JLR No.: 23405-003.1 May 2, 2018

Servicing Report

Commercial Plaza
5100 Kanata Avenue

J.L.Richards
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1.0 Introduction

Urbandale Corporation (Urbandale) has retained the services of J.L. Richards & Associates Limited (JLR) to proceed with the detailed design of municipal infrastructure for the development of their Commercial Plaza located at 5100 Kanata Avenue in the Kanata Lakes Community in the City of Ottawa (City).

This Site Servicing Report outlines the design objectives and criteria, servicing constraints and strategies for developing the subject lands with water, wastewater and stormwater services in accordance with the 2001 Walden Village Subdivision Design completed by IBI Group (formerly Cumming Cockburn Limited (CCL)) and the September 2016 Servicing Report for Block 111 prepared by JLR, as well as the City of Ottawa Sewer Design Guidelines (2012) and associated Technical Bulletins. This Report also includes strategies and solutions for implementing erosion and sedimentation control measures throughout construction.

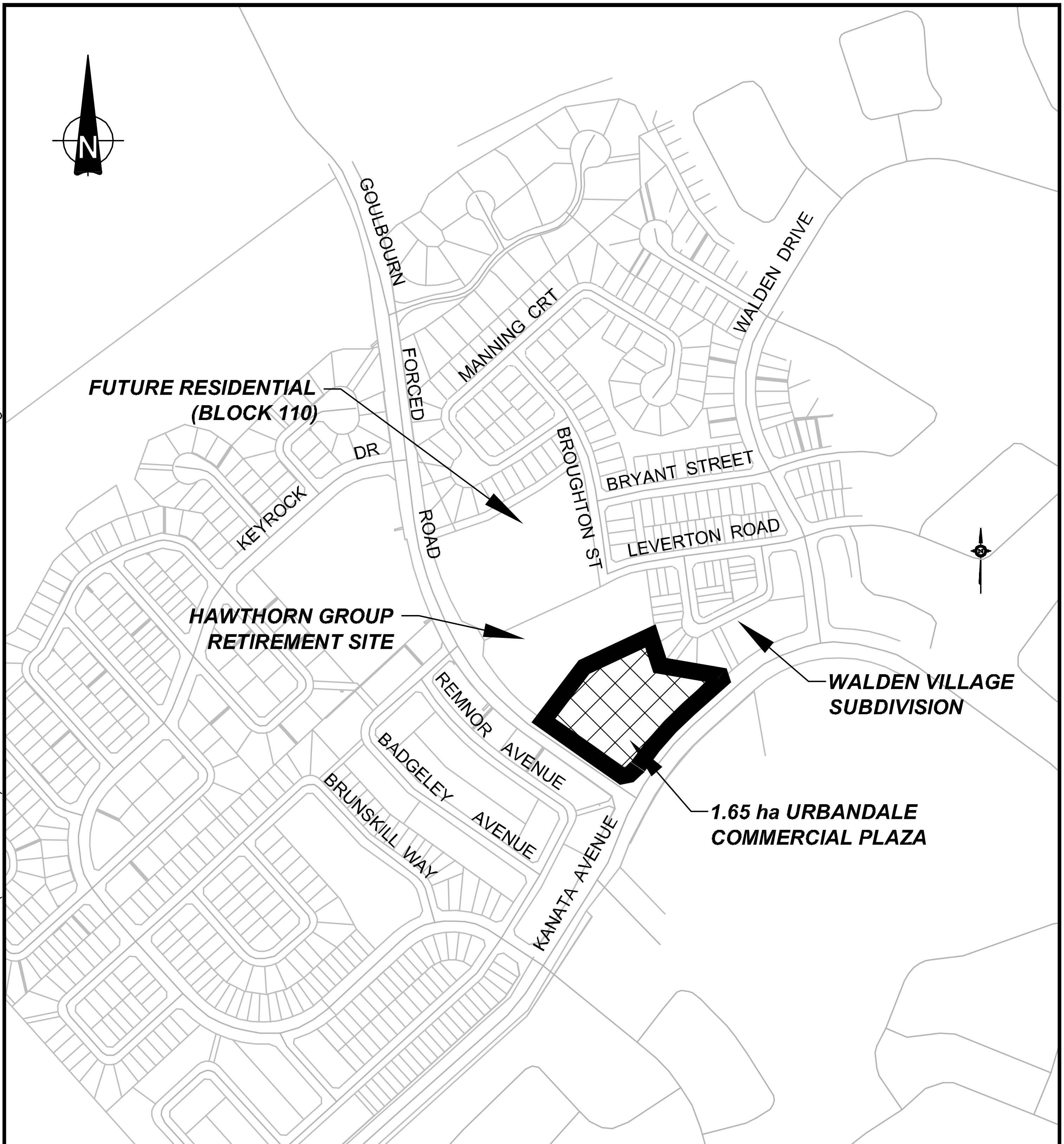
1.1 Site Description and Background

The 1.65 ha property is situated in the northeastern quadrant of the Kanata Avenue and Goulbourn Forced Road intersection in the Kanata Lakes Community. The site is bounded by Goulbourn Forced Road to the west, Kanata Avenue (formerly Castlefrank Road) to the south, the existing Walden Village residential subdivision to the east and a retirement residence site to the north, as shown on Figure 1 - Location Plan.

In the 2001 Walden Village Subdivision Design completed by IBI Group (formerly CCL), the subject site was identified as being part of Block 115, which in 2016 was sub-divided into two separate parcels. The northern portion of the former Block 115 (± 1.70 ha) is owned by Hawthorne Retirement Group and is being developed as a retirement residence. The southern portion of the former Block 115 (± 1.65 ha), the subject property, is owned by Urbandale Corporation who is proposing to develop a Commercial Plaza.

Wastewater and stormwater generated within the proposed Commercial Plaza was accounted for in the sanitary and storm sewer design for the adjacent Walden Village Subdivision. Peak flows were allocated for the subject site to the Bryant Street (formerly Davenport Street) sanitary and storm sewers at the intersection with Broughton Street. Furthermore, the Beaver Pond Stormwater Management Facility was assigned to be the dedicated stormwater outlet for the subject site.

In 2017, the Ministry of Environment and Climate Change (MOECC) and the City granted approvals for the construction of shared storm and sanitary sewers to service both the Hawthorne retirement residence and the Urbandale commercial site. The shared storm and sanitary sewers extend from the southern limit of the retirement residence site and outlet to existing Bryant Street storm and sanitary sewers via the future residential Block 110 to the north of the retirement residence and via Broughton Street, respectively, as shown on the Site Servicing Plan provided in Appendix 'A1'.



PROJECT:

COMMERCIAL PLAZA

5100 KANATA AVENUE, CITY OF OTTAWA

DRAWING:

LOCATION PLAN

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DESIGN:	AT	JLR NO:	23405-003.1
DRAWN:	CJM	DRAWING NO.:	1
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1.2 Proposed Development

The proposed Commercial Plaza includes five (5) buildings identified 'A' through 'E'. The footprint areas of each building are as follows:

Table 1.2: Building Footprint Areas

Building	Footprint Area (m^2)
A	405
B	954
C	848
D	1060
E	530

The site also includes a six (6) metre wide pathway block totaling 0.07 ha located along the eastern property limit adjacent to the Walden Village subdivision. The pathway will connect to the existing Kanata Avenue sidewalk.

1.3 Existing Infrastructure

The following existing infrastructure is within the vicinity of the site:

Watermain

- Existing 600 mm diameter watermain on Kanata Avenue along the southern frontage of the Commercial Plaza.

- Existing 400 mm diameter watermain on Goulbourn Forced Road on the western side of the Commercial Plaza.

Sanitary

- Existing 200 mm PVC sanitary sewer located to the north of the Commercial Plaza within the retirement residence site, ± 17 m from the eastern property limit.

Storm

- Existing 600 mm concrete storm sewer located to the north of the Commercial Plaza within the retirement residence site, ± 15 m from the eastern property limit.

1.4 Permits and Approvals

An MOECC ECA was granted in 2017 for the existing shared sanitary and storm sewers designed to service both the retirement residence and the subject commercial site. Refer to Appendix ‘A2’ for a copy of the MOECC ECA No.4070-AN9PJ2, dated June 15, 2017. Given that the proposed Commercial Plaza will be privately owned and operated, it is anticipated that no additional ECA is required for the proposed private sewer works.

The City of Ottawa Development Servicing Study Checklist has been included in Appendix 'A3' which provides all the details associated with this development and the approval and permit requirements.

1.5 Engineering Drawings

Engineering Drawings have been prepared in support of the development of the Commercial Plaza. The following five (5) drawings are included at the back of the Report:

- Site Servicing Plan (Drawing S1);
- Site Grading Plan (Drawing G1);
- Storm Drainage Plan (DST);
- Stormwater Management Plan (Drawing SWM); and
- Erosion and Sediment Control Plan (Drawing ESC).

2.0 Water Servicing

2.1 Design Criteria

A Hydraulic Network Analysis (HNA) was completed for the proposed Commercial Plaza to confirm that the proposed watermain distribution system identified on the Site Servicing Plan (Drawing S1) can provide adequate supply while complying with both the City of Ottawa Design Guidelines for Water Distribution (July 2010) and Technical Bulletin ISDTB-2014-02. These documents have been referred to in this section as the Design Guidelines and TB-2014-02, respectively. The Design Guidelines require that a water supply system be designed to satisfy the following demand criteria:

- maximum day demand plus fire flow; and
- maximum hourly demand (peak hour demand).

2.2 System Pressures

Section 4.2.2 of the Design Guidelines requires that new development additions to the public water distribution system be designed such that the minimum and maximum water pressures, as well as flow rates, conform to the following:

i. Under maximum hourly demand conditions (peak hour), the pressures shall not fall below 276 kPa (40 psi).

ii. During periods of simultaneous maximum day and fire flow demand, the residual pressure at any point in the distribution system shall not be less than 140 kPa (20 psi).

iii. In accordance with the Ontario Code & Guide for Plumbing, the static pressure at any fixture shall not exceed 552 kPa (80 psi) in areas that may be occupied.

iv. The maximum pressure at any point in the distribution system shall not exceed 689 kPa (100 psi) in unoccupied areas.

v. Feedermains, which have been provided primarily for the purpose of redundancy, shall meet, at a minimum, the basic day plus fire flow demand. This criterion is irrelevant to this HNA as there are no feedermains proposed.

The HNA was carried out to fulfill the above watermain pressure and demand objectives.

2.3 Water Demands

To assess the performance of the proposed water distribution system (refer to Drawing S1 at the back of the Report for system layout), the above-noted water demand scenarios were developed and evaluated against the pressure criteria listed in Section 2.2 using the WaterCAD® software platform. The total average day demand for the commercial site was calculated based on a daily commercial consumption rate of 25,000 L/ha/day, as per the Design Guidelines, and occurring over a 12-hour business day. The individual building demands were then assigned to each of the five (5) proposed buildings by distributing the total site area on a proportional building footprint area basis, and multiplying the area distribution factor by the total average day demand. Once calculated, the average day demands were used to compute both maximum day and peak hour demands using a peaking factor of 1.5 and 1.8, respectively, as prescribed in the Design Guidelines for commercial development. Based on the above, a water consumption of 37,500 L/ha/day and 67,500 L/ha/day was simulated for the maximum day demand and peak hour demand, respectively. Table 2.3 summarizes the water demands associated with each of the proposed commercial buildings. Refer to Appendix 'B1' for the water demand calculations.

Table 2.3: Calculated Water Demands

BLDG	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hourly Demand (L/s)
A	0.10	0.15	0.27
B	0.23	0.35	0.63
C	0.20	0.30	0.55
D	0.25	0.38	0.69
E	0.13	0.19	0.34
TOTAL	**0.91**	**1.37**	**2.48**

2.4 Simulation of Fire Flows

Various guidelines are used throughout North America to establish fire flow requirements for different types of buildings. The Guidelines entitled “Water Supply for Public Fire Protection (1999)” developed by the Fire Underwriters Survey (FUS) govern fire flow protection requirements in the City of Ottawa. In addition, fire flow requirements used in this HNA have been calculated in accordance with TB-2014-02. Fire flow requirements were calculated for each of the proposed buildings. It was assumed that each building will consist of a single storey and that only Buildings B and D will have sprinkler protection. It was also assumed that Buildings A and E will have wood frame construction. Based on the calculations, it was found that the governing fire flow requirement is 10,000 L/min (167 L/s) at Building E. This fire flow was used conservatively as the targeted requirement for the entire site. Refer to Appendix 'B2' for the FUS calculations.

2.5 Proposed Watermain Servicing, Pipe Sizing and Roughness Coefficients

The proposed watermain layout for the Commercial Plaza is shown on the Site Servicing Plan (Drawing S1 at the back of the Report). Water will be supplied to the site by a 200 mm diameter connection to the existing 400 mm diameter watermain along Goulbourn Forced Road. It should be noted that this connection is proposed and supersedes the watermain service connection previously proposed and shown on the September 2016 Site Servicing Plan provided in Appendix 'A1'. Water supply to the proposed buildings will be provided by an on-site 150 mm diameter watermain loop, with a 150 mm diameter water service for Buildings B, C, and D, and a 50 mm diameter water service for Buildings A and E. Fire flow requirements will be achieved by one (1) proposed on-site hydrant supplemented by three (3) existing hydrants – one (1) on Goulbourn Forced Road and two (2) on Kanata Avenue. It should be noted that Junctions J-9, J-10, J-11, J-12 and J-13 were set to the finished floor elevations of Buildings A, B, C, D and E, respectively. Refer to Appendix 'B3' for the overall schematic of the WaterCAD® model.

Watermain roughness coefficients were set based on the recommended Hazen-Williams friction factors presented in Section 4.2.12 of the Design Guidelines and the internal pipe diameters were modelled based on Section 4.3.5 of the Design Guidelines, as summarized in Table 2.5.

Table 2.5: PVC Watermain Pipe Diameters and Roughness Coefficients

Nominal diameter of Watermain	Internal Diameter	C-Factor
50 mm	50 mm	100
150 mm	155 mm	100
200 mm	204 mm	110
400 mm	393 mm	120
600 mm	600 mm	120

2.6 Hydraulic Boundary Conditions

The HNA was carried out based on hydraulic boundary conditions provided by the City under various water demands (refer to Appendix 'B4' for a copy of the e-mail correspondence). It is noted that a fire flow requirement of 11,000 L/min (183 L/s) was specified in the request for hydraulic boundary conditions due to unknown building specifics at the time. Since the governing fire flow requirement of 10,000 L/min is less than what was used to generate the boundary conditions, the maximum day plus fire flow simulation results are considered to be conservative.

Boundary conditions received from the City are summarized in Table 2.6 below.

Table 2.6: Hydraulic Boundary Conditions

Water Demands	Goulbourn Forced Road HGL (m)
Peak Hour	157.8
Maximum Day + Fire Flow	151.7
High Pressure Check	162.3

2.7 Simulation Results

2.7.1 Peak Hour Demand

The proposed water distribution system as depicted on Drawing S1 was simulated under the peak hour demand based on the water demand summarized in Table 2.3 and the hydraulic boundary condition presented in Table 2.6.

The simulation results show a minimum residual pressure of 486 kPa (70.5 psi) at Junction J-9 (i.e., Building A) under the peak hour demand, exceeding the minimum operating pressure of 276 kPa (40 psi) as recommended in the Design Guidelines (refer to Appendix 'B5' for WaterCAD® simulation schematic and results).

2.7.2 Maximum Day Demand plus Fire Flow

Section 4.2.2.3 of the Design Guidelines requires that the water distribution system satisfy the maximum day demand combined with the FUS fire flow requirement, as presented in Appendix 'B2'. The fire flow simulation was carried out by allowing WaterCAD® to calculate the available fire flow that can be drawn from a hydrant without allowing any part of the system to experience pressures less than 140 kPa (20 psi).

The proposed servicing as depicted on Drawing S1 was simulated under the maximum day demand based on the water demand summarized in Table 2.3 and the hydraulic boundary condition presented in Table 2.6. A fire flow requirement of 167 L/s was targeted for the entire site.

The simulation results indicate that a minimum fire flow of 173 L/s is available at Hydrant H-4 (on-site hydrant) while fulfilling the maximum day demand. Consequently, the distribution system can deliver fire flows in excess of 167 L/s (refer to Appendix 'B6' for WaterCAD® simulation schematic and results).

2.7.3 High Pressure Check

The Design Guidelines require that a high pressure check (maximum hydraulic grade elevation) be performed on the proposed system to ensure that the maximum pressure constraint of 552 kPa (80 psi) as per the Ontario Code & Guide for Plumbing is not exceeded. To generate the highest pressure, the demand at all Junctions was set to zero (0).

The simulation results show a maximum residual pressure of 540 kPa (78.3 psi) at Junction J-3 (near Building D) under the maximum pressure scenario, which is less than the maximum pressure constraint of 552 kPa (80 psi) as recommended in the Design Guidelines (refer to Appendix 'B7' for WaterCAD® simulation schematic and results).

2.8 Internal Pumping

Simulation results have shown that there is no requirement to provide internal pumping during domestic usage as the minimum pressure of 276 kPa (40 psi) is exceeded for all of the proposed fixtures at ground level. In terms of pumping requirements for the sprinkler system, it will be the responsibility of the certified fire protection specialist to recommend whether this system is required.

2.9 Summary and Conclusions

Based on the above simulation results, it is recommended that the water distribution system shown on the Site Servicing Plan (Drawing S1) be implemented to provide potable water for domestic and fire flow usages for the proposed Commercial Plaza.

