FUNCTIONAL SERVICING & STORMWATER MANAGEMENT REPORT

ASHBURY EAST DEVELOPMENT

VILLAGE OF THORNBURY
TOWN OF THE BLUE MOUNTAINS

PREPARED FOR:

61 ALFRED STREET WEST GP INC.

PREPARED BY:

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SEPTEMBER 2019

CFCA FILE NO. 1284-4979

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CROZIER
CONSULTING ENGINEERS

Revision Number	Date	Comments
Rev.0	September 2019	Issued for Draft Plan Approval

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1.0 Introduction

C.F. Crozier and Associates (Crozier) has been retained by 61 Alfred Street West GP Inc. to prepare a Functional Servicing and Stormwater Management Report to support the Draft Plan Application for the proposed Ashbury East Development located at 61 Alfred Street West in the Town of The Blue Mountains, Grey County. The Site is legally described as All of Lots 1, 2 and Part Of Lot 3, Township of Thornbury, Town of The Blue Mountains, County of Grey. Refer to the Site Location on Figure 1 for the location of the proposed development.

2.0 Site Description

Ashbury East covers approximately 1.3 hectares and is bound by Alfred Street West (Grey Road 113) to the north, Victoria Street to the west, and existing residential dwellings to the south and east. The Site currently consists of a two-storey residential dwelling, garage and a driveway which fronts onto Alfred Street West. The rest of the land consists of an open grass field with small trees scattered throughout the Site.

The proposed development consists of a mixed-residential subdivision including 15 units of various types fronting onto a public roadway/cul-de-sac. Refer to the Draft Plan of Subdivision prepared by MHBC, dated August 22, 2019 in Figure 2. The north-east corner of the Site will be severed from the overall property into two lots, which will be developed separately from the Ashbury East development. Refer to the Preliminary Severance Sketch prepared by MHBC, dated January 17, 2019 in Figure 3. The severed parcel will be split into two lots, one will be used for a new single detached dwelling unit and the other will feature the existing residence.

The proposed internal roadway will be consistent with Town standards for a residential cul-de-sac. The cul-de-sac will have a 20m radius road allowance and with a minimum edge of pavement radius of 15m. The longitudinal road grade will be less than 4% from the centre bulb to the intersecting roadway.

External documents/plans were reviewed over the course of completing this engineering report. As such, the servicing and design considerations contained herein are assisted by the following:

- As constructed drawings provided by the Town of The Blue Mountains – 1976 (Orchard Drive), 1982 (Alfred Street West), 2001 (Victoria Street), 2002 (Thorncroft Court), 2017 (Ashbury Court);
- Ashbury Court - Servicing Brief prepared by WSP Canada Inc – April 2015;
- Ashbury Court – Approved for Construction Drawings by WSP Canada Inc – May 2017
- Site Survey by Hewitt and Milne Ltd – October 2018;
- DC Background Study by Hemson Consulting Ltd – February 2019; and
- Geotechnical Report by Peto MacCallum Ltd – August 2019.

3.0 Water Servicing

Potable water for the Site will be supplied by the Town of The Blue Mountains water distribution system.

3.1 Existing Water Servicing

The existing water distribution infrastructure at or near the Subject Site includes the following:

- An existing 300 mm diameter trunk watermain on Victoria Street South
- An existing 150 mm diameter watermain on Alfred Street West

3.2 Design Water Demand

To estimate the proposed water demands for future development of the Site, the Town of The Blue Mountains Engineering Standards (2009) were consulted to determine the average, maximum day and peak hour water demands.

Water demands for the residential development were determined using the following design figures:

- Average Residential Flow Rate 450 L/cap/day
- Max Day/Peak Hour Factors 2.0/4.5

It is estimated that the maximum water demands for the proposed development are as follows:

- Average Day 0.20 L/sec
- Max Day 0.41 L/sec
- Peak Hour 0.92 L/sec

Fire flows required to service the site were calculated to be 100.00 L/s per the Fire Underwriter's Survey and 45 L/s per the Ontario Building Code. The preliminary design flow (peak hour + fire flow) for the Subject Site is 100.92 L/s, subject to detailed design. Refer to Appendix A for potable water servicing demand and fire flow demand calculations.

3.3 Proposed Water Servicing

The watermain for the Site is proposed to be municipally owned and operated. Watermain will be constructed within the roadway per Town standards for a typical road section and will connect to the existing watermain on Victoria Street. Based on the expected water demand and similar developments in the area the proposed internal watermain is expected to be a 150mm diameter pipe with individual lot services of appropriate size. This water demand in the previous section is being provided to the Town to incorporate into the Town-wide water model to confirm sizing and available pressures. Internal watermain sizing may be subject to change.

Fire protection for the residential units will be provided by fire hydrants spaced as per Town Standards. It is noted that a hydrant flow test has not been completed to verify existing pressures and flow relationships; however, it is expected that adequate fire flows will be available to meet Town requirements. An auto flusher is proposed at the end of the proposed internal roadway to provide water circulation for water quality purposes and will outlet to the closest sanitary maintenance hole.

Refer to Figure 2 for the proposed water distribution strategy.

4.0 Sanitary Servicing

Sanitary servicing for the development will be achieved via connection to the Town of The Blue Mountains sanitary sewer system.

4.1 Existing Sanitary Servicing

The As-Constructed drawings indicate that the following infrastructure is available to service the Site:

- An existing 200 mm diameter sanitary sewer on Victoria Street South.
- An existing 200 mm diameter sanitary sewer on Alfred Street West.

4.2 Design Sanitary Flow

Preliminary sanitary flows for the Site were estimated using the following criteria as specified in the Town of The Blue Mountains Engineering Standards:

- Average Residential Flow Rate 450 L/cap/day
- Infiltration 0.23 L/s/ha
- Persons Per Residential Unit 2.3

Based on these values it is estimated that peak sanitary flow from the site will be 1.18 L/s. Since the Site was designated to be developed by the Town in the Official Plan (2016) and the relatively low flows from the proposed development it is assumed that there will be sufficient capacity in the existing municipal sanitary system. Refer to Appendix B for sanitary design calculations.

4.3 Proposed Sanitary Servicing

The Site will be serviced via a gravity connection to the 200mm diameter sanitary sewer along Victoria Street. The internal sanitary sewer will follow the centre line of the internal roadway network per Town standards for a typical road section. Individual connections to each building that will be sufficiently deep to drain units with basements. Due to the relatively low peak sanitary flows calculated in the previous section it is reasonable to assume that a 200mm diameter internal sanitary sewer will provide adequate capacity to convey the wastewater to the Municipal system.

Sanitary maintenance holes will be installed with spacing consistent with Town standards. The proposed 200mm diameter internal sanitary sewer will be designed with sufficient slope to provide cleansing velocity within the sewer to reduce maintenance issues post construction.

Refer to Figure 2 for the proposed sanitary servicing strategy.

5.0 Stormwater Management

The management of stormwater and site drainage for the proposed development must comply with the policies and standards of the various agencies including the Town of The Blue Mountains, Grey Sauble Conservation Authority (GSCA), and Ministry of the Environment, Conservation and Parks (MECP).

The stormwater management criteria that will be met with the development of Ashbury East are as follows:

- Water Quality Control
    - "Enhanced Protection" given that Little Beaver River is the receiver.

- Water Quantity Control
    - The proposed SWM design must control post development flows to the available capacity of the outlet on Victoria Street, which will be determined during detailed design.

- Erosion Control
    - Erosion control for the 25mm storm event.

- Development Standard
    - Urban cross section complete with curb & gutter;
    - Lot grading at 2% optimum; and,
    - Minor and major drainage system to convey frequent and infrequent rainfall/runoff events, respectively.

5.1 Existing Drainage

5.1.1 Internal Drainage

On-site soils are classified as Brighton (BRS) sand with good drainage characteristics (Grey County Soil Mapping, 1979). Based on the topographic survey completed by Hewitt and Milne Ltd. (October 2018) the Site is relatively flat, but gently slopes from south to north conveying overland runoff to the roadside ditches along Alfred Street West and Victoria Street South.

The Alfred Street West ditch has been graded to convey overland flows to the east, and ultimately collected by the Alfred Street West storm sewer. The stormwater enters the existing Municipal 750mm diameter storm sewer on Alfred Street West, followed by a 1050mm diameter sewer west of Victoria Street South, which eventually outlets to Little Beaver River. A portion of the Site drains towards the Victoria Street South ditch, which is intercepted by a ditch-inlet catchbasin manhole and conveyed by the existing 675mm diameter storm sewer to the 1050mm diameter sewer on Alfred Street West. Refer to Figure 3 for the existing infrastructure and pre-development drainage areas.

Our office has reviewed the Geotechnical Investigation Report, dated August 1, 2019 by Peto MacCallum Ltd. (PML), which will be submitted under separate cover. It is understood that the Site will require topsoil to be stripped to a depth of approximately 0.7 to 1.0 m. PML identified the presence of a perched ground water table 1.3 to 1.5m below existing grade on July 8th, 2019. PML will be conducting year-long water table monitoring program to confirm the seasonal high ground water table. Based on the initial results it has been assumed that the Site will need to be raised between 1 to 1.5m above existing grade to provide clearance between the basement slab and the seasonal high groundwater table.

5.1.2 External Drainage

Based on As-Constructed drawings received from the Town, there are no external flows being conveyed through the Site as the adjacent lots from Thorncroft Court and Orchard Drive are graded with rear-to-front drainage. The adjacent lots on Orchard Drive have a row of mature trees that are located just outside the property limits of the Site. It is our understanding that all efforts should be made to maintain these trees.

