SHALL BE RESPONSIBLE FOR THE ACCURACY OF THE DATA AND ITS APPLICATION.

CAIVAN COMMUNITIES THE RIDGE PHASE 1

Ottawa CITY OF OTTAWA

GRADING PLAN

PROJECT No. 18-10-30 SHEET No. 73

SCALE: HORIZ 1:500

DATE: 18-10-30

DATE: 18-10-30

CITY PLAN No. 17503

CITY FILE No. D07-16-19-0005

NOTE:
FOR CROSS-SECTIONS
SEE PLAN A-1, REFER TO
D-2 AND A-1, REFER TO
D-2 AND A-1, REFER TO

NOTE:
ALL SLOPES SHALL BE 0.5%
UNLESS OTHERWISE INDICATED.

NOTE: PERFORATED PIPE
FOR SLOPE LESS THAN
0.5% REFER TO CITY TECH. SPEC.
SECTION 05110 FOR TRENCH AND
PIPE DETAIL ONLY.

NOTE:
A GEOTECHNICAL ENGINEER LICENSED
IN THE PROVINCE OF ONTARIO IS TO
VERIFY ALL SUBGRADE SURFACES
FOR TRENCH AND FOUNDATION
STRUCTURES PRIOR TO CONSTRUCTION.

ANY DISTURBED AREA DURING
CONSTRUCTION TO BE RESTORED TO THE
ORIGINAL CONDITION OR BETTER TO THE
SATISFACTION OF THE ADJACENT
PROPERTY OWNERS.

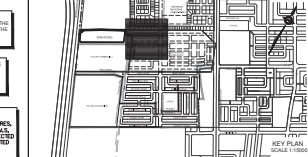
CONTRACTOR TO KEEP THE PRECISE
LOCATION AND ADJUST ELEVATIONS
OF ALL MEASUREMENT SERVICES AND
BE UTILIZED PRIOR TO STARTING
CONSTRUCTION.

NOTE:
ALL EXISTING ABOVE GROUND FEATURES
E.G. MANHOLE COVERS, PERESTALS,
HYDRO AND FIRE TRENCHES, SHALL
BE ADJUSTED TO BE ACCURATE
TO FIT TO THE SUBMITTAL OF
PHASES AFFECTED.

NOTE:
ALL EXISTING ABOVE GROUND FEATURES
E.G. MANHOLE COVERS, PERESTALS,
HYDRO AND FIRE TRENCHES, SHALL
BE ADJUSTED TO BE ACCURATE
TO FIT TO THE SUBMITTAL OF
PHASES AFFECTED.

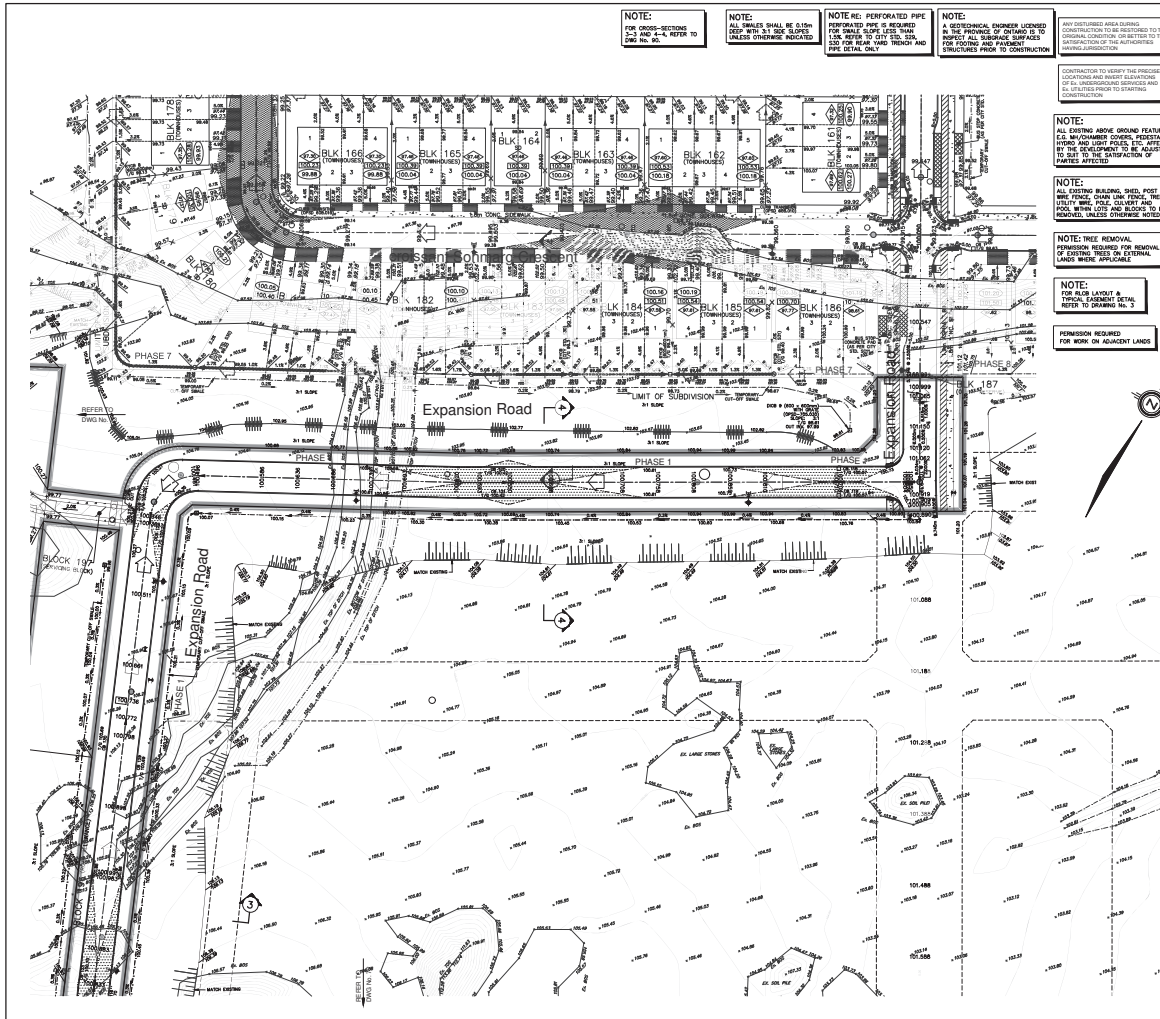
NOTE:
FOR PIPE LAYOUT
PERMISSION REQUIRED FOR REMOVAL
OF EXISTING TREES ON EXTERNAL
LANDS WHERE APPLICABLE.

NOTE:
PERMISSION REQUIRED
FOR WORK ON ADJACENT LANDS



LEGEND

103.45	OVERLAND FLOW DIRECTION	→
103.27	PROPOSED ELEVATION	—
103.00	EXISTING ELEVATION	—
102.82	FUTURE ELEVATION	—
102.64	PROPOSED GRADE	—
102.46	HIGH POINT	○
102.28	STREET CATCHBASIN	□
102.10	EXISTING MANHOLE	○
101.92	NEW CATCHBASIN	□
101.74	EXISTING CATCHBASIN	□
101.56	NEW CATCHBASIN	□
101.38	HYDRANT, VALVE & IS	○
101.20	VALVE & IS	○
101.02	BUILDING FOOTPRINT	—
100.84	TOP OF FOUNDATION (TOF)	—
100.66	PROPOSED FLOOR ELEVATION	—
100.48	EXISTING FLOOR ELEVATION	—
100.30	UNITS, SLOPING WATER	—
100.12	RAILROAD TRACKS	—
100.00	FINISH GRADE	—
99.82	HYDRO TRANSFORMER	○
99.64	STREET LIGHT STANDBY	○
99.46	TACTILE WALKING SURFACE	—
99.28	INDICATOR (SEE THE CITY OF OTTAWA'S WEBSITE FOR DETAILS)	—
99.10	PROPOSED PHASES / PHASES NOT PART OF CURRENT GRADING APPROVAL	—



NOT FOR CONSTRUCTION

1	ADJ. 20-21-22 5th SUBMISSION
2	ADJ. 20-22-23 4th SUBMISSION
3	ADJ. 20-24-24 3rd SUBMISSION
4	ADJ. 19-13-13 2nd SUBMISSION
5	ADJ. 19-13-24 1st SUBMISSION
6	ADJ. 18-12-24 1st SUBMISSION

TOPOGRAPHIC INFORMATION
AS SHOWN PROVIDED BY JD BARNES LTD. PROJECT 18-10-145-00 DATED JULY 26, 2019

LEGAL INFORMATION
CALVA COMMUNITIES PROJECT NUMBER 18-10-145-00 DATED APRIL 5, 2018

BENCH MARK No. 001196403710
ELEVATION SHOWN ON THIS PLAN ARE RELATED TO GDS020 DATUM AND ARE DERIVED FROM THE MUNICIPALITY OF OTTAWA'S SPATIAL DATA FRAMEWORK (SDA) DATUM.

CAIVA COMMUNITIES THE RIDGE PHASE 1

Ottawa CITY OF OTTAWA

GRADING PLAN

PROJECT No. 18-1030
SHEET No. 74

SCALE: HORIZ. 1:500

CITY PLAN No. 17593
CITY FILE No. D07-16-19-0005

NOTE:
ALL SIZES SHALL BE 0.15m
RIP WITH 1.0% SLOPE
UNLESS OTHERWISE INDICATED

NOTE: PERFORATED PIPE
FOR SLOPE LESS THAN
1.0% REFER TO CITY SPEC.
330 FOR REAR YARD TRENCH AND
PIPE DETAIL ONLY

NOTE:
A GEOTECHNICAL ENGINEER LICENSED
IN THE PROVINCE OF ONTARIO IS TO
VERIFY ALL SUBGRADE SURFACES
FOR FOOTING AND FOUNDATION
STRUCTURES PRIOR TO CONSTRUCTION

ANY DISTURBED AREA DURING
CONSTRUCTION TO BE RESTORED TO THE
ORIGINAL CONDITION OR BETTER TO THE
SATISFACTION OF THE ADJOINING
PROPERTY OWNER

CONTRACTOR TO KEEP THE PRECISE
LOCATION AND ADJACENT ELEVATIONS
OF ALL MEASUREMENT POINTS AND
BE LIFELINES PRIOR TO STARTING
CONSTRUCTION

NOTE:
ALL EXISTING ABOVE GROUND FEATURES
E.G. MANHOLE COVERS, PEDESTALS,
SIGNS AND LIGHT FIXTURES, TO BE
REMOVED AND REPLACED AS NOTED
TO SUIT TO THE SATISFACTION OF
PARTIES AFFECTED

NOTE:
ALL EXISTING BUILDING SHIELD POSTS,
WIRE FENCE, CHAIN LINK FENCE, TREE,
UTILITY WIRE, FENCE, SIGNET, AND
POOL WIRE (SEE BLOCK NO. 195)
REMOVED UNLESS OTHERWISE NOTED

NOTE: TREE REMOVAL
PERMISSION REQUIRED FOR REMOVAL
OF EXISTING TREES ON EXTERNAL
LANDS WHERE APPLICABLE

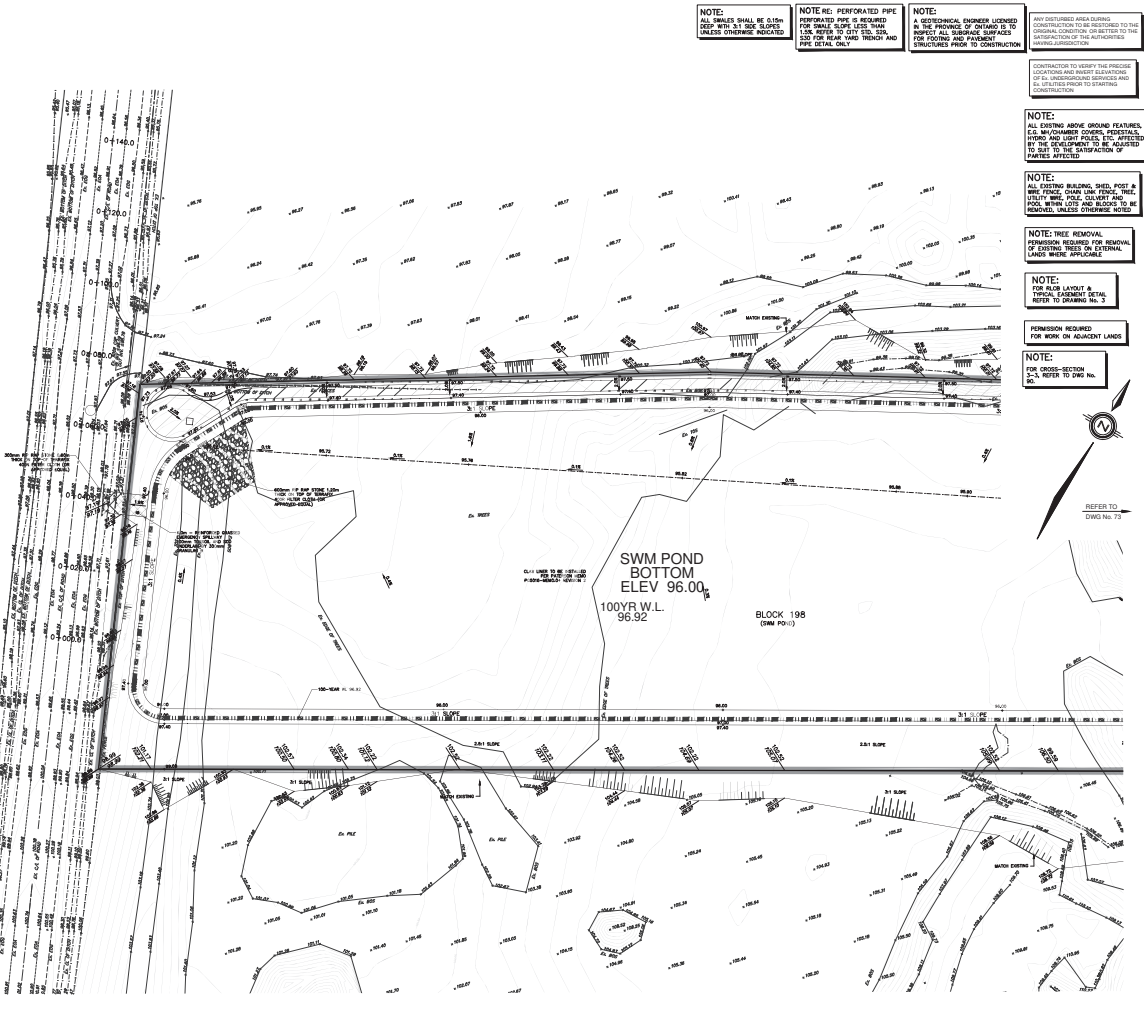
NOTE: PERMITS REQUIRED
FOR POLE LAYOUT &
TRENCH ELEVATION DETAIL
REFER TO DRAWING NO. 3

PERMISSION REQUIRED
FOR WORK ON ADJACENT LANDS

NOTE:
FOR CROSS-SECTION
REFER TO DWG NO. 70

LEGEND

PROPOSED ELEVATION	103.45	OVERLAND FLOW DIRECTION	
EXISTING ELEVATION	102.22	EXTERNAL OVERLAND FLOW DIRECTION	
FUTURE ELEVATION (4% SLOPE)	102.00	IMMEDIATE OVERLAND FLOW DIRECTION	
PROPOSED GRADE	102.00	RETAINING WALL AND ELEVATION	
HIGH POINT	102.18	PROPERTY BOUNDARY	
STREET CATCHBASIN		1:1 TERRACING MAXIMUM SLOPE	
CUSTOMER MANHOLE		FOOTING AREA WITH SPILLWAY ELEVATION (MINIMUM 0.30%)	
TELEPHONE CATCHBASIN		20% P&G PERFORATED PIPE	
ELDER CATCHBASIN		10% TRIP AND FARE DETAILS ONLY (CUSTOMER APPLIED FOR)	
VALVE 8" I.C.			
VALVE 6" I.C.			
VALVE 4" I.C.			
EMERGENCY OF FOOTING ELEVATION (TOP)			
BUILDING ENVELOPE			
TOP OF FOUNDATION (TOP)			
PROPOSED FLOOR ELEVATION (PFE)			
FINISH GRADE			
HYDRO TRANSFORMER			
STREET LIGHT STANDBY			
TACTILE WALKING SURFACE INDICATOR (AS PER CITY OF OTTAWA SPECIFICATIONS)			



SWM POND
BOTTOM
ELEV 96.00
100% R.W.L.
96.00
BLOCK 198

NOT FOR CONSTRUCTION

1	ADP	20-01-23 5th SUBMISSION
2	ADP	20-02-16 4th SUBMISSION
3	ADP	20-04-24 3rd SUBMISSION
4	ADP	19-12-20 2nd SUBMISSION
5	ADP	19-10-24 1st SUBMISSION
6	BY	DISEL

TOPOGRAPHIC INFORMATION
2D BANNER LIMITED PROJECT NUMBER 18-10-100 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
SCHEDULED BY-LAW PROVIDED BY ID BARRIES LTD, PROJECT 18-10-100-00, DATED APRIL 5, 2019

BENCH MARK NO. 001196403710
ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO CGCR80 DATUM AND ARE DERIVED FROM THE MUNICIPALITY OF OTTAWA'S SPATIAL DATA PLATFORM, VERSION 4.0.0

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL
Design Engineering Ltd

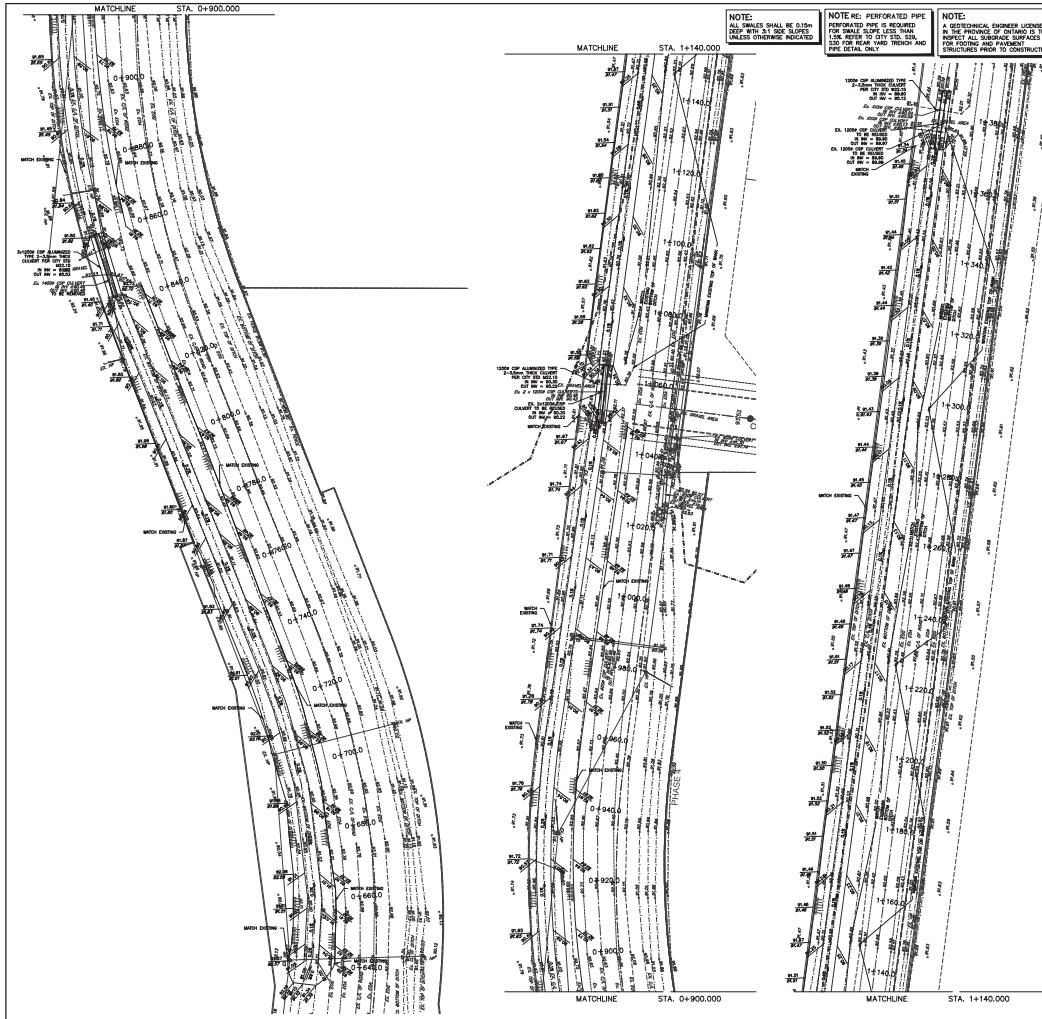
120 Barr Road Unit 103
Ottawa, Ontario K2E 1Z9
Tel: (613) 836-8888
Fax: (613) 836-1182
www.DSEL.ca

A-1 FOREST
SERVICES

Ottawa CITY OF OTTAWA

GRADING PLAN

DRAWN BY: G.D.	CHECKED BY: A.D.F.	PROJECT NO.	18-1030
DESIGNED BY: C.M.A.	CHECKED BY: A.D.F.	SHEET NO.	75
SCALE:			
HORIZ. 1:500			



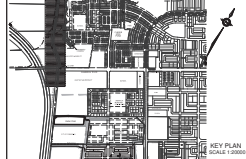
NOTE:
ALL SALES SHALL BE 0.15%
SEE WITH 1% SLOPE
UNLESS OTHERWISE INDICATED

NOTE: PERFORATED PIPE
PERFORATED PIPE IS REQUIRED
FOR SLOPE LESS THAN
1% REFER TO CITY TRM 200
FOR HEAD, SPACING AND
PIPE DETAIL ONLY

NOTE:
A GEOTECHNICAL ENGINEER LICENSED
IN THE PROVINCE OF ONTARIO IS TO
VERIFY ALL SUBGRADE SURFACES
FOR FOOTING AND FOUNDATION
STRUCTURES PRIOR TO CONSTRUCTION

ANY DISTURBED AREA DURING
CONSTRUCTION TO BE RESTORED TO THE
ORIGINAL CONDITION OR BETTER TO THE
SATISFACTION OF THE ADJACENT
PROPERTY OWNERS

CONTRACTOR TO KEEP THE PRECISE
LOCATION AND POINT ELEVATIONS
OF ALL MEASUREMENT SERVICES AND
BE UTILIZED PRIOR TO STARTING
CONSTRUCTION



NOTE:
ALL EXISTING ABOVE GROUND FEATURES
E.G. MANHOLEM COVERS, PERESTALS,
HYDRO AND HYDRO PILES, ETC. DETECTED
BY THE DEVELOPER TO BE ADJUSTED
TO FIT TO THE SURVEYATION OF
PARCELS AFFECTED

NOTE:
ALL EXISTING BUILDING, SHED, POST &
RILEY FENCE, CHAIN LINK FENCE, TREE,
UTILITY WIRE, TREE, UTILITY PILE, TO BE
REMOVED UNLESS OTHERWISE NOTED

NOTE: TREE REMOVAL
PERMISSION REQUIRED FOR REMOVAL
OF EXISTING TREES ON EXTERNAL
LANDS WHERE APPLICABLE

NOTE:
FOR PILE LAYOUT &
TYPICAL ELEMENT DETAIL
REFER TO DRAWING No. 2

**PERMISSION REQUIRED
FOR WORK ON ADJACENT LANDS**

LEGEND

PROPOSED ELEVATION	103.45	OVERLAND FLOW DIRECTION	
EXISTING ELEVATION	102.27	EXTERNAL OVERLAND FLOW DIRECTION	
FUTURE ELEVATION	103.00	IMMEDIATE OVERLAND FLOW DIRECTION	
PROPOSED SLOPE GRADE	1:30	RETAINING WALL AND ELEVATION	
HIGH POINT	102.16	MINIMUM FENCE (LOW LINE UNLESS OTHERWISE NOTED)	
STREET CATCHBASIN	102.00	PROPERTY BOUNDARY	
STREET CATCHBASIN WITH	102.00	1% TYPICAL MINIMUM SLOPE	
CATCHBASIN MANHOLE	102.00	FOODING AREA WITH SPILLWAY ELEVATION (MINIMUM 0.300)	
TELEPHONE CATCHBASIN	102.00	200% P.C. PERFORATED PIPE CONSTRUCTION FENCE	
ELDER CATCHBASIN	102.00	200% P.C. PERFORATED PIPE (SEE TRM AND PIPE DETAILS ONLY - CUSTOMER APPLIED FOR)	
HYDRANT, VALVE & IS	102.00	HYDRO TRANSFORMER	
VALVE & IS	102.00	STREET LIGHT STANDARDS	
BASELINE ELEVATION	102.00	TACTILE WALKING SURFACE INDICATOR (AS PER CITY OF OTTAWA TRM 200)	
TOP OF FOUNDATION (TOP)	102.00	PREVIOUS PHASES / PHASES NOT PART OF CURRENT GRADING APPROVAL	
PROPOSED FLOOR ELEVATION (PFE)	102.00		
FINISH OF FOOTING ELEVATION (FOF)	102.00		
UNITS: DIMENSIONS IN METERS			
WALKOUT UNITS	102.00		
SLAB ON GRADE	102.00		

NOTE:
FOR CROSS-SECTION
DATA REFER TO DWG. No. 10

NOT FOR CONSTRUCTION

1	A.S.F.	20-07-27 5th SUBMISSION
2	A.S.F.	20-08-10 6th SUBMISSION
3	A.S.F.	20-09-24 7th SUBMISSION
4	A.S.F.	20-10-13 8th SUBMISSION
5	A.S.F.	20-11-24 9th SUBMISSION
6	A.S.F.	20-12-15 10th SUBMISSION
7	A.S.F.	21-01-28 11th SUBMISSION

TOPOGRAPHIC INFORMATION
2D BARNES LIMITED PROJECT NUMBER 18-10-140-00 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
COURTESY OF THE CITY OF OTTAWA PROJECT 18-10-140-00, DATED APRIL 5, 2020

BENCH MARK No. 001196403710
ELEVATION SHOWN ON THIS PLAN ARE RELATED TO GCS83 DATUM AND ARE DERIVED FROM THE MUNICIPALITY OF OTTAWA'S SPATIAL DATA FRAMEWORK (SDWF) DATUM OF 2015.

CAIVAN COMMUNITIES THE RIDGE PHASE 1

DSEL
120 Burr Road, Unit 110
Ottawa, Ontario K2H 1Y9
Tel: (613) 836-8858
Fax: (613) 836-1155
www.DSEL.ca

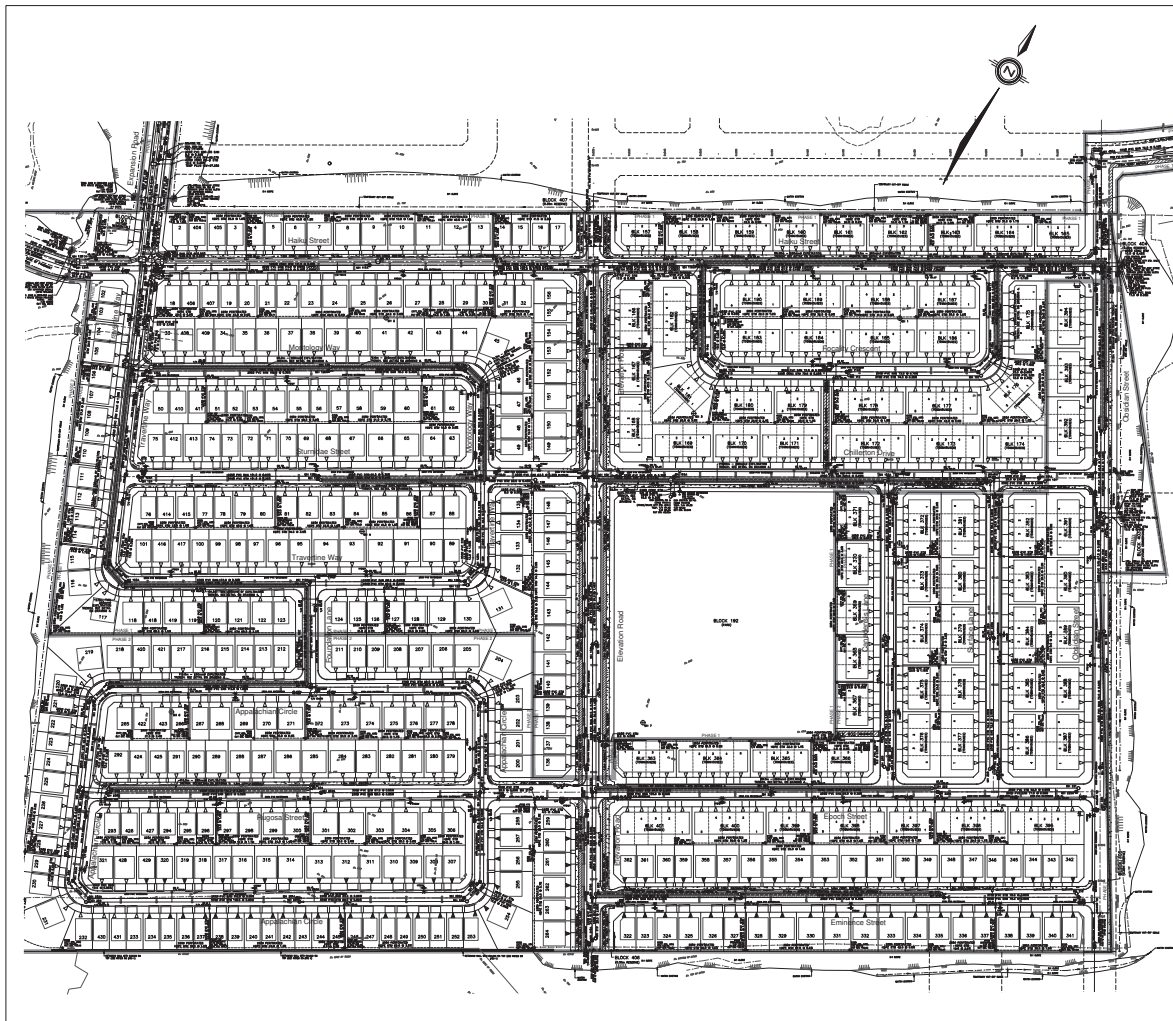
A & B FOREST SERVICES

Ottawa CITY OF OTTAWA

GRADING PLAN

PROJECT No. 18-1030 SHEET No. 76

SCALE: HORIZ 1:500



KEY PLAN
SCALE: 1:5000

LEGEND

- 45° ROAD
- LATERAL
- HYDRANT, VALVE & VB
- TEE
- VALVE & VC
- VALVE & VB
- 32.5' ROAD
- 11.25' ROAD
- RECOVER
- CAP
- SANITARY MAINTENANCE HOLE
- CAP
- SHEET CATCHBASIN & LEAD
- STONE MAINTENANCE HOLE
- BASE IN LT CATCH-BASIN
- MAINTENANCE HOLE
- INTERRUPTED OVERLAND
- CAP
- TEE CATCHBASIN
- BLANK CATCHBASIN
- PREVIOUS PHASES

SINGLE SERVICE LOCATION (E1, S4H & 25mm RED TUBING AREA C-304 MM)
 SERVICE SERVICE LOCATION (E1, S4H & M)
 SERVICE SERVICE LOCATION (E1, S4H & M)
 HYDRO TRANSFORMER
 STREET LIGHT STANDARD
 CURB RAMP, WITH CURB CUMP
 UNITS TO BE IN PHASE 1
 UNITS BECOMING WATER PRESERVE RECEIVING VALVES
 DITCH AND COLLECTOR CONCRETE SIDEWALK
 CURB & DEPRESSION CURB
 ASPHALT SIDEWALK (UNLESS OTHERWISE NOTED)
 CONSTRUCTION FENCE
 CONSTRUCTION FENCE (SEE DETAILS)
 PHASE LIMITS
 PROPERTY BOUNDARY
 OVERLAND FLOW DIRECTION
 INTERRUPTED OVERLAND FLOW DIRECTION
 (WITH REMAINING SURFACE INDICATOR)
 (SEE DETAIL C-307)
 GEOSOL RETAINMENT WALL
 INFILTRATION TRENCH

NOT FOR CONSTRUCTION

NO.	BY	DATE	DESCRIPTION

TOPOGRAPHIC INFORMATION
 JD BARNES LIMITED PROJECT NUMBER 18-10-145-00 SURVEY DATED JULY 26, 2019
LEGAL INFORMATION
 DEVELOPED BY PLAN PROVIDED BY JD BARNES LTD. PROJECT 18-10-145-00, DATED JULY 22, 2019
 BENCH MARK No. 001196403710
 ELEVATIONS ARE SHOWN IN METERS AND ARE DERIVED FROM THE MEANSEA LEVEL DATUM 1984 (MSL) DATUM. ELEVATIONS ARE NOT CORRECTED FOR TIDES.

CAIVAN COMMUNITIES THE RIDGE PHASE 1

120 Bar Road Unit 103
 Ottawa, Ontario K2H 8Z9
 Tel: (613) 836-0866
 Fax: (613) 836-1165
 www.CSEL.ca

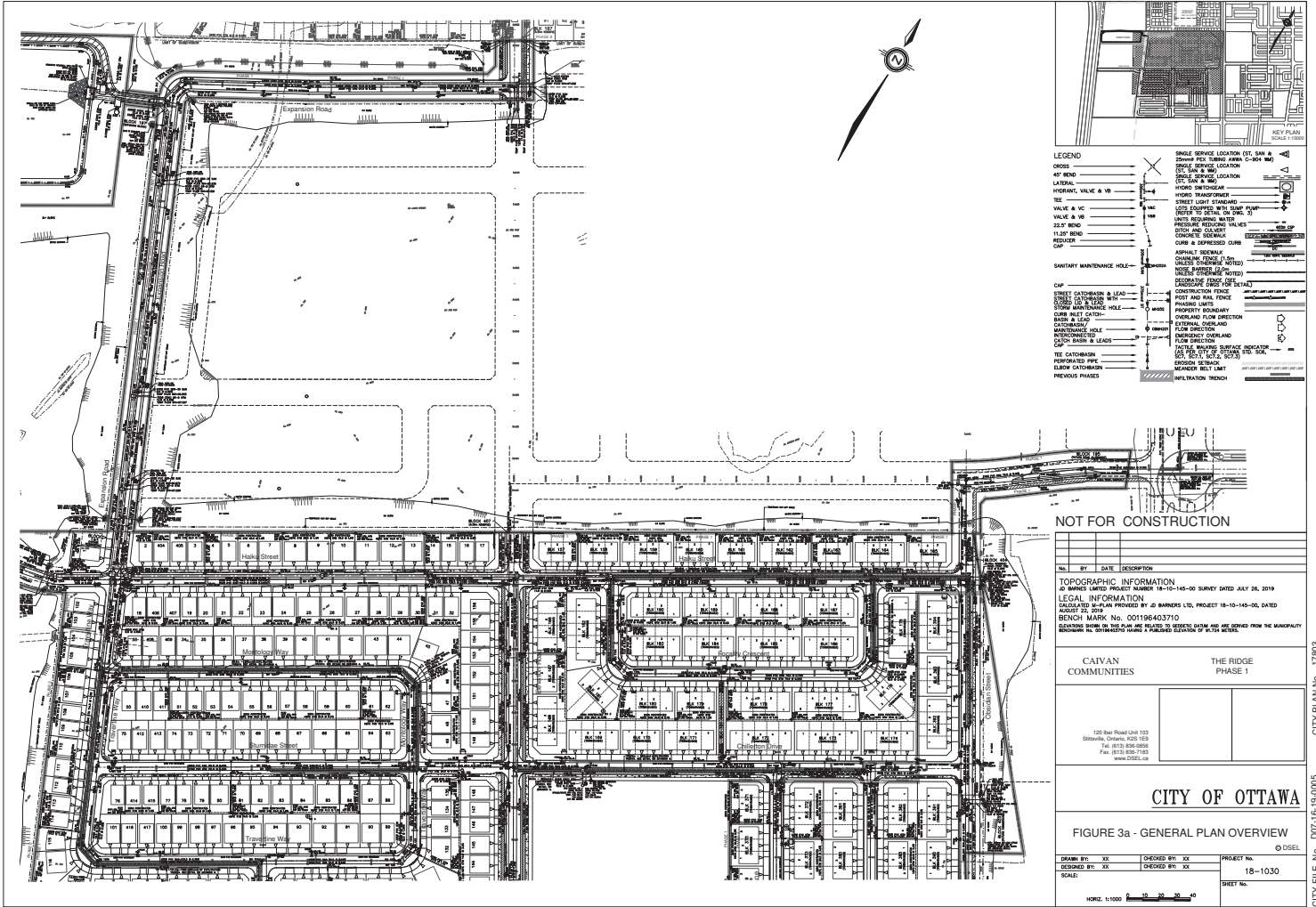
CITY OF OTTAWA

FIGURE 3 - GENERAL PLAN OVERVIEW © DSEL

DRAWN BY: XX CHECKED BY: XX SCALE:	PROJECT No. 18-1030 SHEET No.
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HORIZ: 1:1000

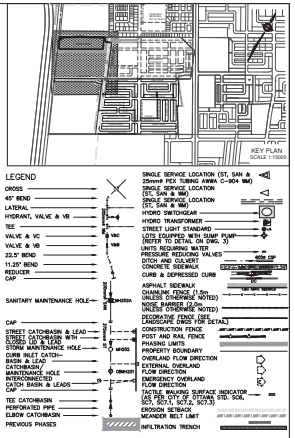
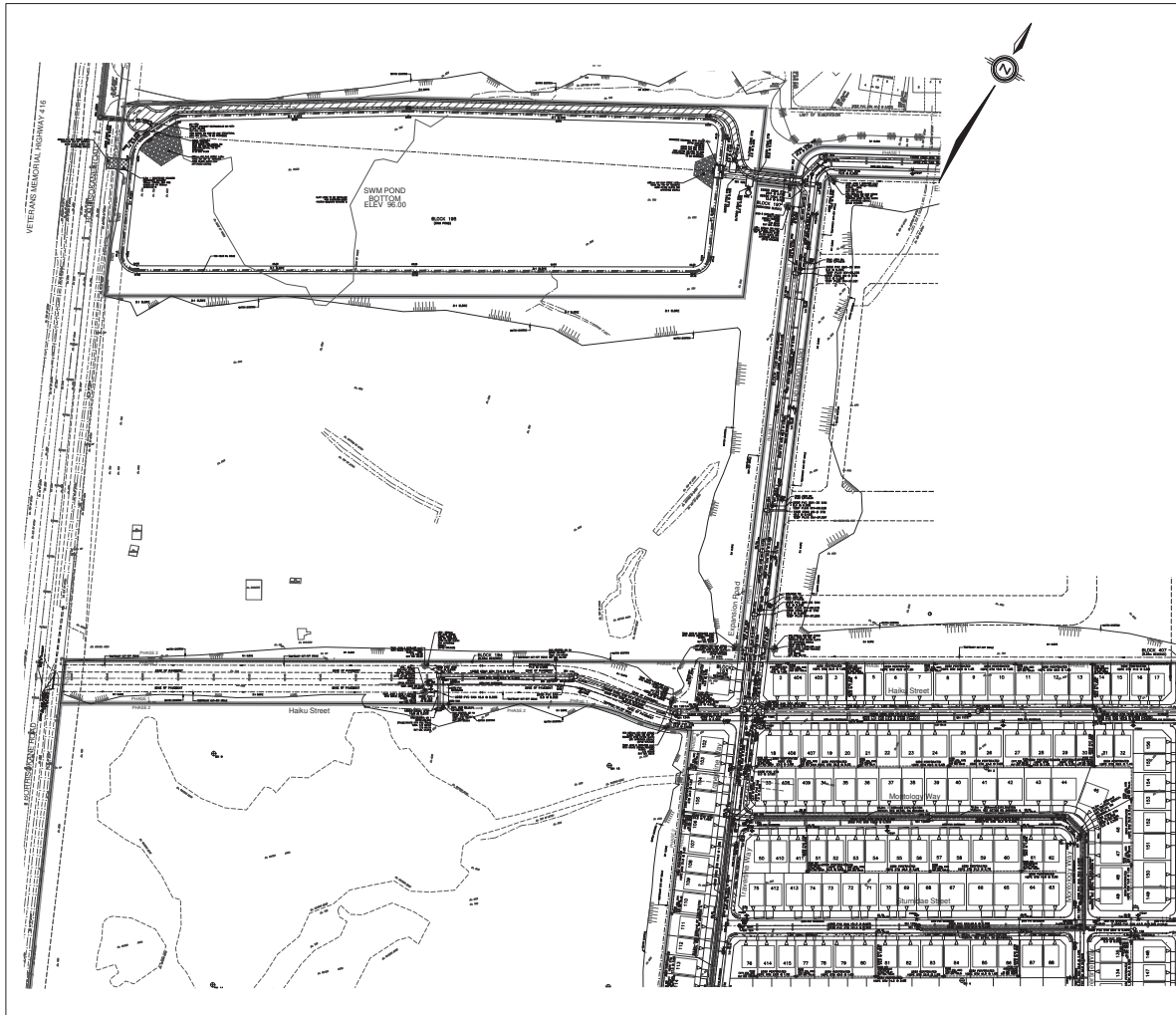
CITY PLAN No. 175933
CITY FILE No. D077-16-19-0005



NOT FOR CONSTRUCTION

NO. BY DATE DESCRIPTION	
TOPOGRAPHIC INFORMATION JO BARNES LIMITED PROJECT NUMBER 18-10-145-00 SURVEY DATED JULY 26, 2019 LEGAL INFORMATION DEVELOPED SURVEY PROVIDED BY JO BARNES LTD. PROJECT 18-10-145-00, DATED JANUARY 22, 2019 BENCH MARK No. 001196403710 RECORDING NO. 010428240 PLANS PUBLISHED DECEMBER 10, 2019	
CAIVAN COMMUNITIES	THE RIDGE PHASE 1
120 Bay Road Unit 103 Toronto, Ontario M2N 5T9 Tel: (416) 856-0856 Fax: (416) 856-1165 www.DSEL.ca	
CITY OF OTTAWA	
FIGURE 3a - GENERAL PLAN OVERVIEW	
DRAWN BY: XX CHECKED BY: XX SCALE:	PROJECT No. 18-1030 SHEET No.
HORIZ. 1:1000 0 10 20 30 40	

CITY PLAN No. 17503 CITY FILE No. D07-16-19-0005



NOT FOR CONSTRUCTION

NO.	BY	DATE	DESCRIPTION

TOPOGRAPHIC INFORMATION
 JO BARNES LIMITED PROJECT NUMBER 18-10-145-00 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
 DEVELOPED BY PLAN PROVIDED BY JO BARNES LTD. PROJECT 18-10-145-00, DATED JULY 22, 2019.
 BENCH MARK No. 001196403710
 BOUNDARY AND DIMENSIONS SHOWN ARE NOT DERIVED FROM THE MUNICIPALITY RECORDING NO. 001048250 PLANS & PUBLISHED DEPART OF 9/24/2019.

CAIVAN COMMUNITIES **THE RIDGE PHASE 1**

120 Bay Road Unit 103
 Oshawa, Ontario M2H 5T9
 Tel: (905) 836-0854
 Fax: (905) 836-1155
 www.CSEL.ca

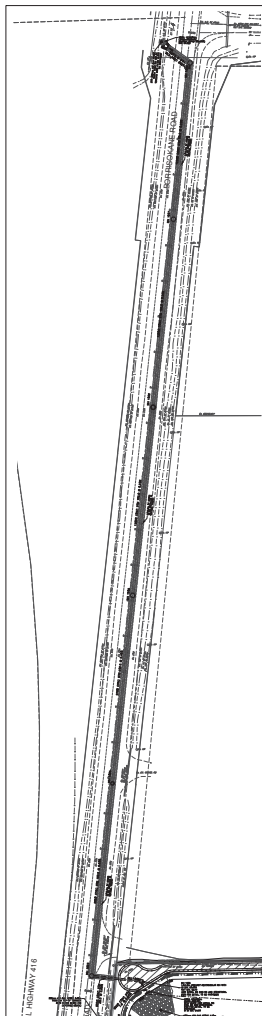
CITY OF OTTAWA

FIGURE 3B - GENERAL PLAN OVERVIEW © DSEL

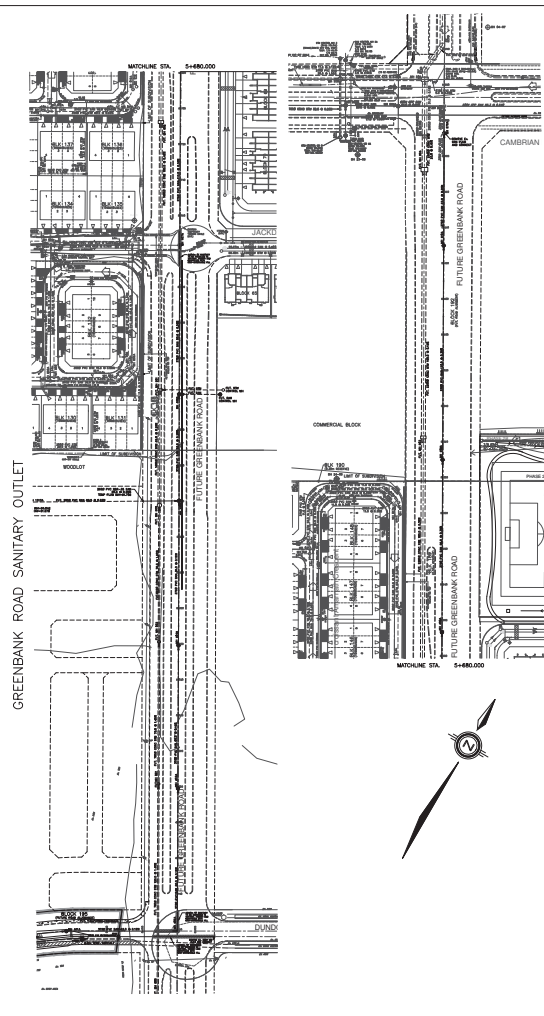
DRAWN BY: XX	CHECKED BY: XX	PROJECT No.
DESIGNED BY: XX	CHECKED BY: XX	18-1030
SCALE:		SHEET No.

HORIZ: 1:1000 0 10 20 30 40

CITY PLAN No. 17503 CITY FILE No. D07-16-19-0005



BORRISOKANE ROAD STORM OUTLET



GREENBANK ROAD SANITARY OUTLET

KEY PLAN
10/14/19

LEGEND

- CROSS
- 45° BEND
- LATERAL
- HORIZONTAL VALVE & V8
- TEE
- VALVE & V8
- 32.5° BEND
- 11.25° BEND
- REDUCER
- CAP
- Sanitary Maintenance Hole
- Cap
- SHEET CATCHBASIN & LEAD
- Closed Top Street
- Storm Maintenance Hole
- Open Top Catchbasin
- Storm Catchment
- Maintenance Hole
- INTERRUPTED
- Cap
- TEE Catchbasin
- ELBOW Catchbasin
- PREVIOUS PHASES

LEGEND (continued)

- SINGLE SERVICE LOCATION (E1, S4K & 25mm PEX TUBING AREA C-104 MM)
- SINGLE SERVICE LOCATION (E1, S4K & 19mm PEX TUBING AREA C-104 MM)
- WATER TRANSFORMER
- STREET LIGHT STANDARD
- CONCRETE CURB AND GUTTER (SEE SHEET 17)
- UNITS INCLUDING MAINT PRESERVE EXISTING VALVES
- SPUR AND COLLECTOR
- CURB & DEPRESSED CURB
- SEWER
- SANITARY (CONCRETE)
- CONSTRUCTION FENCE
- CONCRETE LEAD FOR SEWERS
- PHASING LIMITS
- PROPERTY BOUNDARY
- OVERLAND FLOW DIRECTION
- EXTERNAL OVERLAND FLOW DIRECTION
- INTERNAL OVERLAND FLOW DIRECTION
- WATER WADING SURFACE INDICATOR (E1, S4K & 19mm PEX TUBING AND 25mm PEX TUBING)
- PROPOSED SEWER MANHOLE BELL LIMIT
- INFILTRATION TRENCH

NOT FOR CONSTRUCTION

NO.	BY	DATE	DESCRIPTION

TOPOGRAPHIC INFORMATION
JD BARNS LIMITED PROJECT NUMBER 18-10-145-00 SURVEY DATED JULY 26, 2019

LEGAL INFORMATION
CONSULTED: SUPPLY PROVIDED BY JD BARNS LTD, PROJECT 18-10-145-00, DATED OCTOBER 22, 2019.
BENCH MARK No. 001196403170
RECORDING NO. 018-382830 PLANS APPROVED (EXEMPT FROM THE MURPHY ACT)
RECORDING NO. 018-382830 PLANS APPROVED (EXEMPT FROM THE MURPHY ACT)

CAIVAN COMMUNITIES	THE RIDGE PHASE 1
--------------------	-------------------

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Ottawa, Ontario K2H 8Z9
Tel: (613) 836-8888
Fax: (613) 836-7185
www.CSEL.ca

CITY OF OTTAWA

FIGURE 3C - GENERAL PLAN OVERVIEW

DRAWN BY: XX	CHECKED BY: XX	PROJECT No.
DESIGNED BY: XX	CHECKED BY: XX	18-1030
SCALE:		SHEET No.

HORIZ: 1:1000

E.2 STORMWATER MANAGEMENT REPORT FOR THE RIDGE (BRAZEAU LANDS) BY JFSA (JULY 2020)





Stormwater Management Report for The Ridge (Brazeau) Subdivision

City of Ottawa
July 2020



J.FSA Ref. No.: 1800-19

J.F. Sabourin and Associates Inc.
www.jfsa.com

Prepared for: David Schaeffer Engineering Ltd.

Prepared by:

JFSA

Water Resources and
Environmental Consultants





Stormwater Management Report for The Ridge (Brazeau) Subdivision

in the City of Ottawa

July 2020

Prepared for :

David Schaeffer Engineering Ltd.



Prepared by :

Jonathon Burnett, B.Eng., P.Eng.

Stormwater Management Report for The Ridge (Brazeau) Subdivision in the City of Ottawa

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APPENDICES

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Stormwater Management Report for The Ridge (Brazeau) Subdivision in the City of Ottawa July 2020

1 INTRODUCTION AND OBJECTIVES

J.F. Sabourin and Associates Inc. (JFSA) were retained by David Schaeffer Engineering Ltd. (DSEL) to prepare a Stormwater Management (SWM) Plan for the Ridge (Brazeau) Subdivision, located within the City of Ottawa. As shown by the image provided on the cover page, the future development is located east of Borrisokane and Highway 416, and south of Cambrian Road. The proposed development will be serviced by a dry SWM pond that will be implemented in the northwest corner of the development and will discharge to the Jock River via an existing ditch on the west side of Borrisokane Road. The proposed development will also be serviced by two oil-and-grit separators that discharge to the SWM pond, that have been sized to ensure 80% Total Suspended Solids (TSS) removal, for more details regarding the OGS units with the development please refer to JFSA's July 2020, Pond Design Brief for the Ridge (Brazeau) Subdivision. As documented in the Barrhaven South Urban Expansion Area Master Servicing Study, by J. L Richards 2018, the development will also have Etobicoke Exfiltration Systems (EES) implemented within this subdivision. These EES will be installed within local roadways of the subdivision, to exfiltrate runoff from the development for the more frequent events. To ensure that the SWM analysis is conservative, these EES's have not been included in this detailed analysis. Please refer to JFSA's "The Ridge (Brazeau) LID Design Report" July 2020 for full details regarding the operations and benefits of the proposed Etobicoke Exfiltration Systems within the site.

The Ridge (Brazeau) development has a total drainage area of 37.03 ha, including a 3.94 ha pond block, a 1.72 ha park block, 2.68 ha of commercial blocks and 28.69 ha of residential development. The proposed development will be treated by the dry pond, along with 21.21 ha of external future commercial development and 13.5 ha of external residential development, for a total drainage area of 71.75 ha. Figure 1 provides an overview of the location of these respective blocks within the subdivision.

The purpose of this report is to evaluate the major and minor system flows of the proposed development with respect to new proposed stormwater management guidelines and to check the adequacy of the proposed pipe sizes to convey the 2-year (5-year on collector and 10-year on arterial roads) and the 100-year storm flows from within the development and from external areas. Background documents that were reviewed in preparing this report include the following:

- *Stormwater Management Planning and Design Manual*, Ministry of the Environment, March 2003.



- *Jock River Flood Risk Mapping (within the City of Ottawa) Hydraulics Report*, PSR Group Ltd. and J.F. Sabourin and Associates Inc., November 2004.
- *Erosion and Sediment Control Guidelines for Urban Construction*, Conservation Halton et al., December 2006.
- *Draft City of Ottawa Stormwater Management Facility Design Guidelines*, IBI Group, April 2012.
- *City of Ottawa Sewer Design Guidelines*, City of Ottawa, October 2012.
- *Technical Bulletin ISDTB-2014-01, Revisions to Ottawa Design Guidelines – Sewer*, City of Ottawa, February 2014.
- *City of Ottawa Technical Bulletin PIEDTB-2016-01*, City of Ottawa, September 2016.
- *City of Ottawa Technical Bulletin ISTB-2018-04*, City of Ottawa, June 2018.
- *Functional Servicing Report for Caivan Communities, Brazeau Lands, 3809 Borrisokane Road*, David Schaeffer Engineering Limited, September 2019.
- *Design Brief for the Stormwater Management Pond for the Ridge (Brazeau) Subdivision*, David Schaeffer Engineering Limited and J.F. Sabourin and Associates Inc., April 2020.

As per the new approach formalized in the September 2016 *City of Ottawa Technical Bulletin PIEDTB-2016-01*, the proposed subdivision has been designed with a 2-year minor system level of service on local roads and 5-year level of service on collector roads (Elevation Road). Where possible with grading and minor system capture limitations, road ponding areas up to 35 cm deep were used to contain the 100-year major system flows.

The SWMHYMO and PCSWMM computer programs were used to model the major and minor systems, to ensure that all the new stormwater management requirements are satisfied. The general SWM design criteria and guidelines that are to be met are described in Section 2.



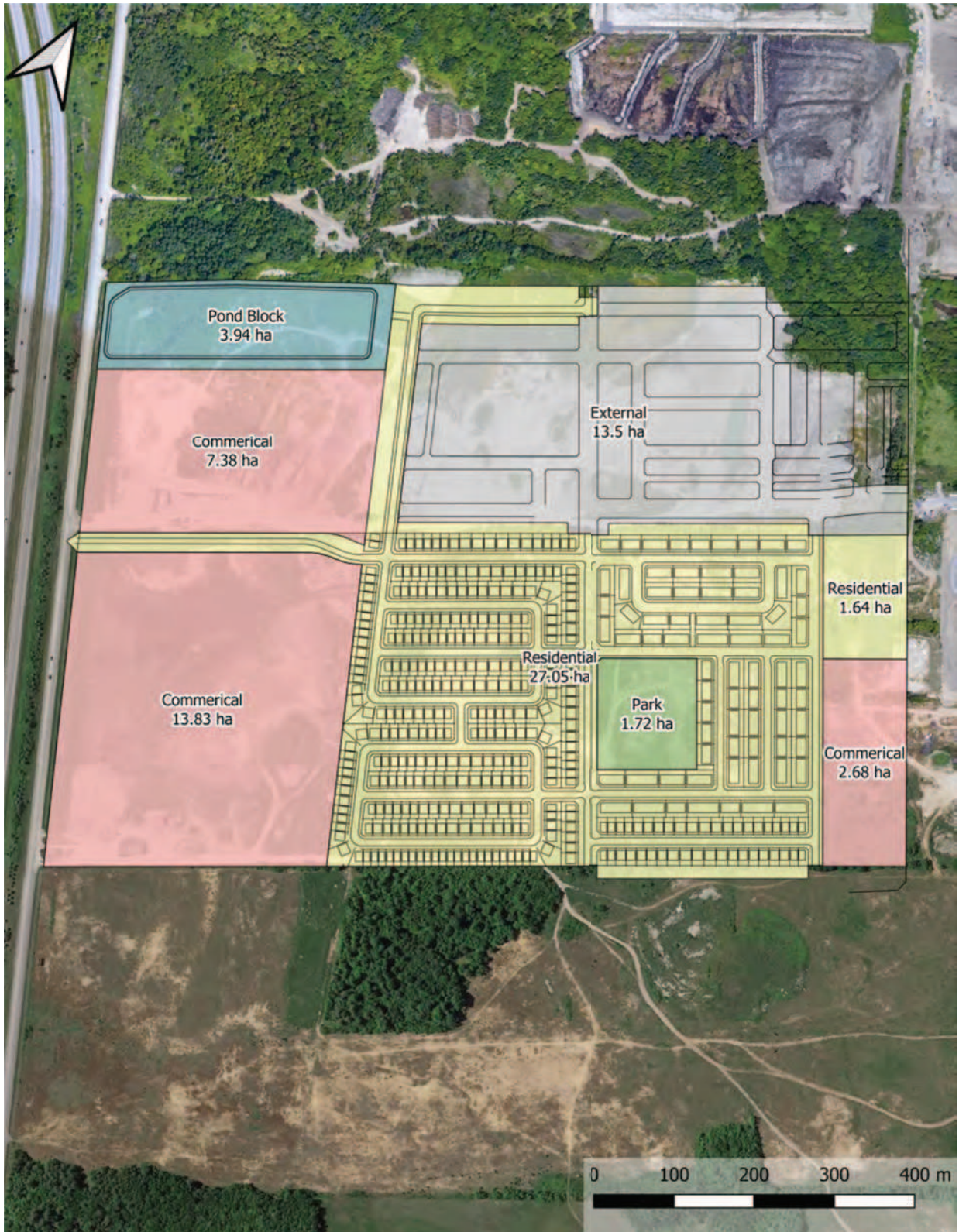


Figure 1: General Site Location



2 DESIGN CRITERIA AND GUIDELINES

The design criteria and guidelines used for the stormwater management of the subject subdivision are those that were developed in the background documents, as well as those provided in the October 2012 *City of Ottawa Sewer Design Guidelines* and subsequent technical memorandums, and generally accepted stormwater management design guidelines.

The detailed design of the proposed development determined that the 37.03 ha subdivision has an average imperviousness of 54%. The total 71.75 ha drainage area to the dry pond has an average imperviousness of 64%.

A detailed analysis of the proposed dual drainage system was required to confirm that the following general design criteria and guidelines for the minor and major systems would be met.

2.1 Minor System

- a) Storm sewers are to be designed to provide a minimum 2-year level of service, plus 5-year inflows on collector roads (Elevation Road) and 10-year inflows on arterial roads.
- b) The 100-year hydraulic grade line (HGL) within the development minor systems must be maintained at least 0.3 m below the underside of footing elevation where gravity house connections are installed.
- c) For less frequent storms (i.e. larger than 1:2 year or 1:5 year on collector / 1:10 year on arterial roads), the minor system shall, if required, will be limited with the use of inlet control devices to prevent excessive hydraulic surcharges and to maximize the use of surface storage on the road where desired.
- d) Catchbasins on the road are to be equipped with City standard type S19 (fish) grates or City standard type S22 side inlets, and grates for catchbasins in rear yards, park and open spaces with pedestrian traffic are to be City standard type S19, S30 and S31.
- e) Single catchbasins are to be equipped with 200 mm minimum lead pipes, and double catchbasins are to be equipped with 250 mm minimum lead pipes.
- f) Rearyard catchbasins are to be equipped with 250 mm minimum lead pipes. Catchbasins installed on the street, where rearyard catchbasins connect to the main storm sewer through the catchbasin, are to be equipped with 250 mm minimum lead pipes for both single and double catchbasins.
- g) Under full flow conditions, the allowable velocity in storm sewers is to be no less than 0.80 m/s and no greater than 3.0 m/s. Where velocities over 3.0 m/s are proposed,



provisions shall be made to protect against displacement of sewers by sudden jarring or movement. Velocities greater than 6 m/s are not permitted.

2.2 Major System

- a) The major system shall be designed with enough road surface storage to allow the excess runoff of a 100-year storm to be retained within road ponding areas where desired.
- b) Inlet control devices should be sized such that they do not create surface ponding on the road during the 2-year design storm on local roads (5-year design storm on collector and 10-year design storm on arterial roads); it should be noted that surface ponding over grates is present during rainfall under any design, as an appropriate depth of water is required for runoff to enter the grate (refer to Tables D-6 of Appendix D).
- c) Roof leaders shall be installed to direct the runoff to splash pads and on to grassed areas.
- d) For the 100-year storm, the maximum total depth of water (static + dynamic) on all roads shall not exceed 35 cm at the gutter.
- e) During the 100-year + 20% stress test, the maximum extent of surface water on streets, rearyards, public space and parking areas shall not touch the building envelope.
- f) When catchbasins are installed in rear yards, safe overland flow routes are to be provided to allow the release of excess flows from such areas.
- g) The product of the maximum flow depths on streets and maximum flow velocity must be less than $0.60 \text{ m}^2/\text{s}$ on all roads.
- h) The excess major system flows up to the 100-year return period are to be retained on-site in development blocks such as parks, schools, commercial, etc.
- i) There must be at least 15 cm of vertical clearance between the spill elevation on the street and the ground elevation at the nearest building envelope that is in the proximity of the flow route or ponding area.
- j) There must be at least 30 cm of vertical clearance between the rearyard spill elevation and the ground elevation at the adjacent building envelope.



3 ASSUMPTIONS AND SOURCE OF DATA USED IN THIS STUDY

Sources of information and assumptions made in this study are listed below:

- Stormwater management model: *SWMHYMO (version 5.50), and PCSWMM (version 7.2)*
- Minor system design: *1:2 year, plus 1:5-year inflows on collector roads and 1:10 year on arterial roads. See the Rational Method Calculations in Appendix A.*
- Major system design: *1:100 year*
- Max. 100-yr water depth on roads: *35 cm above the gutter*
- Extent of the major system: *Shall not touch the building envelope during the 100-year + 20% stress test*
- PCSWMM model parameters: *Fo = 76.2 mm/hr, Fc = 13.2 mm/hr, DCAY = 4.14/hr, D.Stor.Imp. = 1.57 mm, D.Stor.Per. = 4.67 mm (as per 2012 City of Ottawa Sewer Design Guidelines)*
Detailed Area Imperviousness: based on development layout. Lumped Area Imperviousness: based on runoff coefficient (C) where C = 0.7 x imperviousness ratio + 0.2.
- Design storms: *2-, 5-, 10- and 100-year 3-hour Chicago and 100-year 24-hour SCS Type II storms as per 2012 City of Ottawa Sewer Design Guidelines; peak averaged over 10 minutes.*
- Historical Events: *July 1st, 1979; August 4th, 1988; and August 8th, 1996 events as per 2012 City of Ottawa Sewer Design Guidelines.*
- Stress Test: *20% increase in the 100-year 3-hour Chicago storm.*
- Street catchbasin covers: *City Standard Type S19 (fish) or City Standard Type S22 (side inlet). Type S19 approach flow-capture curves as per MTO design charts (equivalent to OPSD 400.010). Type S22 approach flow-capture curves as per the 2004 City of Ottawa Guidelines.*
- Rearyard catchbasin covers: *City Standard Type S19, S30 and S31*
- Curb and gutter: *City Standard SC1.3 (mountable) and SC1.1 (barrier). In the absence of flow capture curves for these curbs and gutters, OPSD 600.010 curb and gutters are assumed.*
- Manning's' roughness coeff.: *0.013 for concrete and PVC pipes (free flow).*
- Minor system losses: *Refer to Appendix C for maintenance hole loss coefficients.*
- Underside of footing elevations: *As provided by DSEL.*
- Freeboard in HGL analysis: *0.3 m between the underside of footing elevation and 100-year hydraulic gradeline.*
- Inlet Control Devices: *Refer to Appendix B for Plas-Tech ICD details.*
- Depth of backyard swales: *As per DSEL's Grading Plan*
- Street and pipe dimensions: *As per DSEL's Plan and Profiles*
- Right-of-way characteristics: *As per DSEL's Details of Roads*
- Downstream HGL: *92.5 m based on the top of bank elevation of the ditch that the SWM pond will outlet to.*



4 PROPOSED MINOR AND MAJOR SYSTEM DRAINAGE

The proposed minor and major system drainage routes are shown in plan view in Figures 2 and 3. The residential areas where enough detail was available were modelled in PCSWMM. External or large undetailed future development areas within the subdivision were modelled in SWMHYMO based on the preliminary design information available. The hydrographs generated by SWMHYMO were then read into the PCSWMM model as external hydrographs.

Per the new proposed standards, the minor system has been designed to accommodate a minimum of the 2-year post-development flows from within the site and from external areas, plus 5-year inflows on collector roads (Elevation Road) and 10-year inflows on arterial roads. A Rational Method design was conducted by DSEL (refer to Appendix A) to estimate minor system flows based on the City of Ottawa IDF relationship and selected runoff coefficients.

The minor system release rates from the parklands were set to the 5-year flow based on the rational method, with onsite storage provided up to the 100-year event. The east most commercial lands were limited to the 2-year rational method, with onsite storage provided up to the 100-year event. The ABIC commercial lands were limited to the 2-year pre-development flow per the rational method, and the Brazeau Commercial site limited to maximum flow 1.8m³/s (as per the most recent analysis for the Commercial Brazeau lands), with both sites assumed to have onsite storage provided to the 100-year event. Refer to DSEL's June 2020 Site Plan Report for more details regarding the ABIC site. The collector roads (Elevation Road) were limited to the 5-year rational method as per the City guidelines. The residential lands were limited to 2-year Chicago 3-hour flow + 14% (as calculated by SWMHYMO) to account for additional capture during the 100-year storm as a result of increased head over the catchbasins and lead pipes or inlet control devices, with onsite storage provided to the 100-year event.