3.0 Sanitary Servicing

3.1 Background

Wastewater flows generated by the proposed Commercial Plaza were accounted for in the overall sanitary sewer design of the Walden Village Subdivision completed by IBI Group (formerly CCL) in 2001. The Commercial Plaza was identified at the time of the Walden Village subdivision design as being part of Block 115, with an area of 3.23 ha (refer to the Walden Village Sanitary Drainage Area Plan Drawing 501 in Appendix 'C1'). This 3.23 ha commercial area was designed to be tributary to sanitary maintenance hole 38A (SAN MH38A), located at the intersection of Broughton Street and Bryant Street (formerly Davenport Street).

In 2017, approvals were granted by the MOECC and City for an alternate sanitary sewer outlet for the former Block 115, which now consists of a retirement residence site and the proposed Commercial Plaza. As outlined in JLR's 2016 Site Servicing Report and as shown on the Site Servicing Plan provided in Appendix 'A1', wastewater flows from the commercial site will outlet to SAN MH4A located at the southern limit of the retirement residence, and will be conveyed northerly across the retirement residence site, via a shared 200 mm diameter sanitary sewer, to existing SAN MH 37A located on Broughton Street. From existing SAN MH37A, wastewater is then conveyed northerly along Broughton Street to SAN MH38A, the original outlet for the site designated in the Walden Village subdivision design. As part of the updated 2016 design, the proposed Commercial Plaza was allocated a peak flow of 1.76 L/s, as indicated in the May 2016 Sanitary Sewer Design Sheets provided in Appendices 'C2' and 'C3'.

3.2 Design Criteria

The sanitary sewers for the proposed Commercial Plaza were designed based on the City of Ottawa Sewer Design Guidelines (October 2012) and associated Technical Bulletins. Key design parameters have been summarized in Table 3.2 below:

Table 3.2: Wastewater Servicing Design Criteria

Design Criteria	Design Value	Reference
Commercial average flow	28,000 L/gross ha/day	Technical Bulletin ISTB-2018-01
Commercial peaking factor	1.5	City Section 4.4.1
Infiltration flow	0.33 L/s/effective gross ha	Technical Bulletin ISTB-2018-01
Minimum velocity	0.6 m/s	City Section 6.1.2.2
Maximum velocity	3.0 m/s	City Section 6.1.2.2
Manning Roughness Coefficient (for smooth wall pipes)	0.013	City Section 6.1.8.2
Minimum allowable slopes	Varies	City Table 6.2, Section 6.1.2.2

3.3 Proposed Sanitary Servicing

It is proposed to collect and convey wastewater flows generated within the Commercial Plaza site via a 200 mm diameter sanitary sewer collection system that will outlet to the existing SAN MH 4A located at the northern limit of the Commercial Plaza, ± 17 m from the eastern property limit. A Sanitary Sewer Design Sheet was prepared for the proposed sewer system and is presented in Appendix ‘C4’. A peak flow of 2.06 L/s was calculated for the Commercial Plaza based on the parameters described in Table 3.2 and assuming that the plaza is in operation 12 hours per day.

It is noted that the calculated peak flow for the Commercial Plaza is approximately 0.3 L/s greater than that allocated for the site in the 2016 design. This is due to a slight change in total tributary area as well as the assumption of the 12 hours per day of operation. Although JLR does not have the residual capacities of all existing downstream sanitary sewers on record, it would appear that the existing downstream sanitary sewers within the retirement residence site and in the Walden Village Subdivision have the residual capacity to accommodate the additional 0.3 L/s wastewater flow (refer to Sanitary Sewer Design Sheets for existing sewers provided in Appendices ‘C2’ and ‘C3’).

3.4 Summary and Conclusions

Based on the above servicing details and the Sanitary Sewer Design Sheet provided in Appendix ‘C4’, it is recommended that sanitary sewers shown on Drawing S1 (at the back of the Report) be implemented to provide sanitary servicing for the Commercial Plaza.

4.0 Stormwater Servicing

4.1 Background

Stormwater Management (SWM) for the Commercial Plaza was accounted for in the overall storm sewer design of the Walden Village Subdivision. The drainage area associated with the subject site was identified as being part of Block 115 within the Site Stormwater Management Plan (SSMP-WV), prepared by IBI, dated October 2001 (refer to Drawing No. 500 in Appendix 'D1'). The SWM for the Walden Village subdivision follows the dual drainage principle; the minor storm sewer system captures and conveys runoff during frequent storm events with up to a 1:2 year recurrence, while the major overland system conveys excess runoff generated from severe storm events that are not captured by the minor system and up to a 1:100 year recurrence.

The IBI Storm Sewer Design Sheet (provided in Appendix 'D1') indicates that runoff from the former Block 115 is to be conveyed to existing storm maintenance hole 38 (ST MH 38) located at the intersection of Broughton Street and Bryant Street (formerly Davenport Street). From ST MH 38, stormwater is conveyed by the existing 900 mm diameter storm sewer system along Bryant Street, then northerly through existing storm sewers, and ultimately outlets to the Kanata Lakes Beaver Pond Stormwater Management Facility, herein referred to as the Beaver Pond, via a sediment forebay at Cecil Walden Ridge. The Beaver Pond is a wet pond facility that provides stormwater quality treatment before discharging into the Kizell Drain. It should be noted that runoff generated by the proposed pathway block located to the east of the Commercial Plaza was allocated to the rear yards of single family home lots fronting onto Weaver Crescent and to Kanata Avenue (former Castlefrank Road), as shown on the Storm Drainage Plan Drawing No. 500 in Appendix 'D1'.

The SSMP-WV Report also indicated that runoff in excess of the allowable minor system release rate of the former Block 115 is to be contained on-site up to and including the 1:100 year storm event. Alternatively, excess runoff could be conveyed overland across Goulbourn Forced Road to the Beaver Pond (as indicated on Drawing 500 in Appendix 'D1').

In 2017, approvals were granted by the City and MOECC for the construction of shared storm sewers to service the retirement site and proposed commercial site which, combined, make up the former Block 115. This included an 825 mm diameter storm sewer along the length of the future residential Block 110 located to the north of the retirement residence site and a 600 mm diameter storm sewer extending between the northern to southern property limits of the retirement residence site, as shown on the Site Servicing Plan provided in Appendix 'A1' and in the Storm Sewer Design Sheet provided in Appendix 'D2'.

With the severance of former Block 115, the allowable minor system release rate of 289.1 L/s allocated for former Block 115 to the existing Bryant Street storm sewer had to be shared amongst the two properties. This was achieved on a weighted area and runoff coefficient basis, as outlined in the Block 111 Site Servicing Report prepared by JLR dated September 2016. An allowable minor system release rate of 139.7 L/s was, therefore, allocated for the proposed Commercial Plaza.

4.2 Storm Criteria

Storm servicing developed for the proposed Commercial Plaza was designed in accordance with the following stormwater criteria, which has been approved by the City and MOECC as part of the development of the Hawthorne Retirement Group retirement residence site:

- Storm runoff outletting to the existing Bryant Street sewer is to be limited to the allocated peak flow of 139.7 L/s.
- Runoff in excess of allocated minor system release rate and up to the 1:100 year recurrence shall be retained on site.
- Major overland flow in excess of the 1:100 year recurrence is to be conveyed to Goulbourn Forced Road.
- Quality control for the site is to be provided by the Beaver Pond.

Furthermore, the detailed SWM design was carried out in accordance with the design criteria prescribed in the City of Ottawa Sewer Design Guidelines (2012) and associated Technical Bulletins, as summarized in the table below.

Table 4.2: Storm Servicing Design Criteria

General Design Criteria
Storm sewers sized to accommodate the 1:2 year peak flows calculated with the Rational Method and the City of Ottawa Intensity-Duration-Frequency (IDF) curves.
Storm sewers designed based on an inlet time of ten (10) minutes, as per the Technical Bulletin ISDTB-2012-4.
The 1:100 year peak flows to be detained on-site by means of on-site storage designed to limit the total outflows to the allowable release rate.
Minimum swale grades at 1.5% (with lower grades, a sub-drain must be provided).
Minimum roadway profile grades at 0.5%.
Maximum 0.30 m street/parking lot ponding depth.
Provide measures to ensure that site preparation and construction is in accordance with the current Best Management Practices for Erosion and Sediment Control.

4.3 Proposed Stormwater Servicing and SWM Strategy

The proposed storm servicing strategy for the subject site includes both uncontrolled off-site runoff and captured minor system runoff. The uncontrolled off-site runoff includes drainage from some of the perimeter landscaped areas along the north, south and western property limits of the Commercial Plaza, as well as the pathway block to the east. The controlled captured minor system flows include runoff from the remainder of the site (i.e., access lanes, paved parking areas, landscaped areas, and building roofs). Runoff from these areas will be directed to catch basins and roof drains (with or without flow restrictors) and will outlet to the storm sewer system.

Refer to Drawings (at the back of the Report) for ICD and roof drain information, grading, drainage and ponding areas, overland flow route and outlet details.

4.3.1 Off-Site Runoff and Allowable Minor System Release Rate

Due to site grading constraints, some of the narrow landscaped strips along the northern property limit (the retirement residence), Kanata Avenue and Goulbourn Forced Road will drain off-site as major overland flow. Additionally, the pathway block to the east of the Commercial Plaza will drain off-site as overland flow towards the rear yards of the Walden Village subdivision. Table 4.3.1 below provides a comparison between the off-site overland peak flows allocated for the site as part of the Walden Village and retirement residence detailed design versus the off-site overland peak flows proposed as part of the Commercial Plaza development, refer to detailed calculations provided in Appendix ‘D4’.

Table 4.3.1: Off-Site Peak Flow Comparison

	Allocated		Proposed	
Off-site Outlet	**Area**	**Peak Flow (1:5 year)**	**Area**	**Peak Flow (1:5 year)**
Retirement Residence (1)	0.03 ha	5.39 L/s	0.034 ha	4.33 L/s
Kanata Avenue(2)	0.07 ha	4.06 L/s	0.022 ha	1.34 L/s
Goulbourn Forced Road	N/A	N/A	0.028 ha	4.43 L/s
Walden Village Residential Rear Yards(2)	0.12 ha	19.12 L/s	0.064 ha	8.37 L/s

Notes
(1) Refer to Retirement Residence Storm Drainage Plan prepared by SCS Consulting Ltd. dated August 17th 2016, provided in Appendix ‘D3’.
(2) Refer to Walden Village Storm Drainage Plan Drawing No. 500 provided in Appendix ‘D1’.

As summarized in the table above, off-site drainage areas and peak flows are generally less than those allocated for the site with the exception of the overland flow to Goulbourn Forced Road. Based on the SSMP-WV, there was no uncontrolled flow allocated to Goulbourn Forced Road. To compensate for this additional flow, it is proposed to reduce the allowable minor system release rate of 139.7 L/s for the site by subtracting the 1:5 year peak flow discharging overland to Goulbourn Forced Road. Therefore, a revised restricted minor system release rate of 135.27 L/s (139.7 L/s – 4.43 L/s) has been used as the design target for the Commercial Plaza.

The allowable minor system release rate of 135.27 L/s will be achieved through the use of controlled rooftop drains and inlet control devices (ICDs) combined with surface storage, as depicted on the ponding plan (Drawing SMW1) and underground pipe storage. With the exception of the underground pipe storage, the storm sewer system presented on Site Servicing Plan (Drawing S1) was sized to accommodate peak flows generated during the 1:2 year storm event as shown in the Storm Sewer Design Sheet in Appendix ‘D5'. The minimum 1:2 year capture is consistent with Technical Bulletin PIEDTB-2016-01.

4.3.2 Rooftop Controls

Stormwater runoff generated from building rooftops will be controlled by the implementation of restricted roof drain systems on Buildings B, C and D. Rooftop storage (i.e., ponding) will, therefore be provided for Buildings B, C and D. Given the smaller footprint area of Buildings A and E, it is assumed that these building roofs would be slanted and, therefore, would not accommodate rooftop storage.

Given that municipal servicing is being carried out prior to the detailed design of the buildings, rooftop control charts were used to determine appropriate roof drain release rates based on commercially available products. The Zurn Control-Flo rooftop drainage system (Model Z 105 5, single notch) was used to assess viable restricted flow rates (refer to Appendix 'D6'). It was assumed that all of the buildings (i.e., B, C, and D) will have an effective ponding area of at least 80 percent of the total roof area with a maximum ponding depth of 5'' (127 mm). Further, it was assumed that all roofs would be sloped towards each of the rooftop drains.

Table 4.3.2 presents the restricted release rates and ponding details for each of the three (3) buildings as well as the 1:100 year release rates for Buildings A and E. Additional roof drain calculations are provided in Appendix 'D4'. At the time of detailed design of the buildings, the Mechanical Engineer is to comply with the maximum allowable release rate and the minimum storage volume requirements for each building as indicated in Table 4.3.2. However, the Mechanical Engineer can use any manufacturer or other combination of roof drains, as long as the specified release rates are not exceeded and minimum storage volume requirements are fulfilled.

Table 4.3.2: Rooftop Storage and Release Characteristics

Building	Max. Release Rate (1:100 year) (L/s)	Min. Storage Requirement (1:100 year) (m^3)	Storage Volume Provided(1) (m^3)
A	20.10	0	N/A
B	7.74	29.74	32.17
C	6.45	27.47	28.79
D	7.74	34.85	35.90
E	26.30	0	N/A

Notes:
(1) Based on 80% effective roof ponding area and max ponding depth of 127 mm for a sloped roof.
(2) Maximum release rate for Buildings A and E based on the 1:100 year unrestricted peak flow.

4.3.3 Inlet Control Devices (ICDs)

In addition to the aforementioned rooftop restrictors, the allowable minor system release rate will be met using five (5) ICDs in parking lot catch basins and storm maintenance holes. Details associated with each ICD, catchment area and storage requirements are as follows:

ICD No. 53

As shown on Drawings DST and SWM, the ICD at MH530 controls numerous catchment areas that amount to an overall area of 0.683 ha. Within this catchment, there are six (6) above ground storage cells, as depicted on Drawing SWM, with storage volumes of 23.57 m^3, 5.85 m^3, 3.38 m^3, 2.23 m^3, 25.18 m^3 and 1.61 m^3. Based on high level Modified Rational Method calculations (Appendix 'D4'), it was determined that the above-ground storage volume of 61.82 m^3 was insufficient to contain runoff generated during the 1:100 year storm event. Consequently, it is proposed to oversize specific sewers to supplement the surface storage. Four (4) pipe reaches were oversized as follows:

- 1050 mm diameter sewer for pipe reaches MH510-MH511, MH511-MH520 and MH520-MH530;
- 750 mm diameter sewer for the catch basin lead spanning between CBMH510-MH511.

The storage volume in the oversized maintenance holes was also accounted for in the calculations. The aforementioned above-ground storage of 61.82 m^3 was, therefore, supplemented with underground storage of 88.28 m^3 and 62.26 m^3 for the oversized sewers and maintenance holes, respectively.

Given that approximately 29% of the overall storage volume is at the surface, the use of the Modified Rational Method may underestimate the storage volume requirements. Consequently, the SWMHYMO software platform was used to assess storage volume requirements for this catchment. A rating was first developed at various stages that estimated the outflows at various elevations, which are dictated by the ICD, and associated incremental storage volumes were assessed. The various storage volumes consisting of 61.82 m^3 (above ground), 88.28 m^3 (oversized sewers) and 62.26 m^3 (oversized maintenance holes) were incorporated in the outflow-storage relationship. Appendix 'D7' (see Model 1) provides the details associated with the rating curve used in SWMHYMO. Runoff for this 0.683 ha area was generated using a single lumped catchment with a total C-Factor of 0.86 estimated from the weighted average of runoff coefficients for each sub catchment area.

Results of this simulation (Appendix 'D7' – Model 1) have shown that the overall storage volume of 212.36 m^3 is sufficient to contain the 3 hour Chicago Design Storm event while releasing a maximum outflow of 74.0 L/s. The simulation results show that 212.30 m^3 of the 212.36 m^3 will be the maximum storage used during the 1:100 year storm event.

ICD No. 52

The ICD at CB 552 controls one catchment area totaling 0.090 ha. The catchment area has one surface storage cell as depicted on Drawing SWM which provides 40.40 m^3 of storage. Based on the assigned ICD release rate of 4.0 L/s, the Modified Rational Method calculations (Appendix 'D4') show that the minimum storage volume requirement of 34.40 m³ generated during the 1:100 year storm event can be contained within the designed ponding area.

ICD No. 71

The ICD at CBMH 571 controls two (2) catchment areas totaling 0.323 ha. Within these catchment areas, there are two surface storage cells which provide 71.97 m^3 and 26.44 m^3 of storage. Based on the assigned ICD release rate of 18.0 L/s, the surface storage cells provide insufficient storage to contain the 1:100 year storm event. Consequently, an oversized 975 mm diameter catch basin lead is proposed between CBMH 570 and CBMH 571 to provide underground storage to supplement the surface storage provided.

The aforementioned above-ground storage of 98.41 m^3 was, therefore, supplemented with underground storage of 30.85 m^3 and 17.63 m^3 for the oversized sewer and maintenance holes, respectively. Given that a significant volume of storage will be provided underground, the SWMHYMO software platform was used to assess storage volume requirements for this catchment (Refer to Appendix 'D7' - Model 3). Runoff for this 0.323 ha area was generated using a single lumped catchment with a total C-Factor of 0.84 estimated from the weighted average of runoff coefficients for each sub catchment area.

Results of this simulation (Appendix 'D7' – Model 3) have shown that the overall storage volume of 146.89 m^3 is sufficient to contain the 3 hour Chicago Design Storm event while releasing a maximum outflow of 18.0 L/s. The simulation results show that 125.80 m^3 of the 146.89 m^3 will be the maximum storage used during the 1:100 year storm event.