5.2 Proposed Drainage

Proposed post-development drainage conditions are depicted in Figure 4, which include preliminary grading, swales, existing and proposed storm sewer locations and sizes. Minor storm events up to and including the 5-year storm event will be conveyed via appropriately sized storm sewers. Major storm events (greater than a 5-year storm event) will be conveyed by overland flow routes via roadways and overland channels/swales.

It has been assumed that the majority of the lots in Ashbury East will be graded with split drainage and side yard swales, which will convey stormwater towards either the internal roadway or rear yard swale. Lots 1, 2 and 3 will be graded with rear to front drainage, similar to the adjacent lots on Thorncroft Court, and convey run-off to the internal storm sewer system via side yard swales. Lots 4, 5, 6 and 7 will be graded with split drainage to attempt to maintain the existing mature trees along the east property line. The rear yards will drain towards the proposed rear-lot catchbasin located in the backyard of Lot 5 and flow/drain into the proposed internal storm sewer system.

As shown in Figure 4, the Site will be split into two catchments. Proposed Catchment 1 will drain towards the internal roadway, which will convey runoff to Victoria Street South. Runoff from minor storm events will be collected by the internal storm sewer system and major storm events will be conveyed overland via the internal roadway. Proposed Catchment 2 will drain uncontrolled to the existing Alfred Street West roadway and storm sewer system.

As the Site drains into existing storm systems downstream, Crozier has completed a preliminary capacity assessment of the following infrastructure:

1. Victoria Street South Storm Sewer; and
2. Alfred Street West Storm Sewer.

5.2.1 Victoria Street South Storm Sewer

Victoria Street West currently consists of a rural roadway cross-section. Stormwater is conveyed via the existing 675mm diameter storm sewer located within the ditch on the east side of the roadway. Our office has reviewed the Ashbury Court - Servicing Brief prepared by WSP (April 2015), and it is understood that the existing 675mm storm sewer on Victoria Street does not have any residual capacity to convey runoff produced from the Site.

The Development Charges Background Study (Hemson, 2019) identified the section of Victoria Street between Alfred Street and Ashbury Court requires roadway and storm sewer upgrades in the future, which would provide additional capacity. At this stage we have assumed that the proposed development will provide quantity control to meet the available capacity in the storm sewer provided by any future upgrades. Upon review of the record drawings for Victoria Street South and Alfred Street West there appears to be an adequate amount of elevation difference between the storm sewers to potentially increase the size of the storm sewer on Victoria Street South to a 900mm diameter pipe. The proposed storm sewer would match obverts with the 675mm diameter pipe upstream and the 1050mm diameter pipe downstream.

5.2.2 Alfred Street West Storm Sewer

Based on the storm sewer design sheets appended in the Ashbury Court - Servicing Brief prepared by WSP (April 2015), it is understood that the existing 750mm diameter storm sewer on Alfred Street West is at approximately 80% capacity, which is not enough to convey the total amount of runoff produced from the proposed development. The proposed development will ensure that the total runoff being directed to Alfred Street West is less than or equal to the flow rate under pre-development conditions.

The available capacity of the 1050mm diameter storm sewer on Alfred Street West, immediately west of Victoria Street was calculated to be 922 L/s. Per the Ashbury Court Approved For Construction (AFC) Drawings (WSP, May 2017) there was an additional 0.492 ha catchment from Ashbury contributing stormwater to the Alfred Street West storm sewer. Based on the runoff coefficients provided in the AFC Drawings the remaining capacity in the Alfred Street West storm sewer post construction of Ashbury Court is approximately 847 L/s, which can accommodate the increased run-off from the proposed development.

5.3 Stormwater Quantity Control

To determine the pre and post development flows being directed to the storm sewer on Victoria Street South and Alfred Street West the Modified Rational Method was used to quantify the capacity required for the 2-year to 100-year storm events. Refer to Appendix C for the full Modified Rational Method Calculations. Per the Town of The Blue Mountains Engineering Standards (2009), the Intensity Duration Frequency Curves for the Owen Sound area were used in the calculations. The pre and post-development flows for Victoria Street South and Alfred Street West are shown below in Table 1 and Table 2, respectively.

Table 1: Modified Rational Method – Victoria Street South

	Pre Development				Post Development			
	5 yr	10 yr	25 yr	100 yr	5 yr	10 yr	25 yr	100 yr
Uncontrolled Peak Flow (m^3/s)	0.019	0.022	0.026	0.031	0.139	0.162	0.191	0.233

Table 2: Modified Rational Method - Alfred Street West

	Pre Development				Post Development			
	5 yr	10 yr	25 yr	100 yr	5 yr	10 yr	25 yr	100 yr
Uncontrolled Peak Flow (m^3/s)	0.070	0.081	0.095	0.116	0.044	0.052	0.061	0.074

Per the Town Engineering Standards, increases in the post-development runoff rates of any storm event should be controlled to the pre-development rates. Per Table 2, the post-development runoff rate for Alfred Street is reduced compared to the pre-development rates, therefore no quantity control is required for this drainage catchment.

As previously indicated, the storm sewer on Victoria Street South is identified in the DC Background Study (Hemson, 2019) as requiring upgrades. Since this development is the last parcel in the catchment to be developed it is expected that any capacity created by these upgrades would be available to the convey the post development flow rates from the Site.

If quantity control is required, onsite storage could be achieved through a number of methods. At this preliminary stage we have not determined the method of quantity control that would be utilized for the Ashbury East development; however, there are multiple options that can be implemented to achieve the required storage volumes. Table 3 below presents typical forms of quantity and quality control and their suitability for the Site.

Table 3: SWM Facility Options for Ashbury East

SWM Facility Type	Comments	Recommended (Yes/No)
Wet Pond	Wet ponds are an effective way to control the flows and are not affected by groundwater and bedrock. However, this form of quantity control takes up a significant amount of space and as per MOE design guidelines are not recommended for areas less than 5 ha.	**No**
Dry Pond	Similar to wet pond, dry ponds take up large areas and are not recommended for areas less than 5 ha. In addition, dry pond.	**No**
Infiltration Basin	Infiltration basins are acceptable for smaller areas like Ashbury East and the geotechnical report provided by Peto MacCallum indicates that the sandy soils may provide the filtration required for this form of quantity control. However, infiltration basins take up more space than is available on the Draft Plan and may be limited by the seasonal high groundwater elevation.	**No**
Surface Storage	Since the developed area will consist of a cul-de-sac lot there is an opportunity to grade the roadway to include a sag to allow for surface storage during the major storm events. These storage areas have the potential to freeze in the winter months so the size and location would need to be carefully determined during detailed design.	**Yes**
Super Pipes	Storage within the pipes, manholes and catchbasins located within the internal roadway can be utilised in conjunction with an orifice plate placed on an outlet structure downstream to provide storage internally. This method is effective in all seasons assuming adequate cover is provided to avoid freezing.	**Yes**
Subsurface Storage Tanks	Similar to super pipes, the internal roadway could be used for subsurface storage tanks (Stormtech chambers or equivalent), which can control a larger volume of storm water.	**Yes**
Low Impact Designs (LIDs)	The individual lots in Ashbury East provide opportunities to include LIDs such as infiltration trenches and soak-away pits into the grading plans to provide additional quantity control. Due to the relatively small amount of storage these methods provide, they would likely need to be accompanied with another method of quantity control. However, due to the potential for high groundwater and the maintenance that these methods typically require we are not recommending utilizing LIDs for Ashbury East.	**No**

If quantity control is required for the proposed development the method(s) to achieve the required storage volume on site will be determined during detailed design, which may include one or a combination of the SWM facilities listed above.

5.4 Stormwater Quality Control

It will be necessary to implement stormwater management practices to address the water quality control requirements of the regulatory agencies. Georgian Bay is the ultimate receiver of drainage from the Site and therefore the development will incorporate measures to provide "enhanced protection" to treat runoff before entering the harbour.

Some of the significant factors involved in selecting the optimum SWM approach in Table 3 were the "infill" nature of the development and the relatively flat nature of the site, which make it unsuitable for an end-of-pipe stormwater management facility (i.e. wet pond). Therefore, a treatment train approach will be developed, consisting of lot level control and end of pipe control. The proposed treatment train will provide the Enhanced Quality Control required by the review agencies and is listed below:

1. **Lot Level Control**
    - Reduced lot grading; and
    - Grassed swales underlain with permeable material.
2. **End of Pipe Control**
    - Oil/grit separators (Stormceptor or equivalent).

5.4.1 <u>Stormwater Lot Level Controls</u>

These controls will primarily consist of disconnected roof leaders, reduced lot grading and grass swales. Swales will be underlain with select permeable material and perforated tile ("French Drains") where deemed necessary. These swales are intended to promote water quality benefits of vegetation and filtering from a nutrient perspective. The majority of the lot level controls will be implemented within the individual lot grading plans.

5.4.2 <u>Stormwater End-Of-Pipe Controls</u>

Oil/grit separators are recommended to treat runoff from the internal roadway, which are the source of oils and sediment from the vehicles and expected maintenance activities on the site. The type of product will be determined during detailed design, which will likely be a Stormceptor or equivalent unit. These structures are typically pre-manufactured and provide effective removal of oils and total suspended solids. The oil/grit separators have been sized to treat minimum 95% annual runoff and a minimum 80% of annual total suspended solids (TSS) removal.