For these residential lands under the stress test scenario (100-year Chicago 3-hour +20%) it was assumed that the minor system was set at 107% of 100-year capture, and 100-year + 20% stress test storage set to 145% of 100-year storage. This approach for the residential lands is based on the Abbottsville Crossing was a pilot project. Which looked at the 2-year capture on local road and containment of excess 100-year flows in road ponding areas. Minor system capture during the 100-year + 20% stress test at the detailed design stage for a subdivision or site plan can be evaluated based on the actual design information, e.g. catch basin grate and ICD head-capture relationships, surface storage volumes, simulated water depth, etc. However, there is no set standard or easy rule of thumb for excess capture through catch basin grates, lead pipes and Inlet Control Devices (ICDs) during the 100-year + 20% stress test for undetailed future development areas, where these details don't exist yet. As such, the detailed modelling for the Abbottsville Crossing pilot project has been used as a reference to create a rule of thumb for undetailed areas. As shown in Table D-8 of Appendix D of the September 2018 SWM Report for the Abbottsville Crossing subdivision, minor system capture in the detailed subdivision modelling during the 100-year + 20% storm was 107% greater than the 100-year capture. Similarly, 100-year + 20% surface storage volumes used were 155% greater than those used during the 100-year storm. This was reduced to 145% to be conservative for preliminary



modelling of undetailed areas. Refer to Table D-3C in Appendix D for the simulated release rates for the various undetailed lands for the full suite of return periods based on the SWMHYMO modelling.

As noted earlier in this report, where possible with grading limitations, road ponding areas up to 35 cm deep were used to contain the 100-year major system flows in the development. Note that rearyard catchbasins were connected to catchbasins on the road where possible, to allow rearyard runoff access to the storage in road ponding areas at regular intervals. In a design of this type where lots are serviced by gravity house connections, inlet control devices (ICDs) can be used to limit minor system capture at each catchbasin to the appropriate level of service.

Within the development, circular orifice plate type Inlet Control Devices (ICDs) of City standard diameters 83 mm, 94 mm, 102 mm, 108 mm, 127 mm, 152 mm and 178 mm will be used to limit minor system capture to a minimum of the 2-year flow (refer to Appendix B for Plas-Tech ICD details), allowing for sub-surface storage of 0.5 m³ in single catchbasins, 1.0 m³ in double catch basins, and 1.9 m³ in catchbasin manholes. Note that this subsurface catchbasin storage has not been included in the modelling to be conservative.

The street segments within the proposed development have been designed using a 'saw tooth' or 'sagged' road profile. The runoff from within these segments will be conveyed to catchbasins located at the lowest point within the street segment. Flows more than the catchbasin capture rate will be temporarily stored within the 'sagged' street segments and released slowly to the storm sewers, up to the 100-year design storm. When the storage on a specific street segment is surpassed due to blockage or an event greater than the 100-year storm, the excess water will flow towards the next downstream street sag, and eventually to the pond. It should be noted that the major system would outlet during the 100-year + 20% stress test without flooding any of the properties within the subdivision.

If the drainage system's capacity to capture surface flows is exceeded, Figure 4 presents the maximum extent of static surface ponding and volume on the streets based on grading. Additionally, surface storage volumes that may exist in the rear yards have not been considered in this model, and runoff from these areas have been directed straight to the catchbasin that the rear yard swale will discharge to. This has been completed to ensure that the peak flows and ponding volumes calculated in the model are conservative.

The SWMHYMO and PCSWMM analyses, discussed in Sections 4.1 and 4.2, have demonstrated that the proposed drainage system for the subdivision will have sufficient capacity to control the excess flow during a 100-year storm and safely capture and convey the 2-year (plus 5-year on collector roads and 10-year on arterial roads) flow to the pond.



4.1 Major System and SWM Analysis

The PCSWMM and SWMHYMO computer programs were used to model the major and minor system flows within the proposed development and from external areas. As noted above, as the PCSWMM program is most appropriate for use in modelling small urban drainage areas, most undetailed future development areas were instead modelled using SWMHYMO.

The PCSWMM and SWMHYMO models were developed based on the information provided in Figures 2 and 3. Nine (9) simulations were conducted, one for each of the following rainfall events:

- i) The 25 mm, 3-hour Chicago storm;
- ii) the 2-year, 3-hour Chicago storm;
- iii) the 5-year, 3-hour Chicago storm;
- iv) the 100-year, 3-hour Chicago storm;
- v) the 100-year, 24-hour SCS Type II storm
- vi) the July 1st, 1979 historical event;
- vii) the August 4th, 1988 historical event;
- viii) the August 8th, 1996 historical event; and
- ix) the 100-year, 3-hour Chicago storm + 20%.

Note that the purpose of simulating the 100-year, 3-hour Chicago storm with a 20% increase is to stress test the drainage system for potential flooding, as per the October 2012 *City of Ottawa Sewer Design Guidelines*.

The depression storage and infiltration parameters in both the PCSWMM and SWMHYMO models are as per the October 2012 *City of Ottawa Sewer Design Guidelines*. The percent imperviousness of the detailed drainage areas was measured based on the proposed development layout. The proposed development layouts have been established based on zoning requirements and represent the largest allowable footprint on each lot. DSEL have measured the impervious area in each catchment discreetly, and as such, the percent impervious values can be considered to be based on zoning. The percent imperviousness of undetailed (lumped/external) drainage areas were calculated based on the runoff coefficient (C), where $C = 0.7 \times \text{imperviousness ratio} + 0.2$. Figure 1 provides an overview of the subcatchments, and Table D-3A and D-3B provide a full summary of all subcatchment parameters modelled in PCSWMM and SWMHYMO respectively.

The approach flow/capture curves applied in the PCSWMM model were based on the values outlined in the *City of Ottawa Sewer Design Guidelines* (Appendix 7-A.13). These approach flow/capture curves were converted to a depth/capture curve using PCSWMM's diversion node and kinematic wave equations. A depth/capture curve was derived for each of the cross-section profiles and the various slopes. Where required inflows are limited by circular orifice plate type Inlet Control Devices (ICDs) of City standard diameters 83 mm, 94 mm, 102 mm, 108 mm, 127 mm, 152 mm and 178 mm. Note that 200 mm diameter lead pipes were assumed and are



required between single catchbasins and the storm sewers, and 250 mm diameter lead pipes were assumed and are required between rearyard catchbasins or single catchbasin manholes and the storm sewers. Double catchbasins and double catchbasin maintenance holes are to be equipped with 250 mm diameter lead pipes. No temporary CBs are required within the development. Refer to Table D-4A in Appendix D for the depth/capture curves applied in the model for catch basins on a constant slope, and Table D-4B for catchbasins at localized depressions with ICD's.

Within the proposed subdivision, the dynamic flow depth on the road (at the gutter) will be minimal during the 100-year Chicago storm, as the 100-year flows are mostly retained within the road ponding areas and do not accumulate as in a typical subdivision design. Furthermore, it was determined that for the 100-year storm at all major system segments, the product of the depth of water (m) at the gutter multiplied by the velocity of flow (m/s) will not exceed the maximum allowable $0.6 \text{ m}^2/\text{s}$ (refer to Table D-8 of Appendix D, where the calculated maximum was determined to be $0.56 \text{ m}^2/\text{s}$). Table D-9 of Appendix D presents the stress test results for dynamic flow depth on the road based on a 20% increase in the 100-year storm, as per the October 2012 *City of Ottawa Sewer Design Guidelines*. As shown in Table D-9, the maximum dynamic flow depth under these conditions is calculated as 0.48 cm, and the product of the depth of water at the gutter multiplied by the velocity of flow is $0.59 \text{ m}^2/\text{s}$. Refer below for an assessment of the ponding depth on the road.

Details of the 100-year street maximum water depth and surf elevations are provided in Table D-7 of Appendix D. Based on DSEL's grading the major system has approximately 896 m^3 of storage at these localized low points throughout the development. Depths calculated by the PCSWMM model demonstrates that a total 100-year depth of water (static and dynamic) on the street at these ponding areas will not exceed the maximum depth of 35 cm.

Table D-7 of Appendix D also presents the street storage stress test results based on a 20% increase in the 100-year storm, as per the October 2012 *City of Ottawa Sewer Design Guidelines*. As shown in Table D-7, the maximum depth of water (static + dynamic overflow) at any ponding area under these conditions is calculated as 48 cm. The maximum extent of surface water during the 100-year + 20% stress test will not touch the building envelopes, refer to DSEL drawings number 95-97 for the flood extent of these ponding depths.

An overland flow route is to be provided on Expansion Road in the subdivision to safely convey flows to the pond (Junction C144). This overflow has been set that the crest of the spill elevation and has been represented in the model as a 5m wide open rectangular cross-section. The curb cut and overland flow route are to be constructed as required to convey the 100-year major system flow without exceeding 35 cm during the 100-year storm, and without touching the building envelopes during the 100-year + 20% stress test. Based on the PCSWMM model the overland flow route will have a maximum normal flow depth of 5 cm during the 100-year 3-hour Chicago storm and 6 cm during the 100-year + 20% stress test. Table 1 presents a summary of the major system results simulated in PCSWMM during the 100-year Chicago storm.

Table 1: Summary of Major System Results for the 100-Year

Catch Basin ID	Flow Depth (cm)	Approach Flow (m ³ /s)	Captured Flow (m ³ /s)
CB_001	20	0.032	0.021
CB_002	20	0.032	0.019
CB_003	28	0.222	0.099
CB_004	28	0.222	0.045
CB_005	21	0.132	0.044
CB_006	21	0.132	0.071
CB_007	10	0.180	0.038
CB_008	9	0.133	0.034
CB_009	9	0.133	0.034
CB_010	7	0.070	0.020
CB_011	7	0.070	0.020
CB_012	15	0.043	0.031
CB_013	15	0.043	0.018
CB_014	5	0.048	0.014
CB_015	5	0.048	0.014
CB_016	5	0.064	0.016
CB_017	9	0.747	0.195
CB_018	10	0.414	0.036
CB_019	10	0.453	0.034
CB_020	9	0.406	0.033
CB_021	27	0.120	0.033
CB_022	27	0.120	0.033
CB_023	13	0.085	0.021
CB_024	29	0.177	0.073
CB_025	29	0.177	0.046
CB_026	23	0.077	0.019
CB_027	23	0.077	0.024
CB_028	23	0.076	0.032
CB_029	23	0.076	0.019
CB_030	28	0.204	0.051
CB_031	28	0.204	0.073
CB_032	20	0.101	0.070
CB_033	20	0.101	0.019
CB_034	5	0.054	0.011
CB_035	4	0.056	0.012
CB_036	8	0.113	0.026
CB_037	8	0.113	0.026
CB_038	9	0.249	0.035
CB_039	25	0.190	0.098
CB_040	25	0.190	0.064
CB_041	7	0.112	0.023
CB_042	7	0.112	0.023
CB_043	9	0.192	0.030
CB_044	9	0.192	0.030
CB_045	27	0.197	0.089
CB_046	27	0.197	0.065
CB_047	29	0.307	0.090
CB_048	29	0.307	0.090
CB_049	27	0.168	0.045
CB_050	27	0.168	0.072
CB_051	29	0.192	0.073
CB_052	29	0.192	0.046
CB_053	10	0.496	0.033
CB_054	9	0.412	0.029
CB_055	12	0.428	0.042

Table 1: Summary of Major System Results for the 100-Yea

Catch Basin ID	Flow Depth (cm)	Approach Flow (m ³ /s)	Captured Flow (m ³ /s)
CB_056	9	0.130	0.030
CB_057	9	0.130	0.030
CB_058	10	0.273	0.039
CB_059	8	0.210	0.029
CB_060	8	0.210	0.029
CB_061	6	0.112	0.022
CB_062	6	0.112	0.022
CB_065	3	0.032	0.006
CB_066	6	0.047	0.016
CB_067	6	0.047	0.016
CB_068	6	0.074	0.017
CB_069	6	0.074	0.017
CB_070	6	0.067	0.018
CB_071	6	0.067	0.018
CB_072	6	0.133	0.020
CB_073	35	0.278	0.074
CB_074	35	0.278	0.067
CB_075	13	0.273	0.043
CB_076	13	0.273	0.043
CB_077	8	0.300	0.029
CB_078	28	0.204	0.036
CB_079	28	0.204	0.029
CB_080	35	0.225	0.101
CB_081	35	0.225	0.091
CB_082	29	0.165	0.066
CB_083	29	0.165	0.100
CB_084	34	0.172	0.034
CB_085	34	0.172	0.046
CB_086	21	0.141	0.071
CB_087	21	0.141	0.044
CB_088	31	0.109	0.020
CB_089	31	0.109	0.046
CB_090	4	0.058	0.011
CB_091	6	0.101	0.018
CB_092	6	0.101	0.018
CB_093	8	0.234	0.025
CB_095	9	0.135	0.036
CB_096	9	0.135	0.036
CB_097	6	0.059	0.018
CB_098	6	0.059	0.018
CB_099	27	0.146	0.045
CB_100	27	0.146	0.050
CB_101	3	0.016	0.004
CB_102	31	0.178	0.073
CB_103	31	0.178	0.020
CB_104	9	0.060	0.029
CB_105	9	0.060	0.029
CB_106	30	0.199	0.066
CB_107	30	0.199	0.100
CB_108	8	0.164	0.028
CB_109	6	0.152	0.023
CB_111	29	0.182	0.046
CB_112	9	0.062	0.028
CB_113	9	0.062	0.028
CB_114	26	0.181	0.072

Table 1: Summary of Major System Results for the 100-Year

Catch Basin ID	Flow Depth (cm)	Approach Flow (m ³ /s)	Captured Flow (m ³ /s)
CB_115	26	0.181	0.072
CB_116	12	0.071	0.043
CB_118	19	0.059	0.027
CB_119	19	0.059	0.024
CB_120	19	0.112	0.070
CB_121	19	0.112	0.044
CB_123	12	0.071	0.048
CB_124	16	0.050	0.035
CB_125	16	0.050	0.018
CB_126	19	0.069	0.021
CB_127	19	0.069	0.032
CB_128	10	0.180	0.038
CB_129	6	0.045	0.015
CB_130	6	0.045	0.015
CB_131	11	0.402	0.037
CB_201	0	0.012	0.012
CB_203	11	0.103	0.020
CB_204	0	0.014	0.014
CB_205	14	0.146	0.048
CB_206	16	0.090	0.021
CB_207	16	0.086	0.021
CB_208	0	0.018	0.018
DCB_063	28	0.170	0.033
DCB_064	28	0.170	0.051
DCB_110	29	0.182	0.073
DCB_117	5	0.160	0.082
DCB_122	5	0.160	0.042
DICB_1	22	0.052	0.019
DICB_2	22	0.052	0.019
DICB_3	25	0.097	0.025
DICB_4	25	0.097	0.025

4.2 Minor System and Hydraulic Grade line Analysis

The minor system analysis was completed using the PCSWMM program based on the peak flows captured during the rainfall events. Note that the storm sewer design is as provided by DSEL, and a Manning's roughness coefficient of 0.013 was used for concrete and PVC storm sewer pipes. Refer to Appendix C for maintenance hole loss coefficients used in the PCSWMM model.

The minor system performance was analyzed under restrictive downstream conditions. Restrictive downstream conditions for the pond are based on the approximate top of bank elevation of 92.5 m at the existing Borrisokane Road ditch that the storm sewer will outlet too. Table 2 presents the peak minor system outflows obtained with the above-mentioned simulations.

Table 2: Comparison of Minor System Flows to the Pond

Location	DSEL Rational Method Flow (m ³ /s)	2-Year PCSWMM/ SWMHYMO Flow (m ³ /s)	5-Year PCSWMM/ SWMHYMO Flow (m ³ /s)	100-Year PCSWMM/ SWMHYMO Flow (m ³ /s)
MH 501 to Pond	1.028	2.924	3.966	5.175
MH 401 to Pond	4.787	2.836	4.252	5.737
Total ⁽¹⁾	5.815	5.76	8.218	10.912

⁽¹⁾The total flow is taken as the direct summation of peak inflows and does not consider the difference in the timing of peaks

Table 2 shows that the total 2-year flows simulated by the PCSWMM/SWMHYMO models are similar to the values calculated by DSEL's Rational Method calculations. Although there is a difference in the individual flows calculated at MH 401 and MH 501 between the Rational method and PCSWMM results. This can be explained by the fact that these two branches will be connected upstream at MH 313 and MH 307 to make full use of the OGS units and minor system infrastructure; this connection has been represented in the PCSWMM modelling but not in the Rational Method calculations.

The PCSWMM/SWMHYMO simulations have determined that for the selected 2-, 5- and 100-year storms, the total minor system flows would be 5.76 m³/s, 8.218 m³/s and 10.912 m³/s, respectively. Note that the values above are simply a summation of peak flows from MH 501 and MH 401 and do not consider the timing of peaks. Although the 100-year flow will surcharge most parts of the minor system, a freeboard of 0.3 m between the 100-year hydraulic grade line and the underside of footings has been provided throughout the proposed development.

The proposed development will provide 80% TSS removal through the use of 2 OGS units, that will treat runoff from high pollutant areas. The total area directed to the OGS units is equal to 60.42 ha, note this does not include the Pond Block or ABIC lands which would not contribute to the OGS. The two OGS units (manufacturer: CDS model: PMSU5668_10) will be implemented within this development downstream of MH 313 and MH 307. Each unit will have a total holding capacity of 25,960 L, a sump capacity of 8,896 L and an oil capacity of 4,435 L. Note that the two units are identical as the flow to each unit will be close to equal for a given event due to the upstream flow connection, and have been sized based on this consideration. Full details of the OGS unit sizing and specifications can be found in JFSA's July 2020 Pond Design Brief for the Ridge (Brazeau) subdivision. Refer to DSEL drawing sheet number 79 for detailed drawings of the proposed OGS units.

A portion of the Ridge development will also be treated for water quality via EES units that will capture and infiltrate runoff from local street roads. For full details regarding the EES units within the development refer to JFSA July 2020 LID Memo for the Ridge (Brazeau) Development. Catchbasins that capture runoff to these EES units will be fitted with Goss traps. It has been assumed that the surrounding future lands will have independent water quality measures on-site, whether that be by way of OGS or EES units or SWM ponds.

Tables C-1A and C-1E of Appendix C summarizes the pipe data and hydraulic simulation results for the 100-year 3-hour Chicago storm, 100-year 24-hour SCS Type II storm and the three historical events. Note that a minimum freeboard of 0.3 m between the hydraulic grade line and the underside of footings has been provided throughout the proposed developments for the 100-year storms, and a minimum freeboard of 0 m has been provided throughout the proposed development for the historical events. Additionally, note that the majority of the flowing full pipe velocities are no less than 0.80 m/s and no greater than 3.0 m/s for all proposed pipes with the exception of 4 locations. Where velocities over 3.0 m/s are proposed, provisions shall be made to protect against displacement of sewers by sudden jarring or movement. Velocities greater than 6 m/s are not permitted.

Table C-1F of Appendix C presents the climate change stress test results for the hydraulic grade line analysis based on a 20% increase in the 100-year storm, as per the October 2012 *City of Ottawa Sewer Design Guidelines*. Under these conditions, no locations within the proposed developments have a USF freeboard less than 0 m.

Table 3 presents the composite hydraulic grade line results for the 100-year 3-hour Chicago and 100-year 24-hour SCS Type II design storms. Note to simplify this analysis, the highest HGL and the lowest USF on a single pipe length are compared, if it is found that the freeboard between these two locations is either less than 0.3m or less than 0.0m this location is flagged yellow or red respectively. This flag then initiates a detailed analysis for this segment, where the HGL is interpolated along the full length of the pipe and then compared with the individual USF along with the distance, to confirm whether there is an HGL issue along that segment.



Table 3: Composite Hydraulic Gradeline Results for 100-Year Design Storms

U/S MH	D/S MH	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard ⁽²⁾ (m)	Interpolated HGL		
							Length HGL (m)	Dist. From D/S MH (m)	HGL (m)
MH_401	POND	96.930	96.730	#N/A	#N/A	#N/A			
MH_501	POND	96.920	96.730	#N/A	#N/A	#N/A			
MH_1002	MH_1003	95.200	94.592	#N/A	#N/A	#N/A			
MH_1003	MH_1004	94.592	93.316	#N/A	#N/A	#N/A			
MH_1004	MH_1005	93.316	92.923	#N/A	#N/A	#N/A			
MH_1005	MH_1006	92.923	92.831	#N/A	#N/A	#N/A			
MH_1006	MH_1007	92.831	92.740	#N/A	#N/A	#N/A			
MH_1007	MH_1008	92.740	92.580	#N/A	#N/A	#N/A			
MH_1008	MH_1009	92.580	92.500	#N/A	#N/A	#N/A			
MH_101	MH_102	100.935	100.197	174-2	101.41	0.475			
MH_102	MH_103	100.197	99.575	172-5	100.47	0.273			
				172-5	100.47	0.822	59.0	6.9	99.648
				173-1	100.78	1.014	59.0	18.1	99.766
				173-2	100.78	0.930	59.0	26.1	99.850
				173-3	101.1	1.174	59.0	33.3	99.926
				173-4	101.1	1.090	59.0	41.3	100.010
				173-5	101.1	1.009	59.0	48.9	100.091
				174-1	101.41	1.241	59.0	56.3	100.169
MH_103	MH_104	99.575	99.245	169-2	99.81	0.235			
				169-2	99.81	0.558	120.0	2.7	99.252
				169-3	99.81	0.538	120.0	10	99.273
				169-4	99.81	0.516	120.0	18	99.295
				170-1	99.93	0.606	120.0	28.6	99.324
				170-2	99.93	0.584	120.0	36.6	99.346
				170-3	99.93	0.563	120.0	44.2	99.367
				171-1	99.99	0.594	120.0	54.9	99.396
				171-2	99.99	0.572	120.0	62.9	99.418
				171-3	99.99	0.552	120.0	70.1	99.438
				171-4	99.99	0.530	120.0	78.1	99.460
				172-1	100.47	0.961	120.0	96.1	99.509
				172-2	100.47	0.939	120.0	104.1	99.531
				172-3	100.47	0.919	120.0	111.3	99.551
				172-4	100.47	0.903	120.0	117	99.567
MH_104	MH_106	99.245	99.115	169-1	99.81	0.565			
MH_105	MH_106	100.002	99.115	148	100.03	0.028			
				148	100.03	0.792	91.0	12.6	99.238
				147	100.16	0.803	91.0	24.8	99.357
				146	100.3	0.844	91.0	35	99.456
				145	100.42	0.855	91.0	46.2	99.565
				144	100.56	0.856	91.0	60.4	99.704
				143	100.93	1.092	91.0	74.2	99.838
				142	101.5	1.518	91.0	88.9	99.982
MH_106	MH_116	99.115	98.880	166-1	99.53	0.415			
MH_107	MH_108	99.460	99.478	176-1	100.1	0.640			
MH_107	MH_112	99.460	99.411	185-1	99.89	0.430			
MH_108	MH_110	99.478	99.456	175-1	100.15	0.672			
MH_109	MH_110	99.691	99.456	164-2	100.01	0.319			
				164-2	100.01	0.549	60.0	1.2	99.461
				164-3	100.25	0.768	60.0	6.7	99.482
				164-4	100.25	0.736	60.0	14.7	99.514
				165-1	100.42	0.865	60.0	25.3	99.555
				165-2	100.93	1.345	60.0	32.9	99.585
				165-3	100.93	1.314	60.0	40.9	99.616
MH_110	MH_111	99.456	99.235	162-1	99.69	0.234			
				188-4	99.86	0.619	75.0	2	99.241
				162-1	99.69	0.436	75.0	6.3	99.254

Table 3: Composite Hydraulic Gradeline Results for 100-Year Design Storms

U/S MH	D/S MH	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard ⁽²⁾ (m)	Interpolated HGL		
							Length HGL (m)	Dist. From D/S MH (m)	HGL (m)
				188-3	99.86	0.598	75.0	9.2	99.262
				162-2	99.69	0.413	75.0	14.3	99.277
				188-2	99.86	0.574	75.0	17.2	99.286
				162-3	99.69	0.391	75.0	21.6	99.299
				188-1	99.86	0.552	75.0	24.8	99.308
				162-4	99.69	0.362	75.0	31.6	99.328
				187-4	99.86	0.520	75.0	35.5	99.340
				163-1	99.77	0.417	75.0	40.2	99.353
				187-3	99.86	0.497	75.0	43.5	99.363
				163-2	99.77	0.394	75.0	47.8	99.376
				187-2	99.86	0.476	75.0	50.7	99.384
				163-3	99.77	0.371	75.0	55.8	99.399
				187-1	99.86	0.452	75.0	58.7	99.408
				164-1	100.01	0.579	75.0	66.5	99.431
MH_111	MH_115	99.235	99.046	159-1	99.58	0.345			
MH_112	MH_113	99.411	99.214	183-1	99.74	0.329			
MH_113	MH_114	99.214	99.146	181-1	99.85	0.636			
MH_1	MH_133	98.777	98.629	Est. Fut	99.86	1.083			
MH_114	MH_115	99.146	99.046	182-1	99.58	0.434			
MH_115	MH_116	99.046	98.880	157-1	99.46	0.414			
MH_116	MH_117	98.880	98.727	30	99.32	0.440			
MH_117	MH_118	98.727	98.545	20	99.11	0.383			
				18	99.18	0.628	121.0	4.4	98.552
				2	99.16	0.603	121.0	7.7	98.557
				406	99.18	0.611	121.0	16.1	98.569
				404	99.18	0.604	121.0	20.3	98.576
				407	99.16	0.576	121.0	25.7	98.584
				405	99.18	0.589	121.0	30.5	98.591
				19	99.16	0.558	121.0	37.9	98.602
				3	99.14	0.534	121.0	40.7	98.606
				20	99.11	0.493	121.0	48.1	98.617
				4	99.14	0.518	121.0	51.2	98.622
				21	99.12	0.486	121.0	59.3	98.634
				5	99.22	0.582	121.0	62.1	98.638
				22	99.21	0.557	121.0	71.5	98.653
				6	99.23	0.575	121.0	73.3	98.655
				23	99.22	0.550	121.0	82.9	98.670
				7	99.24	0.563	121.0	87.8	98.677
				24	99.28	0.589	121.0	97.3	98.691
8	99.31	0.610	121.0	102.8	98.700				
25	99.36	0.645	121.0	113.1	98.715				
9	99.4	0.677	121.0	118.2	98.723				
MH_118	MH_136	98.545	98.434	#N/A	#N/A	#N/A			
MH_119	MH_120	100.114	99.688	101	100.65	0.536			
MH_119	MH_122	100.114	99.693	#N/A	#N/A	#N/A			
MH_120	MH_121	99.688	99.310	116	101.03	1.342			
MH_121	MH_132	99.310	98.588	106	99.54	0.230			
				106	99.54	0.906	114.0	7.2	98.634
				107	99.71	0.999	114.0	19.4	98.711
				108	99.88	1.098	114.0	30.6	98.782
				109	100.05	1.204	114.0	40.8	98.846
				110	100.15	1.224	114.0	53.4	98.926
				111	100.32	1.322	114.0	64.8	98.998
				112	100.48	1.404	114.0	77	99.076
				113	100.57	1.423	114.0	88.2	99.147
				114	100.57	1.359	114.0	98.4	99.211

Table 3: Composite Hydraulic Gradeline Results for 100-Year Design Storms

U/S MH	D/S MH	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard ⁽²⁾ (m)	Interpolated HGL		
							Length HGL (m)	Dist. From D/S MH (m)	HGL (m)
				115	100.65	1.373	114.0	108.8	99.277
MH_122	MH_123	99.663	99.517	131	100.61	0.947			
MH_123	MH_127	99.517	99.112	135	99.89	0.373			
MH_124	MH_125	99.469	99.331	72	99.77	0.301			
				82	99.89	0.552	101.0	5.4	99.338
				69	99.84	0.498	101.0	8.4	99.342
				70	99.78	0.424	101.0	18.6	99.356
				81	99.89	0.532	101.0	19.6	99.358
				71	99.78	0.408	101.0	29.7	99.372
				80	99.92	0.547	101.0	31	99.373
				72	99.77	0.384	101.0	39.9	99.386
				79	100.04	0.645	101.0	46.9	99.395
				73	99.82	0.419	101.0	51.1	99.401
				78	100.04	0.635	101.0	54.4	99.405
				74	99.88	0.465	101.0	61.3	99.415
				77	100	0.581	101.0	64.6	99.419
				413	99.93	0.499	101.0	73.4	99.431
				415	100.08	0.646	101.0	75.2	99.434
				412	99.98	0.537	101.0	82.3	99.443
				414	100.1	0.651	101.0	86.4	99.449
				75	99.98	0.521	101.0	94	99.459
				76	100.16	0.695	101.0	98.1	99.465
MH_125	MH_127	99.331	99.112	65	99.58	0.249			
				88	99.82	0.670	91.5	16	99.150
				63	99.59	0.438	91.5	16.6	99.152
				87	99.82	0.637	91.5	29.7	99.183
				64	99.59	0.405	91.5	30.3	99.185
				86	99.65	0.440	91.5	41.1	99.210
				65	99.58	0.363	91.5	43.9	99.217
				85	99.74	0.495	91.5	55.5	99.245
				66	99.69	0.438	91.5	58.6	99.252
				84	99.76	0.477	91.5	71.3	99.283
				67	99.78	0.490	91.5	74.4	99.290
				83	99.89	0.573	91.5	85.7	99.317
				68	99.84	0.515	91.5	88.8	99.325
MH_126	MH_127	100.307	99.112	#N/A	#N/A	#N/A			
MH_127	MH_128	99.112	99.004	47	99.56	0.448			
MH_128	MH_129	99.004	98.958	45	99.49	0.486			
MH_129	MH_130	98.958	98.842	43	99.41	0.452			
MH_130	MH_131	98.842	98.616	33	99.18	0.338			
MH_1302	MH_302	98.440	98.370	Est. Fut	99.36	0.920			
MH_1303	MH_303	98.435	98.291	Est. Fut	99.29	0.855			
MH_1304	MH_304	98.185	98.086	Est. Fut	98.86	0.675			
MH_131	MH_132	98.616	98.588	#N/A	#N/A	#N/A			
MH_1312	MH_310	97.937	97.853	Est. Fut	99.14	1.203			
MH_132	MH_136	98.588	98.434	103	99.33	0.742			
MH_133	MH_134	98.629	98.573	#N/A	#N/A	#N/A			
MH_134	MH_135	98.573	98.511	#N/A	#N/A	#N/A			
MH_135	MH_136	98.511	98.434	#N/A	#N/A	#N/A			
MH_136	MH_302	98.434	98.370	1	99.38	0.946			
MH_201	MH_202	105.434	104.453	321	105.28	-0.154			
				321	105.28	0.757	119.5	8.5	104.523
				430	107.31	2.770	119.5	10.6	104.540
				431	107.37	2.783	119.5	16.3	104.587
				428	105.36	0.725	119.5	22.2	104.635
				233	107.4	2.705	119.5	29.5	104.695

Table 3: Composite Hydraulic Gradeline Results for 100-Year Design Storms

U/S MH	D/S MH	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard ⁽²⁾ (m)	Interpolated HGL		
							Length HGL (m)	Dist. From D/S MH (m)	HGL (m)
				429	105.37	0.658	119.5	31.5	104.712
				234	107.46	2.718	119.5	35.2	104.742
				320	105.45	0.638	119.5	43.7	104.812
				235	107.5	2.655	119.5	47.7	104.845
				319	105.56	0.657	119.5	54.8	104.903
				236	107.62	2.716	119.5	54.9	104.904
				318	105.66	0.673	119.5	65	104.987
				237	107.69	2.685	119.5	67.3	105.005
				238	107.8	2.748	119.5	73	105.052
				317	105.77	0.691	119.5	76.2	105.079
				239	107.87	2.709	119.5	86.2	105.161
				316	105.9	0.721	119.5	88.4	105.179
				240	107.99	2.783	119.5	91.9	105.207
				315	106.02	0.748	119.5	99.8	105.272
				241	108.06	2.744	119.5	105.1	105.316
				242	108.16	2.797	119.5	110.8	105.363
				314	106.13	0.741	119.5	114	105.389
MH_202	MH_203	104.453	104.385	230	105.39	0.937			
MH_203	MH_206	104.385	103.787	225	104.9	0.515			
MH_204	MH_205	103.979	103.873	285	104.64	0.661			
MH_205	MH_206	103.873	103.787	#N/A	#N/A	#N/A			
MH_206	MH_207	103.787	103.339	221	104.52	0.733			
MH_207	MH_208	103.339	103.021	219	104.39	1.051			
MH_208	MH_215	103.021	101.393	212	102.46	-0.561			
				271	102.46	0.938	112.0	8.9	101.522
				212	102.46	0.882	112.0	12.7	101.578
				270	102.67	0.941	112.0	23.1	101.729
				213	102.68	0.927	112.0	24.8	101.753
				214	102.89	0.988	112.0	35	101.902
				269	102.93	1.015	112.0	35.9	101.915
				215	103.1	1.035	112.0	46.2	102.065
				268	103.18	1.099	112.0	47.3	102.081
				216	103.36	1.118	112.0	58.4	102.242
				267	103.42	1.162	112.0	59.5	102.258
				217	103.62	1.212	112.0	69.8	102.408
				266	103.68	1.259	112.0	70.7	102.421
				423	103.94	1.371	112.0	80.9	102.569
				421	103.83	1.245	112.0	82	102.585
422	104.04	1.310	112.0	92	102.730				
420	104.04	1.294	112.0	93.1	102.746				
265	104.35	1.450	112.0	103.7	102.900				
218	104.3	1.372	112.0	105.6	102.928				
MH_209	MH_201	105.833	105.434	313	106.24	0.407			
MH_209	MH_210	105.833	105.596	254	108.31	2.477			
MH_210	MH_212	105.596	103.579	258	105.12	-0.476			
				258	105.12	0.955	54.0	15.7	104.165
				257	105.54	0.938	54.0	27.4	104.602
				256	106.05	1.025	54.0	38.7	105.025
				255	106.58	1.178	54.0	48.8	105.402
MH_211	MH_212	104.040	103.579	#N/A	#N/A	#N/A			
MH_212	MH_204	103.579	103.979	284	104.71	1.131			
MH_212	MH_213	103.579	103.233	203	104.1	0.521			
MH_213	MH_214	103.233	103.053	204	104.02	0.787			
MH_214	MH_215	103.053	101.393	272	102.37	-0.683			
				272	102.37	0.841	90.0	7.4	101.529
				211	102.46	0.776	90.0	15.8	101.684

Table 3: Composite Hydraulic Gradeline Results for 100-Year Design Storms

U/S MH	D/S MH	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard ⁽²⁾ (m)	Interpolated HGL		
							Length HGL (m)	Dist. From D/S MH (m)	HGL (m)
				273	102.59	0.799	90.0	21.6	101.791
				210	102.68	0.771	90.0	28	101.909
				274	102.86	0.788	90.0	36.8	102.072
				209	102.89	0.792	90.0	38.2	102.098
				275	103.11	0.828	90.0	48.2	102.282
				208	103.15	0.846	90.0	49.4	102.304
				276	103.37	0.863	90.0	60.4	102.507
				207	103.4	0.834	90.0	63.6	102.566
				277	103.55	0.905	90.0	67.9	102.645
				206	103.66	0.884	90.0	75	102.776
				278	103.55	0.613	90.0	83.7	102.937
				205	103.83	0.860	90.0	85.5	102.970
MH_215	MH_119	101.393	100.114	#N/A	#N/A	#N/A			
MH_216	MH_217	105.511	105.093	346	105.85	0.339			
MH_217	MH_218	105.093	104.927	356	105.71	0.617			
MH_218	MH_220	104.927	104.166	357	105.75	0.823			
MH_219	MH_220	105.649	104.166	#N/A	#N/A	#N/A			
MH_220	MH_224	103.894	102.523	259	104.74	0.846			
MH_221	MH_222	103.088	102.811	396-1	103.56	0.472			
MH_222	MH_223	102.811	102.698	366-1	103.37	0.559			
MH_2	MH_2260	102.506	102.126	Est. Fut	103.49	0.984			
MH_223	MH_224	102.698	102.523	365-1	103.42	0.722			
MH_224	MH_105	102.025	100.067	141	101.9	-0.125			
				141	101.9	1.561	82.0	11.4	100.339
				140	102.18	1.502	82.0	25.6	100.678
				139	102.55	1.602	82.0	36.9	100.948
				138	102.92	1.728	82.0	47.1	101.192
				137	103.3	1.843	82.0	58.2	101.457
				136	103.81	2.029	82.0	71.8	101.781
MH_225	MH_226	103.572	103.053	388-3	103.75	0.178			
				389-2	103.75	0.667	99.5	5.8	103.083
				389-1	103.75	0.610	82.0	13.8	103.140
				388-3	103.75	0.543	82.0	24.4	103.207
				388-2	103.88	0.624	82.0	32.1	103.256
				388-1	103.88	0.573	82.0	40.1	103.307
				387-4	104.02	0.646	82.0	50.7	103.374
				387-3	104.02	0.595	82.0	58.7	103.425
				387-2	104.02	0.550	82.0	65.9	103.470
				387-1	104.02	0.499	82.0	73.9	103.521
MH_2260	MH_227	102.126	101.119	392-1	102.46	0.334			
MH_226	MH_2260	103.053	102.126	391-3	103.08	0.027			
				391-3	103.08	0.921	64.0	2.3	102.159
				391-2	103.45	1.185	64.0	9.6	102.265
				391-1	103.45	1.069	64.0	17.6	102.381
				390-3	103.58	1.046	64.0	28.2	102.534
				390-2	103.58	0.930	64.0	36.2	102.650
				390-1	103.58	0.820	64.0	43.8	102.760
				389-4	103.75	0.835	64.0	54.5	102.915
				389-3	103.75	0.719	64.0	62.5	103.031
MH_227	MH_109	101.119	99.691	394-3	100.86	-0.259			
				394-4	100.86	0.874	93.0	19.2	99.986
				394-3	100.86	0.751	93.0	27.2	100.109
				394-2	101.26	1.039	93.0	34.5	100.221
				394-1	101.26	0.916	93.0	42.5	100.344
				393-3	101.49	0.968	93.0	54.1	100.522
				393-2	101.81	1.172	93.0	61.7	100.638

Table 3: Composite Hydraulic Gradeline Results for 100-Year Design Storms

U/S MH	D/S MH	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard ⁽²⁾ (m)	Interpolated HGL		
							Length HGL (m)	Dist. From D/S MH (m)	HGL (m)
				393-1	101.81	1.049	93.0	69.7	100.761
				392-4	102.21	1.269	93.0	81.4	100.941
				392-3	102.21	1.146	93.0	89.4	101.064
MH_228	MH_229	102.612	101.073	384-3	102.12	-0.492			
				384-3	102.12	0.997	74.5	2.4	101.123
				379-2	102.14	0.997	74.5	3.4	101.143
				384-4	102.12	0.832	74.5	10.4	101.288
				379-1	102.14	0.832	74.5	11.4	101.308
				385-1	102.35	0.843	74.5	21	101.507
				378-3	102.57	1.043	74.5	22	101.527
				385-2	102.65	0.986	74.5	28.6	101.664
				378-2	102.67	0.983	74.5	29.7	101.687
				385-3	102.65	0.821	74.5	36.6	101.829
				378-1	102.67	0.818	74.5	37.7	101.852
				386-1	102.73	0.680	74.5	47.3	102.050
				377-4	103.02	0.949	74.5	48.3	102.071
				386-2	103.08	0.865	74.5	55.3	102.215
				377-3	103.28	1.044	74.5	56.3	102.236
				377-2	103.34	0.955	74.5	63.5	102.385
				377-1	103.34	0.790	74.5	71.5	102.550
MH_229	MH_102	101.073	100.197	381-1	101.35	0.277			
				382-1	101.52	1.184	86.5	13.7	100.336
				381-4	101.35	1.004	86.5	14.7	100.346
				382-2	101.52	1.103	86.5	21.7	100.417
				381-3	101.35	0.923	86.5	22.7	100.427
				382-3	101.52	1.030	86.5	28.9	100.490
				381-2	101.35	0.849	86.5	30	100.501
				382-4	101.52	0.949	86.5	36.9	100.571
				381-1	101.35	0.768	86.5	38	100.582
				383-1	101.62	0.941	86.5	47.6	100.679
				380-3	101.59	0.901	86.5	48.6	100.689
				383-2	101.62	0.860	86.5	55.6	100.760
				380-2	101.59	0.820	86.5	56.6	100.770
				383-3	101.62	0.783	86.5	63.2	100.837
				380-1	101.59	0.743	86.5	64.2	100.847
				384-1	101.95	1.006	86.5	73.8	100.944
				379-4	101.96	1.004	86.5	74.9	100.956
				384-2	101.95	0.925	86.5	81.8	101.025
				379-3	101.96	0.923	86.5	82.9	101.037
MH_230	MH_231	102.557	100.982	374-3	102.03	-0.527			
				374-3	102.03	0.994	73.5	2.5	101.036
				368-3	102.24	1.151	73.5	5	101.089
				374-4	102.03	0.823	73.5	10.5	101.207
				368-2	102.24	0.979	73.5	13	101.261
				368-1	102.24	0.817	73.5	20.6	101.423
				375-1	102.4	0.964	73.5	21.2	101.436
				375-2	102.57	0.971	73.5	28.8	101.599
				367-3	102.71	1.057	73.5	31.3	101.653
				375-3	102.57	0.799	73.5	36.8	101.771
				367-2	102.71	0.886	73.5	39.3	101.824
				367-1	102.71	0.723	73.5	46.9	101.987
				376-1	103	1.002	73.5	47.4	101.998
				376-2	103	0.831	73.5	55.4	102.169
				376-3	103.37	1.044	73.5	62.7	102.326
				376-4	103.37	0.873	73.5	70.7	102.497
MH_231	MH_103	100.982	99.575	371-1	100.56	-0.422			

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U/S MH	D/S MH	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard ⁽²⁾ (m)	Interpolated HGL		
							Length HGL (m)	Dist. From D/S MH (m)	HGL (m)
				371-3	100.56	0.775	87.0	13	99.785
				372-1	100.95	1.150	87.0	13.9	99.800
				371-2	100.56	0.645	87.0	21	99.915
				372-2	100.95	1.021	87.0	21.9	99.929
				371-1	100.56	0.522	87.0	28.6	100.038
				372-3	100.95	0.903	87.0	29.2	100.047
				372-4	100.95	0.773	87.0	37.2	100.177
				370-3	101.09	0.879	87.0	39.3	100.211
				370-2	101.09	0.750	87.0	47.3	100.340
				373-1	100.97	0.622	87.0	47.8	100.348
				370-1	101.09	0.627	87.0	54.9	100.463
				373-2	101.32	0.843	87.0	55.8	100.477
				373-3	101.32	0.720	87.0	63.4	100.600
				369-3	101.61	0.976	87.0	65.5	100.634
				369-2	101.61	0.846	87.0	73.5	100.764
				374-1	101.56	0.787	87.0	74.1	100.773
				369-1	101.61	0.722	87.0	81.2	100.888
								374-2	101.56
MH_302	MH_303	98.370	98.291	#N/A	#N/A	#N/A			
MH_303	MH_304	98.291	98.086	#N/A	#N/A	#N/A			
MH_304	MH_306TEE	98.086	97.813	#N/A	#N/A	#N/A			
MH_306TEE	MH_307	97.813	97.550	#N/A	#N/A	#N/A			
MH_313	MH_307	97.449	97.550	#N/A	#N/A	#N/A			
MH_307	MH_400	97.550	97.537	#N/A	#N/A	#N/A			
MH_309	MH_310	97.979	97.853	#N/A	#N/A	#N/A			
MH_310	MH_311	97.853	97.779	#N/A	#N/A	#N/A			
MH_3	MH_109	99.716	99.691	#N/A	#N/A	#N/A			
MH_3111TEE	MH_312	97.671	97.526	#N/A	#N/A	#N/A			
MH_311	MH_3111TEE	97.779	97.671	#N/A	#N/A	#N/A			
MH_312	MH_313	97.526	97.449	#N/A	#N/A	#N/A			
MH_313	MH_500	97.449	97.416	#N/A	#N/A	#N/A			
MH_400	OGS_1	97.537	97.517	#N/A	#N/A	#N/A			
OGS_1	OGS_1-Out	97.517	97.265	#N/A	#N/A	#N/A			
OGS_1-Out	MH_401	97.265	96.930	#N/A	#N/A	#N/A			
MH_4	MH_104	99.324	99.245	#N/A	#N/A	#N/A			
MH_500	OGS_2	97.416	97.406	#N/A	#N/A	#N/A			
OGS_2	OGS_2-Out	97.406	97.174	#N/A	#N/A	#N/A			
OGS_2-Out	MH_501	97.174	96.920	#N/A	#N/A	#N/A			

⁽²⁾ Conservative estimate of freeboard based on U/S HGL and lowest USF connected to pipe. Actual HGL / freeboard at all connecting lots interpolated where conservative estimate does not meet freeboard requirements.

⁽³⁾ Future USF elevations estimated as 1.8 m below the upstream top of manhole elevations.

	Interpolated HGL elevation
	Freeboard Less than 0.3m
	Freeboard Less than 0.0m

5 EROSION AND SEDIMENT CONTROL DURING AND AFTER CONSTRUCTION

Silt and erosion control strategies shall be implemented during construction activities to minimize the transfer of silt off-site. The following measures should be implemented:

- i) Silt control fences shall be installed as required to prevent the movement of silt off-site during rainfall events.
- ii) Construction of a mud mat shall be installed at the site entrance to promote self-cleaning of truck tires when leaving the site.
- iii) All catch basins shall be equipped with a crushed stone filter to prevent the capture of silt in the storm sewer system.
- iv) Regular cleaning of the adjacent roads shall be undertaken during the construction activities.
- v) Regular inspection and maintenance of the silt control measures shall be undertaken until the site has been stabilized.
- vi) The erosion and sediment control devices shall be removed after the site has been stabilized.



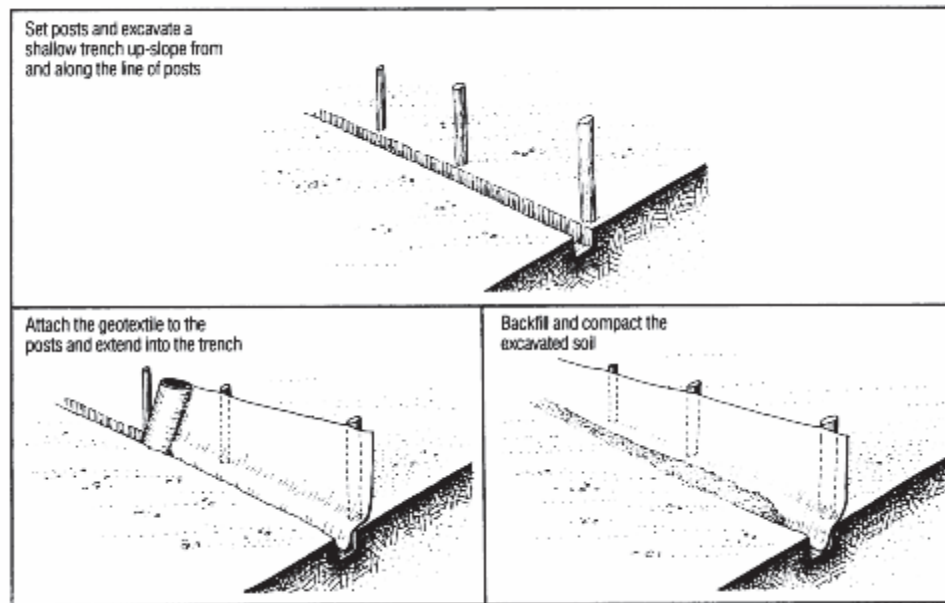


Figure 5: Typical installation of silt fences

Figure 6: Catchbasin with geotextile to protect storm sewer pipes from sediment contamination



6 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The Ridge (Brazeau) development is in the City of Ottawa, east of Borrisokane and Highway 416, and south of Cambrian Road. The development has a total drainage area of 37.03 ha, which will be treated by two oil-and-grit separators for quality control, which then discharges to a dry SWM pond. The dry SWM pond discharges to the Jock River through an existing ditch running north, parallel to Borrisokane Road. The development will also have Etobicoke Exfiltration Systems (EES) implemented within this subdivision. These EES will be installed within local roadways of the subdivision, to exfiltrate runoff from the development for the more frequent events.

Per the City of Ottawa design guidelines, the minor system has been designed to accommodate a minimum of the 2-year post-development flows from within the site and from external areas (plus 5-year flows on collector and 10-year flows on arterial roads). The combined SWMHYMO / PCSWMM model analyses have determined that the minor system will surcharge in most parts of the system. However, with the use of Inlet Control Devices, a minimum freeboard of 0.3 m is provided between the 100-year hydraulic grade line and the underside of footings throughout the subdivision.

The PCSWMM/SWMHYMO simulations have determined that for the selected 2-, 5- and 100-year storms, the total minor system flows would be 5.76 m³/s, 8.218 m³/s and 10.912 m³/s, respectively.

Within the subdivision, the peak water depths do not exceed the maximum allowable 35 cm depth at the gutter for the simulated 100-year storm (Table D-7 of Appendix D). Furthermore, it was determined that for the 100-year event, the product of the velocity and depth of flow does not exceed the maximum allowable 0.60 m²/s. Also as required, the maximum extent of surface water during the 100-year + 20% stress test will not touch the building envelopes.

Table C-1A- C1F of Appendix C summarizes the hydraulic grade line analysis for the various storm. Note that the full pipe velocities are generally no less than 0.80 m/s and no greater than 3.0 m/s for the proposed pipes. Where velocities over 3.0 m/s are proposed, provisions shall be made to protect against displacement of sewers by sudden jarring or movement.

Stress test results for the major and minor drainage systems based on a 20% increase in the 100-year storm, as per the October 2012 *City of Ottawa Sewer Design Guidelines*, are summarized in Section 4.

Recommendations for silt and erosion control strategies to be implemented during construction are presented in Section 6.

In conclusion, the proposed design satisfies all selected design guidelines and requirements.





Legend

ICD Type

- 83mm Circular Orifice Plate
- 94mm Circular Orifice Plate
- 102mm Circular Orifice Plate
- 108mm Circular Orifice Plate
- 127mm Circular Orifice Plate
- 152mm Circular Orifice Plate
- 178mm Circular Orifice Plate
- No ICD

Conduits

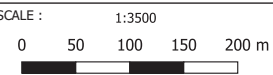
— Minor System

Junctions

● Maintenance Hole

— Site Plan

J.F. Sabourin and Associates Inc.
 WATER RESOURCES AND ENVIRONMENTAL CONSULTANTS
 52 Springbrook Drive
 Ottawa, ON, K2S 1B9
 (613) 836-3884
 www.jfsa.com



PROJECT :
 The Ridge Phase 1

TITLE :
 Figure 2: Minor System Overview

PROJECT	1800-19
DRAWN:	JB
DATE:	JUNE 2020



Legend

- Subcatchments
- Junctions
- Major System
- Low Point
- Major System
- Catch Basins
- Site Plan

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DSEL
 david schaeffer engineering ltd

SCALE : 1:3,500
 0 50 100 150 200 m

PROJECT : Brazeau Phase 1

TITLE : Figure 3: Major System Overview

PROJECT	1800-19
DRAWN:	JB
DATE:	APRIL 2020



Legend
 Maximum Available Storage
 - Volume at Low Points (m³)
 -Max Depth at Low Points(m)
 — Site Plan

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DSEL
 david schaeffer engineering ltd

SCALE : 1:3500
 0 50 100 150 200 m

PROJECT : Brazeau Phase 1

TITLE : Figure 4: Major System Storage

PROJECT	1800-19
DRAWN:	JB
DATE:	APRIL 2020

APPENDIX

A

Rational Method Design Sheets (as per DSEL)

JFSA

Water Resources and
Environmental Consultants



STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Arterial Roads Return Frequency = 10 years



LOCATION	AREA (Ha)																FLOW								SEWER DATA															
	2 YEAR				5 YEAR				10 YEAR				100 YEAR				Time of Conc.	Intensity 2 Year	Intensity 5 Year	Intensity 10 Year	Intensity 100 Year	Peak Flow Q (l/s)	DIA (mm) (actual)	DIA (mm) (nominal)	TYPE	SLOPE (%)	LENGTH (m)	CAPACITY (l/s)	VELOCITY (m/s)	TIME OF TRAVEL (min)	RATIO Q/Q Full									
From Node	To Node	AREA (Ha)	R	Accum. 2.78 AC	AREA (Ha)	R	Accum. 2.78 AC	AREA (Ha)	R	Accum. 2.78 AC	AREA (Ha)	R	Accum. 2.78 AC	AREA (Ha)	R	Accum. 2.78 AC	(min)	(mm/h)	(mm/h)	(mm/h)	(mm/h)																			
FUTURE ROAD (DRUMMOND LAND)																																								
To Expansion Road, Pipe 304 - 306TEE																																								
Plug 304		1.20	0.65	2.17	2.17			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	167	600	600	CONC	0.20	10.0	274.6	0.97	0.17	0.61								
		1.00	0.65	1.81	1.81			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	167	600	600	CONC	0.20	10.0	274.6	0.97	0.17	0.61								
		1.00	0.65	1.81	1.81	1.45	0.40	1.61	1.61			0.00	0.00			0.00	0.00	15.00																						
To Expansion Road, Pipe 303 - 304																																								
Plug 303								0.00	0.00	1.81	1.81			0.00	0.00	0.00	0.00	15.11	61.51	83.20	97.44	142.28	245	750	750	CONC	0.15	10.5	431.2	0.98	0.18	0.57								
		0.99	0.65	1.79	1.79			0.00	0.00	1.81	1.81			0.00	0.00	0.00	0.00	15.29																						
To Expansion Road, Pipe 302 - 303																																								
Plug 302								0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	137	525	525	CONC	0.20	10.5	192.3	0.89	0.20	0.71								
								0.00	0.00	1.79	1.79			0.00	0.00	0.00	0.00	10.20																						
COMMERCIAL BLOCK - SOUTH																																								
To Halku Street, Pipe 133 - 134																																								
CTRL MH 1	133							0.00	0.00	13.83	0.75	28.84	28.84			0.00	0.00	13.00																						
		0.00						0.00	0.00	28.84	28.84			0.00	0.00	0.00	0.00	13.00																						
COMMERCIAL BLOCK - SOUTH, Pipe CTRL MH 1 - 133																																								
From ABIC Property																																								
133	134	0.58	0.90	1.45	30.29			0.00	0.00	7.39	0.30																													
134	135	0.31	0.90	0.78	31.06			0.00	0.00																															
135	136	0.18	0.71	0.36	31.49			0.00	0.00																															
To Expansion Road, Pipe 136 - 302																																								
								0.00	0.00																															
Sturmidae Street																																								
126	127	0.19	0.71	0.38	0.53			0.00	0.00																															
To Montology Way, Pipe 127 - 128																																								
		0.23	0.54	0.35	0.35			0.00	0.00																															
124	125	0.36	0.71	0.71	1.06			0.00	0.00																															
125	127	0.34	0.71	0.67	2.04			0.00	0.00																															
To Montology Way, Pipe 127 - 128																																								
								0.00	0.00																															
Montology Way																																								
Contribution From Traverline Way, Pipe 123 - 127																																								
								0.00	0.00																															
Contribution From Sturmidae Street, Pipe 126 - 127																																								
								0.00	0.00																															
127	128							0.00	0.00	0.53	0.06																													
128	129							0.00	0.00	0.53	0.06																													
129	130	0.40	0.71	0.79	5.06			0.00	0.00	0.38	0.27																													
130	131	0.40	0.71	0.79	6.12			0.00	0.00	0.38	0.27																													
131	132							0.00	0.00	0.38	0.27																													
To Traverline Way, Pipe 132 - 136																																								
								0.00	0.00	6.12	0.06																													
Ruososa Street																																								
211	212	0.26	0.54	0.39	0.39			0.00	0.00																															
To Appalachian Circle, Pipe 212 - 213																																								
		0.49	0.54	0.74	0.74			0.00	0.00																															
212	204							0.00	0.00																															
204	205	0.50	0.71	0.99	1.72			0.00	0.00																															
Definitions:																																								
Q = 2.78 ABR, where																																								
Q = Peak Flow in Litres per second (L/s)																																								
A = Area in hectares (ha)																																								
I = Rainfall Intensity (mm/h)																																								
R = Runoff Coefficient																																								
Notes:																																								
1) Ottawa Rainfall-Intensity Curve																																								
2) Min. Velocity = 0.80 m/s																																								
Design: SLM																PROJECT: Clavan Communities - Brazeau Phase 1				ADP																				
Checked: ADP																LOCATION: City of Ottawa				File Ref: 15-1010																				
Drawn: Storm Drainage Plan B4-87																Date: 15-Jun-20				Sheet No: 1 OF 6																				



STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Arterial Roads Return Frequency = 10 years

Manning 0.013

Table with columns: LOCATION, AREA (Ha), 2 YEAR, 5 YEAR, 10 YEAR, 100 YEAR, FLOW, SEWER DATA. Rows include various street segments like 107-112, 112-113, 113-114, 114-115, Haiku Street, Commercial Block - East, Obsidian Street, Haiku Street, Park Block, and Canadensis Lane.

Design Data for HMB ph B storm outlet point (MH 3)

Definitions: Q = 2.78 AIR, where Q = Peak Flow in Litres per second (L/s)
Notes: 1) Ottawa Rainfall Intensity Curve 2) Min. Velocity = 0.80 m/s
Designed: SLM PROJECT: Clavan Communities - Braxatu Phase 1
Checked: ADP LOCATION: City of Ottawa
Dwg. Reference: Storm Drainage Plan B3-86 File Ref: 18-1030 Date: 15-Jun-20 Sheet No: 3 OF 6



STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Arterial Roads Return Frequency = 10 years

Table with columns for LOCATION, AREA (Ha), R, Indiv., Accum., 2 YEAR, 5 YEAR, 10 YEAR, 100 YEAR, Time of Conc., Intensity (2 Year, 5 Year, 10 Year, 100 Year), Peak Flow, DIA (mm), TYPE, SLOPE (%), LENGTH (m), CAPACITY (l/s), VELOCITY (m/s), TIME OF FLOW (min), and RATIO. The table contains multiple rows of data for various street segments and contributions.

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Area in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Velocity = 0.80 m/s

Designed: SLM
Checked: ADJ
Proj. Reference: Storm Drainage Plan B3-86
PROJECT: Clavan Communities - Brazeau Phase 1
LOCATION: City of Ottawa
File Ref: 18-1030
Date: 15-Jun-20
Sheet No: 4 OF 6



STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Arterial Roads Return Frequency = 10 years

Table with columns: LOCATION, AREA (Ha), R, Indiv. Accum., 2 YEAR, 5 YEAR, 10 YEAR, 100 YEAR, Intensity, Peak Flow, D/A, SLOPE, LENGTH, CAPACITY, VELOCITY, TIME OF FLOW, RATIO. Includes rows for various pipe sections and expansion roads.

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Area in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall Intensity Curve
2) Mn. Velocity = 0.80 m/s

Designated: SLM
Checked: ADF
Dwg. Reference: Storm Drainage Plan 83-86
PROJECT: Clavien Communities - Brabant Phase 1
LOCATION: City of Ottawa
File Ref: 18-1030
Date: 15-Jun-20
Sheet No: 5 OF 6

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)



Manning 0.013
 Local Roads Return Frequency = 2 years
 Collector Roads Return Frequency = 5 years
 Arterial Roads Return Frequency = 10 years

LOCATION			AREA (Ha)												FLOW										SEWER DATA					
Location	From Node	To Node	2 YEAR		5 YEAR		10 YEAR		100 YEAR		Time of Conc. (min)	Intensity 2 Year (mm/h)	Intensity 5 Year (mm/h)	Intensity 10 Year (mm/h)	Intensity 100 Year (mm/h)	Peak Flow Q (l/s)	DIA (mm) (actual)	DIA (mm) (nominal)	TYPE	SLOPE (%)	LENGTH (m)	CAPACITY (l/s)	VELOCITY (m/s)	TIME OF TRAVEL (min)	RATIO					
			AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC																AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)
Contribution From Expansion Road, Pipe 306TEE - 306TEE			88.72								0.00	23.17																		
306TEE	307	0.18	0.71	0.36	89.08						0.00	6.21																		
307	400			0.00	89.08						0.00	6.21																		
400	HW401			0.00	89.08						0.00	6.21																		
POND OUTLET - CONSTANT FLOW RATE 1300 L/S											0.00	0.00																		
HW OUT	1002			0.00	0.00						0.00	0.00																		
1002	1003			0.00	0.00						0.00	0.00																		
To BORRISOKANE - 190, Pipe 1003 - 1004											0.00	0.00																		
BORRISOKANE ROAD - CONSTANT FLOW RATE 1300 L/S											0.00	0.00																		
Contribution From POND OUTLET - 192, Pipe 1002 - 1003											0.00	0.00																		
1003	1004			0.00	0.00						0.00	0.00																		
1004	1005			0.00	0.00						0.00	0.00																		
1005	1006			0.00	0.00						0.00	0.00																		
1006	1007			0.00	0.00						0.00	0.00																		
1007	1008			0.00	0.00						0.00	0.00																		
1008	HW1009			0.00	0.00						0.00	0.00																		

Definitions:
 Q = 2.78 AIR, where
 Q = Peak Flow in Litres per second (L/s)
 A = Area in hectares (ha)
 I = Rainfall Intensity (mm/h)
 R = Runoff Coefficient

Notes:
 1) Ottawa Rainfall-Intensity Curve
 2) Min. Velocity = 0.80 m/s

Design: SLM
Checked: ADJ
Draw. Reference: Storm Drainage Plan B3-86

PROJECT: Clavan Communities - Brazeau Phase 1
LOCATION: City of Ottawa
File Ref: 18-1030
Date: 15-Jun-20
Sheet No.: 6 OF 6

APPENDIX

B

Inlet Control Devices
SWMHYMO Input and Summary Files
PCSWMM Input Files

JFSA

Water Resources and
Environmental Consultants



Products – StormTech Orifice Plate

Our StormTech Orifice Plate uses a calibrated orifice to control the outflow at a specific rate at a specific head in the catch basin. This is our simplest and most economical Inlet Control Device (ICD), and can be sometimes used by municipalities as a starting point for storm water management until more information is gathered. As with all our products, it can be swapped out with another StormTech ICD once more is known about the system.

Orifice Plate units can have any shape or size of orifice customized to meet your needs. Standard designs include Round, Diamond, Keyhole and Diamond Keyhole shaped orifices. Keyholes help create a torsional flow pattern through the orifice that can help unblock some debris.

Orifice plate ICD's do not form water traps to prevent odours and are also prone to blockage by floatables like leaves, twigs, bottles and cans, especially during higher rainfall periods. Monitoring of these types of installs is recommended and sometimes leads to recommendations to upgrade to water trap devices, such as Odour Traps and Sumps, to prevent blockage and odours. But in locations where they work properly they are an economical alternative solution.

Primary Function(s): Flow Control for Medium to High Flow Rates (15 to 100 l/s | 237 to 1585 GPM).

Other Functions(s): None.

Outflow Pipe Diameter: 150 mm to 300 mm | 6 inch to 12 inch. Special orders can be made for larger sizes.

Catch Basin Types: All – with or without sumps.
Rectangular or Round Catch Basins (Round requires built-in adapter that can be provided).
Standard Round is 600 mm, but larger sizes available (900 mm, 1200 mm, 1600 mm ...etc.).
Fits through even small Catch Basin openings (300 mm x 450 mm).

Specifications:

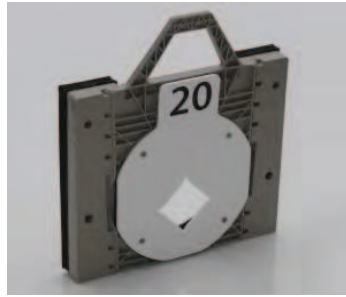
- Orifice Plate:** HDPE Thermoplastic with UV resistant additives.
- Handle Plate (common):** HDPE Thermoplastic.
- Handle Plate (common):** HDPE Thermoplastic.
- Mounting Plate (common):** HDPE Thermoplastic.
- Hardware (common):** Stainless Steel Wedge Bolts with Nut and Washer (4).
- Welds:** None.
- Inner Ring Seal:** Rubber Bulb Seal EPDM. Held in place and reusable. No need to replace.
- Wall Seal:** 3/8 or 5/8 inch Neoprene closed cell sponge gasket attached to Mounting Plate.
- Identifier:** 50 mm high numeric's on top of unit. Peel and stick. Note: Not visible from street surface.
- Special Tools:** None required.
- Weight:** Removable Unit: 0.5 kg / 1 lb. Maximum Total Assembly: 2.3 kg / 5 lb.

Products – StormTech Orifice Plate (continued)

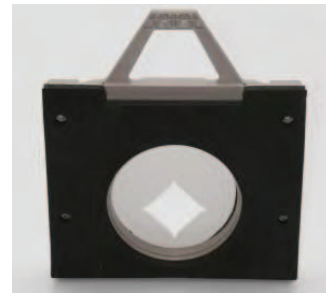
Orifice Plate – Square Adapter (with Diamond Orifice pictured)



Front

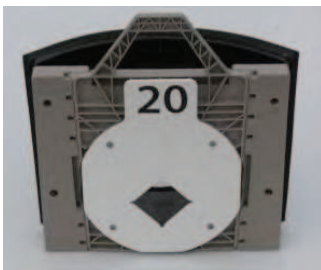


Left Angle



Back – View from Wall

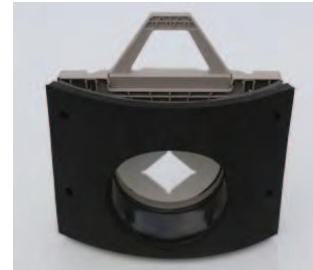
Orifice Plate – Round Adapter



Front



Left Angle



Back – View from Wall

Installation:

1. If necessary, cut protruding out-flowing pipe back flush to Catch Basin wall.
2. Use Mounting Plate as template to mark four hole pattern on Catch Basin wall.
3. Install four Stainless Steel Wedge Bolts (provided) perpendicular to Mounting Plate.
4. Install Mounting Plate and hand secure with four washers and nuts (provided).
5. Torque nuts to 40 N·m or 30 lbf·ft. Do not over-tighten.
6. Snap unit into place by pushing Handle Plate into dove-tail slot of Mounting Plate.
7. Record Unit Identifier along with Catch Basin Location according to municipal requirements.
8. Note – Unit Identifier with this model is NOT easily seen from street level.