ICD No. 73

The ICD at CBMH 573 controls two (2) catchment areas totaling 0.072 ha. The catchment area has one (1) surface storage cell as depicted on Drawing SWM which provides 9.28 m³ of storage. Based on the assigned ICD release rate of 4.0 L/s, the surface storage cell provides insufficient storage to contain the 1:100 year storm event. Consequently, the catch basin lead spanning between CBMH 572 and CBMH 573 was upsized to a 600 mm diameter pipe to provide underground storage to supplement the surface storage provided.

The aforementioned above-ground storage of 9.28 m^3 was, therefore, supplemented with underground storage of 16.25 m^3 and 7.11 m^3 for the oversized sewer and maintenance holes, respectively. Given that most of the storage will be provided underground, the SWMHYMO software platform was used to assess storage volume requirements for this catchment (refer to Appendix 'D7' – Model 2). Runoff for this 0.072 ha area was generated using a single lumped catchment with a total C-Factor of 0.53 estimated from the weighted average of runoff coefficients for each sub catchment area.

Results of this simulation (Appendix 'D7' – Model 2) have shown that the overall storage volume of 32.64 m^3 is sufficient to contain the 3 hour Chicago Design Storm event while releasing a maximum outflow of 4.0 L/s. The simulation results show that 30.90 m^3 of the 32.64 m^3 will be the maximum storage used during the 1:100 year storm event.

ICD No. 80

The ICD at CB 580 controls one catchment area totaling 0.048 ha. The catchment area has one (1) surface storage cell as depicted on Drawing SWM which provides 4.35 m^3 of storage. Based on the assigned ICD release rate of 13.0L/s, the Modified Rational Method calculations (Appendix 'D4') show that the minimum storage volume requirement of 1.60 m^3 generated during the 1:100 year storm event can be contained within the designed ponding area.

Table 4.3.3 below summarizes the aforementioned specific release rates and storage volumes associated with each ICD, refer to Appendix 'D4' for detailed Modified Rational Method calculations and Appendix 'D7' for SWMHYMO results.

Table 4.3.3: ICD and Storage Volume Characteristics

ICD No.	Restricted Release Rate	ICD Type	STO_{REQ} (1:100 year)	Surface Storage Provided (m^3)	Underground Storage Provided (m^3) (3)	Total Storage Provided (m^3)
53	74.0	200 VHV-2	212.30(2)	61.82	150.54	212.36
52	4.0	50 VHV-1	34.40(1)	40.40	0	40.40
71	18.0	100 VHV-1	125.80(2)	98.41	48.48	146.89
73	4.0	50 VHV-1	30.90(2)	9.28	23.36	32.64
80	13.0	100 VHV-1	1.60(1)	4.35	0	4.35
Total	**113.0**		**405.00**	**214.26**	**222.38**	**436.64**
	Notes: (1) Storage Requirement as per Modified Rational Method Calculations in Appendix 'D4' (2) Storage Requirement as per SWMHYMO results provided in Appendix 'D7' (3) As per SWMHYMO model provided in Appendix 'D7'					

4.3.4 Summary of Proposed Restricted Flows and Storage

The above stormwater flow determinations show that, with the implementation of ICDs and roof drains, the design provides sufficient storage onsite to attenuate peak flows to meet the 135.27 L/s minor system release rate criterion. The maximum peak flows and storage results are summarized in Table 4.3.4 below. As indicated in the Table below, the Commercial Plaza will release a maximum of 134.93 L/s to the existing downstream storm sewer system.

Table 4.3.4: Restricted Flow and Storage Results

Flow Component	Restricted Flow Rate (L/s)	Max. Storage Requirement (m^3)	Storage Provided (m^3)
Rooftop (controlled)	21.93	92.06	96.86
ICDs	113.0	405.00	436.64
Total	**134.93**	**497.06**	**533.50**

4.3.5 Overland Flow

A major overland flow route was designed for the site to outlet to Goulbourn Forced Road for storm events in excess of the 1:100 year event, in accordance with the criteria described in Section 4.2. Refer to the Grading Plan (Drawing G1) at the back of the Report for details.

4.3.6 Water Quality

Stormwater runoff from the Commercial Plaza is to be conveyed by both minor and major drainage systems to the Kizell Drain via Beaver Pond. This end-of-pipe facility was designed to provide stormwater quality control for the Commercial Plaza. Consequently, there are no additional water quality measures proposed as part of the proposed servicing.

4.4 Summary and Conclusions

The storm and stormwater management solution presented in this Site Servicing Report was found to fulfill the water quantity criteria presented in Section 4.3.1. The calculated off-site overland flows and the restricted minor system flows were designed to be less than those allocated for the site as part of the Walden Village detailed design. Furthermore, the site has been designed with adequate surface and underground pipe storage to contain stormwater onsite up to the 1:100 year event. It is, therefore, recommended that the stormwater servicing shown on the Site Servicing Plan (Drawing S1) be implemented to provide adequate stormwater management for the Commercial Plaza.

5.0 Erosion and Sediment Control

During construction of the proposed site, appropriate erosion and sedimentation control measures, as outlined in the Ontario Ministry of Natural Resources (MNR) Guidelines on Erosion and Sediment Control for Urban Construction Sites, should be implemented to trap sediment on site.

As a minimum, the following erosion and sedimentation control measures are proposed, as shown on Drawing ESC:

- supply and installation of a silt fence barrier, as per OPSD 219.110;
- supply and installation of filter fabric between the frame and cover of catch basins and maintenance holes adjacent to the project area during construction, to prevent sediment

from entering the existing sewer system. The filter fabric is to be inspected regularly and corrected as required;

- stockpiling of material during construction is to be located along flat areas away from drainage paths. For material placed on sloped areas, stockpiles are to be enclosed with a silt fence to protect watercourses;
- all catch basins are to be equipped with sumps, inspected frequently, and cleaned as required;
- sandbags are to be placed blocking part of the sewer pipe in the connecting storm maintenance holes to eliminate construction debris from entering the existing storm sewer system. The sandbags are to be removed after the proposed storm sewers have been fully cleaned.

The proposed erosion control measures shall conform to the following documents:

- “Guidelines on Erosion and Sediment Control for Urban Construction Sites” published by Ontario Ministries of Natural Resources, Environment, Municipal Affairs, and Transportation & Communication, Association of Construction Authorities of Ontario and Urban Development Institute, Ontario, May 1987.
- “MTO Drainage Manual”, Chapter F: “Erosion of Materials and Sediment Control”, Ministry of Transportation & Communications, 1985.
- “Erosion and Sediment Control” Training Manual by Ministry of Environment, Spring 1998.
- Applicable Regulations and Guidelines of the Ministry of Natural Resources.

6.0 Conclusion

This Servicing Report and the associated Drawings describe the servicing solutions to provide municipal services for the proposed Commercial Plaza at 5100 Kanata Avenue, in accordance with the City of Ottawa Design Guidelines. Construction details are to be in accordance with Local and Provincial design standards. It is recommended that this Servicing Report be reviewed with the intent of providing approval to permit the Owner to proceed with the presented servicing.

This report has been prepared for the exclusive use of Urbandale Corporation, for the stated purpose, for the named facility. Its discussions and conclusions are summary in nature and cannot be properly used, interpreted or extended to other purposes without a detailed understanding and discussions with the client as to its mandated purpose, scope and limitations. This report was prepared for the sole benefit and use of Urbandale Corporation and may not be used or relied on by any other party without the express written consent of J.L. Richards & Associates Limited.

J.L. RICHARDS & ASSOCIATES LIMITED

Prepared by: Reviewed by:

Julie White, EIT

Hilary MacKay, P.Eng.

Appendix A1

Block 111 Site Servicing Plan (S1)
(Prepared by JLR, 2016)

GENERAL NOTES

1. ALL MATERIALS, SERVICES AND CONSTRUCTION METHODS TO BE IN ACCORDANCE WITH THE CITY OF OTTAWA CURRENT STANDARDS AND SPECIFICATIONS.
2. ALL DIMENSIONS SHOWN ON PLANS ARE IN METRES UNLESS OTHERWISE NOTED.
3. UNLESS OTHERWISE NOTED, DIMENSIONS FROM STREET LINE ARE TO THE CENTRELINE OF SEWER OR MANHOLE.
4. THE INSIDE DIAMETER OF PIPES ARE REFERRED TO IN PLAN VIEW AND THE OUTSIDE DIAMETER OF CONCRETE PIPES ARE DRAWN IN PROFILE VIEW.
5. THE CONTRACTOR IS RESPONSIBLE TO DETERMINE THE EXACT LOCATION, SIZE, MATERIAL AND ELEVATION OF ALL SERVICES AND UTILITIES PRIOR TO CONSTRUCTION AND SHALL PROTECT AND ASSURE RESPONSIBILITY FOR ALL UTILITIES WHETHER OR NOT SHOWN ON THIS DRAWING.
6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL EXCAVATION, BACKFILL, REINSTATEMENT OF ALL AREAS DISTURBED DURING CONSTRUCTION AND ALL ASSOCIATED WORKS TO THE SATISFACTION OF THE ENGINEER AND THE CITY OF OTTAWA.
7. THE CONTRACTOR SHALL BE RESPONSIBLE TO DETERMINE, VIA EXCAVATION, THE EXACT LOCATION AND ELEVATION OF THE EXISTING WATERMAINS, SEWERS AND UNDERGROUND STRUCTURES AS REQUIRED FOR ALL CONNECTIONS, RELOCATIONS AND BLANKINGS.
8. EXCAVATION FOR THE INSTALLATION OF SERVICES ALONG OR IN PROXIMITY OF A BUILDING OR A STRUCTURE IS TO BE CONTAINED WITHIN A TRENCH BOX WIDTH AND IS TO ENSURE NO CONFLICT WITH ANY FUTURE FOOTINGS. SELECT SUBGRADE MATERIAL, COMPACTED TO 100% SPD TO 1.0m BELOW EXISTING GRADE FOR FULL TRENCH WIDTH OF DISTURBED AREA SHALL BE USED FOR BACKFILL, INCLUDING ALONG ANY SEWERS AND WATERMAINS ADJACENT TO A BUILDING OR OTHER STRUCTURE.

WATERMAIN NOTES

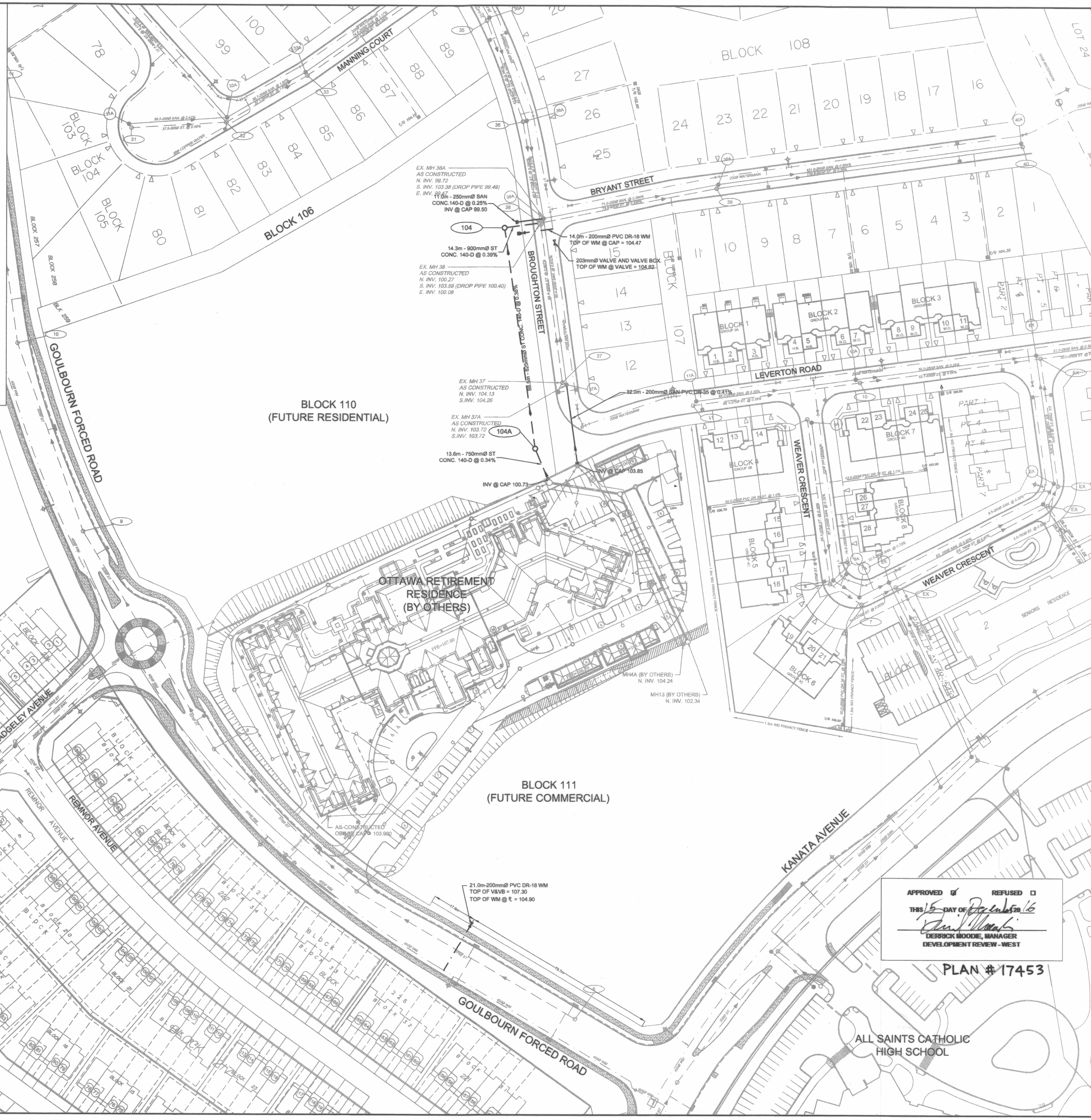
9. EXISTING WATERMAIN INFORMATION SHOWN ON PLANS IS BASED ON BEST CURRENT INFORMATION. CONTRACTOR TO VERIFY EXACT LOCATION OF WATERMAIN AND APPURTENANCES. REPORT ANY DISCREPANCIES TO ENGINEER.
10. EXCAVATION, INSTALLATION, BACKFILL AND RESTORATION OF ALL WATERMAINS BY CONTRACTOR. NO WATERMAIN SITE WORK IS TO COMMENCE UNLESS THE CITY OF OTTAWA . WATER WORKS INSPECTOR AND/OR CONSULTANT ARE PRESENT ON SITE TO WITNESS WORK.
11. WATERMAIN AND WATER SERVICE TO HAVE A MINIMUM OF 2.4 METERS OF COVER. INSULATION TO BE BE PROVIDED WHERE MINIMUM COVER CANNOT BE PROVIDED. WATERMAIN TO BE INSTALLED TO DEPTHS SHOWN ON PLANS.
12. WATERMAIN THRUST BLOCKS TO BE CONSTRUCTED PER CITY OF OTTAWA DETAILS W25.3 AND W25.4. THRUST BLOCKS ARE REQUIRED AT ALL BENDS, TEES, PLUGS, DEAD END CAPS, VALVES, REDUCERS OR OTHER FITTINGS WHERE CHANGES OCCUR IN PIPE DIAMETER OR DIRECTION ALL IN ACCORDANCE WITH CURRENT CITY OF OTTAWA STANDARDS AND SPECIFICATIONS.

SANITARY & STORM SEWER NOTES

13. SANITARY & STORM SEWERS TO BE REINFORCED CONCRETE, PVC, OR CITY APPROVED EQUIVALENT.
14. SANITARY & STORM SEWERS WITH LESS THAN 2.0m COVER SHALL BE INSULATED.
15. SANITARY & STORM MAINTENANCE HOLES TO BE CONCRETE PER OPSD 701.010 TO 701.013.

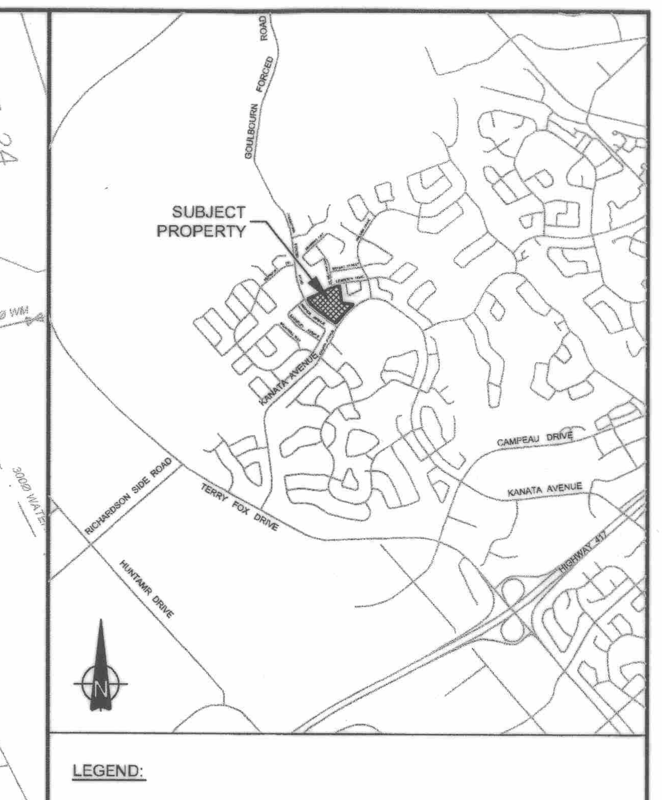
GRADING NOTES:

16. MATCH EXISTING ELEVATIONS AT ALL EXTERIOR PROPERTY LINES. ENSURE POSITIVE DRAINAGE TOWARD A SUITABLE OUTLET WHETHER INDICATED OR NOT.