6.0 Utilities

The proposed development will be serviced with natural gas, telephone, cable TV and hydro. All such utilities are currently available on the boundary roadways. Utilities have not been contacted at the time of this investigation. Circulation and coordination with the utilities will be undertaken to confirm capacity at the appropriate phase of design.

7.0 Conclusions and Recommendations

Based on the information offered in this report, we offer the following conclusions:

1. A 20 m ROW and cul-de-sac with a 15 m radius is proposed for the public roadway and will consist of an urban cross section consisting of curb and gutter and storm sewer system.
2. A public watermain will be extended from Victoria Street South and terminate at an autoflusher or equivalent. Additional watermain modelling and hydrant testing may be required.
3. Fire flows have been determined based on the short method calculations for grouping of townhome dwellings as per the Fire Underwriter Survey (FUS) and Ontario Building Code (OBC).
4. A public sanitary sewer will be extended from Victoria Street South and service Ashbury East along the internal roadway. The existing sanitary sewer downstream of Ashbury East is assumed to be sufficiently sized to convey the proposed sewage generated.
5. Internal preliminary grading has been completed to maintain, where feasible, existing drainage patterns for Ashbury East. Preliminary grading has proposed some of the lots will drain towards the internal roadway via rear to front drainage, while the majority will have split drainage. The overall master grading will be completed during detailed design.
6. The existing 675mm dia. storm sewer downstream of Ashbury East along Victoria Street South does not have capacity to convey pre or post development flows of the development. The existing 675mm diameter storm sewer will need to be upgraded to a larger diameter storm sewer to accommodate run-off produced from the Site.
7. Water quality controls for the Site will be provided by a treatment train including an oil grit separator.

Based on the above conclusions, we recommend the approval of the Planning Applications for Ashbury East, from the perspective of functional servicing and stormwater management. Thank you.

Respectfully submitted,

C.F. CROZIER & ASSOCIATES INC.

Kevin Morris, P. Eng.
Founding Partner

C.F. CROZIER & ASSOCIATES INC.

George Cooper, E.I.T.
Engineering Intern

KM/gc

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APPENDIX A

Potable Water Demand and Fire Flow Demand Calculations

CROZIER
CONSULTING ENGINEERS

File:	1284-4979
Date:	July 22, 2019
By:	BDP
Check By:	KM

Ashbury East Development - Domestic Water Design Criteria

Developed Site Area	1.30	ha
Number of Residential Units (Including Existing)	17	units
Persons Per Unit (Town of The Blue Mountains Engineering Standards)	2.3	persons/unit
Residential Population	39	persons
Water Design Flows		
Residential	450	L/C-day
Total Domestic Water Design Flows		
Average Residential Daily Flow	0.20	L/sec
Max Day Peak Factor (Town of The Blue Mountains Engineering Standards)	2.00	
Max Day Demand Flow	**0.41**	L/sec
Peak Hour Factor (Town of The Blue Mountains Engineering Standards)	4.50	
Peak Hour Flow	**0.92**	L/sec

ASHBURY EAST

September 13, 2019

Fire Protection Volume Calculation - Townhome Units

CFCA File: 1284-4979

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \text{sqrt } A$$

where

F = the required fire flow in litres per minute
C = coefficient related to the type of construction
= 1.5 for wood frame construction (structure essentially all combustible)
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
= 0.8 for non-combustible construction (unprotected metal structural components)
= 0.6 for fire-resistive construction (fully protected frame, floors, roof)
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Buildings	Fire resistive construction
390 sq.m. total floor area	1.0 C

Therefore F= 4,000 L/min (rounded to nearest 1000 L/min)

Fire flow determined above shall not exceed:
30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Buring	25%
Combustible	No Charge		

Low fire Hazard occupancy for dwellings 0% reduction
0 L/min reduction

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above maybe reduce by up to 50% for complete automatic sprinkler protection.
Buildings will have automatic sprinklers (typical 30% reduction)
0 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) esposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%		

Exposed buildings

Name		**Distance**		
North	Adjacent Dwelling	50	0%	0
East	Adjacent Dwelling	2.4	25%	1000
South	Adjacent Dwelling	40	5%	200
West	Adjacent Dwelling	6.17	20%	800
				2,000 L/min Surcharge

Determine Required Fire Flow

No.1	4,000			
No. 2	0	reduction		
No. 3	0	reduction		
No. 4	2,000	surcharge		
Required Flow:	**6,000**	**L/min**		
Rounded to nearest 1000l/min:	**6,000**	**L/min**	or	100.0 L/s
				1,585 USGPM

Determine Required Fire Storage Volume

Flow from above 6,000 L/min

Required duration 2.00 hours

Therefore: 720,000 Litres or
720 cu.m. is the required fire storage volume.

Required Duration of Fire Flow	
Flow Required L/min	Duration (hours)
2,000 or less	1.0
3,000	1.25
4,000	1.5
5,000	1.75
6,000	2.0
8,000	2.0
10,000	2.0
12,000	2.5
14,000	3.0
16,000	3.5
18,000	4.0
20,000	4.5
22,000	5.0
24,000	5.5
26,000	6.0
28,000	6.5
30,000	7.0
32,000	7.5
34,000	8.0
36,000	8.5
38,000	9.0
40,000 and over	9.5

Fire Protection Water Supply Guideline
Part 3 of the Ontario Building Code (2006)

$$Q = KVS_{TOT}$$

Q = minimum supply of water in litres (L)
K = water supply coefficient
V = total building volume in cubic metres
S_{TOT} = total of spatial coefficient values from property line exposures on all sides

K =	23.0	Group C building with combustible construction (Table 1)
V =	2145	Total building volume in cubic metres
S_{TOT} =	2	S_{TOT} Need Not Exceed 2.0

Q = 98670 L

Based on ranges listed in Table 2, the required minimum water supply flow rate is **2700 L/min**

45 L/s

APPENDIX B

Sanitary Servicing Demand Calculations

CROZIER CONSULTING ENGINEERS

File: 1284-4979
Date: July 22, 2019
By: BDP
Check By: KM

Ashbury East Development - Sanitary Design Criteria

Developed Site Area (Roads + Residences)		1.30	ha
Number of Residential Units		17	units
Person Per Residential Unit		2.30	persons/unit
Residential Population		39	persons

Unit Sewage flows

Residential	450	L/C-day
Infiltration (typical)	0.23	L/s/ha

Total Design Sewage Flows

Infiltration/Inflow Residential		0.30	L/sec
Average Daily Residential Flow		0.20	L/sec
Residential Peak Factor	(Harmon Formula)	4.3	
Total Peak Daily Flow		**1.18**	**L/sec**

APPENDIX C

Modified Rational Method

CROZIER CONSULTING ENGINEERS

PROJECT: Ashbury East
PROJECT No.: 1284-4979
FILE: Modified Rational Method
DATE: 7/22/2019
DESIGN: BDP
CHECK: GC

Owen Sound IDF Curve Parameters		
Storm Event	**A**	**B**
2	22.3	-0.714
5	29.1	-0.724
10	33.6	-0.729
25	39.3	-0.734
50	43.5	-0.736
100	47.7	-0.738

Ashbury East - Victoria Street (Catchment #1)

Surface	Pre-development		Post-development	
	Area (ha)	Runoff Coefficient	Area (ha)	Runoff Coefficient
Landscapes	0.28	0.30	0.330	0.40
Asphalt	0.00	0.90	0.35	0.90
Building	0.00	0.90	0.20	0.90
Total *	0.28	0.30	0.88	0.71

CRONZIER CONSULTING ENGINEERS

PROJECT: Ashbury East
PROJECT No.: 1284-4979
DATE: 7/22/2019
DESIGN: BDP
CHECK: GC

Modified Rational Method Storage Sizing (2-Year Storm)

Peak Flow

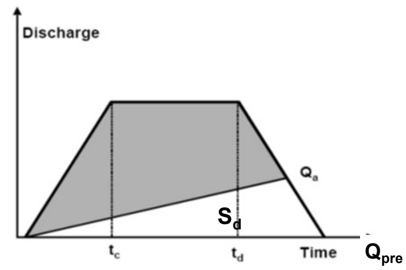
$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(T_d)} \cdot A$

Intensity

$i_{(T_d)} = A\,(T_d)^{B}$

Storage

$S_d = Q_{post} \cdot T_d - Q_{pre}\,(T_d + T_c) / 2$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	60.00
Return Period	2 yr		
Time of Concentration (min)	15		
Coeff A	22.3		
Coeff B	-0.714		
Runoff Coeff (Unadjusted)	0.30	Flow (m^3/s)	0.014
Area (ha)	0.28		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	60.00
Return Period	2 yr		
Time of Concentration (min)	15		
Coeff A	22.3		
Coeff B	-0.714		
Runoff Coeff (unadjusted)	0.71	Uncont. Flow (m^3/s)	0.105
Area (ha)	0.88		

Target Flow (m^3/s)	0.014

REQUIRED STORAGE VOLUME:	**113.8**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
15	60.00	900	0.105	82.1
20	48.86	1200	0.086	88.1
25	41.67	1500	0.073	92.8
30	36.58	1800	0.064	96.5
35	32.77	2100	0.058	99.6
40	29.79	2400	0.052	102.2
45	27.38	2700	0.048	104.4
50	25.40	3000	0.045	106.3
55	23.73	3300	0.042	107.8
60	22.30	3600	0.039	109.2
65	21.06	3900	0.037	110.3
70	19.98	4200	0.035	111.3
75	19.02	4500	0.033	112.1
80	18.16	4800	0.032	112.8
85	17.39	5100	0.031	113.4
90	16.69	5400	0.029	113.8