Table B-1: Plas-Tech StormTech Orifice Plate Inlet Control Device (ICD) Capacities ⁽¹⁾

ICD Diameter (mm)	Capture (L/s)							
	CB (1.38 m lead pipe invert depth)				CBMH (1.74 m lead pipe invert depth)			
<i>Water Depth:</i>	<i>0 cm</i>	<i>Average</i>	<i>30 cm</i>	<i>35 cm</i>	<i>0 cm</i>	<i>Average</i>	<i>30 cm</i>	<i>35 cm</i>
<i>Head:</i>	<i>1.28 m</i>	<i>1.4 m</i>	<i>1.58 m</i>	<i>1.63 m</i>	<i>1.64 m</i>	<i>1.76 m</i>	<i>1.94 m</i>	<i>1.99 m</i>
83	17.6	18.4	19.6	19.9	19.9	20.7	21.7	22.0
94	22.6	23.6	25.1	25.5	25.6	26.5	27.8	28.2
102	26.6	27.8	29.6	30.0	30.1	31.2	32.8	33.2
108	29.8	31.2	33.2	33.7	33.8	35.0	36.7	37.2
127	41.3	43.2	45.8	46.6	46.7	48.4	50.8	51.5
152	59.1	61.8	65.7	66.7	66.9	69.3	72.8	73.7
178	81.1	84.8	90.1	91.5	91.8	95.0	99.8	101.1

⁽¹⁾ For circular orifices plate type with diameters as specified by City of Ottawa standards.

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1  20    Metric units / ID numbers OFF
2  *#*****
3  *# SWMHYMO / INPUT DATA FILE
4  *#*****
5  *# Project Name: [Brazeau Lands]    Project Number: [1800]
6  *# Date       : 16-September-2019
7  *# Modeller   : [JB]
8  *# Updated    : [JB - Feb 2020]
9  *#           : [JB - June 2020]
10 *# Company    : JFSAinc.
11 *# License #  : 2549237
12
13 *#*****
14 *# Model developed to simulate runoff from catchments that are greater than 0.5 ha
15 *#*****
16 *# Updated     : 22 April 2020 to reflect development boundary changes and on-site
17 controls - JB JFSA
18 *% 25 mm Storm based on 2-Year, 3-Hour Chicago Storm
19 START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[001]
20                ["25MMC3H.stm"] <--storm filename, one per line for NSTORM time
21 *%-----|-----|
22 READ STORM    STORM_FILENAME=[" STORM.001" ]
23 *%-----|-----|
24 *SAVE ALL HYDS      ON=[1]
25 *%-----|-----|
26 *# Park Lands
27 CALI B STANDHYD  NHYD=["A104PK"], DT=[1] (min), AREA=[1.720] (ha), XIMP=[0.19],
28 TIMP=[0.29], DWF=[0] (cms),
29 LOSS=[1] Horton Equ: Fo=[76.2] (mm/hr), Fc=[13.2] (mm/hr),
30 DCAY=[4.14] (/hr), F=[0.00] (mm),
31 Pervious areas: IAper=[4.67] (mm), SLPP=[2.0] (%), LGP=[135] (m),
32 MNP=[0.25], SCP=[0] (min),
33 Impervious areas: IAimp=[1.57] (mm), SLPI=[0.5] (%), LGI=[107] (m),
34 MNI=[0.013], SCI=[0] (min),
35 RAINFALL=[ , , -1] (mm/hr)
36 *%-----|-----|
37 *# Minor system flow limited to 5-Year Rational (0.199m3/s)
38 *# On-site storage provided up to the 100 year event.
39 ROUTE RESERVOI R  NHYDout=["A104PKmi"], NHYDin=["A104PK"], RDT=[1] (min),
40 TABLE of ( OUTFLOW-STORAGE ) values
41 (cms) - (ha-m)
42 [ 0.0 , 0.0 ]
43 [ 0.199, 0.001]
44 [ 0.199, 0.0075]
45 [ -1 , -1 ] (maximum one hundred pairs of points)
46 NHYDovf=["A104PKMa"],
47 *%-----|-----|
48 SAVE HYD       NHYD=["A104PKmi"], # OF PCYCLES=[-1], ICASEsh=[1]
49 HYD_COMMENT=["A104PK-minor"]
50 SAVE HYD       NHYD=["A104PKMa"], # OF PCYCLES=[-1], ICASEsh=[1]
51 HYD_COMMENT=["A104PK-Major"]
52 *%-----|-----|
53 *# Residential Lands
54 CALI B STANDHYD  NHYD=["A109RES"], DT=[1] (min), AREA=[1.64] (ha), XIMP=[.59],
55 TIMP=[.69], DWF=[0] (cms),
56 LOSS=[1] Horton Equ: Fo=[76.2] (mm/hr), Fc=[13.2] (mm/hr),
57 DCAY=[4.14] (/hr), F=[0.00] (mm),
58 Pervious areas: IAper=[4.67] (mm), SLPP=[2.0] (%), LGP=[40] (m),
59 MNP=[0.25], SCP=[0] (min),
60 Impervious areas: IAimp=[1.57] (mm), SLPI=[0.5] (%), LGI=[104] (m),
61 MNI=[0.013], SCI=[0] (min),
62 RAINFALL=[ , , -1] (mm/hr)
63 *%-----|-----|

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55  *# Minor system limited to 2-Year Chicago 3hr +14% (0.230m3/s)
56  *# On-site storage provided up to the 100 year event.
57  *# 100-year + 20% stress test capture set at 107% of 100-year capture,
58  *# and 100-year + 20% stress test storage set to 145% of 100-year storage
59  ROUTE RESERVOIR      NHYDout=["A109RESmi"], NHYDin=["A109RES"], RDT=[1] (min),
60                        TABLE of ( OUTFLOW-STORAGE ) values
61                        (cms) - (ha-m)
62                        [ 0.0 , 0.0 ]
63                        [ 0.230, 0.001]
64                        [ 0.230, 0.026]
65                        [ 0.246, 0.044]
66                        [ -1 , -1 ] (maximum one hundred pairs of points)
67                        NHYDovf=["A109RESMa"],
68  *#-----|-----|
69  SAVE HYD              NHYD=["A109RESmi"], # OF PCYCLES=[-1], ICASEsh=[1]
70                        HYD_COMMENT=["A109RES-minor"]
71  SAVE HYD              NHYD=["A109RESMa"], # OF PCYCLES=[-1], ICASEsh=[1]
72                        HYD_COMMENT=["A109RES-Major"]
73  *#-----|-----|
74  *# Commercial Block
75  CALI B STANDHYD      NHYD=["A2260COM"], DT=[1] (min), AREA=[2.68] (ha), XIMP=[.69],
76  TIMP=[.79], DWF=[0] (cms),
77                        LOSS=[1] Horton Equ: Fo=[76.2] (mm/hr), Fc=[13.2] (mm/hr),
78                        DCAY=[4.14] (/hr), F=[0.00] (mm),
79                        Pervious areas: IAper=[4.67] (mm), SLPP=[2.0] (%), LGP=[40] (m),
80                        MNP=[0.25], SCP=[0] (min),
81                        Impervious areas: IAimp=[1.57] (mm), SLPI=[0.5] (%), LGI=[133] (m),
82                        MNI=[0.013], SCI=[0] (min),
83                        RAINFALL=[ , , -1] (mm/hr)
84  *#-----|-----|
85  *# Minor system limited to 2-Yr Rational Method (0.382 m3/s)
86  *# On-site storage provided up to the 100 year event.
87  ROUTE RESERVOIR      NHYDout=["A2260COMmi"], NHYDin=["A2260COM"], RDT=[1] (min),
88                        TABLE of ( OUTFLOW-STORAGE ) values
89                        (cms) - (ha-m)
90                        [ 0.0 , 0.0 ]
91                        [ 0.382, .001]
92                        [ 0.382, .0445]
93                        [ -1 , -1 ] (maximum one hundred pairs of points)
94                        NHYDovf=["A2260COMMa"],
95  *#-----|-----|
96  SAVE HYD              NHYD=["A2260COMmi"], # OF PCYCLES=[-1], ICASEsh=[1]
97                        HYD_COMMENT=["A2260COM-minor"]
98  SAVE HYD              NHYD=["A2260COMMa"], # OF PCYCLES=[-1], ICASEsh=[1]
99                        HYD_COMMENT=["A2260COM-Major"]
100  *#-----|-----|
101  *# Residential Block
102  CALI B STANDHYD      NHYD=["A303EXT"], DT=[1] (min), AREA=[2.451] (ha), XIMP=[.59],
103  TIMP=[.69], DWF=[0] (cms),
104                        LOSS=[1] Horton Equ: Fo=[76.2] (mm/hr), Fc=[13.2] (mm/hr),
105                        DCAY=[4.14] (/hr), F=[0.00] (mm),
106                        Pervious areas: IAper=[4.67] (mm), SLPP=[2.0] (%), LGP=[40] (m),
107                        MNP=[0.25], SCP=[0] (min),
108                        Impervious areas: IAimp=[1.57] (mm), SLPI=[0.5] (%), LGI=[127] (m),
109                        MNI=[0.013], SCI=[0] (min),
110                        RAINFALL=[ , , -1] (mm/hr)
111  *#-----|-----|
112  *# Minor system limited to 2-Year Chicago 3hr +14% (0.336 m3/s)
113  *# On-site storage provided up to the 100 year event.
114  *# 100-year + 20% stress test capture set at 107% of 100-year capture,
115  *# and 100-year + 20% stress test storage set to 145% of 100-year storage
116  ROUTE RESERVOIR      NHYDout=["A303EXTmi"], NHYDin=["A303EXT"], RDT=[1] (min),
117                        TABLE of ( OUTFLOW-STORAGE ) values
118                        (cms) - (ha-m)
119                        [ 0.0 , 0.0 ]
120                        [ 0.336, .001]
121                        [ 0.336, .038]

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114 [ 0.360, .055]
115 [ -1 , -1 ] (maximum one hundred pairs of points)
116 NHYDovf=["A303EXTMa"],
117 *%-----|-----|
118 SAVE HYD NHYD=["A303EXTmi"], # OF PCYCLES=[-1], ICASEsh=[1]
119 HYD_COMMENT=["A301EXT-minor"]
120 SAVE HYD NHYD=["A303EXTMa"], # OF PCYCLES=[-1], ICASEsh=[1]
121 HYD_COMMENT=["A301EXT-Major"]
122 *%-----|-----|
123 *# Residential Block
124 CALI B STANDHYD NHYD=["A302EXT"], DT=[1] (min), AREA=[0.99] (ha), XIMP=[.59],
TIMP=[.69], DWF=[0] (cms),
125 LOSS=[1] Horton Equ: Fo=[76.2] (mm/hr), Fc=[13.2] (mm/hr),
DCAY=[4.14] (/hr), F=[0.00] (mm),
126 Pervious areas: IAper=[4.67] (mm), SLPP=[2.0] (%), LGP=[40] (m),
MNP=[0.25], SCP=[0] (min),
127 Impervious areas: IAimp=[1.57] (mm), SLPI=[0.5] (%), LGI=[81] (m),
MNI=[0.013], SCI=[0] (min),
128 RAINFALL=[ , , -1] (mm/hr)
129 *%-----|-----|
130 *# Minor system limited to 2-Year Chicago 3hr +14% (0.146 m³/s)
131 *# On-site storage provided up to the 100 year event.
132 *# 100-year + 20% stress test capture set at 107% of 100-year capture,
133 *# and 100-year + 20% stress test storage set to 145% of 100-year storage
134 ROUTE RESERVOI R NHYDout=["A302EXTmi"], NHYDin=["A302EXT"], RDT=[1] (min),
135 TABLE of ( OUTFLOW-STORAGE ) values
136 (cms) - (ha-m)
137 [ 0.0 , 0.0 ]
138 [ 0.146, .001]
139 [ 0.146, .015]
140 [ 0.156, .021]
141 [ -1 , -1 ] (maximum one hundred pairs of points)
142 NHYDovf=["A302EXTMa"],
143 *%-----|-----|
144 SAVE HYD NHYD=["A302EXTmi"], # OF PCYCLES=[-1], ICASEsh=[1]
145 HYD_COMMENT=["A302EXT-minor"]
146 SAVE HYD NHYD=["A302EXTMa"], # OF PCYCLES=[-1], ICASEsh=[1]
147 HYD_COMMENT=["A302EXT-Major"]
148 *%-----|-----|
149 *# Residential Block
150 CALI B STANDHYD NHYD=["A304EXT"], DT=[1] (min), AREA=[1.199] (ha), XIMP=[.59],
TIMP=[.69], DWF=[0] (cms),
151 LOSS=[1] Horton Equ: Fo=[76.2] (mm/hr), Fc=[13.2] (mm/hr),
DCAY=[4.14] (/hr), F=[0.00] (mm),
152 Pervious areas: IAper=[4.67] (mm), SLPP=[2.0] (%), LGP=[40] (m),
MNP=[0.25], SCP=[0] (min),
153 Impervious areas: IAimp=[1.57] (mm), SLPI=[0.5] (%), LGI=[89] (m),
MNI=[0.013], SCI=[0] (min),
154 RAINFALL=[ , , -1] (mm/hr)
155 *%-----|-----|
156 *# Minor system limited to 2-Year Chicago 3hr +14% (0.173 m³/s)
157 *# On-site storage provided up to the 100 year event.
158 *# 100-year + 20% stress test capture set at 107% of 100-year capture,
159 *# and 100-year + 20% stress test storage set to 145% of 100-year storage
160 ROUTE RESERVOI R NHYDout=["A304EXTmi"], NHYDin=["A304EXT"], RDT=[1] (min),
161 TABLE of ( OUTFLOW-STORAGE ) values
162 (cms) - (ha-m)
163 [ 0.0 , 0.0 ]
164 [ 0.173, .001]
165 [ 0.173, .0180]
166 [ 0.185, .0261]
167 [ -1 , -1 ] (maximum one hundred pairs of points)
168 NHYDovf=["A304EXTMa"],
169 *%-----|-----|
170 SAVE HYD NHYD=["A304EXTmi"], # OF PCYCLES=[-1], ICASEsh=[1]
171 HYD_COMMENT=["A304EXT-minor"]
172 SAVE HYD NHYD=["A304EXTMa"], # OF PCYCLES=[-1], ICASEsh=[1]

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173 HYD_COMMENT=[" A304EXT-Major" ]
174 *%-----|-----|
175 *# Residential Block
176 CALI B STANDHYD NHYD=[" A310EXT1" ], DT=[1] (min), AREA=[1.223] (ha), XIMP=[.59],
TIMP=[.69], DWF=[0] (cms),
177 LOSS=[1] Horton Equ: Fo=[76.2] (mm/hr), Fc=[13.2] (mm/hr),
DCAY=[4.14] (/hr), F=[0.00] (mm),
178 Pervious areas: IAper=[4.67] (mm), SLPP=[2.0] (%), LGP=[40] (m),
MNP=[0.25], SCP=[0] (min),
179 Impervious areas: IAimp=[1.57] (mm), SLPI=[0.5] (%), LGI=[90] (m),
MNI=[0.013], SCI=[0] (min),
180 RAINFALL=[ , , -1] (mm/hr)
181 *%-----|-----|
182 *# Minor system limited to 2-Year Chicago 3hr +14% (0.177 m³/s)
183 *# On-site storage provided up to the 100 year event.
184 *# 100-year + 20% stress test capture set at 107% of 100-year capture,
185 *# and 100-year + 20% stress test storage set to 145% of 100-year storage
186 ROUTE RESERVOI R NHYDout=[" A310EXT1mi" ], NHYDin=[" A310EXT1" ], RDT=[1] (min),
187 TABLE of ( OUTFLOW-STORAGE ) values
188 (cms) - (ha-m)
189 [ 0.0 , 0.0 ]
190 [ 0.177, .001]
191 [ 0.177, .019]
192 [ 0.189, .028]
193 [ -1 , -1 ] (maximum one hundred pairs of points)
194 NHYDovf=[" A310EXT1Ma" ],
195 *%-----|-----|
196 SAVE HYD NHYD=[" A310EXT1mi" ], # OF PCYCLES=[-1], ICASEsh=[1]
197 HYD_COMMENT=[" A310EXT1-minor" ]
198 SAVE HYD NHYD=[" A310EXT1Ma" ], # OF PCYCLES=[-1], ICASEsh=[1]
199 HYD_COMMENT=[" A310EXT1-Major" ]
200 *%-----|-----|
201 *# Residential Block
202 CALI B STANDHYD NHYD=[" A310EXT2" ], DT=[1] (min), AREA=[7.636] (ha), XIMP=[.59],
TIMP=[.69], DWF=[0] (cms),
203 LOSS=[1] Horton Equ: Fo=[76.2] (mm/hr), Fc=[13.2] (mm/hr),
DCAY=[4.14] (/hr), F=[0.00] (mm),
204 Pervious areas: IAper=[4.67] (mm), SLPP=[2.0] (%), LGP=[40] (m),
MNP=[0.25], SCP=[0] (min),
205 Impervious areas: IAimp=[1.57] (mm), SLPI=[0.5] (%), LGI=[226] (m),
MNI=[0.013], SCI=[0] (min),
206 RAINFALL=[ , , -1] (mm/hr)
207 *%-----|-----|
208 *# Minor system limited to 2-Year Chicago 3hr +14% (0.877 m³/s)
209 *# On-site storage provided up to the 100 year event.
210 *# 100-year + 20% stress test capture set at 107% of 100-year capture,
211 *# and 100-year + 20% stress test storage set to 145% of 100-year storage
212 ROUTE RESERVOI R NHYDout=[" A310EXT2mi" ], NHYDin=[" A310EXT2" ], RDT=[1] (min),
213 TABLE of ( OUTFLOW-STORAGE ) values
214 (cms) - (ha-m)
215 [ 0.0 , 0.0 ]
216 [ 0.877, .001]
217 [ 0.877, .133]
218 [ 0.939, .192]
219 [ -1 , -1 ] (maximum one hundred pairs of points)
220 NHYDovf=[" A310EXT2Ma" ],
221 *%-----|-----|
222 SAVE HYD NHYD=[" A310EXT2mi" ], # OF PCYCLES=[-1], ICASEsh=[1]
223 HYD_COMMENT=[" A310EXT2-minor" ]
224 SAVE HYD NHYD=[" A310EXT2Ma" ], # OF PCYCLES=[-1], ICASEsh=[1]
225 HYD_COMMENT=[" A310EXT2-Major" ]
226 *%-----|-----|
227 *# Brazeau Commercial Block
228 CALI B STANDHYD NHYD=[" A133COM" ], DT=[1] (min), AREA=[13.831] (ha), XIMP=[.69],
TIMP=[.79], DWF=[0] (cms),
229 LOSS=[1] Horton Equ: Fo=[76.2] (mm/hr), Fc=[13.2] (mm/hr),
DCAY=[4.14] (/hr), F=[0.00] (mm),

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230 Pervious areas: IAper=[4.67] (mm), SLPP=[2.0] (%), LGP=[40] (m),
231 MNP=[0.25], SCP=[0] (min),
232 Impervious areas: IAimp=[1.57] (mm), SLPI=[0.5] (%), LGI=[303] (m),
233 MNI=[0.013], SCI=[0] (min),
234 RAINFALL=[ , , -1] (mm/hr)
235 *%-----|-----|
236 *# Site controlled to (1.8 m³/s)
237 *# On-site storage provided up to the 100 year event + 20%.
238 ROUTE RESERVOIR NHYDout=["A133COMmi"], NHYDin=["A133COM"], RDT=[1] (min),
239 TABLE of ( OUTFLOW-STORAGE ) values
240 (cms) - (ha-m)
241 [ 0.0 , 0.0 ]
242 [ 1.8, .001]
243 [ 1.8, .35]
244 [ -1 , -1 ] (maximum one hundred pairs of points)
245 NHYDovf=["A133COMMa"],
246 *%-----|-----|
247 SAVE HYD NHYD=["A133COMmi"], # OF PCYCLES=[-1], ICASEsh=[1]
248 HYD_COMMENT=["A133COM-minor"]
249 SAVE HYD NHYD=["A133COMMa"], # OF PCYCLES=[-1], ICASEsh=[1]
250 HYD_COMMENT=["A133COM-Major"]
251 *%-----|-----|
252 *# ABIC Commercial Block
253 CALI B STANDHYD NHYD=["A303COM"], DT=[1] (min), AREA=[7.381] (ha), XIMP=[.69],
254 TIMP=[.79], DWF=[0] (cms),
255 LOSS=[1] Horton Equ: Fo=[76.2] (mm/hr), Fc=[13.2] (mm/hr),
256 DCAY=[4.14] (/hr), F=[0.00] (mm),
257 Pervious areas: IAper=[4.67] (mm), SLPP=[2.0] (%), LGP=[40] (m),
258 MNP=[0.25], SCP=[0] (min),
259 Impervious areas: IAimp=[1.57] (mm), SLPI=[0.5] (%), LGI=[222] (m),
260 MNI=[0.013], SCI=[0] (min),
261 RAINFALL=[ , , -1] (mm/hr)
262 *%-----|-----|
263 *# Site controlled to the pre-development 2-Year rational method peak flow (0.2104 m³/s)
264 * SWM control reduced from 253 L/s to 210.4 L/s
265 * On-site storage provided up to the 100 Year + 20%
266 ROUTE RESERVOIR NHYDout=["A303COMmi"], NHYDin=["A303COM"], RDT=[1] (min),
267 TABLE of ( OUTFLOW-STORAGE ) values
268 (cms) - (ha-m)
269 [ 0.0 , 0.0 ]
270 [ 0.2104, .001]
271 [ 0.2104, .385]
272 [ -1 , -1 ] (maximum one hundred pairs of points)
273 NHYDovf=["A303COMMa"],
274 *%-----|-----|
275 SAVE HYD NHYD=["A303COMmi"], # OF PCYCLES=[-1], ICASEsh=[1]
276 HYD_COMMENT=["A303COM-minor"]
277 SAVE HYD NHYD=["A303COMMa"], # OF PCYCLES=[-1], ICASEsh=[1]
278 HYD_COMMENT=["A303COM-Major"]
279 *%-----|-----|
280 *# SWM Pond Block
281 * Imperviousness increased to 93% based on impermeable clay liner in the pond up to the
282 100-Year water level
283 CALI B STANDHYD NHYD=["APOND1"], DT=[1] (min), AREA=[3.94] (ha), XIMP=[.93],
284 TIMP=[.93], DWF=[0] (cms),
285 LOSS=[1] Horton Equ: Fo=[76.2] (mm/hr), Fc=[13.2] (mm/hr),
286 DCAY=[4.14] (/hr), F=[0.00] (mm),
287 Pervious areas: IAper=[4.67] (mm), SLPP=[2.0] (%), LGP=[40] (m),
288 MNP=[0.25], SCP=[0] (min),
289 Impervious areas: IAimp=[1.57] (mm), SLPI=[0.5] (%), LGI=[162] (m),
290 MNI=[0.013], SCI=[0] (min),
291 RAINFALL=[ , , -1] (mm/hr)
292 *%-----|-----|
293 *SAVE HYD NHYD=["APOND1"], # OF PCYCLES=[-1], ICASEsh=[1]
294 * HYD_COMMENT=["APOND1"]
295 *%-----|-----|
296 *Add Major and minor flows from A303COM directly to Pond

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286 ADD HYD          NHYDsum=["PND-A303"], NHYDs to add=["A303COMMa"+"A303COMmi"+"APOND1"]
287 *%-----|-----|
288 SAVE HYD        NHYD=["PND-A303"], # OF PCYCLES=[-1], ICASEsh=[1]
289                HYD_COMMENT=["PND-A303"]
290 *%-----|-----|
291 *#####|
292 *# STORMS
293 *#####|
294 *% 25 mm Storm based on 2-Year, 3-Hour Chicago Storm
295 *%START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[001]
296 *%              ["25MMC3H.stm"] <--storm filename, one per line for NSTORM time
297 *%-----|-----|
298 *% 2-Year, 3-Hour Chicago Storm
299 START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[002]
300 *%              ["002YC3H.stm"] <--storm filename, one per line for NSTORM time
301 *%-----|-----|
302 *% 5-Year, 3-Hour Chicago Storm
303 START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[005]
304 *%              ["005YC3H.stm"] <--storm filename, one per line for NSTORM time
305 *%-----|-----|
306 *% 10-Year, 3-Hour Chicago Storm
307 *START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[010]
308 *%              ["010YC3H.stm"] <--storm filename, one per line for NSTORM time
309 *%-----|-----|
310 *% 25-Year, 3-Hour Chicago Storm
311 *START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[025]
312 *%              ["025YC3H.stm"] <--storm filename, one per line for NSTORM time
313 *%-----|-----|
314 *% 50-Year, 3-Hour Chicago Storm
315 *START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[050]
316 *%              ["050YC3H.stm"] <--storm filename, one per line for NSTORM time
317 *%-----|-----|
318 *% 100-Year, 3-Hour Chicago Storm
319 START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[099]
320 *%              ["100YC3H.stm"] <--storm filename, one per line for NSTORM time
321 *%-----|-----|
322 *% 2-Year, 24-Hour SCS Storm
323 START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[102]
324 *%              ["SC24002x.stm"] <--storm filename, one per line for NSTORM time
325 *%-----|-----|
326 *% 5-Year, 24-Hour SCS Storm
327 START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[105]
328 *%              ["SC24005x.stm"] <--storm filename, one per line for NSTORM time
329 *%-----|-----|
330 *% 10-Year, 24-Hour SCS Storm
331 START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[110]
332 *%              ["SC24010x.stm"] <--storm filename, one per line for NSTORM time
333 *%-----|-----|
334 *% 25-Year, 24-Hour SCS Storm
335 START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[125]
336 *%              ["SC24025x.stm"] <--storm filename, one per line for NSTORM time
337 *%-----|-----|
338 *% 50-Year, 24-Hour SCS Storm
339 START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[150]
340 *%              ["SC24050x.stm"] <--storm filename, one per line for NSTORM time
341 *%-----|-----|
342 *% 100-Year, 24-Hour SCS Storm
343 START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[199]
344 *%              ["SC24100x.stm"] <--storm filename, one per line for NSTORM time
345 *%-----|-----|
346 *% July 1st, 1979 Storm - Ottawa International Airport
347 START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[979]
348 *%              ["19790701.stm"] <--storm filename, one per line for NSTORM time
349 *%-----|-----|
350 *% August 4th, 1988 Storm - Ottawa International Airport
351 START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[988]
352 *%              ["19880804.stm"] <--storm filename, one per line for NSTORM time