LEGEND:

- EXISTING CATCH BASIN
- EXISTING WATERMAIN, VALVE & HYDRANT
- EXISTING SANITARY SEWER & MANHOLE
- EXISTING STORM SEWER & MANHOLE
- PROPOSED SANITARY SEWER & MANHOLE
- PROPOSED STORM SEWER & MANHOLE
- PROPOSED WATERMAIN & VALVE



No.	ISSUE / REVISION	DD/MM/YY
5	REVISED PER CITY COMMENT / ISSUED FOR MYLARS	04/10/16
4	ISSUED FOR CITY REVIEW - 4TH SUBMISSION	22/09/16
3	ISSUED FOR CITY REVIEW - 3rd SUBMISSION	13/05/16
2	ISSUED FOR CITY REVIEW - 2ND SUBMISSION	26/01/16
1	ISSUED FOR CITY REVIEW - 1ST SUBMISSION	14/09/15

VERIFY SHEET SIZE AND SCALES. BAR TO THE RIGHT IS 25mm IF THIS IS A FULL SIZE DRAWING. 0 25mm

SCALE: 1:750

CLIENT: Urbandale Corporation
2193 Arch Street
Ottawa, ON Canada
K1G 2H5
Tel: 613 737 6331
Fax: 613 731 9226

CONSULTANT: J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS
www.jlrichards.ca

CONSULTANT:

PROFESSIONAL STAMP: LICENSED PROFESSIONAL ENGINEER H. R. MACKAY 100186588 Oct 4/16 PROVINCE OF ONTARIO

PROJECT NORTH

PROJECT: URBANDALE CORPORATION
BLOCK 111
5100 KANATA AVENUE

DRAWING: SITE SERVICING PLAN

APPROVED ☑ REFUSED ☐
THIS 15 DAY OF December 2016
DERRICK MOODIE, MANAGER
DEVELOPMENT REVIEW - WEST

PLAN # 17453

DESIGN:	HM		
DRAWN:	BR	DRAWING #:	S1
CHECKED:	LD		
JLR #:	23405-01		

PLOT DATE: October 25, 2016 7:51:10 AM

D07-12-15-0136

File Location: P:\23000\23405-01 LD\23405-01 C S1.dwg

Appendix A2

MOE Environmental Compliance Approval

Ontario

Ministry of the Environment and Climate Change
Ministère de l'Environnement et de l'Action en matière de changement climatique

ENVIRONMENTAL COMPLIANCE APPROVAL

NUMBER 4070-AN9PJ2
Issue Date: June 15, 2017

Urbandale Corporation
2193 Arch Street
Ottawa, Ontario
K1G 2H5

Site Location: 5100 Kanata Avenue and 130 Goulbourn Forced Road
City of Ottawa

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act*, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:*

the construction stormwater and wastewater infrastructure to service the 1.7 hectare Hawthorn Retirement Group Residence at 130 Goulbourn Forced Road, as well as the 1.5 hectare Urbandale Corporation future commercial site at 5100 Kanata Avenue, in the City of Ottawa, consisting of;

Storm sewers running along the east side of the property at 130 Goulbourn Forced Road, from approximately 180 m south of Bryant Street, and then along 91 Broughton Street (Block 110) from approximately 105 m south of Bryant Street to Bryant Street, discharging through a 250 mm pipe to existing storm sewers on Bryant Street;

Sanitary sewers running along the east side of the property at 130 Goulbourn Forced Road, from approximately 180 m south of Bryant Street, and then along Broughton Street from approximately 105 m south of Bryant Street to approximately 72 m south of Bryant Street, discharging to existing sanitary sewers on Broughton Street;

Sanitary sewers on Bryant Street from Block 110, discharging to existing sanitary sewers on Bryant Street;

including erosion/sedimentation control measures during construction and all other controls and appurtenances essential for the proper operation of the aforementioned Works;

all in accordance with the submitted application and supporting documents listed in Schedule "A" forming part of this Approval.

For the purpose of this environmental compliance approval, the following definitions apply:

"Approval" means this entire document and any schedules attached to it, and the application;

"Director" means a person appointed by the Minister pursuant to section 5 of the EPA for the purposes of Part II.1 of the EPA;

"District Manager" means the District Manager of the appropriate local District Office of the Ministry, where the Works are geographically located;

"EPA" means the Environmental Protection Act, R.S.O. 1990, c.E.19, as amended;

"Ministry" means the ministry of the government of Ontario responsible for the EPA and OWRA and includes all officials, employees or other persons acting on its behalf;

"Owner" means Urbandale Corporation, and includes its successors and assignees;

"OWRA" means the Ontario Water Resources Act, R.S.O. 1990, c. O.40, as amended;

"Works" means the sewage works described in the Owner's application, and this Approval.

You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL CONDITIONS

(1) The Owner shall ensure that any person authorized to carry out work on or operate any aspect of the Works is notified of this Approval and the conditions herein and shall take all reasonable measures to ensure any such person complies with the same.

(2) Except as otherwise provided by these Conditions, the Owner shall design, build, install, operate and maintain the Works in accordance with the description given in this Approval, and the application for approval of the Works.

(3) Where there is a conflict between a provision of any document in the schedule referred to in this Approval and the conditions of this Approval, the conditions in this Approval shall take precedence, and where there is a conflict between the documents in the schedule, the document bearing the most recent date shall prevail.

(4) Where there is a conflict between the documents listed in Schedule ‘A’ and the application,

the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

(5) The conditions of this Approval are severable. If any condition of this Approval, or the application of any requirement of this Approval to any circumstance, is held invalid or unenforceable, the application of such condition to other circumstances and the remainder of this Approval shall not be affected thereby.

2. EXPIRY OF APPROVAL

(1) This Approval will cease to apply to those parts of the Work which have not been constructed within five (5) years of the date of this Approval.

(2) In the event that completion and commissioning of any portion of the Works is anticipated to be delayed beyond the specified expiry period, the Owner shall submit an application of extension to the expiry period, at least twelve (12) months prior to the end of the period. The application for extension shall include the reason(s) for the delay, whether there is any design change(s) and a review of whether the standards applicable at the time of Approval of the Works are still applicable at the time of request for extension, to ensure the ongoing protection of the environment.

3. CHANGE OF OWNER

(1) The Owner shall notify the District Manager and the Director, in writing, of any of the following changes within thirty (30) days of the change occurring:

(a) change of Owner;

(b) change of address of the Owner;

(c) change of partners where the Owner is or at any time becomes a partnership, and a copy of the most recent declaration filed under the Business Names Act, R.S.O. 1990, c.B17 shall be included in the notification to the District Manager; or

(d) change of name of the corporation where the Owner is or at any time becomes a corporation, and a copy of the most current information filed under the Corporations Information Act, R.S.O. 1990, c. C39 shall be included in the notification to the District Manager.

(2) In the event of any change in ownership of the Works, other than a change to a successor municipality, the Owner shall notify in writing the succeeding owner of the existence of this Approval, and a copy of such notice shall be forwarded to the District Manager and the Director.

(3) The Owner shall ensure that all communications made pursuant to this condition refer to the

number at the top of this Approval.

(4) Notwithstanding any other requirements in this Approval, upon transfer of the ownership or assumption of the Works to a municipality if applicable, any reference to the District Manager shall be replaced with the Water Supervisor.

4. **OPERATION AND MAINTENANCE**

(1) If applicable, any proposed storm sewers or other stormwater conveyance in this Approval can be constructed but not operated until the proposed stormwater management facilities in this Approval or any other Approval that are designed to service the storm sewers or other stormwater conveyance are in operation.

Schedule "A"

Application for Environmental Compliance Approval for Municipal and Private Sewage Works, dated January 4, 2017 and received on April 26, 2017, submitted by Urbandale Corporation;

Pipe Data Sheet, prepared by J.L. Richards & Associates Limited;

Block 111 – 5100 Kanata Avenue – Servicing Report, dated September 2015 prepared by J.L. Richards & Associates Limited;

Engineering Drawings: Urbandale Corporation – Block 111, dated October 2016, prepared by J.L. Richards & Associates Limited; and

E-mail from Hilary MacKay of .L. Richards & Associates Limited to the MOECC, dated June 13, 2017;

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is imposed to ensure that the Works are constructed and operated in the manner in which they were described and upon which approval was granted. This condition is also included to emphasize the precedence of conditions in the Approval and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review.

2. Condition 2 is included to ensure that, when the Works are constructed, the Works will meet the standards that apply at the time of construction to ensure the ongoing protection of the environment.

3. Condition 3 is included to ensure that the Ministry records are kept accurate and current with respect to approved Works and to ensure that subsequent owners of the Works are made aware of the Approval and continue to operate the Works in compliance with it.

4. Condition 4 is included to prevent the operation of stormwater pipes and other conveyance until such time that their required associated stormwater management Works are also constructed.

In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:

a. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
b. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

1. The name of the appellant;
2. The address of the appellant;
3. The environmental compliance approval number;
4. The date of the environmental compliance approval;
5. The name of the Director, and;
6. The municipality or municipalities within which the project is to be engaged in.

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary***** Environmental Review Tribunal 655 Bay Street, Suite 1500 Toronto, Ontario M5G 1E5	<u>AND</u>	The Director appointed for the purposes of Part II.1 of the Environmental Protection Act Ministry of the Environment and Climate Change 135 St. Clair Avenue West, 1st Floor Toronto, Ontario M4V 1P5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 326-5370 or www.ert.gov.on.ca**

The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.

DATED AT TORONTO this 15th day of June, 2017

Gregory Zimmer, P.Eng.
Director
appointed for the purposes of Part II.1 of the
Environmental Protection Act

EC/
c: District Manager, MOECC Ottawa
Hilary MacKay, P.Eng., J.L. Richards & Associates Limited

Appendix A3

City of Ottawa Development Servicing Checklist

UBANDALE COMMERCIAL PLAZA 5100 KANATA AVENUE DEVELOPMENT SERVICING STUDY CHECKLIST	
REFERENCED STUDIES AND REPORTS	**REFERENCE**
Servicing Study, Commercial Plaza 5100 Kanata Avenue, prepared by J.L. Richards & Associates Limited dated March 21, 2018	SSR

4.1	**GENERAL CONTENT**	**REFERENCE**
☐	Executive Summary (for larger reports only).	N/A
☒	Date and revision number of the report.	SSR (Title Page)
☒	Location map and plan showing municipal address, boundary, and layout of proposed development.	SSR (Figure 1)
☒	Plan showing the site and location of all existing services.	Site Servicing Plan (S1)
☐	Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to which individual developments must adhere.	N/A
☐	Summary of Pre-consultation Meetings with City and other approval agencies.	
☒	Reference and confirm conformance to higher level studies and reports (Master Servicing Studies, Environmental Assessments, Community Design Plans), or in the case where it is not in conformance, the proponent must provide justification and develop a defendable design criteria.	SSR (Section 1.1)
☒	Statement of objectives and servicing criteria.	SSR (Sect. 1.0; 2.1; 2.2; 2.3; 3.2; 4.2)
☒	Identification of existing and proposed infrastructure available in the immediate area.	SSR (Sect. 1.1; 1.3;)
☐	Identification of Environmentally Significant Areas, watercourses and Municipal Drains potentially impacted by the proposed development (Reference can be made to the Natural Heritage Studies, if available).	N/A
☒	Concept level master grading plan to confirm existing and proposed grades in the development. This is required to confirm the feasibility of proposed stormwater management and drainage, soil removal and fill constraints, and potential impacts to neighbouring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths.	Grading Plan (G1)
☐	Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to address potential impacts.	N/A

☐	Proposed phasing of the development, if applicable.	N/A
☒	Reference to geotechnical studies and recommendations concerning servicing.	Site Servicing Plan (S1)
☒	All preliminary and formal site plan submissions should have the following information: ▪ Metric scale ▪ North arrow (including construction North) ▪ Key plan ▪ Name and contact information of applicant and property owner ▪ Property limits, including bearings and dimensions ▪ Existing and proposed structures and parking areas ▪ Easements, road widening and rights-of-way ▪ Adjacent street names	All Drawings

4.2	**DEVELOPMENT SERVICING REPORT: WATER**	**REFERENCE**
☐	Confirm consistency with Master Servicing Study, if available.	N/A
☒	Availability of public infrastructure to service proposed development.	Site Servicing Plan (S1)
☒	Identification of system constraints.	SSR (Sect.1.1; 1.3)
☒	Identify boundary conditions.	SSR (Sect. 2.6; Table 2.6; Appendix B4)
☒	Confirmation of adequate domestic supply and pressure.	SSR (Sect. 2.7.1; Appendix B5;)
☒	Confirmation of adequate fire flow protection and confirmation that fire flow is calculated as per the Fire Underwriter's Survey. Output should show available fire flow at locations throughout the development.	SSR (Sect. 2.7.2; Appendix B6)
☒	Provide a check of high pressures. If pressure is found to be high, an assessment is required to confirm the application of pressure reducing valves.	SSR (Sect. 2.7.3; Appendix B7)
☒	Definition of phasing constraints. Hydraulic modelling is required to confirm servicing for all defined phases of the project, including the ultimate design.	SSR (Sect. 2.7)
☒	Address reliability requirements, such as appropriate location of shutoff valves.	Site Servicing Plan (S1)
☒	Check on the necessity of a pressure zone boundary modification.	SSR (Sect. 2.7)
☒	Reference to water supply analysis to show that major infrastructure is capable of delivering sufficient water for the proposed land use. This includes data that shows that the expected demands under average day, peak hour and fire flow conditions provide water within the required pressure range.	SSR (Sect 2.7.1; 2.7.2; 2.7.5; Appendices B5, B6; B7)

☒	Description of the proposed water distribution network, including locations of proposed connections to the existing system, provisions for necessary looping, and appurtenances (valves, pressure reducing valves, valve chambers, and fire hydrants), including special metering provisions.	SSR (Sect. 2.9) Site Servicing Plan (S1)
☐	Description of off-site required feedermains, booster pumping stations, and other water infrastructure that will be ultimately required to service proposed development, including financing, interim facilities, and timing of implementation.	N/A
☒	Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.	SSR (Sect. 2.3; Appendix B1)
☒	Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.	Site Servicing Plan (S1), SSR Appendix B3

4.3	**DEVELOPMENT SERVICING REPORT: WASTEWATER**	**REFERENCE**
☒	Summary of proposed design criteria (Note: Wet weather flow criteria should not deviate from the City of Ottawa Sewer Design Guidelines. Monitored flow data from relatively new infrastructure cannot be used to justify capacity requirements for proposed infrastructure).	SSR (Sect. 3.2)
☐	Confirm consistency with Master Servicing Study and/or justifications for deviations.	N/A
☐	Consideration of local conditions that may contribute to extraneous flows that are higher than the recommended flows in the Guidelines. This includes groundwater and soil conditions, and age and condition of sewers.	N/A
☒	Description of existing sanitary sewer available for discharge of wastewater from proposed development.	SSR (Sect. 1.3; 3.1)
☒	Verify available capacity in downstream sanitary sewer and/or identification of upgrades necessary to service the proposed development. (Reference can be made to previously completed Master Servicing Study if applicable.)	SSR (Sect. 3.3)
☐	Calculations related to dry weather and wet weather flow rates from the development in standard MOE sanitary sewer design table (Appendix ‘C’) format.	N/A
☒	Description of proposed sewer network, including sewers, pumping stations and forcemains.	SSR (Sect. 3.4) Site Servicing Plan (S1)
☐	Discussion of previously identified environmental constraints and impact on servicing (environmental constraints are related to limitations imposed on the development in order to preserve the physical condition of watercourses, vegetation, soil cover, as well as protecting against water quantity and quality).	N/A

☐	Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development.	N/A
☐	Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity.	N/A
☐	Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding.	N/A
☐	Special considerations, such as contamination, corrosive environment, etc.	N/A

4.4	**DEVELOPMENT SERVICING REPORT: STORMWATER**	**REFERENCE**
☒	Description of Drainage outlets and downstream constraints, including legality of outlets (i.e., municipal drain, right-of-way, watercourse, or private property).	SSR (Sect. 4.1)
☒	Analysis of available capacity in existing public infrastructure.	SSR (Sect. 4.1)
☒	A Drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern.	SSR (Figure 1) Site Servicing Plan (S1)
☒	Water quantity control objective (e.g. controlling post-development peak flows to pre-development level for storm events ranging from the 2 or 5 year event (dependent on the receiving sewer design) to 100 year return period); if other objectives are being applied, a rationale must be included with reference to hydrologic analyses of the potentially affected subwatersheds, taking into account long-term cumulative effects.	SSR (4.3; Appendix D3,D4)
☒	Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.	SSR (Sect. 4.2)
☐	Description of the stormwater management concept with facility locations and descriptions with references and supporting information.	SSR (Sect. 4.3)
☐	Setback from private sewage disposal systems.	N/A
☐	Watercourse and hazard lands setbacks.	N/A
☒	Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.	SSR (Sect. 1.4; Appendix A2)
☐	Confirm consistency with subwatershed and Master Servicing Study, if applicable study exists.	N/A