CROZIER
CONSULTING ENGINEERS

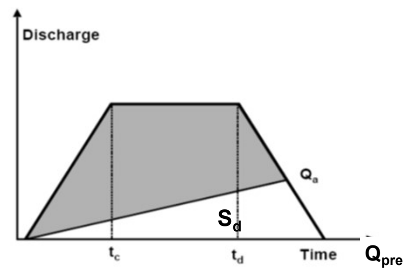
PROJECT: Ashbury East
PROJECT No.: 1284-4979
DATE: 7/22/2019
DESIGN: BDP
CHECK: GC

Modified Rational Method Storage Sizing (5-Year Storm)

Peak Flow
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(T_d)} \cdot A$$

Intensity
$$i_{(T_d)} = A\,(T_d)^{B}$$

Storage
$$S_d = Q_{post} \cdot T_d - Q_{pre}\,(T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	79.39
Return Period	5 yr		
Time of Concentration (min)	15		
Coeff A	29.1		
Coeff B	-0.724		
Runoff Coeff (Unadjusted)	0.30	Flow (m^3/s)	0.019
Area (ha)	0.28		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	79.39
Return Period	5 yr		
Time of Concentration (min)	15		
Coeff A	29.1		
Coeff B	-0.724		
Runoff Coeff (unadjusted)	0.71	Uncont. Flow (m^3/s)	0.139
Area (ha)	0.88		

Target Flow (m^3/s)	0.019

REQUIRED STORAGE VOLUME:	**146.9**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
15	79.39	900	0.139	108.6
20	64.47	1200	0.113	116.2
25	54.85	1500	0.096	122.0
30	48.07	1800	0.084	126.7
35	42.99	2100	0.075	130.5
40	39.03	2400	0.069	133.6
45	35.84	2700	0.063	136.3
50	33.21	3000	0.058	138.5
55	30.99	3300	0.054	140.3
60	29.10	3600	0.051	141.9
65	27.46	3900	0.048	143.2
70	26.03	4200	0.046	144.3
75	24.76	4500	0.043	145.2
80	23.63	4800	0.041	145.9
85	22.61	5100	0.040	146.5
90	21.70	5400	0.038	146.9

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CONSULTING ENGINEERS

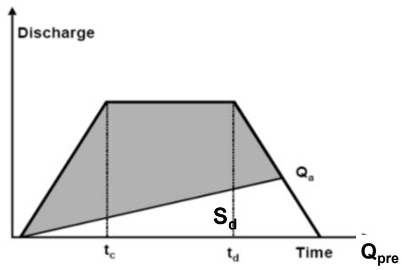
PROJECT: Ashbury East
PROJECT No.: 1284-4979
DATE: 7/22/2019
DESIGN: BDP
CHECK: GC

Modified Rational Method Storage Sizing (10-Year Storm)

Peak Flow
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(T_d)} \cdot A$$

Intensity
$$i_{(T_d)} = A (T_d)^B$$

Storage
$$S_d = Q_{post} \cdot T_d - Q_{pre} (T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	92.31
Return Period	10 yr		
Time of Concentration (min)	15		
Coeff A	33.6		
Coeff B	-0.729		
Runoff Coeff (Unadjusted)	0.30	Flow (m^3/s)	0.022
Area (ha)	0.28		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	92.31
Return Period	10 yr		
Time of Concentration (min)	15		
Coeff A	33.6		
Coeff B	-0.729		
Runoff Coeff (unadjusted)	0.71	Uncont. Flow (m^3/s)	0.162
Area (ha)	0.88		

Target Flow (m^3/s)	0.022

REQUIRED STORAGE VOLUME:	**168.6**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
15	92.31	900	0.162	126.3
20	74.84	1200	0.131	134.9
25	63.61	1500	0.112	141.5
30	55.69	1800	0.098	146.7
35	49.77	2100	0.087	150.9
40	45.16	2400	0.079	154.4
45	41.44	2700	0.073	157.4
50	38.38	3000	0.067	159.8
55	35.80	3300	0.063	161.8
60	33.60	3600	0.059	163.5
65	31.70	3900	0.056	164.9
70	30.03	4200	0.053	166.1
75	28.56	4500	0.050	167.0
80	27.24	4800	0.048	167.7
85	26.07	5100	0.046	168.2
90	25.00	5400	0.044	168.6

CROZIER
CONSULTING ENGINEERS

PROJECT: Ashbury East
PROJECT No.: 1284-4979
DATE: 7/22/2019
DESIGN: BDP
CHECK: GC

Modified Rational Method Storage Sizing (25-Year Storm)

Peak Flow

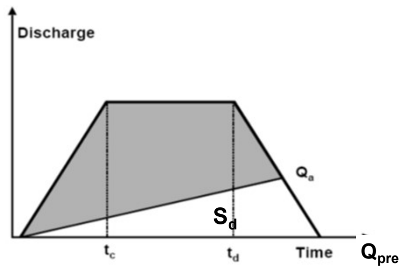
$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(T_d)} \cdot A$

Intensity

$i_{(T_d)} = A\,(T_d)^{B}$

Storage

$S_d = Q_{post} \cdot T_d - Q_{pre}\,(T_d + T_c) / 2$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	108.72
Return Period	25 yr		
Time of Concentration (min)	15		
Coeff A	39.3		
Coeff B	-0.734		
Runoff Coeff (Unadjusted)	0.30	Flow (m^3/s)	0.026
Area (ha)	0.28		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	108.72
Return Period	25 yr		
Time of Concentration (min)	15		
Coeff A	39.3		
Coeff B	-0.734		
Runoff Coeff (unadjusted)	0.71	Uncont. Flow (m^3/s)	0.191
Area (ha)	0.88		

Target Flow (m^3/s)	0.026

REQUIRED STORAGE VOLUME:	**196.1**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
15	108.72	900	0.191	148.8
20	88.02	1200	0.155	158.6
25	74.73	1500	0.131	166.1
30	65.37	1800	0.115	172.0
35	58.37	2100	0.102	176.9
40	52.92	2400	0.093	180.8
45	48.54	2700	0.085	184.1
50	44.93	3000	0.079	186.8
55	41.89	3300	0.074	189.0
60	39.30	3600	0.069	190.8
65	37.06	3900	0.065	192.4
70	35.10	4200	0.062	193.6
75	33.36	4500	0.059	194.5
80	31.82	4800	0.056	195.3
85	30.43	5100	0.053	195.8
90	29.18	5400	0.051	196.1

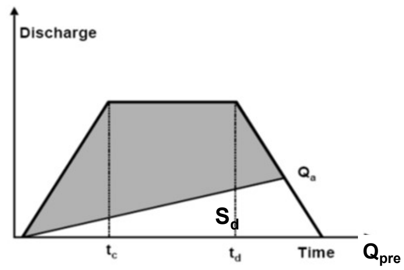
PROJECT: Ashbury East
PROJECT No.: 1284-4979
DATE: 7/22/2019
DESIGN: BDP
CHECK: GC

Modified Rational Method Storage Sizing (50-Year Storm)

Peak Flow
$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(T_d)} \cdot A$

Intensity
$i_{(T_d)} = A\,(T_d)^{B}$

Storage
$S_d = Q_{post} \cdot T_d - Q_{pre}\,(T_d + T_c) / 2$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	120.67
Return Period	50 yr		
Time of Concentration (min)	15		
Coeff A	43.5		
Coeff B	-0.736		
Runoff Coeff (Unadjusted)	0.30	Flow (m^3/s)	0.028
Area (ha)	0.28		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	120.67
Return Period	50 yr		
Time of Concentration (min)	15		
Coeff A	43.5		
Coeff B	-0.736		
Runoff Coeff (unadjusted)	0.71	Uncont. Flow (m^3/s)	0.212
Area (ha)	0.88		

Target Flow (m^3/s)	0.028

REQUIRED STORAGE VOLUME:	**216.6**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
15	120.67	900	0.212	165.1
20	97.65	1200	0.171	175.9
25	82.86	1500	0.145	184.1
30	72.45	1800	0.127	190.6
35	64.68	2100	0.114	195.9
40	58.63	2400	0.103	200.2
45	53.76	2700	0.094	203.7
50	49.75	3000	0.087	206.7
55	46.38	3300	0.081	209.1
60	43.50	3600	0.076	211.1
65	41.01	3900	0.072	212.7
70	38.83	4200	0.068	214.0
75	36.91	4500	0.065	215.0
80	35.20	4800	0.062	215.7
85	33.66	5100	0.059	216.3
90	32.28	5400	0.057	216.6

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PROJECT: Ashbury East
PROJECT No.: 1284-4979
DATE: 7/22/2019
DESIGN: BDP
CHECK: GC

Modified Rational Method Storage Sizing (100-Year Storm)

Peak Flow

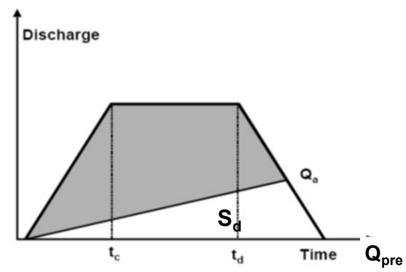
$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(T_d)} \cdot A$