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```
353  *%-----|-----|
354  *% August 8th, 1996 Storm - Ottawa International Airport
355  START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[996]
356  *%             ["19960808.stm"] <--storm filename, one per line for NSTORM time
357  *%-----|-----|
358  *% 100-Year, 24-Hour SCS Storm + 20%
359  START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[998]
360  *%             ["SC24100x+.stm"] <--storm filename, one per line for NSTORM time
361  *%-----|-----|
362  *% 100-Year, 3-Hour Chicago Storm + 20%
363  START          TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[999]
364  *%             ["100YC3H+.stm"] <--storm filename, one per line for NSTORM time
365  *%-----|-----|
366  FINI SH
367
```

00001 *****
00002
00003 SSSS W W M M H H Y Y M M O O 222 000 11 555 *****
00004 S W W M M M H H Y Y M M O O 2 0 0 11 5
00005 SSSS W W M M M H H Y Y M M O O 222 0 0 11 5 Ver 5.500
00006 S W W M M M H H Y Y M M O O 222 0 0 11 555 FEB 2013
00007 SSSS W W M M H H Y Y M M O O 222 0 0 11 5 *****
00008
00009 StormWater Management Hydrologic Model 222 000 11 555 *****
00010
00011
00012 ***** SWHYMO Ver 5.500 *****
00013 A single event and continuous hydrologic simulation model
00014 based on the principles of HYMO and its successors
00015 CTRM=3 and OTRM=99.
00016
00017 Distributed by: J.F. Sabourin and Associates Inc./PROJ/20200615-Development
00018
00019 Ottawa, Ontario: (613) 836-3884
00020 Gatineau, Quebec: (819) 243-6858
00021 E-mail: swhymo@jfsa.com
00022
00023
00024 ***** Licensed user: JFSAi.n.c. *****
00025 SERIAL#:2549237
00026
00027
00028 ***** PROGRAM ARRAY DIMENSIONS *****
00029 ***** Maximum Value for ID numbers: 21 *****
00030
00031 ***** Max. number of rainfall points: 105408 *****
00032
00033
00034
00035
00036 ***** S U M M A R Y O U T P U T *****
00037
00038 ***** RUN DATE: 2020-06-17 TIME: 11:43:37 RUN COUNTER: 00314 *****
00039
00040 ***** Input file: C:\OneDrive\OneDrive - J.F. Sabourin and Associates Inc\PROJ\20200615-Development
00041 ***** \BRAS_v04.dat *****
00042 ***** Output file: C:\OneDrive\OneDrive - J.F. Sabourin and Associates Inc\PROJ\20200615-Development
00043 ***** \BRAS_v04.out *****
00044 ***** Summary file: C:\OneDrive\OneDrive - J.F. Sabourin and Associates Inc\PROJ\20200615-Development
00045 ***** \BRAS_v04.sum *****
00046 ***** User comments: *****
00047 ***** 1. *****
00048 ***** 2. *****
00049 ***** 3. *****
00050
00051
00052
00053
00054 ***** SWHYMO / INPUT DATA FILE *****
00055 *****
00056 # Project Name: (Brascan Lands) Project Number: 1800
00057 # Date: 16-September-2019
00058 # Modeller: [JF] *****
00059 # Updated: [JF - Feb 2020] *****
00060 # License #: [JFSAi.n.c. 2020] *****
00061 # Company: JFSAi.n.c. *****
00062 # License #: [JFSAi.n.c. 2020] *****
00063 # *****
00064 # Model developed to simulate runoff from catchments that are greater than 0.5 ha
00065 # *****
00066 # Updated: 22 April 2020 to reflect development boundary changes and onsite controls - JB JFSA
00067 # *****
00068 *****
00069 *****
00070 *****
00071 [METOUT= 2 (Imperial, 2-metric output)] *****
00072 [ITERS= 0] *****
00073 [NRUN= 0001] *****
00074 R0001:CO002 *****
00075 *****
00076 *****
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007223 [Impervious area] IAlp=1.5751SfL=50.10I=127.1MMI-.0131SCI=.01
007224 # Minor system limited to 2-year Chicago 3hr 144 (0.173 m³/s)
007225 # On-site storage provided up to the 100 year event.
007226 # 100-year + 204 stress test capture set at 107% of 100-year capture
007227 # 100-year + 204 stress test storage set to 145% of 100-year storage

009010 [Residential Block]
009011 CALIB STANDHYD 1.0 0.01A30EXET 99 1.92 NuDate 1:00 29.71 699 .000
009012 [XIMP=59TIMP=69]
009013 [Horton parameters] Fw=76.20F=13.20DCAY=1.41 F= .00]
009014 [Previous area] IAlp=4.67SLFP=2.00ILGF= 40.1MNP=250ISCP= .01
009015 [Impervious area] IAlp=1.5751SfL=50.10I=127.1MMI-.0131SCI=.01
009016 [Minor system limited to 2-year Chicago 3hr 144 (0.173 m³/s)]
009017 # On-site storage provided up to the 100 year event.
009018 # 100-year + 204 stress test capture set at 107% of 100-year capture
009019 # and 100-year + 204 stress test storage set to 145% of 100-year storage


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01801 R01101C00006 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01802 * SAVE HYD 1.0 0.01A30EXM 1.64 .329 NoDate 12:00 .00 n/a .000
01803 frma :A104FKM.010
01804 remark:A104FK-Major
01805 # Residential Block
01806 R01101C00007 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01807 CALIB STANDHYD 1.0 0.01A30EXM 1.64 .329 NoDate 12:00 52.25 704 .000
01808 [XMP:59;TfMP=69]
01809 (Horton parameters: Pav =76.20;Fc =13.20;DCAY=4.14; Fc =.00]
01810 (Previous area: IApwr =4.67;SLFP=2.00;LGF= 40.0;MFP=.250;SCP=.0]
01811 (Impervious area: IAlmp =1.57;SLFI=.50;LSI= 89.0;MI=.01;SICI=.0]
01812 # Minor system limited to 100 year event.
01813 # On-site storage provided up to the 100 year event.
01814 # 100-year + 204 stress test capture set at 107% of 100-year capture.
01815 # and 100-year + 204 stress test storage set to 145% of 100-year storage.
01816 R01101C00008 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01817 ROUTE RESERVOIR -> 1.0 0.02A30EXM 1.64 .329 NoDate 12:00 52.25 n/a .000
01818 out <= 1.0 0.01A30EXM 1.64 .230 NoDate 11:54 52.25 n/a .000
01819 (over flow <= 1.0 0.03A109RESM 1.64 .230 NoDate 0:00 .00 n/a .000
01820 (MStoUsed=.489E-02 m3, TotDevVol=.000E+00 m3, N-Over= 0, TotDur=0v= 0 hrs)
01821 R01101C00009 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01822 * SAVE HYD 1.0 0.01A30EXM 1.64 .230 NoDate 11:54 52.25 n/a .000
01823 frma :A109RESM.010
01824 remark:A109RES-minor
01825 R01101C00010 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01826 * SAVE HYD 1.0 0.01A30EXM 1.64 .230 NoDate 0:00 .00 n/a .000
01827 frma :A109RESM-Major
01828 remark:A109RES-Major
01829 # Commercial Block
01830 R01101C00011 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01831 CALIB STANDHYD 1.0 0.01A26OCM 2.68 .559 NoDate 12:00 57.76 777 .000
01832 [XMP:69;TfMP=79]
01833 (Horton parameters: Pav =76.20;Fc =13.20;DCAY=4.14; Fc =.00]
01834 (Previous area: IApwr =4.67;SLFP=2.00;LGF= 40.0;MFP=.250;SCP=.0]
01835 (Impervious area: IAlmp =1.57;SLFI=.50;LSI= 133.0;MI=.01;SICI=.0]
01836 # Minor system limited to 2-Yr Rational Method (0.382 m3/s)
01837 # On-site storage provided up to the 100 year event.
01838 R01101C00012 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01839 ROUTE RESERVOIR -> 1.0 0.02A26OCM 2.68 .559 NoDate 12:00 57.76 n/a .000
01840 out <= 1.0 0.02A26OCM 2.68 .382 NoDate 0:00 .00 n/a .000
01841 (over flow <= 1.0 0.03A30EXM 2.68 .559 NoDate 11:54 57.76 n/a .000
01842 (MStoUsed=.879E-02 m3, TotDevVol=.000E+00 m3, N-Over= 0, TotDur=0v= 0 hrs)
01843 R01101C00013 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01844 * SAVE HYD 1.0 0.01A26OCM 2.68 .382 NoDate 11:54 57.76 n/a .000
01845 frma :A226OCM.010
01846 remark:A226OCM-minor
01847 R01101C00014 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01848 * SAVE HYD 1.0 0.01A26OCM 2.68 .382 NoDate 0:00 .00 n/a .000
01849 frma :A226OCM-Major
01850 remark:A26OCM-Major
01851 # Residential Block
01852 R01101C00015 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01853 CALIB STANDHYD 1.0 0.01A30EXT 2.45 .475 NoDate 12:00 52.25 704 .000
01854 [XMP:59;TfMP=69]
01855 (Horton parameters: Pav =76.20;Fc =13.20;DCAY=4.14; Fc =.00]
01856 (Previous area: IApwr =4.67;SLFP=2.00;LGF= 40.0;MFP=.250;SCP=.0]
01857 (Impervious area: IAlmp =1.57;SLFI=.50;LSI= 127.0;MI=.01;SICI=.0]
01858 # Minor system limited to 2-Year Chicago 3hr +144 (0.336 m3/s)
01859 # On-site storage provided up to the 100 year event.
01860 # 100-year + 204 stress test capture set at 107% of 100-year capture.
01861 # and 100-year + 204 stress test storage set to 145% of 100-year storage.
01862 R01101C00016 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01863 ROUTE RESERVOIR -> 1.0 0.02A30EXT 2.45 .475 NoDate 12:00 52.25 n/a .000
01864 out <= 1.0 0.01A30EXT 2.45 .336 NoDate 11:54 52.25 n/a .000
01865 (over flow <= 1.0 0.03A30EXM 2.45 .475 NoDate 0:00 .00 n/a .000
01866 (MStoUsed=.690E-02 m3, TotDevVol=.000E+00 m3, N-Over= 0, TotDur=0v= 0 hrs)
01867 R01101C00017 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01868 * SAVE HYD 1.0 0.01A30EXT 2.45 .336 NoDate 11:54 52.25 n/a .000
01869 frma :A30EXTM.010
01870 remark:A30EXT-minor
01871 R01101C00018 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01872 * SAVE HYD 1.0 0.01A30EXT 2.45 .336 NoDate 0:00 .00 n/a .000
01873 frma :A30EXTM-Major
01874 remark:A30EXT-Major
01875 # Residential Block
01876 R01101C00019 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01877 CALIB STANDHYD 1.0 0.01A30EXT 2.45 .475 NoDate 12:00 52.25 704 .000
01878 [XMP:59;TfMP=69]
01879 (Horton parameters: Pav =76.20;Fc =13.20;DCAY=4.14; Fc =.00]
01880 (Previous area: IApwr =4.67;SLFP=2.00;LGF= 40.0;MFP=.250;SCP=.0]
01881 (Impervious area: IAlmp =1.57;SLFI=.50;LSI= 81.0;MI=.01;SICI=.0]
01882 # Minor system limited to 2-Year Chicago 3hr +144 (0.146 m3/s)
01883 # On-site storage provided up to the 100 year event.
01884 # 100-year + 204 stress test capture set at 107% of 100-year capture.
01885 # and 100-year + 204 stress test storage set to 145% of 100-year storage.
01886 R01101C00020 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01887 ROUTE RESERVOIR -> 1.0 0.02A30EXT 2.45 .475 NoDate 12:00 52.25 n/a .000
01888 out <= 1.0 0.01A30EXT 2.45 .146 NoDate 11:54 52.25 n/a .000
01889 (over flow <= 1.0 0.03A30EXM 2.45 .475 NoDate 0:00 .00 n/a .000
01890 (MStoUsed=.166E-02 m3, TotDevVol=.000E+00 m3, N-Over= 0, TotDur=0v= 0 hrs)
01891 R01101C00021 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01892 * SAVE HYD 1.0 0.01A30EXT 2.45 .146 NoDate 11:54 52.25 n/a .000
01893 frma :A30EXTM.010
01894 remark:A30EXT-minor
01895 R01101C00022 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01896 * SAVE HYD 1.0 0.01A30EXT 2.45 .146 NoDate 0:00 .00 n/a .000
01897 frma :A30EXTM-Major
01898 remark:A30EXT-Major
01899 # Residential Block
01900 R01101C00023 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01901 CALIB STANDHYD 1.0 0.01A30EXT 1.20 .242 NoDate 12:00 52.25 704 .000
01902 [XMP:59;TfMP=69]
01903 (Horton parameters: Pav =76.20;Fc =13.20;DCAY=4.14; Fc =.00]
01904 (Previous area: IApwr =4.67;SLFP=2.00;LGF= 40.0;MFP=.250;SCP=.0]
01905 (Impervious area: IAlmp =1.57;SLFI=.50;LSI= 89.0;MI=.01;SICI=.0]
01906 # Minor system limited to 2-Year Chicago 3hr +144 (0.173 m3/s)
01907 # On-site storage provided up to the 100 year event.
01908 # 100-year + 204 stress test capture set at 107% of 100-year capture.
01909 # and 100-year + 204 stress test storage set to 145% of 100-year storage.
01910 R01101C00024 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01911 ROUTE RESERVOIR -> 1.0 0.02A30EXT 1.20 .242 NoDate 12:00 52.25 n/a .000
01912 out <= 1.0 0.01A30EXT 1.20 .173 NoDate 11:54 52.25 n/a .000
01913 (over flow <= 1.0 0.03A30EXM 1.20 .242 NoDate 0:00 .00 n/a .000
01914 (MStoUsed=.366E-02 m3, TotDevVol=.000E+00 m3, N-Over= 0, TotDur=0v= 0 hrs)
01915 R01101C00025 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01916 * SAVE HYD 1.0 0.01A30EXT 1.20 .173 NoDate 11:54 52.25 n/a .000
01917 frma :A30EXTM.010
01918 remark:A30EXT-minor
01919 R01101C00026 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01920 * SAVE HYD 1.0 0.01A30EXT 1.20 .173 NoDate 0:00 .00 n/a .000
01921 frma :A30EXTM.010
01922 remark:A30EXT-Major
01923 # Residential Block
01924 R01101C00027 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01925 CALIB STANDHYD 1.0 0.01A30EXT 1.20 .242 NoDate 12:00 52.25 704 .000
01926 [XMP:59;TfMP=69]
01927 (Horton parameters: Pav =76.20;Fc =13.20;DCAY=4.14; Fc =.00]
01928 (Previous area: IApwr =4.67;SLFP=2.00;LGF= 40.0;MFP=.250;SCP=.0]
01929 (Impervious area: IAlmp =1.57;SLFI=.50;LSI= 90.0;MI=.01;SICI=.0]
01930 # Minor system limited to 2-Year Chicago 3hr +144 (0.177 m3/s)
01931 # On-site storage provided up to the 100 year event.
01932 # 100-year + 204 stress test capture set at 107% of 100-year capture.
01933 # and 100-year + 204 stress test storage set to 145% of 100-year storage.
01934 R01101C00028 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01935 ROUTE RESERVOIR -> 1.0 0.02A30EXT 1.20 .242 NoDate 12:00 52.25 n/a .000
01936 out <= 1.0 0.01A30EXT 1.22 .177 NoDate 11:54 52.25 n/a .000
01937 (over flow <= 1.0 0.03A30EXM 1.22 .242 NoDate 0:00 .00 n/a .000
01938 (MStoUsed=.367E-02 m3, TotDevVol=.000E+00 m3, N-Over= 0, TotDur=0v= 0 hrs)
01939 R01101C00029 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01940 * SAVE HYD 1.0 0.01A30EXT 1.22 .177 NoDate 11:54 52.25 n/a .000
01941 frma :A30EXTM.010
01942 remark:A30EXT-minor
01943 R01101C00030 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01944 * SAVE HYD 1.0 0.01A30EXT 1.22 .177 NoDate 0:00 .00 n/a .000
01945 frma :A30EXTM-Major
01946 remark:A30EXT-Major
01947 # Residential Block
01948 R01101C00031 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01949 CALIB STANDHYD 1.0 0.01A30EXT 2.64 1.387 NoDate 12:01 52.25 704 .000
01950 [XMP:69;TfMP=79]
01951 (Horton parameters: Pav =76.20;Fc =13.20;DCAY=4.14; Fc =.00]
01952 (Previous area: IApwr =4.67;SLFP=2.00;LGF= 40.0;MFP=.250;SCP=.0]
01953 (Impervious area: IAlmp =1.57;SLFI=.50;LSI= 226.0;MI=.01;SICI=.0]
01954 # Minor system limited to 2-Year Chicago 3hr +144 (0.877 m3/s)
01955 # On-site storage provided up to the 100 year event.
01956 # 100-year + 204 stress test capture set at 107% of 100-year capture.
01957 # and 100-year + 204 stress test storage set to 145% of 100-year storage.
01958 R01101C00032 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01959 ROUTE RESERVOIR -> 1.0 0.02A10EXT 2.64 1.387 NoDate 12:01 52.25 n/a .000
01960 out <= 1.0 0.01A10EXT 7.64 .877 NoDate 11:53 52.25 n/a .000
01961 (over flow <= 1.0 0.03A30EXM 2.64 .139 NoDate 0:00 .00 n/a .000
01962 (MStoUsed=.182E-01 m3, TotDevVol=.000E+00 m3, N-Over= 0, TotDur=0v= 0 hrs)
01963 R01101C00033 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01964 * SAVE HYD 1.0 0.01A10EXT 7.64 .877 NoDate 11:53 52.25 n/a .000
01965 frma :A10EXTM.010
01966 remark:A10EXT-minor
01967 R01101C00034 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01968 * SAVE HYD 1.0 0.01A10EXT 7.64 .877 NoDate 0:00 .00 n/a .000
01969 frma :A10EXTM-Major
01970 remark:A10EXT-Major
01971 # Breaux Commercial Block
01972 R01101C00035 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms
01973 CALIB STANDHYD 1.0 0.01A30COM 3.83 2.549 NoDate 12:01 57.76 777 .000
01974 [XMP:69;TfMP=79]
01975 (Horton parameters: Pav =76.20;Fc =13.20;DCAY=4.14; Fc =.00]
01976 (Previous area: IApwr =4.67;SLFP=2.00;LGF= 40.0;MFP=.250;SCP=.0]
01977 (Impervious area: IAlmp =1.57;SLFI=.50;LSI= 303.0;MI=.01;SICI=.0]
01978 # Site controlled to (1.8 m3/s)
01979 # On-site storage provided up to the 100 year event + 204.
01980 R01101C00036 -----Dtain-ID:HYND-----AREAA-QFEARCs=TspeakDate_hh:mm-----Rvm=R-C-----DWfcms

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025213 [Impervious area] IALmp=1.5718E+01;501Iz=226.1MM;013ISCI= .01
025223 # Minor system limited to 2-year Chicago 3hr 144 (0.173 m3/s)
025233 # On-site storage provided up to the 100 year event.
025243 # 100-year + 20% stress test capture set at 107% of 100-year capture.
025253 # and 100-year + 20% stress test storage set to 145% of 100-year storage
025263 ROUTE RESERVOIR --> --Dtain-ID:HYD--AREAA-QFEAKMS-TPeakDate_hh:mm--Rvm-R.C--DWFCMS
025273 ROUTE RESERVOIR --> --Dtain-ID:HYD--AREAA-QFEAKMS-TPeakDate_hh:mm--Rvm-R.C--DWFCMS
025283 out <= 1.0 01A10EXTZml 7.64 .977 NoDate 1148 69.93 n/a .000
025293 overflow <= 1.0 01A10EXTZm 0.00 .000 NoDate 0:00 .00 n/a .000
025303 [MktStoUsed=148E+00 m3, TotDurVol=0.000E+00 m3, N-Over= 0, TotDurOvr= 0 hrs]

02881 # remark:PHD-A303
02882 *****
02883 # STORMS
02884 *****
02885 # END OF RUN 987
02886 *****
02887 *****
02888 *****
02889 *****
02890 *****
02891 *****
02892 *****
02893 RUN:COMMAND#
02894 R0979:CO001#
02895 START
02896 [TZERO = .00 hrs on 0]
02897 [MOUT= 2 (1=imperial, 2=metric output)]
02898 [INSTORM= 1]
02899 [NRUN = 0979]
02900 *****
02901 # SWSHYMO / INPUT DATA FILE
02902 *****
02903 # Project Name: [Brazee Lands] Project Number: [1800]
02904 # Date : 16-September-2019
02905 # Modeler [JFSAi]
02906 # Updated [LB - June 2020]
02907 # []
02908 # Company [JFSAi]
02909 # License # [254297]
02910 # *****
02911 # Model developed to simulate runoff from catchments that are greater than 0.5 ha
02912 # *****
02913 # Updated : 22 April 2020 to reflect development boundary changes and onsite controls - JB JFSAi
02914 READ STORM#
02915 Filename = STORM_001
02916 Comment = [1879 Storm (38)] - Ottawa International Airport step 5 min
02917 [SDT= 5.00:SDMR= 3.00:PTOT= 8.99]
02918 # Park Lands
02919 # *****
02920 CALIB STANHYD# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
02921 [XIMP=.59:TIMP=.69]
02922 [Horton parameters: Fw= 76.20:Fc= 13.20:DCAY=4.14: F= .00]
02923 [Previous area: IAPer= 4.67:SLF=2.00:IGP= 40.0:MP=250:SCF= .0]
02924 [Impervious area: IAIMp= 1.57:SLF= .50:IGI= 107.0:MI= .01:SC1= .0]
02925 # Minor system limited to 2-Year Chicago 3hr +14 (0.177 m3/s)
02926 # On-site storage provided up to the 100 year event.
02927 # *****
02928 R0979:CO002# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
02929 ROUTE RESERVOIR -> 1.0 0.02A104FK# 1.72 .265 NoDate 141 53.15 633 .000
02930 out <= 1.0 0.01A104FK# 1.72 .199 NoDate 129 53.15 n/a .000
02931 overflow <= 1.0 0.01A104FK# 0.0 .014 NoDate 116 53.15 n/a .000
02932 [MstUse=sd=1418E-01 m3, TotDevVol=1.000E+00 m3, N-Dev= 0, TotDevOvr= 0 hrs]
02933 R0979:CO003# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
02934 SAVE HYD 1.0 0.01A104FK# 1.72 .199 NoDate 129 53.15 n/a .000
02935 # *****
02936 remark:A104FK#-minor
02937 R0979:CO004# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
02938 SAVE HYD 1.0 0.01A104FK# 0.0 .014 NoDate 116 53.15 n/a .000
02939 # *****
02940 # Residential Block
02941 # *****
02942 CALIB STANHYD# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
02943 [XIMP=.59:TIMP=.69]
02944 [Horton parameters: Fw= 76.20:Fc= 13.20:DCAY=4.14: F= .00]
02945 [Previous area: IAPer= 4.67:SLF=2.00:IGP= 40.0:MP=250:SCF= .0]
02946 [Impervious area: IAIMp= 1.57:SLF= .50:IGI= 107.0:MI= .01:SC1= .0]
02947 # Minor system limited to 2-Year Chicago 3hr +14 (0.230m3/s)
02948 # On-site storage provided up to the 100 year event.
02949 # *****
02950 R0979:CO005# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
02951 ROUTE RESERVOIR -> 1.0 0.02A104FK# 1.64 .400 NoDate 1131 69.37 826 .000
02952 out <= 1.0 0.01A104FK# 1.64 .230 NoDate 1120 69.37 n/a .000
02953 overflow <= 1.0 0.01A104FK# 0.0 .000 NoDate 0100 .00 n/a .000
02954 [MstUse=sd=1818E-01 m3, TotDevVol=1.000E+00 m3, N-Dev= 0, TotDevOvr= 0 hrs]
02955 R0979:CO006# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
02956 SAVE HYD 1.0 0.01A104FK# 1.64 .230 NoDate 1120 69.37 n/a .000
02957 # *****
02958 remark:A104FK#-major
02959 R0979:CO007# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
02960 SAVE HYD 1.0 0.01A104FK# 0.0 .000 NoDate 0100 .00 n/a .000
02961 # *****
02962 # Commercial Block
02963 # *****
02964 CALIB STANHYD# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
02965 [XIMP=.69:TIMP=.79]
02966 [Horton parameters: Fw= 76.20:Fc= 13.20:DCAY=4.14: F= .00]
02967 [Previous area: IAPer= 4.67:SLF=2.00:IGP= 40.0:MP=250:SCF= .0]
02968 [Impervious area: IAIMp= 1.57:SLF= .50:IGI= 127.0:MI= .01:SC1= .0]
02969 # Minor system limited to 2-Year Chicago 3hr +14 (0.326 m3/s)
02970 # On-site storage provided up to the 100 year event.
02971 # *****
02972 R0979:CO008# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
02973 ROUTE RESERVOIR -> 1.0 0.02A104FK# 2.68 .480 NoDate 1131 73.42 874 .000
02974 out <= 1.0 0.01A104FK# 2.68 .382 NoDate 1120 73.42 n/a .000
02975 overflow <= 1.0 0.01A104FK# 0.0 .000 NoDate 0100 .00 n/a .000
02976 [MstUse=sd=2907E-01 m3, TotDevVol=1.000E+00 m3, N-Dev= 0, TotDevOvr= 0 hrs]
02977 R0979:CO009# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
02978 SAVE HYD 1.0 0.01A104FK# 2.68 .382 NoDate 1120 73.42 n/a .000
02979 # *****
02980 remark:A104FK#-major
02981 R0979:CO010# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
02982 SAVE HYD 1.0 0.01A104FK# 0.0 .000 NoDate 0100 .00 n/a .000
02983 # *****
02984 # Residential Block
02985 # *****
02986 CALIB STANHYD# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
02987 [XIMP=.59:TIMP=.69]
02988 [Horton parameters: Fw= 76.20:Fc= 13.20:DCAY=4.14: F= .00]
02989 [Previous area: IAPer= 4.67:SLF=2.00:IGP= 40.0:MP=250:SCF= .0]
02990 [Impervious area: IAIMp= 1.57:SLF= .50:IGI= 127.0:MI= .01:SC1= .0]
02991 # Minor system limited to 2-Year Chicago 3hr +14 (0.336 m3/s)
02992 # On-site storage provided up to the 100 year event.
02993 # *****
02994 R0979:CO011# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
02995 ROUTE RESERVOIR -> 1.0 0.02A104FK# 2.45 .594 NoDate 1131 69.37 826 .000
02996 out <= 1.0 0.01A104FK# 2.45 .316 NoDate 1120 69.37 n/a .000
02997 overflow <= 1.0 0.01A104FK# 0.0 .000 NoDate 0100 .00 n/a .000
02998 [MstUse=sd=912E-02 m3, TotDevVol=1.000E+00 m3, N-Dev= 0, TotDevOvr= 0 hrs]
02999 R0979:CO012# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
03000 SAVE HYD 1.0 0.01A104FK# 2.45 .316 NoDate 1120 69.37 n/a .000
03001 # *****
03002 remark:A104FK#-minor
03003 R0979:CO013# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
03004 SAVE HYD 1.0 0.01A104FK# 0.0 .000 NoDate 0100 .00 n/a .000
03005 # *****
03006 # Residential Block
03007 # *****
03008 CALIB STANHYD# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
03009 [XIMP=.59:TIMP=.69]
03010 [Horton parameters: Fw= 76.20:Fc= 13.20:DCAY=4.14: F= .00]
03011 [Previous area: IAPer= 4.67:SLF=2.00:IGP= 40.0:MP=250:SCF= .0]
03012 [Impervious area: IAIMp= 1.57:SLF= .50:IGI= 81.0:MI= .01:SC1= .0]
03013 # Minor system limited to 2-Year Chicago 3hr +14 (0.177 m3/s)
03014 # On-site storage provided up to the 100 year event.
03015 # *****
03016 R0979:CO014# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
03017 ROUTE RESERVOIR -> 1.0 0.02A104FK# 1.20 .373 NoDate 1120 69.37 n/a .000
03018 out <= 1.0 0.01A104FK# 1.20 .173 NoDate 1120 69.37 n/a .000
03019 overflow <= 1.0 0.01A104FK# 0.0 .000 NoDate 0100 .00 n/a .000
03020 [MstUse=sd=912E-02 m3, TotDevVol=1.000E+00 m3, N-Dev= 0, TotDevOvr= 0 hrs]
03021 R0979:CO015# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
03022 SAVE HYD 1.0 0.01A104FK# 1.20 .373 NoDate 1120 69.37 n/a .000
03023 # *****
03024 remark:A104FK#-major
03025 R0979:CO016# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
03026 SAVE HYD 1.0 0.01A104FK# 0.0 .000 NoDate 0100 .00 n/a .000
03027 # *****
03028 # Residential Block
03029 # *****
03030 CALIB STANHYD# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
03031 [XIMP=.59:TIMP=.69]
03032 [Horton parameters: Fw= 76.20:Fc= 13.20:DCAY=4.14: F= .00]
03033 [Previous area: IAPer= 4.67:SLF=2.00:IGP= 40.0:MP=250:SCF= .0]
03034 [Impervious area: IAIMp= 1.57:SLF= .50:IGI= 81.0:MI= .01:SC1= .0]
03035 # Minor system limited to 2-Year Chicago 3hr +14 (0.177 m3/s)
03036 # On-site storage provided up to the 100 year event.
03037 # *****
03038 R0979:CO017# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
03039 ROUTE RESERVOIR -> 1.0 0.02A104FK# 1.20 .373 NoDate 1120 69.37 n/a .000
03040 out <= 1.0 0.01A104FK# 1.20 .173 NoDate 1120 69.37 n/a .000
03041 overflow <= 1.0 0.01A104FK# 0.0 .000 NoDate 0100 .00 n/a .000
03042 [MstUse=sd=1088E-01 m3, TotDevVol=1.000E+00 m3, N-Dev= 0, TotDevOvr= 0 hrs]
03043 R0979:CO018# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
03044 SAVE HYD 1.0 0.01A104FK# 1.20 .373 NoDate 1120 69.37 n/a .000
03045 # *****
03046 remark:A104FK#-minor
03047 R0979:CO019# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
03048 SAVE HYD 1.0 0.01A104FK# 0.0 .000 NoDate 0100 .00 n/a .000
03049 # *****
03050 # Residential Block
03051 # *****
03052 CALIB STANHYD# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
03053 [XIMP=.59:TIMP=.69]
03054 [Horton parameters: Fw= 76.20:Fc= 13.20:DCAY=4.14: F= .00]
03055 [Previous area: IAPer= 4.67:SLF=2.00:IGP= 40.0:MP=250:SCF= .0]
03056 [Impervious area: IAIMp= 1.57:SLF= .50:IGI= 81.0:MI= .01:SC1= .0]
03057 # Minor system limited to 2-Year Chicago 3hr +14 (0.177 m3/s)
03058 # On-site storage provided up to the 100 year event.
03059 # *****
03060 R0979:CO020# 1.0 0.01A104FK# AREAH=QFEARCS=TPeakDate_hh:mm--Rvm=R.C.--DWFCMS
03061 ROUTE RESERVOIR -> 1.0 0.02A104FK# 1.20 .373 NoDate 1120 69.37 n/a .000
03062 out <= 1.0 0.01A104FK# 1.20 .173 NoDate 1120 69.37 n/a .000
03063 overflow <= 1.0 0.01A104FK# 0.0 .000 NoDate 0100 .00 n/a .000
03064 [MstUse=sd=1088E-01 m3, TotDevVol=1.000E+00 m3, N-Dev= 0, TotDevOvr= 0 hrs]

APPENDIX

C

PCSWMM Model Schematic

Manhole Loss Coefficient Nomograph and Table

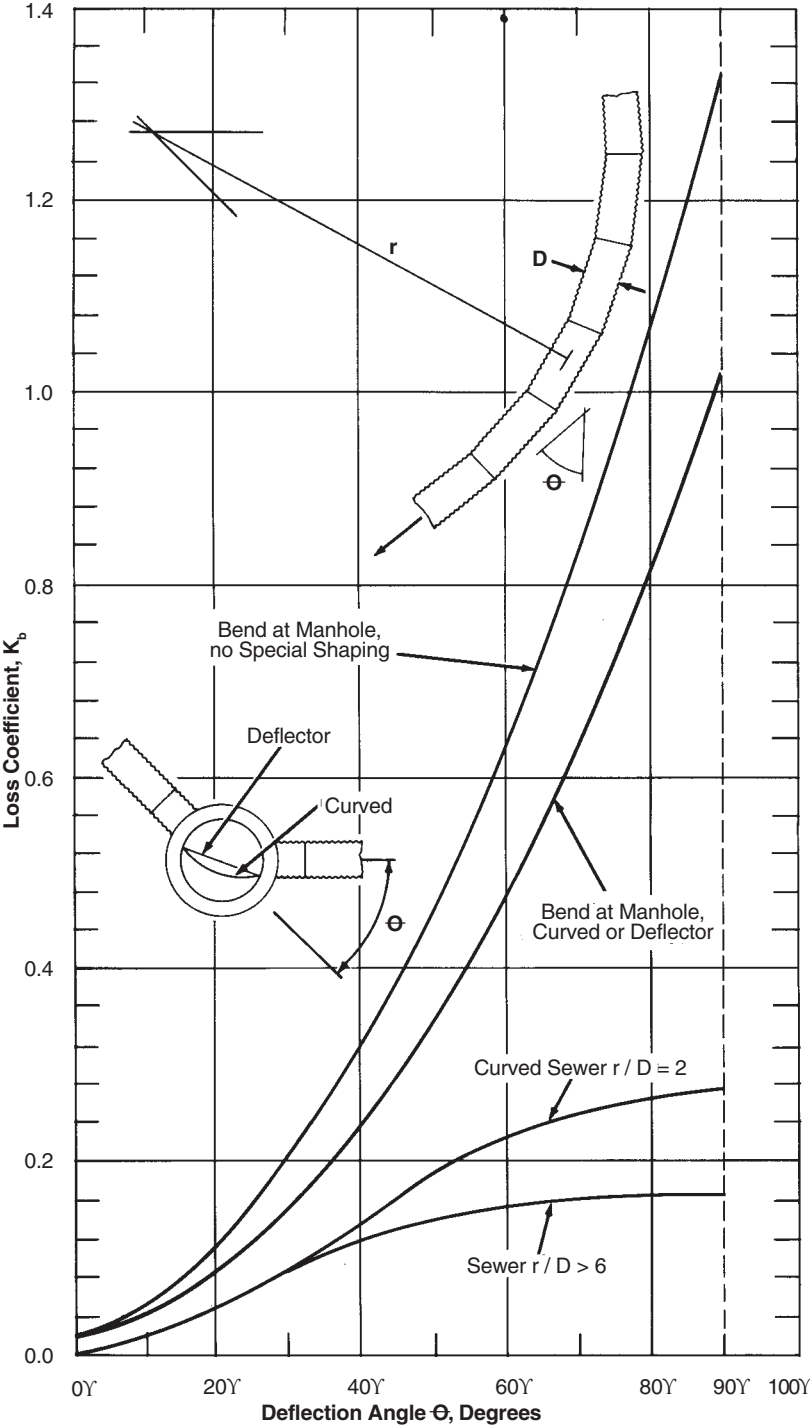
Pipe Data and Hydraulic Simulation Results

JFSA

Water Resources and
Environmental Consultants



MANHOLE LOSS COEFFICIENT NOMOGRAPH AND TABLE



Angle	Exit Loss
0	0.02
5	0.035
10	0.055
15	0.08
20	0.11
25	0.16
30	0.21
35	0.26
40	0.32
45	0.39
50	0.47
55	0.54
60	0.635
65	0.73
70	0.84
75	0.95
80	1.07
85	1.19
90	1.33

Figure 4.13 Sewer bend loss coefficient¹⁶



- Legend**
- Conduits
 - Minor System
 - Junctions
 - Maintenance Hole
 - Site Plan

J.F. Sabourin and Associates Inc.
 WATER RESOURCES AND ENVIRONMENTAL CONSULTANTS
 52 Springbrook Drive
 Ottawa, ON, K2S 1B6
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 www.jfsa.com



SCALE : 1:3500
 0 50 100 150 200 m

PROJECT : Brazeau Phase 1

TITLE : Figure C1: Minor System Overview

PROJECT	1800-19
DRAWN:	JB
DATE:	APRIL 2020



Legend

- Conduits
- ➔ Major System
- Junctions
- Major-System
- Site Plan

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DSEL
 david schaeffer engineering ltd

SCALE : 1:3500
 0 50 100 150 200 m

PROJECT :
 Brazeau Phase 1

TITLE :
 Figure C2: Major System Overview

PROJECT	1800-19
DRAWN:	JB
DATE:	APRIL 2020

Table C-1A: Pipe Data and Hydraulic Simulation Results for the 100-Year, 3-Hour Chicago Storm

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL				
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)		
MH_401	POND	96.000	99.800	2250	10.0	0.5	0.013	100.350	#N/A	3.706	14.74	5.31	0.4	-1.320	01:17	96.930	96.730	#N/A	#N/A	#N/A					
MH_501	POND	96.000	99.800	2250	10.0	0.5	0.013	100.350	#N/A	3.706	14.74	4.52	0.3	-1.330	01:18	96.920	96.730	#N/A	#N/A	#N/A					
MH_1002	MH_1003	94.150	93.982	900	28.0	0.6	0.013	98.370	98.040	2.204	1.40	1.27	0.9	0.150	02:13	95.200	94.592	#N/A	#N/A	#N/A					
MH_1003	MH_1004	93.922	93.271	900	108.5	0.6	0.013	98.040	96.170	3.188	17.21	1.27	0.1	-0.230	02:14	94.592	93.316	#N/A	#N/A	#N/A					
MH_1004	MH_1005	92.586	92.162	975	106.0	0.4	0.013	96.170	95.150	1.898	1.42	1.27	0.9	-0.245	02:14	93.316	92.923	#N/A	#N/A	#N/A					
MH_1005	MH_1006	91.933	91.721	1200	106.0	0.2	0.013	95.150	94.970	1.542	1.74	1.27	0.7	-0.210	02:15	92.923	92.831	#N/A	#N/A	#N/A					
MH_1006	MH_1007	91.701	91.489	1200	106.0	0.2	0.013	94.970	94.270	1.542	1.74	1.27	0.7	-0.070	02:16	92.831	92.740	#N/A	#N/A	#N/A					
MH_1007	MH_1008	91.470	91.230	1200	88.0	0.3	0.013	94.270	93.460	1.801	2.04	1.56	0.8	0.070	00:00	92.740	92.580	#N/A	#N/A	#N/A					
MH_1008	MH_1009	91.230	91.200	1200	14.5	0.2	0.013	93.460	#N/A	1.568	1.77	1.58	0.9	0.150	00:01	92.580	92.500	#N/A	#N/A	#N/A					
MH_101	MH_102	100.935	100.142	300	30.5	2.6	0.013	103.750	103.240	2.206	0.16	0.00	0.0	-0.300	00:00	100.935	100.197	174-2	101.41	0.475					
MH_102	MH_103	99.917	99.002	525	59.0	1.6	0.013	103.240	102.350	2.474	0.54	0.29	0.5	-0.245	01:11	100.197	99.575	172-5	100.47	0.273					
																				172-5	100.47	0.822	59.0	6.9	99.648
																				173-1	100.78	1.014	59.0	18.1	99.766
																				173-2	100.78	0.930	59.0	26.1	99.850
																				173-3	101.1	1.174	59.0	33.3	99.926
																				173-4	101.1	1.090	59.0	41.3	100.010
																				173-5	101.1	1.009	59.0	48.9	100.091
																				174-1	101.41	1.241	59.0	56.3	100.169
MH_103	MH_104	98.755	98.516	750	120.0	0.4	0.013	102.350	101.590	1.594	0.70	0.63	0.9	0.070	01:10	99.575	99.245	169-2	99.81	0.235					
																				169-2	99.81	0.558	120.0	2.7	99.252
																				169-3	99.81	0.538	120.0	10	99.273
																				169-4	99.81	0.516	120.0	18	99.295
																				170-1	99.93	0.606	120.0	28.6	99.324
																				170-2	99.93	0.584	120.0	36.6	99.346
																				170-3	99.93	0.563	120.0	44.2	99.367
																				171-1	99.99	0.594	120.0	54.9	99.396
																				171-2	99.99	0.572	120.0	62.9	99.418
																				171-3	99.99	0.552	120.0	70.1	99.438
																				171-4	99.99	0.530	120.0	78.1	99.460
																				172-1	100.47	0.961	120.0	96.1	99.509
																				172-2	100.47	0.939	120.0	104.1	99.531
																				172-3	100.47	0.919	120.0	111.3	99.551
																				172-4	100.47	0.903	120.0	117	99.567
MH_104	MH_106	97.975	97.913	1050	41.5	0.1	0.013	101.590	101.840	1.217	1.05	0.97	0.9	0.220	01:11	99.245	99.115	169-1	99.81	0.565					
MH_105	MH_106	99.562	97.913	675	91.0	1.4	0.013	103.170	101.840	4.109	16.64	0.76	0.0	-0.235	01:11	100.002	99.115	148	100.03	0.028					
																				148	100.03	0.792	91.0	12.6	99.238
																				147	100.16	0.803	91.0	24.8	99.357
																				146	100.3	0.844	91.0	35	99.456
																				145	100.42	0.855	91.0	46.2	99.565
																				144	100.56	0.856	91.0	60.4	99.704
																				143	100.93	1.092	91.0	74.2	99.838
																				142	101.5	1.518	91.0	88.9	99.982
MH_106	MH_116	97.605	97.360	1350	122.5	0.2	0.013	101.840	101.580	1.668	2.39	1.80	0.8	0.160	01:13	99.115	98.880	166-1	99.53	0.415					
MH_107	MH_108	99.165	99.080	300	74.0	0.4	0.013	101.895	101.880	0.809	0.06	0.03	0.5	-0.005	01:12	99.460	99.478	176-1	100.1	0.640					
MH_107	MH_112	99.165	98.906	300	74.0	0.4	0.013	101.895	101.695	0.809	0.06	0.03	0.5	-0.005	01:12	99.460	99.411	185-1	99.89	0.430					
MH_108	MH_110	98.908	98.800	450	54.0	0.2	0.013	101.880	101.980	0.802	0.13	0.09	0.7	0.120	01:10	99.478	99.456	175-1	100.15	0.672					
MH_109	MH_110	99.151	98.800	750	60.0	0.7	0.013	102.650	101.980	2.108	0.93	0.79	0.8	-0.210	01:10	99.691	99.456	164-2	100.01	0.319					
																				164-2	100.01	0.549	60.0	1.2	99.461
																				164-3	100.25	0.768	60.0	6.7	99.482
																				164-4	100.25	0.736	60.0	14.7	99.514
																				165-1	100.42	0.865	60.0	25.3	99.555
																				165-2	100.93	1.345	60.0	32.9	99.585
																				165-3	100.93	1.314	60.0	40.9	99.616
MH_110	MH_111	98.346	98.046	900	75.0	0.4	0.013	101.980	101.770	1.800	1.14	1.02	0.9	0.210	01:09	99.456	99.235	162-1	99.69	0.234					
																				162-1	99.69	0.619	75.0	2	99.241
																				162-2	99.69	0.436	75.0	6.3	99.254
																				162-3	99.69	0.598	75.0	9.2	99.262

Table C-1A: Pipe Data and Hydraulic Simulation Results for the 100-Year, 3-Hour Chicago Storm

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m ³ /s)	Peak Pipe Flow (m ³ /s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL		
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)
MH_123	MH_127	99.407	98.615	300	49.5	1.6	0.013	102.270	101.675	1.730	0.12	0.03	0.3	-0.190	01:11	99.517	99.112	135	99.89	0.373			
MH_124	MH_125	99.069	98.715	375	101.0	0.4	0.013	102.060	101.870	1.421	2.66	0.07	0.0	0.025	01:23	99.469	99.331	72	99.77	0.301			
																		82	99.89	0.552	101.0	5.4	99.338
																		69	99.84	0.498	101.0	8.4	99.342
																		70	99.78	0.424	101.0	18.6	99.356
																		81	99.89	0.532	101.0	19.6	99.358
																		71	99.78	0.408	101.0	29.7	99.372
																		80	99.92	0.547	101.0	31	99.373
																		72	99.77	0.384	101.0	39.9	99.386
																		79	100.04	0.645	101.0	46.9	99.395
																		73	99.82	0.419	101.0	51.1	99.401
																		78	100.04	0.635	101.0	54.4	99.405
																		74	99.88	0.465	101.0	61.3	99.415
																		77	100	0.581	101.0	64.6	99.419
																		413	99.93	0.499	101.0	73.4	99.431
																		415	100.08	0.646	101.0	75.2	99.434
																		412	99.98	0.537	101.0	82.3	99.443
																		414	100.1	0.651	101.0	86.4	99.449
																		75	99.98	0.521	101.0	94	99.459
																		76	100.16	0.695	101.0	98.1	99.465
MH_125	MH_127	98.481	98.615	600	91.5	0.3	0.013	101.870	101.675	1.618	5.82	0.27	0.0	0.250	01:29	99.331	99.112	65	99.58	0.249			
																		88	99.82	0.670	91.5	16	99.150
																		63	99.59	0.438	91.5	16.6	99.152
																		87	99.82	0.637	91.5	29.7	99.183
																		64	99.59	0.405	91.5	30.3	99.185
																		86	99.65	0.440	91.5	41.1	99.210
																		65	99.58	0.363	91.5	43.9	99.217
																		85	99.74	0.495	91.5	55.5	99.245
																		66	99.69	0.438	91.5	58.6	99.252
																		84	99.76	0.477	91.5	71.3	99.283
																		67	99.78	0.490	91.5	74.4	99.290
																		83	99.89	0.573	91.5	85.7	99.317
																		68	99.84	0.515	91.5	88.8	99.325
MH_126	MH_127	98.697	98.615	300	28.5	0.4	0.013	101.500	101.675	0.865	0.06	0.17	2.7	1.310	01:19	100.307	99.112	#N/A	#N/A	#N/A			
MH_127	MH_128	98.102	97.994	750	54.0	0.2	0.013	101.675	101.395	1.654	7.44	0.45	0.1	0.260	01:14	99.112	99.004	47	99.56	0.448			
MH_128	MH_129	97.964	97.923	750	13.5	0.3	0.013	101.395	101.315	1.389	0.61	0.45	0.7	0.290	01:14	99.004	98.958	45	99.49	0.486			
MH_129	MH_130	97.848	97.732	825	77.0	0.2	0.013	101.315	101.420	1.496	6.17	0.57	0.1	0.285	01:14	98.958	98.842	43	99.41	0.452			
MH_130	MH_131	97.732	97.581	825	100.5	0.2	0.013	101.420	101.200	1.040	0.56	0.69	1.2	0.285	01:31	98.842	98.616	33	99.18	0.338			
MH_1302	MH_302	97.470	96.430	600	98.5	0.2	0.013	101.160	101.140	0.971	0.27	0.15	0.5	0.370	00:57	98.440	98.370	Est. Fut	99.36	0.920			
MH_1303	MH_303	97.245	96.351	750	109.0	0.2	0.013	101.090	101.080	0.976	0.43	0.34	0.8	0.440	01:45	98.435	98.291	Est. Fut	99.29	0.855			
MH_1304	MH_304	97.175	96.196	600	87.0	0.2	0.013	100.660	100.730	0.971	0.27	0.18	0.6	0.410	00:56	98.185	98.086	Est. Fut	98.86	0.675			
MH_131	MH_132	97.206	97.536	1200	12.0	0.2	0.013	101.200	101.320	1.335	1.51	0.69	0.5	0.210	01:31	98.616	98.588	#N/A	#N/A	#N/A			
MH_1312	MH_310	97.627	97.113	750	62.0	0.2	0.013	100.940	100.940	1.127	0.50	0.18	0.4	-0.440	00:54	97.937	97.853	Est. Fut	99.14	1.203			
MH_132	MH_136	97.128	96.634	1200	59.5	0.2	0.013	101.320	101.190	1.542	1.74	2.00	1.1	0.260	01:12	98.588	98.434	103	99.33	0.742			
MH_133	MH_134	97.509	97.393	1500	77.0	0.2	0.013	101.660	101.550	2.126	19.14	1.87	0.1	-0.380	01:24	98.629	98.573	#N/A	#N/A	#N/A			
MH_134	MH_135	97.363	97.271	1500	61.0	0.2	0.013	101.550	101.440	1.554	2.75	1.93	0.7	-0.290	01:25	98.573	98.511	#N/A	#N/A	#N/A			
MH_135	MH_136	97.121	96.634	1650	37.0	0.1	0.013	101.440	101.190	1.348	2.88	1.95	0.7	-0.260	01:24	98.511	98.434	#N/A	#N/A	#N/A			
MH_136	MH_302	96.484	96.430	2250	54.0	0.1	0.013	101.190	101.140	1.658	6.59	7.32	1.1	-0.300	01:14	98.434	98.370	1	99.38	0.946			
MH_201	MH_202	105.214	104.138	375	119.5	0.9	0.013	108.120	107.180	1.506	0.17	0.11	0.6	-0.155	01:10	105.434	104.453	321	105.28	-0.154			
																		321	105.28	0.757	119.5	8.5	104.523
																		430	107.31	2.770	119.5	10.6	104.540
																		431	107.37	2.783	119.5	16.3	104.587
																		428	105.36	0.725	119.5	22.2	104.635
																		233	107.4	2.705	119.5	29.5	104.695
																		429	105.37	0.658	119.5	31.5	104.712
																		234	107.46	2.718	119.5	35.2	104.742
																		320	105.45	0.638	119.5	43.7	104.812

Table C-1A: Pipe Data and Hydraulic Simulation Results for the 100-Year, 3-Hour Chicago Storm

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL						
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)				
																						235	107.5	2.655	119.5	47.7	104.845
																						319	105.56	0.657	119.5	54.8	104.903
																						236	107.62	2.716	119.5	54.9	104.904
																						318	105.66	0.673	119.5	65	104.987
																						237	107.69	2.685	119.5	67.3	105.005
																						238	107.8	2.748	119.5	73	105.052
																						317	105.77	0.691	119.5	76.2	105.079
																						239	107.87	2.709	119.5	86.2	105.161
																						316	105.9	0.721	119.5	88.4	105.179
																						240	107.99	2.783	119.5	91.9	105.207
																						315	106.02	0.748	119.5	99.8	105.272
																						241	108.06	2.744	119.5	105.1	105.316
																						242	108.16	2.797	119.5	110.8	105.363
																						314	106.13	0.741	119.5	114	105.389
MH_202	MH_203	104.063	104.035	450	14.0	0.2	0.013	107.180	107.090	0.802	0.13	0.14	1.1	-0.060	01:10	104.453	104.385	230	105.39	0.937							
MH_203	MH_206	103.975	103.730	450	54.5	0.5	0.013	107.090	106.720	1.203	0.19	0.22	1.1	-0.040	01:11	104.385	103.787	225	104.9	0.515							
MH_204	MH_205	103.579	103.343	525	118.0	0.2	0.013	106.620	106.610	0.888	0.19	0.15	0.8	-0.125	01:15	103.979	103.873	285	104.64	0.661							
MH_205	MH_206	103.313	103.730	525	16.0	0.2	0.013	106.610	106.720	0.888	0.19	0.21	1.1	0.035	01:15	103.873	103.787	#N/A	#N/A	#N/A							
MH_206	MH_207	103.197	102.999	600	49.5	0.4	0.013	106.720	106.460	1.373	0.39	0.44	1.1	-0.010	01:11	103.787	103.339	221	104.52	0.733							
MH_207	MH_208	102.969	102.731	600	12.5	1.9	0.013	106.460	106.320	2.997	0.85	0.44	0.5	-0.230	01:11	103.339	103.021	219	104.39	1.051							
MH_208	MH_215	102.671	100.543	600	112.0	1.9	0.013	106.320	104.150	2.993	0.85	0.51	0.6	-0.250	01:12	103.021	101.393	212	102.46	-0.561							
																						271	102.46	0.938	112.0	8.9	101.522
																						212	102.46	0.882	112.0	12.7	101.578
																						270	102.67	0.941	112.0	23.1	101.729
																						213	102.68	0.927	112.0	24.8	101.753
																						214	102.89	0.988	112.0	35	101.902
																						269	102.93	1.015	112.0	35.9	101.915
																						215	103.1	1.035	112.0	46.2	102.065
																						268	103.18	1.099	112.0	47.3	102.081
																						216	103.36	1.118	112.0	58.4	102.242
																						267	103.42	1.162	112.0	59.5	102.258
																						217	103.62	1.212	112.0	69.8	102.408
																						266	103.68	1.259	112.0	70.7	102.421
																						423	103.94	1.371	112.0	80.9	102.569
																						421	103.83	1.245	112.0	82	102.585
																						422	104.04	1.310	112.0	92	102.730
																						420	104.04	1.294	112.0	93.1	102.746
																						265	104.35	1.450	112.0	103.7	102.900
																						218	104.3	1.372	112.0	105.6	102.928
MH_209	MH_201	105.833	105.316	300	94.0	0.6	0.013	108.630	108.120	1.015	0.07	0.00	0.0	-0.300	00:00	105.833	105.434	313	106.24	0.407							
MH_209	MH_210	105.833	105.518	300	94.0	0.6	0.013	108.630	108.320	1.015	0.07	0.00	0.0	-0.300	00:00	105.833	105.596	254	108.31	2.477							
MH_210	MH_212	105.486	103.434	300	54.0	3.8	0.013	108.320	107.010	2.668	0.19	0.05	0.3	-0.190	01:11	105.596	103.579	258	105.12	-0.476							
																						258	105.12	0.955	54.0	15.7	104.165
																						257	105.54	0.938	54.0	27.4	104.602
																						256	106.05	1.025	54.0	38.7	105.025
																						255	106.58	1.178	54.0	48.8	105.402
MH_211	MH_212	103.900	103.434	300	26.5	0.4	0.013	106.090	107.010	0.810	0.06	0.02	0.3	-0.160	01:10	104.040	103.579	#N/A	#N/A	#N/A							
MH_212	MH_204	103.359	103.804	375	49.5	0.5	0.013	107.010	106.620	1.066	0.12	0.07	0.6	-0.155	01:12	103.579	103.979	284	104.71	1.131							
MH_212	MH_213	103.359	103.136	375	49.5	0.5	0.013	107.010	106.020	1.066	0.12	0.07	0.6	-0.155	01:12	103.579	103.233	203	104.1	0.521							
MH_213	MH_214	103.053	102.918	375	13.5	1.0	0.013	106.020	105.800	1.587	0.18	0.07	0.4	-0.195	01:12	103.233	103.053	204	104.02	0.787							
MH_214	MH_215	102.883	100.543	375	90.0	2.4	0.013	105.800	104.150	2.434	0.27	0.11	0.4	-0.205	01:10	103.053	101.393	272	102.37	-0.683							
																						272	102.37	0.841	90.0	7.4	101.529
																						211	102.46	0.776	90.0	15.8	101.684
																						273	102.59	0.799	90.0	21.6	101.791
																						210	102.68	0.771	90.0	28	101.909
																						274	102.86	0.788	90.0	36.8	102.072
																						209	102.89	0.792	90.0	38.2	102.098

Table C-1A: Pipe Data and Hydraulic Simulation Results for the 100-Year, 3-Hour Chicago Storm

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL									
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)							
																						275	103.11	0.828	90.0	48.2	102.282			
																						208	103.15	0.846	90.0	49.4	102.304			
																						276	103.37	0.863	90.0	60.4	102.507			
																						207	103.4	0.834	90.0	63.6	102.566			
																						277	103.55	0.905	90.0	67.9	102.645			
																						206	103.66	0.884	90.0	75	102.776			
																						278	103.55	0.613	90.0	83.7	102.937			
																						205	103.83	0.860	90.0	85.5	102.970			
MH_215	MH_119	100.303	99.423	675	55.0	1.6	0.013	104.150	103.010	2.971	1.06	0.99	0.9	0.415	01:11	101.393	100.114	#N/A	#N/A	#N/A										
MH_216	MH_217	105.251	104.798	375	75.5	0.6	0.013	108.100	107.980	1.230	0.14	0.12	0.8	-0.115	01:14	105.511	105.093	346	105.85	0.339										
MH_217	MH_218	104.573	104.347	600	113.0	0.2	0.013	107.980	107.690	0.971	0.27	0.26	0.9	-0.080	01:18	105.093	104.927	356	105.71	0.617										
MH_218	MH_220	104.327	104.166	600	80.5	0.2	0.013	107.690	107.790	0.971	0.27	0.30	1.1	0.000	01:20	104.927	104.166	357	105.75	0.823										
MH_219	MH_220	105.649	104.166	300	25.0	2.7	0.013	108.450	107.790	2.228	0.16	0.00	0.0	-0.300	00:00	105.649	104.166	#N/A	#N/A	#N/A										
MH_220	MH_224	103.644	102.523	600	59.0	1.9	0.013	107.790	105.620	2.993	0.85	0.30	0.4	-0.350	01:20	103.894	102.523	259	104.74	0.846										
MH_221	MH_222	103.008	102.620	300	77.5	0.5	0.013	105.960	105.420	0.968	0.07	0.01	0.2	-0.220	01:10	103.088	102.811	396-1	103.56	0.472										
MH_222	MH_223	102.311	102.168	600	95.5	0.2	0.013	105.420	105.450	0.841	0.24	0.22	0.9	-0.100	01:11	102.811	102.698	366-1	103.37	0.559										
MH_2	MH_2260	101.916	101.876	675	10.0	0.4	0.013	105.290	105.290	1.486	0.53	0.38	0.7	-0.085	00:53	102.506	102.126	Est. Fut	103.49	0.984										
MH_223	MH_224	102.148	102.523	600	97.0	0.2	0.013	105.450	105.620	0.971	0.27	0.27	1.0	-0.050	01:13	102.698	102.523	365-1	103.42	0.722										
MH_224	MH_105	101.625	100.067	600	82.0	1.9	0.013	105.620	103.170	2.993	0.85	0.66	0.8	-0.200	01:11	102.025	100.067	141	101.9	-0.125										
																								141	101.9	1.561	82.0	11.4	100.339	
																								140	102.18	1.502	82.0	25.6	100.678	
																								139	102.55	1.602	82.0	36.9	100.948	
																						138	102.92	1.728	82.0	47.1	101.192			
																						137	103.3	1.843	82.0	58.2	101.457			
																						136	103.81	2.029	82.0	71.8	101.781			
MH_225	MH_226	103.412	102.914	300	99.5	0.5	0.013	106.390	105.720	0.968	0.07	0.04	0.5	-0.140	01:10	103.572	103.053	388-3	103.75	0.178										
389-2	103.75	0.667	99.5	5.8	103.083																									
389-1	103.75	0.610	82.0	13.8	103.140																									
388-3	103.75	0.543	82.0	24.4	103.207																									
388-2	103.88	0.624	82.0	32.1	103.256																									
388-1	103.88	0.573	82.0	40.1	103.307																									
387-4	104.02	0.646	82.0	50.7	103.374																									
387-3	104.02	0.595	82.0	58.7	103.425																									
387-2	104.02	0.550	82.0	65.9	103.470																									
387-1	104.02	0.499	82.0	73.9	103.521																									
MH_2260	MH_227	101.816	101.049	675	49.5	1.6	0.013	105.290	104.230	2.925	1.05	0.45	0.4	-0.365	01:10	102.126	101.119	392-1	102.46	0.334										
MH_226	MH_2260	102.863	101.876	300	64.0	1.1	0.013	105.720	105.290	1.402	0.10	0.07	0.7	-0.110	01:10	103.053	102.126	391-3	103.08	0.027										
391-3	103.08	0.921	64.0	2.3	102.159																									
391-2	103.45	1.185	64.0	9.6	102.265																									
391-1	103.45	1.069	64.0	17.6	102.381																									
390-3	103.58	1.046	64.0	28.2	102.534																									
390-2	103.58	0.930	64.0	36.2	102.650																									
390-1	103.58	0.820	64.0	43.8	102.760																									
389-4	103.75	0.835	64.0	54.5	102.915																									
389-3	103.75	0.719	64.0	62.5	103.031																									
MH_227	MH_109	100.759	99.306	675	93.0	1.6	0.013	104.230	102.650	2.971	1.06	0.51	0.5	-0.315	01:10	101.119	99.691	394-3	100.86	-0.259										
394-4	100.86	0.874	93.0	19.2	99.986																									
394-3	100.86	0.751	93.0	27.2	100.109																									
394-2	101.26	1.039	93.0	34.5	100.221																									
394-1	101.26	0.916	93.0	42.5	100.344																									
393-3	101.49	0.968	93.0	54.1	100.522																									
393-2	101.81	1.172	93.0	61.7	100.638																									
393-1	101.81	1.049	93.0	69.7	100.761																									
392-4	102.21	1.269	93.0	81.4	100.941																									
392-3	102.21	1.146	93.0	89.4	101.064																									
MH_228	MH_229	102.472	100.982	300	74.5	2.0	0.013	105.270	103.790	1.935	0.14	0.07	0.5	-0.160	01:10	102.612	101.073	384-3	102.12	-0.492										
384-3	102.12	0.997	74.5	2.4	101.123																									

Table C-1A: Pipe Data and Hydraulic Simulation Results for the 100-Year, 3-Hour Chicago Storm

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL						
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)				
																						379-2	102.14	0.997	74.5	3.4	101.143
																						384-4	102.12	0.832	74.5	10.4	101.288
																						379-1	102.14	0.832	74.5	11.4	101.308
																						385-1	102.35	0.843	74.5	21	101.507
																						378-3	102.57	1.043	74.5	22	101.527
																						385-2	102.65	0.986	74.5	28.6	101.664
																						378-2	102.67	0.983	74.5	29.7	101.687
																						385-3	102.65	0.821	74.5	36.6	101.829
																						378-1	102.67	0.818	74.5	37.7	101.852
																						386-1	102.73	0.680	74.5	47.3	102.050
																						377-4	103.02	0.949	74.5	48.3	102.071
																						386-2	103.08	0.865	74.5	55.3	102.215
																						377-3	103.28	1.044	74.5	56.3	102.236
																						377-2	103.34	0.955	74.5	63.5	102.385
377-1	103.34	0.790	74.5	71.5	102.550																						
MH_229	MH_102	100.723	100.142	525	86.5	0.9	0.013	103.790	103.240	1.832	0.40	0.26	0.7	-0.175	01:10	101.073	100.197	381-1	101.35	0.277							
																						382-1	101.52	1.184	86.5	13.7	100.336
																						381-4	101.35	1.004	86.5	14.7	100.346
																						382-2	101.52	1.103	86.5	21.7	100.417
																						381-3	101.35	0.923	86.5	22.7	100.427
																						382-3	101.52	1.030	86.5	28.9	100.490
																						381-2	101.35	0.849	86.5	30	100.501
																						382-4	101.52	0.949	86.5	36.9	100.571
																						381-1	101.35	0.768	86.5	38	100.582
																						383-1	101.62	0.941	86.5	47.6	100.679
																						380-3	101.59	0.901	86.5	48.6	100.689
																						383-2	101.62	0.860	86.5	55.6	100.760
																						380-2	101.59	0.820	86.5	56.6	100.770
																						383-3	101.62	0.783	86.5	63.2	100.837
																						380-1	101.59	0.743	86.5	64.2	100.847
																						384-1	101.95	1.006	86.5	73.8	100.944
379-4	101.96	1.004	86.5	74.9	100.956																						
384-2	101.95	0.925	86.5	81.8	101.025																						
379-3	101.96	0.923	86.5	82.9	101.037																						
MH_230	MH_231	102.417	100.947	300	73.5	2.0	0.013	105.220	103.750	1.935	0.14	0.06	0.4	-0.160	01:12	102.557	100.982	374-3	102.03	-0.527							
																						374-3	102.03	0.994	73.5	2.5	101.036
																						388-3	102.24	1.151	73.5	5	101.089
																						374-4	102.03	0.823	73.5	10.5	101.207
																						368-2	102.24	0.979	73.5	13	101.261
																						368-1	102.24	0.817	73.5	20.6	101.423
																						375-1	102.4	0.964	73.5	21.2	101.436
																						375-2	102.57	0.971	73.5	28.8	101.599
																						367-3	102.71	1.057	73.5	31.3	101.653
																						375-3	102.57	0.799	73.5	36.8	101.771
																						367-2	102.71	0.886	73.5	39.3	101.824
																						367-1	102.71	0.723	73.5	46.9	101.987
																						376-1	103	1.002	73.5	47.4	101.998
																						376-2	103	0.831	73.5	55.4	102.169
376-3	103.37	1.044	73.5	62.7	102.326																						
376-4	103.37	0.873	73.5	70.7	102.497																						
MH_231	MH_103	100.722	99.002	525	87.0	2.0	0.013	103.750	102.350	2.810	0.61	0.27	0.4	-0.265	01:11	100.982	99.575	371-1	100.56	-0.422							
																						371-1	100.56	0.775	87.0	13	99.789
																						372-1	100.95	1.150	87.0	13.9	99.800
																						371-2	100.56	0.645	87.0	21	99.915
																						372-2	100.95	1.021	87.0	21.9	99.929
																						371-1	100.56	0.522	87.0	28.6	100.038
372-3	100.95	0.903	87.0	29.2	100.047																						

Table C-1A: Pipe Data and Hydraulic Simulation Results for the 100-Year, 3-Hour Chicago Storm

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL		
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)
																		372-4	100.95	0.773	87.0	37.2	100.177
																		370-3	101.09	0.879	87.0	39.3	100.211
																		370-2	101.09	0.750	87.0	47.3	100.340
																		373-1	100.97	0.622	87.0	47.8	100.348
																		370-1	101.09	0.627	87.0	54.9	100.463
																		373-2	101.32	0.843	87.0	55.8	100.477
																		373-3	101.32	0.720	87.0	63.4	100.600
																		369-3	101.61	0.976	87.0	65.5	100.634
																		369-2	101.61	0.846	87.0	73.5	100.764
																		374-1	101.56	0.787	87.0	74.1	100.773
																		369-1	101.61	0.722	87.0	81.2	100.888
																		374-2	101.56	0.657	87.0	82.1	100.903
MH_302	MH_303	96.410	96.351	2250	59.0	0.1	0.013	101.140	101.080	1.658	6.59	7.52	1.1	-0.290	1:15	98.370	98.291	#/A	#/A	#/A			
MH_303	MH_304	96.331	96.196	2250	134.5	0.1	0.013	101.080	100.730	1.658	6.59	7.96	1.2	-0.290	01:15	98.291	98.086	#/A	#/A	#/A			
MH_304	MH_306TEE	96.176	96.133	2250	42.5	0.1	0.013	100.730	100.350	1.666	6.62	8.15	1.2	-0.340	01:15	98.086	97.813	#/A	#/A	#/A			
MH_306TEE	MH_307	96.133	96.120	2250	13.0	0.1	0.013	100.350	100.350	2.128	28.73	8.29	0.3	-0.570	01:15	97.813	97.550	#/A	#/A	#/A			
MH_313	MH_307	96.099	96.120	2250	33.1	0.1	0.013	100.350	100.350	1.682	6.69	4.45	0.7	-0.900	01:16	97.449	97.550	#/A	#/A	#/A			
MH_307	MH_400	96.100	96.076	2250	22.7	0.1	0.013	100.350	100.350	1.707	6.79	5.33	0.8	-0.800	01:17	97.550	97.537	#/A	#/A	#/A			
MH_309	MH_310	97.139	97.113	1200	17.5	0.1	0.013	100.990	100.940	1.331	1.50	0.88	0.6	-0.360	01:31	97.979	97.853	#/A	#/A	#/A			
MH_310	MH_311	97.053	96.959	1200	62.5	0.2	0.013	100.940	100.830	1.335	1.51	1.13	0.7	-0.400	01:28	97.853	97.779	#/A	#/A	#/A			
MH_3	MH_109	99.346	99.306	600	10.0	0.4	0.013	102.650	102.650	1.373	0.39	0.23	0.6	-0.230	00:53	99.716	99.691	#/A	#/A	#/A			
MH_3111TEE	MH_312	96.831	96.716	1200	76.5	0.2	0.013	100.640	100.450	1.335	1.51	1.24	0.8	-0.360	01:21	97.671	97.526	#/A	#/A	#/A			
MH_311	MH_3111TEE	96.939	96.831	1200	72.0	0.2	0.013	100.830	100.640	1.335	1.51	1.22	0.8	-0.360	01:19	97.779	97.671	#/A	#/A	#/A			
MH_312	MH_313	96.656	96.624	1200	21.5	0.1	0.013	100.450	100.350	1.331	1.50	1.25	0.8	-0.330	01:21	97.526	97.449	#/A	#/A	#/A			
MH_313	MH_500	96.099	96.065	2250	33.1	0.1	0.013	100.350	100.350	1.682	6.69	4.45	0.7	-0.900	01:16	97.449	97.416	#/A	#/A	#/A			
MH_400	OGS_1	96.067	96.057	750	4.9	0.2	0.013	100.350	100.500	1.133	0.50	1.00	2.0	0.720	00:59	97.537	97.517	#/A	#/A	#/A			
OGS_1	OGS_1-Out	96.037	96.027	750	4.9	0.2	0.013	100.500	100.350	1.138	0.50	1.00	2.0	0.730	00:59	97.517	97.265	#/A	#/A	#/A			
OGS_1-Out	MH_401	96.015	96.000	2250	14.7	0.1	0.013	100.350	100.350	1.674	6.66	6.35	1.0	-1.000	01:17	97.265	96.930	#/A	#/A	#/A			
MH_4	MH_104	98.554	98.516	525	9.5	0.4	0.013	101.580	101.590	1.256	0.27	0.20	0.7	0.245	01:28	99.324	99.245	#/A	#/A	#/A			
MH_500	OGS_2	96.056	96.046	750	5.0	0.2	0.013	100.350	100.428	1.127	0.50	0.97	1.9	0.610	01:44	97.416	97.406	#/A	#/A	#/A			
OGS_2	OGS_2-Out	96.026	96.016	750	5.1	0.2	0.013	100.428	100.350	1.118	0.49	0.97	2.0	0.630	01:44	97.406	97.174	#/A	#/A	#/A			
OGS_2-Out	MH_501	96.004	96.000	2250	4.2	0.1	0.013	100.350	100.350	1.624	6.46	5.39	0.8	-1.080	01:16	97.174	96.920	#/A	#/A	#/A			

(2) Conservative estimate of freeboard based on U/S HGL and lowest USF connected to pipe. Actual HGL / freeboard at all connecting lots interpolated where conservative estimate does not meet freeboard requirements.

(3) Future USF elevations estimated as 1.8 m below the upstream top of manhole elevations.

Interpolated HGL elevation
Freeboard Less than 0.3m
Freeboard Less than 0.0m

Table C-1B: Pipe Data and Hydraulic Simulation Results for the 100-Year, 24-Hour SCS Type II Storm

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL				
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)		
MH_401	POND	96.000	99.800	2250	10.0	0.5	0.013	100.350	#N/A	3.706	14.74	5.25	0.4	-1.320	12:04	96.930	96.730	#N/A	#N/A	#N/A					
MH_501	POND	96.000	99.800	2250	10.0	0.5	0.013	100.350	#N/A	3.706	14.74	4.54	0.3	-1.370	12:04	96.880	96.730	#N/A	#N/A	#N/A					
MH_1002	MH_1003	94.150	93.982	900	28.0	0.6	0.013	98.370	98.040	2.204	1.40	1.26	0.9	0.140	12:54	95.190	94.592	#N/A	#N/A	#N/A					
MH_1003	MH_1004	93.922	93.271	900	108.5	0.6	0.013	98.040	96.170	3.188	17.21	1.26	0.1	-0.230	12:55	94.592	93.306	#N/A	#N/A	#N/A					
MH_1004	MH_1005	92.586	92.162	975	106.0	0.4	0.013	96.170	95.150	1.898	1.42	1.26	0.9	-0.255	12:55	93.306	92.913	#N/A	#N/A	#N/A					
MH_1005	MH_1006	91.933	91.721	1200	106.0	0.2	0.013	95.150	94.970	1.542	1.74	1.26	0.7	-0.220	12:56	92.913	92.831	#N/A	#N/A	#N/A					
MH_1006	MH_1007	91.701	91.489	1200	106.0	0.2	0.013	94.970	94.270	1.542	1.74	1.26	0.7	-0.070	12:57	92.831	92.730	#N/A	#N/A	#N/A					
MH_1007	MH_1008	91.470	91.230	1200	88.0	0.3	0.013	94.270	93.460	1.801	2.04	1.56	0.8	0.060	00:00	92.730	92.580	#N/A	#N/A	#N/A					
MH_1008	MH_1009	91.230	91.200	1200	14.5	0.2	0.013	93.460	#N/A	1.568	1.77	1.58	0.9	0.150	00:01	92.580	92.500	#N/A	#N/A	#N/A					
MH_101	MH_102	100.935	100.142	300	30.5	2.6	0.013	103.750	103.240	2.206	0.16	0.00	0.0	-0.300	00:00	100.935	100.187	174-2	101.41	0.475					
MH_102	MH_103	99.917	99.002	525	59.0	1.6	0.013	103.240	102.350	2.474	0.54	0.27	0.5	-0.255	12:00	100.187	99.455	172-5	100.47	0.283					
																				172-5	100.47	0.929	59.0	6.9	99.541
																				173-1	100.78	1.100	59.0	18.1	99.680
																				173-2	100.78	1.001	59.0	26.1	99.779
																				173-3	101.1	1.232	59.0	33.3	99.868
																				173-4	101.1	1.133	59.0	41.3	99.967
																				173-5	101.1	1.038	59.0	48.9	100.062
																				174-1	101.41	1.256	59.0	56.3	100.154
MH_103	MH_104	98.755	98.516	750	120.0	0.4	0.013	102.350	101.590	1.594	0.70	0.58	0.8	-0.050	12:04	99.455	99.185	169-2	99.81	0.355					
																				169-2	99.81	0.619	120.0	2.7	99.191
																				169-3	99.81	0.603	120.0	10	99.208
																				169-4	99.81	0.585	120.0	18	99.226
																				170-1	99.93	0.681	120.0	28.6	99.249
																				170-2	99.93	0.663	120.0	36.6	99.267
																				170-3	99.93	0.646	120.0	44.2	99.284
																				171-1	99.99	0.681	120.0	54.9	99.309
																				171-2	99.99	0.663	120.0	62.9	99.327
																				171-3	99.99	0.647	120.0	70.1	99.343
																				171-4	99.99	0.629	120.0	78.1	99.361
																				172-1	100.47	1.069	120.0	96.1	99.401
																				172-2	100.47	1.051	120.0	104.1	99.419
																				172-3	100.47	1.035	120.0	111.3	99.435
																				172-4	100.47	1.022	120.0	117	99.448
MH_104	MH_106	97.975	97.913	1050	41.5	0.1	0.013	101.590	101.840	1.217	1.05	0.92	0.9	0.160	11:58	99.185	99.065	169-1	99.81	0.625					
MH_105	MH_106	99.562	97.913	675	91.0	1.4	0.013	103.170	101.840	4.109	16.64	0.74	0.0	-0.245	11:59	99.992	99.065	148	100.03	0.038					
																				148	100.03	0.837	91.0	12.6	99.193
																				147	100.16	0.842	91.0	24.8	99.318
																				146	100.3	0.878	91.0	35	99.422
																				145	100.42	0.884	91.0	46.2	99.536
																				144	100.56	0.880	91.0	60.4	99.680
																				143	100.93	1.109	91.0	74.2	99.821
																				142	101.5	1.529	91.0	88.9	99.971
MH_106	MH_116	97.605	97.360	1350	122.5	0.2	0.013	101.840	101.580	1.668	2.39	1.74	0.7	0.110	12:01	99.065	98.830	166-1	99.53	0.465					
MH_107	MH_108	99.165	99.080	300	74.0	0.4	0.013	101.895	101.880	0.809	0.06	0.03	0.5	-0.055	12:03	99.410	99.418	176-1	100.1	0.690					
MH_107	MH_112	99.165	98.906	300	74.0	0.4	0.013	101.895	101.695	0.809	0.06	0.03	0.5	-0.055	12:03	99.410	99.361	185-1	99.89	0.480					
MH_108	MH_110	98.908	98.800	450	54.0	0.2	0.013	101.880	101.980	0.802	0.13	0.09	0.7	0.060	11:57	99.418	99.386	175-1	100.15	0.732					
MH_109	MH_110	99.151	98.800	750	60.0	0.7	0.013	102.650	101.980	2.108	0.93	0.77	0.8	-0.220	12:00	99.681	99.386	164-2	100.01	0.329					
																				164-2	100.01	0.618	60.0	1.2	99.392
																				164-3	100.25	0.831	60.0	6.7	99.419
																				164-4	100.25	0.792	60.0	14.7	99.458
																				165-1	100.42	0.910	60.0	25.3	99.510
																				165-2	100.93	1.382	60.0	32.9	99.548
																				165-3	100.93	1.343	60.0	40.9	99.587