☒	Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period).	SSR (Sect.4.3; Appendices D3 & D4)
☐	Identification of watercourses within the proposed development and how watercourses will be protected, or, if necessary, altered by the proposed development with applicable approvals.	N/A
☒	Calculate pre- and post-development peak flow rates, including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions.	SSR (Sect. 4.1; 4.3; Appendices D3 & D4)
☐	Any proposed diversion of drainage catchment areas from one outlet to another.	N/A
☒	Proposed minor and major systems, including locations and sizes of stormwater trunk sewers, and stormwater management facilities.	SSR (Sect. 4.4) Site Servicing Plan (S1)
☐	If quantity control is not proposed, demonstration that downstream system has adequate capacity for the post-development flows up to and including the 100-year return period storm event.	N/A
☐	Identification of potential impacts to receiving watercourses.	N/A
☐	Identification of municipal drains and related approval requirements.	N/A
☒	Description of how the conveyance and storage capacity will be achieved for the development.	SSR (Sect 4.3; 4.4)
☒	100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.	SSR (Sect 4.3) Site Servicing Plan (S1)
☐	Inclusion of hydraulic analysis, including hydraulic grade line elevations.	
☒	Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.	SSR (Sect. 5.0) Erosion & Sediment Control Plan (ESC)
☐	Identification of floodplains – proponent to obtain relevant floodplain information from the appropriate Conservation Authority. The proponent may be required to delineate floodplain elevations to the satisfaction of the Conservation Authority if such information is not available or if information does not match current conditions.	N/A
☐	Identification of fill constraints related to floodplain and geotechnical investigation.	N/A

4.5	**APPROVAL AND PERMIT REQUIREMENTS**	**REFERENCE**

The Servicing Study shall provide a list of applicable permits and regulatory approvals necessary for the proposed development, as well as the relevant issues affecting such approval. The approval and permitting shall include but not be limited to the following:		
☐	Conservation Authority as the designated approval agency for modification of floodplain, potential impact on fish habitat, proposed works in or adjacent to a watercourse, cut/fill permits and Approval under Lakes and Rivers Improvement Act. The Conservation Authority is not the approval authority for the Lakes and Rivers Improvement Act. Where there are Conservation Authority regulations in place, approval under the Lakes and Rivers Improvement Act is not required, except in cases of dams, as defined in the Act.	N/A
☒	Application for Environmental Compliance Approval (ECA) under the Ontario Water Resources Act.	N/A
☐	Changes to Municipal drains.	N/A
☐	Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation, etc.).	N/A

4.6	**CONCLUSION CHECKLIST**	**REFERENCE**
☒	Clearly stated conclusions and recommendations.	SSR (Sect. 2.9; 3.4; 4.4)
☐	Comments received from review agencies, including the City of Ottawa and information on how the comments were addressed. Final sign-off from the responsible reviewing agency.	
☒	All draft and final reports shall be signed and stamped by a Professional Engineer registered in Ontario.	SSR (Section 5.0)

Appendix B

Hydraulic Network Analysis

(Water Distribution System)

Appendix B1

Water Demands

COMMERCIAL PLAZA
5100 Kanata Avenue

2018-03-14

BUILDING ID	BLDG FOOTPRINT (m2)	BLDG AREA DISTRIBUTION (ha)	AREA DISTRIBUTION FACTOR	JUNCTION ID	DEMAND (L/s)		
					Avg Day	Max Day	Peak Hour
A	405	0.17	0.11	J-9	0.10	0.15	0.27
B	954	0.40	0.25	J-10	0.23	0.35	0.63
C	848	0.35	0.22	J-11	0.20	0.30	0.55
D	1,060	0.44	0.28	J-12	0.25	0.38	0.69
E	530	0.22	0.14	J-13	0.13	0.19	0.34
TOTAL	**3,797**	**1.58**	**1.00**		**0.91**	**1.37**	**2.48**

Commercial Consumption		
Total Site Area	1.58	ha
Average Day Demand	25,000	L/ha/day
Maximum Day Demand (1.5 x Avg Day)	37,500	L/ha/day
Peak Hour Demand (1.8 x Max Day)	67,500	L/ha/day

*NOTE - A 12 hour business day was assumed.

Appendix B2

FUS Calculations

Fire Flow Calculation - BLDG A
(per FUS Guidelines)

C=	Coefficient related to type of construction		1.5
	= Wood frame	1.5	
	=ordinary construction	1.0	
	=non-combustible construction	0.8	
	=fire resistive construction (< 2 hrs)	0.7	
	=fire resistive construction (> 2 hrs)	0.6	
	= interpolation		
A=	Area of structure considered (m^2)		405 m^2

F=	**= Required fire flow (litres/minute)**		**Calculated:**		6641 L/min
	= 220 $C(A)^{0.5}$ (25,000 L/min Max)		**(1) Rounded:**		7000 L/min
Occupancy hazard reduction of surcharge			**(2) Surcharge:**		0 L/min
	* non-combustible	-25%			
	* limited combustible	-15%			
	* combustible	0%			0 L/min
	* free burning	15%			
	* rapid burning	25%			
			(1) + (2)		7000 L/min
Sprinkler Reduction					
	* non-combustible -fire resistive			0%	
			(3) Reduction:		0 L/min
Exposure surcharge (cumulative (% of 2)					
	* 0 - 3 m	25%		0	0%
	* 3.1 - 10 m	20%		0	0%
	* 10.1 - 20 m	15%		0	0%
	* 20.1 - 30 m	10%		1	10%
	* 30.1 - 45 m	5%		0	0%
					10%
	* Number of Party Walls * 1000 L/min			0	0 L/min
			(4) Surcharge:		700 L/min
			Fire Flow = Calculated:		**7700 L/min**
			Rounded:		**8000 L/min**
					133 L/s

Fire Flow Calculation - BLDG B
(per FUS Guidelines)

C=	Coefficient related to type of construction			0.8
	= Wood frame		1.5	
	=ordinary construction		1.0	
	=non-combustible construction		0.8	
	=fire resistive construction (< 2 hrs)		0.7	
	=fire resistive construction (> 2 hrs)		0.6	
	= interpolation			
A=	Area of structure considered (m^2)			954 m^2

F=	**= Required fire flow (litres/minute)**		**Calculated:**		5436 L/min
	= 220 $C(A)^{0.5}$ (25,000 L/min Max)		**(1) Rounded:**		5000 L/min
Occupancy hazard reduction of surcharge			**(2) Surcharge:**		0 L/min
	* non-combustible	-25%			
	* limited combustible	-15%			
	* combustible	0%			0 L/min
	* free burning	15%			
	* rapid burning	25%			
			(1) + (2)		5000 L/min
Sprinkler Reduction					
	* non-combustible -fire resistive			-50%	
			(3) Reduction:		-2500 L/min
Exposure surcharge (cumulative (% of 2)					
	* 0 - 3 m	25%		0	0%
	* 3.1 - 10 m	20%		0	0%
	* 10.1 - 20 m	15%		0	0%
	* 20.1 - 30 m	10%		2	20%
	* 30.1 - 45 m	5%		0	0%
					20%
	* Number of Party Walls * 1000 L/min			0	0 L/min
			(4) Surcharge:		1000 L/min
		Fire Flow =	**Calculated:**		**3500 L/min**
			Rounded:		**4000 L/min** **67 L/s**

Fire Flow Calculation - BLDG C
(per FUS Guidelines)

C=	Coefficient related to type of construction			0.8
	= Wood frame		1.5	
	=ordinary construction		1.0	
	=non-combustible construction		0.8	
	=fire resistive construction (< 2 hrs)		0.7	
	=fire resistive construction (> 2 hrs)		0.6	
	= interpolation			
A=	Area of structure considered (m^2)			848 m^2

F=	**= Required fire flow (litres/minute)**		**Calculated:**		5125 L/min
	= 220 $C(A)^{0.5}$ (25,000 L/min Max)		**(1) Rounded:**		5000 L/min
Occupancy hazard reduction of surcharge			**(2) Surcharge:**		0 L/min
	* non-combustible	-25%			
	* limited combustible	-15%			
	* combustible	0%			0 L/min
	* free burning	15%			
	* rapid burning	25%			
			(1) + (2)		5000 L/min
Sprinkler Reduction					
	* non-combustible -fire resistive			0%	
			(3) Reduction:		0 L/min
Exposure surcharge (cumulative (% of 2)					
	* 0 - 3 m	25%		0	0%
	* 3.1 - 10 m	20%		1	20%
	* 10.1 - 20 m	15%		0	0%
	* 20.1 - 30 m	10%		2	20%
	* 30.1 - 45 m	5%		1	5%
					45%
	* Number of Party Walls * 1000 L/min			0	0 L/min
			(4) Surcharge:		2250 L/min
		Fire Flow =	**Calculated:**		**7250 L/min**
			Rounded:		**7000 L/min**
					117 L/s

Fire Flow Calculation - BLDG D
(per FUS Guidelines)

C=	Coefficient related to type of construction			0.8
	= Wood frame		1.5	
	=ordinary construction		1.0	
	=non-combustible construction		0.8	
	=fire resistive construction (< 2 hrs)		0.7	
	=fire resistive construction (> 2 hrs)		0.6	
	= interpolation			
A=	Area of structure considered (m^2)			1060 m^2

F=	**= Required fire flow (litres/minute)**		**Calculated:**		5730 L/min
	= 220 $C(A)^{0.5}$ (25,000 L/min Max)		**(1) Rounded:**		6000 L/min
Occupancy hazard reduction of surcharge			**(2) Surcharge:**		0 L/min
	* non-combustible	-25%			
	* limited combustible	-15%			
	* combustible	0%			0 L/min
	* free burning	15%			
	* rapid burning	25%			
			(1) + (2)		6000 L/min
Sprinkler Reduction					
	* non-combustible -fire resistive			-50%	
			(3) Reduction:		-3000 L/min
Exposure surcharge (cumulative (% of 2)					
	* 0 - 3 m	25%		0	0%
	* 3.1 - 10 m	20%		0	0%
	* 10.1 - 20 m	15%		0	0%
	* 20.1 - 30 m	10%		2	20%
	* 30.1 - 45 m	5%		2	10%
					30%
	* Number of Party Walls * 1000 L/min			0	0 L/min
			(4) Surcharge:		1800 L/min
		Fire Flow =	**Calculated:**		**4800 L/min**
			Rounded:		**5000 L/min** **83 L/s**

Fire Flow Calculation - BLDG E
(per FUS Guidelines)

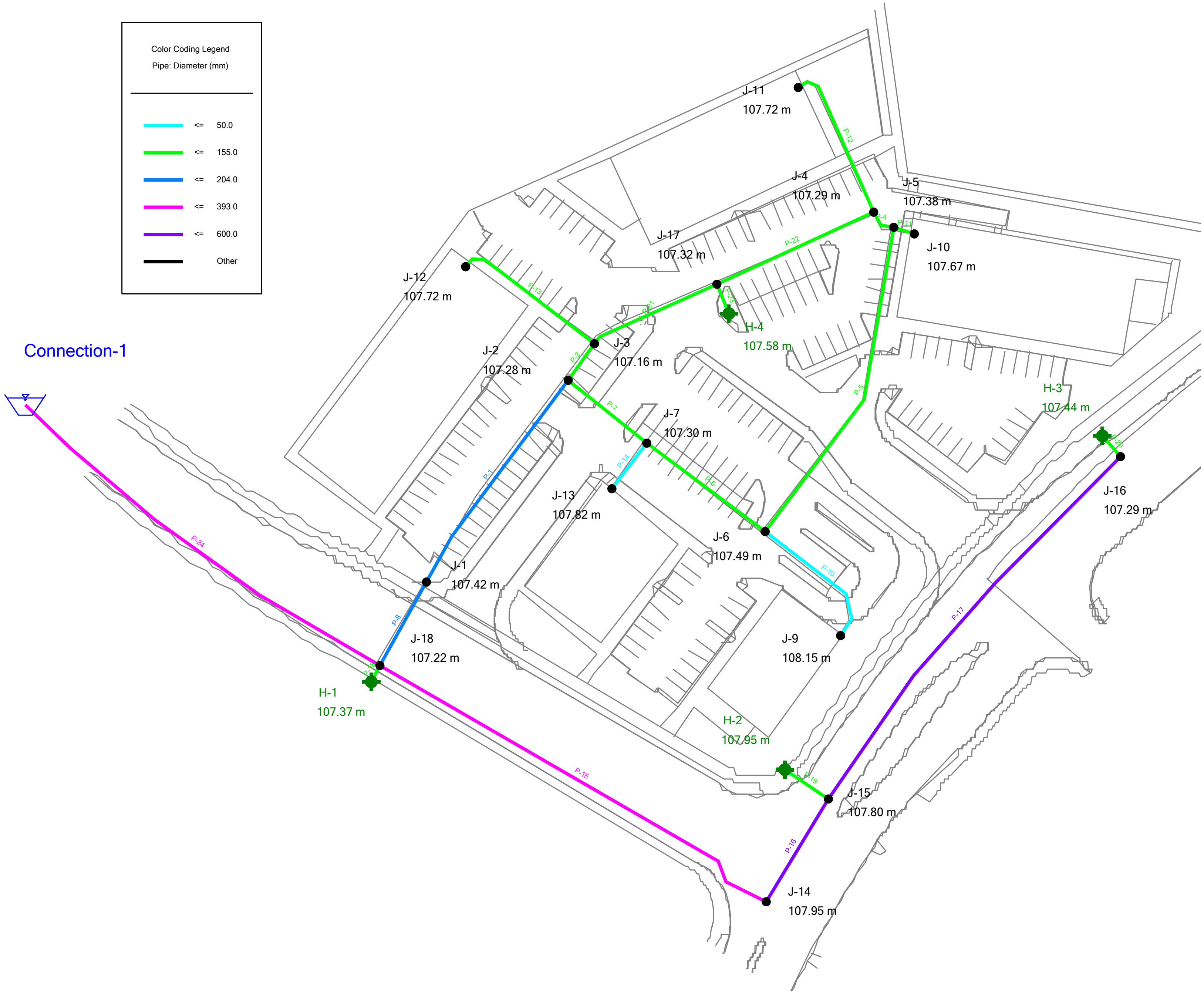
C=	Coefficient related to type of construction			1.5
	= Wood frame		1.5	
	=ordinary construction		1.0	
	=non-combustible construction		0.8	
	=fire resistive construction (< 2 hrs)		0.7	
	=fire resistive construction (> 2 hrs)		0.6	
	= interpolation			
A=	Area of structure considered (m^2)			530 m^2

F=	**= Required fire flow (litres/minute)**		**Calculated:**		7597 L/min
	= 220 C(A)$^{0.5}$ (25,000 L/min Max)		**(1) Rounded:**		8000 L/min
Occupancy hazard reduction of surcharge			**(2) Surcharge:**		0 L/min
	* non-combustible	-25%			
	* limited combustible	-15%			
	* combustible	0%			0 L/min
	* free burning	15%			
	* rapid burning	25%			
			(1) + (2)		8000 L/min
Sprinkler Reduction					
	* non-combustible -fire resistive			0%	
			(3) Reduction:		0 L/min
Exposure surcharge (cumulative (% of 2)					
	* 0 - 3 m	25%		0	0%
	* 3.1 - 10 m	20%		0	0%
	* 10.1 - 20 m	15%		0	0%
	* 20.1 - 30 m	10%		1	10%
	* 30.1 - 45 m	5%		2	10%
					20%
	* Number of Party Walls * 1000 L/min			0	0 L/min
			(4) Surcharge:		1600 L/min
		Fire Flow =	**Calculated:**		**9600 L/min**
			Rounded:		**10000 L/min**
					167 L/s

Appendix B3

Overall Schematic

Commercial Plaza - 5100 Kanata Avenue
Overall Schematic



Appendix B4

Hydraulic Boundary Conditions

5100 Kanata Avenue Boundary Conditions

Information Provided:
Date provided: October 2017

Scenario	Demand	
	L/min	L/s
Average Daily Demand	52.8	0.9
Maximum Daily Demand	79.2	1.3
Peak Hour	142.8	2.4
Fire Flow Demand	11000	183.3

Location:

Results:

Connection 1 - Goulbourn Forced Rd

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	162.3	83.6
Peak Hour	157.8	77.2
Max Day plus Fire (11,000 l/min)	151.7	68.5

[1] Ground Elevation = 103.5 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.