Intensity

$i_{(T_d)} = A\,(T_d)^{B}$

Storage

$S_d = Q_{post} \cdot T_d - Q_{pre}\,(T_d + T_c) / 2$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	132.69
Return Period	100 yr		
Time of Concentration (min)	15		
Coeff A	47.7		
Coeff B	-0.738		
Runoff Coeff (Unadjusted)	0.30	Flow (m^3/s)	0.031
Area (ha)	0.28		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	132.69
Return Period	100 yr		
Time of Concentration (min)	15		
Coeff A	47.7		
Coeff B	-0.738		
Runoff Coeff (unadjusted)	0.71	Uncont. Flow (m^3/s)	0.233
Area (ha)	0.88		

Target Flow (m^3/s)	0.031

REQUIRED STORAGE VOLUME:	**237.0**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
15	132.69	900	0.233	181.6
20	107.31	1200	0.188	193.3
25	91.02	1500	0.160	202.2
30	79.56	1800	0.140	209.3
35	71.00	2100	0.125	215.0
40	64.34	2400	0.113	219.6
45	58.98	2700	0.104	223.4
50	54.57	3000	0.096	226.6
55	50.86	3300	0.089	229.1
60	47.70	3600	0.084	231.3
65	44.96	3900	0.079	233.0
70	42.57	4200	0.075	234.3
75	40.46	4500	0.071	235.4
80	38.58	4800	0.068	236.1
85	36.89	5100	0.065	236.7
90	35.36	5400	0.062	237.0

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CONSULTING ENGINEERS

PROJECT: Ashbury East
PROJECT No.: 1284-4979
FILE: Modified Rational Method
DATE: 7/22/2019
DESIGN: BDP
CHECK: GC

Owen Sound IDF Curve Parameters		
Storm Event	**A**	**B**
2	22.3	-0.714
5	29.1	-0.724
10	33.6	-0.729
25	39.3	-0.734
50	43.5	-0.736
100	47.7	-0.738

Ashbury East - Alfred Street (Catchment #2)

Surface	Pre-development		Post-development	
	Area (ha)	**Runoff Coefficient**	**Area (ha)**	**Runoff Coefficient**
Landscapes	0.90	0.30	0.230	0.40
Asphalt	0.03	0.90	0.04	0.90
Building	0.02	0.90	0.08	0.90
Total *	0.95	0.33	0.35	0.57

CROZIER CONSULTING ENGINEERS

PROJECT: Ashbury East
PROJECT No.: 1284-4979
DATE: 7/22/2019
DESIGN: BDP
CHECK: GC

Modified Rational Method Storage Sizing (2-Year Storm)

Peak Flow

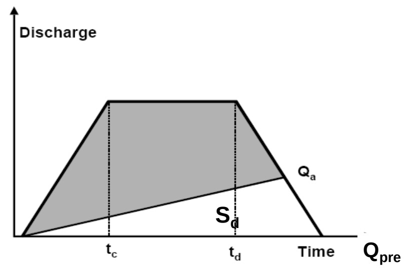
$$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(T_d)} \cdot A$$

Intensity

$$i_{(T_d)} = A\,(T_d)^{B}$$

Storage

$$S_d = Q_{post} \cdot T_d - Q_{pre}\,(T_d + T_c) / 2$$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	60.00
Return Period	2 yr		
Time of Concentration (min)	15		
Coeff A	22.3		
Coeff B	-0.714		
Runoff Coeff (Unadjusted)	0.33	Flow (m^3/s)	0.053
Area (ha)	0.95		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	60.00
Return Period	2 yr		
Time of Concentration (min)	15		
Coeff A	22.3		
Coeff B	-0.714		
Runoff Coeff (unadjusted)	0.57	Uncont. Flow (m^3/s)	0.034
Area (ha)	0.35		

Target Flow (m^3/s)	0.053

REQUIRED STORAGE VOLUME:	**-17.1**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
15	60.00	900	0.034	-17.1
20	48.86	1200	0.027	-22.4
25	41.67	1500	0.023	-28.1
30	36.58	1800	0.020	-34.2
35	32.77	2100	0.018	-40.4
40	29.79	2400	0.017	-46.8
45	27.38	2700	0.015	-53.3
50	25.40	3000	0.014	-59.9
55	23.73	3300	0.013	-66.7
60	22.30	3600	0.012	-73.4
65	21.06	3900	0.012	-80.3
70	19.98	4200	0.011	-87.2
75	19.02	4500	0.011	-94.2
80	18.16	4800	0.010	-101.2
85	17.39	5100	0.010	-108.2
90	16.69	5400	0.009	-115.3

CROZIER CONSULTING ENGINEERS

PROJECT: Ashbury East
PROJECT No.: 1284-4979
DATE: 7/22/2019
DESIGN: BDP
CHECK: GC

Modified Rational Method Storage Sizing (5-Year Storm)

Peak Flow

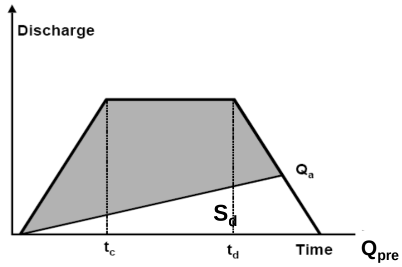
$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(T_d)} \cdot A$

Intensity

$i_{(T_d)} = A (T_d)^B$

Storage

$S_d = Q_{post} \cdot T_d - Q_{pre} (T_d + T_c) / 2$



Pre-Development Scenario Data			
Inputs		Outputs	
IDF Location	Owen Sound	Intensity (mm/hr):	79.39
Return Period	5 yr		
Time of Concentration (min)	15		
Coeff A	29.1		
Coeff B	-0.724		
Runoff Coeff (Unadjusted)	0.33	Flow (m^3/s)	0.070
Area (ha)	0.95		

Post-Development Scenario Data			
Inputs		Outputs	
IDF Location	Owen Sound	Intensity (mm/hr):	79.39
Return Period	5 yr		
Time of Concentration (min)	15		
Coeff A	29.1		
Coeff B	-0.724		
Runoff Coeff (unadjusted)	0.57	Uncont. Flow (m^3/s)	0.044
Area (ha)	0.35		

Target Flow (m^3/s)	0.070

REQUIRED STORAGE VOLUME:	**-22.6**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	mm/hr	sec	m^3/s	m^3
15	79.39	900	0.044	-22.6
20	64.47	1200	0.036	-29.8
25	54.85	1500	0.031	-37.5
30	48.07	1800	0.027	-45.5
35	42.99	2100	0.024	-53.9
40	39.03	2400	0.022	-62.4
45	35.84	2700	0.020	-71.1
50	33.21	3000	0.019	-80.0
55	30.99	3300	0.017	-88.9
60	29.10	3600	0.016	-98.0
65	27.46	3900	0.015	-107.1
70	26.03	4200	0.015	-116.3
75	24.76	4500	0.014	-125.6
80	23.63	4800	0.013	-134.9
85	22.61	5100	0.013	-144.3
90	21.70	5400	0.012	-153.7

CROZIER CONSULTING ENGINEERS

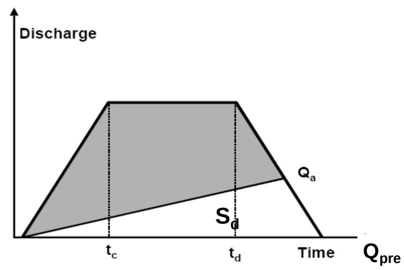
PROJECT: Ashbury East
PROJECT No.: 1284-4979
DATE: 7/22/2019
DESIGN: BDP
CHECK: GC

Modified Rational Method Storage Sizing (10-Year Storm)

Peak Flow
$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(T_d)} \cdot A$

Intensity
$i_{(T_d)} = A\,(T_d)^{B}$

Storage
$S_d = Q_{post} \cdot T_d - Q_{pre}\,(T_d + T_c) / 2$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	92.31
Return Period	10 yr		
Time of Concentration (min)	15		
Coeff A	33.6		
Coeff B	-0.729		
Runoff Coeff (Unadjusted)	0.33	Flow (m^3/s)	0.081
Area (ha)	0.95		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	92.31
Return Period	10 yr		
Time of Concentration (min)	15		
Coeff A	33.6		
Coeff B	-0.729		
Runoff Coeff (unadjusted)	0.57	Uncont. Flow (m^3/s)	0.052
Area (ha)	0.35		

Target Flow (m^3/s)	0.081

REQUIRED STORAGE VOLUME:	**-26.3**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
15	92.31	900	0.052	-26.3
20	74.84	1200	0.042	-34.7
25	63.61	1500	0.036	-43.7
30	55.69	1800	0.031	-53.1
35	49.77	2100	0.028	-62.9
40	45.16	2400	0.025	-72.9
45	41.44	2700	0.023	-83.1
50	38.38	3000	0.021	-93.4
55	35.80	3300	0.020	-103.8
60	33.60	3600	0.019	-114.4
65	31.70	3900	0.018	-125.1
70	30.03	4200	0.017	-135.8
75	28.56	4500	0.016	-146.6
80	27.24	4800	0.015	-157.5
85	26.07	5100	0.015	-168.4
90	25.00	5400	0.014	-179.4

CROZIER
CONSULTING ENGINEERS

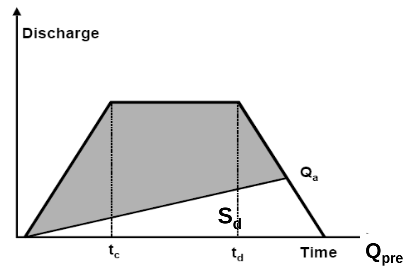
PROJECT: Ashbury East
PROJECT No.: 1284-4979
DATE: 7/22/2019
DESIGN: BDP
CHECK: GC