MH_110	MH_111	98.346	98.046	900	75.0	0.4	0.013	101.980	101.770	1.800	1.14	0.99	0.9	0.140	11:56	99.386	99.175	162-1	99.69	0.304					
																				188-4	99.86	0.679	75.0	2	99.181
																				162-1	99.69	0.497	75.0	6.3	99.193
																				188-3	99.86	0.659	75.0	9.2	99.201

Table C-1B: Pipe Data and Hydraulic Simulation Results for the 100-Year, 24-Hour SCS Type II Storm

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL							
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)					
																						162-2	99.69	0.475	75.0	14.3	99.215	
																						188-2	99.86	0.637	75.0	17.2	99.223	
																						162-3	99.69	0.454	75.0	21.6	99.236	
																						188-1	99.86	0.615	75.0	24.8	99.245	
																						162-4	99.69	0.426	75.0	31.6	99.264	
																						187-4	99.86	0.585	75.0	35.5	99.275	
																						163-1	99.77	0.482	75.0	40.2	99.288	
																						187-3	99.86	0.563	75.0	43.5	99.297	
																						163-2	99.77	0.461	75.0	47.8	99.309	
																						187-2	99.86	0.542	75.0	50.7	99.318	
																						163-3	99.77	0.438	75.0	55.8	99.332	
																						187-1	99.86	0.520	75.0	58.7	99.340	
																						164-1	100.01	0.648	75.0	66.5	99.362	
																						MH_111	MH_115	97.925	97.743	975	91.0	0.2
MH_112	MH_113	98.756	98.609	450	73.5	0.2	0.013	101.695	101.525	0.802	0.13	0.14	1.1	0.155	12:03	99.361	99.154	183-1	99.74	0.379								
MH_113	MH_114	98.549	98.523	450	13.0	0.2	0.013	101.525	101.520	0.802	0.13	0.16	1.3	0.155	12:03	99.154	99.096	181-1	99.85	0.696								
MH_1	MH_133	97.607	97.569	1500	19.0	0.2	0.013	101.660	101.660	1.789	3.16	1.80	0.6	-0.350	12:09	98.757	98.599	Est. Fut	99.86	1.103								
MH_114	MH_115	98.296	97.743	675	54.0	0.4	0.013	101.520	101.450	1.486	0.53	0.29	0.5	0.125	12:02	99.096	98.986	182-1	99.58	0.484								
MH_115	MH_116	97.656	97.360	1050	59.0	0.5	0.013	101.450	101.580	2.230	1.93	1.38	0.7	0.280	12:02	98.986	98.830	157-1	99.46	0.474								
MH_116	MH_117	97.060	96.937	1650	122.5	0.1	0.013	101.580	101.370	1.348	2.88	3.25	1.1	0.120	12:02	98.830	98.677	30	99.32	0.490								
MH_117	MH_118	96.917	96.796	1650	121.0	0.1	0.013	101.370	101.290	1.348	2.88	3.41	1.2	0.110	12:02	98.677	98.505	20	99.11	0.433								
																						18	99.18	0.669	121.0	4.4	98.511	
																						2	99.16	0.644	121.0	7.7	98.516	
																						406	99.18	0.652	121.0	16.1	98.528	
																						404	99.18	0.646	121.0	20.3	98.534	
																						407	99.16	0.618	121.0	25.7	98.542	
																						405	99.18	0.632	121.0	30.5	98.548	
																						19	99.16	0.601	121.0	37.9	98.559	
																						3	99.14	0.577	121.0	40.7	98.563	
																						20	99.11	0.537	121.0	48.1	98.573	
																						4	99.14	0.562	121.0	51.2	98.578	
																						21	99.12	0.531	121.0	59.3	98.589	
																						5	99.22	0.627	121.0	62.1	98.593	
																						22	99.21	0.603	121.0	71.5	98.607	
																						6	99.23	0.621	121.0	73.3	98.609	
23	99.22	0.597	121.0	82.9	98.623																							
7	99.24	0.610	121.0	87.8	98.630																							
24	99.28	0.637	121.0	97.3	98.643																							
8	99.31	0.659	121.0	102.8	98.651																							
25	99.36	0.694	121.0	113.1	98.666																							
9	99.4	0.727	121.0	118.2	98.673																							
MH_118	MH_136	96.645	96.634	1950	11.0	0.1	0.013	101.290	101.190	1.507	4.50	3.41	0.8	-0.090	12:02	98.505	98.394	#N/A	#N/A	#N/A								
MH_119	MH_120	99.144	98.938	900	103.0	0.2	0.013	103.010	102.570	1.273	0.81	1.02	1.3	0.030	12:01	100.074	99.668	101	100.65	0.576								
MH_119	MH_122	99.144	99.693	900	103.0	0.2	0.013	103.010	102.490	1.840	9.94	1.02	0.1	0.030	12:01	100.074	99.693	#N/A	#N/A	#N/A								
MH_120	MH_121	98.878	98.850	900	14.0	0.2	0.013	102.570	102.480	1.273	0.81	1.07	1.3	-0.110	12:01	99.668	99.300	116	101.03	1.362								
MH_121	MH_132	98.790	97.536	900	114.0	1.1	0.013	102.480	101.320	2.985	1.90	1.16	0.6	-0.390	12:01	99.300	98.538	106	99.54	0.240								
																						106	99.54	0.954	114.0	7.2	98.586	
																						107	99.71	1.042	114.0	19.4	98.668	
																						108	99.88	1.137	114.0	30.6	98.743	
																						109	100.05	1.239	114.0	40.8	98.811	
																						110	100.15	1.255	114.0	53.4	98.895	
																						111	100.32	1.349	114.0	64.8	98.971	
																						112	100.48	1.427	114.0	77	99.053	
																						113	100.57	1.442	114.0	88.2	99.128	
114	100.57	1.374	114.0	98.4	99.196																							
115	100.65	1.385	114.0	108.8	99.265																							
MH_122	MH_123	99.663	99.461	300	13.0	1.6	0.013	102.490	102.270	1.705	0.12	0.00	0.0	-0.300	00:00	99.663	99.507	131	100.61	0.947								

Table C-1B: Pipe Data and Hydraulic Simulation Results for the 100-Year, 24-Hour SCS Type II Storm

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (m)	Interpolated HGL						
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)				
MH_123	MH_127	99.407	98.615	300	49.5	1.6	0.013	102.270	101.675	1.730	0.12	0.03	0.2	-0.200	12:00	99.507	99.062	135	99.89	0.383							
MH_124	MH_125	99.069	98.715	375	101.0	0.4	0.013	102.060	101.870	1.421	2.66	0.07	0.0	-0.065	12:08	99.379	99.261	72	99.77	0.391							
																						82	99.89	0.623	101.0	5.4	99.267
																						69	99.84	0.569	101.0	8.4	99.271
																						70	99.78	0.497	101.0	18.6	99.283
																						81	99.89	0.606	101.0	19.6	99.284
																						71	99.78	0.484	101.0	29.7	99.296
																						80	99.92	0.623	101.0	31	99.297
																						72	99.77	0.462	101.0	39.9	99.308
																						79	100.04	0.724	101.0	46.9	99.316
																						73	99.82	0.499	101.0	51.1	99.321
																						78	100.04	0.715	101.0	54.4	99.325
																						74	99.88	0.547	101.0	61.3	99.333
																						77	100	0.664	101.0	64.6	99.336
																						413	99.93	0.583	101.0	73.4	99.347
																						415	100.08	0.731	101.0	75.2	99.349
																						412	99.98	0.623	101.0	82.3	99.357
																						414	100.1	0.738	101.0	86.4	99.362
75	99.98	0.609	101.0	94	99.371																						
76	100.16	0.784	101.0	98.1	99.376																						
MH_125	MH_127	98.481	98.615	600	91.5	0.3	0.013	101.870	101.675	1.618	5.82	0.27	0.0	0.180	12:12	99.261	99.062	65	99.58	0.319							
																						88	99.82	0.723	91.5	16	99.097
																						63	99.59	0.492	91.5	16.6	99.098
																						87	99.82	0.693	91.5	29.7	99.127
																						64	99.59	0.462	91.5	30.3	99.128
																						86	99.65	0.499	91.5	41.1	99.151
																						65	99.58	0.423	91.5	43.9	99.157
																						85	99.74	0.557	91.5	55.5	99.183
																						66	99.69	0.501	91.5	58.6	99.189
																						84	99.76	0.543	91.5	71.3	99.217
																						67	99.78	0.556	91.5	74.4	99.224
																						83	99.89	0.642	91.5	85.7	99.248
68	99.84	0.585	91.5	88.8	99.255																						
MH_126	MH_127	98.697	98.615	300	28.5	0.4	0.013	101.500	101.675	0.865	0.06	0.16	2.6	1.200	12:03	100.197	99.062	#/N/A	#/N/A	#/N/A							
MH_127	MH_128	98.102	97.994	750	54.0	0.2	0.013	101.675	101.395	1.654	7.44	0.44	0.1	0.210	12:11	99.062	98.954	47	99.56	0.498							
MH_128	MH_129	97.964	97.923	750	13.5	0.3	0.013	101.395	101.315	1.389	0.61	0.45	0.7	0.240	12:11	98.954	98.908	45	99.49	0.536							
MH_129	MH_130	97.848	97.732	825	77.0	0.2	0.013	101.315	101.420	1.496	6.17	0.56	0.1	0.235	12:11	98.908	98.792	43	99.41	0.502							
MH_130	MH_131	97.732	97.581	825	100.5	0.2	0.013	101.420	101.200	1.040	0.56	0.68	1.2	0.235	12:12	98.792	98.566	33	99.18	0.388							
MH_1302	MH_302	97.470	96.430	600	98.5	0.2	0.013	101.160	101.140	0.971	0.27	0.16	0.6	0.330	12:26	98.400	98.330	Est. Fut	99.36	0.960							
MH_1303	MH_303	97.245	96.351	750	109.0	0.2	0.013	101.090	101.080	0.976	0.43	0.35	0.8	0.400	12:26	98.395	98.251	Est. Fut	99.29	0.895							
MH_1304	MH_304	97.175	96.196	600	87.0	0.2	0.013	100.660	100.730	0.971	0.27	0.19	0.7	0.360	11:48	98.135	98.036	Est. Fut	98.86	0.725							
MH_131	MH_132	97.206	97.536	1200	12.0	0.2	0.013	101.200	101.320	1.335	1.51	0.69	0.5	0.160	12:12	98.566	98.538	#/N/A	#/N/A	#/N/A							
MH_1312	MH_310	97.627	97.113	750	62.0	0.2	0.013	100.940	100.940	1.127	0.50	0.18	0.4	-0.440	12:10	97.937	97.843	Est. Fut	99.14	1.203							
MH_132	MH_136	97.128	96.634	1200	59.5	0.2	0.013	101.320	101.190	1.542	1.74	1.95	1.1	0.210	12:01	98.538	98.394	103	99.33	0.792							
MH_133	MH_134	97.509	97.393	1500	77.0	0.2	0.013	101.660	101.550	2.126	19.14	1.87	0.1	-0.410	12:09	98.599	98.533	#/N/A	#/N/A	#/N/A							
MH_134	MH_135	97.363	97.271	1500	61.0	0.2	0.013	101.550	101.440	1.554	2.75	1.95	0.7	-0.330	12:10	98.533	98.481	#/N/A	#/N/A	#/N/A							
MH_135	MH_136	97.121	96.634	1650	37.0	0.1	0.013	101.440	101.190	1.348	2.88	1.97	0.7	-0.290	12:09	98.481	98.394	#/N/A	#/N/A	#/N/A							
MH_136	MH_302	96.484	96.430	2250	54.0	0.1	0.013	101.190	101.140	1.658	6.59	7.25	1.1	-0.340	12:03	98.394	98.330	1	99.38	0.986							
MH_201	MH_202	105.214	104.138	375	119.5	0.9	0.013	108.120	107.180	1.506	0.17	0.09	0.5	-0.175	12:00	105.414	104.403	321	105.28	-0.134							
																						321	105.28	0.805	119.5	8.5	104.475
																						430	107.31	2.817	119.5	10.6	104.493
																						431	107.37	2.829	119.5	16.3	104.541
																						428	105.36	0.769	119.5	22.2	104.591
																						233	107.4	2.747	119.5	29.5	104.653
																						429	105.37	0.701	119.5	31.5	104.669
																						234	107.46	2.759	119.5	35.2	104.701
320	105.45	0.677	119.5	43.7	104.773																						

Table C-1B: Pipe Data and Hydraulic Simulation Results for the 100-Year, 24-Hour SCS Type II Storm

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL			
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)	
																			235	107.5	2.693	119.5	47.7	104.807
																			319	105.56	0.693	119.5	54.8	104.867
																			236	107.62	2.753	119.5	54.9	104.867
																			318	105.66	0.707	119.5	65	104.953
																			237	107.69	2.718	119.5	67.3	104.972
																			238	107.8	2.779	119.5	73	105.021
																			317	105.77	0.722	119.5	76.2	105.048
																			239	107.87	2.738	119.5	86.2	105.132
																			316	105.9	0.749	119.5	88.4	105.151
																			240	107.99	2.810	119.5	91.9	105.180
																			315	106.02	0.773	119.5	99.8	105.247
																			241	108.06	2.768	119.5	105.1	105.292
																			242	108.16	2.820	119.5	110.8	105.340
																			314	106.13	0.763	119.5	114	105.367
MH_202	MH_203	104.063	104.035	450	14.0	0.2	0.013	107.180	107.090	0.802	0.13	0.12	1.0	-0.110	12:00	104.403	104.335	230	105.39	0.987				
MH_203	MH_206	103.975	103.730	450	54.5	0.5	0.013	107.090	106.720	1.203	0.19	0.19	1.0	-0.090	12:00	104.335	103.747	225	104.9	0.565				
MH_204	MH_205	103.579	103.343	525	118.0	0.2	0.013	106.620	106.610	0.888	0.19	0.14	0.7	-0.155	12:05	103.949	103.843	285	104.64	0.691				
MH_205	MH_206	103.313	103.730	525	16.0	0.2	0.013	106.610	106.720	0.888	0.19	0.21	1.1	0.005	12:04	103.843	103.747	#N/A	#N/A	#N/A				
MH_206	MH_207	103.197	102.999	600	49.5	0.4	0.013	106.720	106.460	1.373	0.39	0.42	1.1	-0.050	12:01	103.747	103.319	221	104.52	0.773				
MH_207	MH_208	102.969	102.731	600	12.5	1.9	0.013	106.460	106.320	2.997	0.85	0.42	0.5	-0.250	12:01	103.319	102.991	219	104.39	1.071				
MH_208	MH_215	102.671	100.543	600	112.0	1.9	0.013	106.320	104.150	2.993	0.85	0.48	0.6	-0.280	12:01	102.991	101.233	212	102.46	-0.531				
																			271	102.46	1.087	112.0	8.9	101.373
																			212	102.46	1.028	112.0	12.7	101.432
																			270	102.67	1.074	112.0	23.1	101.596
																			213	102.68	1.058	112.0	24.8	101.622
																			214	102.89	1.108	112.0	35	101.782
																			269	102.93	1.133	112.0	35.9	101.797
																			215	103.1	1.142	112.0	46.2	101.958
																			268	103.18	1.205	112.0	47.3	101.975
																			216	103.36	1.210	112.0	58.4	102.150
																			267	103.42	1.253	112.0	59.5	102.167
																			217	103.62	1.291	112.0	69.8	102.329
																			266	103.68	1.337	112.0	70.7	102.343
																			423	103.94	1.437	112.0	80.9	102.503
																			421	103.83	1.310	112.0	82	102.520
																			422	104.04	1.363	112.0	92	102.677
																			420	104.04	1.346	112.0	93.1	102.694
																			265	104.35	1.489	112.0	103.7	102.861
																			218	104.3	1.409	112.0	105.6	102.891
MH_209	MH_201	105.833	105.316	300	94.0	0.6	0.013	108.630	108.120	1.015	0.07	0.00	0.0	-0.300	00:00	105.833	105.414	313	106.24	0.407				
MH_209	MH_210	105.833	105.518	300	94.0	0.6	0.013	108.630	108.320	1.015	0.07	0.00	0.0	-0.300	00:00	105.833	105.586	254	108.31	2.477				
MH_210	MH_212	105.486	103.434	300	54.0	3.8	0.013	108.320	107.010	2.668	0.19	0.05	0.3	-0.200	12:00	105.586	103.579	258	105.12	-0.466				
																			258	105.12	0.957	54.0	15.7	104.163
																			257	105.54	0.943	54.0	27.4	104.597
																			256	106.05	1.033	54.0	38.7	105.017
																			255	106.58	1.187	54.0	48.8	105.393
MH_211	MH_212	103.900	103.434	300	26.5	0.4	0.013	106.090	107.010	0.810	0.06	0.02	0.3	-0.160	12:00	104.040	103.579	#N/A	#N/A	#N/A				
MH_212	MH_204	103.359	103.804	375	49.5	0.5	0.013	107.010	106.620	1.066	0.12	0.07	0.6	-0.155	12:01	103.579	103.949	284	104.71	1.131				
MH_212	MH_213	103.359	103.136	375	49.5	0.5	0.013	107.010	106.020	1.066	0.12	0.07	0.6	-0.155	12:01	103.579	103.233	203	104.1	0.521				
MH_213	MH_214	103.053	102.918	375	13.5	1.0	0.013	106.020	105.800	1.587	0.18	0.07	0.4	-0.195	12:01	103.233	103.053	204	104.02	0.787				
MH_214	MH_215	102.883	100.543	375	90.0	2.4	0.013	105.800	104.150	2.434	0.27	0.11	0.4	-0.205	12:00	103.053	101.233	272	102.37	-0.693				
																			272	102.37	0.987	90.0	7.4	101.383
																			211	102.46	0.907	90.0	15.8	101.553
																			273	102.59	0.920	90.0	21.6	101.670
																			210	102.68	0.881	90.0	28	101.799
																			274	102.86	0.883	90.0	36.8	101.977
																			209	102.89	0.885	90.0	38.2	102.005

Table C-1B: Pipe Data and Hydraulic Simulation Results for the 100-Year, 24-Hour SCS Type II Storm

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m ³ /s)	Peak Pipe Flow (m ³ /s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL					
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)			
																					275	103.11	0.902	90.0	48.2	102.206
																					208	103.15	0.918	90.0	49.4	102.232
																					276	103.37	0.916	90.0	60.4	102.454
																					207	103.4	0.881	90.0	63.6	102.519
																					277	103.55	0.944	90.0	67.9	102.606
																					206	103.66	0.910	90.0	75	102.750
																					278	103.55	0.624	90.0	83.7	102.926
																					205	103.83	0.868	90.0	85.5	102.962
MH_215	MH_119	100.303	99.423	675	55.0	1.6	0.013	104.150	103.010	2.971	1.06	0.96	0.9	0.255	12:00	101.233	100.074	#N/A	#N/A	#N/A						
MH_216	MH_217	105.251	104.798	375	75.5	0.6	0.013	108.100	107.980	1.230	0.14	0.11	0.8	-0.115	12:01	105.511	105.083	346	105.85	0.339						
MH_217	MH_218	104.573	104.347	600	113.0	0.2	0.013	107.980	107.690	0.971	0.27	0.26	1.0	-0.090	12:10	105.083	104.917	356	105.71	0.627						
MH_218	MH_220	104.327	104.166	600	80.5	0.2	0.013	107.690	107.790	0.971	0.27	0.30	1.1	-0.010	12:05	104.917	104.166	357	105.75	0.833						
MH_219	MH_220	105.649	104.166	300	25.0	2.7	0.013	108.450	107.790	2.228	0.16	0.00	0.0	-0.300	00:00	105.649	104.166	#N/A	#N/A	#N/A						
MH_220	MH_224	103.644	102.523	600	59.0	1.9	0.013	107.790	105.620	2.993	0.85	0.30	0.4	-0.350	12:00	103.894	102.523	259	104.74	0.846						
MH_221	MH_222	103.008	102.620	300	77.5	0.5	0.013	105.960	105.420	0.968	0.07	0.01	0.1	-0.230	12:00	103.078	102.811	396-1	103.56	0.482						
MH_222	MH_223	102.311	102.168	600	95.5	0.2	0.013	105.420	105.450	0.841	0.24	0.22	0.9	-0.100	12:01	102.811	102.698	366-1	103.37	0.559						
MH_2	MH_2260	101.916	101.876	675	10.0	0.4	0.013	105.290	105.290	1.486	0.53	0.38	0.7	-0.085	11:46	102.506	102.126	Est. Fut	103.49	0.984						
MH_223	MH_224	102.148	102.523	600	97.0	0.2	0.013	105.450	105.620	0.971	0.27	0.27	1.0	-0.050	12:02	102.698	102.523	365-1	103.42	0.722						
MH_224	MH_105	101.625	100.067	600	82.0	1.9	0.013	105.620	103.170	2.993	0.85	0.65	0.8	-0.200	12:00	102.025	100.067	141	101.9	-0.125						
																					141	101.9	1.561	82.0	11.4	100.339
																					140	102.18	1.502	82.0	25.6	100.678
																					139	102.55	1.602	82.0	36.9	100.948
																					138	102.92	1.728	82.0	47.1	101.192
																					137	103.3	1.843	82.0	58.2	101.457
																					136	103.81	2.029	82.0	71.8	101.781
MH_225	MH_226	103.412	102.914	300	99.5	0.5	0.013	106.390	105.720	0.968	0.07	0.03	0.5	-0.150	12:00	103.562	103.033	388-3	103.75	0.188						
																					389-2	103.75	0.686	99.5	5.8	103.064
																					389-1	103.75	0.628	82.0	13.8	103.122
																					388-3	103.75	0.560	82.0	24.4	103.190
																					388-2	103.88	0.640	82.0	32.1	103.240
																					388-1	103.88	0.588	82.0	40.1	103.292
																					387-4	104.02	0.660	82.0	50.7	103.360
																					387-3	104.02	0.608	82.0	58.7	103.412
																					387-2	104.02	0.562	82.0	65.9	103.458
																					387-1	104.02	0.510	82.0	73.9	103.510
MH_2260	MH_227	101.816	101.049	675	49.5	1.6	0.013	105.290	104.230	2.925	1.05	0.45	0.4	-0.365	12:00	102.126	101.109	392-1	102.46	0.334						
MH_226	MH_2260	102.863	101.876	300	64.0	1.1	0.013	105.720	105.290	1.402	0.10	0.06	0.6	-0.130	12:00	103.033	102.126	391-3	103.08	0.047						
																					391-3	103.08	0.921	64.0	2.3	102.159
																					391-2	103.45	1.188	64.0	9.6	102.262
																					391-1	103.45	1.075	64.0	17.6	102.375
																					390-3	103.58	1.054	64.0	28.2	102.526
																					390-2	103.58	0.941	64.0	36.2	102.639
																					390-1	103.58	0.833	64.0	43.8	102.747
																					389-4	103.75	0.852	64.0	54.5	102.898
																					389-3	103.75	0.738	64.0	62.5	103.012
MH_227	MH_109	100.759	99.306	675	93.0	1.6	0.013	104.230	102.650	2.971	1.06	0.50	0.5	-0.325	11:59	101.109	99.681	394-3	100.86	-0.249						
																					394-4	100.86	0.884	93.0	19.2	99.976
																					394-3	100.86	0.761	93.0	27.2	100.099
																					394-2	101.26	1.049	93.0	34.5	100.211
																					394-1	101.26	0.926	93.0	42.5	100.334
																					393-3	101.49	0.978	93.0	54.1	100.512
																					393-2	101.81	1.182	93.0	61.7	100.628
																					393-1	101.81	1.059	93.0	69.7	100.751
																					392-4	102.21	1.279	93.0	81.4	100.931
																					392-3	102.21	1.156	93.0	89.4	101.054
MH_228	MH_229	102.472	100.982	300	74.5	2.0	0.013	105.270	103.790	1.935	0.14	0.06	0.4	-0.160	12:00	102.612	101.063	384-3	102.12	-0.492						
																					384-3	102.12	1.007	74.5	2.4	101.113

Table C-1B: Pipe Data and Hydraulic Simulation Results for the 100-Year, 24-Hour SCS Type II Storm

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL						
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)				
																						372-4	100.95	0.846	87.0	37.2	100.104
																						370-3	101.09	0.950	87.0	39.3	100.140
																						370-2	101.09	0.810	87.0	47.3	100.288
																						373-1	100.97	0.682	87.0	47.8	100.288
																						370-1	101.09	0.678	87.0	54.9	100.412
																						373-2	101.32	0.892	87.0	55.8	100.428
																						373-3	101.32	0.760	87.0	63.4	100.560
																						369-3	101.61	1.013	87.0	65.5	100.597
																						369-2	101.61	0.873	87.0	73.5	100.737
																						374-1	101.56	0.813	87.0	74.1	100.747
369-1	101.61	0.739	87.0	81.2	100.871																						
374-2	101.56	0.673	87.0	82.1	100.887																						
MH_302	MH_303	96.410	96.351	2250	59.0	0.1	0.013	101.140	101.080	1.658	6.59	7.46	1.1	-0.330	12:03	98.330	98.251	#N/A	#N/A	#N/A							
MH_303	MH_304	96.331	96.196	2250	134.5	0.1	0.013	101.080	100.730	1.658	6.59	7.92	1.2	-0.330	12:02	98.251	98.036	#N/A	#N/A	#N/A							
MH_304	MH_306TEE	96.176	96.133	2250	42.5	0.1	0.013	100.730	100.350	1.666	6.62	8.09	1.2	-0.390	12:03	98.036	97.763	#N/A	#N/A	#N/A							
MH_306TEE	MH_307	96.133	96.120	2250	13.0	0.1	0.013	100.350	100.350	2.128	28.73	8.24	0.3	-0.620	12:03	97.763	97.490	#N/A	#N/A	#N/A							
MH_313	MH_307	96.099	96.120	2250	33.1	0.1	0.013	100.350	100.350	1.682	6.69	4.39	0.7	-0.970	12:03	97.379	97.490	#N/A	#N/A	#N/A							
MH_307	MH_400	96.100	96.076	2250	22.7	0.1	0.013	100.350	100.350	1.707	6.79	5.25	0.8	-0.860	12:03	97.490	97.447	#N/A	#N/A	#N/A							
MH_309	MH_310	97.139	97.113	1200	17.5	0.1	0.013	100.990	100.940	1.331	1.50	0.88	0.6	-0.370	12:12	97.969	97.843	#N/A	#N/A	#N/A							
MH_310	MH_311	97.053	96.959	1200	62.5	0.2	0.013	100.940	100.830	1.335	1.51	1.13	0.8	-0.410	12:09	97.843	97.759	#N/A	#N/A	#N/A							
MH_3	MH_109	99.346	99.306	600	10.0	0.4	0.013	102.650	102.650	1.373	0.39	0.23	0.6	-0.230	12:03	99.716	99.681	#N/A	#N/A	#N/A							
MH_3111TEE	MH_312	96.831	96.716	1200	76.5	0.2	0.013	100.640	100.450	1.335	1.51	1.24	0.8	-0.380	12:02	97.651	97.476	#N/A	#N/A	#N/A							
MH_311	MH_3111TEE	96.939	96.831	1200	72.0	0.2	0.013	100.830	100.640	1.335	1.51	1.22	0.8	-0.380	12:03	97.759	97.651	#N/A	#N/A	#N/A							
MH_312	MH_313	96.656	96.624	1200	21.5	0.1	0.013	100.450	100.350	1.331	1.50	1.25	0.8	-0.380	12:06	97.476	97.379	#N/A	#N/A	#N/A							
MH_313	MH_500	96.099	96.065	2250	33.1	0.1	0.013	100.350	100.350	1.682	6.69	4.39	0.7	-0.970	12:03	97.379	97.326	#N/A	#N/A	#N/A							
MH_400	OGS_1	96.067	96.057	750	4.9	0.2	0.013	100.350	100.500	1.133	0.50	1.00	2.0	0.630	11:46	97.447	97.427	#N/A	#N/A	#N/A							
OGS_1	OGS_1-Out	96.037	96.027	750	4.9	0.2	0.013	100.500	100.350	1.138	0.50	1.00	2.0	0.640	11:46	97.427	97.215	#N/A	#N/A	#N/A							
OGS_1-Out	MH_401	96.015	96.000	2250	14.7	0.1	0.013	100.350	100.350	1.674	6.66	6.30	0.9	-1.050	12:03	97.215	96.930	#N/A	#N/A	#N/A							
MH_4	MH_104	98.554	98.516	525	9.5	0.4	0.013	101.580	101.590	1.256	0.27	0.20	0.7	0.175	12:11	99.254	99.185	#N/A	#N/A	#N/A							
MH_500	OGS_2	96.056	96.046	750	5.0	0.2	0.013	100.350	100.428	1.127	0.50	0.98	2.0	0.520	12:29	97.326	97.306	#N/A	#N/A	#N/A							
OGS_2	OGS_2-Out	96.026	96.016	750	5.1	0.2	0.013	100.428	100.350	1.118	0.49	0.98	2.0	0.530	12:29	97.306	97.134	#N/A	#N/A	#N/A							
OGS_2-Out	MH_501	96.004	96.000	2250	4.2	0.1	0.013	100.350	100.350	1.624	6.46	5.37	0.8	-1.120	12:03	97.134	96.880	#N/A	#N/A	#N/A							

(2) Conservative estimate of freeboard based on U/S HGL and lowest USF connected to pipe. Actual HGL / freeboard at all connecting lots interpolated where conservative estimate does not meet freeboard requirements.

(3) Future USF elevations estimated as 1.8 m below the upstream top of manhole elevations.

Interpolated HGL elevation
Freeboard Less than 0.3m
Freeboard Less than 0.0m

Table C-1C: Pipe Data and Hydraulic Simulation Results for the July 1st, 1979 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL				
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)		
MH_401	POND	96.000	99.800	2250	10.0	0.5	0.013	100.350	#N/A	3.706	14.74	5.15	0.3	-1.060	01:34	97.190	96.730	#N/A	#N/A	#N/A					
MH_501	POND	96.000	99.800	2250	10.0	0.5	0.013	100.350	#N/A	3.706	14.74	4.55	0.3	-1.060	01:47	97.190	96.730	#N/A	#N/A	#N/A					
MH_1002	MH_1003	94.150	93.982	900	28.0	0.6	0.013	98.370	98.040	2.204	1.40	1.35	1.0	0.210	02:29	95.260	94.632	#N/A	#N/A	#N/A					
MH_1003	MH_1004	93.922	93.271	900	108.5	0.6	0.013	98.040	96.170	3.188	17.21	1.35	0.1	-0.190	02:29	94.632	93.366	#N/A	#N/A	#N/A					
MH_1004	MH_1005	92.586	92.162	975	106.0	0.4	0.013	96.170	95.150	1.898	1.42	1.35	1.0	-0.195	02:30	93.366	92.993	#N/A	#N/A	#N/A					
MH_1005	MH_1006	91.933	91.721	1200	106.0	0.2	0.013	95.150	94.970	1.542	1.74	1.35	0.8	-0.140	02:31	92.993	92.891	#N/A	#N/A	#N/A					
MH_1006	MH_1007	91.701	91.489	1200	106.0	0.2	0.013	94.970	94.270	1.542	1.74	1.35	0.8	-0.010	02:32	92.891	92.760	#N/A	#N/A	#N/A					
MH_1007	MH_1008	91.470	91.230	1200	88.0	0.3	0.013	94.270	93.460	1.801	2.04	1.56	0.8	0.090	00:00	92.760	92.590	#N/A	#N/A	#N/A					
MH_1008	MH_1009	91.230	91.200	1200	14.5	0.2	0.013	93.460	#N/A	1.568	1.77	1.58	0.9	0.160	00:01	92.590	92.500	#N/A	#N/A	#N/A					
MH_101	MH_102	100.935	100.142	300	30.5	2.6	0.013	103.750	103.240	2.206	0.16	0.00	0.0	-0.300	00:00	100.935	100.177	174-2	101.41	0.475					
MH_102	MH_103	99.917	99.002	525	59.0	1.6	0.013	103.240	102.350	2.474	0.54	0.26	0.5	-0.265	01:31	100.177	99.295	172-5	100.47	0.293					
																				172-5	100.47	1.072	59.0	6.9	99.398
																				173-1	100.78	1.214	59.0	18.1	99.566
																				173-2	100.78	1.095	59.0	26.1	99.685
																				173-3	101.1	1.307	59.0	33.3	99.793
																				173-4	101.1	1.188	59.0	41.3	99.912
																				173-5	101.1	1.074	59.0	48.9	100.026
																				174-1	101.41	1.273	59.0	56.3	100.137
MH_103	MH_104	98.755	98.516	750	120.0	0.4	0.013	102.350	101.590	1.594	0.70	0.54	0.8	-0.210	01:31	99.295	99.095	169-2	99.81	0.515					
																				169-2	99.81	0.711	120.0	2.7	99.100
																				169-3	99.81	0.698	120.0	10	99.112
																				169-4	99.81	0.685	120.0	18	99.125
																				170-1	99.93	0.787	120.0	28.6	99.143
																				170-2	99.93	0.774	120.0	36.6	99.156
																				170-3	99.93	0.761	120.0	44.2	99.169
																				171-1	99.99	0.804	120.0	54.9	99.187
																				171-2	99.99	0.790	120.0	62.9	99.200
																				171-3	99.99	0.778	120.0	70.1	99.212
																				171-4	99.99	0.765	120.0	78.1	99.225
																				172-1	100.47	1.215	120.0	96.1	99.255
																				172-2	100.47	1.202	120.0	104.1	99.269
																				172-3	100.47	1.190	120.0	111.3	99.281
																				172-4	100.47	1.180	120.0	117	99.290
MH_104	MH_106	97.975	97.913	1050	41.5	0.1	0.013	101.590	101.840	1.217	1.05	0.88	0.8	0.070	01:31	99.095	98.995	169-1	99.81	0.715					
MH_105	MH_106	99.562	97.913	675	91.0	1.4	0.013	103.170	101.840	4.109	16.64	0.71	0.0	-0.255	01:31	99.982	98.995	148	100.03	0.048					
																				148	100.03	0.898	91.0	12.6	99.132
																				147	100.16	0.896	91.0	24.8	99.264
																				146	100.3	0.925	91.0	35	99.375
																				145	100.42	0.924	91.0	46.2	99.496
																				144	100.56	0.910	91.0	60.4	99.650
																				143	100.93	1.130	91.0	74.2	99.800
																				142	101.5	1.541	91.0	88.9	99.959
MH_106	MH_116	97.605	97.360	1350	122.5	0.2	0.013	101.840	101.580	1.668	2.39	1.68	0.7	0.040	01:32	98.995	98.780	166-1	99.53	0.535					
MH_107	MH_108	99.165	99.080	300	74.0	0.4	0.013	101.895	101.880	0.809	0.06	0.02	0.4	-0.155	01:36	99.310	99.338	176-1	100.1	0.790					
MH_107	MH_112	99.165	98.906	300	74.0	0.4	0.013	101.895	101.695	0.809	0.06	0.02	0.4	-0.155	01:36	99.310	99.271	185-1	99.89	0.580					
MH_108	MH_110	98.908	98.800	450	54.0	0.2	0.013	101.880	101.980	0.802	0.13	0.09	0.7	-0.020	01:47	99.338	99.306	175-1	100.15	0.812					
MH_109	MH_110	99.151	98.800	750	60.0	0.7	0.013	102.650	101.980	2.108	0.93	0.75	0.8	-0.240	01:30	99.661	99.306	164-2	100.01	0.349					
																				164-2	100.01	0.697	60.0	1.2	99.313
																				164-3	100.25	0.904	60.0	6.7	99.346
																				164-4	100.25	0.857	60.0	14.7	99.393
																				165-1	100.42	0.964	60.0	25.3	99.456
																				165-2	100.93	1.429	60.0	32.9	99.501
																				165-3	100.93	1.382	60.0	40.9	99.548
MH_110	MH_111	98.346	98.046	900	75.0	0.4	0.013	101.980	101.770	1.800	1.14	0.98	0.9	0.060	01:27	99.306	99.095	162-1	99.69	0.384					
																				188-4	99.86	0.759	75.0	2	99.101
																				162-1	99.69	0.577	75.0	6.3	99.113
																				188-3	99.86	0.739	75.0	9.2	99.121

Table C-1C: Pipe Data and Hydraulic Simulation Results for the July 1st, 1979 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL		
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)
																		162-2	99.69	0.555	75.0	14.3	99.135
																		188-2	99.86	0.717	75.0	17.2	99.143
																		162-3	99.69	0.534	75.0	21.6	99.156
																		188-1	99.86	0.695	75.0	24.8	99.165
																		162-4	99.69	0.506	75.0	31.6	99.184
																		187-4	99.86	0.665	75.0	35.5	99.195
																		163-1	99.77	0.562	75.0	40.2	99.208
																		187-3	99.86	0.643	75.0	43.5	99.217
																		163-2	99.77	0.541	75.0	47.8	99.229
																		187-2	99.86	0.622	75.0	50.7	99.238
																		163-3	99.77	0.518	75.0	55.8	99.252
																		187-1	99.86	0.600	75.0	58.7	99.260
																		164-1	100.01	0.728	75.0	66.5	99.282
MH_111	MH_115	97.925	97.743	975	91.0	0.2	0.013	101.770	101.450	1.342	1.00	0.98	1.0	0.195	01:30	99.095	98.926	159-1	99.58	0.485			
MH_112	MH_113	98.756	98.609	450	73.5	0.2	0.013	101.695	101.525	0.802	0.13	0.14	1.1	0.065	01:36	99.271	99.084	183-1	99.74	0.469			
MH_113	MH_114	98.549	98.523	450	13.0	0.2	0.013	101.525	101.520	0.802	0.13	0.16	1.2	0.085	01:36	99.084	99.026	181-1	99.85	0.766			
MH_1	MH_133	97.607	97.569	1500	19.0	0.2	0.013	101.660	101.660	1.789	3.16	1.80	0.6	-0.360	01:47	98.747	98.589	Est. Fut	99.86	1.113			
MH_114	MH_115	98.296	97.743	675	54.0	0.4	0.013	101.520	101.450	1.486	0.53	0.28	0.5	0.055	01:46	99.026	98.926	182-1	99.58	0.554			
MH_115	MH_116	97.656	97.360	1050	59.0	0.5	0.013	101.450	101.580	2.230	1.93	1.33	0.7	0.220	01:35	98.926	98.780	157-1	99.46	0.534			
MH_116	MH_117	97.060	96.937	1650	122.5	0.1	0.013	101.580	101.370	1.348	2.88	3.13	1.1	0.070	01:34	98.780	98.637	30	99.32	0.540			
MH_117	MH_118	96.917	96.796	1650	121.0	0.1	0.013	101.370	101.290	1.348	2.88	3.26	1.1	0.070	01:34	98.637	98.475	20	99.11	0.473			
																		18	99.18	0.699	121.0	4.4	98.481
																		2	99.16	0.675	121.0	7.7	98.485
																		406	99.18	0.683	121.0	16.1	98.497
																		404	99.18	0.678	121.0	20.3	98.502
																		407	99.16	0.651	121.0	25.7	98.509
																		405	99.18	0.664	121.0	30.5	98.516
																		19	99.16	0.634	121.0	37.9	98.526
																		3	99.14	0.611	121.0	40.7	98.529
																		20	99.11	0.571	121.0	48.1	98.539
																		4	99.14	0.596	121.0	51.2	98.544
																		21	99.12	0.566	121.0	59.3	98.554
																		5	99.22	0.662	121.0	62.1	98.558
																		22	99.21	0.639	121.0	71.5	98.571
																		6	99.23	0.657	121.0	73.3	98.573
																		23	99.22	0.634	121.0	82.9	98.586
																		7	99.24	0.647	121.0	87.8	98.593
																		24	99.28	0.675	121.0	97.3	98.605
																		8	99.31	0.697	121.0	102.8	98.613
																		25	99.36	0.734	121.0	113.1	98.626
																		9	99.4	0.767	121.0	118.2	98.633
MH_118	MH_136	96.645	96.634	1950	11.0	0.1	0.013	101.290	101.190	1.507	4.50	3.26	0.7	-0.120	01:37	98.475	98.374	#N/A	#N/A	#N/A			
MH_119	MH_120	99.144	98.938	900	103.0	0.2	0.013	103.010	102.570	1.273	0.81	0.95	1.2	-0.040	01:33	100.004	99.628	101	100.65	0.646			
MH_119	MH_122	99.144	99.693	900	103.0	0.2	0.013	103.010	102.490	1.840	9.94	0.95	0.1	-0.040	01:33	100.004	99.693	#N/A	#N/A	#N/A			
MH_120	MH_121	98.878	98.850	900	14.0	0.2	0.013	102.570	102.480	1.273	0.81	1.00	1.2	-0.150	01:33	99.628	99.270	116	101.03	1.402			
MH_121	MH_132	98.790	97.536	900	114.0	1.1	0.013	102.480	101.320	2.985	1.90	1.07	0.6	-0.420	01:33	99.270	98.508	106	99.54	0.270			
																		106	99.54	0.984	114.0	7.2	98.556
																		107	99.71	1.072	114.0	19.4	98.638
																		108	99.88	1.167	114.0	30.6	98.713
																		109	100.05	1.269	114.0	40.8	98.781
																		110	100.15	1.285	114.0	53.4	98.865
																		111	100.32	1.379	114.0	64.8	98.941
																		112	100.48	1.457	114.0	77	99.023
																		113	100.57	1.472	114.0	88.2	99.098
																		114	100.57	1.404	114.0	98.4	99.166
																		115	100.65	1.415	114.0	108.8	99.235
MH_122	MH_123	99.663	99.461	300	13.0	1.6	0.013	102.490	102.270	1.705	0.12	0.00	0.0	-0.300	00:00	99.663	99.497	131	100.61	0.947			

Table C-1C: Pipe Data and Hydraulic Simulation Results for the July 1st, 1979 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL						
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)				
MH_123	MH_127	99.407	98.615	300	49.5	1.6	0.013	102.270	101.675	1.730	0.12	0.02	0.2	-0.210	01:33	99.497	99.002	135	99.89	0.393							
MH_124	MH_125	99.069	98.715	375	101.0	0.4	0.013	102.060	101.870	1.421	2.66	0.07	0.0	-0.115	01:42	99.329	99.201	72	99.77	0.441							
																						82	99.89	0.682	101.0	5.4	99.208
																						69	99.84	0.628	101.0	8.4	99.212
																						70	99.78	0.555	101.0	18.6	99.225
																						81	99.89	0.664	101.0	19.6	99.226
																						71	99.78	0.541	101.0	29.7	99.239
																						80	99.92	0.680	101.0	31	99.240
																						72	99.77	0.518	101.0	39.9	99.252
																						79	100.04	0.780	101.0	46.9	99.260
																						73	99.82	0.554	101.0	51.1	99.266
																						78	100.04	0.770	101.0	54.4	99.270
																						74	99.88	0.601	101.0	61.3	99.279
																						77	100	0.717	101.0	64.6	99.283
																						413	99.93	0.636	101.0	73.4	99.294
																						415	100.08	0.784	101.0	75.2	99.296
																						412	99.98	0.675	101.0	82.3	99.305
																						414	100.1	0.790	101.0	86.4	99.310
																						75	99.98	0.660	101.0	94	99.320
																						76	100.16	0.835	101.0	98.1	99.325
MH_125	MH_127	98.481	98.615	600	91.5	0.3	0.013	101.870	101.675	1.618	5.82	0.28	0.0	0.120	01:43	99.201	99.002	65	99.58	0.379							
																						88	99.82	0.783	91.5	16	99.037
																						63	99.59	0.552	91.5	16.6	99.038
																						87	99.82	0.753	91.5	29.7	99.067
																						64	99.59	0.522	91.5	30.3	99.068
																						86	99.65	0.559	91.5	41.1	99.091
																						65	99.58	0.483	91.5	43.9	99.097
																						85	99.74	0.617	91.5	55.5	99.123
																						66	99.69	0.561	91.5	58.6	99.129
																						84	99.76	0.603	91.5	71.3	99.157
																						67	99.78	0.616	91.5	74.4	99.164
																						83	99.89	0.702	91.5	85.7	99.188
																						68	99.84	0.645	91.5	88.8	99.195
MH_126	MH_127	98.697	98.615	300	28.5	0.4	0.013	101.500	101.675	0.865	0.06	0.16	2.5	1.050	01:36	100.047	99.002	#/A	#/A	#/A							
MH_127	MH_128	98.102	97.994	750	54.0	0.2	0.013	101.675	101.395	1.654	7.44	0.42	0.1	0.150	01:39	99.002	98.894	47	99.56	0.558							
MH_128	MH_129	97.964	97.923	750	13.5	0.3	0.013	101.395	101.315	1.389	0.61	0.42	0.7	0.180	01:39	98.894	98.858	45	99.49	0.596							
MH_129	MH_130	97.848	97.732	825	77.0	0.2	0.013	101.315	101.420	1.496	6.17	0.54	0.1	0.185	01:39	98.858	98.752	43	99.41	0.552							
MH_130	MH_131	97.732	97.581	825	100.5	0.2	0.013	101.420	101.200	1.040	0.56	0.66	1.2	0.195	01:39	98.752	98.536	33	99.18	0.428							
MH_1302	MH_302	97.470	96.430	600	98.5	0.2	0.013	101.160	101.140	0.971	0.27	0.16	0.6	0.320	02:07	98.390	98.310	Est. Fut	99.36	0.970							
MH_1303	MH_303	97.245	96.351	750	109.0	0.2	0.013	101.090	101.080	0.976	0.43	0.35	0.8	0.380	02:07	98.375	98.241	Est. Fut	99.29	0.915							
MH_1304	MH_304	97.175	96.196	600	87.0	0.2	0.013	100.660	100.730	0.971	0.27	0.18	0.6	0.360	02:09	98.135	98.036	Est. Fut	98.86	0.725							
MH_131	MH_132	97.206	97.536	1200	12.0	0.2	0.013	101.200	101.320	1.335	1.51	0.66	0.4	0.130	01:39	98.536	98.508	#/A	#/A	#/A							
MH_1312	MH_310	97.627	97.113	750	62.0	0.2	0.013	100.940	100.940	1.127	0.50	0.18	0.4	-0.440	01:50	97.937	97.853	Est. Fut	99.14	1.203							
MH_132	MH_136	97.128	96.634	1200	59.5	0.2	0.013	101.320	101.190	1.542	1.74	1.84	1.1	0.180	01:32	98.508	98.374	103	99.33	0.822							
MH_133	MH_134	97.509	97.393	1500	77.0	0.2	0.013	101.660	101.550	2.126	19.14	1.87	0.1	-0.420	01:46	98.509	98.523	#/A	#/A	#/A							
MH_134	MH_135	97.363	97.271	1500	61.0	0.2	0.013	101.550	101.440	1.554	2.75	1.93	0.7	-0.340	01:46	98.523	98.461	#/A	#/A	#/A							
MH_135	MH_136	97.121	96.634	1650	37.0	0.1	0.013	101.440	101.190	1.348	2.88	1.94	0.7	-0.310	01:45	98.461	98.374	#/A	#/A	#/A							
MH_136	MH_302	96.484	96.430	2250	54.0	0.1	0.013	101.190	101.140	1.658	6.59	7.01	1.1	-0.360	01:37	98.374	98.310	1	99.38	1.006							
MH_201	MH_202	105.214	104.138	375	119.5	0.9	0.013	108.120	107.180	1.506	0.17	0.08	0.5	-0.195	01:30	105.394	104.373	321	105.28	-0.114							
																						321	105.28	0.834	119.5	8.5	104.446
																						430	107.31	2.846	119.5	10.6	104.464
																						431	107.37	2.858	119.5	16.3	104.512
																						428	105.36	0.797	119.5	22.2	104.563
																						233	107.4	2.775	119.5	29.5	104.625
																						429	105.37	0.728	119.5	31.5	104.642
																						234	107.46	2.786	119.5	35.2	104.674
																						320	105.45	0.704	119.5	43.7	104.746

Table C-1C: Pipe Data and Hydraulic Simulation Results for the July 1st, 1979 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL														
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)												
																						235	107.5	2.719	119.5	47.7	104.781								
																							319	105.56	0.719	119.5	54.8	104.841							
																							236	107.62	2.778	119.5	54.9	104.842							
																							318	105.66	0.732	119.5	65	104.928							
																							237	107.69	2.742	119.5	67.3	104.948							
																							238	107.8	2.803	119.5	73	104.997							
																							317	105.77	0.746	119.5	76.2	105.024							
																							239	107.87	2.761	119.5	86.2	105.109							
																							316	105.9	0.772	119.5	88.4	105.128							
																							240	107.99	2.832	119.5	91.9	105.158							
																							315	106.02	0.794	119.5	99.8	105.226							
																							241	108.06	2.789	119.5	105.1	105.271							
																							242	108.16	2.840	119.5	110.8	105.320							
																							314	106.13	0.783	119.5	114	105.347							
MH_202	MH_203	104.063	104.035	450	14.0	0.2	0.013	107.180	107.090	0.802	0.13	0.11	0.9	-0.140	01:30	104.373	104.295	230	105.39	1.017															
MH_203	MH_206	103.975	103.730	450	54.5	0.5	0.013	107.090	106.720	1.203	0.19	0.17	0.9	-0.130	01:31	104.295	103.730	225	104.9	0.605															
MH_204	MH_205	103.579	103.343	525	118.0	0.2	0.013	106.620	106.610	0.888	0.19	0.14	0.7	-0.175	01:37	103.929	103.823	285	104.64	0.711															
MH_205	MH_206	103.313	103.730	525	16.0	0.2	0.013	106.610	106.720	0.888	0.19	0.20	1.1	-0.015	01:36	103.823	103.730	#N/A	#N/A	#N/A															
MH_206	MH_207	103.197	102.999	600	49.5	0.4	0.013	106.720	106.460	1.373	0.39	0.39	1.0	-0.090	01:31	103.707	103.309	221	104.52	0.813															
MH_207	MH_208	102.969	102.731	600	12.5	1.9	0.013	106.460	106.320	2.997	0.85	0.39	0.5	-0.260	01:31	103.309	102.981	219	104.39	1.081															
MH_208	MH_215	102.671	100.543	600	112.0	1.9	0.013	106.320	104.150	2.993	0.85	0.44	0.5	-0.290	01:32	102.981	101.133	212	102.46	-0.521															
																							271	102.46	1.180	112.0	8.9	101.280							
																							212	102.46	1.117	112.0	12.7	101.343							
																							270	102.67	1.156	112.0	23.1	101.514							
																							213	102.68	1.138	112.0	24.8	101.542							
																							214	102.89	1.180	112.0	35	101.711							
																							269	102.93	1.205	112.0	35.9	101.725							
																							215	103.1	1.205	112.0	46.2	101.895							
																							268	103.18	1.267	112.0	47.3	101.913							
																							216	103.36	1.263	112.0	58.4	102.097							
																							267	103.42	1.305	112.0	59.5	102.115							
																							217	103.62	1.335	112.0	69.8	102.285							
																							266	103.68	1.380	112.0	70.7	102.300							
																							423	103.94	1.472	112.0	80.9	102.468							
																							421	103.83	1.344	112.0	82	102.486							
																							422	104.04	1.389	112.0	92	102.651							
																							420	104.04	1.371	112.0	93.1	102.669							
																							265	104.35	1.506	112.0	103.7	102.844							
																							218	104.3	1.425	112.0	105.6	102.875							
MH_209	MH_201	105.833	105.316	300	94.0	0.6	0.013	108.630	108.120	1.015	0.07	0.00	0.0	-0.300	00:00	105.833	105.394	313	106.24	0.407															
MH_209	MH_210	105.833	105.518	300	94.0	0.6	0.013	108.630	108.320	1.015	0.07	0.00	0.0	-0.300	00:00	105.833	105.586	254	108.31	2.477															
MH_210	MH_212	105.486	103.434	300	54.0	3.8	0.013	108.320	107.010	2.668	0.19	0.05	0.3	-0.200	01:30	105.586	103.569	258	105.12	-0.466															
																							258	105.12	0.965	54.0	15.7	104.155							
																							257	105.54	0.948	54.0	27.4	104.592							
																							256	106.05	1.035	54.0	38.7	105.015							
																							255	106.58	1.188	54.0	48.8	105.392							
MH_211	MH_212	103.900	103.434	300	26.5	0.4	0.013	106.090	107.010	0.810	0.06	0.02	0.3	-0.160	01:30	104.040	103.569	#N/A	#N/A	#N/A															
MH_212	MH_204	103.359	103.804	375	49.5	0.5	0.013	107.010	106.620	1.066	0.12	0.07	0.6	-0.165	01:31	103.569	103.929	284	104.71	1.141															
MH_212	MH_213	103.359	103.136	375	49.5	0.5	0.013	107.010	106.020	1.066	0.12	0.07	0.6	-0.165	01:31	103.569	103.233	203	104.1	0.531															
MH_213	MH_214	103.053	102.918	375	13.5	1.0	0.013	106.020	105.800	1.587	0.18	0.07	0.4	-0.195	01:31	103.233	103.053	204	104.02	0.787															
MH_214	MH_215	102.883	100.543	375	90.0	2.4	0.013	105.800	104.150	2.434	0.27	0.10	0.4	-0.205	01:30	103.053	101.133	272	102.37	-0.683															
																							272	102.37	1.079	90.0	7.4	101.291							
																							211	102.46	0.990	90.0	15.8	101.470							
																							273	102.59	0.996	90.0	21.6	101.594							
																							210	102.68	0.950	90.0	28	101.730							
																							274	102.86	0.942	90.0	36.8	101.918							
																							209	102.89	0.942	90.0	38.2	101.948							

Table C-1C: Pipe Data and Hydraulic Simulation Results for the July 1st, 1979 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL							
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)					
																			275	103.11	0.949	90.0	48.2	102.161				
																			208	103.15	0.963	90.0	49.4	102.187				
																			276	103.37	0.948	90.0	60.4	102.422				
																			207	103.4	0.910	90.0	63.6	102.490				
																			277	103.55	0.968	90.0	67.9	102.582				
																			206	103.66	0.927	90.0	75	102.733				
																			278	103.55	0.631	90.0	83.7	102.919				
																			205	103.83	0.873	90.0	85.5	102.957				
MH_215	MH_119	100.303	99.423	675	55.0	1.6	0.013	104.150	103.010	2.971	1.06	0.91	0.9	0.155	01:32	101.133	100.004	#N/A	#N/A	#N/A								
MH_216	MH_217	105.251	104.798	375	75.5	0.6	0.013	108.100	107.980	1.230	0.14	0.11	0.8	-0.115	01:40	105.511	105.073	346	105.85	0.339								
MH_217	MH_218	104.573	104.347	600	113.0	0.2	0.013	107.980	107.690	0.971	0.27	0.26	0.9	-0.100	01:43	105.073	104.907	356	105.71	0.637								
MH_218	MH_220	104.327	104.166	600	80.5	0.2	0.013	107.690	107.790	0.971	0.27	0.29	1.1	-0.020	01:31	104.907	104.166	357	105.75	0.843								
MH_219	MH_220	105.649	104.166	300	25.0	2.7	0.013	108.450	107.790	2.228	0.16	0.00	0.0	-0.300	00:00	105.649	104.166	#N/A	#N/A	#N/A								
MH_220	MH_224	103.644	102.523	600	59.0	1.9	0.013	107.790	105.620	2.993	0.85	0.29	0.3	-0.360	01:31	103.884	102.523	259	104.74	0.856								
MH_221	MH_222	103.008	102.620	300	77.5	0.5	0.013	105.960	105.420	0.968	0.07	0.01	0.1	-0.240	01:30	103.068	102.801	396-1	103.56	0.492								
MH_222	MH_223	102.311	102.168	600	95.5	0.2	0.013	105.420	105.450	0.841	0.24	0.22	0.9	-0.110	01:40	102.801	102.698	366-1	103.37	0.569								
MH_2	MH_2260	101.916	101.876	675	10.0	0.4	0.013	105.290	105.290	1.486	0.53	0.38	0.7	-0.085	01:20	102.506	102.116	Est. Fut	103.49	0.984								
MH_223	MH_224	102.148	102.523	600	97.0	0.2	0.013	105.450	105.620	0.971	0.27	0.27	1.0	-0.050	01:41	102.698	102.523	365-1	103.42	0.722								
MH_224	MH_105	101.625	100.067	600	82.0	1.9	0.013	105.620	103.170	2.993	0.85	0.64	0.8	-0.210	01:31	102.015	100.067	141	101.9	-0.115								
																			141	101.9	1.562	82.0	11.4	100.338				
																			140	102.18	1.505	82.0	25.6	100.675				
																			139	102.55	1.606	82.0	36.9	100.944				
																			138	102.92	1.734	82.0	47.1	101.186				
																			137	103.3	1.850	82.0	58.2	101.450				
																			136	103.81	2.037	82.0	71.8	101.773				
MH_225	MH_226	103.412	102.914	300	99.5	0.5	0.013	106.390	105.720	0.968	0.07	0.03	0.4	-0.170	01:30	103.542	103.023	388-3	103.75	0.208								
																			389-2	103.75	0.697	99.5	5.8	103.053				
																			389-1	103.75	0.640	82.0	13.8	103.110				
																			388-3	103.75	0.573	82.0	24.4	103.177				
																			388-2	103.88	0.654	82.0	32.1	103.226				
																			388-1	103.88	0.603	82.0	40.1	103.277				
																			387-4	104.02	0.676	82.0	50.7	103.344				
																			387-3	104.02	0.625	82.0	58.7	103.395				
																			387-2	104.02	0.580	82.0	65.9	103.440				
																			387-1	104.02	0.529	82.0	73.9	103.491				
MH_2260	MH_227	101.816	101.049	675	49.5	1.6	0.013	105.290	104.230	2.925	1.05	0.44	0.4	-0.375	01:30	102.116	101.099	392-1	102.46	0.344								
MH_226	MH_2260	102.863	101.876	300	64.0	1.1	0.013	105.720	105.290	1.402	0.10	0.05	0.5	-0.140	01:30	103.023	102.116	391-3	103.08	0.057								
																			391-2	103.08	0.931	64.0	2.3	102.149				
																			391-1	103.45	1.198	64.0	9.6	102.252				
																			390-3	103.58	1.064	64.0	17.6	102.365				
																			390-2	103.58	0.951	64.0	28.2	102.516				
																			390-1	103.58	0.843	64.0	36.2	102.629				
																			389-4	103.75	0.862	64.0	43.8	102.737				
																			389-3	103.75	0.748	64.0	54.5	102.888				
																			389-2	103.75	0.625	64.0	62.5	103.002				
MH_227	MH_109	100.759	99.306	675	93.0	1.6	0.013	104.230	102.650	2.971	1.06	0.48	0.5	-0.335	01:30	101.099	99.661	394-3	100.86	-0.239								
																			394-4	100.86	0.902	93.0	19.2	99.958				
																			394-3	100.86	0.778	93.0	27.2	100.082				
																			394-2	101.26	1.066	93.0	34.5	100.194				
																			394-1	101.26	0.942	93.0	42.5	100.318				
																			393-3	101.49	0.992	93.0	51.1	100.498				
																			393-2	101.81	1.195	93.0	61.7	100.615				
																			393-1	101.81	1.071	93.0	69.7	100.739				
																			392-4	102.21	1.290	93.0	81.4	100.920				
																			392-3	102.21	1.167	93.0	89.4	101.043				
MH_228	MH_229	102.472	100.982	300	74.5	2.0	0.013	105.270	103.790	1.935	0.14	0.05	0.4	-0.170	01:30	102.602	101.053	384-3	102.12	-0.482								
																			384-2	102.12	1.017	74.5	2.4	101.103				

Table C-1C: Pipe Data and Hydraulic Simulation Results for the July 1st, 1979 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL							
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)					
																						379-2	102.14	1.016	74.5	3.4	101.124	
																						384-4	102.12	0.851	74.5	10.4	101.269	
																						379-1	102.14	0.850	74.5	11.4	101.290	
																						385-1	102.35	0.860	74.5	21	101.490	
																						378-3	102.57	1.060	74.5	22	101.510	
																						385-2	102.65	1.002	74.5	28.6	101.648	
																						378-2	102.67	0.999	74.5	29.7	101.671	
																						385-3	102.65	0.836	74.5	36.6	101.814	
																						378-1	102.67	0.833	74.5	37.7	101.837	
																						386-1	102.73	0.694	74.5	47.3	102.036	
																						377-4	103.02	0.963	74.5	48.3	102.057	
																						386-2	103.08	0.877	74.5	55.3	102.203	
																						377-3	103.28	1.056	74.5	56.3	102.224	
																						377-2	103.34	0.967	74.5	63.5	102.373	
																						377-1	103.34	0.800	74.5	71.5	102.540	
MH_229	MH_102	100.723	100.142	525	86.5	0.9	0.013	103.790	103.240	1.832	0.40	0.24	0.6	-0.195	01:30	101.053	100.177					381-1	101.35	0.297				
																							382-1	101.52	1.204	86.5	13.7	100.316
																							381-4	101.35	1.024	86.5	14.7	100.326
																							382-2	101.52	1.123	86.5	21.7	100.397
																							381-3	101.35	0.943	86.5	22.7	100.407
																							382-3	101.52	1.050	86.5	28.9	100.470
																							381-2	101.35	0.869	86.5	30	100.481
																							382-4	101.52	0.969	86.5	36.9	100.551
																							381-1	101.35	0.788	86.5	38	100.562
																							383-1	101.62	0.961	86.5	47.6	100.659
																							380-3	101.59	0.921	86.5	48.6	100.669
																							383-2	101.62	0.880	86.5	55.6	100.740
																							380-2	101.59	0.840	86.5	56.6	100.750
																							383-3	101.62	0.803	86.5	63.2	100.817
																							380-1	101.59	0.763	86.5	64.2	100.827
																							384-1	101.95	1.026	86.5	73.8	100.924
																							379-4	101.96	1.024	86.5	74.9	100.936
																							384-2	101.95	0.945	86.5	81.8	101.005
																							379-3	101.96	0.943	86.5	82.9	101.017
MH_230	MH_231	102.417	100.947	300	73.5	2.0	0.013	105.220	103.750	1.935	0.14	0.04	0.3	-0.190	01:30	102.527	100.962					374-3	102.03	-0.497				
																							374-3	102.03	1.015	73.5	2.5	101.015
																							388-3	102.24	1.172	73.5	5	101.068
																							374-4	102.03	0.844	73.5	10.5	101.186
																							368-2	102.24	1.001	73.5	13	101.239
																							368-1	102.24	0.839	73.5	20.6	101.401
																							375-1	102.4	0.987	73.5	21.2	101.413
																							375-2	102.57	0.995	73.5	28.8	101.575
																							367-3	102.71	1.082	73.5	31.3	101.628
																							375-3	102.57	0.824	73.5	36.8	101.746
																							367-2	102.71	0.911	73.5	39.3	101.799
																							367-1	102.71	0.749	73.5	46.9	101.961
																							376-1	103	1.029	73.5	47.4	101.971
																							376-2	103	0.858	73.5	55.4	102.142
																							376-3	103.37	1.073	73.5	62.7	102.297
																							376-4	103.37	0.903	73.5	70.7	102.467
MH_231	MH_103	100.722	99.002	525	87.0	2.0	0.013	103.750	102.350	2.810	0.61	0.24	0.4	-0.285	01:30	100.962	99.295					371-1	100.56	-0.402				
																							371-3	100.56	1.016	87.0	13	99.544
																							372-1	100.95	1.389	87.0	13.9	99.561
																							371-2	100.56	0.863	87.0	21	99.697
																							372-2	100.95	1.235	87.0	21.9	99.715
																							371-1	100.56	0.717	87.0	28.6	99.843
																							372-3	100.95	1.096	87.0	29.2	99.854

Table C-1D: Pipe Data and Hydraulic Simulation Results for the August 4th, 1988 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL			
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)	
MH_401	POND	96.000	99.800	2250	10.0	0.5	0.013	100.350	#N/A	3.706	14.74	5.05	0.3	-1.270	02:03	96.980	96.730	#N/A	#N/A	#N/A				
MH_501	POND	96.000	99.800	2250	10.0	0.5	0.013	100.350	#N/A	3.706	14.74	4.37	0.3	-1.270	02:03	96.980	96.730	#N/A	#N/A	#N/A				
MH_1002	MH_1003	94.150	93.982	900	28.0	0.6	0.013	98.370	98.040	2.204	1.40	1.29	0.9	0.170	02:32	95.220	94.602	#N/A	#N/A	#N/A				
MH_1003	MH_1004	93.922	93.271	900	108.5	0.6	0.013	98.040	96.170	3.188	17.21	1.29	0.1	-0.220	02:33	94.602	93.326	#N/A	#N/A	#N/A				
MH_1004	MH_1005	92.586	92.162	975	106.0	0.4	0.013	96.170	95.150	1.898	1.42	1.29	0.9	-0.235	02:33	93.326	92.943	#N/A	#N/A	#N/A				
MH_1005	MH_1006	91.933	91.721	1200	106.0	0.2	0.013	95.150	94.970	1.542	1.74	1.29	0.7	-0.190	02:34	92.943	92.841	#N/A	#N/A	#N/A				
MH_1006	MH_1007	91.701	91.489	1200	106.0	0.2	0.013	94.970	94.270	1.542	1.74	1.29	0.7	-0.060	02:35	92.841	92.740	#N/A	#N/A	#N/A				
MH_1007	MH_1008	91.470	91.230	1200	88.0	0.3	0.013	94.270	93.460	1.801	2.04	1.56	0.8	0.070	00:00	92.740	92.580	#N/A	#N/A	#N/A				
MH_1008	MH_1009	91.230	91.200	1200	14.5	0.2	0.013	93.460	#N/A	1.568	1.77	1.58	0.9	0.150	00:01	92.580	92.500	#N/A	#N/A	#N/A				
MH_101	MH_102	100.935	100.142	300	30.5	2.6	0.013	103.750	103.240	2.206	0.16	0.00	0.0	-0.300	00:00	100.935	100.177	174-2	101.41	0.475				
MH_102	MH_103	99.917	99.002	525	59.0	1.6	0.013	103.240	102.350	2.474	0.54	0.27	0.5	-0.265	02:01	100.177	99.285	172-5	100.47	0.293				
																			172-5	100.47	1.081	59.0	6.9	99.389
																			173-1	100.78	1.221	59.0	18.1	99.559
																			173-2	100.78	1.100	59.0	26.1	99.680
																			173-3	101.1	1.312	59.0	33.3	99.788
																			173-4	101.1	1.191	59.0	41.3	99.909
																			173-5	101.1	1.076	59.0	48.9	100.024
																			174-1	101.41	1.274	59.0	56.3	100.138
MH_103	MH_104	98.755	98.516	750	120.0	0.4	0.013	102.350	101.590	1.594	0.70	0.57	0.8	-0.220	02:01	99.285	99.065	169-2	99.81	0.525				
																			169-2	99.81	0.740	120.0	2.7	99.070
																			169-3	99.81	0.727	120.0	10	99.083
																			169-4	99.81	0.712	120.0	18	99.098
																			170-1	99.93	0.813	120.0	28.6	99.117
																			170-2	99.93	0.798	120.0	36.6	99.132
																			170-3	99.93	0.784	120.0	44.2	99.146
																			171-1	99.99	0.824	120.0	54.9	99.166
																			171-2	99.99	0.810	120.0	62.9	99.180
																			171-3	99.99	0.796	120.0	70.1	99.194
																			171-4	99.99	0.782	120.0	78.1	99.208
																			172-1	100.47	1.229	120.0	96.1	99.241
																			172-2	100.47	1.214	120.0	104.1	99.256
																			172-3	100.47	1.201	120.0	111.3	99.269
																			172-4	100.47	1.191	120.0	117	99.280
MH_104	MH_106	97.975	97.913	1050	41.5	0.1	0.013	101.590	101.840	1.217	1.05	0.90	0.9	0.040	02:02	99.065	98.965	169-1	99.81	0.745				
MH_105	MH_106	99.562	97.913	675	91.0	1.4	0.013	103.170	101.840	4.109	16.64	0.72	0.0	-0.245	02:00	99.992	98.965	148	100.03	0.038				
																			148	100.03	0.923	91.0	12.6	99.107
																			147	100.16	0.915	91.0	24.8	99.245
																			146	100.3	0.940	91.0	35	99.360
																			145	100.42	0.934	91.0	46.2	99.486
																			144	100.56	0.913	91.0	60.4	99.647
																			143	100.93	1.128	91.0	74.2	99.802
																			142	101.5	1.532	91.0	88.9	99.968
MH_106	MH_116	97.605	97.360	1350	122.5	0.2	0.013	101.840	101.580	1.668	2.39	1.69	0.7	0.010	02:02	98.965	98.770	166-1	99.53	0.565				
MH_107	MH_108	99.165	99.080	300	74.0	0.4	0.013	101.895	101.880	0.809	0.06	0.02	0.3	-0.185	02:04	99.280	99.318	176-1	100.1	0.820				
MH_107	MH_112	99.165	98.906	300	74.0	0.4	0.013	101.895	101.695	0.809	0.06	0.02	0.3	-0.185	02:04	99.280	99.191	185-1	99.89	0.610				
MH_108	MH_110	98.908	98.800	450	54.0	0.2	0.013	101.880	101.980	0.802	0.13	0.09	0.7	-0.040	02:00	99.318	99.286	175-1	100.15	0.832				
MH_109	MH_110	99.151	98.800	750	60.0	0.7	0.013	102.650	101.980	2.108	0.93	0.77	0.8	-0.230	02:00	99.671	99.286	164-2	100.01	0.339				
																			164-2	100.01	0.716	60.0	1.2	99.294
																			164-3	100.25	0.921	60.0	6.7	99.329
																			164-4	100.25	0.870	60.0	14.7	99.380
																			165-1	100.42	0.972	60.0	25.3	99.448
																			165-2	100.93	1.433	60.0	32.9	99.497
																			165-3	100.93	1.382	60.0	40.9	99.548
MH_110	MH_111	98.346	98.046	900	75.0	0.4	0.013	101.980	101.770	1.800	1.14	0.99	0.9	0.040	01:59	99.286	99.075	162-1	99.69	0.404				
																			188-4	99.86	0.779	75.0	2	99.081
																			162-1	99.69	0.597	75.0	6.3	99.093
																			188-3	99.86	0.759	75.0	9.2	99.101

Table C-1D: Pipe Data and Hydraulic Simulation Results for the August 4th, 1988 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL						
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)				
																						162-2	99.69	0.575	75.0	14.3	99.115
																						188-2	99.86	0.737	75.0	17.2	99.123
																						162-3	99.69	0.554	75.0	21.6	99.136
																						188-1	99.86	0.715	75.0	24.8	99.145
																						162-4	99.69	0.526	75.0	31.6	99.164
																						187-4	99.86	0.685	75.0	35.5	99.175
																						163-1	99.77	0.582	75.0	40.2	99.188
																						187-3	99.86	0.663	75.0	43.5	99.197
																						163-2	99.77	0.561	75.0	47.8	99.209
																						187-2	99.86	0.642	75.0	50.7	99.218
																						163-3	99.77	0.538	75.0	55.8	99.232
																						187-1	99.86	0.620	75.0	58.7	99.240
																						164-1	100.01	0.748	75.0	66.5	99.262
																						MH_111	MH_115	97.925	97.743	975	91.0
MH_112	MH_113	98.756	98.609	450	73.5	0.2	0.013	101.695	101.525	0.802	0.13	0.13	1.1	-0.015	02:05	99.191	99.044	183-1	99.74	0.549							
MH_113	MH_114	98.549	98.523	450	13.0	0.2	0.013	101.525	101.520	0.802	0.13	0.16	1.2	0.045	02:06	99.044	98.996	181-1	99.85	0.806							
MH_1	MH_133	97.607	97.569	1500	19.0	0.2	0.013	101.660	101.660	1.789	3.16	1.80	0.6	-0.360	02:09	98.747	98.579	Est. Fut	99.86	1.113							
MH_114	MH_115	98.296	97.743	675	54.0	0.4	0.013	101.520	101.450	1.486	0.53	0.28	0.5	0.025	02:05	98.996	98.906	182-1	99.58	0.584							
MH_115	MH_116	97.656	97.360	1050	59.0	0.5	0.013	101.450	101.580	2.230	1.93	1.33	0.7	0.200	02:01	98.906	98.770	157-1	99.46	0.554							
MH_116	MH_117	97.060	96.937	1650	122.5	0.1	0.013	101.580	101.370	1.348	2.88	3.12	1.1	0.060	02:02	98.770	98.617	30	99.32	0.550							
MH_117	MH_118	96.917	96.796	1650	121.0	0.1	0.013	101.370	101.290	1.348	2.88	3.26	1.1	0.050	02:02	98.617	98.455	20	99.11	0.493							