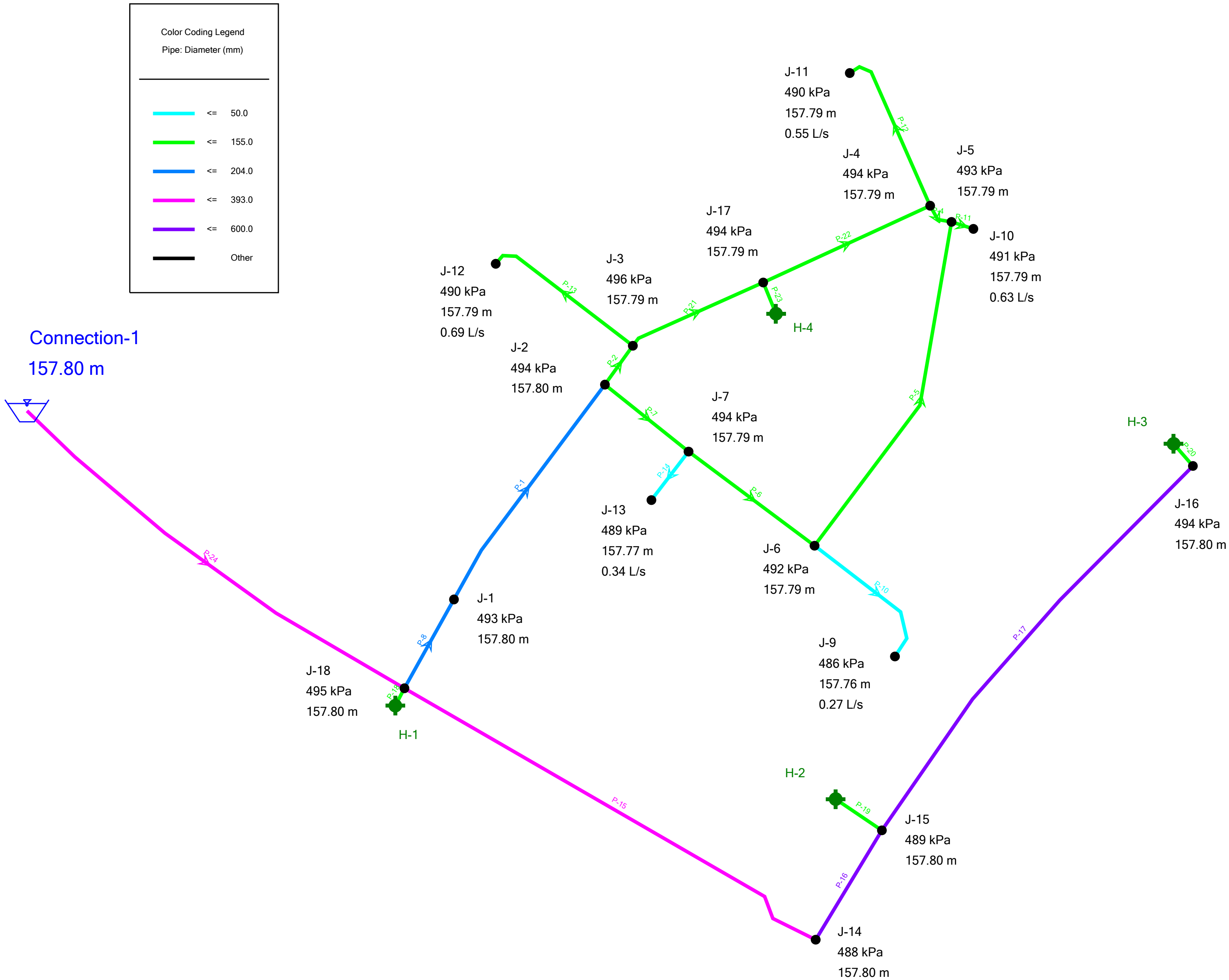
Disclaimer

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 B5

Peak Hour Simulation Results

Commercial Plaza - 5100 Kanata Avenue
Peak Hour Demand



Commercial Plaza - 5100 Kanata Avenue

Peak Hour Demand

Junction Table

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
J-9	108.15	0.27	157.76	486
J-14	107.95	0.00	157.80	488
J-13	107.82	0.34	157.77	489
J-15	107.80	0.00	157.80	489
J-11	107.72	0.55	157.79	490
J-12	107.72	0.69	157.79	490
J-10	107.67	0.63	157.79	491
J-6	107.49	0.00	157.79	492
J-1	107.42	0.00	157.80	493
J-5	107.38	0.00	157.79	493
J-17	107.32	0.00	157.79	494
J-7	107.30	0.00	157.79	494
J-4	107.29	0.00	157.79	494
J-16	107.29	0.00	157.80	494
J-2	107.28	0.00	157.80	494
J-18	107.22	0.00	157.80	495
J-3	107.16	0.00	157.79	496

Commercial Plaza - 5100 Kanata Avenue

Peak Hour Demand

Pipe Table

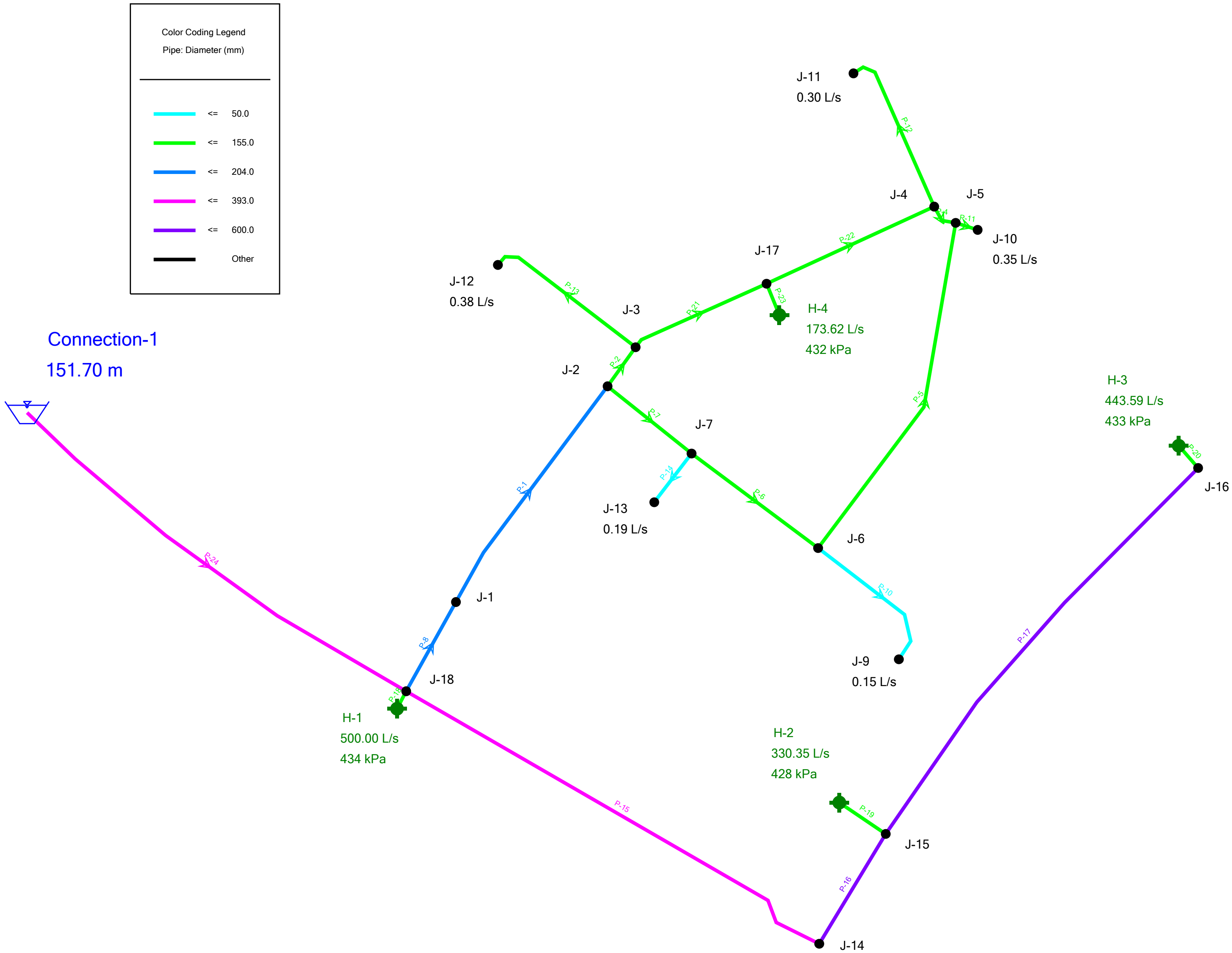
Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Hydraulic Grade (Start) (m)	Hydraulic Grade (Stop) (m)	Velocity (m/s)	Flow (L/s)
P-1	49.4	204.0	PVC	110.0	157.80	157.80	0.08	2.48
P-2	10.6	155.0	PVC	100.0	157.80	157.79	0.08	1.42
P-4	5.5	155.0	PVC	100.0	157.79	157.79	0.01	0.18
P-5	69.9	155.0	PVC	100.0	157.79	157.79	0.02	-0.45
P-6	30.6	155.0	PVC	100.0	157.79	157.79	0.04	-0.72
P-7	21.1	155.0	PVC	100.0	157.79	157.80	0.06	-1.06
P-8	20.6	204.0	PVC	110.0	157.80	157.80	0.08	-2.48
P-10	30.8	50.0	PVC	100.0	157.79	157.76	0.14	0.27
P-11	4.2	155.0	PVC	100.0	157.79	157.79	0.03	0.63
P-12	32.5	155.0	PVC	100.0	157.79	157.79	0.03	0.55
P-13	32.5	155.0	PVC	100.0	157.79	157.79	0.04	0.69
P-14	12.0	50.0	PVC	100.0	157.79	157.77	0.17	0.34
P-15	95.1	393.0	PVC	120.0	157.80	157.80	0.00	0.00
P-16	24.9	600.0	PVC	120.0	157.80	157.80	0.00	0.00
P-17	93.8	600.0	PVC	120.0	157.80	157.80	0.00	0.00
P-18	3.8	155.0	PVC	100.0	157.80	157.80	0.00	0.00
P-19	10.9	155.0	PVC	100.0	157.80	157.80	0.00	0.00
P-20	5.7	155.0	PVC	100.0	157.80	157.80	0.00	0.00
P-21	29.7	155.0	PVC	100.0	157.79	157.79	0.04	0.73
P-22	35.2	155.0	PVC	100.0	157.79	157.79	0.04	0.73
P-23	5.0	155.0	PVC	100.0	157.79	157.79	0.00	0.00
P-24	91.8	393.0	PVC	120.0	157.80	157.80	0.02	2.48

Appendix B6

Maximum Day Plus Fire Flow

Simulation Results

Commercial Plaza - 5100 Kanata Avenue
Maximum Day Demand + Fire Flow



Commercial Plaza - 5100 Kanata Avenue

Maximum Day Demand + Fire Flow

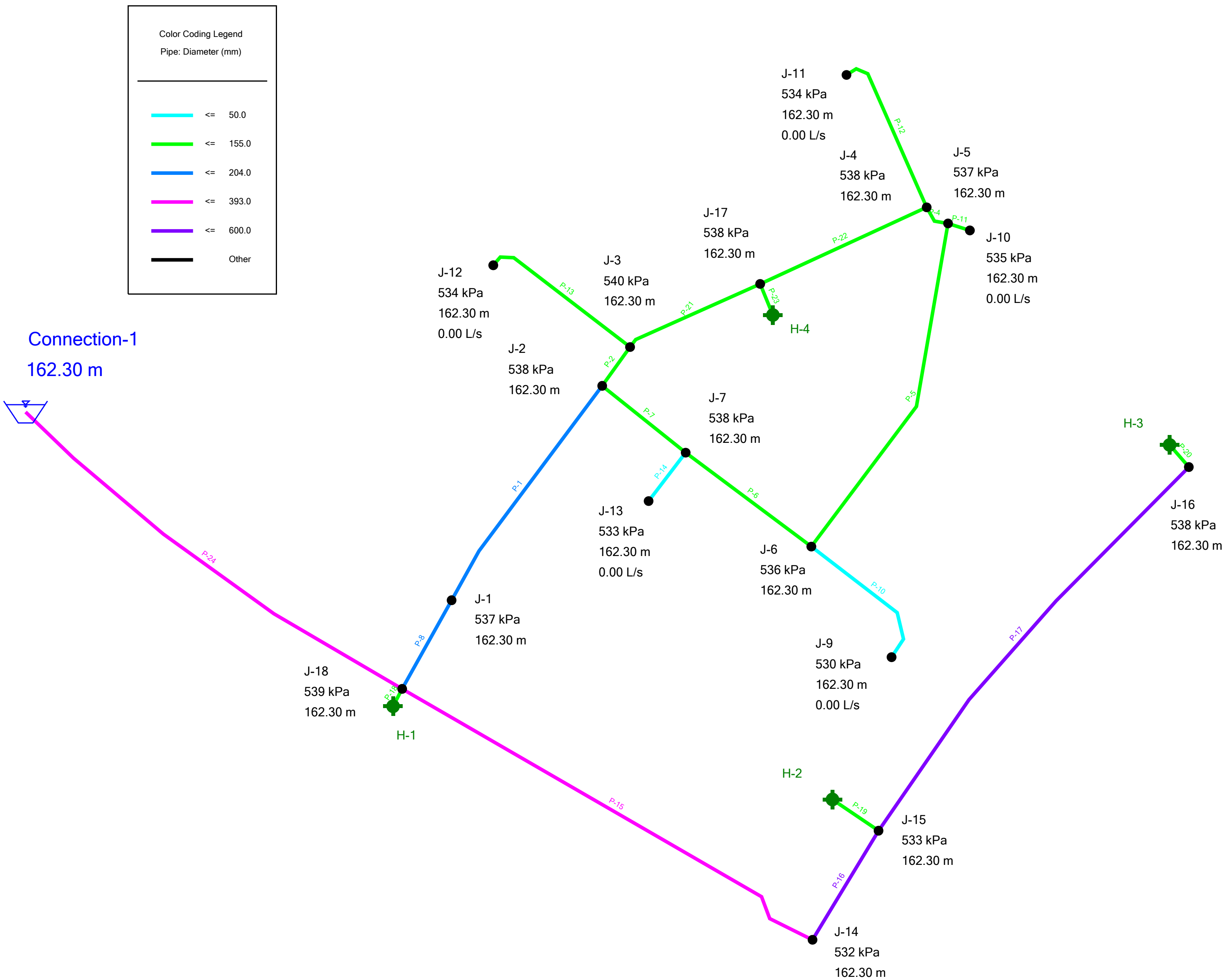
Fire Flow Table

Label	Satisfies Fire Flow Constraints?	Fire Flow (Needed) (L/s)	Fire Flow (Available) (L/s)	Flow (Total Needed) (L/s)	Flow (Total Available) (L/s)	Pressure (Residual Lower Limit) (kPa)	Pressure (Calculated Residual) (kPa)	Pressure (kPa)	Pressure (Calculated Residual @ Total Flow Needed) (kPa)	Junction w/ Minimum Pressure (System)	Is Fire Flow Run Balanced?
H-1	True	167.00	500.00	167.00	500.00	140	206	434	404	J-9	True
H-3	True	167.00	443.59	167.00	443.59	140	140	433	385	H-2	True
H-2	True	167.00	330.35	167.00	330.35	140	140	428	347	J-14	True
H-4	True	167.00	173.62	167.00	173.62	140	140	432	160	J-17	True

Appendix B7

Maximum Pressure Check

Commercial Plaza - 5100 Kanata Avenue
Maximum Pressure



Commercial Plaza - 5100 Kanata Avenue

Maximum Pressure

Junction Table

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (kPa)
J-3	107.16	0.00	162.30	540
J-18	107.22	0.00	162.30	539
J-2	107.28	0.00	162.30	538
J-4	107.29	0.00	162.30	538
J-16	107.29	0.00	162.30	538
J-7	107.30	0.00	162.30	538
J-17	107.32	0.00	162.30	538
J-5	107.38	0.00	162.30	537
J-1	107.42	0.00	162.30	537
J-6	107.49	0.00	162.30	536
J-10	107.67	0.00	162.30	535
J-11	107.72	0.00	162.30	534
J-12	107.72	0.00	162.30	534
J-15	107.80	0.00	162.30	533
J-13	107.82	0.00	162.30	533
J-14	107.95	0.00	162.30	532
J-9	108.15	0.00	162.30	530

Commercial Plaza - 5100 Kanata Avenue

Maximum Pressure

Pipe Table

Label	Length (m)	Diameter (mm)	Material	Hazen-Williams C	Hydraulic Grade (Start) (m)	Hydraulic Grade (Stop) (m)	Velocity (m/s)	Flow (L/s)
P-1	49.4	204.0	PVC	110.0	162.30	162.30	0.00	0.00
P-2	10.6	155.0	PVC	100.0	162.30	162.30	0.00	0.00
P-4	5.5	155.0	PVC	100.0	162.30	162.30	0.00	0.00
P-5	69.9	155.0	PVC	100.0	162.30	162.30	0.00	0.00
P-6	30.6	155.0	PVC	100.0	162.30	162.30	0.00	0.00
P-7	21.1	155.0	PVC	100.0	162.30	162.30	0.00	0.00
P-8	20.6	204.0	PVC	110.0	162.30	162.30	0.00	0.00
P-10	30.8	50.0	PVC	100.0	162.30	162.30	0.00	0.00
P-11	4.2	155.0	PVC	100.0	162.30	162.30	0.00	0.00
P-12	32.5	155.0	PVC	100.0	162.30	162.30	0.00	0.00
P-13	32.5	155.0	PVC	100.0	162.30	162.30	0.00	0.00
P-14	12.0	50.0	PVC	100.0	162.30	162.30	0.00	0.00
P-15	95.1	393.0	PVC	120.0	162.30	162.30	0.00	0.00
P-16	24.9	600.0	PVC	120.0	162.30	162.30	0.00	0.00
P-17	93.8	600.0	PVC	120.0	162.30	162.30	0.00	0.00
P-18	3.8	155.0	PVC	100.0	162.30	162.30	0.00	0.00
P-19	10.9	155.0	PVC	100.0	162.30	162.30	0.00	0.00
P-20	5.7	155.0	PVC	100.0	162.30	162.30	0.00	0.00
P-21	29.7	155.0	PVC	100.0	162.30	162.30	0.00	0.00
P-22	35.2	155.0	PVC	100.0	162.30	162.30	0.00	0.00
P-23	5.0	155.0	PVC	100.0	162.30	162.30	0.00	0.00
P-24	91.8	393.0	PVC	120.0	162.30	162.30	0.00	0.00

Appendix C1

Sanitary Sewer Walden Village Subdivision Design Documents and Drawings (Prepared by IBI, 2001)