Modified Rational Method Storage Sizing (25-Year Storm)

Peak Flow
$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(T_d)} \cdot A$

Intensity
$i_{(T_d)} = A\,(T_d)^{B}$

Storage
$S_d = Q_{post} \cdot T_d - Q_{pre}\,(T_d + T_c) / 2$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	108.72
Return Period	25 yr		
Time of Concentration (min)	15		
Coeff A	39.3		
Coeff B	-0.734		
Runoff Coeff (Unadjusted)	0.33	Flow (m^3/s)	0.095
Area (ha)	0.95		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	108.72
Return Period	25 yr		
Time of Concentration (min)	15		
Coeff A	39.3		
Coeff B	-0.734		
Runoff Coeff (unadjusted)	0.57	Uncont. Flow (m^3/s)	0.061
Area (ha)	0.35		

Target Flow (m^3/s)	0.095

REQUIRED STORAGE VOLUME:	**-31.0**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
15	108.72	900	0.061	-31.0
20	88.02	1200	0.049	-41.0
25	74.73	1500	0.042	-51.6
30	65.37	1800	0.037	-62.8
35	58.37	2100	0.033	-74.4
40	52.92	2400	0.030	-86.2
45	48.54	2700	0.027	-98.2
50	44.93	3000	0.025	-110.4
55	41.89	3300	0.023	-122.8
60	39.30	3600	0.022	-135.3
65	37.06	3900	0.021	-147.9
70	35.10	4200	0.020	-160.6
75	33.36	4500	0.019	-173.3
80	31.82	4800	0.018	-186.2
85	30.43	5100	0.017	-199.1
90	29.18	5400	0.016	-212.1

CROZIER CONSULTING ENGINEERS

PROJECT: Ashbury East
PROJECT No.: 1284-4979
DATE: 7/22/2019
DESIGN: BDP
CHECK: GC

Modified Rational Method Storage Sizing (50-Year Storm)

Peak Flow

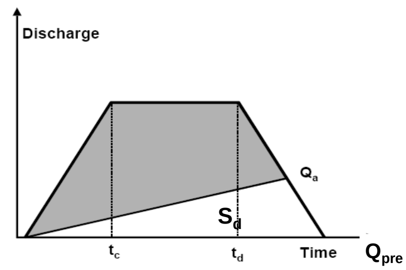
$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(T_d)} \cdot A$

Intensity

$i_{(T_d)} = A\,(T_d)^{B}$

Storage

$S_d = Q_{post} \cdot T_d - Q_{pre}\,(T_d + T_c) / 2$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	120.67
Return Period	50 yr		
Time of Concentration (min)	15		
Coeff A	43.5		
Coeff B	-0.736		
Runoff Coeff (Unadjusted)	0.33	Flow (m^3/s)	0.106
Area (ha)	0.95		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	120.67
Return Period	50 yr		
Time of Concentration (min)	15		
Coeff A	43.5		
Coeff B	-0.736		
Runoff Coeff (unadjusted)	0.57	Uncont. Flow (m^3/s)	0.068
Area (ha)	0.35		

Target Flow (m^3/s)	0.106

REQUIRED STORAGE VOLUME:	**-34.4**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
15	120.67	900	0.068	-34.4
20	97.65	1200	0.055	-45.5
25	82.86	1500	0.046	-57.4
30	72.45	1800	0.041	-69.8
35	64.68	2100	0.036	-82.7
40	58.63	2400	0.033	-95.8
45	53.76	2700	0.030	-109.2
50	49.75	3000	0.028	-122.8
55	46.38	3300	0.026	-136.5
60	43.50	3600	0.024	-150.4
65	41.01	3900	0.023	-164.4
70	38.83	4200	0.022	-178.5
75	36.91	4500	0.021	-192.7
80	35.20	4800	0.020	-207.0
85	33.66	5100	0.019	-221.3
90	32.28	5400	0.018	-235.7

CROZIER CONSULTING ENGINEERS

PROJECT: Ashbury East
PROJECT No.: 1284-4979
DATE: 7/22/2019
DESIGN: BDP
CHECK: GC

Modified Rational Method Storage Sizing (100-Year Storm)

Peak Flow

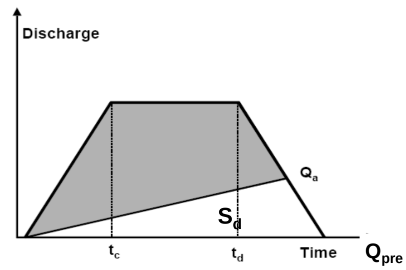
$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(T_d)} \cdot A$

Intensity

$i_{(T_d)} = A\,(T_d)^{B}$

Storage

$S_d = Q_{post} \cdot T_d - Q_{pre}\,(T_d + T_c) / 2$



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	132.69
Return Period	100 yr		
Time of Concentration (min)	15		
Coeff A	47.7		
Coeff B	-0.738		
Runoff Coeff (Unadjusted)	0.33	Flow (m^3/s)	0.116
Area (ha)	0.95		

Post-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	132.69
Return Period	100 yr		
Time of Concentration (min)	15		
Coeff A	47.7		
Coeff B	-0.738		
Runoff Coeff (unadjusted)	0.57	Uncont. Flow (m^3/s)	0.074
Area (ha)	0.35		

Target Flow (m^3/s)	0.116

REQUIRED STORAGE VOLUME:	**-37.9**

Storage Volume Determination (Detailed)

T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
15	132.69	900	0.074	-37.9
20	107.31	1200	0.060	-50.1
25	91.02	1500	0.051	-63.2
30	79.56	1800	0.045	-76.9
35	71.00	2100	0.040	-91.0
40	64.34	2400	0.036	-105.5
45	58.98	2700	0.033	-120.3
50	54.57	3000	0.031	-135.2
55	50.86	3300	0.028	-150.4
60	47.70	3600	0.027	-165.7
65	44.96	3900	0.025	-181.1
70	42.57	4200	0.024	-196.6
75	40.46	4500	0.023	-212.2
80	38.58	4800	0.022	-227.9
85	36.89	5100	0.021	-243.7
90	35.36	5400	0.020	-259.6

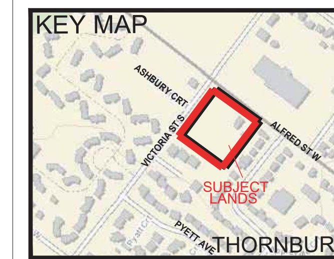
FIGURES

Legend	Project	
[hatched box] = SUBJECT LANDS	ASHBURY EAST THE TOWN OF THE BLUEMOUTAINS	CROZIER CONSULTING ENGINEERS The HarbourEdge Building, 40 Huron Street, Suite 301, Collingwood, ON L9Y 4R3 705 446-3510 T 705 446-3520 F www.cfcrozier.ca info@cfcrozier.ca
	Drawing: GENERAL SITE LOCATION	Drawn By: N.L. / Design By: N.L. / Project: 1284–4979 Scale: N.T.S. / Date: 07/05/2019 / Check By: K.M. / Drawing: FIG. 1

J:\1200\1284 - Carey Homes\4979-Ashbury East\CAD\Civil_Sheets\4979-700_FIG.dwg, FIG. 1, 2019-09-13 10:54:15 AM, nlefebvre

Legal Description
ALL OF LOTS 1, 2 AND PART OF LOT 3
REGISTERED PLAN 105
IN THE
TOWNPLOT OF THORNBURY
(Geographic Town of Thornbury)
TOWN OF THE BLUE MOUNTAINS
IN THE
COUNTY OF GREY

KEY MAP



OWNER'S CERTIFICATE

I HEREBY AUTHORIZE MACNAUGHTON HERMSEN BRITTON CLARKSON PLANNING LIMITED TO SUBMIT THIS PLAN FOR APPROVAL.

DATE: NOVEMBER 20, 2019

RYAN CAREY
61 ALFRED STREET WEST GP INC.

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED ON THIS PLAN AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

DATE: NOVEMBER 20, 2019

JAMIE LAWS, O.L.S.
ONTARIO LAND SURVEYOR
VAN HARTEN SURVEYING INC.