																						18	99.18	0.719	121.0	4.4	98.461
																						2	99.16	0.695	121.0	7.7	98.465
																						406	99.18	0.703	121.0	16.1	98.477
																						404	99.18	0.698	121.0	20.3	98.482
																						407	99.16	0.671	121.0	25.7	98.489
																						405	99.18	0.684	121.0	30.5	98.496
																						19	99.16	0.654	121.0	37.9	98.506
																						3	99.14	0.631	121.0	40.7	98.509
																						20	99.11	0.591	121.0	48.1	98.519
																						4	99.14	0.616	121.0	51.2	98.524
																						21	99.12	0.586	121.0	59.3	98.534
																						5	99.22	0.682	121.0	62.1	98.538
																						22	99.21	0.659	121.0	71.5	98.551
																						6	99.23	0.677	121.0	73.3	98.553
23	99.22	0.654	121.0	82.9	98.566																						
7	99.24	0.667	121.0	87.8	98.573																						
24	99.28	0.695	121.0	97.3	98.585																						
8	99.31	0.717	121.0	102.8	98.593																						
25	99.36	0.754	121.0	113.1	98.606																						
9	99.4	0.787	121.0	118.2	98.613																						
MH_118	MH_136	96.645	96.634	1950	11.0	0.1	0.013	101.290	101.190	1.507	4.50	3.25	0.7	-0.140	02:02	98.455	98.364	#N/A	#N/A	#N/A							
MH_119	MH_120	99.144	98.938	900	103.0	0.2	0.013	103.010	102.570	1.273	0.81	0.99	1.2	-0.010	02:02	100.034	99.638	101	100.65	0.616							
MH_119	MH_122	99.144	99.693	900	103.0	0.2	0.013	103.010	102.490	1.840	9.94	0.99	0.1	-0.010	02:02	100.034	99.693	#N/A	#N/A	#N/A							
MH_120	MH_121	98.878	98.850	900	14.0	0.2	0.013	102.570	102.480	1.273	0.81	1.03	1.3	-0.140	02:02	99.638	99.280	116	101.03	1.392							
MH_121	MH_132	98.790	97.536	900	114.0	1.1	0.013	102.480	101.320	2.985	1.90	1.10	0.6	-0.410	02:02	99.280	98.498	106	99.54	0.260							
																						106	99.54	0.993	114.0	7.2	98.547
																						107	99.71	1.079	114.0	19.4	98.631
																						108	99.88	1.172	114.0	30.6	98.708
																						109	100.05	1.272	114.0	40.8	98.778
																						110	100.15	1.286	114.0	53.4	98.864
																						111	100.32	1.377	114.0	64.8	98.943
																						112	100.48	1.454	114.0	77	99.026
																						113	100.57	1.467	114.0	88.2	99.103
																						114	100.57	1.397	114.0	98.4	99.173
																						115	100.65	1.406	114.0	108.8	99.244
MH_122	MH_123	99.663	99.461	300	13.0	1.6	0.013	102.490	102.270	1.705	0.12	0.00	0.0	-0.300	00:00	99.663	99.497	131	100.61	0.947							

Table C-1D: Pipe Data and Hydraulic Simulation Results for the August 4th, 1988 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL					
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)			
MH_123	MH_127	99.407	98.615	300	49.5	1.6	0.013	102.270	101.675	1.730	0.12	0.02	0.2	-0.210	02:02	99.497	98.992	135	99.89	0.393						
MH_124	MH_125	99.069	98.715	375	101.0	0.4	0.013	102.060	101.870	1.421	2.66	0.07	0.0	-0.125	02:06	99.319	99.191	72	99.77	0.451						
																					82	99.89	0.692	101.0	5.4	99.198
																					69	99.84	0.638	101.0	8.4	99.202
																					70	99.78	0.565	101.0	18.6	99.215
																					81	99.89	0.674	101.0	19.6	99.216
																					71	99.78	0.551	101.0	29.7	99.229
																					80	99.92	0.690	101.0	31	99.230
																					72	99.77	0.528	101.0	39.9	99.242
																					79	100.04	0.790	101.0	46.9	99.250
																					73	99.82	0.564	101.0	51.1	99.256
																					78	100.04	0.780	101.0	54.4	99.260
																					74	99.88	0.611	101.0	61.3	99.269
																					77	100	0.727	101.0	64.6	99.273
																					413	99.93	0.646	101.0	73.4	99.284
																					415	100.08	0.794	101.0	75.2	99.286
																					412	99.98	0.685	101.0	82.3	99.295
																					414	100.1	0.800	101.0	86.4	99.300
																					75	99.98	0.670	101.0	94	99.310
																					76	100.16	0.845	101.0	98.1	99.315
MH_125	MH_127	98.481	98.615	600	91.5	0.3	0.013	101.870	101.675	1.618	5.82	0.28	0.0	0.110	02:08	99.191	98.992	65	99.58	0.389						
																					88	99.82	0.793	91.5	16	99.027
																					63	99.59	0.562	91.5	16.6	99.028
																					87	99.82	0.763	91.5	29.7	99.057
																					64	99.59	0.532	91.5	30.3	99.058
																					86	99.65	0.569	91.5	41.1	99.081
																					65	99.58	0.493	91.5	43.9	99.087
																					85	99.74	0.627	91.5	55.5	99.113
																					66	99.69	0.571	91.5	58.6	99.119
																					84	99.76	0.613	91.5	71.3	99.147
																					67	99.78	0.626	91.5	74.4	99.154
																					83	99.89	0.712	91.5	85.7	99.178
																					68	99.84	0.655	91.5	88.8	99.185
MH_126	MH_127	98.697	98.615	300	28.5	0.4	0.013	101.500	101.675	0.865	0.06	0.16	2.6	1.070	02:02	100.067	98.992	#/A	#/A	#/A						
MH_127	MH_128	98.102	97.994	750	54.0	0.2	0.013	101.675	101.395	1.654	7.44	0.43	0.1	0.140	02:04	98.992	98.894	47	99.56	0.568						
MH_128	MH_129	97.964	97.923	750	13.5	0.3	0.013	101.395	101.315	1.389	0.61	0.43	0.7	0.180	02:04	98.894	98.848	45	99.49	0.596						
MH_129	MH_130	97.848	97.732	825	77.0	0.2	0.013	101.315	101.420	1.496	6.17	0.54	0.1	0.175	02:04	98.848	98.732	43	99.41	0.562						
MH_130	MH_131	97.732	97.581	825	100.5	0.2	0.013	101.420	101.200	1.040	0.56	0.66	1.2	0.175	02:04	98.732	98.516	33	99.18	0.448						
MH_1302	MH_302	97.470	96.430	600	98.5	0.2	0.013	101.160	101.140	0.971	0.27	0.15	0.6	0.300	01:30	98.370	98.300	Est. Fut	99.36	0.990						
MH_1303	MH_303	97.245	96.351	750	109.0	0.2	0.013	101.090	101.080	0.976	0.43	0.36	0.8	0.370	02:18	98.365	98.221	Est. Fut	99.29	0.925						
MH_1304	MH_304	97.175	96.196	600	87.0	0.2	0.013	100.660	100.730	0.971	0.27	0.19	0.7	0.340	01:30	98.115	98.026	Est. Fut	98.86	0.745						
MH_131	MH_132	97.206	97.536	1200	12.0	0.2	0.013	101.200	101.320	1.335	1.51	0.66	0.4	0.110	02:04	98.516	98.498	#/A	#/A	#/A						
MH_1312	MH_310	97.627	97.113	750	62.0	0.2	0.013	100.940	100.940	1.127	0.50	0.18	0.4	-0.440	02:07	97.937	97.843	Est. Fut	99.14	1.203						
MH_132	MH_136	97.128	96.634	1200	59.5	0.2	0.013	101.320	101.190	1.542	1.74	1.87	1.1	0.170	02:02	98.498	98.364	103	99.33	0.832						
MH_133	MH_134	97.509	97.393	1500	77.0	0.2	0.013	101.660	101.550	2.126	19.14	1.88	0.1	-0.430	02:09	98.579	98.513	#/A	#/A	#/A						
MH_134	MH_135	97.363	97.271	1500	61.0	0.2	0.013	101.550	101.440	1.554	2.75	1.95	0.7	-0.350	02:09	98.513	98.451	#/A	#/A	#/A						
MH_135	MH_136	97.121	96.634	1650	37.0	0.1	0.013	101.440	101.190	1.348	2.88	1.97	0.7	-0.320	02:09	98.451	98.364	#/A	#/A	#/A						
MH_136	MH_302	96.484	96.430	2250	54.0	0.1	0.013	101.190	101.140	1.658	6.59	6.99	1.1	-0.370	02:03	98.364	98.300	1	99.38	1.016						
MH_201	MH_202	105.214	104.138	375	119.5	0.9	0.013	108.120	107.180	1.506	0.17	0.10	0.6	-0.175	02:00	105.414	104.413	321	105.28	-0.134						
																					321	105.28	0.796	119.5	8.5	104.484
																					430	107.31	2.808	119.5	10.6	104.502
																					431	107.37	2.820	119.5	16.3	104.550
																					428	105.36	0.761	119.5	22.2	104.599
																					233	107.4	2.740	119.5	29.5	104.660
																					429	105.37	0.693	119.5	31.5	104.677
																					234	107.46	2.752	119.5	35.2	104.708
																					320	105.45	0.671	119.5	43.7	104.779

Table C-1D: Pipe Data and Hydraulic Simulation Results for the August 4th, 1988 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m ³ /s)	Peak Pipe Flow (m ³ /s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL						
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)				
																						235	107.5	2.687	119.5	47.7	104.813
																						319	105.56	0.688	119.5	54.8	104.872
																						236	107.62	2.747	119.5	54.9	104.873
																						318	105.66	0.703	119.5	65	104.957
																						237	107.69	2.713	119.5	67.3	104.977
																						238	107.8	2.776	119.5	73	105.024
																						317	105.77	0.719	119.5	76.2	105.051
																						239	107.87	2.735	119.5	86.2	105.135
																						316	105.9	0.747	119.5	88.4	105.153
																						240	107.99	2.807	119.5	91.9	105.183
																						315	106.02	0.771	119.5	99.8	105.249
																						241	108.06	2.767	119.5	105.1	105.293
																						242	108.16	2.819	119.5	110.8	105.341
																						314	106.13	0.762	119.5	114	105.368
MH_202	MH_203	104.063	104.035	450	14.0	0.2	0.013	107.180	107.090	0.802	0.13	0.13	1.0	-0.100	02:00	104.413	104.345	230	105.39	0.977							
MH_203	MH_206	103.975	103.730	450	54.5	0.5	0.013	107.090	106.720	1.203	0.19	0.20	1.0	-0.080	02:01	104.345	103.737	225	104.9	0.555							
MH_204	MH_205	103.579	103.343	525	118.0	0.2	0.013	106.620	106.610	0.888	0.19	0.14	0.7	-0.165	02:05	103.939	103.833	285	104.64	0.701							
MH_205	MH_206	103.313	103.730	525	16.0	0.2	0.013	106.610	106.720	0.888	0.19	0.21	1.1	-0.005	02:04	103.833	103.737	#N/A	#N/A	#N/A							
MH_206	MH_207	103.197	102.999	600	49.5	0.4	0.013	106.720	106.460	1.373	0.39	0.41	1.1	-0.060	02:01	103.737	103.319	221	104.52	0.783							
MH_207	MH_208	102.969	102.731	600	12.5	1.9	0.013	106.460	106.320	2.997	0.85	0.41	0.5	-0.250	02:01	103.319	102.991	219	104.39	1.071							
MH_208	MH_215	102.671	100.543	600	112.0	1.9	0.013	106.320	104.150	2.993	0.85	0.47	0.6	-0.280	02:01	102.991	101.193	212	102.46	-0.531							
																						271	102.46	1.124	112.0	8.9	101.336
																						212	102.46	1.063	112.0	12.7	101.397
																						270	102.67	1.106	112.0	23.1	101.564
																						213	102.68	1.089	112.0	24.8	101.591
																						214	102.89	1.135	112.0	35	101.755
																						269	102.93	1.161	112.0	35.9	101.769
																						215	103.1	1.165	112.0	46.2	101.935
																						268	103.18	1.228	112.0	47.3	101.952
																						216	103.36	1.229	112.0	58.4	102.131
																						267	103.42	1.272	112.0	59.5	102.148
																						217	103.62	1.306	112.0	69.8	102.314
																						266	103.68	1.352	112.0	70.7	102.328
																						423	103.94	1.448	112.0	80.9	102.492
																						421	103.83	1.321	112.0	82	102.509
																						422	104.04	1.370	112.0	92	102.670
																						420	104.04	1.352	112.0	93.1	102.688
																						265	104.35	1.492	112.0	103.7	102.858
																						218	104.3	1.412	112.0	105.6	102.888
MH_209	MH_201	105.833	105.316	300	94.0	0.6	0.013	108.630	108.120	1.015	0.07	0.00	0.0	-0.300	00:00	105.833	105.414	313	106.24	0.407							
MH_209	MH_210	105.833	105.518	300	94.0	0.6	0.013	108.630	108.320	1.015	0.07	0.00	0.0	-0.300	00:00	105.833	105.586	254	108.31	2.477							
MH_210	MH_212	105.486	103.434	300	54.0	3.8	0.013	108.320	107.010	2.668	0.19	0.05	0.3	-0.200	02:00	105.586	103.569	258	105.12	-0.466							
																						258	105.12	0.965	54.0	15.7	104.155
																						257	105.54	0.948	54.0	27.4	104.592
																						256	106.05	1.035	54.0	38.7	105.015
																						255	106.58	1.188	54.0	48.8	105.392
MH_211	MH_212	103.900	103.434	300	26.5	0.4	0.013	106.090	107.010	0.810	0.06	0.02	0.3	-0.160	02:00	104.040	103.569	#N/A	#N/A	#N/A							
MH_212	MH_204	103.359	103.804	375	49.5	0.5	0.013	107.010	106.620	1.066	0.12	0.07	0.6	-0.165	02:01	103.569	103.939	284	104.71	1.141							
MH_212	MH_213	103.359	103.136	375	49.5	0.5	0.013	107.010	106.020	1.066	0.12	0.07	0.6	-0.165	02:01	103.569	103.233	203	104.1	0.531							
MH_213	MH_214	103.053	102.918	375	13.5	1.0	0.013	106.020	105.800	1.587	0.18	0.07	0.4	-0.195	02:01	103.233	103.053	204	104.02	0.787							
MH_214	MH_215	102.883	100.543	375	90.0	2.4	0.013	105.800	104.150	2.434	0.27	0.11	0.4	-0.205	02:00	103.053	101.193	272	102.37	-0.693							
																						272	102.37	1.024	90.0	7.4	101.346
																						211	102.46	0.940	90.0	15.8	101.520
																						273	102.59	0.951	90.0	21.6	101.639
																						210	102.68	0.908	90.0	28	101.772
																						274	102.86	0.906	90.0	36.8	101.954
																						209	102.89	0.908	90.0	38.2	101.982

Table C-1D: Pipe Data and Hydraulic Simulation Results for the August 4th, 1988 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL																								
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)																						
																						275	103.11	0.921	90.0	48.2	102.189																		
																						208	103.15	0.936	90.0	49.4	102.214																		
																						276	103.37	0.929	90.0	60.4	102.441																		
																						207	103.4	0.893	90.0	63.6	102.507																		
																						277	103.55	0.954	90.0	67.9	102.596																		
																						206	103.66	0.917	90.0	75	102.743																		
																						278	103.55	0.627	90.0	83.7	102.923																		
																						205	103.83	0.870	90.0	85.5	102.960																		
																						MH_215	MH_119	100.303	99.423	675	55.0	1.6	0.013	104.150	103.010	2.971	1.06	0.95	0.9	0.215	02:01	101.193	100.034	#N/A	#N/A	#N/A			
																						MH_216	MH_217	105.251	104.798	375	75.5	0.6	0.013	108.100	107.980	1.230	0.14	0.11	0.8	-0.115	02:02	105.511	105.073	346	105.85	0.339			
MH_217	MH_218	104.573	104.347	600	113.0	0.2	0.013	107.980	107.690	0.971	0.27	0.26	0.9	-0.100	02:05	105.073	104.907	356	105.71	0.637																									
MH_218	MH_220	104.327	104.166	600	80.5	0.2	0.013	107.690	107.790	0.971	0.27	0.29	1.1	-0.020	02:03	104.907	104.166	357	105.75	0.843																									
MH_219	MH_220	105.649	104.166	300	25.0	2.7	0.013	108.450	107.790	2.228	0.16	0.00	0.0	-0.300	00:00	105.649	104.166	#N/A	#N/A	#N/A																									
MH_220	MH_224	103.644	102.523	600	59.0	1.9	0.013	107.790	105.620	2.993	0.85	0.29	0.3	-0.360	02:00	103.884	102.523	259	104.74	0.856																									
MH_221	MH_222	103.008	102.620	300	77.5	0.5	0.013	105.960	105.420	0.968	0.07	0.01	0.1	-0.230	02:00	103.078	102.801	396-1	103.56	0.482																									
MH_222	MH_223	102.311	102.168	600	95.5	0.2	0.013	105.420	105.450	0.841	0.24	0.22	0.9	-0.110	02:01	102.801	102.688	366-1	103.37	0.569																									
MH_2	MH_2260	101.916	101.876	675	10.0	0.4	0.013	105.290	105.290	1.486	0.53	0.38	0.7	-0.085	01:49	102.506	102.126	Est. Fut	103.49	0.984																									
MH_223	MH_224	102.148	102.523	600	97.0	0.2	0.013	105.450	105.620	0.971	0.27	0.26	1.0	-0.060	02:03	102.688	102.523	365-1	103.42	0.732																									
MH_224	MH_105	101.625	100.067	600	82.0	1.9	0.013	105.620	103.170	2.993	0.85	0.64	0.8	-0.210	02:01	102.015	100.067	141	101.9	-0.115																									
																						141	101.9	1.562	82.0	11.4	100.338																		
																						140	102.18	1.505	82.0	25.6	100.675																		
																						139	102.55	1.606	82.0	36.9	100.944																		
																						138	102.92	1.734	82.0	47.1	101.186																		
																						137	103.3	1.850	82.0	58.2	101.450																		
																						136	103.81	2.037	82.0	71.8	101.773																		
MH_225	MH_226	103.412	102.914	300	99.5	0.5	0.013	106.390	105.720	0.968	0.07	0.03	0.5	-0.150	02:00	103.562	103.043	388-3	103.75	0.188																									
																						389-2	103.75	0.677	99.5	5.8	103.073																		
																						389-1	103.75	0.620	82.0	13.8	103.130																		
																						388-3	103.75	0.553	82.0	24.4	103.197																		
																						388-2	103.88	0.634	82.0	32.1	103.246																		
																						388-1	103.88	0.583	82.0	40.1	103.297																		
																						387-4	104.02	0.656	82.0	50.7	103.364																		
																						387-3	104.02	0.605	82.0	58.7	103.415																		
MH_2260	MH_227	101.816	101.049	675	49.5	1.6	0.013	105.290	104.230	2.925	1.05	0.45	0.4	-0.365	02:01	102.126	101.109	392-1	102.46	0.334																									
MH_226	MH_2260	102.863	101.876	300	64.0	1.1	0.013	105.720	105.290	1.402	0.10	0.06	0.6	-0.120	02:00	103.043	102.126	391-3	103.08	0.037																									
																						391-3	103.08	0.921	64.0	2.3	102.159																		
																						391-2	103.45	1.186	64.0	9.6	102.264																		
																						391-1	103.45	1.072	64.0	17.6	102.378																		
																						390-3	103.58	1.050	64.0	28.2	102.530																		
																						390-2	103.58	0.935	64.0	36.2	102.645																		
																						390-1	103.58	0.826	64.0	43.8	102.754																		
																						389-4	103.75	0.843	64.0	54.5	102.907																		
																						389-3	103.75	0.728	64.0	62.5	103.022																		
MH_227	MH_109	100.759	99.306	675	93.0	1.6	0.013	104.230	102.650	2.971	1.06	0.50	0.5	-0.325	02:00	101.109	99.671	394-3	100.86	-0.249																									
																						394-4	100.86	0.892	93.0	19.2	99.968																		
																						394-3	100.86	0.768	93.0	27.2	100.092																		
																						394-2	101.26	1.056	93.0	34.5	100.204																		
																						394-1	101.26	0.932	93.0	42.5	100.328																		
																						393-3	101.49	0.982	93.0	54.1	100.508																		
																						393-2	101.81	1.185	93.0	61.7	100.625																		
																						393-1	101.81	1.061	93.0	69.7	100.749																		
																						392-4	102.21	1.280	93.0	81.4	100.930																		
																						392-3	102.21	1.157	93.0	89.4	101.053																		
MH_228	MH_229	102.472	100.982	300	74.5	2.0	0.013	105.270	103.790	1.935	0.14	0.06	0.4	-0.160	02:00	102.612	101.063	384-3	102.12	-0.492																									
																						384-3	102.12	1.007	74.5	2.4	101.113																		

Table C-1D: Pipe Data and Hydraulic Simulation Results for the August 4th, 1988 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m ³ /s)	Peak Pipe Flow (m ³ /s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL				
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)		
																			379-2	102.14	1.006	74.5	3.4	101.134	
																			384-4	102.12	0.841	74.5	10.4	101.279	
																			379-1	102.14	0.840	74.5	11.4	101.300	
																			385-1	102.35	0.850	74.5	21	101.500	
																			378-3	102.57	1.050	74.5	22	101.520	
																			385-2	102.65	0.992	74.5	28.6	101.658	
																			378-2	102.67	0.989	74.5	29.7	101.681	
																			385-3	102.65	0.826	74.5	36.6	101.824	
																			378-1	102.67	0.823	74.5	37.7	101.847	
																			386-1	102.73	0.684	74.5	47.3	102.046	
																			377-4	103.02	0.953	74.5	48.3	102.067	
																			386-2	103.08	0.867	74.5	55.3	102.213	
																			377-3	103.28	1.046	74.5	56.3	102.234	
																			377-2	103.34	0.957	74.5	63.5	102.383	
																			377-1	103.34	0.790	74.5	71.5	102.550	
MH_229	MH_102	100.723	100.142	525	86.5	0.9	0.013	103.790	103.240	1.832	0.40	0.25	0.6	-0.185	02:01	101.063	100.177	381-1	101.35	0.287					
																			382-1	101.52	1.203	86.5	13.7	100.317	
																			381-4	101.35	1.022	86.5	14.7	100.328	
																			382-2	101.52	1.121	86.5	21.7	100.399	
																			381-3	101.35	0.940	86.5	22.7	100.410	
																			382-3	101.52	1.047	86.5	28.9	100.473	
																			381-2	101.35	0.866	86.5	30	100.484	
																			382-4	101.52	0.965	86.5	36.9	100.555	
																			381-1	101.35	0.784	86.5	38	100.566	
																			383-1	101.62	0.955	86.5	47.6	100.665	
																			380-3	101.59	0.915	86.5	48.6	100.675	
																			383-2	101.62	0.874	86.5	55.6	100.746	
																			380-2	101.59	0.833	86.5	56.6	100.757	
																			383-3	101.62	0.796	86.5	63.2	100.824	
																			380-1	101.59	0.755	86.5	64.2	100.835	
																			384-1	101.95	1.017	86.5	73.8	100.933	
																			379-4	101.96	1.016	86.5	74.9	100.944	
																			384-2	101.95	0.935	86.5	81.8	101.015	
																			379-3	101.96	0.934	86.5	82.9	101.026	
MH_230	MH_231	102.417	100.947	300	73.5	2.0	0.013	105.220	103.750	1.935	0.14	0.05	0.4	-0.180	02:00	102.537	100.972	374-3	102.03	-0.507					
																			374-3	102.03	1.005	73.5	2.5	101.025	
																			388-3	102.24	1.162	73.5	5	101.078	
																			374-4	102.03	0.834	73.5	10.5	101.196	
																			368-2	102.24	0.991	73.5	13	101.249	
																			368-1	102.24	0.829	73.5	20.6	101.411	
																			375-1	102.4	0.977	73.5	21.2	101.423	
																			375-2	102.57	0.985	73.5	28.8	101.585	
																			367-3	102.71	1.072	73.5	31.3	101.638	
																			375-3	102.57	0.814	73.5	36.8	101.756	
																			367-2	102.71	0.901	73.5	39.3	101.809	
																			367-1	102.71	0.739	73.5	46.9	101.971	
																			376-1	103	1.019	73.5	47.4	101.981	
																			376-2	103	0.848	73.5	55.4	102.152	
																			376-3	103.37	1.063	73.5	62.7	102.307	
																			376-4	103.37	0.893	73.5	70.7	102.477	
MH_231	MH_103	100.722	99.002	525	87.0	2.0	0.013	103.750	102.350	2.810	0.61	0.26	0.4	-0.275	02:00	100.972	99.285	371-1	100.56	-0.412					
																			371-1	100.56	1.023	87.0	13	99.537	
																			372-1	100.95	1.395	87.0	13.9	99.555	
																			371-2	100.56	0.868	87.0	21	99.692	
																			372-2	100.95	1.240	87.0	21.9	99.710	
																			371-1	100.56	0.720	87.0	28.6	99.840	
																			372-3	100.95	1.099	87.0	29.2	99.851	

Table C-1E: Pipe Data and Hydraulic Simulation Results for the August 8th, 1996 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL			
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)	
MH_401	POND	96.000	99.800	2250	10.0	0.5	0.013	100.350	#N/A	3.706	14.74	4.72	0.3	-1.370	01:32	96.880	96.730	#N/A	#N/A	#N/A				
MH_501	POND	96.000	99.800	2250	10.0	0.5	0.013	100.350	#N/A	3.706	14.74	4.00	0.3	-1.420	01:34	96.830	96.730	#N/A	#N/A	#N/A				
MH_1002	MH_1003	94.150	93.982	900	28.0	0.6	0.013	98.370	98.040	2.204	1.40	1.24	0.9	0.130	03:47	95.180	94.582	#N/A	#N/A	#N/A				
MH_1003	MH_1004	93.922	93.271	900	108.5	0.6	0.013	98.040	96.170	3.188	17.21	1.24	0.1	-0.240	03:48	94.582	93.306	#N/A	#N/A	#N/A				
MH_1004	MH_1005	92.586	92.162	975	106.0	0.4	0.013	96.170	95.150	1.898	1.42	1.24	0.9	-0.255	03:48	93.306	92.903	#N/A	#N/A	#N/A				
MH_1005	MH_1006	91.933	91.721	1200	106.0	0.2	0.013	95.150	94.970	1.542	1.74	1.24	0.7	-0.230	03:49	92.903	92.821	#N/A	#N/A	#N/A				
MH_1006	MH_1007	91.701	91.489	1200	106.0	0.2	0.013	94.970	94.270	1.542	1.74	1.24	0.7	-0.080	03:50	92.821	92.720	#N/A	#N/A	#N/A				
MH_1007	MH_1008	91.470	91.230	1200	88.0	0.3	0.013	94.270	93.460	1.801	2.04	1.56	0.8	0.050	00:00	92.720	92.580	#N/A	#N/A	#N/A				
MH_1008	MH_1009	91.230	91.200	1200	14.5	0.2	0.013	93.460	#N/A	1.568	1.77	1.58	0.9	0.150	00:01	92.580	92.500	#N/A	#N/A	#N/A				
MH_101	MH_102	100.935	100.142	300	30.5	2.6	0.013	103.750	103.240	2.206	0.16	0.00	0.0	-0.300	00:00	100.935	100.167	174-2	101.41	0.475				
MH_102	MH_103	99.917	99.002	525	59.0	1.6	0.013	103.240	102.350	2.474	0.54	0.24	0.4	-0.275	01:28	100.167	99.225	172-5	100.47	0.303				
																			172-5	100.47	1.135	59.0	6.9	99.335
																			173-1	100.78	1.266	59.0	18.1	99.514
																			173-2	100.78	1.138	59.0	26.1	99.642
																			173-3	101.1	1.343	59.0	33.3	99.757
																			173-4	101.1	1.216	59.0	41.3	99.884
																			173-5	101.1	1.094	59.0	48.9	100.006
																			174-1	101.41	1.286	59.0	56.3	100.124
MH_103	MH_104	98.755	98.516	750	120.0	0.4	0.013	102.350	101.590	1.594	0.70	0.50	0.7	-0.280	01:30	99.225	98.825	169-2	99.81	0.585				
																			169-2	99.81	0.976	120.0	2.7	98.834
																			169-3	99.81	0.952	120.0	10	98.858
																			169-4	99.81	0.925	120.0	18	98.885
																			170-1	99.93	1.010	120.0	28.6	98.920
																			170-2	99.93	0.983	120.0	36.6	98.947
																			170-3	99.93	0.958	120.0	44.2	98.972
																			171-1	99.99	0.982	120.0	54.9	99.008
																			171-2	99.99	0.955	120.0	62.9	99.035
																			171-3	99.99	0.931	120.0	70.1	99.059
																			171-4	99.99	0.905	120.0	78.1	99.085
																			172-1	100.47	1.325	120.0	96.1	99.145
																			172-2	100.47	1.298	120.0	104.1	99.172
																			172-3	100.47	1.274	120.0	111.3	99.196
																			172-4	100.47	1.255	120.0	117	99.215
MH_104	MH_106	97.975	97.913	1050	41.5	0.1	0.013	101.590	101.840	1.217	1.05	0.74	0.7	-0.200	01:26	98.825	98.725	169-1	99.81	0.985				
MH_105	MH_106	99.562	97.913	675	91.0	1.4	0.013	103.170	101.840	4.109	16.64	0.67	0.0	-0.265	01:30	99.972	98.725	148	100.03	0.058				
																			148	100.03	1.132	91.0	12.6	98.898
																			147	100.16	1.095	91.0	24.8	99.065
																			146	100.3	1.095	91.0	35	99.205
																			145	100.42	1.062	91.0	46.2	99.358
																			144	100.56	1.007	91.0	60.4	99.553
																			143	100.93	1.188	91.0	74.2	99.742
																			142	101.5	1.557	91.0	88.9	99.943
MH_106	MH_116	97.605	97.360	1350	122.5	0.2	0.013	101.840	101.580	1.668	2.39	1.48	0.6	-0.230	01:30	98.725	98.570	166-1	99.53	0.805				
MH_107	MH_108	99.165	99.080	300	74.0	0.4	0.013	101.895	101.880	0.809	0.06	0.00	0.0	-0.265	01:31	99.200	99.208	176-1	100.1	0.900				
MH_107	MH_112	99.165	98.906	300	74.0	0.4	0.013	101.895	101.695	0.809	0.06	0.00	0.0	-0.265	01:31	99.200	99.101	185-1	99.89	0.690				
MH_108	MH_110	98.908	98.800	450	54.0	0.2	0.013	101.880	101.980	0.802	0.13	0.08	0.6	-0.150	01:31	99.208	99.006	175-1	100.15	0.942				
MH_109	MH_110	99.151	98.800	750	60.0	0.7	0.013	102.650	101.980	2.108	0.93	0.73	0.8	-0.250	01:27	99.651	99.006	164-2	100.01	0.359				
																			164-2	100.01	0.991	60.0	1.2	99.019
																			164-3	100.25	1.172	60.0	6.7	99.078
																			164-4	100.25	1.086	60.0	14.7	99.164
																			165-1	100.42	1.142	60.0	25.3	99.278
																			165-2	100.93	1.570	60.0	32.9	99.360
																			165-3	100.93	1.484	60.0	40.9	99.446
MH_110	MH_111	98.346	98.046	900	75.0	0.4	0.013	101.980	101.770	1.800	1.14	0.97	0.8	-0.240	01:27	99.006	98.845	162-1	99.69	0.684				
																			188-4	99.86	1.011	75.0	2	98.849
																			162-1	99.69	0.831	75.0	6.3	98.859
																			188-3	99.86	0.995	75.0	9.2	98.865

Table C-1E: Pipe Data and Hydraulic Simulation Results for the August 8th, 1996 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL						
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)				
																						162-2	99.69	0.814	75.0	14.3	98.876
																						188-2	99.86	0.978	75.0	17.2	98.882
																						162-3	99.69	0.799	75.0	21.6	98.891
																						188-1	99.86	0.962	75.0	24.8	98.898
																						162-4	99.69	0.777	75.0	31.6	98.913
																						187-4	99.86	0.939	75.0	35.5	98.921
																						163-1	99.77	0.839	75.0	40.2	98.931
																						187-3	99.86	0.922	75.0	43.5	98.938
																						163-2	99.77	0.822	75.0	47.8	98.948
																						187-2	99.86	0.906	75.0	50.7	98.954
																						163-3	99.77	0.805	75.0	55.8	98.965
																						187-1	99.86	0.889	75.0	58.7	98.971
																						164-1	100.01	1.022	75.0	66.5	98.988
MH_111	MH_115	97.925	97.743	975	91.0	0.2	0.013	101.770	101.450	1.342	1.00	0.98	1.0	-0.055	01:27	98.845	98.706	159-1	99.58	0.735							
MH_112	MH_113	98.756	98.609	450	73.5	0.2	0.013	101.695	101.525	0.802	0.13	0.11	0.9	-0.105	01:31	99.101	98.874	183-1	99.74	0.639							
MH_113	MH_114	98.549	98.523	450	13.0	0.2	0.013	101.525	101.520	0.802	0.13	0.14	1.1	-0.125	01:33	98.874	98.786	181-1	99.85	0.976							
MH_1	MH_133	97.607	97.569	1500	19.0	0.2	0.013	101.660	101.660	1.789	3.16	1.80	0.6	-0.390	01:48	98.717	98.519	Est. Fut	99.86	1.143							
MH_114	MH_115	98.296	97.743	675	54.0	0.4	0.013	101.520	101.450	1.486	0.53	0.26	0.5	-0.185	01:27	98.786	98.706	182-1	99.58	0.794							
MH_115	MH_116	97.656	97.360	1050	59.0	0.5	0.013	101.450	101.580	2.230	1.93	1.30	0.7	0.000	01:35	98.706	98.570	157-1	99.46	0.754							
MH_116	MH_117	97.060	96.937	1650	122.5	0.1	0.013	101.580	101.370	1.348	2.88	2.85	1.0	-0.140	01:32	98.570	98.467	30	99.32	0.750							
MH_117	MH_118	96.917	96.796	1650	121.0	0.1	0.013	101.370	101.290	1.348	2.88	2.98	1.0	-0.100	01:34	98.467	98.345	20	99.11	0.643							
																						18	99.18	0.831	121.0	4.4	98.349
																						2	99.16	0.807	121.0	7.7	98.353
																						406	99.18	0.819	121.0	16.1	98.361
																						404	99.18	0.815	121.0	20.3	98.365
																						407	99.16	0.789	121.0	25.7	98.371
																						405	99.18	0.804	121.0	30.5	98.376
																						19	99.16	0.777	121.0	37.9	98.383
																						3	99.14	0.754	121.0	40.7	98.386
																						20	99.11	0.717	121.0	48.1	98.393
																						4	99.14	0.743	121.0	51.2	98.397
																						21	99.12	0.715	121.0	59.3	98.405
																						5	99.22	0.812	121.0	62.1	98.408
																						22	99.21	0.793	121.0	71.5	98.417
																						6	99.23	0.811	121.0	73.3	98.419
																						23	99.22	0.791	121.0	82.9	98.429
																						7	99.24	0.806	121.0	87.8	98.434
																						24	99.28	0.837	121.0	97.3	98.443
																						8	99.31	0.861	121.0	102.8	98.449
																						25	99.36	0.901	121.0	113.1	98.459
																						9	99.4	0.936	121.0	118.2	98.464
MH_118	MH_136	96.645	96.634	1950	11.0	0.1	0.013	101.290	101.190	1.507	4.50	2.98	0.7	-0.250	01:34	98.345	98.254	#N/A	#N/A	#N/A							
MH_119	MH_120	99.144	98.938	900	103.0	0.2	0.013	103.010	102.570	1.273	0.81	0.88	1.1	-0.100	01:27	99.944	99.588	101	100.65	0.706							
MH_119	MH_122	99.144	99.693	900	103.0	0.2	0.013	103.010	102.490	1.840	9.94	0.88	0.1	-0.100	01:27	99.944	99.693	#N/A	#N/A	#N/A							
MH_120	MH_121	98.878	98.850	900	14.0	0.2	0.013	102.570	102.480	1.273	0.81	0.92	1.1	-0.190	01:28	99.588	99.250	116	101.03	1.442							
MH_121	MH_132	98.790	97.536	900	114.0	1.1	0.013	102.480	101.320	2.985	1.90	0.99	0.5	-0.440	01:28	99.250	98.358	106	99.54	0.290							
																						106	99.54	1.126	114.0	7.2	98.414
																						107	99.71	1.200	114.0	19.4	98.510
																						108	99.88	1.283	114.0	30.6	98.597
																						109	100.05	1.373	114.0	40.8	98.677
																						110	100.15	1.374	114.0	53.4	98.776
																						111	100.32	1.455	114.0	64.8	98.865
																						112	100.48	1.520	114.0	77	98.960
																						113	100.57	1.522	114.0	88.2	99.048
																						114	100.57	1.442	114.0	98.4	99.128
																						115	100.65	1.441	114.0	108.8	99.209
MH_122	MH_123	99.663	99.461	300	13.0	1.6	0.013	102.490	102.270	1.705	0.12	0.00	0.0	-0.300	00:00	99.663	99.487	131	100.61	0.947							

Table C-1E: Pipe Data and Hydraulic Simulation Results for the August 8th, 1996 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m ³ /s)	Peak Pipe Flow (m ³ /s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL					
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)			
MH_123	MH_127	99.407	98.615	300	49.5	1.6	0.013	102.270	101.675	1.730	0.12	0.02	0.1	-0.220	01:26	99.487	98.642	135	99.89	0.403						
MH_124	MH_125	99.069	98.715	375	101.0	0.4	0.013	102.060	101.870	1.421	2.66	0.07	0.0	-0.155	01:35	99.289	98.921	72	99.77	0.481						
																					82	99.89	0.949	101.0	5.4	98.941
																					69	99.84	0.888	101.0	8.4	98.952
																					70	99.78	0.791	101.0	18.6	98.989
																					81	99.89	0.898	101.0	19.6	98.992
																					71	99.78	0.751	101.0	29.7	99.029
																					80	99.92	0.886	101.0	31	99.034
																					72	99.77	0.704	101.0	39.9	99.066
																					79	100.04	0.948	101.0	46.9	99.092
																					73	99.82	0.713	101.0	51.1	99.107
																					78	100.04	0.921	101.0	54.4	99.119
																					74	99.88	0.736	101.0	61.3	99.144
																					77	100	0.844	101.0	64.6	99.156
																					413	99.93	0.742	101.0	73.4	99.188
																					415	100.08	0.885	101.0	75.2	99.195
																					412	99.98	0.759	101.0	82.3	99.221
																					414	100.1	0.864	101.0	86.4	99.236
																					75	99.98	0.717	101.0	94	99.263
																					76	100.16	0.882	101.0	98.1	99.278
MH_125	MH_127	98.481	98.615	600	91.5	0.3	0.013	101.870	101.675	1.618	5.82	0.22	0.0	-0.160	01:25	98.921	98.642	65	99.58	0.659						
																					88	99.82	1.129	91.5	16	98.691
																					63	99.59	0.897	91.5	16.6	98.693
																					87	99.82	1.087	91.5	29.7	98.733
																					64	99.59	0.856	91.5	30.3	98.734
																					86	99.65	0.883	91.5	41.1	98.767
																					65	99.58	0.804	91.5	43.9	98.776
																					85	99.74	0.929	91.5	55.5	98.811
																					66	99.69	0.869	91.5	58.6	98.821
																					84	99.76	0.901	91.5	71.3	98.859
																					67	99.78	0.911	91.5	74.4	98.869
																					83	99.89	0.987	91.5	85.7	98.903
																					68	99.84	0.927	91.5	88.8	98.913
MH_126	MH_127	98.697	98.615	300	28.5	0.4	0.013	101.500	101.675	0.865	0.06	0.14	2.3	0.690	01:25	99.687	98.642	#/N/A	#/N/A	#/N/A						
MH_127	MH_128	98.102	97.994	750	54.0	0.2	0.013	101.675	101.395	1.654	7.44	0.38	0.1	-0.210	01:25	98.642	98.574	47	99.56	0.918						
MH_128	MH_129	97.964	97.923	750	13.5	0.3	0.013	101.395	101.315	1.389	0.61	0.37	0.6	-0.140	01:26	98.574	98.548	45	99.49	0.916						
MH_129	MH_130	97.848	97.732	825	77.0	0.2	0.013	101.315	101.420	1.496	6.17	0.48	0.1	-0.125	01:26	98.548	98.502	43	99.41	0.862						
MH_130	MH_131	97.732	97.581	825	100.5	0.2	0.013	101.420	101.200	1.040	0.56	0.56	1.0	-0.055	01:27	98.502	98.376	33	99.18	0.678						
MH_1302	MH_302	97.470	96.430	600	98.5	0.2	0.013	101.160	101.140	0.971	0.27	0.16	0.6	0.200	01:42	98.270	98.200	Est. Fut	99.36	1.090						
MH_1303	MH_303	97.245	96.351	750	109.0	0.2	0.013	101.090	101.080	0.976	0.43	0.35	0.8	0.270	01:44	98.265	98.131	Est. Fut	99.29	1.025						
MH_1304	MH_304	97.175	96.196	600	87.0	0.2	0.013	100.660	100.730	0.971	0.27	0.18	0.6	0.260	01:25	98.035	97.946	Est. Fut	98.86	0.825						
MH_131	MH_132	97.206	97.536	1200	12.0	0.2	0.013	101.200	101.320	1.335	1.51	0.54	0.4	-0.030	01:31	98.376	98.358	#/N/A	#/N/A	#/N/A						
MH_1312	MH_310	97.627	97.113	750	62.0	0.2	0.013	100.940	100.940	1.127	0.50	0.18	0.4	-0.440	01:36	97.937	97.843	Est. Fut	99.14	1.203						
MH_132	MH_136	97.128	96.634	1200	59.5	0.2	0.013	101.320	101.190	1.542	1.74	1.62	0.9	0.030	01:31	98.358	98.254	103	99.33	0.972						
MH_133	MH_134	97.509	97.393	1500	77.0	0.2	0.013	101.660	101.550	2.126	19.14	1.87	0.1	-0.490	01:37	98.519	98.433	#/N/A	#/N/A	#/N/A						
MH_134	MH_135	97.363	97.271	1500	61.0	0.2	0.013	101.550	101.440	1.554	2.75	1.91	0.7	-0.430	01:36	98.433	98.361	#/N/A	#/N/A	#/N/A						
MH_135	MH_136	97.121	96.634	1650	37.0	0.1	0.013	101.440	101.190	1.348	2.88	1.93	0.7	-0.410	01:36	98.361	98.254	#/N/A	#/N/A	#/N/A						
MH_136	MH_302	96.484	96.430	2250	54.0	0.1	0.013	101.190	101.140	1.658	6.59	6.45	1.0	-0.480	01:32	98.254	98.200	1	99.38	1.126						
MH_201	MH_202	105.214	104.138	375	119.5	0.9	0.013	108.120	107.180	1.506	0.17	0.08	0.5	-0.195	01:26	105.394	104.363	321	105.28	-0.114						
																					321	105.28	0.844	119.5	8.5	104.436
																					430	107.31	2.856	119.5	10.6	104.454
																					431	107.37	2.866	119.5	16.3	104.504
																					428	105.36	0.805	119.5	22.2	104.555
																					233	107.4	2.782	119.5	29.5	104.618
																					429	105.37	0.735	119.5	31.5	104.635
																					234	107.46	2.793	119.5	35.2	104.667
																					320	105.45	0.710	119.5	43.7	104.740

Table C-1E: Pipe Data and Hydraulic Simulation Results for the August 8th, 1996 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL						
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)				
																						235	107.5	2.725	119.5	47.7	104.775
																						319	105.56	0.724	119.5	54.8	104.836
																						236	107.62	2.783	119.5	54.9	104.837
																						318	105.66	0.736	119.5	65	104.924
																						237	107.69	2.746	119.5	67.3	104.944
																						238	107.8	2.807	119.5	73	104.993
																						317	105.77	0.750	119.5	76.2	105.020
																						239	107.87	2.763	119.5	86.2	105.107
																						316	105.9	0.774	119.5	88.4	105.126
																						240	107.99	2.834	119.5	91.9	105.156
																						315	106.02	0.796	119.5	99.8	105.224
																						241	108.06	2.790	119.5	105.1	105.270
																						242	108.16	2.841	119.5	110.8	105.319
																						314	106.13	0.783	119.5	114	105.347
MH_202	MH_203	104.063	104.035	450	14.0	0.2	0.013	107.180	107.090	0.802	0.13	0.10	0.8	-0.150	01:26	104.363	104.285	230	105.39	1.027							
MH_203	MH_206	103.975	103.730	450	54.5	0.5	0.013	107.090	106.720	1.203	0.19	0.16	0.8	-0.140	01:27	104.285	103.730	225	104.9	0.615							
MH_204	MH_205	103.579	103.343	525	118.0	0.2	0.013	106.620	106.610	0.888	0.19	0.14	0.7	-0.185	01:34	103.919	103.803	285	104.64	0.721							
MH_205	MH_206	103.313	103.730	525	16.0	0.2	0.013	106.610	106.720	0.888	0.19	0.20	1.0	-0.035	01:34	103.803	103.730	#N/A	#N/A	#N/A							
MH_206	MH_207	103.197	102.999	600	49.5	0.4	0.013	106.720	106.460	1.373	0.39	0.37	0.9	-0.110	01:30	103.687	103.299	221	104.52	0.833							
MH_207	MH_208	102.969	102.731	600	12.5	1.9	0.013	106.460	106.320	2.997	0.85	0.37	0.4	-0.270	01:30	103.299	102.981	219	104.39	1.091							
MH_208	MH_215	102.671	100.543	600	112.0	1.9	0.013	106.320	104.150	2.993	0.85	0.41	0.5	-0.290	01:30	102.981	101.023	212	102.46	-0.521							
																						271	102.46	1.281	112.0	8.9	101.179
																						212	102.46	1.215	112.0	12.7	101.245
																						270	102.67	1.243	112.0	23.1	101.427
																						213	102.68	1.223	112.0	24.8	101.457
																						214	102.89	1.255	112.0	35	101.635
																						269	102.93	1.279	112.0	35.9	101.651
																						215	103.1	1.269	112.0	46.2	101.831
																						268	103.18	1.330	112.0	47.3	101.850
																						216	103.36	1.316	112.0	58.4	102.044
																						267	103.42	1.357	112.0	59.5	102.063
																						217	103.62	1.377	112.0	69.8	102.243
																						266	103.68	1.421	112.0	70.7	102.259
																						423	103.94	1.503	112.0	80.9	102.437
																						421	103.83	1.373	112.0	82	102.457
																						422	104.04	1.409	112.0	92	102.631
																						420	104.04	1.389	112.0	93.1	102.651
																						265	104.35	1.514	112.0	103.7	102.836
																						218	104.3	1.431	112.0	105.6	102.869
MH_209	MH_201	105.833	105.316	300	94.0	0.6	0.013	108.630	108.120	1.015	0.07	0.00	0.0	-0.300	00:00	105.833	105.394	313	106.24	0.407							
MH_209	MH_210	105.833	105.518	300	94.0	0.6	0.013	108.630	108.320	1.015	0.07	0.00	0.0	-0.300	00:00	105.833	105.586	254	108.31	2.477							
MH_210	MH_212	105.486	103.434	300	54.0	3.8	0.013	108.320	107.010	2.668	0.19	0.05	0.3	-0.200	01:25	105.586	103.569	258	105.12	-0.466							
																						258	105.12	0.965	54.0	15.7	104.155
																						257	105.54	0.948	54.0	27.4	104.592
																						256	106.05	1.035	54.0	38.7	105.015
																						255	106.58	1.188	54.0	48.8	105.392
MH_211	MH_212	103.900	103.434	300	26.5	0.4	0.013	106.090	107.010	0.810	0.06	0.02	0.3	-0.160	01:30	104.040	103.569	#N/A	#N/A	#N/A							
MH_212	MH_204	103.359	103.804	375	49.5	0.5	0.013	107.010	106.620	1.066	0.12	0.07	0.6	-0.165	01:26	103.569	103.919	284	104.71	1.141							
MH_212	MH_213	103.359	103.136	375	49.5	0.5	0.013	107.010	106.020	1.066	0.12	0.07	0.6	-0.165	01:26	103.569	103.233	203	104.1	0.531							
MH_213	MH_214	103.053	102.918	375	13.5	1.0	0.013	106.020	105.800	1.587	0.18	0.07	0.4	-0.195	01:26	103.233	103.043	204	104.02	0.787							
MH_214	MH_215	102.883	100.543	375	90.0	2.4	0.013	105.800	104.150	2.434	0.27	0.10	0.4	-0.215	01:26	103.043	101.023	272	102.37	-0.673							
																						272	102.37	1.181	90.0	7.4	101.189
																						211	102.46	1.082	90.0	15.8	101.378
																						273	102.59	1.082	90.0	21.6	101.508
																						210	102.68	1.029	90.0	28	101.651
																						274	102.86	1.011	90.0	36.8	101.849
																						209	102.89	1.010	90.0	38.2	101.880

Table C-1E: Pipe Data and Hydraulic Simulation Results for the August 8th, 1996 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL											
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)									
																						379-2	102.14	1.026	74.5	3.4	101.114					
																							384-4	102.12	0.861	74.5	10.4	101.259				
																							379-1	102.14	0.860	74.5	11.4	101.280				
																							385-1	102.35	0.870	74.5	21	101.480				
																							378-3	102.57	1.070	74.5	22	101.500				
																							385-2	102.65	1.012	74.5	28.6	101.638				
																							378-2	102.67	1.009	74.5	29.7	101.661				
																							385-3	102.65	0.846	74.5	36.6	101.804				
																							378-1	102.67	0.843	74.5	37.7	101.827				
																							386-1	102.73	0.704	74.5	47.3	102.026				
																							377-4	103.02	0.973	74.5	48.3	102.047				
																							386-2	103.08	0.887	74.5	55.3	102.193				
																							377-3	103.28	1.066	74.5	56.3	102.214				
																							377-2	103.34	0.977	74.5	63.5	102.363				
																							377-1	103.34	0.810	74.5	71.5	102.530				
MH_229	MH_102	100.723	100.142	525	86.5	0.9	0.013	103.790	103.240	1.832	0.40	0.23	0.6	-0.205	01:30	101.043	100.167	381-1	101.35	0.307												
																							382-1	101.52	1.214	86.5	13.7	100.306				
																							381-4	101.35	1.034	86.5	14.7	100.316				
																							382-2	101.52	1.133	86.5	21.7	100.387				
																							381-3	101.35	0.953	86.5	22.7	100.397				
																							382-3	101.52	1.060	86.5	28.9	100.460				
																							381-2	101.35	0.879	86.5	30	100.471				
																							382-4	101.52	0.979	86.5	36.9	100.541				
																							381-1	101.35	0.798	86.5	38	100.552				
																							383-1	101.62	0.971	86.5	47.6	100.649				
																							380-3	101.59	0.931	86.5	48.6	100.659				
																							383-2	101.62	0.890	86.5	55.6	100.730				
																							380-2	101.59	0.850	86.5	56.6	100.740				
																							383-3	101.62	0.813	86.5	63.2	100.807				
																							380-1	101.59	0.773	86.5	64.2	100.817				
																							384-1	101.95	1.036	86.5	73.8	100.914				
																							379-4	101.96	1.034	86.5	74.9	100.926				
																							384-2	101.95	0.955	86.5	81.8	100.995				
																							379-3	101.96	0.953	86.5	82.9	101.007				
MH_230	MH_231	102.417	100.947	300	73.5	2.0	0.013	105.220	103.750	1.935	0.14	0.04	0.3	-0.190	01:26	102.527	100.962	374-3	102.03	-0.497												
																							374-3	102.03	1.015	73.5	2.5	101.015				
																							388-3	102.24	1.172	73.5	5	101.068				
																							374-4	102.03	0.844	73.5	10.5	101.186				
																							368-2	102.24	1.001	73.5	13	101.239				
																							368-1	102.24	0.839	73.5	20.6	101.401				
																							375-1	102.4	0.987	73.5	21.2	101.413				
																							375-2	102.57	0.995	73.5	28.8	101.575				
																							367-3	102.71	1.082	73.5	31.3	101.628				
																							375-3	102.57	0.824	73.5	36.8	101.746				
																							367-2	102.71	0.911	73.5	39.3	101.799				
																							367-1	102.71	0.749	73.5	46.9	101.961				
																							376-1	103	1.029	73.5	47.4	101.971				
																							376-2	103	0.858	73.5	55.4	102.142				
																							376-3	103.37	1.073	73.5	62.7	102.297				
																							376-4	103.37	0.903	73.5	70.7	102.467				
MH_231	MH_103	100.722	99.002	525	87.0	2.0	0.013	103.750	102.350	2.810	0.61	0.23	0.4	-0.285	01:26	100.962	99.225	371-1	100.56	-0.402												
																							371-1	100.56	1.075	87.0	13	99.485				
																							372-1	100.95	1.447	87.0	13.9	99.503				
																							371-2	100.56	0.916	87.0	21	99.644				
																							372-2	100.95	1.288	87.0	21.9	99.662				
																							371-1	100.56	0.764	87.0	28.6	99.796				
																							372-3	100.95	1.142	87.0	29.2	99.808				

Table C-1E: Pipe Data and Hydraulic Simulation Results for the August 8th, 1996 Historical Event

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL					
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)			
																					372-4	100.95	0.982	87.0	37.2	99.968
																					370-3	101.09	1.080	87.0	39.3	100.010
																					370-2	101.09	0.921	87.0	47.3	100.169
																					373-1	100.97	0.791	87.0	47.8	100.179
																					370-1	101.09	0.769	87.0	54.9	100.321
																					373-2	101.32	0.981	87.0	55.8	100.339
																					373-3	101.32	0.829	87.0	63.4	100.491
																					369-3	101.61	1.077	87.0	65.5	100.533
																					369-2	101.61	0.918	87.0	73.5	100.692
																					374-1	101.56	0.856	87.0	74.1	100.704
																					369-1	101.61	0.764	87.0	81.2	100.846
																					374-2	101.56	0.696	87.0	82.1	100.864
MH_302	MH_303	96.410	96.351	2250	59.0	0.1	0.013	101.140	101.080	1.658	6.59	6.61	1.0	-0.460	01:32	98.200	98.131	#N/A	#N/A	#N/A						
MH_303	MH_304	96.331	96.196	2250	134.5	0.1	0.013	101.080	100.730	1.658	6.59	6.98	1.1	-0.450	01:33	98.131	97.946	#N/A	#N/A	#N/A						
MH_304	MH_306TEE	96.176	96.133	2250	42.5	0.1	0.013	100.730	100.350	1.666	6.62	7.16	1.1	-0.480	01:33	97.946	97.693	#N/A	#N/A	#N/A						
MH_306TEE	MH_307	96.133	96.120	2250	13.0	0.1	0.013	100.350	100.350	2.128	28.73	7.23	0.3	-0.690	01:32	97.693	97.470	#N/A	#N/A	#N/A						
MH_313	MH_307	96.099	96.120	2250	33.1	0.1	0.013	100.350	100.350	1.682	6.69	3.89	0.6	-0.970	01:34	97.379	97.470	#N/A	#N/A	#N/A						
MH_307	MH_400	96.100	96.076	2250	22.7	0.1	0.013	100.350	100.350	1.707	6.79	4.65	0.7	-0.880	01:32	97.470	97.447	#N/A	#N/A	#N/A						
MH_309	MH_310	97.139	97.113	1200	17.5	0.1	0.013	100.990	100.940	1.331	1.50	0.88	0.6	-0.370	01:35	97.969	97.843	#N/A	#N/A	#N/A						
MH_310	MH_311	97.053	96.959	1200	62.5	0.2	0.013	100.940	100.830	1.335	1.51	1.12	0.7	-0.410	01:32	97.843	97.749	#N/A	#N/A	#N/A						
MH_3	MH_109	99.346	99.306	600	10.0	0.4	0.013	102.650	102.650	1.373	0.39	0.23	0.6	-0.260	01:32	99.686	99.651	#N/A	#N/A	#N/A						
MH_3111TEE	MH_312	96.831	96.716	1200	76.5	0.2	0.013	100.640	100.450	1.335	1.51	1.21	0.8	-0.390	01:31	97.641	97.466	#N/A	#N/A	#N/A						
MH_311	MH_3111TEE	96.939	96.831	1200	72.0	0.2	0.013	100.830	100.640	1.335	1.51	1.21	0.8	-0.390	01:31	97.749	97.641	#N/A	#N/A	#N/A						
MH_312	MH_313	96.656	96.624	1200	21.5	0.1	0.013	100.450	100.350	1.331	1.50	1.21	0.8	-0.390	01:31	97.466	97.379	#N/A	#N/A	#N/A						
MH_313	MH_500	96.099	96.065	2250	33.1	0.1	0.013	100.350	100.350	1.682	6.69	3.89	0.6	-0.970	01:34	97.379	97.346	#N/A	#N/A	#N/A						
MH_400	OGS_1	96.067	96.057	750	4.9	0.2	0.013	100.350	100.500	1.133	0.50	1.00	2.0	0.630	03:03	97.447	97.417	#N/A	#N/A	#N/A						
OGS_1	OGS_1-Out	96.037	96.027	750	4.9	0.2	0.013	100.500	100.350	1.138	0.50	1.00	2.0	0.630	03:03	97.417	97.135	#N/A	#N/A	#N/A						
OGS_1-Out	MH_401	96.015	96.000	2250	14.7	0.1	0.013	100.350	100.350	1.674	6.66	5.32	0.8	-1.130	01:32	97.135	96.880	#N/A	#N/A	#N/A						
MH_4	MH_104	98.554	98.516	525	9.5	0.4	0.013	101.580	101.590	1.256	0.27	0.14	0.5	-0.155	01:31	98.924	98.825	#N/A	#N/A	#N/A						
MH_500	OGS_2	96.056	96.046	750	5.0	0.2	0.013	100.350	100.428	1.127	0.50	0.98	2.0	0.540	03:25	97.346	97.326	#N/A	#N/A	#N/A						
OGS_2	OGS_2-Out	96.026	96.016	750	5.1	0.2	0.013	100.428	100.350	1.118	0.49	0.98	2.0	0.550	03:25	97.326	97.094	#N/A	#N/A	#N/A						
OGS_2-Out	MH_501	96.004	96.000	2250	4.2	0.1	0.013	100.350	100.350	1.624	6.46	4.73	0.7	-1.160	01:32	97.094	96.830	#N/A	#N/A	#N/A						

(2) Conservative estimate of freeboard based on U/S HGL and lowest USF connected to pipe. Actual HGL / freeboard at all connecting lots interpolated where conservative estimate does not meet freeboard requirements.

(3) Future USF elevations estimated as 1.8 m below the upstream top of manhole elevations.

	Interpolated HGL elevation
	Freeboard Less than 0.3m
	Freeboard Less than 0.0m

Table C-1F: Pipe Data and Hydraulic Simulation Results for the 100-Year, 3-Hour Chicago Storm + 20%

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL		
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)
MH_401	POND	96.000	95.950	2250	10.0	0.5	0.013	100.350	#N/A	3.706	14.74	5.74	0.4	-1.070	01:13	97.180	96.730	#N/A	#N/A	#N/A			
MH_501	POND	96.000	95.950	2250	10.0	0.5	0.013	100.350	#N/A	3.706	14.74	5.04	0.3	-1.070	01:13	97.180	96.730	#N/A	#N/A	#N/A			
MH_1002	MH_1003	94.150	93.982	900	28.0	0.6	0.013	98.370	98.040	2.204	1.40	1.35	1.0	0.210	02:18	95.260	94.632	#N/A	#N/A	#N/A			
MH_1003	MH_1004	93.922	93.271	900	108.5	0.6	0.013	98.040	96.170	2.204	1.40	1.35	1.0	-0.190	02:19	94.632	93.366	#N/A	#N/A	#N/A			
MH_1004	MH_1005	92.586	92.162	975	106.0	0.4	0.013	96.170	95.150	1.898	1.42	1.35	1.0	-0.195	02:20	93.366	92.993	#N/A	#N/A	#N/A			
MH_1005	MH_1006	91.933	91.721	1200	106.0	0.2	0.013	95.150	94.970	1.542	1.74	1.35	0.8	-0.140	02:22	92.993	92.891	#N/A	#N/A	#N/A			
MH_1006	MH_1007	91.701	91.489	1200	106.0	0.2	0.013	94.970	94.270	1.542	1.74	1.35	0.8	-0.010	02:22	92.891	92.760	#N/A	#N/A	#N/A			
MH_1007	MH_1008	91.470	91.230	1200	88.0	0.3	0.013	94.270	93.460	1.801	2.04	1.56	0.8	0.090	00:00	92.760	92.590	#N/A	#N/A	#N/A			
MH_1008	MH_1009	91.230	91.200	1200	14.5	0.2	0.013	93.460	#N/A	1.568	1.77	1.58	0.9	0.160	00:01	92.590	92.500	#N/A	#N/A	#N/A			
MH_101	MH_102	100.935	99.988	300	30.5	2.6	0.013	103.750	103.240	2.206	0.16	0.00	0.0	-0.300	00:00	100.935	100.327	174-2	101.41	0.475			
MH_102	MH_103	99.917	98.982	525	59.0	1.6	0.013	103.240	102.350	2.474	0.54	0.31	0.6	-0.115	01:10	100.327	100.075	172-5	100.47	0.143			
																		172-5	100.47	0.366	59.0	6.9	100.104
																		173-1	100.78	0.628	59.0	18.1	100.152
																		173-2	100.78	0.594	59.0	26.1	100.186
																		173-3	101.1	0.883	59.0	33.3	100.217
																		173-4	101.1	0.849	59.0	41.3	100.251
																		173-5	101.1	0.816	59.0	48.9	100.284
																		174-1	101.41	1.095	59.0	56.3	100.315
MH_103	MH_104	98.755	98.516	750	120.0	0.4	0.013	102.350	101.590	1.594	0.70	0.72	1.0	0.570	01:10	100.075	99.585	169-2	99.81	-0.265			
																		169-2	99.81	0.214	120.0	2.7	99.596
																		169-3	99.81	0.184	120.0	10	99.626
																		169-4	99.81	0.152	120.0	18	99.659
																		170-1	99.93	0.228	120.0	28.6	99.702
																		170-2	99.93	0.196	120.0	36.6	99.734
																		170-3	99.93	0.165	120.0	44.2	99.765
																		171-1	99.99	0.181	120.0	54.9	99.809
																		171-2	99.99	0.148	120.0	62.9	99.842
																		171-3	99.99	0.119	120.0	70.1	99.871
																		171-4	99.99	0.086	120.0	78.1	99.904
																		172-1	100.47	0.493	120.0	96.1	99.977
																		172-2	100.47	0.460	120.0	104.1	100.010
																		172-3	100.47	0.431	120.0	111.3	100.039
																		172-4	100.47	0.407	120.0	117	100.063
MH_104	MH_106	97.975	98.288	1050	41.5	0.1	0.013	101.590	101.840	1.217	1.05	1.06	1.0	0.560	01:10	99.585	99.425	169-1	99.81	0.225			
MH_105	MH_106	99.562	98.288	675	91.0	1.4	0.013	103.170	101.840	2.779	0.99	0.79	0.8	-0.135	01:10	100.102	99.425	148	100.03	-0.072			
																		148	100.03	0.511	91.0	12.6	99.519
																		147	100.16	0.550	91.0	24.8	99.610
																		146	100.3	0.615	91.0	35	99.685
																		145	100.42	0.651	91.0	46.2	99.769
																		144	100.56	0.686	91.0	60.4	99.874
																		143	100.93	0.953	91.0	74.2	99.977
																		142	101.5	1.414	91.0	88.9	100.086
MH_106	MH_116	97.605	97.361	1350	122.5	0.2	0.013	101.840	101.580	1.668	2.39	2.01	0.8	0.470	01:11	99.425	99.120	166-1	99.53	0.105			
MH_107	MH_108	99.165	99.080	300	74.0	0.4	0.013	101.895	101.880	0.809	0.06	0.04	0.7	0.365	01:09	99.830	100.018	176-1	100.1	0.270			
MH_107	MH_112	99.165	98.906	300	74.0	0.4	0.013	101.895	101.695	0.809	0.06	0.04	0.7	0.365	01:09	99.830	99.731	185-1	99.89	0.060			
MH_108	MH_110	98.908	98.731	450	54.0	0.2	0.013	101.880	101.980	0.802	0.13	0.09	0.7	0.660	01:07	100.018	99.836	175-1	100.15	0.132			
MH_109	MH_110	99.151	98.731	750	60.0	0.7	0.013	102.650	101.980	2.108	0.93	0.90	1.0	0.330	01:06	100.231	99.836	164-2	100.01	-0.221			
																		164-2	100.01	0.166	60.0	1.2	99.844
																		164-3	100.25	0.370	60.0	6.7	99.880
																		164-4	100.25	0.317	60.0	14.7	99.933
																		165-1	100.42	0.417	60.0	25.3	100.003
																		165-2	100.93	0.877	60.0	32.9	100.053
																		165-3	100.93	0.825	60.0	40.9	100.105
MH_110	MH_111	98.346	98.046	900	75.0	0.4	0.013	101.980	101.770	1.800	1.14	1.15	1.0	0.590	01:06	99.836	99.565	162-1	99.69	-0.146			
																		188-4	99.86	0.288	75.0	2	99.572
																		162-1	99.69	0.102	75.0	6.3	99.588
																		188-3	99.86	0.262	75.0	9.2	99.598

Table C-1F: Pipe Data and Hydraulic Simulation Results for the 100-Year, 3-Hour Chicago Storm + 20%

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL																						
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)																				
																						162-2	99.69	0.073	75.0	14.3	99.617																
																						188-2	99.86	0.233	75.0	17.2	99.627																
																						162-3	99.69	0.047	75.0	21.6	99.643																
																						188-1	99.86	0.205	75.0	24.8	99.655																
																						162-4	99.69	0.011	75.0	31.6	99.679																
																						187-4	99.86	0.167	75.0	35.5	99.693																
																						163-1	99.77	0.060	75.0	40.2	99.710																
																						187-3	99.86	0.138	75.0	43.5	99.722																
																						163-2	99.77	0.032	75.0	47.8	99.738																
																						187-2	99.86	0.112	75.0	50.7	99.748																
																						163-3	99.77	0.003	75.0	55.8	99.767																
																						187-1	99.86	0.083	75.0	58.7	99.777																
																						164-1	100.01	0.205	75.0	66.5	99.805																
																						MH_111	MH_115	97.925	98.080	975	91.0	0.2	0.013	101.770	101.450	1.342	1.00	1.19	1.2	0.665	01:11	99.565	99.316	159-1	99.58	0.015	
																						MH_112	MH_113	98.756	98.609	450	73.5	0.2	0.013	101.695	101.525	0.802	0.13	0.15	1.2	0.525	01:11	99.731	99.504	183-1	99.74	0.009	
MH_113	MH_114	98.549	98.523	450	13.0	0.2	0.013	101.525	101.520	0.802	0.13	0.18	1.4	0.505	01:11	99.504	99.436	181-1	99.85	0.346																							
MH_1	MH_133	97.607	97.569	1500	19.0	0.2	0.013	101.660	101.660	1.789	3.16	1.80	0.6	-0.250	01:27	98.857	98.739	Est. Fut	99.86	1.003																							
MH_114	MH_115	98.296	98.080	675	54.0	0.4	0.013	101.520	101.450	1.486	0.53	0.31	0.6	0.465	01:10	99.436	99.316	182-1	99.58	0.144																							
MH_115	MH_116	97.656	97.361	1050	59.0	0.5	0.013	101.450	101.580	2.230	1.93	1.58	0.8	0.610	01:11	99.316	99.120	157-1	99.46	0.144																							
MH_116	MH_117	97.060	96.937	1650	122.5	0.1	0.013	101.580	101.370	1.348	2.88	3.74	1.3	0.410	01:11	99.120	98.917	30	99.32	0.200																							
MH_117	MH_118	96.917	96.796	1650	121.0	0.1	0.013	101.370	101.290	1.348	2.88	3.94	1.4	0.350	01:12	98.917	98.695	20	99.11	0.193																							
																						18	99.18	0.477	121.0	4.4	98.703																
																						2	99.16	0.451	121.0	7.7	98.709																
																						406	99.18	0.455	121.0	16.1	98.725																
																						404	99.18	0.448	121.0	20.3	98.732																
																						407	99.16	0.418	121.0	25.7	98.742																
																						405	99.18	0.429	121.0	30.5	98.751																
																						19	99.16	0.395	121.0	37.9	98.765																
																						3	99.14	0.370	121.0	40.7	98.770																
																						20	99.11	0.327	121.0	48.1	98.783																
																						4	99.14	0.351	121.0	51.2	98.789																
																						21	99.12	0.316	121.0	59.3	98.804																
																						5	99.22	0.411	121.0	62.1	98.809																
																						22	99.21	0.384	121.0	71.5	98.826																
																						6	99.23	0.401	121.0	73.3	98.829																
																						23	99.22	0.373	121.0	82.9	98.847																
7	99.24	0.384	121.0	87.8	98.856																																						
24	99.28	0.406	121.0	97.3	98.874																																						
8	99.31	0.426	121.0	102.8	98.884																																						
25	99.36	0.457	121.0	113.1	98.903																																						
9	99.4	0.488	121.0	118.2	98.912																																						
MH_118	MH_136	96.645	97.084	1950	11.0	0.1	0.013	101.290	101.190	1.507	4.50	3.94	0.9	0.100	01:12	98.695	98.564	#N/A	#N/A	#N/A																							
MH_119	MH_120	100.183	98.938	300	89.0	0.6	0.013	103.010	102.570	1.015	0.07	0.00	0.0	-0.289	01:11	100.194	99.738	101	100.65	0.456																							
MH_119	MH_122	100.183	99.693	300	89.0	0.6	0.013	103.010	102.490	1.015	0.07	0.00	0.0	-0.289	01:11	100.194	99.693	#N/A	#N/A	#N/A																							
MH_120	MH_121	98.878	98.850	900	14.0	0.2	0.013	102.570	102.480	1.273	0.81	1.21	1.5	-0.040	01:11	99.738	99.370	116	101.03	1.292																							