CUMMING COCKBURN LIMITED
1770 WOODWARD DRIVE
OTTAWA, ONTARIO
K2C OP8

SANITARY SEWER DESIGN SHEET

PROJECT : KANATA LAKES
WALDEN VILLAGE
DEVELOPER : KNL DEVELOPMENTS

FILE: 3302-LD
DATE: MAY 2001
DESIGN: LE

LOCATION			INDIVIDUAL		CUMULATIVE		PROPOSED SEWER									
STREET	FROM MH	TO MH	POPLN.	AREA (Ha)	POPLN.	AREA (Ha)	PEAK FACT. (M)	POPLN FLOW (l/s)	INFILT FLOW (l/s)	PEAK FLOW (l/s)	CAPACITY l/s	VELOCITY m/s	LGTH. (m)	PIPE (mm)	GRADE %	AVAIL. CAP. (%)
BYRANT	32A	33A	20	0.36	64	1.58	4.00	1.05	0.44	1.49	48.38	1.49	36.0	200	2.00	96.92%
BYRANT	33A	34A	24	0.49	88	2.07	4.00	1.44	0.58	2.02	36.68	1.13	74.0	200	1.15	94.49%
BROUGHTON	34A	35A	8	0.15	308	6.67	4.00	5.05	1.87	6.92	36.69	0.72	24.5	250	0.35	81.14%
BROUGHTON	35A	36A	8	0.23	316	6.90	4.00	5.18	1.93	7.11	36.69	0.72	44.0	250	0.35	80.62%
BROUGHTON	36A	38A	8	0.22	324	7.12	4.00	5.31	1.99	7.30	36.69	0.72	39.0	250	0.35	80.10%
BROUGHTON	37A	38A	16	0.39	16	0.39	4.00	0.26	0.11	0.37	26.49	0.82	67.0	200	0.60	98.60%
DAVENPORT	Future	38A	Comm.	3.23		3.16	1.50	2.84	0.88	3.72						
DAVENPORT	Future	38A	1028	2.57	1028	5.73	4.00	16.86	1.60	21.30						
DAVENPORT	38A	39A	8	0.28	1376	13.52	3.71	20.93	3.79	27.56	36.69	0.72	70.0	250	0.35	24.86%
DAVENPORT	39A	40A	64	0.90	1440	14.42	3.69	21.79	4.04	28.67	36.69	0.72	121.0	250	0.35	21.84%
DAVENPORT	40A	EX.	4	0.09	1444	14.51	3.69	21.85	4.06	28.75	59.69	0.82	5.0	300	0.35	51.82%

Where Q = average daily per capita flow (350 l/cap.d.)
I = Unit of peak extraneous flow (0.28 l/sec/ha)
M = Peaking factor
Q(p) = Peak population flow (l/s)
Q(i) = peak extraneous flow (l/s)

Population = 4.0 per single family (SF) residential unit
Commercial and School - Average flow 50,000 l/ha/day with Peaking factor = 1.5

LICENSED PROFESSIONAL ENGINEER
L. M. ERION
03/10/01
PROVINCE OF ONTARIO

SPECIFY
Coeff. of friction (n 0.013

LEGEND :

32 / 0.81	POPULATION @ 4 P.P.U. / AREA IN HECTARES

No.	DATE	REVISIONS	BY	No.	DATE	REVISIONS	BY
0.	01/02/21	ISSUED FOR MOEE APPROVAL		5.	02/05/29	RE ISSUED FOR MOEE-WEAVER	
1.	01/05/22	REVISED AS PER NEW LEGAL					
2.	01/08/22	REVISED AS PER CITY COMMENTS					
3.	01/10/01	REVISED AS PER CITY COMMENTS					
4.	02/01/10	REVISED PER UTILITY CIRCULATION					

LICENSED PROFESSIONAL ENGINEER
L. M. ERION
01:02:15
PROVINCE OF ONTARIO

SCALES 1:1000

Cumming Cockburn Limited
Consulting Engineers, Planners, and Environmental Scientists
Ottawa, Kingston, Toronto, Waterloo, London

CCL

DESIGN	L.E.
CHECKED	M.M.
DRAWN	M.M.
CHECKED	L.E.
APPROVED	R.W.W.

Ottawa

KNL DEVELOPMENTS INC.

WALDEN VILLAGE
SANITARY DRAINAGE AREA PLAN

PROJ. No.	3302-LD
CONT. No.	–
DATED	FEBRUARY'01
DWG. No.	501

Appendix C2

Block 111 Sanitary Sewer Design Sheet
(prepared by JLR, 2016)

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

BLOCK 111
5100 Kanata Avenue
URBANDALE CORPORATION
CITY OF OTTAWA
JLR No. 23405-01

SANITARY SEWER DESIGN SHEET

Designed by: H.M
Reviewed by: L.D.

Dated: May 2016

SING. HOUSING	3.4	pers/unit	q =	275	L/cap/day
MULT. HOUSING	2.7	pers/unit	I =	0.280	L/s/ha
Manning's Coeff. N =	0.013		Comm.	50000	L/ha/day

STREET	M.H. Number		RESIDENTIAL							COMMERICAL/INSTITUTIONAL					SEWER DATA					RESIDUAL	UPSTREAM				DOWNSTREAM				
			NUMBER OF UNITS			CUMULATIVE		PEAKING	POPUL.		CUMM.	COMM.	PEAK EXTR.	PEAK DES.															
	FROM	TO	SING.	MULT.	AREA ha	POPUL. peop.	AREA ha	FACTOR	FLOW l/s	AREA ha	AREA ha	FLOW l/s	FLOW l/s	FLOW l/s	DIA. mm	SLOPE %	CAPAC. l/s	VEL. m/s	LENGTH m	CAP. l/s	Center Line	Obvert	Invert	Cover	Center Line	Obvert Drop	Obvert	Invert	Cover
Future Commercial Site		Stub1								1.53	1.53	1.33	0.43	1.76															
Institutional Site		Stub1				157	1.70	4.00	2.00				0.48	2.48															
Broughton Street	Stub1	EX. 37A				157	1.70	4.00	2.00		1.53	1.33	0.91	4.24	200	0.41	21.9	0.68	32.00	17.67	107.19	104.05	103.85	3.14	107.23		103.92	103.72	3.31
																									Ex.37A OBV/INV (N):		103.92	103.72	
Block 110	Stub2	EX. 38A				1028	2.57	4.00	16.86		0.00	0.00	0.72	17.58	250	0.25	31.0	0.61	11.00	13.44	107.10	99.75	99.50	7.35	106.99		99.72	99.47	7.27
																									Ex.38A OBV/INV (E):		99.72	99.47	

Legend:
[grey] = sanitary peak flow as per Sanitary Sewer Design Sheet for Ottawa Retirement Residence prepared by SCS Consulting Group Ltd. dated May 2016
[orange] = Block 110 residential lands sanitary peak flow as per Walden Village Sanitary Sewer Design Sheet prepared by IBI (formerly CCL), dated May 2001

Appendix C3

Sanitary Sewer Hawthorn Retirement Residence (Prepared by SCS Group, 2016)

Minimum Dia. =	**200 mm**
Mannings "n"=	**0.013**
Minimum Velocity =	**0.6 m/s**
Minimum Grade =	**0.4 %**
Avg. Domestic Flow =	**275 l/c/d**
Infiltration =	**0.28 l/s/ha**
Max. Peaking Factor=	**4.0**
Min. Peaking Factor=	**2.0**
Maximum Velocity =	**3 m/s**

SANITARY SEWER DESIGN SHEET
130 Goulbourn Forced Road
City of Ottawa

Project:	**130 Goulbourn Forced Road**
Project No:	**1698**
Date:	**06/05/2016**
Designed by:	**I.K.**
NOMINAL PIPE SIZE USED	

STREET	FROM MH	TO MH	RESIDENTIAL							COMMERCIAL/INDUSTRIAL/INSTITUTIONAL					FLOW CALCULATIONS						PIPE DATA			
			AREA (ha)	ACC. AREA (ha)	UNITS (#)	DENISTY (P/ha)	DENSITY (P/unit)	POP	ACC. RES. POP.	AREA (ha)	ACC. AREA (ha)	EQUIV. POP. (p/ha)	FLOW RATE (l/s/ha)	ACC. EQUIV. POP.	INFILTRATION (l/s)	TOTAL ACC. POP.	PEAKING FACTOR	RES. FLOW (l/s)	COMM. FLOW (l/s)	TOTAL FLOW (l/s)	DIA. (mm)	SLOPE (%)	Q FULL (l/s)	V FULL (m/s)
Commercial	SITE	MH4A	0	0	0			0	0	1.53	1.53	0	0.868056	0	0.43	0	4.00	0.0	1.3	1.8	200	0.50	23.2	0.74
0	MH4A	MH3A	0	0	0			0	0	0.29	1.82	0	0	0	0.51	0	4.00	0.0	1.3	1.8	200	0.39	20.5	0.65
0	MH3A	MH2A	0	0	0			0	0	0	1.82	0	0	0	0.51	0	4.00	0.0	1.3	1.8	200	0.41	21.0	0.67
Retirement Residence	BLDG	MH2A	1.45	1.45	0	108.275		156.999	157	0	0	0	0.22425	0	0.41	156.999	4.00	2.0	0.0	2.4	200	1.00	32.8	1.04

Appendix C4

Commercial Plaza Sanitary Sewer Design Sheet

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

Urbandale Commercial Plaza

5100 Kanata Ave.

JLR No. 23405-003.1

SANITARY SEWER DESIGN SHEET

Commercial Flow =	28,000	L / ha / day*
Comm. Peaking Factor =	1.5	
Infiltration =	0.33	L / s / ha
Manning's Coeff. N =	0.013	

*Assuming 12 hrs/day operation

Per SCS consulting group retirement residence design dated August 2016 (grey)
Building Service Laterals (blue)

Designed by:	A.W.
Checked by:	H.M.
Date:	May 2018

M.H. #		INSTITUTIONAL / COMMERICAL			INFILTRATION			PEAK DES.	SEWER DATA					RESIDUAL	UPSTREAM				DOWNSTREAM				
FROM	TO	AREA ha	CUMM. AREA ha	PEAK** FLOW l/s	AREA ha	CUMM. AREA ha	PEAK EXTR. l/s	l/s	DIA. mm	SLOPE %	CAPAC. l/s	VEL. m/s	LENGTH m	CAP. l/s	Center Line	Obvert	Invert	Cover	Center Line	Obvert Drop	Obvert	Invert	Cover
Building A	MH 10	0.17	0.17	0.17	0.17	0.17	0.06	**0.22**	150	3.00	27.5	1.51	5.4	27.31	108.15	105.87	105.72	2.28	107.86	0.00	105.71	105.56	2.15
MH 10	MH 20		0.17	0.17	0.00	0.17	0.06	**0.22**	200	1.00	34.2	1.06	51.1	34.00	107.86	105.71	105.50	2.15	107.31		105.20	104.99	2.11
Building E	MH 20	0.22	0.22	0.21	0.22	0.22	0.07	**0.29**	150	3.00	27.5	1.51	9.0	27.24	107.82	105.52	105.37	2.30	107.31	0.05	105.25	105.10	2.06
MH 20	MH 30		0.39	0.38	0.00	0.39	0.13	**0.51**	200	0.35	20.2	0.62	25.1	19.73	107.31	105.20	104.99	2.11	107.39	0.06	105.11	104.91	2.28
MH30	MH 40		0.39	0.38	0.00	0.39	0.13	**0.51**	200	0.35	20.2	0.62	16.6	19.73	107.39	105.05	104.85	2.34	107.23	0.03	104.99	104.79	2.24
Building D	MH 50	0.44	0.44	0.43	0.44	0.44	0.15	**0.57**	150	3.00	27.5	1.51	9.9	26.93	107.72	105.42	105.27	2.30	107.27	0.02	105.12	104.97	2.15
MH 50	MH 40		0.44	0.43	0.00	0.44	0.15	**0.57**	200	0.37	20.7	0.64	21.8	20.15	107.27	105.10	104.90	2.17	107.23	0.06	105.02	104.82	2.21
MH 40	MH 70		0.83	0.81	0.00	0.83	0.27	**1.08**	200	0.35	20.2	0.62	65.6	19.16	107.23	104.96	104.76	2.27	107.25	0.06	104.73	104.53	2.52
Building B	MH 70	0.40	0.40	0.39	0.40	0.40	0.13	**0.52**	150	3.00	27.5	1.51	9.6	26.98	107.67	105.37	105.22	2.30	107.25	0.41	105.08	104.93	2.17
MH 70	EX. MH 4A		1.23	1.20	0.00	1.23	0.41	**1.60**	200	0.35	20.2	0.62	36.6	18.64	107.25	104.67	104.47	2.58	106.81		104.54	104.34	2.27
Building C	EX. MH 4A	0.35	0.35	0.34	0.35	0.35	0.12	**0.46**	150	7.50	43.5	2.38	9.0	43.05	107.72	105.42	105.27	2.30	106.81	0.20	104.75	104.59	2.06
EX. MH 4A	MH EX.		1.58	1.54	0.00	1.58	0.52	**2.06**	200	0.39	21.4	0.66			106.81	104.54	104.34						

** 12 hrs/day operation assumed , Peak flow = 28 000 l/ha/day x Cumulative Area x Peaking Factor x 24hrs/12rs/(86,400 s/day)

Appendix D1

Storm Sewer Walden Village Subdivision Design Documents and Drawings (prepared by IBI, 2001)

CUMMING COCKBURN LIMITED
1770 WOODWARD DRIVE
OTTAWA, ONTARIO
K2C OP8

STORM SEWER DESIGN SHEET

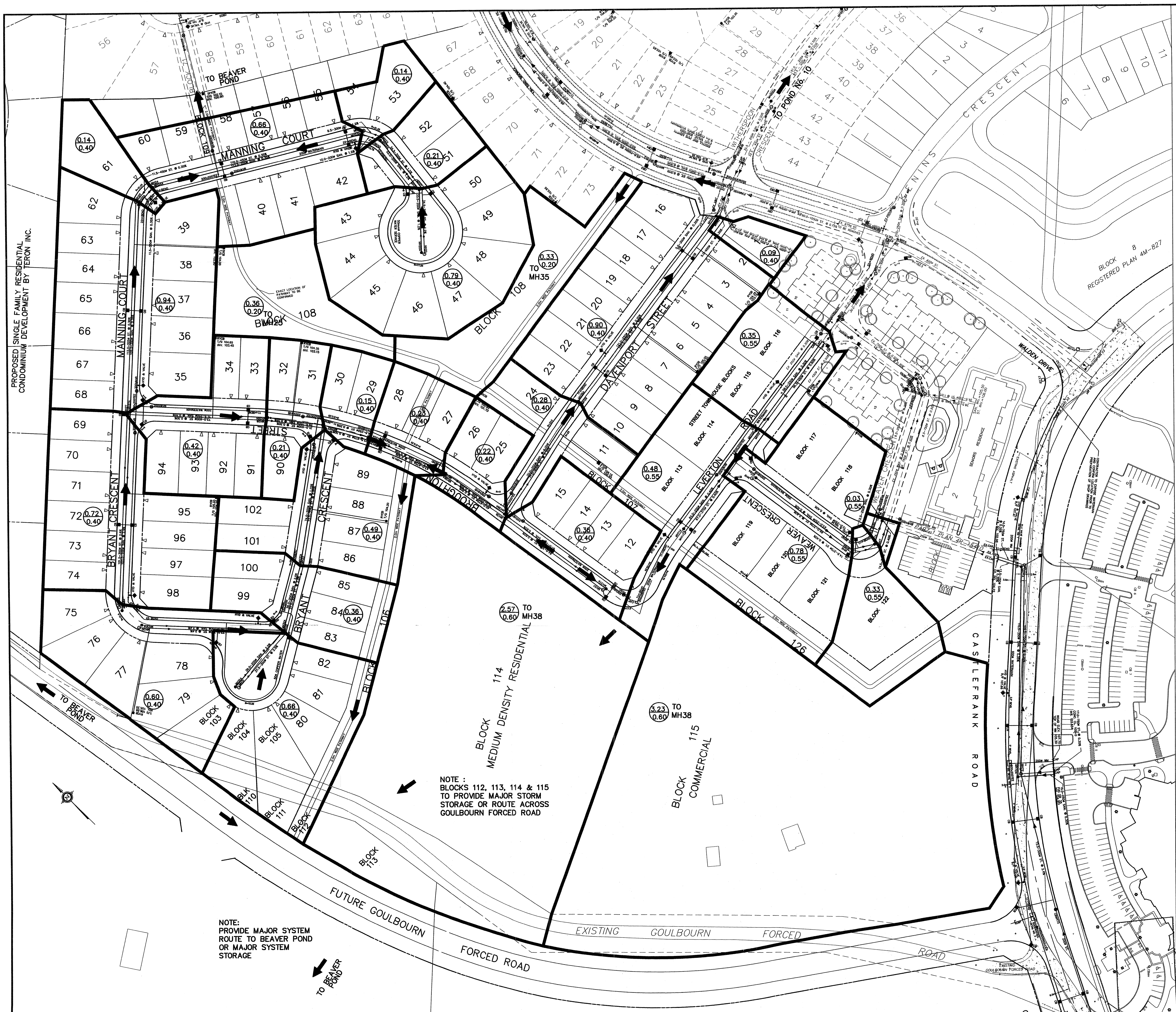
PROJECT : KANATA LAKES
WALDEN VILLAGE
DEVELOPER : KNL DEVELOPMENTS

FILE: 3302-LD
DATE: MAY 2001
DESIGN: LE

LOCATION			AREA (Ha.)					RAINFALL					SEWER DATA					
STREET	FROM MH	TO MH	C= 0.40	C= 0.55	C= 0.20	INDIV. 2.78AC	ACCUM. 2.78AC	INLET (min.)	TIME IN PIPE	TOTAL	I (mm/Hr)	PK. FLOW (l/s)	LENGTH (M)	PIPE (mm)	SLOPE (%)	CAP. (l/s)	VEL. (M/s)	AVAIL. CAP. (%)
BYRANT	32	33	0.36			0.40	1.80	20.60	0.32	20.91	65.92	**118.66**	37.0	300	2.00	**142.65**	1.96	16.82%
BYRANT	33	34	0.49			0.54	2.34	20.91	0.82	21.74	65.19	**152.54**	73.0	375	0.85	**168.62**	1.48	9.53%
BROUGHTON	34	35	0.15			0.17	7.52	25.99	0.29	26.28	55.67	**418.64**	22.5	675	0.30	**480.21**	1.30	12.82%
BROUGHTON	35	36	0.23		0.33	0.53	8.05	26.28	0.55	26.83	55.23	**444.60**	43.0	675	0.30	**480.21**	1.30	7.41%
BROUGHTON	36	38	0.22			0.24	8.29	26.83	0.51	27.34	54.40	**450.98**	40.0	675	0.30	**480.21**	1.30	6.09%
BROUGHTON	37	38	0.36			0.40	0.40	20.00	1.00	21.00	67.35	**26.94**	64.0	300	0.60	**78.15**	1.07	65.53%
					C= 0.60													
DAVENPORT	Future	38			5.80	9.67	9.67											
DAVENPORT	38	39	0.28			0.31	18.67	27.34	0.70	28.04	53.66	**1,001.8**	71.0	900	0.35	**1,117.0**	1.70	10.31%
DAVENPORT	39	40	0.90			1.00	19.67	28.04	1.20	29.23	52.68	**1,036.2**	122.0	900	0.35	**1,117.0**	1.70	7.24%
DAVENPORT	40	EX.	0.09			0.10	19.77	29.23	0.05	29.28	51.11	**1,010.4**	5.0	900	0.35	**1,117.0**	1.70	9.54%