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT R.S.O. 1990,c.P.13

A. AS SHOWN	B. AS SHOWN	C. AS SHOWN
D. RESIDENTIAL	E. AS SHOWN	F. AS SHOWN
G. AS SHOWN	H. MUNICIPAL WATER	I. SANDY LOAM/SILTY CLAY LOAM
J. AS SHOWN	K. ALL SERVICES AS REQUIRED	L. AS SHOWN

SITE DATA

DESCRIPTION	LOTS/BLKS	AREA
RESIDENTIAL - SEMI DETACHED	1 - 2	0.211 ha
RESIDENTIAL - SINGLE DETACHED	3 - 7	0.346 ha
RESIDENTIAL - ROW HOUSE DWELLING	8 - 9	0.321 ha
0.3m RESERVE	10-12	0.004 ha
ROAD		0.205 ha
TOTAL		1.087 ha

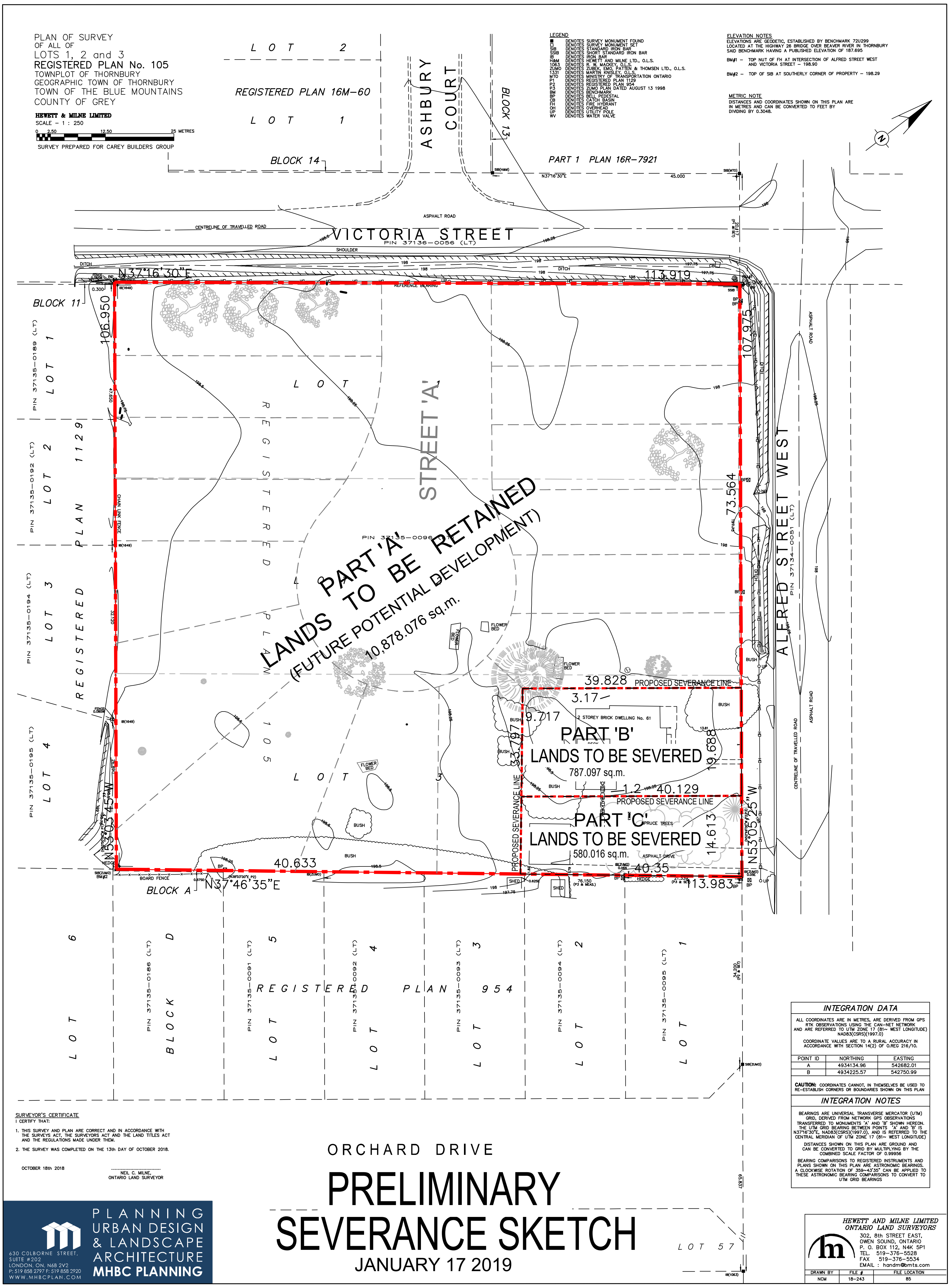
MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE
630 COLBORNE ST., SUITE 202, LONDON, ON, N6B 2V2 | P: 519.858.2797 | WWW.MHBCPLAN.COM

Date	November 18, 2019
Drawn By	L.M.
Plan Scale	1:375
File No.	15188'E'
Dwg No.	1 of 1

DRAFT PLAN OF SUBDIVISION

0 2.50 12.50 25 METRES

P:\15188'E'-CAREY\THORNBURY\Graphics\Draft Plan of Subdivision_November 18 2019.dwg