MH_121	MH_132	98.790	97.188	900	114.0	1.1	0.013	102.480	101.320	2.985	1.90	1.31	0.7	-0.320	01:12	99.370	98.748	106	99.54	0.170																							
106	99.54	0.753	114.0	7.2	98.787																																						
107	99.71	0.856	114.0	19.4	98.854																																						
108	99.88	0.965	114.0	30.6	98.915																																						
109	100.05	1.079	114.0	40.8	98.971																																						
110	100.15	1.111	114.0	53.4	99.039																																						
111	100.32	1.218	114.0	64.8	99.102																																						
112	100.48	1.312	114.0	77	99.168																																						
113	100.57	1.341	114.0	88.2	99.229																																						
114	100.57	1.285	114.0	98.4	99.285																																						
115	100.65	1.308	114.0	108.8	99.342																																						
MH_122	MH_123	99.663	99.461	300	13.0	1.6	0.013	102.490	102.270	1.705	0.12	0.00	0.0	-0.290	01:12	99.673	99.527	131	100.61	0.937																							

Table C-1F: Pipe Data and Hydraulic Simulation Results for the 100-Year, 3-Hour Chicago Storm + 20%

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL						
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)				
																						235	107.5	2.569	119.5	47.7	104.931
																						319	105.56	0.578	119.5	54.8	104.982
																						236	107.62	2.637	119.5	54.9	104.983
																						318	105.66	0.603	119.5	65	105.057
																						237	107.69	2.616	119.5	67.3	105.074
																						238	107.8	2.685	119.5	73	105.115
																						317	105.77	0.632	119.5	76.2	105.138
																						239	107.87	2.659	119.5	86.2	105.211
																						316	105.9	0.673	119.5	88.4	105.227
																						240	107.99	2.737	119.5	91.9	105.253
																						315	106.02	0.710	119.5	99.8	105.310
																						241	108.06	2.711	119.5	105.1	105.349
																						242	108.16	2.769	119.5	110.8	105.391
																						314	106.13	0.716	119.5	114	105.414
MH_202	MH_203	104.063	104.035	450	14.0	0.2	0.013	107.180	107.090	0.802	0.13	0.16	1.3	0.070	01:08	104.583	104.515	230	105.39	0.807							
MH_203	MH_206	103.975	103.281	450	54.5	0.5	0.013	107.090	106.720	1.203	0.19	0.25	1.3	0.090	01:09	104.515	103.847	225	104.9	0.385							
MH_204	MH_205	103.579	103.343	525	118.0	0.2	0.013	106.620	106.610	0.888	0.19	0.16	0.8	-0.055	01:16	104.049	103.943	285	104.64	0.591							
MH_205	MH_206	103.313	103.281	525	16.0	0.2	0.013	106.610	106.720	0.888	0.19	0.22	1.2	0.105	01:16	103.943	103.847	#N/A	#N/A	#N/A							
MH_206	MH_207	103.197	102.999	600	49.5	0.4	0.013	106.720	106.460	1.373	0.39	0.48	1.2	0.050	01:11	103.847	103.359	221	104.52	0.673							
MH_207	MH_208	102.969	102.731	600	12.5	1.9	0.013	106.460	106.320	2.997	0.85	0.48	0.6	-0.210	01:11	103.359	103.081	219	104.39	1.031							
MH_208	MH_215	102.671	100.768	600	112.0	1.9	0.013	106.320	104.150	2.993	0.85	0.56	0.7	-0.190	01:11	103.081	101.643	212	102.46	-0.621							
																						271	102.46	0.703	112.0	8.9	101.757
																						212	102.46	0.654	112.0	12.7	101.806
																						270	102.67	0.730	112.0	23.1	101.940
																						213	102.68	0.719	112.0	24.8	101.961
																						214	102.89	0.798	112.0	35	102.092
																						269	102.93	0.826	112.0	35.9	102.104
																						215	103.1	0.864	112.0	46.2	102.236
																						268	103.18	0.930	112.0	47.3	102.250
																						216	103.36	0.967	112.0	58.4	102.393
																						267	103.42	1.013	112.0	59.5	102.407
																						217	103.62	1.081	112.0	69.8	102.539
																						266	103.68	1.129	112.0	70.7	102.551
																						423	103.94	1.258	112.0	80.9	102.682
																						421	103.83	1.134	112.0	82	102.696
																						422	104.04	1.216	112.0	92	102.824
																						420	104.04	1.202	112.0	93.1	102.838
																						265	104.35	1.376	112.0	103.7	102.974
																						218	104.3	1.301	112.0	105.6	102.999
MH_209	MH_201	105.830	105.316	300	13.0	2.4	0.013	108.630	108.120	2.120	0.15	0.00	0.0	-0.300	00:00	105.830	105.454	313	106.24	0.410							
MH_209	MH_210	105.830	105.518	300	13.0	2.4	0.013	108.630	108.320	2.120	0.15	0.00	0.0	-0.300	00:00	105.830	105.596	254	108.31	2.480							
MH_210	MH_212	105.486	103.807	300	54.0	3.8	0.013	108.320	107.010	2.668	0.19	0.05	0.3	-0.190	01:10	105.596	103.807	258	105.12	-0.476							
																						258	105.12	0.793	54.0	15.7	104.327
																						257	105.54	0.825	54.0	27.4	104.715
																						256	106.05	0.961	54.0	38.7	105.089
																						255	106.58	1.156	54.0	48.8	105.424
MH_211	MH_212	103.900	103.807	300	26.5	0.4	0.013	106.090	107.010	0.810	0.06	0.02	0.4	-0.160	01:10	104.040	103.807	#N/A	#N/A	#N/A							
MH_212	MH_204	103.359	103.804	375	49.5	0.5	0.013	107.010	106.620	1.066	0.12	0.07	0.6	-0.155	01:11	103.579	104.049	284	104.71	1.131							
MH_212	MH_213	103.359	103.136	375	49.5	0.5	0.013	107.010	106.020	1.066	0.12	0.07	0.6	-0.155	01:11	103.579	103.233	203	104.1	0.521							
MH_213	MH_214	103.053	102.918	375	13.5	1.0	0.013	106.020	105.800	1.587	0.18	0.07	0.4	-0.195	01:11	103.233	103.063	204	104.02	0.787							
MH_214	MH_215	102.883	100.768	375	90.0	2.4	0.013	105.800	104.150	2.434	0.27	0.12	0.5	-0.195	01:10	103.063	101.643	272	102.37	-0.693							
																						272	102.37	0.610	90.0	7.4	101.760
																						211	102.46	0.568	90.0	15.8	101.892
																						273	102.59	0.606	90.0	21.6	101.984
																						210	102.68	0.595	90.0	28	102.085
																						274	102.86	0.636	90.0	36.8	102.224
																						209	102.89	0.644	90.0	38.2	102.246

Table C-1F: Pipe Data and Hydraulic Simulation Results for the 100-Year, 3-Hour Chicago Storm + 20%

U/S MH	D/S MH	U/S Invert (m)	D/S Invert (m)	Pipe Dia. / Height (mm)	Pipe Length (m)	Pipe Slope (%)	n	U/S MH Cover Elev. (m)	D/S MH Cover Elev. (m)	Design Vel. (m/s)	Design Flow (m³/s)	Peak Pipe Flow (m³/s)	Peak / Design Flow	Surcharge U/S (1) (m)	Time to Peak (hh:mm)	Max. U/S HGL (m)	Max. D/S HGL (m)	Lot Number	USF (m)	Freeboard (2) (m)	Interpolated HGL						
																					Length HGL (m)	Dist. From D/S MH (m)	HGL (m)				
																						275	103.11	0.707	90.0	48.2	102.403
																						208	103.15	0.728	90.0	49.4	102.422
																						276	103.37	0.774	90.0	60.4	102.596
																						207	103.4	0.754	90.0	63.6	102.646
																						277	103.55	0.836	90.0	67.9	102.714
																						206	103.66	0.834	90.0	75	102.826
																						278	103.55	0.586	90.0	83.7	102.964
																						205	103.83	0.838	90.0	85.5	102.992
MH_215	MH_119	100.303	99.423	675	55.0	1.6	0.013	104.150	103.010	2.971	1.06	1.05	1.0	0.665	01:11	101.643	100.194	#N/A	#N/A	#N/A							
MH_216	MH_217	105.251	104.798	375	75.5	0.6	0.013	108.100	107.980	1.230	0.14	0.12	0.9	-0.105	01:16	105.521	105.113	346	105.85	0.329							
MH_217	MH_218	104.573	104.347	600	113.0	0.2	0.013	107.980	107.690	0.971	0.27	0.26	1.0	-0.060	01:18	105.113	104.937	356	105.71	0.597							
MH_218	MH_220	104.327	104.986	600	80.5	0.2	0.013	107.690	107.790	0.971	0.27	0.30	1.1	0.010	01:20	104.937	104.986	357	105.75	0.813							
MH_219	MH_220	105.649	104.986	300	25.0	2.7	0.013	108.450	107.790	2.228	0.16	0.00	0.0	-0.300	00:00	105.649	104.986	#N/A	#N/A	#N/A							
MH_220	MH_224	103.644	101.954	600	59.0	1.9	0.013	107.790	105.620	2.993	0.85	0.32	0.4	-0.340	01:17	103.904	102.035	259	104.74	0.836							
MH_221	MH_222	103.008	102.620	300	77.5	0.5	0.013	105.960	105.420	0.968	0.07	0.01	0.2	-0.210	01:10	103.098	102.821	396-1	103.56	0.462							
MH_222	MH_223	102.311	102.168	600	95.5	0.2	0.013	105.420	105.450	0.841	0.24	0.23	0.9	-0.090	01:11	102.821	102.708	366-1	103.37	0.549							
MH_2	MH_2260	101.916	102.191	675	10.0	0.4	0.013	105.290	105.290	1.486	0.53	0.38	0.7	-0.085	00:52	102.506	102.191	Est. Fut	103.49	0.984							
MH_223	MH_224	102.148	101.954	600	97.0	0.2	0.013	105.450	105.620	0.971	0.27	0.27	1.0	-0.040	01:12	102.708	102.035	365-1	103.42	0.712							
MH_224	MH_105	101.625	100.067	600	82.0	1.9	0.013	105.620	103.170	2.993	0.85	0.68	0.8	-0.190	01:13	102.035	100.102	141	101.9	-0.135							
																						141	101.9	1.529	82.0	11.4	100.371
																						140	102.18	1.475	82.0	25.6	100.705
																						139	102.55	1.578	82.0	36.9	100.972
																						138	102.92	1.708	82.0	47.1	101.212
																						137	103.3	1.826	82.0	58.2	101.474
																						136	103.81	2.015	82.0	71.8	101.795
MH_225	MH_226	103.412	102.914	300	99.5	0.5	0.013	106.390	105.720	0.968	0.07	0.05	0.7	-0.120	01:10	103.592	103.173	388-3	103.75	0.158							
																						389-2	103.75	0.553	99.5	5.8	103.197
																						389-1	103.75	0.506	82.0	13.8	103.244
																						388-3	103.75	0.452	82.0	24.4	103.298
																						388-2	103.88	0.543	82.0	32.1	103.337
																						388-1	103.88	0.502	82.0	40.1	103.378
																						387-4	104.02	0.588	82.0	50.7	103.432
																						387-3	104.02	0.547	82.0	58.7	103.473
																						387-2	104.02	0.510	82.0	65.9	103.510
																						387-1	104.02	0.469	82.0	73.9	103.551
MH_2260	MH_227	101.816	101.049	675	49.5	1.6	0.013	105.290	104.230	2.925	1.05	0.49	0.5	-0.345	01:06	102.146	101.149	392-1	102.46	0.314							
MH_226	MH_2260	102.863	102.191	300	64.0	1.1	0.013	105.720	105.290	1.402	0.10	0.11	1.1	0.010	01:06	103.173	102.191	391-3	103.08	-0.093							
																						391-3	103.08	0.854	64.0	2.3	102.226
																						391-2	103.45	1.112	64.0	9.6	102.338
																						391-1	103.45	0.989	64.0	17.6	102.461
																						390-3	103.58	0.956	64.0	28.2	102.624
																						390-2	103.58	0.834	64.0	36.2	102.746
																						390-1	103.58	0.717	64.0	43.8	102.863
																						389-4	103.75	0.723	64.0	54.5	103.027
																						389-3	103.75	0.600	64.0	62.5	103.150
MH_227	MH_109	100.759	99.306	675	93.0	1.6	0.013	104.230	102.650	2.971	1.06	0.60	0.6	-0.285	01:10	101.149	100.231	394-3	100.86	-0.289							
																						394-4	100.86	0.439	93.0	19.2	100.421
																						394-3	100.86	0.361	93.0	27.2	100.499
																						394-2	101.26	0.688	93.0	34.5	100.572
																						394-1	101.26	0.609	93.0	42.5	100.651
																						393-3	101.49	0.725	93.0	54.1	100.765
																						393-2	101.81	0.970	93.0	61.7	100.840
																						393-1	101.81	0.891	93.0	69.7	100.919
																						392-4	102.21	1.176	93.0	81.4	101.034
																						392-3	102.21	1.097	93.0	89.4	101.113
MH_228	MH_229	102.472	100.982	300	74.5	2.0	0.013	105.270	103.790	1.935	0.14	0.08	0.6	-0.140	01:11	102.632	101.093	384-3	102.12	-0.512							
																						384-3	102.12	0.977	74.5	2.4	101.143

APPENDIX

D

Tables and Calculation Sheets

JFSA

Water Resources and
Environmental Consultants



Table D-1: Approach Flows and Captured Flows for the 100-Year Chicago Storm

Catch Basin ID	Approach Flow (m ³ /s)	Captured Flow (m ³ /s)	Catch Basin ID	Approach Flow (m ³ /s)	Captured Flow (m ³ /s)	Catch Basin ID	Approach Flow (m ³ /s)	Captured Flow (m ³ /s)
CB_001	0.032	0.021	CB_048	0.307	0.090	CB_098	0.059	0.018
CB_002	0.032	0.019	CB_049	0.168	0.045	CB_099	0.146	0.045
CB_003	0.222	0.099	CB_050	0.168	0.072	CB_100	0.146	0.050
CB_004	0.222	0.045	CB_051	0.192	0.073	CB_101	0.016	0.004
CB_005	0.132	0.044	CB_052	0.192	0.046	CB_102	0.178	0.073
CB_006	0.132	0.071	CB_053	0.496	0.033	CB_103	0.178	0.020
CB_007	0.180	0.038	CB_054	0.412	0.029	CB_104	0.060	0.029
CB_008	0.133	0.034	CB_055	0.428	0.042	CB_105	0.060	0.029
CB_009	0.133	0.034	CB_056	0.130	0.030	CB_106	0.199	0.066
CB_010	0.070	0.020	CB_057	0.130	0.030	CB_107	0.199	0.100
CB_011	0.070	0.020	CB_058	0.273	0.039	CB_108	0.164	0.028
CB_012	0.043	0.031	CB_059	0.210	0.029	CB_109	0.152	0.023
CB_013	0.043	0.018	CB_060	0.210	0.029	CB_111	0.182	0.046
CB_014	0.048	0.014	CB_061	0.112	0.022	CB_112	0.062	0.028
CB_015	0.048	0.014	CB_062	0.112	0.022	CB_113	0.062	0.028
CB_016	0.064	0.016	CB_065	0.032	0.006	CB_114	0.181	0.072
CB_017	0.747	0.195	CB_066	0.047	0.016	CB_115	0.181	0.072
CB_018	0.414	0.036	CB_067	0.047	0.016	CB_116	0.071	0.043
CB_019	0.453	0.034	CB_068	0.074	0.017	CB_118	0.059	0.027
CB_020	0.406	0.033	CB_069	0.074	0.017	CB_119	0.059	0.024
CB_021	0.120	0.033	CB_070	0.067	0.018	CB_120	0.112	0.070
CB_022	0.120	0.033	CB_071	0.067	0.018	CB_121	0.112	0.044
CB_023	0.085	0.021	CB_072	0.133	0.020	CB_123	0.071	0.048
CB_024	0.177	0.073	CB_073	0.278	0.074	CB_124	0.050	0.035
CB_025	0.177	0.046	CB_074	0.278	0.067	CB_125	0.050	0.018
CB_026	0.077	0.019	CB_075	0.273	0.043	CB_126	0.069	0.021
CB_027	0.077	0.024	CB_076	0.273	0.043	CB_127	0.069	0.032
CB_028	0.076	0.032	CB_077	0.300	0.029	CB_128	0.180	0.038
CB_029	0.076	0.019	CB_078	0.204	0.036	CB_129	0.045	0.015
CB_030	0.204	0.051	CB_079	0.204	0.029	CB_130	0.045	0.015
CB_031	0.204	0.073	CB_080	0.225	0.101	CB_131	0.402	0.037
CB_032	0.101	0.070	CB_081	0.225	0.091	CB_201	0.012	0.012
CB_033	0.101	0.019	CB_082	0.165	0.066	CB_203	0.103	0.020
CB_034	0.054	0.011	CB_083	0.165	0.100	CB_204	0.014	0.014
CB_035	0.056	0.012	CB_084	0.172	0.034	CB_205	0.146	0.048
CB_036	0.113	0.026	CB_085	0.172	0.046	CB_206	0.090	0.021
CB_037	0.113	0.026	CB_086	0.141	0.071	CB_207	0.086	0.021
CB_038	0.249	0.035	CB_087	0.141	0.044	CB_208	0.018	0.018
CB_039	0.190	0.098	CB_088	0.109	0.020	DCB_063	0.170	0.033
CB_040	0.190	0.064	CB_089	0.109	0.046	DCB_064	0.170	0.051
CB_041	0.112	0.023	CB_090	0.058	0.011	DCB_110	0.182	0.073
CB_042	0.112	0.023	CB_091	0.101	0.018	DCB_117	0.160	0.082
CB_043	0.192	0.030	CB_092	0.101	0.018	DCB_122	0.160	0.042
CB_044	0.192	0.030	CB_093	0.234	0.025	DICB_1	0.052	0.019
CB_045	0.197	0.089	CB_095	0.135	0.036	DICB_2	0.052	0.019
CB_046	0.197	0.065	CB_096	0.135	0.036	DICB_3	0.097	0.025
CB_047	0.307	0.090	CB_097	0.059	0.018	DICB_4	0.097	0.025

Table D-2: Major System Flow Depths for the 100-Year Chicago Storm

Catch Basin ID	Depth (cm)	Catch Basin ID	Depth (cm)	Catch Basin ID	Depth (cm)
CB_001	20	CB_048	29	CB_098	6
CB_002	20	CB_049	27	CB_099	27
CB_003	28	CB_050	27	CB_100	27
CB_004	28	CB_051	29	CB_101	3
CB_005	21	CB_052	29	CB_102	31
CB_006	21	CB_053	10	CB_103	31
CB_007	10	CB_054	9	CB_104	9
CB_008	9	CB_055	12	CB_105	9
CB_009	9	CB_056	9	CB_106	30
CB_010	7	CB_057	9	CB_107	30
CB_011	7	CB_058	10	CB_108	8
CB_012	15	CB_059	8	CB_109	6
CB_013	15	CB_060	8	CB_111	29
CB_014	5	CB_061	6	CB_112	9
CB_015	5	CB_062	6	CB_113	9
CB_016	5	CB_065	3	CB_114	26
CB_017	9	CB_066	6	CB_115	26
CB_018	10	CB_067	6	CB_116	12
CB_019	10	CB_068	6	CB_118	19
CB_020	9	CB_069	6	CB_119	19
CB_021	27	CB_070	6	CB_120	19
CB_022	27	CB_071	6	CB_121	19
CB_023	13	CB_072	6	CB_123	12
CB_024	29	CB_073	35	CB_124	16
CB_025	29	CB_074	35	CB_125	16
CB_026	23	CB_075	13	CB_126	19
CB_027	23	CB_076	13	CB_127	19
CB_028	23	CB_077	8	CB_128	10
CB_029	23	CB_078	28	CB_129	6
CB_030	28	CB_079	28	CB_130	6
CB_031	28	CB_080	35	CB_131	11
CB_032	20	CB_081	35	CB_201	0
CB_033	20	CB_082	29	CB_203	11
CB_034	5	CB_083	29	CB_204	0
CB_035	4	CB_084	34	CB_205	14
CB_036	8	CB_085	34	CB_206	16
CB_037	8	CB_086	21	CB_207	16
CB_038	9	CB_087	21	CB_208	0
CB_039	25	CB_088	31	DCB_063	28
CB_040	25	CB_089	31	DCB_064	28
CB_041	7	CB_090	4	DCB_110	29
CB_042	7	CB_091	6	DCB_117	5
CB_043	9	CB_092	6	DCB_122	5
CB_044	9	CB_093	8	DICB_1	22
CB_045	27	CB_095	9	DICB_2	22
CB_046	27	CB_096	9	DICB_3	25
CB_047	29	CB_097	6	DICB_4	25

Note: Depth calculated as per PCSWMM model

Table D-3A: PCSWMM Subcatchment Parameters

Name	Area (ha)	Width (m)	Slope (%)	Imperv. (%)	Dstore		Subarea Routing	Percent Routed (%)	Max. Infil. Rate (mm/hr)	Min. Infil. Rate (mm/hr)	Decay Constant (1/hr)	Drying Time (days)		
					N Imperv	N Perv							Imperv (mm)	Perv (mm)
A102NE	0.134	90	0.5	66	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A103NE	0.135	83	0.5	76	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A103SW	0.058	70	0.5	70	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A104NE	0.138	80	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A104NW	0.047	31	0.5	43	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A104SE	0.053	64	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A104SW	0.047	31	0.5	74	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A105NE	0.058	48	0.5	70	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A105NW	0.105	49	0.5	77	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A105SE	0.058	48	0.5	70	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A105SW	0.104	49	0.5	82	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A106N1	0.085	48	0.5	80	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A106N2	0.077	45	0.5	82	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A106NE	0.063	30	0.5	75	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A106NW	0.064	30	0.5	78	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A106R1	0.047	46	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A106R2	0.151	116	0.5	36	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A106SE	0.073	43	0.5	83	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A106SW	0.067	40	0.5	79	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A108N1	0.052	48	0.5	42	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A108NE	0.039	30	0.5	74	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A108NW	0.029	30	0.5	49	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A108R1	0.223	152	0.5	40	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A108R2	0.114	96	0.5	38	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A108SE	0.114	46	0.5	70	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A108SW	0.051	46	0.5	62	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A109NE	0.029	30	0.5	43	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A109NW	0.053	39	0.5	72	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A109SE	0.094	56	0.5	70	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A110NE	0.103	59	0.5	74	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A110NW	0.087	50	0.5	75	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A110R1	0.039	32	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A110R10	0.038	27	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A110R2	0.036	29	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A110R3	0.039	32	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A110R4	0.047	41	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A110R5	0.045	32	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A110R6	0.042	29	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A110R7	0.046	32	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A110R8	0.059	41	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A110R9	0.032	27	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A110SE	0.059	41	0.5	77	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A110SW	0.082	47	0.5	71	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A111NW	0.091	52	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A111SE	0.087	50	0.5	75	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A112NE	0.118	68	0.5	72	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A112NW	0.053	31	0.5	75	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A112R3	0.056	50	0.5	50	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A112R4	0.098	80	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A112SE	0.119	69	0.5	75	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A112SW	0.044	29	0.5	79	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A112WK	0.039	43	0.5	32	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A113R1	0.135	112	0.5	40	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A113R2	0.084	72	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A114NE	0.029	24	0.5	78	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A114R1	0.068	58	0.5	50	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A114R2	0.053	44	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A114R3	0.074	60	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A114R4	0.145	118	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7

Table D-3A: PCSWMM Subcatchment Parameters

Name	Area (ha)	Width (m)	Slope (%)	Imperv. (%)	Dstore		Subarea Routing	Percent Routed (%)	Max. Infil. Rate (mm/hr)	Min. Infil. Rate (mm/hr)	Decay Constant (1/hr)	Drying Time (days)		
					N Imperv	N Perv							Imperv (mm)	Perv (mm)
A114SE	0.105	95	0.5	65	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A114SW	0.184	95	0.5	72	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A115NE	0.080	46	0.5	71	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A115NW	0.050	39	0.5	75	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A115R1	0.044	39	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A115R2	0.043	35	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A115R3	0.035	28	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A115R4	0.036	25	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A115R5	0.050	35	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A115R6	0.041	28	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A115SE	0.022	24	0.5	45	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A115SW	0.039	39	0.5	44	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A115W1	0.035	30	0.5	63	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A116E1	0.037	30	0.5	61	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A116NE	0.081	57	0.5	71	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A116NW	0.075	43	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A116R1	0.108	76	0.5	36	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A116R2	0.102	86	0.5	30	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A116R3	0.080	72	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A116R4	0.059	48	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A116R5	0.069	47	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A116R6	0.066	48	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A116R7	0.062	45	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A116SE	0.079	57	0.5	64	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A116SW	0.076	44	0.5	81	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A117NE	0.084	48	0.5	72	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A117NW	0.082	47	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A117R1	0.085	70	0.5	40	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A117R2	0.062	50	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A117R3	0.094	70	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A117R4	0.068	50	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A117SE	0.077	44	0.5	74	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A117SW	0.086	49	0.5	78	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A117W1	0.079	56	0.5	78	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A117W2	0.087	57	0.5	74	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A119NE	0.146	85	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A119NW	0.114	65	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A119R1	0.160	124	0.5	20	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A119R2	0.228	194	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A119R3	0.147	126	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A119SE	0.060	43	0.5	72	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A119SW	0.092	61	0.5	74	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A121NE	0.062	60	0.5	54	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A121NW	0.099	58	0.5	72	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A121R1	0.042	36	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A121R2	0.072	59	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A121R3	0.044	36	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A121R4	0.059	98	0.5	40	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A121S1	0.154	65	0.5	71	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A121SE	0.122	100	0.5	56	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A121SW	0.077	45	0.5	71	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A122NE	0.128	54	0.5	70	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A122R1	0.073	64	0.5	30	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A122R2	0.214	170	0.5	30	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A124NE	0.047	27	0.5	65	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A124NW	0.131	86	0.5	72	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A124R1	0.092	76	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A124R2	0.136	120	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A124SE	0.047	27	0.5	77	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7

Table D-3A: PCSWMM Subcatchment Parameters

Name	Area (ha)	Width (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (mm)	Dstore Perv (mm)	Subarea Routing	Percent Routed (%)	Max. Infil. Rate (mm/hr)	Min. Infil. Rate (mm/hr)	Decay Constant (1/hr)	Drying Time (days)
A124SW	0.136	86	0.5	78	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A125E1	0.058	64	0.5	47	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A125NE	0.048	36	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A125NW	0.093	53	0.5	76	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A125R1	0.105	92	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A125R2	0.109	90	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A125SE	0.048	36	0.5	79	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A125SW	0.093	53	0.5	80	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A126E1	0.033	23	0.5	80	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A126NE	0.033	36	0.5	46	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A126NW	0.026	27	0.5	45	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A126R1	0.098	86	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A126SE	0.032	36	0.5	60	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A126SW	0.026	27	0.5	58	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A126W1	0.077	52	0.5	77	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A129NE	0.172	87	0.5	72	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A129NW	0.066	38	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A129R1	0.123	106	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A129R2	0.127	104	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A129SE	0.097	88	0.5	58	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A129SW	0.064	37	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A130NE	0.150	86	0.5	75	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A130NW	0.047	38	0.5	72	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A130R1	0.175	152	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A130SE	0.147	85	0.5	71	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A130SW	0.055	39	0.5	75	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A132N1	0.029	30	0.5	45	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A132NE	0.028	27	0.5	54	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A132NW	0.033	29	0.5	79	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A132R1	0.088	80	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A132R2	0.112	92	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A132R3	0.115	94	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A132R4	0.101	84	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A132SE	0.033	33	0.5	57	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A132SW	0.048	28	0.5	70	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A133NE	0.043	43	0.5	37	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A133NW	0.095	95	0.5	37	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A133SE	0.060	43	0.5	26	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A133SW	0.132	95	0.5	26	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A133W1	0.043	43	0.5	37	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A133W2	0.060	43	0.5	26	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A133W3	0.062	70	0.5	42	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A133W4	0.088	70	0.5	30	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A134NE	0.047	28	0.5	22	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A134NW	0.126	95	0.5	28	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A134SE	0.025	28	0.5	43	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A134SW	0.115	95	0.5	30	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A135R1	0.023	22	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A136NE	0.031	30	0.5	55	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A136NE1	0.024	29	0.5	54	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A136NW	0.039	30	0.5	77	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A136NW1	0.025	29	0.5	54	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A136NW2	0.033	32	0.5	77	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A136R1	0.034	33	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A136SE	0.028	30	0.5	45	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A201NE	0.139	80	0.5	70	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A201S1	0.098	56	0.5	77	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A201SW	0.133	76	0.5	76	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A203NE	0.103	37	0.5	70	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7

Table D-3A: PCSWMM Subcatchment Parameters

Name	Area (ha)	Width (m)	Slope (%)	Imperv. (%)	Dstore		Subarea Routing	Percent Routed (%)	Max. Infil. Rate (mm/hr)	Min. Infil. Rate (mm/hr)	Decay Constant (1/hr)	Drying Time (days)		
					N Imperv	N Perv								
A203NW	0.098	73	0.5	67	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A203R1	0.116	98	0.5	26	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A203R2	0.088	72	0.5	34	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A203R3	0.111	91	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A204E1	0.154	96	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A204E2	0.154	96	0.5	79	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A204NE	0.096	55	0.5	79	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A204NW	0.107	71	0.5	78	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A204R1	0.136	120	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A204R2	0.067	54	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A204R3	0.135	112	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A204R4	0.081	66	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A204R5	0.073	66	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A204SE	0.096	55	0.5	74	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A205SE	0.109	71	0.5	72	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A205SW	0.037	35	0.5	40	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A206NE	0.138	79	0.5	71	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A206R1	0.078	128	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A208NW	0.183	87	0.5	72	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A208R1	0.092	84	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A208R2	0.114	94	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A208R3	0.120	98	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A208R4	0.064	52	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A208R5	0.049	40	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A208R6	0.037	36	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A208SE	0.135	108	0.5	59	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A209NW	0.141	81	0.5	75	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A209R1	0.053	44	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A209SE	0.112	63	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A210NW	0.061	67	0.5	48	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A210SE	0.136	67	0.5	72	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A211R1	0.033	32	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A211R2	0.153	122	0.5	40	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A211R3	0.080	81	0.5	22	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A213NE	0.121	61	0.5	72	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A214NE	0.117	64	0.5	75	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A214NW	0.119	68	0.5	74	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A214SE	0.094	86	0.5	56	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A214SW	0.108	62	0.5	72	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A215NE	0.055	59	0.5	45	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A215NW	0.055	59	0.5	45	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A215SE	0.027	24	0.5	72	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A215SW	0.063	44	0.5	71	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A216E1	0.031	31	0.5	45	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A216NE	0.092	61	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A216NW	0.089	51	0.5	74	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A216R1	0.048	36	0.5	40	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A216R2	0.041	33	0.5	40	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A216R3	0.060	36	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A216R4	0.055	33	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A216SE	0.089	60	0.5	78	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A216SW	0.092	53	0.5	79	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A217NE	0.152	87	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A217NW	0.078	45	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A217R1	0.061	50	0.5	40	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A217R2	0.068	53	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A217R3	0.068	52	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A217R4	0.050	38	0.5	40	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A217R5	0.084	50	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7

Table D-3A: PCSWMM Subcatchment Parameters

Name	Area (ha)	Width (m)	Slope (%)	Imperv. (%)	Dstore		Subarea Routing	Percent Routed (%)	Max. Infil. Rate (mm/hr)	Min. Infil. Rate (mm/hr)	Decay Constant (1/hr)	Drying Time (days)		
					N Imperv	N Perv							Imperv (mm)	Perv (mm)
A217R6	0.088	53	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A217R7	0.086	52	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A217R8	0.063	38	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A217SE	0.152	87	0.5	79	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A217SW	0.078	45	0.5	82	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A218NE	0.051	40	0.5	69	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A218SE	0.052	40	0.5	76	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A218W3	0.036	30	0.5	62	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A220NE	0.046	30	0.5	83	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A220NW	0.058	63	0.5	60	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A220SW	0.125	59	0.5	76	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A221NE	0.033	26	0.5	76	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A221SE	0.056	59	0.5	44	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A222E1	0.025	25	0.5	44	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A222E2	0.044	25	0.5	75	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A222E3	0.033	34	0.5	44	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A222E4	0.118	68	0.5	74	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A222NE	0.064	44	0.5	74	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A222NW	0.130	75	0.5	75	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A222R1	0.031	25	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A222R2	0.048	39	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A222R3	0.035	29	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A222R4	0.116	102	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A222R5	0.095	78	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A222R6	0.108	88	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A222R7	0.091	76	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A222R8	0.106	88	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A222R9	0.112	96	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A222SE	0.076	44	0.5	72	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A222SW	0.130	75	0.5	74	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A223NE	0.067	47	0.5	74	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A223SE	0.065	47	0.5	76	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A223SW	0.071	59	0.5	62	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A224NE	0.062	55	0.5	68	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A224NW	0.099	55	0.5	77	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A224R1	0.112	98	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A224R2	0.032	28	0.5	50	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A224SW	0.058	63	0.5	46	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A225NE	0.068	76	0.5	49	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A225NW	0.123	76	0.5	71	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A225SE	0.075	83	0.5	49	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A226NE	0.068	76	0.5	50	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A226NW	0.135	75	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A227NE	0.029	32	0.5	50	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A227NW	0.065	72	0.5	50	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A227SE	0.068	76	0.5	50	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A227SW	0.098	63	0.5	72	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A228NE	0.105	60	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A228NW	0.137	87	0.5	74	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A228R1	0.063	52	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A228R2	0.104	92	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A228SE	0.065	60	0.5	47	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A229N2	0.031	25	0.5	78	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A229NE	0.059	60	0.5	56	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A229NW	0.060	43	0.5	78	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A229R1	0.122	100	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A229R2	0.080	66	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A229SE	0.105	60	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A229SW	0.140	89	0.5	74	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7

Table D-3A: PCSWMM Subcatchment Parameters

Name	Area (ha)	Width (m)	Slope (%)	Imperv. (%)	Dstore		Subarea Routing	Percent Routed (%)	Max. Infil. Rate (mm/hr)	Min. Infil. Rate (mm/hr)	Decay Constant (1/hr)	Drying Time (days)		
					N Imperv	N Perv							Imperv (mm)	Perv (mm)
A230NE	0.110	72	0.5	74	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A230NW	0.079	64	0.5	62	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A230R1	0.037	31	0.5	42	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A230R2	0.027	24	0.5	50	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A230R3	0.063	52	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A230R4	0.098	88	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A230WK	0.013	21	0.5	50	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A231N1	0.060	59	0.5	55	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A231NE	0.060	43	0.5	78	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A231NW	0.047	34	0.5	78	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A231R1	0.024	22	0.5	50	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A231R2	0.033	27	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A231R3	0.032	26	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A231R4	0.032	26	0.5	44	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A231R5	0.117	96	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A231R6	0.091	76	0.5	46	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A231SE	0.107	61	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A231SW	0.137	79	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A302NE	0.020	24	0.5	54	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A302NW	0.020	24	0.5	54	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A302NW1	0.026	24	0.5	77	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A302R1	0.063	59	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A302SE	0.028	34	0.5	54	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A302SW	0.028	34	0.5	54	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A302SW1	0.037	34	0.5	77	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A303NE1	0.025	30	0.5	54	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A303NW1	0.025	30	0.5	54	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A303NW2	0.032	30	0.5	77	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A303R1	0.102	96	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A303R2	0.088	83	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A303SE	0.030	36	0.5	54	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A303SE1	0.044	53	0.5	54	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A303SW	0.030	36	0.5	54	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A303SW1	0.044	53	0.5	54	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A303SW2	0.056	53	0.5	77	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A303SW3	0.039	36	0.5	77	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A306NE	0.111	71	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A306NW	0.156	71	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A306R2	0.127	122	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A306SE	0.051	62	0.5	54	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A306SW	0.051	62	0.5	54	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A306SW1	0.064	60	0.5	77	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A310NE	0.043	25	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A310NE1	0.028	23	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A310NW	0.054	29	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A310R1	0.044	42	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A310SE	0.034	25	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A310SW	0.054	29	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A311NE	0.120	76	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A311NW	0.067	36	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A311R1	0.107	99	0.5	48	0.013	0.25	1.57	4.67	PERVIOUS	100	76.2	13.2	4.14	7
A311SE	0.119	64	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
A311SW	0.067	36	0.5	73	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7
APOND2	0.019	21	0.5	56	0.013	0.25	1.57	4.67	OUTLET	100	76.2	13.2	4.14	7

Table D-3B: SWMHYMO Subcatchment Parameters

Name	Area (ha)	XIMP (%)	TIMP (5)	Fo (mm/hr)	Fc (mm/hr)	DCAV (1/Hr)	IA Perv (mm)	Slope Perv (%)	LGP (m)	MNP	IA Imp (mm)	Slope Imp (%)	LGI (m)	MNI MNI
A104PK	1.72	19	29	76.2	13.2	4.14	4.67	2	135	0.25	1.57	0.5	107	0.013
A109RES	1.64	59	69	76.2	13.2	4.14	4.67	2	40	0.25	1.57	0.5	104	0.013
A133COM	13.831	69	79	76.2	13.2	4.14	4.67	2	40	0.25	1.57	0.5	303	0.013
A2260COM	2.68	69	79	76.2	13.2	4.14	4.67	2	40	0.25	1.57	0.5	133	0.013
A303EXT	2.451	59	69	76.2	13.2	4.14	4.67	2	40	0.25	1.57	0.5	127	0.013
A302EXT	0.99	59	69	76.2	13.2	4.14	4.67	2	40	0.25	1.57	0.5	81	0.013
A304EXT	1.199	59	69	76.2	13.2	4.14	4.67	2	40	0.25	1.57	0.5	89	0.013
A310EXT1	1.223	59	69	76.2	13.2	4.14	4.67	2	40	0.25	1.57	0.5	90	0.013
A310EXT2	7.636	59	69	76.2	13.2	4.14	4.67	2	40	0.25	1.57	0.5	226	0.013
A303COM	7.381	69	79	76.2	13.2	4.14	4.67	2	40	0.25	1.57	0.5	222	0.013
APOND1	3.94	93	93	76.2	13.2	4.14	4.67	2	40	0.25	1.57	0.5	162	0.013

Table D-3C: SWMHYMO Subcatchment Release Rates

Event	A104PK		A109RES		A2260COM		A303EXT		A302EXT		A304EXT		A310EXT1		A310EXT2		A133COM		A303COM	
	Minor	Major	Minor	Major	Minor	Major	Minor	Major	Minor	Major	Minor	Major	Minor	Major	Minor	Major	Minor	Major	Minor	Major
25mm CHI 3Hr	0.050	0.000	0.148	0.000	0.271	0.000	0.216	0.000	0.092	0.000	0.109	0.000	0.112	0.000	0.595	0.000	1.174	0.000	0.210	0.000
2 Year CHI 3Hr	0.065	0.000	0.201	0.000	0.371	0.000	0.294	0.000	0.125	0.000	0.150	0.000	0.153	0.000	0.818	0.000	1.606	0.000	0.210	0.000
5 Year CHI 3Hr	0.099	0.000	0.230	0.000	0.382	0.000	0.336	0.000	0.146	0.000	0.173	0.000	0.177	0.000	0.877	0.000	1.800	0.000	0.210	0.000
100 Year CHI 3Hr	0.199	0.000	0.230	0.000	0.382	0.000	0.336	0.000	0.146	0.000	0.173	0.000	0.177	0.000	0.877	0.000	1.800	0.000	0.210	0.000
100 Year CHI 3Hr +20%	0.199	0.260	0.241	0.000	0.382	0.743	0.360	0.131	0.156	0.660	0.185	0.074	0.189	0.000	0.939	0.282	1.800	0.000	0.210	0.000
2 years SCS 24 Hr	0.063	0.000	0.184	0.000	0.327	0.000	0.269	0.000	0.114	0.000	0.136	0.000	0.138	0.000	0.767	0.000	1.465	0.000	0.210	0.000
5 years SCS 24 Hr	0.112	0.000	0.230	0.000	0.382	0.000	0.336	0.000	0.146	0.000	0.173	0.000	0.177	0.000	0.877	0.000	1.800	0.000	0.210	0.000
10 years SCS 24 Hr	0.150	0.000	0.230	0.000	0.382	0.000	0.336	0.000	0.146	0.000	0.173	0.000	0.177	0.000	0.877	0.000	1.800	0.000	0.210	0.000
25 years SCS 24 Hr	0.199	0.000	0.230	0.000	0.382	0.000	0.336	0.000	0.146	0.000	0.173	0.000	0.177	0.000	0.877	0.000	1.800	0.000	0.210	0.000
50 years SCS 24 Hr	0.199	0.000	0.230	0.000	0.382	0.000	0.336	0.000	0.146	0.000	0.173	0.000	0.177	0.000	0.877	0.000	1.800	0.000	0.210	0.000
100 years SCS 24 Hr	0.199	0.000	0.230	0.000	0.382	0.000	0.336	0.000	0.146	0.000	0.173	0.000	0.177	0.000	0.877	0.000	1.800	0.000	0.210	0.000
100 years SCS 24 Hr +20%	0.199	0.180	0.233	0.000	0.382	0.444	0.344	0.000	0.149	0.000	0.177	0.000	0.180	0.000	0.899	0.000	1.800	0.000	0.210	0.000

Table D-4A: Catch Basin Depth-Outflow Rating Curves - Constant Slope

16m ROW								24m ROW							
1 Catch Basin Slope = 0.5%		1 Catch Basin Slope = 1.0%		1 Catch Basin Slope = 2.0%		1 Catch Basin Slope = 3.0%		1 Catch Basin Slope = 0.5%		1 Catch Basin Slope = 1.0%		1 Catch Basin Slope = 2.0%		1 Catch Basin Slope = 3.0%	
Depth (m)	Outflow (m³/s)	Depth (m)	Outflow (m³/s)	Depth (m)	Outflow (m³/s)	Depth (m)	Outflow (m³/s)	Depth (m)	Outflow (m³/s)	Depth (m)	Outflow (m³/s)	Depth (m)	Outflow (m³/s)	Depth (m)	Outflow (m³/s)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00
0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00
0.03	0.00	0.03	0.01	0.03	0.01	0.03	0.01	0.03	0.00	0.03	0.01	0.03	0.01	0.03	0.01
0.04	0.01	0.04	0.01	0.04	0.01	0.04	0.01	0.04	0.01	0.04	0.01	0.04	0.01	0.04	0.01
0.05	0.01	0.05	0.02	0.05	0.02	0.05	0.01	0.05	0.01	0.05	0.02	0.05	0.02	0.05	0.02
0.06	0.02	0.06	0.02	0.06	0.02	0.06	0.02	0.06	0.02	0.06	0.02	0.06	0.02	0.06	0.02
0.07	0.02	0.07	0.03	0.07	0.02	0.07	0.02	0.07	0.02	0.07	0.03	0.07	0.02	0.07	0.02
0.08	0.03	0.08	0.03	0.08	0.03	0.08	0.03	0.08	0.03	0.08	0.03	0.08	0.03	0.08	0.03
0.09	0.03	0.09	0.03	0.09	0.03	0.09	0.03	0.09	0.03	0.09	0.04	0.09	0.03	0.09	0.03
0.10	0.03	0.10	0.04	0.10	0.04	0.10	0.03	0.10	0.03	0.10	0.04	0.10	0.04	0.10	0.03
0.11	0.04	0.11	0.04	0.11	0.04	0.11	0.04	0.11	0.04	0.11	0.04	0.11	0.04	0.11	0.04
0.12	0.04	0.12	0.05	0.12	0.05	0.12	0.04	0.12	0.04	0.12	0.05	0.12	0.05	0.12	0.04
0.13	0.04	0.13	0.05	0.13	0.05	0.13	0.04	0.13	0.05	0.13	0.05	0.13	0.05	0.13	0.04
0.14	0.05	0.14	0.05	0.14	0.05	0.14	0.04	0.14	0.05	0.14	0.05	0.14	0.05	0.14	0.04
0.15	0.05	0.15	0.05	0.15	0.05	0.15	0.04	0.15	0.05	0.15	0.05	0.15	0.05	0.15	0.04
0.16	0.05	0.16	0.05	0.16	0.05	0.16	0.04	0.16	0.05	0.16	0.05	0.16	0.05	0.16	0.04
0.17	0.05	0.17	0.05	0.17	0.05	0.17	0.04	0.17	0.05	0.17	0.05	0.17	0.05	0.17	0.04
0.18	0.05	0.18	0.05	0.18	0.05	0.18	0.04	0.18	0.05	0.18	0.05	0.18	0.05	0.18	0.04
0.19	0.05	0.19	0.05	0.19	0.05	0.19	0.04	0.19	0.05	0.19	0.05	0.19	0.05	0.19	0.04
0.20	0.05	0.20	0.05	0.20	0.05	0.20	0.04	0.20	0.05	0.20	0.05	0.20	0.05	0.20	0.04
0.21	0.05	0.21	0.05	0.21	0.05	0.21	0.04	0.21	0.05	0.21	0.05	0.21	0.05	0.21	0.04
0.22	0.05	0.22	0.05	0.22	0.05	0.22	0.04	0.22	0.05	0.22	0.05	0.22	0.05	0.22	0.04
0.23	0.05	0.23	0.05	0.23	0.05	0.23	0.04	0.23	0.05	0.23	0.05	0.23	0.05	0.23	0.04
0.24	0.05	0.24	0.05	0.24	0.05	0.24	0.04	0.24	0.05	0.24	0.05	0.24	0.05	0.24	0.04
0.25	0.05	0.25	0.05	0.25	0.05	0.25	0.04	0.25	0.05	0.25	0.05	0.25	0.05	0.25	0.04
0.26	0.05	0.26	0.05	0.26	0.05	0.26	0.04	0.26	0.05	0.26	0.05	0.26	0.05	0.26	0.04
0.27	0.05	0.27	0.05	0.27	0.05	0.27	0.04	0.27	0.05	0.27	0.05	0.27	0.05	0.27	0.04
0.28	0.05	0.28	0.05	0.28	0.05	0.28	0.04	0.28	0.05	0.28	0.05	0.28	0.05	0.28	0.04
0.29	0.05	0.29	0.05	0.29	0.05	0.29	0.04	0.29	0.05	0.29	0.05	0.29	0.05	0.29	0.04
0.30	0.05	0.30	0.05	0.30	0.05	0.30	0.04	0.30	0.05	0.30	0.05	0.30	0.05	0.30	0.04
0.31	0.05	0.31	0.05	0.31	0.05			0.31	0.05	0.31	0.05	0.31	0.05		
0.32	0.05	0.32	0.05	0.32	0.05			0.32	0.05	0.32	0.05	0.32	0.05		
0.33	0.05	0.33	0.05					0.33	0.05	0.33	0.05				
0.34	0.05	0.34	0.05					0.34	0.05	0.34	0.05				
0.35	0.05	0.35	0.05					0.35	0.05	0.35	0.05				
0.36	0.05	0.36	0.05					0.36	0.05	0.36	0.05				
0.37	0.05	0.37	0.05					0.37	0.05	0.37	0.05				
0.38	0.05							0.38	0.05						
0.39	0.05							0.39	0.05						
0.40	0.05							0.40	0.05						

D-4B- ICD Depth Flow Rating Curves

Depth ⁽¹⁾	Flow (m ³ /s)						
	83 mm	94 mm	102 mm	108 mm	127 mm	152 mm	178 mm
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.005	0.018	0.023	0.027	0.030	0.041	0.059	0.081
0.15	0.018	0.024	0.028	0.031	0.043	0.062	0.085
0.3	0.020	0.025	0.030	0.033	0.046	0.066	0.090
0.35	0.020	0.026	0.030	0.034	0.047	0.067	0.092

(1) Depth taken at the top of catchbasin

Table D-5A: Capacity of Grates

Water Depth H (m)	Q _{captured} (L/s)	
	PSD 400.01	
	SINGLE * (L/s)	TWIN * (L/s)
0.00	0	0
0.01	1	1
0.02	2	3
0.03	4	5
0.04	7	9
0.05	11	16
0.06	16	27
0.07	20	36
0.08	36	54
0.09	48	71
0.10	61	91
0.11	73	109
0.12	86	127
0.13	99	140
0.14	109	155
0.15	120	169
0.16	129	183
0.17	136	196
0.18	145	211
0.19	150	228
0.20	156	243
0.21	161	259
0.22	167	275
0.23	172	291
0.24	176	307
0.25	181	322
0.26	186	337
0.27	189	354
0.28	194	371
0.29	199	387
0.30	202	403

Table D-5B: Capacity of Side Inlet ⁽¹⁾

Water Depth (m)	SINGLE Capacity (L/s)	TWIN Capacity (L/s)
0.00	0	0
0.01	1	2
0.02	3	6
0.03	6	12
0.04	9	18
0.05	13	26
0.06	17	34
0.07	22	44
0.08	26	52
0.09	32	64
0.10	37	74
0.11	43	86
0.12	49	98
0.13	62	124
0.14	67	134
0.15	71	142
0.16	75	150
0.17	79	158
0.18	83	166
0.19	86	172
0.20	89	178
0.21	93	186
0.22	96	192
0.23	99	198
0.24	102	204
0.25	105	210
0.26	107	214
0.27	110	220
0.28	113	226
0.29	115	230
0.30	118	236

⁽¹⁾ As per $Q_{weir} = CLH^{3/2}$ where $C = 1.8$,

* From MTO Drainage Management Manual (and $Q_{orifice} = CA \times (2gh)^{0.5}$ where $C = 0.65$
Design Chart 4.19 for a 13 cm high x 65 cm wide side inlet.

Table D-5C: Capacity of Lead Pipes

Head (m)	Release Rate (L/s) by Pipe Diameter (mm)						
	100	150	200	250	300	375	450
0.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.050	6.4	14.4	25.5	39.9	57.4	89.7	129.2
0.100	9.0	20.3	36.1	56.4	81.2	126.9	182.7
0.150	11.0	24.9	44.2	69.1	99.4	155.4	223.7
0.200	12.8	28.7	51.0	79.7	114.8	179.4	258.3
0.250	14.3	32.1	57.1	89.1	128.4	200.6	288.8
0.300	15.6	35.2	62.5	97.7	140.6	219.7	316.4
0.350	16.9	38.0	67.5	105.5	151.9	237.3	341.8
0.400	18.0	40.6	72.2	112.8	162.4	253.7	365.3
0.450	19.1	43.1	76.5	119.6	172.2	269.1	387.5
0.500	20.2	45.4	80.7	126.1	181.5	283.7	408.5
0.550	21.2	47.6	84.6	132.2	190.4	297.5	428.4
0.600	22.1	49.7	88.4	138.1	198.9	310.7	447.5
0.650	23.0	51.7	92.0	143.7	207.0	323.4	465.7
0.700	23.9	53.7	95.5	149.2	214.8	335.6	483.3
0.750	24.7	55.6	98.8	154.4	222.3	347.4	500.3
0.800	25.5	57.4	102.1	159.5	229.6	358.8	516.7
0.850	26.3	59.2	105.2	164.4	236.7	369.8	532.6
0.900	27.1	60.9	108.3	169.1	243.6	380.6	548.0
0.950	27.8	62.6	111.2	173.8	250.2	391.0	563.0
1.000	28.5	64.2	114.1	178.3	256.7	401.2	577.7
1.050	29.2	65.8	116.9	182.7	263.1	411.1	591.9
1.100	29.9	67.3	119.7	187.0	269.3	420.7	605.9
1.150	30.6	68.8	122.4	191.2	275.3	430.2	619.5
1.200	31.2	70.3	125.0	195.3	281.2	439.4	632.8
1.250	31.9	71.8	127.6	199.3	287.0	448.5	645.9
1.300	32.5	73.2	130.1	203.3	292.7	457.4	658.6
1.350	33.1	74.6	132.6	207.2	298.3	466.1	671.2
1.400	33.8	75.9	135.0	211.0	303.8	474.7	683.5
1.450	34.4	77.3	137.4	214.7	309.2	483.1	695.6
1.500	34.9	78.6	139.8	218.4	314.4	491.3	707.5
1.550	35.5	79.9	142.1	222.0	319.6	499.4	719.2
1.600	36.1	81.2	144.3	225.5	324.8	507.4	730.7

Short tube orifice coefficient =

0.82

Short tube release rate = $C\pi(\text{Dia}/1000)^2/4 \times (2 \times 9.81 \times H)^{0.5} \times 1000$

Table D-6: ICD Type and Inlet Capture Results for the 2-Year Chicago Storm ⁽¹⁾

Catch Basin ID	Peak Flow (m ³ /s)	Actual Capture (m ³ /s)	Max Depth (cm)	Flow Spread (m)	% of Total Travel Lane ⁽¹⁾	ICD Type	Comment
CB_001	0.011	0.011	0.0	0.00	0%	83mm	Low Point CB
CB_002	0.011	0.010	0.0	0.00	0%	83mm	Low Point CB
CB_003	0.081	0.081	0.0	0.00	0%	178mm	Low Point CB
CB_004	0.036	0.036	0.0	0.00	0%	127mm	Low Point CB
CB_005	0.029	0.029	0.0	0.00	0%	127mm	Low Point CB
CB_006	0.047	0.047	0.0	0.00	0%	152mm	Low Point CB
CB_007	0.038	0.016	5.0	1.63	19%	-	CB on Slope
CB_008	0.043	0.017	5.0	1.63	19%	-	CB on Slope
CB_009	0.043	0.017	5.0	1.63	19%	-	CB on Slope
CB_010	0.023	0.008	4.0	1.31	15%	-	CB on Slope
CB_011	0.023	0.008	4.0	1.31	15%	-	CB on Slope
CB_012	0.017	0.017	0.0	0.00	0%	108mm	Low Point CB
CB_013	0.010	0.010	0.0	0.00	0%	83mm	Low Point CB
CB_014	0.015	0.006	3.0	0.98	12%	-	CB on Slope
CB_015	0.015	0.006	3.0	0.98	12%	-	CB on Slope
CB_016	0.018	0.008	3.0	0.98	12%	-	CB on Slope
CB_017	0.149	0.148	1.0	0.33	4%	-	Low Point CB
CB_018	0.065	0.017	5.0	1.63	19%	-	CB on Slope
CB_019	0.081	0.015	5.0	1.63	19%	-	CB on Slope
CB_020	0.048	0.011	4.0	1.31	15%	-	CB on Slope
CB_021	0.029	0.029	0.0	0.00	0%	108mm	Low Point CB
CB_022	0.029	0.029	0.0	0.00	0%	108mm	Low Point CB
CB_023	0.016	0.016	0.0	0.00	0%	83mm	Rearyard CB
CB_024	0.065	0.065	0.0	0.00	0%	152mm	Low Point CB
CB_025	0.040	0.040	0.0	0.00	0%	127mm	Low Point CB
CB_026	0.011	0.011	0.0	0.00	0%	83mm	Low Point CB
CB_027	0.014	0.014	0.0	0.00	0%	94mm	Low Point CB
CB_028	0.022	0.022	0.0	0.00	0%	108mm	Low Point CB
CB_029	0.013	0.013	0.0	0.00	0%	83mm	Low Point CB
CB_030	0.045	0.045	0.0	0.00	0%	127mm	Low Point CB
CB_031	0.064	0.064	0.0	0.00	0%	152mm	Low Point CB
CB_032	0.041	0.041	0.0	0.00	0%	152mm	Low Point CB
CB_033	0.011	0.011	0.0	0.00	0%	83mm	Low Point CB
CB_034	0.015	0.003	3.0	0.98	12%	-	CB on Slope
CB_035	0.016	0.004	3.0	0.98	12%	-	CB on Slope
CB_036	0.033	0.013	4.0	1.31	15%	-	CB on Slope
CB_037	0.033	0.013	4.0	1.31	15%	-	CB on Slope
CB_038	0.059	0.020	6.0	1.96	23%	-	CB on Slope
CB_039	0.058	0.058	0.0	0.00	0%	178mm	Low Point CB
CB_040	0.037	0.037	0.0	0.00	0%	152mm	Low Point CB
CB_041	0.023	0.008	3.0	0.98	12%	-	CB on Slope
CB_042	0.023	0.008	3.0	0.98	12%	-	CB on Slope
CB_043	0.047	0.017	6.0	1.96	23%	-	CB on Slope
CB_044	0.047	0.017	6.0	1.96	23%	-	CB on Slope
CB_045	0.051	0.051	0.0	0.00	0%	178mm	Low Point CB
CB_046	0.037	0.037	0.0	0.00	0%	152mm	Low Point CB
CB_047	0.013	0.013	0.0	0.00	0%	178mm	Low Point CB
CB_048	0.013	0.013	0.0	0.00	0%	178mm	Low Point CB
CB_049	0.034	0.034	0.0	0.00	0%	127mm	Low Point CB
CB_050	0.055	0.055	0.0	0.00	0%	152mm	Low Point CB
CB_051	0.057	0.057	0.0	0.00	0%	152mm	Low Point CB
CB_052	0.035	0.035	0.0	0.00	0%	127mm	Low Point CB
CB_053	0.060	0.009	4.0	1.31	15%	-	CB on Slope
CB_054	0.036	0.006	4.0	1.31	15%	-	CB on Slope
CB_055	0.021	0.005	3.0	0.98	12%	-	CB on Slope
CB_056	0.028	0.011	5.0	1.63	19%	-	CB on Slope

Table D-6: ICD Type and Inlet Capture Results for the 2-Year Chicago Storm ⁽¹⁾

Catch Basin ID	Peak Flow (m ³ /s)	Actual Capture (m ³ /s)	Max Depth (cm)	Flow Spread (m)	% of Total Travel Lane ⁽¹⁾	ICD Type	Comment
CB_057	0.028	0.011	5.0	1.63	19%	-	CB on Slope
CB_058	0.058	0.017	5.0	1.63	19%	-	CB on Slope
CB_059	0.046	0.011	4.0	1.31	15%	-	CB on Slope
CB_060	0.046	0.011	4.0	1.31	15%	-	CB on Slope
CB_061	0.023	0.009	4.0	1.31	15%	-	CB on Slope
CB_062	0.023	0.009	4.0	1.31	15%	-	CB on Slope
CB_065	0.008	0.001	2.0	0.65	8%	-	CB on Slope
CB_066	0.014	0.006	4.0	1.31	15%	-	CB on Slope
CB_067	0.014	0.006	4.0	1.31	15%	-	CB on Slope
CB_068	0.023	0.007	4.0	1.31	15%	-	CB on Slope
CB_069	0.023	0.007	4.0	1.31	15%	-	CB on Slope
CB_070	0.020	0.008	3.0	0.98	12%	-	CB on Slope
CB_071	0.020	0.008	3.0	0.98	12%	-	CB on Slope
CB_072	0.034	0.009	4.0	1.31	15%	-	CB on Slope
CB_073	0.038	0.038	0.0	0.00	0%	152mm	Low Point CB
CB_074	0.033	0.033	0.0	0.00	0%	152mm	Low Point CB
CB_075	0.022	0.012	5.0	1.63	19%	-	CB on Slope
CB_076	0.022	0.012	5.0	1.63	19%	-	CB on Slope
CB_077	0.030	0.008	3.0	0.98	12%	-	CB on Slope
CB_078	0.051	0.034	6.0	1.96	23%	108mm	Low Point CB
CB_079	0.051	0.027	6.0	1.96	23%	102mm	Low Point CB
CB_080	0.044	0.044	0.0	0.00	0%	178mm	Low Point CB
CB_081	0.039	0.039	0.0	0.00	0%	178mm	Low Point CB
CB_082	0.026	0.026	0.0	0.00	0%	152mm	Low Point CB
CB_083	0.041	0.041	0.0	0.00	0%	178mm	Low Point CB
CB_084	0.024	0.024	0.0	0.00	0%	108mm	Low Point CB
CB_085	0.034	0.034	0.0	0.00	0%	127mm	Low Point CB
CB_086	0.048	0.048	0.0	0.00	0%	152mm	Low Point CB
CB_087	0.030	0.030	0.0	0.00	0%	127mm	Low Point CB
CB_088	0.015	0.015	0.0	0.00	0%	83mm	Low Point CB
CB_089	0.036	0.036	0.0	0.00	0%	127mm	Low Point CB
CB_090	0.020	0.004	3.0	0.98	12%	-	CB on Slope
CB_091	0.022	0.007	3.0	0.98	12%	-	CB on Slope
CB_092	0.022	0.007	3.0	0.98	12%	-	CB on Slope
CB_093	0.056	0.012	4.0	1.31	15%	-	CB on Slope
CB_095	0.034	0.016	5.0	1.63	19%	-	CB on Slope
CB_096	0.034	0.016	5.0	1.63	19%	-	CB on Slope
CB_097	0.020	0.010	4.0	1.31	15%	-	CB on Slope
CB_098	0.020	0.010	4.0	1.31	15%	-	CB on Slope
CB_099	0.038	0.038	0.0	0.00	0%	127mm	Low Point CB
CB_100	0.043	0.043	0.0	0.00	0%	127mm	Low Point CB
CB_101	0.005	0.001	2.0	0.65	8%	-	CB on Slope
CB_102	0.047	0.047	0.0	0.00	0%	152mm	Low Point CB