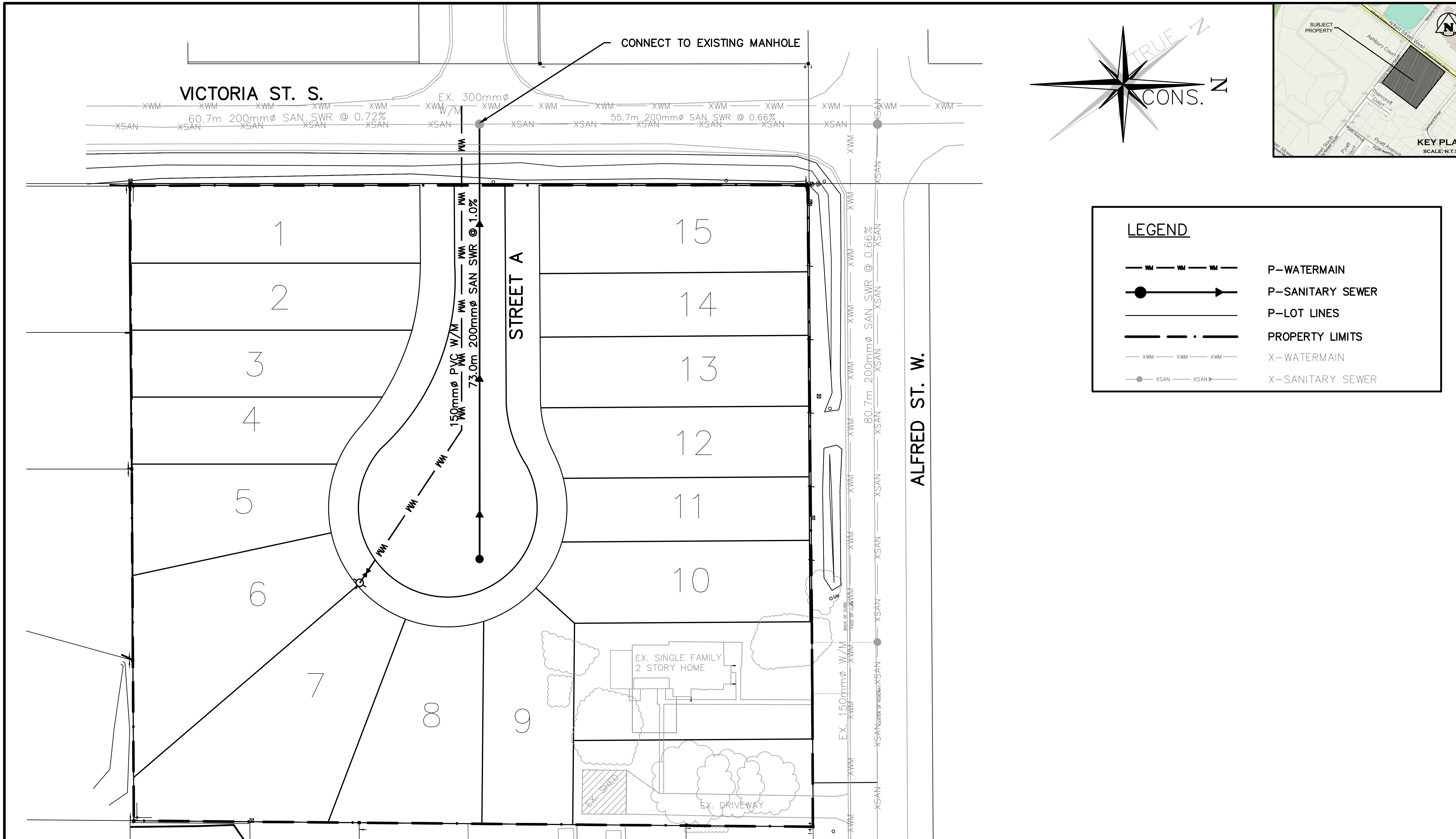


PRELIMINARY SEVERANCE SKETCH

JANUARY 17 2019

PLANNING
URBAN DESIGN
& LANDSCAPE
ARCHITECTURE
MHBC PLANNING

630 COLBORNE STREET, SUITE #202
LONDON, ON, N6B 2V2
P: 519 858 2797 F: 519 858 2920
WWW.MHBCPLAN.COM



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TEMPORARY BENCHMARKS

TBM#1–
TBM#2–
TBM#3–

Town

No.	ISSUE	DATE: MM/DD/YYYY
0	DRAFT PLAN APPROVAL	09/13/2019

Engineer

Engineer

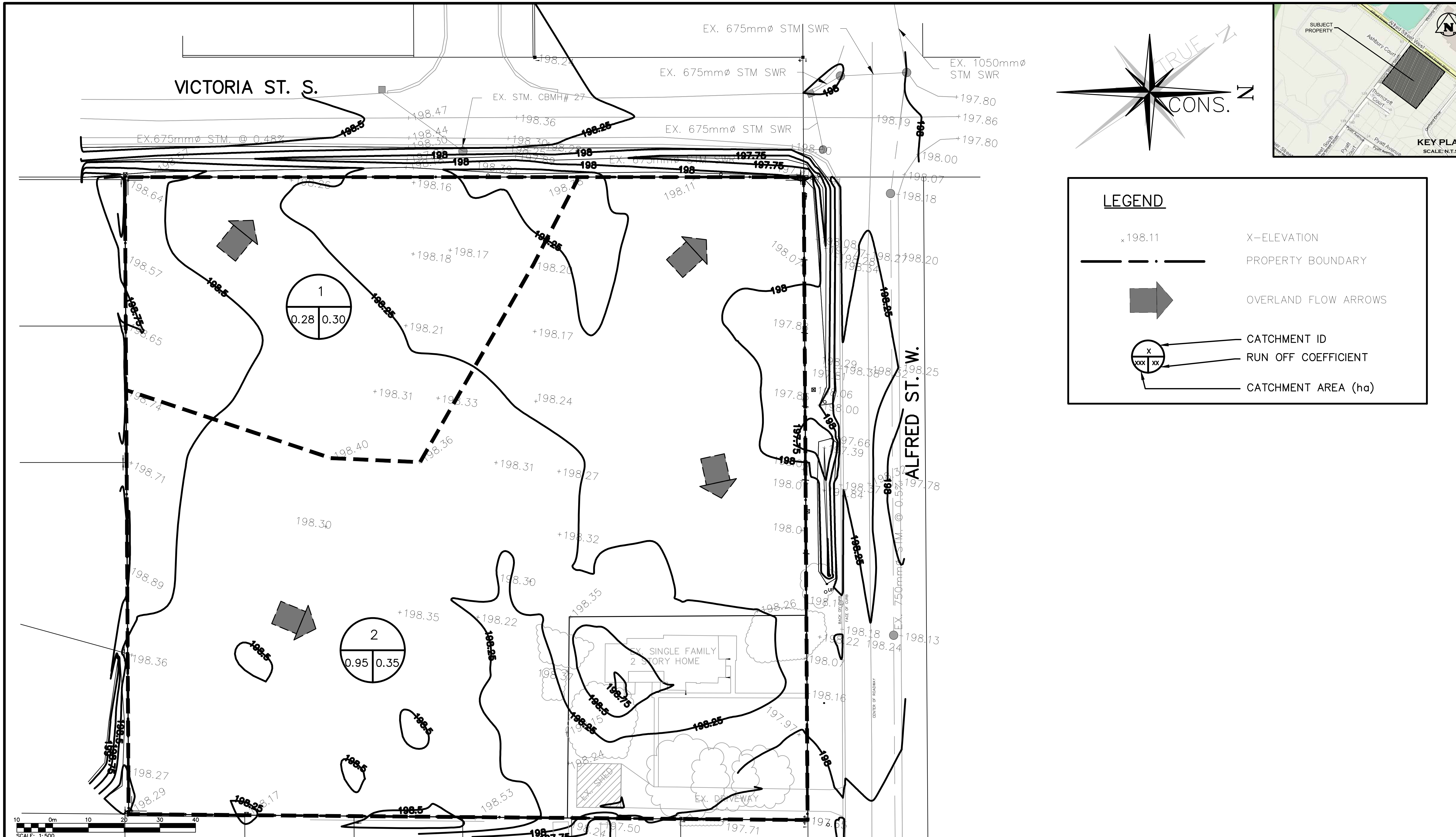
DRAFT
FOR DISCUSSION PURPOSES ONLY

Project
ASHBURY EAST
THE TOWN OF THE BLUE MOUNTAINS

Drawing
PRELIMINARY SITE SERVICING PLAN

CROZIER CONSULTING ENGINEERS
THE HARBOUREDGE BUILDING,
40 HURON STREET, SUITE 301,
COLLINGWOOD, ON L9Y 4R3
705 446-3510 T
705 446-3520 F
WWW.CFCROZIER.CA
INFO@CFCROZIER.CA

Drawn By N.L.	Design By N.L.	Project 1284–4979	
Check By K.M.	Check By G.C.	Scale 1:600	Drawing FIG. 4



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TEMPORARY BENCHMARKS

TBM#1–
TBM#2–
TBM#3–

Town

No.	ISSUE	DATE: MM/DD/YYYY
0	DRAFT PLAN APPROVAL	09/13/2019

Engineer

Engineer

DRAFT
FOR DISCUSSION PURPOSES ONLY

Project
ASHBURY EAST
THE TOWN OF THE BLUE MOUNTAINS

Drawing
PRE DEVELOPMENT DRAINAGE AREA

CROZIER CONSULTING ENGINEERS
THE HARBOUREDGE BUILDING,
40 HURON STREET, SUITE 301,
COLLINGWOOD, ON L9Y 4R3
705 446-3510 T
705 446-3520 F
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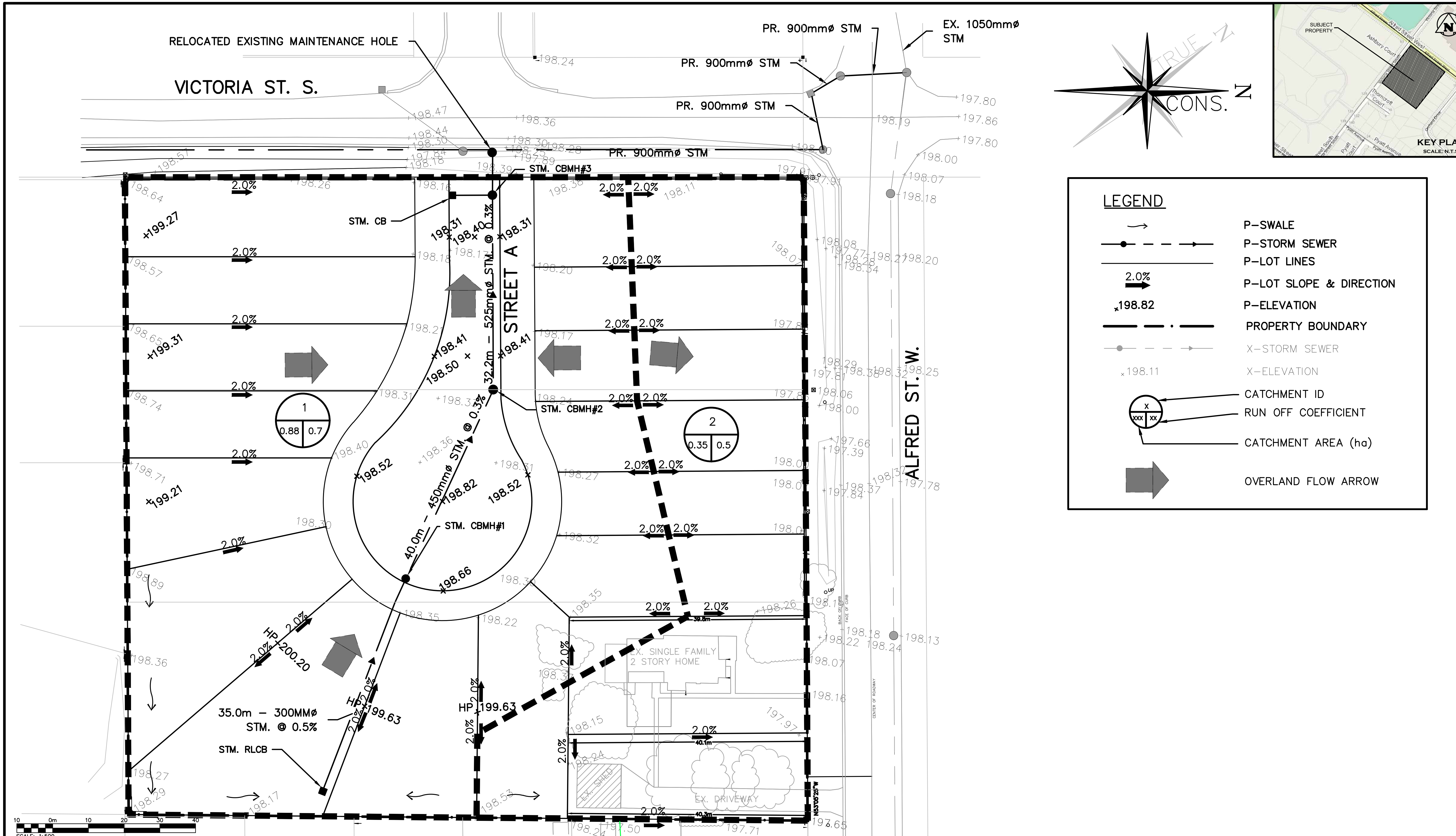
INFO@CFCROZIER.CA

Drawn By N.L.	Design By N.L.	Project 1284–4979	
Check By K.M.	Check By G.C.	Scale 1:600	Drawing FIG. 5

J:\1200\1284 - Carey Homes\4979-Ashbury East\CAD\Civil_Sheets\4979-700_FIG.dwg, FIG. 5, 2019-09-13 11:00:26 AM, nlefebvre



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TEMPORARY BENCHMARKS

TBM#1–
TBM#2–
TBM#3–

Town

No.	ISSUE	DATE: MM/DD/YYYY
0	DRAFT PLAN APPROVAL	09/13/2019

Engineer

Engineer

DRAFT
FOR DISCUSSION PURPOSES ONLY

Project
ASHBURY EAST
THE TOWN OF THE BLUE MOUNTAINS

Drawing
PRELIMINARY SITE GRADING AND POST DEVELOPMENT DRAINAGE PLAN

CROZIER CONSULTING ENGINEERS
THE HARBOUREDGE BUILDING, 40 HURON STREET, SUITE 301, COLLINGWOOD, ON L9Y 4R3
705 446-3510 T
705 446-3520 F
WWW.CFCROZIER.CA
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Drawn By N.L.	Design By N.L.	Project 1284–4979
Check By K.M.	Check By G.C.	Scale 1:600 / Drawing FIG. 6

J:\1200\1284 - Carey Homes\4979-Ashbury East\CAD\Civil_Sheets\4979-700_FIG.dwg, FIG. 6, 2019-09-13 10:56:10 AM, nlefebvre