CB_103	0.012	0.012	0.0	0.00	0%	83mm	Low Point CB
CB_104	0.014	0.006	4.0	1.31	15%	-	CB on Slope
CB_105	0.014	0.006	4.0	1.31	15%	-	CB on Slope
CB_106	0.040	0.040	0.0	0.00	0%	152mm	Low Point CB
CB_107	0.063	0.063	0.0	0.00	0%	178m	Low Point CB
CB_108	0.040	0.012	4.0	1.31	15%	-	CB on Slope
CB_109	0.038	0.009	4.0	1.31	15%	-	CB on Slope
CB_111	0.035	0.035	0.0	0.00	0%	127mm	Low Point CB
CB_112	0.013	0.007	4.0	1.31	15%	-	CB on Slope
CB_113	0.013	0.007	4.0	1.31	15%	-	CB on Slope
CB_114	0.043	0.043	0.0	0.00	0%	152mm	Low Point CB
CB_115	0.043	0.043	0.0	0.00	0%	152mm	Low Point CB
CB_116	0.019	0.019	0.0	0.00	0%	127mm	Low Point CB

Table D-6: ICD Type and Inlet Capture Results for the 2-Year Chicago Storm ⁽¹⁾

Catch Basin ID	Peak Flow (m ³ /s)	Actual Capture (m ³ /s)	Max Depth (cm)	Flow Spread (m)	% of Total Travel Lane ⁽¹⁾	ICD Type	Comment
CB_118	0.020	0.020	0.0	0.00	0%	94mm	Low Point CB
CB_119	0.018	0.018	0.0	0.00	0%	94mm	Low Point CB
CB_120	0.043	0.043	0.0	0.00	0%	152mm	Low Point CB
CB_121	0.026	0.026	0.0	0.00	0%	127mm	Low Point CB
CB_123	0.021	0.021	0.0	0.00	0%	127mm	Low Point CB
CB_124	0.019	0.019	0.0	0.00	0%	108mm	Low Point CB
CB_125	0.010	0.010	0.0	0.00	0%	83mm	Low Point CB
CB_126	0.011	0.011	0.0	0.00	0%	83mm	Low Point CB
CB_127	0.016	0.016	0.0	0.00	0%	102mm	Low Point CB
CB_128	0.038	0.016	5.0	1.63	19%	-	CB on Slope
CB_129	0.012	0.006	4.0	1.31	15%	-	CB on Slope
CB_130	0.012	0.006	4.0	1.31	15%	-	CB on Slope
CB_131	0.097	0.018	6.0	1.96	23%	-	CB on Slope
CB_201	0.003	0.003	0.0	-	-	83mm	Rearyard CB
CB_203	0.015	0.015	0.0	-	-	83mm	Rearyard CB
CB_204	0.003	0.003	0.0	-	-	83mm	Rearyard CB
CB_205	0.032	0.032	0.0	-	-	127mm	Rearyard CB
CB_206	0.017	0.017	0.0	-	-	83mm	Rearyard CB
CB_207	0.014	0.014	0.0	-	-	83mm	Rearyard CB
CB_208	0.005	0.005	0.0	-	-	83mm	Rearyard CB
DCB_063	0.027	0.027	0.0	0.00	0%	108mm	Low Point CB
DCB_064	0.043	0.043	0.0	0.00	0%	127mm	Low Point CB
DCB_110	0.056	0.056	0.0	0.00	0%	152mm	Low Point CB
DCB_117	0.058	0.058	0.0	0.00	0%	178mm	Low Point CB
DCB_122	0.030	0.030	0.0	0.00	0%	127mm	Low Point CB
DICB_1	0.010	0.010	0.0	0.00	0%	83mm	Low Point CB
DICB_2	0.010	0.010	0.0	0.00	0%	83mm	Low Point CB
DICB_3	0.020	0.020	0.0	0.00	0%	94mm	Low Point CB
DICB_4	0.020	0.020	0.0	0.00	0%	94mm	Low Point CB

⁽¹⁾Total travel lane width assumed to be 8.5 m (minimum road width in subdivision)

Table D-7: Ponding at Major Low Points for the 100-Year Chicago Storm & 100-Year Chicago Storm +20%⁽¹⁾

Catch Basin ID	Total Depth ⁽¹⁾		Water Surface Elevation ⁽¹⁾	
	100 Year 3 Hr Chi (cm)	100 Year 3 Hr Chi+20% (cm)	100 Year 3 Hr Chi (m)	100 Year 3 Hr Chi+20% (m)
CB_001	20.0	26.0	107.72	107.78
CB_002	20.0	26.0	107.72	107.78
CB_003	28.0	31.0	107.82	107.85
CB_004	28.0	31.0	107.82	107.85
CB_005	21.0	27.0	107.91	107.97
CB_006	21.0	27.0	107.91	107.97
CB_012	15.0	18.0	106.94	106.97
CB_013	15.0	18.0	106.94	106.97
CB_017	9.0	11.0	104.17	104.19
CB_021	27.0	29.0	106.73	106.74
CB_022	27.0	29.0	106.73	106.74
CB_024	29.0	33.0	106.76	106.80
CB_025	29.0	33.0	106.76	106.80
CB_026	23.0	25.0	105.61	105.63
CB_027	23.0	25.0	105.61	105.63
CB_028	23.0	24.0	105.60	105.62
CB_029	23.0	24.0	105.60	105.62
CB_030	28.0	32.0	105.48	105.51
CB_031	28.0	32.0	105.48	105.51
CB_032	20.0	22.0	105.47	105.49
CB_033	20.0	22.0	105.47	105.49
CB_039	25.0	28.0	103.24	103.27
CB_040	25.0	28.0	103.24	103.27
CB_045	27.0	31.0	102.37	102.41
CB_046	27.0	31.0	102.37	102.41
CB_047	29.0	33.0	103.01	103.05
CB_048	29.0	33.0	103.01	103.05
CB_049	27.0	45.0	101.19	101.36
CB_050	27.0	45.0	101.19	101.36
CB_051	29.0	42.0	101.41	101.54
CB_052	29.0	42.0	101.41	101.54
CB_073	35.0	45.0	101.75	101.85
CB_074	35.0	45.0	101.75	101.85
CB_078	28.0	31.0	101.83	101.85
CB_079	28.0	31.0	101.83	101.85
CB_080	35.0	48.0	101.64	101.77
CB_081	35.0	48.0	101.64	101.77
CB_082	29.0	42.0	101.65	101.78
CB_083	29.0	42.0	101.65	101.78
CB_084	34.0	45.0	101.51	101.62
CB_085	34.0	45.0	101.51	101.62
CB_086	21.0	24.0	101.81	101.83
CB_087	21.0	24.0	101.81	101.83
CB_088	31.0	35.0	101.89	101.94
CB_089	31.0	35.0	101.89	101.94
CB_099	27.0	34.0	101.54	101.62
CB_100	27.0	34.0	101.54	101.62
CB_102	31.0	42.0	101.51	101.62
CB_103	31.0	42.0	101.51	101.62
CB_106	30.0	37.0	101.76	101.83
CB_107	30.0	37.0	101.76	101.83
CB_111	29.0	38.0	101.16	101.25
CB_114	26.0	34.0	101.38	101.46
CB_115	26.0	34.0	101.38	101.46
CB_116	12.0	30.0	100.83	101.01
CB_118	19.0	21.0	100.76	100.78
CB_119	19.0	21.0	100.76	100.78
CB_120	19.0	24.0	100.61	100.66
CB_121	19.0	24.0	100.61	100.66
CB_123	12.0	30.0	100.83	101.01
CB_124	16.0	29.0	100.99	101.12
CB_125	16.0	29.0	100.99	101.12
CB_126	19.0	30.0	101.08	101.18

Table D-7: Ponding at Major Low Points for the 100-Year Chicago Storm & 100-Year Chicago Storm +20% ⁽¹⁾

Catch Basin ID	Total Depth ⁽¹⁾		Water Surface Elevation ⁽¹⁾	
	100 Year 3 Hr Chi (cm)	100 Year 3 Hr Chi+20% (cm)	100 Year 3 Hr Chi (m)	100 Year 3 Hr Chi+20% (m)
CB 127	19.0	30.0	101.08	101.18
DCB 063	28.0	35.0	101.19	101.26
DCB 064	28.0	35.0	101.19	101.26
DCB 110	29.0	38.0	101.16	101.25
DCB 117	5.0	6.0	100.27	100.28
DCB 122	5.0	6.0	100.27	100.28

⁽¹⁾ As per PCSWMM models for the 100-year, 3-hour Chicago storm and the 100-year, 3-hour Chicago storm + 20%.

Table D8: Flow Depths 100-Year Peak Flow

Link Name	Transect	Max Velocity (m/s)	Max Depth (m)	Depth x Velocity (m ² /s)
C1	24mROW-DbI-Sidewalk	0.00	0.00	0.00
C10	16.5mROW-No-Sidewalk	0.29	0.16	0.05
C100	16.5mROW-No-Sidewalk	0.13	0.28	0.04
C101_2	16.5mROW-No-Sidewalk	1.10	0.06	0.07
C101_3	16.5mROW-No-Sidewalk	0.97	0.09	0.09
C101_4	16.5mROW-No-Sidewalk	2.00	0.27	0.54
C101_5	16.5mROW-No-Sidewalk	0.95	0.07	0.07
C102	16.5mROW-No-Sidewalk	1.11	0.27	0.30
C103_1	16.5mROW-No-Sidewalk	0.73	0.09	0.07
C103_2	16.5mROW-No-Sidewalk	1.22	0.25	0.31
C104	16.5mROW-No-Sidewalk	0.94	0.25	0.24
C105	16.5mROW-Sidewalk	1.02	0.09	0.09
C106_1	16.5mROW-Sidewalk	1.08	0.09	0.10
C106_2	16.5mROW-Sidewalk	0.94	0.11	0.10
C107	16.5mROW-Sidewalk	1.00	0.13	0.13
C108_1	16.5mROW-Sidewalk	1.02	0.13	0.13
C108_2	16.5mROW-Sidewalk	0.86	0.35	0.30
C109	16.5mROW-Sidewalk	0.91	0.35	0.32
C11	16.5mROW-No-Sidewalk	0.60	0.29	0.17
C11_1	16.5mROW-No-Sidewalk	0.37	0.19	0.07
C11_2	24mROW-DbI-Sidewalk	0.20	0.19	0.04
C110	16.5mROW-No-Sidewalk	0.00	0.00	0.00
C111	16.5mROW-No-Sidewalk	0.00	0.00	0.00
C112_1	16.5mROW-No-Sidewalk	0.00	0.09	0.00
C112_2	16.5mROW-No-Sidewalk	1.02	0.25	0.26
C113	16.5mROW-No-Sidewalk	0.12	0.25	0.03
C114_1	16.5mROW-No-Sidewalk	0.48	0.04	0.02
C114_3	16.5mROW-No-Sidewalk	0.45	0.04	0.02
C114_4	16.5mROW-No-Sidewalk	0.30	0.22	0.07
C116	16.5mROW-No-Sidewalk	0.09	0.07	0.01
C117	16.5mROW-No-Sidewalk	0.08	0.22	0.02
C118_1	16.5mROW-Sidewalk	0.00	0.05	0.00
C118_2	16.5mROW-Sidewalk	0.42	0.23	0.10
C119	16.5mROW-Sidewalk	0.73	0.23	0.17
C12	16.5mROW-Sidewalk	0.27	0.28	0.08
C13	16.5mROW-Sidewalk	0.92	0.28	0.26
C14	16.5mROW-Sidewalk	1.21	0.08	0.10
C144	Major System Overflow	0.78	0.05	0.04
C15	16.5mROW-Sidewalk	0.25	0.27	0.07
C15_1	16.5mROW-No-Sidewalk	0.65	0.10	0.07
C15_2	16.5mROW-No-Sidewalk	0.84	0.10	0.08
C16_2	16.5mROW-No-Sidewalk	0.74	0.09	0.07
C16_3	16.5mROW-No-Sidewalk	0.25	0.12	0.03
C16_4	16.5mROW-No-Sidewalk	0.28	0.09	0.03
C17	16.5mROW-No-Sidewalk	2.00	0.28	0.56
C18	16.5mROW-No-Sidewalk	1.48	0.12	0.18
C2	16.5mROW-No-Sidewalk	0.00	0.19	0.00
C20_1	16.5mROW-No-Sidewalk	1.38	0.10	0.14
C20_3	16.5mROW-No-Sidewalk	0.94	0.12	0.11
C20_4	16.5mROW-No-Sidewalk	1.26	0.10	0.13
C20_5	16.5mROW-No-Sidewalk	1.66	0.10	0.17
C22	16.5mROW-No-Sidewalk	1.01	0.12	0.12
C23	16.5mROW-No-Sidewalk	1.00	0.11	0.11
C24_1	16.5mROW-No-Sidewalk	0.52	0.09	0.05
C24_2	16.5mROW-No-Sidewalk	0.61	0.11	0.07
C25_1	16.5mROW-No-Sidewalk	0.00	0.07	0.00

Table D8: Flow Depths 100-Year Peak Flow

Link Name	Transect	Max Velocity (m/s)	Max Depth (m)	Depth x Velocity (m ² /s)
C25_2	16.5mROW-No-Sidewalk	0.71	0.07	0.05
C26	16.5mROW-No-Sidewalk	0.00	0.00	0.00
C27	16.5mROW-No-Sidewalk	0.00	0.00	0.00
C28	16.5mROW-No-Sidewalk	0.00	0.15	0.00
C29_1	16.5mROW-No-Sidewalk	0.76	0.04	0.03
C29_2	16.5mROW-No-Sidewalk	0.40	0.08	0.03
C3	16.5mROW-No-Sidewalk	0.21	0.19	0.04
C30	16.5mROW-No-Sidewalk	0.00	0.15	0.00
C31_1	16.5mROW-No-Sidewalk	0.00	0.05	0.00
C31_2	16.5mROW-No-Sidewalk	0.82	0.05	0.04
C32	16.5mROW-No-Sidewalk	0.75	0.09	0.07
C33_1	16.5mROW-No-Sidewalk	0.77	0.12	0.09
C33_2	16.5mROW-No-Sidewalk	1.00	0.12	0.12
C34_1	16.5mROW-No-Sidewalk	1.27	0.10	0.13
C34_2	16.5mROW-No-Sidewalk	1.11	0.13	0.14
C35	16.5mROW-No-Sidewalk	1.41	0.13	0.18
C36	16.5mROW-No-Sidewalk	0.70	0.29	0.20
C39	16.5mROW-No-Sidewalk	0.24	0.29	0.07
C4_1	16.5mROW-No-Sidewalk	0.26	0.19	0.05
C4_2	16.5mROW-No-Sidewalk	0.01	0.19	0.00
C41	16.5mROW-No-Sidewalk	0.26	0.27	0.07
C42	16.5mROW-No-Sidewalk	0.77	0.27	0.21
C43	16.5mROW-Sidewalk	0.70	0.28	0.20
C44	16.5mROW-Sidewalk	0.17	0.28	0.05
C45	16.5mROW-Sidewalk	0.44	0.35	0.15
C46	16.5mROW-Sidewalk	1.13	0.35	0.40
C47_1	16.5mROW-Sidewalk	0.00	0.03	0.00
C47_2	16.5mROW-Sidewalk	0.09	0.13	0.01
C47_3	16.5mROW-Sidewalk	0.30	0.29	0.09
C48	16.5mROW-Sidewalk	0.03	0.29	0.01
C49_1	16.5mROW-Sidewalk	0.02	0.12	0.00
C49_2	16.5mROW-Sidewalk	0.29	0.27	0.08
C5	16.5mROW-No-Sidewalk	0.00	0.00	0.00
C50	16.5mROW-Sidewalk	1.09	0.27	0.29
C51_1	24mROW-Dbl-Sidewalk	0.00	0.00	0.00
C51_2	24mROW-Dbl-Sidewalk	0.00	0.00	0.00
C51_4	24mROW-Dbl-Sidewalk	0.00	0.00	0.00
C51_5	24mROW-Dbl-Sidewalk	0.00	0.00	0.00
C52	24mROW-Dbl-Sidewalk	0.00	0.00	0.00
C53	24mROW-Dbl-Sidewalk	0.63	0.03	0.02
C54	24mROW-Dbl-Sidewalk	0.53	0.03	0.02
C55	16.5mROW-Sidewalk	0.34	0.26	0.09
C56	16.5mROW-Sidewalk	0.20	0.26	0.05
C57_1	16.5mROW-Sidewalk	0.12	0.09	0.01
C57_2	16.5mROW-Sidewalk	0.73	0.29	0.21
C58	16.5mROW-Sidewalk	0.20	0.29	0.06
C59	24mROW-Dbl-Sidewalk	0.00	0.00	0.00
C6	16.5mROW-No-Sidewalk	0.00	0.05	0.00
C60_1	24mROW-Dbl-Sidewalk	0.00	0.04	0.00
C60_2	24mROW-Dbl-Sidewalk	1.18	0.05	0.06
C61_2	24mROW-Dbl-Sidewalk	0.98	0.08	0.08
C61_3	24mROW-Dbl-Sidewalk	1.08	0.05	0.05
C61_4	24mROW-Dbl-Sidewalk	0.83	0.06	0.05
C62_1	24mROW-Dbl-Sidewalk	0.81	0.09	0.07
C62_2	24mROW-Dbl-Sidewalk	1.04	0.09	0.09
C63_1	24mROW-Dbl-Sidewalk	0.56	0.06	0.03

Table D8: Flow Depths 100-Year Peak Flow

Link Name	Transect	Max Velocity (m/s)	Max Depth (m)	Depth x Velocity (m ² /s)
C63_2	24mROW-DbI-Sidewalk	0.83	0.27	0.22
C64	16.5mROW-Sidewalk	1.12	0.29	0.32
C65	16.5mROW-Sidewalk	1.16	0.29	0.34
C66	16.5mROW-Sidewalk	0.00	0.21	0.00
C67	16.5mROW-Sidewalk	0.00	0.28	0.00
C68	16.5mROW-Sidewalk	0.00	0.21	0.00
C69	16.5mROW-Sidewalk	0.18	0.28	0.05
C7_1	16.5mROW-No-Sidewalk	0.00	0.06	0.00
C7_2	16.5mROW-No-Sidewalk	0.93	0.06	0.06
C70	16.5mROW-Sidewalk	0.37	0.20	0.07
C71	16.5mROW-Sidewalk	0.00	0.20	0.00
C72	16.5mROW-No-Sidewalk	0.00	0.00	0.00
C73	16.5mROW-No-Sidewalk	0.00	0.03	0.00
C74_1	16.5mROW-No-Sidewalk	0.15	0.06	0.01
C74_2	16.5mROW-No-Sidewalk	0.49	0.06	0.03
C75	16.5mROW-No-Sidewalk	1.18	0.06	0.07
C76_1	16.5mROW-No-Sidewalk	0.70	0.06	0.04
C76_2	16.5mROW-No-Sidewalk	0.80	0.06	0.05
C77_2	16.5mROW-No-Sidewalk	0.82	0.06	0.05
C77_4	16.5mROW-No-Sidewalk	0.92	0.08	0.07
C77_5	16.5mROW-No-Sidewalk	0.76	0.08	0.06
C78	16.5mROW-No-Sidewalk	0.92	0.30	0.28
C79	16.5mROW-No-Sidewalk	0.24	0.30	0.07
C8	16.5mROW-No-Sidewalk	0.00	0.12	0.00
C80_1	16.5mROW-No-Sidewalk	0.19	0.09	0.02
C80_2	16.5mROW-No-Sidewalk	0.65	0.18	0.12
C81	16.5mROW-No-Sidewalk	0.68	0.31	0.21
C82	16.5mROW-No-Sidewalk	0.33	0.31	0.10
C83_1	16.5mROW-No-Sidewalk	0.00	0.15	0.00
C83_2	16.5mROW-No-Sidewalk	0.30	0.31	0.09
C84	16.5mROW-No-Sidewalk	0.84	0.31	0.26
C85	16.5mROW-No-Sidewalk	0.00	0.21	0.00
C86	16.5mROW-No-Sidewalk	0.16	0.21	0.03
C88_1	16.5mROW-No-Sidewalk	0.50	0.07	0.04
C88_2	16.5mROW-No-Sidewalk	0.45	0.16	0.07
C89	16.5mROW-No-Sidewalk	1.20	0.34	0.41
C9_1	16.5mROW-No-Sidewalk	0.22	0.16	0.04
C9_2	16.5mROW-No-Sidewalk	0.60	0.12	0.07
C90	16.5mROW-No-Sidewalk	1.02	0.34	0.35
C91	16.5mROW-No-Sidewalk	0.00	0.06	0.00
C93_1	16.5mROW-No-Sidewalk	0.34	0.05	0.02
C93_2	16.5mROW-No-Sidewalk	0.51	0.05	0.03
C94	16.5mROW-No-Sidewalk	0.68	0.05	0.03
C95	16.5mROW-No-Sidewalk	0.44	0.20	0.09
C96	16.5mROW-No-Sidewalk	0.28	0.20	0.06
C97	16.5mROW-No-Sidewalk	0.28	0.23	0.06
C98	16.5mROW-No-Sidewalk	0.75	0.23	0.17
C99	16.5mROW-No-Sidewalk	0.2	0.28	0.06
	Max	2.00	0.35	0.56

Note: Depth and velocity calculated by PCSWMM model

Table D9: Flow Depths 100-Year 3 Hour Chicago +20% Peak Flow

Link Name	Transect	Max Velocity (m/s)	Max Depth (m)	Depth x Velocity (m ² /s)
C1	24mROW-DbI-Sidewalk	0.00	0.04	0.00
C10	16.5mROW-No-Sidewalk	0.41	0.29	0.12
C100	16.5mROW-No-Sidewalk	0.22	0.32	0.07
C101_2	16.5mROW-No-Sidewalk	1.30	0.08	0.10
C101_3	16.5mROW-No-Sidewalk	1.19	0.10	0.12
C101_4	16.5mROW-No-Sidewalk	1.96	0.30	0.59
C101_5	16.5mROW-No-Sidewalk	1.18	0.09	0.11
C102	16.5mROW-No-Sidewalk	1.07	0.31	0.33
C103_1	16.5mROW-No-Sidewalk	0.79	0.10	0.08
C103_2	16.5mROW-No-Sidewalk	1.14	0.28	0.32
C104	16.5mROW-No-Sidewalk	0.95	0.28	0.27
C105	16.5mROW-Sidewalk	1.74	0.11	0.19
C106_1	16.5mROW-Sidewalk	1.29	0.11	0.14
C106_2	16.5mROW-Sidewalk	1.29	0.14	0.18
C107	16.5mROW-Sidewalk	1.26	0.17	0.21
C108_1	16.5mROW-Sidewalk	1.08	0.18	0.19
C108_2	16.5mROW-Sidewalk	0.79	0.45	0.36
C109	16.5mROW-Sidewalk	0.83	0.45	0.37
C11	16.5mROW-No-Sidewalk	0.64	0.33	0.21
C11_1	16.5mROW-No-Sidewalk	0.43	0.30	0.13
C11_2	24mROW-DbI-Sidewalk	0.28	0.30	0.08
C110	16.5mROW-No-Sidewalk	0.00	0.00	0.00
C111	16.5mROW-No-Sidewalk	0.00	0.00	0.00
C112_1	16.5mROW-No-Sidewalk	0.00	0.10	0.00
C112_2	16.5mROW-No-Sidewalk	1.01	0.27	0.27
C113	16.5mROW-No-Sidewalk	0.12	0.27	0.03
C114_1	16.5mROW-No-Sidewalk	0.63	0.06	0.04
C114_3	16.5mROW-No-Sidewalk	0.47	0.08	0.04
C114_4	16.5mROW-No-Sidewalk	0.28	0.27	0.08
C116	16.5mROW-No-Sidewalk	0.29	0.13	0.04
C117	16.5mROW-No-Sidewalk	0.10	0.27	0.03
C118_1	16.5mROW-Sidewalk	0.24	0.06	0.01
C118_2	16.5mROW-Sidewalk	0.40	0.25	0.10
C119	16.5mROW-Sidewalk	0.76	0.25	0.19
C12	16.5mROW-Sidewalk	0.33	0.35	0.12
C13	16.5mROW-Sidewalk	0.93	0.35	0.33
C14	16.5mROW-Sidewalk	1.32	0.12	0.16
C144	Major System Overflow	0.91	0.06	0.05
C15	16.5mROW-Sidewalk	0.27	0.34	0.09
C15_1	16.5mROW-No-Sidewalk	0.75	0.12	0.09
C15_2	16.5mROW-No-Sidewalk	0.96	0.12	0.12
C16_2	16.5mROW-No-Sidewalk	0.83	0.11	0.09
C16_3	16.5mROW-No-Sidewalk	0.31	0.14	0.04
C16_4	16.5mROW-No-Sidewalk	0.41	0.11	0.05
C17	16.5mROW-No-Sidewalk	2.05	0.29	0.59
C18	16.5mROW-No-Sidewalk	1.70	0.14	0.24
C2	16.5mROW-No-Sidewalk	0.60	0.21	0.13
C20_1	16.5mROW-No-Sidewalk	1.53	0.12	0.18
C20_3	16.5mROW-No-Sidewalk	1.04	0.13	0.14
C20_4	16.5mROW-No-Sidewalk	1.38	0.11	0.15
C20_5	16.5mROW-No-Sidewalk	1.72	0.12	0.21
C22	16.5mROW-No-Sidewalk	1.07	0.13	0.14
C23	16.5mROW-No-Sidewalk	1.06	0.12	0.13
C24_1	16.5mROW-No-Sidewalk	0.55	0.10	0.06
C24_2	16.5mROW-No-Sidewalk	0.65	0.12	0.08
C25_1	16.5mROW-No-Sidewalk	0.00	0.07	0.00

Table D9: Flow Depths 100-Year 3 Hour Chicago +20% Peak Flow

Link Name	Transect	Max Velocity (m/s)	Max Depth (m)	Depth x Velocity (m ² /s)
C25_2	16.5mROW-No-Sidewalk	0.75	0.07	0.05
C26	16.5mROW-No-Sidewalk	0.00	0.00	0.00
C27	16.5mROW-No-Sidewalk	0.00	0.00	0.00
C28	16.5mROW-No-Sidewalk	0.00	0.18	0.00
C29_1	16.5mROW-No-Sidewalk	1.05	0.06	0.06
C29_2	16.5mROW-No-Sidewalk	0.62	0.09	0.06
C3	16.5mROW-No-Sidewalk	0.20	0.21	0.04
C30	16.5mROW-No-Sidewalk	0.15	0.18	0.03
C31_1	16.5mROW-No-Sidewalk	0.23	0.05	0.01
C31_2	16.5mROW-No-Sidewalk	0.87	0.06	0.05
C32	16.5mROW-No-Sidewalk	0.77	0.11	0.08
C33_1	16.5mROW-No-Sidewalk	0.93	0.15	0.14
C33_2	16.5mROW-No-Sidewalk	1.20	0.15	0.18
C34_1	16.5mROW-No-Sidewalk	1.50	0.12	0.18
C34_2	16.5mROW-No-Sidewalk	1.32	0.15	0.20
C35	16.5mROW-No-Sidewalk	1.66	0.16	0.27
C36	16.5mROW-No-Sidewalk	0.72	0.42	0.30
C39	16.5mROW-No-Sidewalk	0.31	0.42	0.13
C4_1	16.5mROW-No-Sidewalk	0.28	0.24	0.07
C4_2	16.5mROW-No-Sidewalk	0.18	0.24	0.04
C41	16.5mROW-No-Sidewalk	0.28	0.45	0.13
C42	16.5mROW-No-Sidewalk	0.80	0.45	0.36
C43	16.5mROW-Sidewalk	0.73	0.31	0.23
C44	16.5mROW-Sidewalk	0.23	0.31	0.07
C45	16.5mROW-Sidewalk	0.37	0.48	0.18
C46	16.5mROW-Sidewalk	1.05	0.48	0.50
C47_1	16.5mROW-Sidewalk	0.09	0.07	0.01
C47_2	16.5mROW-Sidewalk	0.12	0.17	0.02
C47_3	16.5mROW-Sidewalk	0.30	0.33	0.10
C48	16.5mROW-Sidewalk	0.18	0.33	0.06
C49_1	16.5mROW-Sidewalk	0.17	0.14	0.02
C49_2	16.5mROW-Sidewalk	0.35	0.29	0.10
C5	16.5mROW-No-Sidewalk	0.66	0.05	0.03
C50	16.5mROW-Sidewalk	1.13	0.29	0.33
C51_1	24mROW-DbI-Sidewalk	0.00	0.08	0.00
C51_2	24mROW-DbI-Sidewalk	0.96	0.08	0.08
C51_4	24mROW-DbI-Sidewalk	0.75	0.10	0.08
C51_5	24mROW-DbI-Sidewalk	0.21	0.10	0.02
C52	24mROW-DbI-Sidewalk	0.00	0.00	0.00
C53	24mROW-DbI-Sidewalk	0.67	0.03	0.02
C54	24mROW-DbI-Sidewalk	0.56	0.11	0.06
C55	16.5mROW-Sidewalk	0.36	0.34	0.12
C56	16.5mROW-Sidewalk	0.24	0.34	0.08
C57_1	16.5mROW-Sidewalk	0.51	0.18	0.09
C57_2	16.5mROW-Sidewalk	0.70	0.38	0.27
C58	16.5mROW-Sidewalk	0.21	0.38	0.08
C59	24mROW-DbI-Sidewalk	0.00	0.05	0.00
C6	16.5mROW-No-Sidewalk	0.63	0.06	0.04
C60_1	24mROW-DbI-Sidewalk	1.24	0.05	0.06
C60_2	24mROW-DbI-Sidewalk	1.25	0.06	0.08
C61_2	24mROW-DbI-Sidewalk	1.13	0.09	0.10
C61_3	24mROW-DbI-Sidewalk	1.30	0.07	0.09
C61_4	24mROW-DbI-Sidewalk	1.16	0.07	0.08
C62_1	24mROW-DbI-Sidewalk	0.92	0.11	0.10
C62_2	24mROW-DbI-Sidewalk	1.15	0.12	0.14
C63_1	24mROW-DbI-Sidewalk	0.98	0.12	0.12

Table D9: Flow Depths 100-Year 3 Hour Chicago +20% Peak Flow

Link Name	Transect	Max Velocity (m/s)	Max Depth (m)	Depth x Velocity (m ² /s)
C63_2	24mROW-DbI-Sidewalk	0.82	0.34	0.28
C64	16.5mROW-Sidewalk	1.04	0.42	0.44
C65	16.5mROW-Sidewalk	1.09	0.42	0.46
C66	16.5mROW-Sidewalk	0.00	0.27	0.00
C67	16.5mROW-Sidewalk	0.00	0.31	0.00
C68	16.5mROW-Sidewalk	0.00	0.27	0.00
C69	16.5mROW-Sidewalk	0.18	0.31	0.06
C7_1	16.5mROW-No-Sidewalk	0.87	0.12	0.10
C7_2	16.5mROW-No-Sidewalk	1.39	0.12	0.17
C70	16.5mROW-Sidewalk	0.35	0.26	0.09
C71	16.5mROW-Sidewalk	0.16	0.26	0.04
C72	16.5mROW-No-Sidewalk	0.00	0.00	0.00
C73	16.5mROW-No-Sidewalk	0.00	0.03	0.00
C74_1	16.5mROW-No-Sidewalk	0.15	0.07	0.01
C74_2	16.5mROW-No-Sidewalk	0.41	0.12	0.05
C75	16.5mROW-No-Sidewalk	1.99	0.12	0.24
C76_1	16.5mROW-No-Sidewalk	1.43	0.09	0.13
C76_2	16.5mROW-No-Sidewalk	1.25	0.10	0.13
C77_2	16.5mROW-No-Sidewalk	1.14	0.10	0.11
C77_4	16.5mROW-No-Sidewalk	1.20	0.11	0.13
C77_5	16.5mROW-No-Sidewalk	1.01	0.11	0.11
C78	16.5mROW-No-Sidewalk	0.95	0.37	0.35
C79	16.5mROW-No-Sidewalk	0.28	0.37	0.10
C8	16.5mROW-No-Sidewalk	0.29	0.30	0.09
C80_1	16.5mROW-No-Sidewalk	0.56	0.20	0.11
C80_2	16.5mROW-No-Sidewalk	0.70	0.29	0.20
C81	16.5mROW-No-Sidewalk	0.64	0.42	0.27
C82	16.5mROW-No-Sidewalk	0.35	0.42	0.15
C83_1	16.5mROW-No-Sidewalk	0.00	0.20	0.00
C83_2	16.5mROW-No-Sidewalk	0.29	0.35	0.10
C84	16.5mROW-No-Sidewalk	0.87	0.35	0.30
C85	16.5mROW-No-Sidewalk	0.00	0.24	0.00
C86	16.5mROW-No-Sidewalk	0.21	0.24	0.05
C88_1	16.5mROW-No-Sidewalk	0.67	0.17	0.11
C88_2	16.5mROW-No-Sidewalk	0.49	0.28	0.14
C89	16.5mROW-No-Sidewalk	1.19	0.45	0.54
C9_1	16.5mROW-No-Sidewalk	0.37	0.29	0.11
C9_2	16.5mROW-No-Sidewalk	0.35	0.30	0.11
C90	16.5mROW-No-Sidewalk	1.01	0.45	0.45
C91	16.5mROW-No-Sidewalk	0.00	0.10	0.00
C93_1	16.5mROW-No-Sidewalk	0.35	0.05	0.02
C93_2	16.5mROW-No-Sidewalk	0.55	0.06	0.03
C94	16.5mROW-No-Sidewalk	0.72	0.06	0.04
C95	16.5mROW-No-Sidewalk	0.44	0.22	0.10
C96	16.5mROW-No-Sidewalk	0.28	0.22	0.06
C97	16.5mROW-No-Sidewalk	0.29	0.24	0.07
C98	16.5mROW-No-Sidewalk	0.77	0.24	0.18
C99	16.5mROW-No-Sidewalk	0.20	0.32	0.06
	Max	2.05	0.48	0.59

Note: Depth and velocity calculated by PCSWMM model

E.3 GEOTECHNICAL INVESTIGATION REPORT BY PATERSON INC.
(MARCH 2020)



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Geotechnical Investigation

Proposed Mixed Use Development
Half Moon Bay South - Phase 8
3718 Greenbank Road - Ottawa

Prepared For

Mattamy Homes

March 30, 2021

Report: PG5690-1

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Appendices

Appendix 1

Soil Profile and Test Data Sheets
Symbols and Terms
Grain Size Distribution Test Results
Analytical Testing

Appendix 2

Figure 1 - Key Plan
Figure 2 to 5 - Aerial Photographs
Drawing PG5690-1 - Test Hole Location Plan

1.0 Introduction

Paterson Group (Paterson) was commissioned by Mattamy Homes to conduct a geotechnical investigation for Phase 8 of Half Moon Bay South development located at 3718 Greenbank Road, in the City of Ottawa (refer to Figure 1 - Key Plan presented in Appendix 2).

The objective of the investigation was to:

- determine the subsoil and groundwater conditions at this site by means of a borehole program.
- provide geotechnical recommendations for the design of the proposed development based on the results of the boreholes and other soil information available.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. The report contains our findings and includes geotechnical recommendations pertaining to the design and construction of the proposed development as understood at the time of this report.

2.0 Proposed Development

It is understood that the current phase of the proposed development will consist of residential condominium blocks with or without basements and commercial areas consisting of slab on grade buildings. Associated driveways, local roadways and landscaping areas are also anticipated as part of the proposed development.

It is further understood that the proposed development will be serviced by future municipal water, sanitary and storm services.

3.0 Method of Investigation

3.1 Field Investigation

The field program for the current geotechnical investigation was carried out between February 17 and 23, 2021 and consisted of advancing a total of 12 boreholes to a maximum depth of 9.8 m below existing grade. Previous investigations were completed within the general area and surroundings of the subject site and consisted of a series of boreholes and test pits advanced to a maximum depth of 9.1 m below ground surface. The borehole locations were distributed in a manner to provide general coverage of the subject site and taking into consideration current site conditions. The test holes locations are shown on Drawing PG5690-1 - Test Hole Location Plan included in Appendix 2.

The test holes were completed using a track mounted drill operated by a two-person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer. The drilling procedure consisted of drilling to the required depths at the selected locations, and sampling and testing the overburden.

Sampling and In Situ Testing

Soil samples were collected from the boreholes using a 50 mm diameter split-spoon (SS) sampler. All soil samples were visually inspected and initially classified on site. The auger, split-spoon and grab samples were placed in sealed plastic bags and transported to the our laboratory for examination and classification. The depths at which the auger, and split-spoon samples were recovered from the test holes are shown as AU, and SS, respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

The Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split-spoon samples. The SPT results are recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split-spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

The thickness of the silty sand deposit was evaluated by a dynamic cone penetration testing (DCPT) completed at BH 7-21. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at the tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

The subsurface conditions observed at the test hole locations were recorded in detail in the field. Our findings are presented in the Soil Profile and Test Data sheets in Appendix 1.

Groundwater Monitoring

All boreholes were fitted with flexible piezometers to allow groundwater level monitoring. The groundwater observations are discussed in Subsection 4.3 and presented in the Soil Profile and Test Data sheets in Appendix 1.

Sample Storage

All samples from the current investigation will be stored in the laboratory for a period of one month after issuance of this report. They will then be discarded unless we are otherwise directed.

3.2 Field Survey

The test hole locations were determined by Paterson personnel and surveyed in the field by Paterson using a handheld, high precision GPS. The ground surface elevation at each test hole location is referenced to a geodetic datum. The locations of the boreholes are presented on Drawing PG5690-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soil samples were collected from the subject site during the investigation and were visually examined in our laboratory to review the results of the field logging. Three grain size distribution analyses were completed on selected soil samples. The results of our testing are presented in Subsection 4.2 and on Grain Size Distribution Analysis sheets presented in Appendix 1.

3.4 Analytical Testing

One (1) soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The sample was submitted to determine the concentration of sulphate and chloride, the resistivity and the pH of the sample. The results are presented in Appendix 1 and are discussed further in Subsection 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site is a former agricultural land. The bulk of the current phase of the proposed development has been recently cleared of topsoil and peat which has been stockpiled in several piles across the site. Generally, the ground surface across the subject site is relatively flat within the central portion and slopes up towards the edges. It should be noted that parts of the subject site had undergone excavation and in-filling activities as part of a previous sand extraction operation. Historical aerial photographs of the site indicating fill movement activities since 1976 are presented in Appendix 2. The area to the south is significantly elevated. The area to the north and west also present a steep slope where fill was encountered.

The site is bordered to the south by a park and vacant land and to the north and west by future residential developments and the east by the future Greenbank Road.

4.2 Subsurface Profile

Generally, the subsurface profile across the subject site consists of varying amounts of fill consisting of silty sand mixed with occasional silty clay, gravel and cobbles. It should be noted that the fill thickness within BH 9-21, BH 10-21 and BH 11-21 ranged from 4.5 m and up to 8.23 m below ground surface.

A deep deposit of compact to dense brown silty sand to underlain the fill layer. Gravel and cobbles were occasionally encountered within the silty sand layer. The silty sand was observed to be underlain by a glacial till deposit composed of dense brown sandy silt to silty sand with gravel, cobbles and boulders within BH 3-21.

Practical refusal to augering was encountered at a range between 4.6 m and 8.3 m below existing ground surface. Practical refusal to DCPT was encountered at 9.8 m below existing ground surface at BH 7-21.

Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for specific details of the soil profiles encountered at each test hole location.

Bedrock

Based on available geological mapping, the bedrock in the subject area consists of Paleozoic interbedded Sandstone and Dolomite from the March formation, with an overburden drift thickness of 10 to 15 m depth.

Grain Size Distribution and Hydrometer Testing

Grain size distribution (sieve and hydrometer analysis) testing was completed on three selected soil samples. The results of the grain size analysis are summarized in Table 1 and presented on the Grain-Size Distribution and Hydrometer Testing Results sheets in Appendix 1.

Table 1 - Grain Size Distribution				
Borehole	Sample	Gravel (%)	Sand (%)	Silt and Clay (%)
BH2-21	SS3 & SS4	1.8	89.4	8.8
BH4-21	SS4 & SS5	0	88.9	11.1
BH8-21	SS4 & SS5	46.9	43.1	10

4.3 Groundwater

Groundwater levels were measured in the groundwater monitoring wells on March 4, 2021. The piezometers in BH 7-21, BH 11-21 and BH 12-21 were damaged or buried and could not be recorded. The remaining boreholes were dry upon completion.

Long-term groundwater level can also be estimated based on the observed moisture levels, colour and consistency of the recovered soil samples. Based on these observations, the long-term groundwater table can be expected well below 8 m below existing ground surface. It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater level could vary at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed mixed-use development. It is anticipated that the proposed buildings will be founded over conventional footings placed over an undisturbed compact to dense silty sand or dense glacial till bearing surface or an engineered fill pad over an approved fill subgrade bearing medium.

To adequately distribute the foundation loads in areas where the existing fill is encountered below the building footprint, a woven geotextile liner, such as Terratrack 200 or equivalent, should be placed 500 mm below design underside of footing level and extend at least 1 m horizontally beyond the footing face. A biaxial geogrid, such as Terrafix TBX2500 or equivalent, should be placed over the woven geotextile liner. A minimum 500 mm thick pad, consisting of a Granular B Type II, compacted to 98% of its SPMDD should be placed up to design underside of footing level. Prior to placement of the abovenoted engineered fill pad, it is recommended that a proof-rolling program be completed by a vibratory roller making several passes and approved by Paterson personnel over the sub-excavated area below the proposed footings.

For areas where a fill layer is encountered below the granular layer for the floor slab, it is recommended to sub-excavate 500 mm below the underside of floor slab granulars and place a woven geotextile liner, such as Terratrack 200W or equivalent, and a biaxial geogrid, such as Terrafix TBX2500 or equivalent. It is recommended that a proof-rolling program be completed by a vibratory roller making several passes and approved by Paterson personnel prior to placement of the geotextile liner and biaxial geogrid. Any poor performing areas should be removed and reinstated with a select subgrade fill compacted to 98% of its SPMDD under dry and above freezing temperatures.

The proof-rolling program should also be completed across paved areas to ensure that any poor performing soils are removed prior to pavement structure placement.

Due to the absence of a silty clay deposit, the aforementioned site will not be subjected to permissible grade raise restrictions. Also, no tree planting setback restrictions are required for the subject phase of the proposed development due to the absence of a silty clay deposit.

The above and other considerations are further discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures.

Fill Placement

Fill used for grading beneath the proposed building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. The fill should be placed in lifts of 300 mm thick or less and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building areas should be compacted to at least 99% of the Standard Proctor Maximum Dry Density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill and beneath parking areas where settlement of the ground surface is of minor concern. In landscaped areas, these materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of the SPMDD.

Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

Proof Rolling

Proof rolling of the subgrade is required in areas where the existing fill, free of significant amounts of organics and deleterious materials, is encountered. It is recommended that the subgrade surface be proof-rolled **under dry conditions and in above freezing temperatures** by an adequately sized roller making several passes to achieve optimum compaction levels. The compaction program should be reviewed and approved by the geotechnical consultant at the time of construction.

5.3 Foundation Design

Conventional Spread Footings

Footings placed directly on an undisturbed, compact silty sand or glacial till bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **225 kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

Footings placed over a minimum 500 mm thick geogrid reinforced engineered pad, consisting of a Granular A or Granular B Type II or approved granular fill alternative placed in maximum 300 mm loose lifts and compacted to 98% of its SPMDD, placed over a subgrade soil approved by the Paterson personnel at the time of construction, can be designed using a bearing resistance value at SLS of **150 kPa** and a factored bearing resistance value at ULS of **250 kPa**.

An undisturbed soil bearing surface consists of a surface from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

Footings placed on a soil bearing surface and designed using the bearing resistance values at SLS given above will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively.

Where the silty sand subgrade is found to be in a loose state, the contractor should compact the subgrade under dry conditions and above freezing temperatures, using suitable compaction equipment, making several passes and approved by Paterson.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to the in-situ bearing medium soils above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class D**. Based on the current information, including the level of groundwater table and compactness of the underlying sand layer, the soil underlying the subject site is not susceptible to liquefaction. Reference should be made to the latest revision of the 2012 Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Basement Slab / Slab-on-Grade Construction

With the removal of all topsoil and fill, containing significant amounts of deleterious or organic materials, the native soil and/or approved fill pad (placed as per Subsection 5.0) will be considered to be an acceptable subgrade surface on which to commence backfilling for the floor slab. Any poor performing areas should be removed and reinstated with an engineered fill, such as Granular B Type II.

For slab-on-grade areas, it is recommended that the upper 200 mm of sub-slab fill consist OPSS Granular A crushed stone. For basement slabs, it is recommended that the upper 200 mm of sub-floor fill consist of 19 mm clear crushed stone

5.6 Pavement Structure

Driveways, local residential roadways, heavy truck parking/loading areas and roadways with bus traffic are anticipated at this site. The proposed pavement structures are shown in Tables 2, 3 and 4.

Table 2 - Recommended Pavement Structure - Driveways and at-grade car parking areas	
Thickness (mm)	Material Description
50	Wear Course - HL 3 or Superpave 12.5 Asphaltic Concrete
150	BASE - OPSS Granular A Crushed Stone
300	SUBBASE - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 3 - Recommended Pavement Structure - Local Residential Roadways and Heavy Truck Parking / Loading Areas	
Thickness (mm)	Material Description
40	Wear Course - Superpave 12.5 Asphaltic Concrete
50	Binder Course - Superpave 19.0 Asphaltic Concrete
150	BASE - OPSS Granular A Crushed Stone
400	SUBBASE - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil	

Table 4 - Recommended Pavement Structure - Roadways with Bus Traffic	
Thickness mm	Material Description
40	Wear Course - Superpave 12.5 Asphaltic Concrete
50	Upper Binder Course - Superpave 19.0 Asphaltic Concrete
50	Lower Binder Course - Superpave 19.0 Asphaltic Concrete
150	BASE - OPSS Granular A Crushed Stone
600	SUBBASE - OPSS Granular B Type II
SUBGRADE - Either in situ soil or OPSS Granular B Type II material placed over in situ soil	

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment. Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

A perimeter foundation drainage system is recommended for proposed structures. The system should consist of a 100 to 150 mm diameter, geotextile-wrapped, perforated, corrugated, plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Foundation Backfill

Backfill against the exterior sides of the foundation walls should consist of free-draining, non frost susceptible granular materials. The site materials will be frost susceptible and, as such, are not recommended for re-use as backfill unless a composite drainage system (such as system Delta Drain 6000 or Miradrain G100N) connected to a perimeter drainage system is provided.

6.2 Protection Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect of frost action. A minimum 1.5 m thick soil cover should be provided for adequate frost protection of heated structured, or an equivalent combination of soil cover and foundation insulation.

Exterior unheated footings, such as those for isolated exterior piers and loading docks, are more prone to deleterious movement associated with frost action than the exterior walls of the heated structure and require additional protection, such as soil cover of 2.1 m or an equivalent combination of soil cover and foundation insulation.

6.3 Excavation Side Slopes

The side slopes of the excavations in the soil and fill overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is expected that sufficient room will be available for the greater part of the excavation to be undertaken by open-cut methods (i.e. unsupported excavations).

Unsupported Excavations

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or shallower. The shallower slope is required for excavation below groundwater level. The subsoil at this site is considered to be mainly Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by “cut and cover” methods and excavations will not be left open for extended periods of time.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications & Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa.

At least 150 mm of OPSS Granular A should be used for pipe bedding for sewer and water pipes. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe, should consist of OPSS Granular A or Granular B Type II with a maximum size of 25 mm. The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to 98% of the material's SPMDD.

It should generally be possible to re-use the site excavated materials above the cover material if the operations are carried out in dry weather conditions.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone, (about 1.5 m below finished grade) and above the cover material should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 225 mm thick lifts and compacted to 95% of the materials SPMDD.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be low to moderate and controllable using open sumps. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

Permit to Take Water

A temporary Ministry of the Environment, Conservation and Parks (MECP) permit to take water (PTTW) may be required for this project if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase. A minimum of 4 to 5 months should be allowed for completion of the PTTW application package and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project, where excavations are completed in proximity of existing structures which may be adversely affected due to the freezing conditions.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the installation of straw, propane heaters and tarpaulins or other suitable means. The base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

Trench excavations and pavement construction are difficult activities to complete during freezing conditions without introducing frost in the subgrade or in the excavation walls and bottoms. Precautions should be considered if such activities are to be completed during freezing conditions. Additional information could be provided, if required.

6.7 Corrosion Potential and Sulphate

The results on analytical testing show that the sulphate content is less than 0.1%. The results are indicative that Type 10 Portland Cement (normal cement) would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a very low to slightly aggressive corrosive environment.

7.0 Recommendations

It is recommended that the following be completed once the master plan and site development are determined:

- Review detailed grading plan(s) from a geotechnical perspective.
- Observation of all bearing surfaces prior to the placement of concrete.
- Sampling and testing of the concrete and fill materials used.
- Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- Observation of all subgrades prior to placing backfilling materials.
- Field density tests to determine the level of compaction achieved.
- Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these works have been conducted in general accordance with Paterson's recommendations could be issued upon request, following the completion of a satisfactory material testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations made in this report are in accordance with Paterson's present understanding of the project. Paterson requests permission to review the grading plan once available. Paterson's recommendations should be reviewed when the drawings and specifications are complete.

The client should be aware that any information pertaining to soils and the test hole log are furnished as a matter of general information only. Test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests to be notified immediately in order to permit reassessment of the recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Mattamy Homes or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.



Faisal I. Abou-Seido, P.Eng.



David J. Gilbert, P.Eng.

Report Distribution:

- Mattamy Homes (1 digital copy)
- Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

GRAIN SIZE DISTRIBUTION ANALYSIS

ANALYTICAL TESTING

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2021 February 17

FILE NO. **PG5690**

HOLE NO. **BH 1-21**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %					
GROUND SURFACE								20	40	60	80		
Compact to dense, brown SILTY SAND - Trace gravel by 3.0 m depth		AU	1			0	103.45						
		SS	2	75	17	1	102.45						
		SS	3	75	14	2	101.45						
		SS	4	83	17	3	100.45						
		SS	5	83	13	4	99.45						
		SS	6	67	25	5	98.45						
		SS	7	75	11	6	97.45						
		SS	8	75	20	7	96.45						
		SS	9	83	27	8	95.45						
		SS	10	92	35	9	94.45						
		SS	11	83	24	10	93.45						
		SS	12	83	32	11	92.45						
End of Borehole (Piezometer dry - March 4, 2021)	8.99												

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2021 February 17

FILE NO. **PG5690**

HOLE NO. **BH 2-21**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			20	40	60	80		
GROUND SURFACE						0	102.61						
Compact to dense, brown SILTY SAND - Trace gravel by 7.5 m depth		AU	1										
		SS	2	75	25	1	101.61						
		SS	3	75	19	2	100.61						
		SS	4	75	56	3	99.61						
		SS	5	83	32	4	98.61						
		SS	6	67	39	5	97.61						
		SS	7	75	28	6	96.61						
		SS	8	75	32	7	95.61						
		SS	9	75	33	8	94.61						
		SS	10	75	30	9	93.61						
		SS	11	75	37	10	92.61						
		SS	12	75	30	11	91.61						
End of Borehole (Piezometer dry - March 4, 2021)	8.99												

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2021 February 18

FILE NO. **PG5690**

HOLE NO. **BH 3-21**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE			DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction		
		TYPE	NUMBER	RECOVERY %			N VALUE or RQD	20	40	60		80	
GROUND SURFACE													
FILL: Brown silty sand, some crushed stone and gravel		AU	1			0	107.88						
Dense brown SILTY SAND some gravel		SS	2	33	+50	1	106.88						
GLACIAL TILL: Dense brown sandy silt to silty sand with gravel, cobbles and boulders		SS	3	25	+50	2	105.88						
		SS	4	50	+50	3	104.88						
		SS	5	50	+50	4	103.88						
		SS	6	33	+50	5	102.88						
		SS	7	42	+50	6	101.88						
		SS	8	33	+50								
		SS	9	42	+50								
End of Borehole													
Practical refusal to augering at 6.86 m depth													
(Piezometer dry - March 4, 2021)													

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

DATUM Geodetic

FILE NO. **PG5690**

REMARKS

HOLE NO. **BH 4-21**

BORINGS BY CME 55 Power Auger

DATE 2021 February 18

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			20	40	60	80		
GROUND SURFACE													
FILL: Brown silty sand some clay, gravel, cobbles, trace topsoil	0.76	AU	1			0	105.21						
Compact to dense, brown SILTY SAND		SS	2	50	14	1	104.21						
		SS	3	50	27	2	103.21						
		SS	4	83	28	3	102.21						
		SS	5	83	25	4	101.21						
		SS	6	83	30	5	100.21						
		SS	7	83	28	6	99.21						
		SS	8	83	34	7	98.21						
		SS	9	83	35	8	97.21						
		SS	10	83	29	9	96.21						
		SS	11	75	25	10	95.21						
		SS	12	58	31	11	94.21						
	End of Borehole (Piezometer dry - March 4, 2021)	8.99											

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2021 February 18

FILE NO. **PG5690**

HOLE NO. **BH 5-21**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %					
								20	40	60	80		
GROUND SURFACE													
FILL: Brown silty sand with clay, gravel, trace topsoil	0.81	AU	1			0	105.57						
Compact to dense, reddish brown SILTY SAND - Brown by 2.2 m depth		SS	2	58	25	1	104.57						
		SS	3	58	7	2	103.57						
		SS	4	83	14	3	102.57						
		SS	5	83	9	4	101.57						
		SS	6	58	18	5	100.57						
		SS	7	83	32	6	99.57						
		SS	8	100	16	7	98.57						
		SS	9	83	11	8	97.57						
		SS	10	75	19	9	96.57						
		SS	11	75	23	10	95.57						
		SS	12	75	24	11	94.57						
	End of Borehole (Piezometer dry - March 4, 2021)	8.99											

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2021 February 19

FILE NO. **PG5690**

HOLE NO. **BH 6-21**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			20	40	60	80		
GROUND SURFACE						0	103.25						
FILL: Brown silty sand	0.61	AU	1										
Compact to dense brown SILTY SAND		SS	2	75	46	1	102.25						
		SS	3	58	22	2	101.25						
		SS	4	75	25	3	100.25						
		SS	5	75	23	4	99.25						
		SS	6	67	29	5	98.25						
		SS	7	67	28	6	97.25						
		SS	8	67	26	7	96.25						
		SS	9	75	27	8	95.25						
		SS	10	67	22	9	94.25						
		SS	11	67	22	10	93.25						
		SS	12	67	20	11	92.25						
	End of Borehole (Piezoemter dry - March 4, 2021)	8.99											

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

DATUM Geodetic

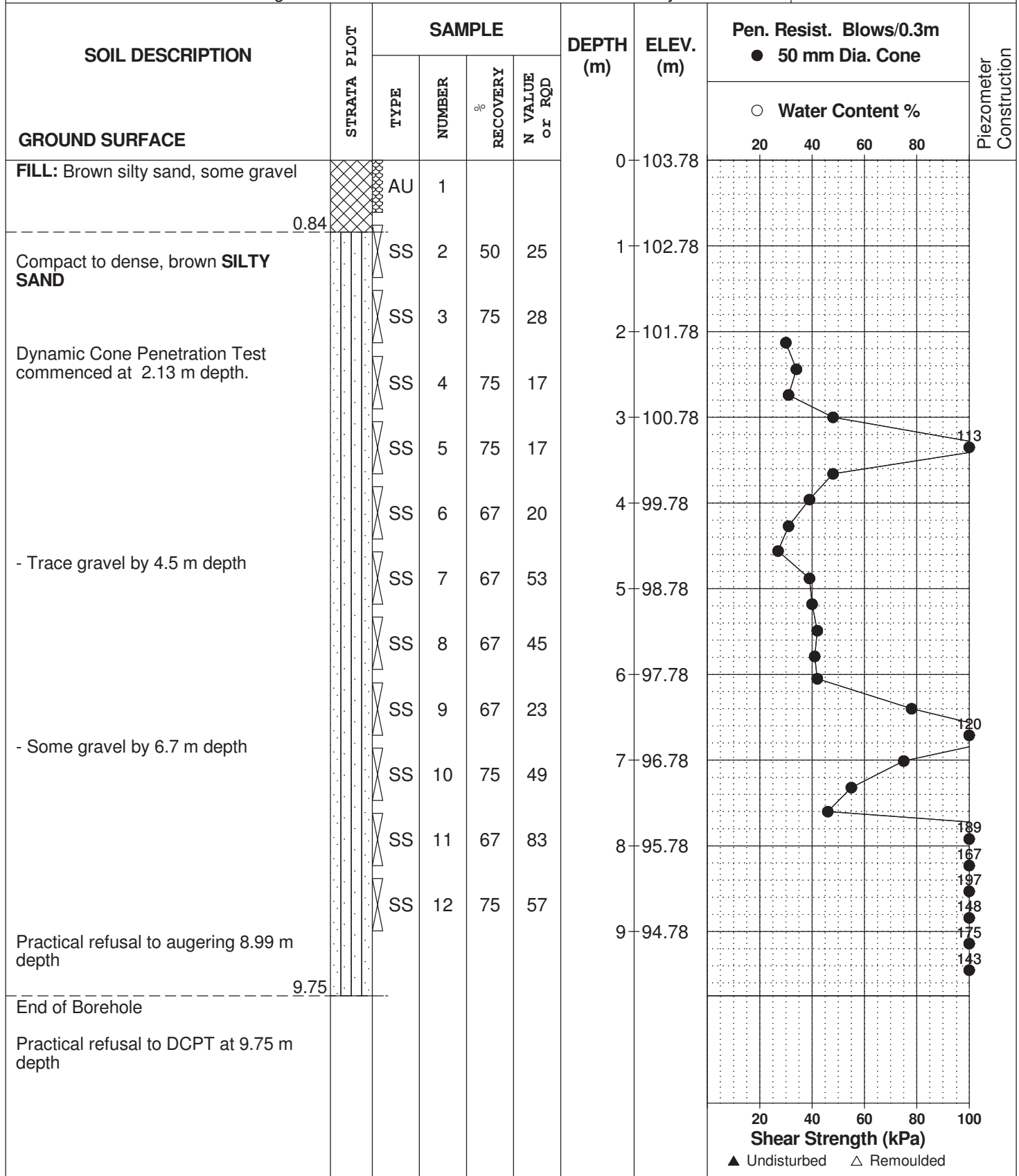
REMARKS

BORINGS BY CME 55 Power Auger

DATE 2021 February 19

FILE NO. **PG5690**

HOLE NO. **BH 7-21**



DATUM Geodetic























REMARKS

BORINGS BY CME 55 Power Auger

DATE 2021 February 22

FILE NO. **PG5690**

HOLE NO. **BH 8-21**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %					
GROUND SURFACE								20	40	60	80		
FILL: Brown silty sand with gravel and crushed stone		AU	1			0	106.13						
	0.61												
Compact to dense, brown SILTY SAND with gravel and cobbles		SS	2	75	47	1	105.13						
		SS	3	75	55	2	104.13						
		SS	4	50	45	3	103.13						
		SS	5	50	51	4	102.13						
		SS	6	50	56	5	101.13						
		SS	7	33	49	6	100.13						
		SS	8	50	61	7	99.13						
		SS	9	50	24	8	98.13						
		SS	10	33	31	9	98.13						
		SS	11	50	51	10	98.13						
	8.38												
End of Borehole													
Practical refusal to augering at 8.38 m depth													
(Piezometer dry - March 4, 2021)													
													
													
													
													
													

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2021 February 22

FILE NO. **PG5690**

HOLE NO. **BH 9-21**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			20	40	60	80	
GROUND SURFACE												
ORGANICS	0.05					0	109.17					
FILL: Brown silty sand with gravel	0.69	AU	1									
FILL: Brown silty clay with sand, gravel, cobbles, trace topsoil		SS	2	17	21	1	108.17					
		SS	3	25	11	2	107.17					
		SS	4	8	4							
		SS	5	50	7	3	106.17					
		SS	6	17	26	4	105.17					
End of Borehole	4.57											
Practical refusal to augering at 4.57 m depth (Piezometer dry - March 4, 2021)												

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2021 February 23

FILE NO. **PG5690**

HOLE NO. **BH10-21**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			20	40	60	80	
GROUND SURFACE												
TOPSOIL	0.05					0	107.98					
FILL: Brown to grey silty clay with sand, gravel, cobbles, trace topsoil		AU	1									
		SS	2	42	12	1	106.98					
		SS	3	42	5	2	105.98					
		SS	4	17	3	3	104.98					
		SS	5	33	5	4	103.98					
		SS	6	25	5	5	102.98					
		SS	7	50	10	6	101.98					
	5.49											
FILL: Brown silty sand, some gravel		SS	8	33	7	7	100.98					
	6.02											
FILL: Brown to grey silty clay with sand, gravel, trace wood and organics		SS	9	42	8	8	99.98					
		SS	10	33	6	9						
		SS	11	4	9	10						
	8.23											
End of Borehole (Piezometer dry - March 4, 2021)												

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2021 February 23

FILE NO. **PG5690**

HOLE NO. **BH11-21**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %					
								20	40	60	80		
GROUND SURFACE													
TOPSOIL FILL: Brown silty clay some sand, gravel, trace topsoil - Wood fragments present at 0.9 m depth	0.05	AU	1			0	105.87						
		SS	2	50	4	1	104.87						
		SS	3	33	5	2	103.87						
		SS	4	50	6	3	102.87						
	3.51	SS	5	42	23	4	101.87						
FILL: Brown silty sand with gravel, trace clay		SS	6	8	28	5	100.87						
	5.03	SS	7	33	21	6	99.87						
FILL: Brown silty clay with sand, gravel, cobbles, trace organics - Increasing sand with depth		SS	8	25	11	7	98.87						
	7.54	SS	9	33	5	8	97.87						
FILL: Brown silty sand with gravel, trace topsoil		SS	10	17	+50	9	96.87						
	8.23	SS	11	42	28								
Compact brown SILTY SAND with gravel, trace cobbles		SS	12	42	67								
	9.14	SS	13	0	+50								
End of Borehole (Piezometer destroyed - March 4, 2021)													

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2021 February 23

FILE NO. **PG5690**

HOLE NO. **BH12-21**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			20	40	60	80		
GROUND SURFACE						0	101.30						
FILL: Brown silty sand with gravel, trace clay		AU	1										
		SS	2	50	64	1	100.30						
		SS	3	50	69	2							
		SS	4	42	28	2	99.30						
End of Borehole (Piezometer destroyed - March 4, 2021)													

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

DATUM Geodetic elevations interpolated from City of Ottawa basemap.

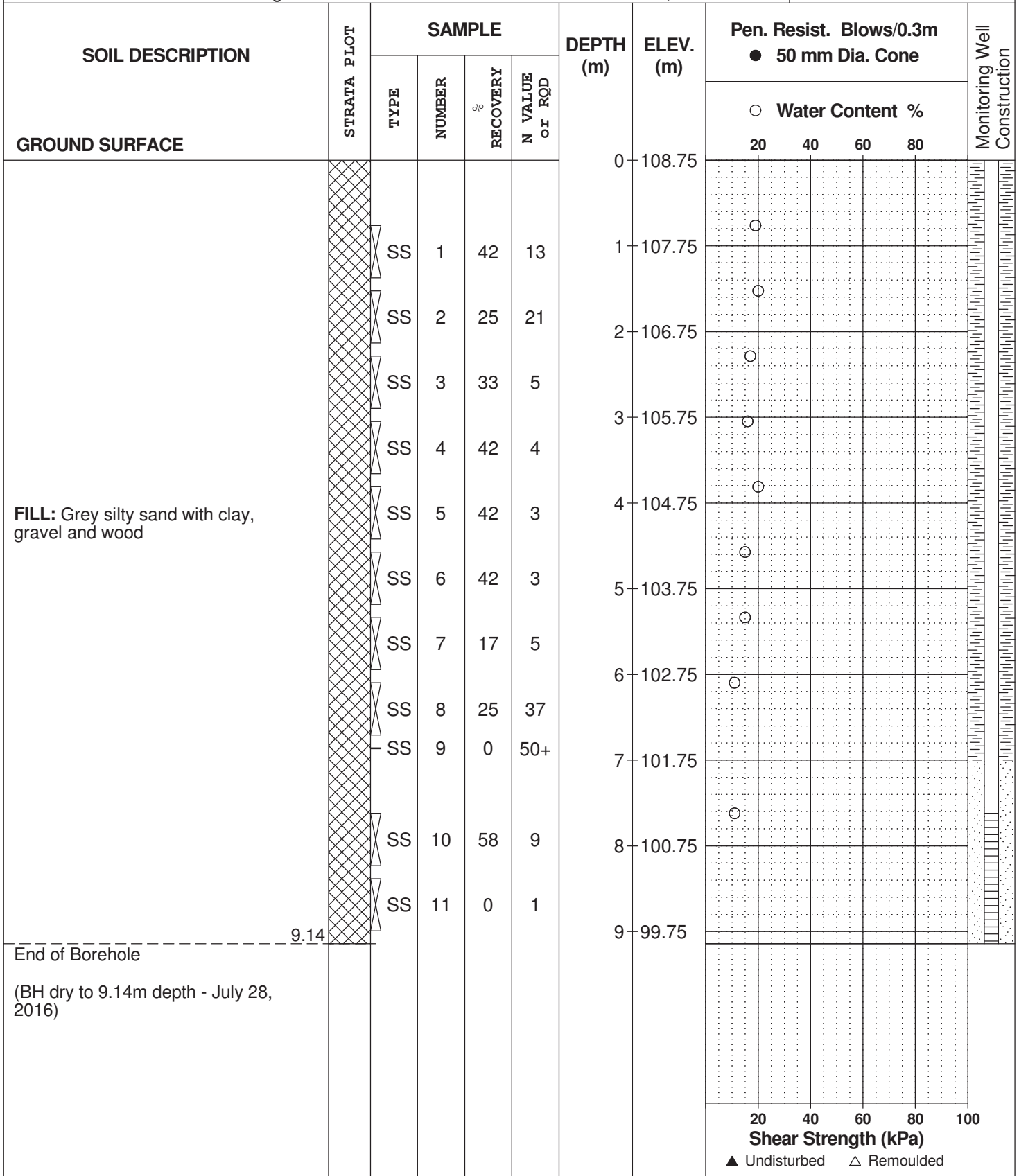
REMARKS

BORINGS BY CME 75 Power Auger

DATE December 10, 2015

FILE NO. **PG3607**

HOLE NO. **BH 5-15**



DATUM Geodetic elevations interpolated from City of Ottawa basemap.

FILE NO. **PG3607**

REMARKS

HOLE NO. **TP 1-15**

BORINGS BY Backhoe

DATE December 2, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	RECOVERY	N VALUE or RQD			20	40	60	80		
GROUND SURFACE						0	105.10						
TOPSOIL	0.10	G	1										
Compact, brown SILTY SAND , trace boulders and cobbles		G	2			1	104.10						
						2	103.10						
End of Test Pit (TP dry upon completion)	3.00					3	102.10						

○ Water Content %

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

DATUM Geodetic elevations interpolated from City of Ottawa basemap.

REMARKS

BORINGS BY Backhoe

DATE December 2, 2015

FILE NO. **PG3607**

HOLE NO. **TP 2-15**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			20	40	60	80		
GROUND SURFACE						0	106.80						
TOPSOIL	0.10												
Compact, brown SILTY SAND		G	1			1	105.80						
		G	2			2	104.80						
End of Test Pit (TP dry upon completion)	3.00					3	103.80						

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

DATUM Geodetic elevations interpolated from City of Ottawa basemap.

REMARKS

BORINGS BY Backhoe

DATE December 2, 2015

FILE NO. **PG3607**

HOLE NO. **TP 9-15**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			20	40	60	80		
GROUND SURFACE						0	108.40						
TOPSOIL	0.20												
Brown SILTY SAND , trace cobbles		G	1			1	107.40						
		G	2			2	106.40						
End of Test Pit (TP dry upon completion)	3.00					3	105.40						

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the relative strength of cohesionless soils is the compactness condition, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm. An SPT N value of "P" denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

Compactness Condition	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity, S_t , is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity:	$S_t < 2$
Medium Sensitivity:	$2 < S_t < 4$
Sensitive:	$4 < S_t < 8$
Extra Sensitive:	$8 < S_t < 16$
Quick Clay:	$S_t > 16$

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	ROCK QUALITY
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube, generally recovered using a piston sampler
G	-	"Grab" sample from test pit or surface materials
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC%	-	Natural water content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic Limit, % (water content above which soil behaves plastically)
PI	-	Plasticity Index, % (difference between LL and PL)
D _{xx}	-	Grain size at which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D ₁₀	-	Grain size at which 10% of the soil is finer (effective grain size)
D ₆₀	-	Grain size at which 60% of the soil is finer
C _c	-	Concavity coefficient = $(D_{30})^2 / (D_{10} \times D_{60})$
C _u	-	Uniformity coefficient = D_{60} / D_{10}

C_c and C_u are used to assess the grading of sands and gravels:

Well-graded gravels have: $1 < C_c < 3$ and $C_u > 4$

Well-graded sands have: $1 < C_c < 3$ and $C_u > 6$

Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.

C_c and C_u are not applicable for the description of soils with more than 10% silt and clay (more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

p' _o	-	Present effective overburden pressure at sample depth
p' _c	-	Preconsolidation pressure of (maximum past pressure on) sample
C _{cr}	-	Recompression index (in effect at pressures below p' _c)
C _c	-	Compression index (in effect at pressures above p' _c)
OC Ratio		Overconsolidation ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
W _o	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.
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SYMBOLS AND TERMS (continued)

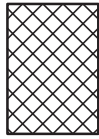
STRATA PLOT



Topsoil



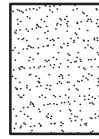
Asphalt



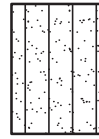
Fill



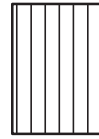
Peat



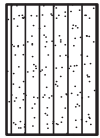
Sand



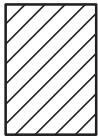
Silty Sand



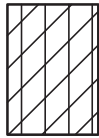
Silt



Sandy Silt



Clay



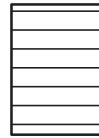
Silty Clay



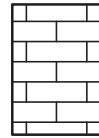
Clayey Silty Sand



Glacial Till



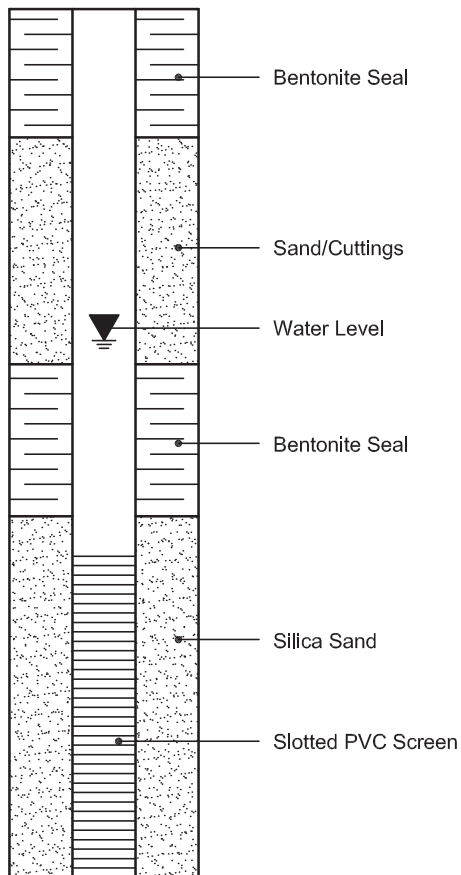
Shale



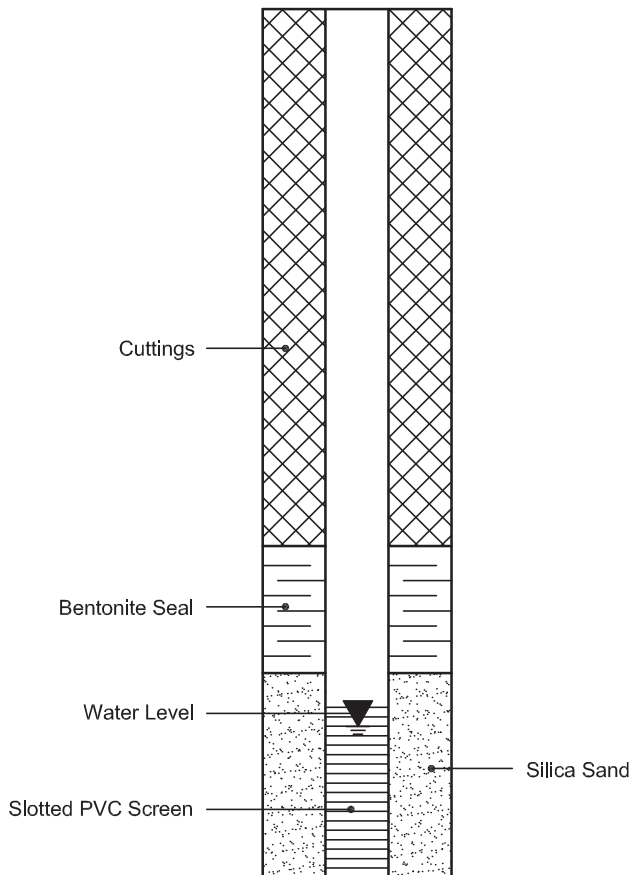
Bedrock

MONITORING WELL AND PIEZOMETER CONSTRUCTION

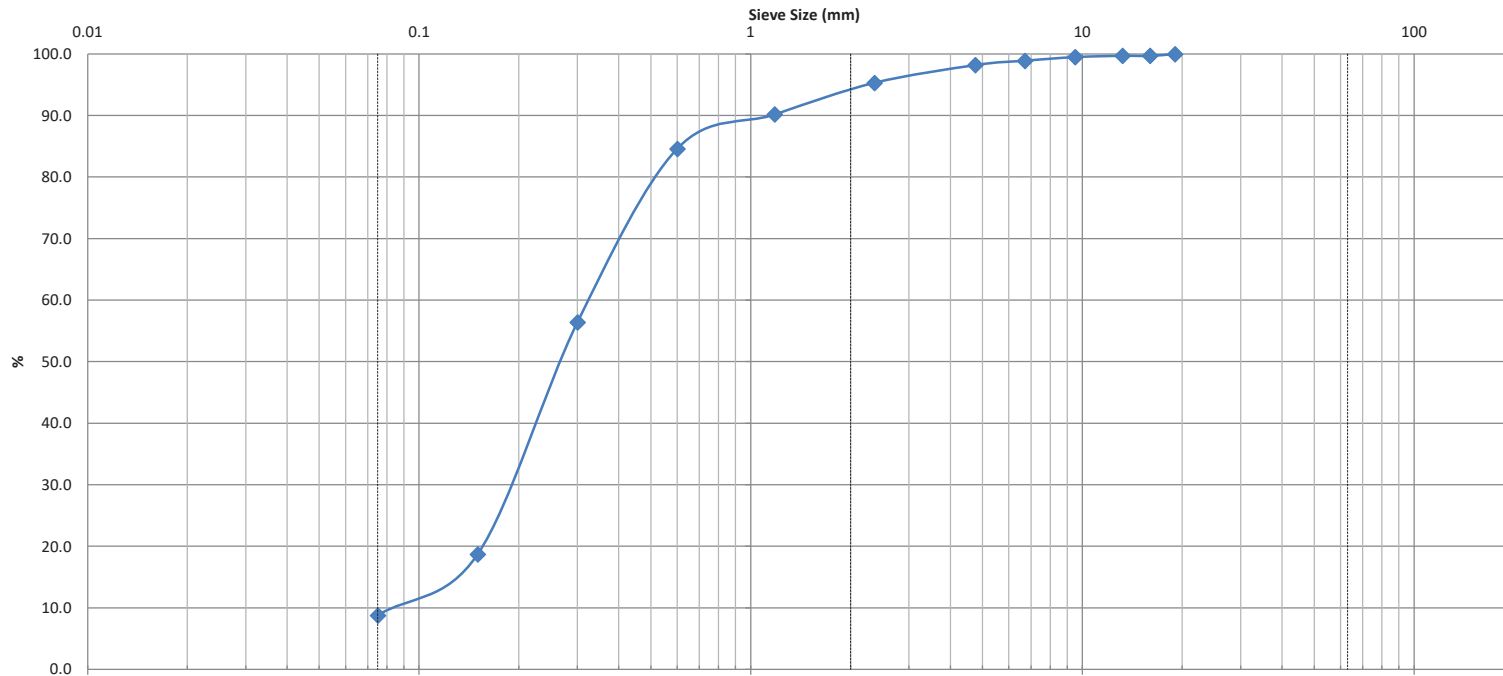
MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



CLIENT:	Mattamy Homes	DESCRIPTION:	Soil	FILE NO:	PG5690
CONTRACT NO.:	-	SPECIFICATION:	Silty Sand	LAB NO:	23721
PROJECT:	3718 Greenbank Road	INTENDED USE:	-	DATE RECEIVED:	25-Mar-21
		PIT OR QUARRY:	in-Situ	DATE TESTED:	26-Mar-21
DATE SAMPLED:	17-Feb-21	SOURCE LOCATION:	BH2-21 SS3 & SS4	DATE REPORTED:	29-Mar-21
SAMPLED BY:	G. Paterson	SAMPLE LOCATION:	1.5 - 2.9 m	TESTED BY:	DK



Silt and Clay	Sand			Gravel		Cobble
	Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification					MC(%)	LL	PL	PI	Cc	Cu
										1.38	3.9
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)	
19.0	0.32	0.19	0.082	1.8	89.4		8.8				

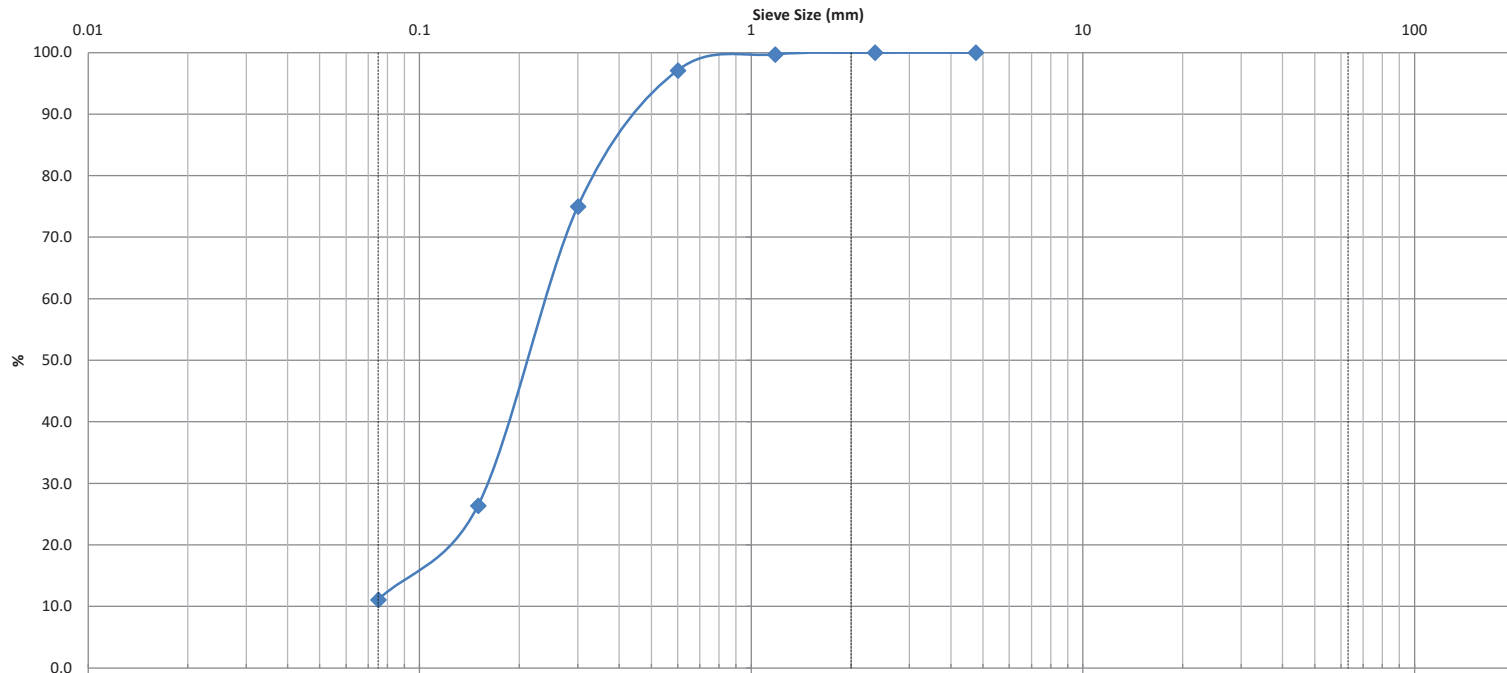
Comments:

REVIEWED BY:

Curtis Beadow

Joe Fosyth, P. Eng.

CLIENT:	Mattamy Homes	DESCRIPTION:	Soil	FILE NO:	PG5690
CONTRACT NO.:	-	SPECIFICATION:	Silty Sand	LAB NO:	23722
PROJECT:	3718 Greenbank Road	INTENDED USE:	-	DATE RECEIVED:	25-Mar-21
		PIT OR QUARRY:	in-Situ	DATE TESTED:	26-Mar-21
DATE SAMPLED:	17-Feb-21	SOURCE LOCATION:	BH4-21 SS4 & SS5	DATE REPORTED:	29-Mar-21
SAMPLED BY:	G. Paterson	SAMPLE LOCATION:	2.29 - 3.66 m	TESTED BY:	DK



Silt and Clay	Sand			Gravel		Cobble
	Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification					MC(%)	LL	PL	PI	Cc	Cu
										1.80	3.3
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)	
4.8	0.23	0.17	0.07	0.0	88.9		11.1				

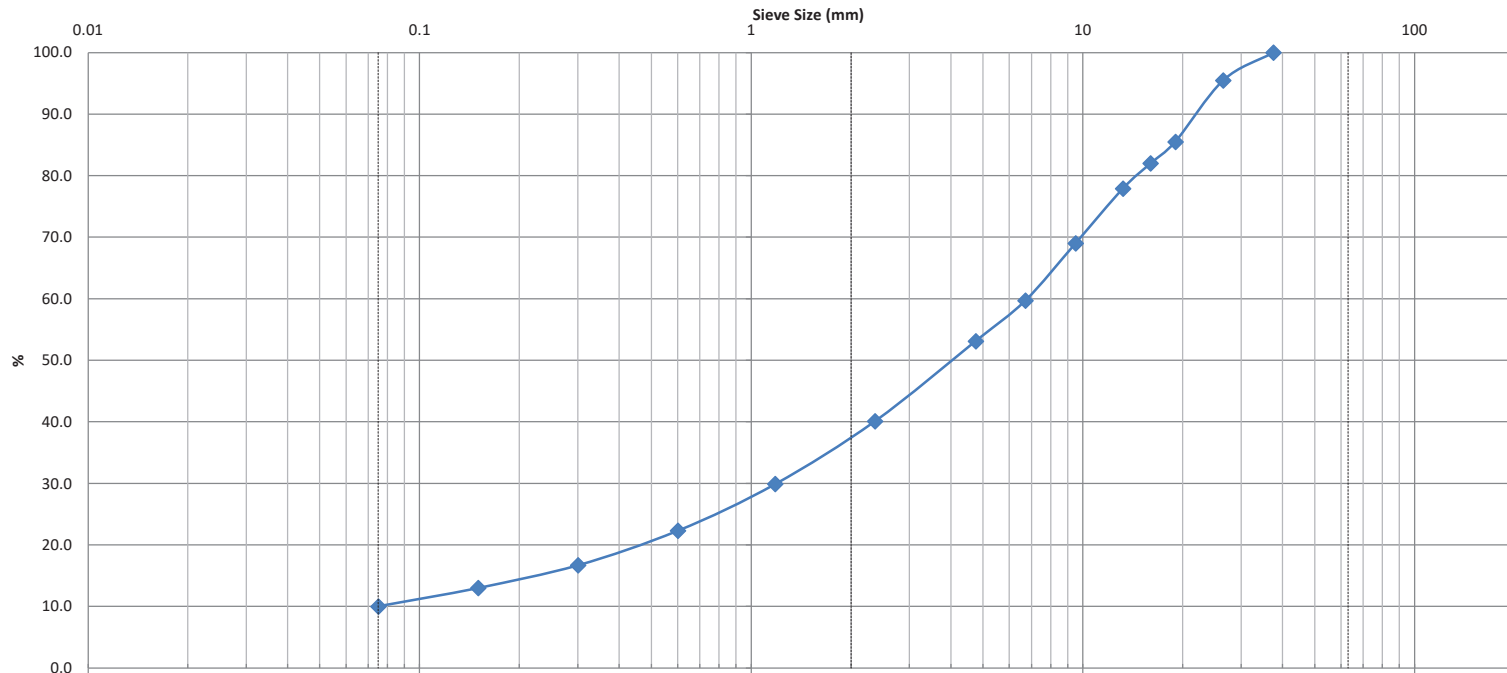
Comments:

REVIEWED BY:

Curtis Beadow

Joe Fosyth, P. Eng.

CLIENT:	Mattamy Homes	DESCRIPTION:	Soil	FILE NO:	PG5690
CONTRACT NO.:	-	SPECIFICATION:	Silty Sand	LAB NO:	23723
PROJECT:	3718 Greenbank Road	INTENDED USE:	-	DATE RECEIVED:	25-Mar-21
		PIT OR QUARRY:	in-Situ	DATE TESTED:	26-Mar-21
DATE SAMPLED:	17-Feb-21	SOURCE LOCATION:	BH8-21 SS4 & SS5	DATE REPORTED:	29-Mar-21
SAMPLED BY:	G. Paterson	SAMPLE LOCATION:	2.29 - 3.66 m	TESTED BY:	DK



Silt and Clay	Sand			Gravel		Cobble
	Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification					MC(%)	LL	PL	PI	Cc	Cu
										3.54	104.6
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)	
37.5	6.8	1.25	0.065	46.9	43.1		10.0				

Comments:

REVIEWED BY:

Curtis Beadow

Joe Fosyth, P. Eng.

Certificate of Analysis

Report Date: 25-Feb-2021

Client: Paterson Group Consulting Engineers

Order Date: 19-Feb-2021

Client PO: 31927

Project Description: PG5690

Client ID:	BH7-21-SS5	-	-	-
Sample Date:	19-Feb-21 09:00	-	-	-
Sample ID:	2108430-01	-	-	-
MDL/Units	Soil	-	-	-

Physical Characteristics

% Solids	0.1 % by Wt.	95.7	-	-	-
----------	--------------	------	---	---	---

General Inorganics

pH	0.05 pH Units	7.30	-	-	-
Resistivity	0.10 Ohm.m	143	-	-	-

Anions

Chloride	5 ug/g dry	7	-	-	-
Sulphate	5 ug/g dry	<5	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURE 2 TO 5 - AERIAL PHOTOGRAPHS

DRAWING PG5690-1 - TEST HOLE LOCATION PLAN



FIGURE 1

KEY PLAN



FIGURE 2

Aerial Photograph - 1976



FIGURE 3

Aerial Photograph - 2002



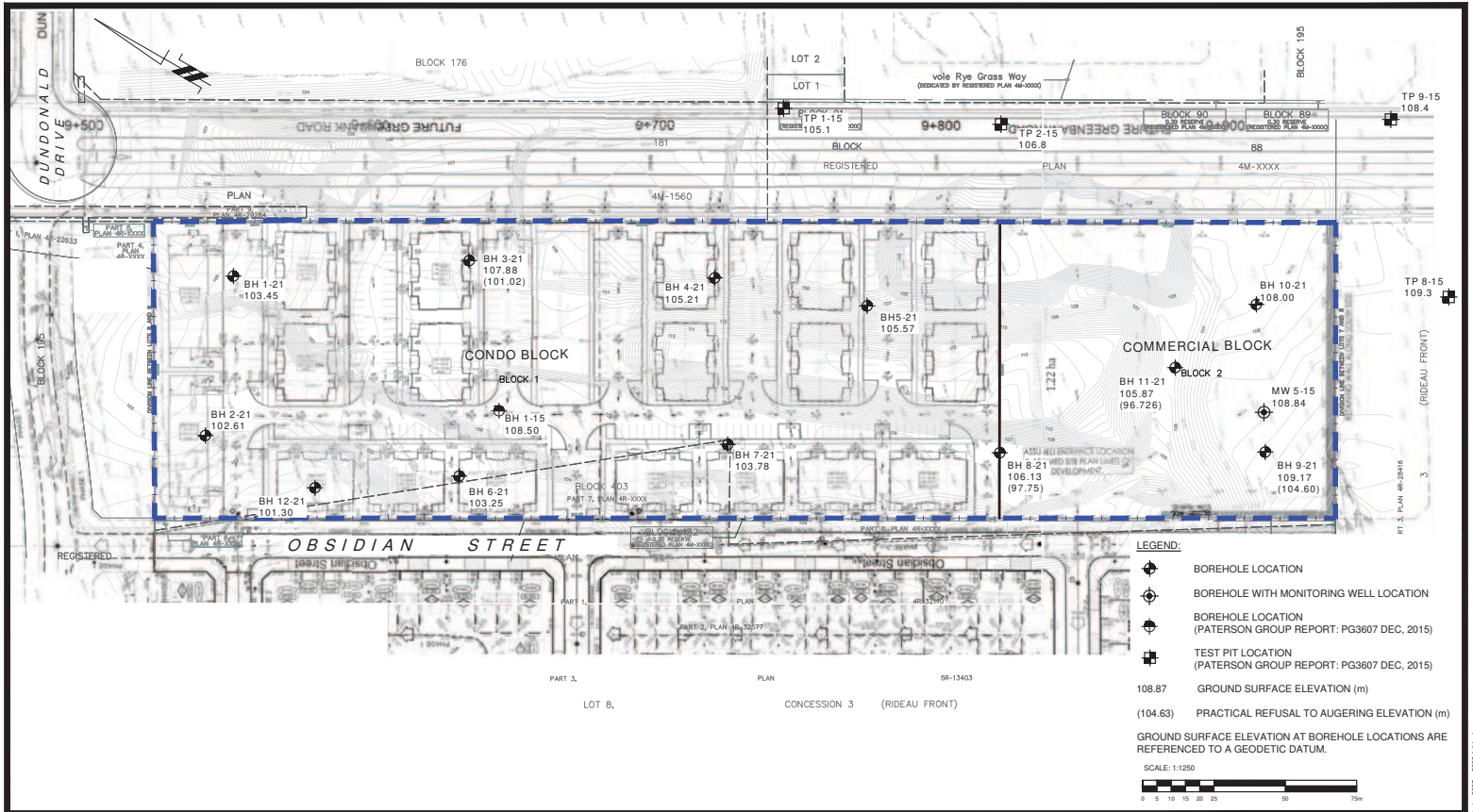
FIGURE 4

Aerial Photograph - 2008



FIGURE 5

Aerial Photograph - 2019



patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL

OTTAWA,

Title:

MATTAMY HOMES
GEOTECHNICAL INVESTIGATION
PROPOSED BOREHOLES
HALF MOON BAY - SOUTH

ONTARIO

TEST HOLE LOCATION PLAN

Scale:	1:1250	Date:	03/2021
Drawn by:	JM	Report No.:	PG5690-1
Checked by:	OC	Dwg No.:	PG5690-1
Approved by:	DJG	Revision No.:	

Appendix F FUNCTIONAL SERVICING DRAWINGS