Q = 2.78AIC, where:
- Q = Peak Flow in Litres per Second (l/s)
- A = Area in Hectares (ha.)
- I = Rainfall Intensity in Millimeters per Hour (mm/hr)
- C = Runoff Coefficient

LICENSED PROFESSIONAL ENGINEER
L. M. ERION
05/10/01
PROVINCE OF ONTARIO



LEGEND :

(0.98 / 0.40) AREA IN HECTARES / RUN OFF COEFFICIENT

➔ DIRECTION OF MAJOR SYSTEM

No.	DATE	REVISIONS	BY	No.	DATE	REVISIONS	BY
0.	01/02/21	ISSUED FOR MOEE APPROVAL		5.	02/05/29	RE ISSUED FOR MOEE-WEAVER	
1.	01/05/22	REVISED AS PER NEW LEGAL					
2.	01/08/22	REVISED AS PER CITY COMMENTS					
3.	01/10/01	REVISED AS PER CITY COMMENTS					
4.	02/01/10	REVISED PER UTILITY CIRCULATION					

LICENSED PROFESSIONAL ENGINEER
L. M. ERION
01:02:15
PROVINCE OF ONTARIO

SCALES 1:1000

Cumming Cockburn Limited
Consulting Engineers, Planners, and Environmental Scientists
Ottawa, Kingston, Toronto, Waterloo, London

DESIGN L.E.
CHECKED M.M.
DRAWN M.M.
CHECKED L.E.
APPROVED R.W.W.

Ottawa

KNL DEVELOPMENTS INC.

WALDEN VILLAGE

STORM DRAINAGE AREA PLAN

PROJ. No. 3302-LD
CONT. No. –
DATED FEBRUARY'01
DWG. No. 500

Appendix D2

Block 111 Storm Sewer Design Sheet
(prepared by JLR, 2016)

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

BLOCK 111
5110 Kanata Avenue
URBANDALE CORPORATION
CITY OF OTTAWA
JLR NO. 23405-01

STORM SEWER DESIGN SHEET
1: 5 YEAR

Designed by: H.M.
Checked by: L.D.
Date: Sept 2016

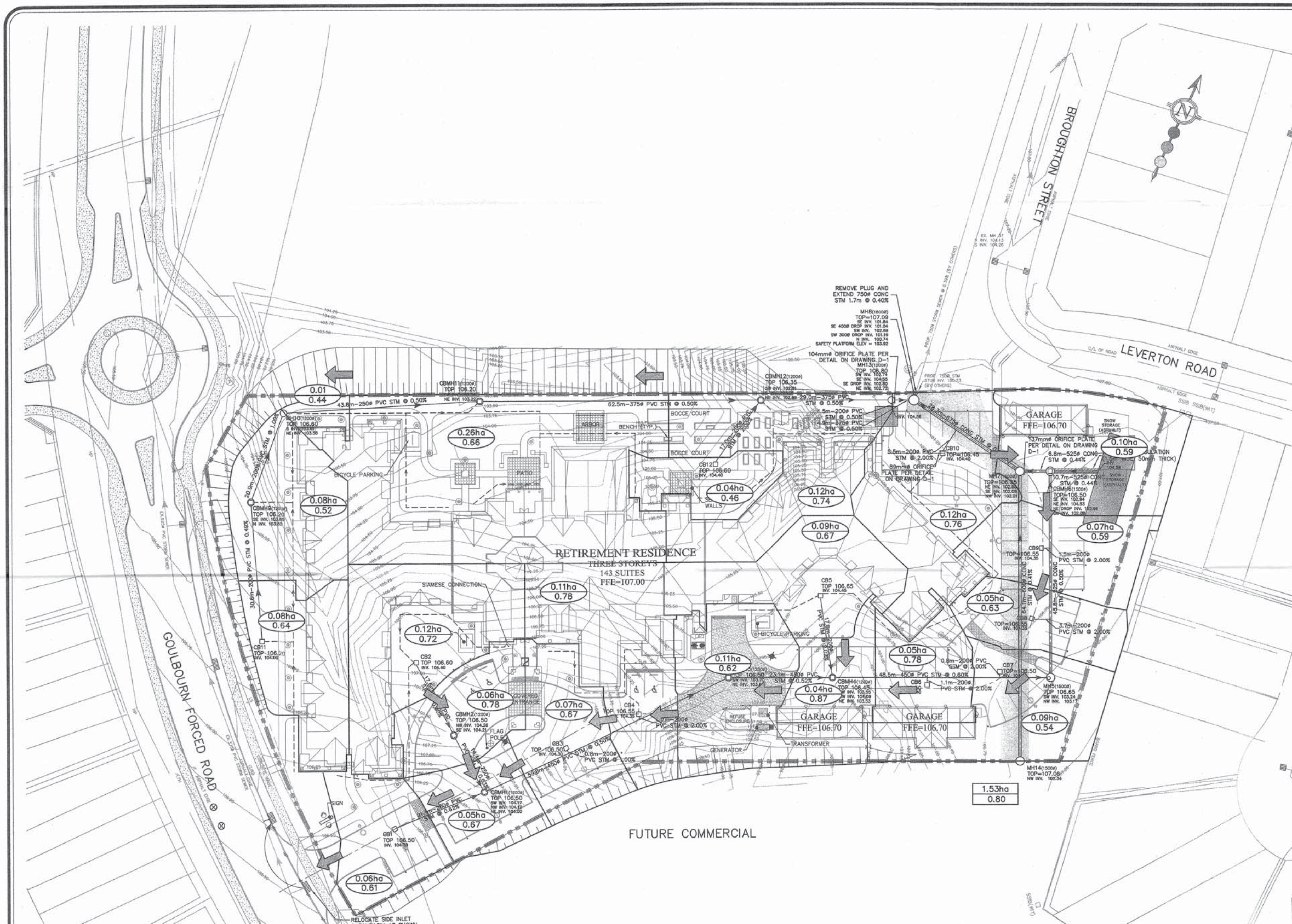
Manning's Coefficient n = 0.013
IDF CURVE = 5 year

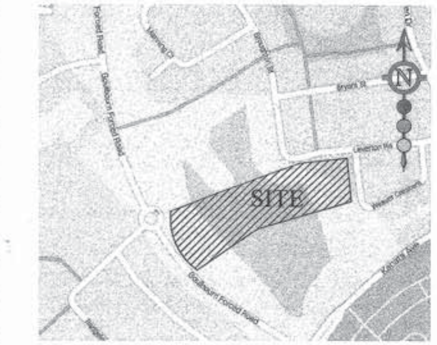
STREET	M.H. Number		DRAINAGE AREAS				Inlet	In Pipe	5 YR PEAK FLOW COMPUTATION				SEWER DATA					Residual	UPSTREAM				DOWNSTREAM				
	FROM	TO	0.75	0.80	Total Area (ha)	Cum. Area (ha)	Time (min.)	Flow Time (min.)	2.78AR	Cum. 2.78AR	5 Yr Intensity (mm/hr)	Peak Flow (L/s)	Pipe Dia (mm)	Slope (%)	Q full (L/s)	V full (m/s)	Length (m)	Capacity $Q_{cap} - Q_d$ (L/s)	Center Line	Obvert	Invert	Cover	Center Line	Drop	Obvert	Invert	Cover
Block 111 (Institutional & Commercial Sites)		Stub			3.18	3.18	13.31	0.02	6.42	6.42	89.43	575.00															
							13.33																				
Block 110	Stub	104A			0.00	3.18	13.33	0.15	0.00	6.42	89.43	575.00	750	0.34	677.2	1.48	13.60	102.2	107.09	101.49	100.73	5.60	107.00		101.45	100.68	5.55
Block 110	104A	104	1.00		1.00	4.18	13.49	0.88	2.09	8.51	88.79	756.00	825	0.38	923.1	1.67	88.50	167.1	107.00	101.45	100.61	5.55	107.00	0.06	101.11	100.27	5.89
Broughton Street	104	EX38	1.57		1.57	5.75	14.37	0.13	3.27	11.78	85.66	1009.08	900	0.39	1179.4	1.80	14.30	170.3	107.00	101.05	100.14	5.95	106.99		100.99	100.08	6.00
							14.50																				
																							EX.38 OBV/INV (E.)		100.99	100.08	

Legend:
= 1:5 yr storm peak flow as per Storm Sewer Design Sheet for Ottawa Retirement Residence prepared by SCS Consulting Group Ltd. dated May 2016
= Block 110 residential lands as per Walden Village Storm Drainage Area Plan prepared by CCL Dated May 25, 2002

Appendix D3

Hawthorn Retirement Residence Storm Sewer Design (Prepared by SCS Group, 2016)





KEY PLAN
N.T.S.

SITE BENCHMARK: ELEV. 107.78

ELEVATIONS ARE GEODETIC AND ARE ESTABLISHED USING GLOBAL POSITIONING SYSTEM (GPS) EQUIPMENT TO ESTABLISH ELLIPSOIDAL HEIGHTS. ELLIPSOIDAL HEIGHTS WERE TRANSFORMED TO CGVD-1928 DATUM (GEODETIC) USING THE FEDERAL HT2.0 HEIGHT TRANSFORMATIONAL

LEGEND:

- PROPERTY BOUNDARY
- STORM DRAINAGE BOUNDARY
- 0.12ha — DRAINAGE AREA (ha); 0.71 — RUNOFF COEFFICIENT
- 1.53ha — EXTERNAL DRAINAGE AREA (ha); 0.80 — EXTERNAL RUNOFF COEFFICIENT
- OVERLAND FLOW DIRECTION
- STORM SEWER AND MANHOLE
- CATCHBASIN MANHOLE
- CATCHBASIN
- DOUBLE CATCHBASIN
- ROOF WATER COLLECTOR - 150Ø PVC @ 1.0% INSTALL 1.5m DEEP AT CONNECTION TO STORM SYSTEM
- EXISTING STORM SEWER AND MANHOLE
- EXISTING CATCH BASIN

TOPOGRAPHIC SURVEY PROVIDED BY J.D. BARNES LIMITED PROVIDED TO SCS ON JAN 09, 2015.

REVISIONS

No.	DESCRIPTION	DATE	BY	APPROVED
1.	ISSUED FOR SITE PLAN APPLICATION - 2ND SUBMISSION	JAN 21/16	P.G.	
2.	ISSUED FOR SITE PLAN APPLICATION - 3RD SUBMISSION	MAY 16/16	P.G.	
3.	ISSUED FOR SITE PLAN APPLICATION - 4TH SUBMISSION	AUG 17/16	P.G.	

SCS consulting group ltd
30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
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FAX: (905)475-8335

HAWTHORN RETIREMENT GROUP
9310 NE VANCOUVER MALL DR. SUITE 200
VANCOUVER, WA 98662-8210
TEL: (360) 213-1550
FAX: (360) 213-1540

Ottawa
110 LAURIER AVENUE WEST
OTTAWA, ONTARIO K1P 1J1
TEL: (613) 580-2400

130 GOULBOURN FORCED ROAD

STORM DRAINAGE PLAN

LICENSED PROFESSIONAL ENGINEER
J. M. PRIAMO
100126893
Aug 17, 2016
PROVINCE OF ONTARIO

DATE:	AUGUST 2016	DESIGNED BY:	V.S./I.K.	CHECKED BY:	J.M.P./P.G.
SCALE:	1:400	DRAWN BY:	I.K.	CHECKED BY:	J.M.P./P.G.

PROJECT No: 1698

DRAWING No: STM-1

APPROVED ☑ REFUSED ☐

THIS 15 DAY OF December, 20 16

DERRICK MOODIE, ACTING MANAGER
DEVELOPMENT REVIEW, SUBURBAN SERVICES

D07-12-15-0136

File: P:\1698 Ottawa Hawthorne Development\Drawings\Phase 1\Dr\1698D-STRM.dwg – Revised by <KABIR> : Tue, Aug 16 2016 – 5:11pm

Storm Sewer Design Sheet
130 Goulbourn Forced Road

Rainfall Intensity = $\frac{A}{(Tc+B)^c}$

	5-YEAR	100-YEAR
A=	998.071	0
B=	6.053	0
c=	0.814	0

Starting Tc = 10 min

Project: 130 Goulbourn Forced Road
Project No: 1698
Date: 06-May-16
Designed by: I.K.

STREET	FROM MH	TO MH	5-YR AREA (ha)	5-YR RUNOFF COEFFICIENT "R"	5-YR "AR"	5-YR ACCUM. "AR"	5-YR RAINFALL INTENSITY (mm/hr)	5-YR ACCUM. FLOW (m^3/s)	COMM. AREA (ha)	COMM. FLOW RATE (l/s/ha)	COMM. FLOW (m^3/s)	ACCUM. COMM. FLOW (m^3/s)	Total Flow (m^3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONC. (min)
Site	CB1	CBMH1	0.06	0.61	0.04	0.04	104.19	0.011	0.000	0.000	0.000	0.000	0.011	21.10	0.62	200	0.026	0.822	0.428	10.428
Site	CB2	CBMH2	0.12	0.72	0.09	0.09	104.19	0.025	0.000	0.000	0.000	0.000	0.025	17.60	0.80	200	0.029	0.934	0.314	10.314
Site	CBMH2	CBMH1	0.06	0.78	0.05	0.13	102.56	0.038	0.000	0.000	0.000	0.000	0.038	14.40	0.63	250	0.047	0.962	0.250	10.564
Site	CB3	CBMH1	0.07	0.67	0.05	0.05	104.19	0.014	0.000	0.000	0.000	0.000	0.014	0.80	1.00	200	0.033	1.044	0.013	10.013
Site	CB4	CBMH1	0.11	0.78	0.09	0.09	104.19	0.025	0.000	0.000	0.000	0.000	0.025	0.70	2.00	200	0.046	1.476	0.008	10.008
Site	CBMH1	CBMH3	0.05	0.67	0.03	0.34	101.31	0.095	0.000	0.000	0.000	0.000	0.095	59.80	0.50	450	0.201	1.268	0.786	11.350
Site	CBMH3	CBMH4	0.11	0.62	0.07	0.40	97.56	0.110	0.000	0.000	0.000	0.000	0.110	23.10	0.52	450	0.205	1.293	0.298	11.648
Site	CB5	CBMH4	0.09	0.67	0.06	0.06	104.19	0.017	0.000	0.000	0.000	0.000	0.017	17.80	2.02	200	0.047	1.484	0.200	10.200
Site	CB6	CBMH4	0.05	0.78	0.04	0.04	104.19	0.011	0.000	0.000	0.000	0.000	0.011	1.10	2.00	200	0.046	1.476	0.012	10.012
Site	CB7	CBMH4	0.09	0.54	0.05	0.05	104.19	0.014	0.000	0.000	0.000	0.000	0.014	0.80	2.00	200	0.046	1.476	0.009	10.009
Site	CBMH4	MH5	0.04	0.87	0.03	0.59	96.23	0.157	0.000	0.000	0.000	0.000	0.157	48.50	0.60	450	0.221	1.389	0.582	12.230
Site	CB8	MH5	0.05	0.63	0.03	0.03	104.19	0.009	0.000	0.000	0.000	0.000	0.009	3.70	2.00	200	0.046	1.476	0.042	10.042
Site	CB9	MH5	0.07	0.59	0.04	0.04	104.19	0.012	0.000	0.000	0.000	0.000	0.012	1.50	2.00	200	0.046	1.476	0.017	10.017
Site	MH5	CBMH6	0	0.00	0.00	0.66	93.73	0.172	0.000	0.000	0.000	0.000	0.172	45.80	0.50	525	0.304	1.405	0.543	12.773
Site	CBMH6	MH7	0.1	0.59	0.06	0.72	91.52	0.183	0.000	0.000	0.000	0.000	0.183	6.80	0.44	525	0.285	1.318	0.086	12.859
External	MH14	MH7	1.53	0.80	1.22	1.22	104.19	0.354	0.000	0.000	0.0000	0.0000	0.3543	64.10	0.41	600	0.393	1.391	0.768	10.768
Site	MH7	MH8	0	0.00	0.00	1.94	91.18	0.492	0.000	0.000	0.000	0.000	0.492	28.30	0.60	675	0.651	1.820	0.259	13.119
Site	CB11	CBMH9	0.08	0.64	0.05	0.05	104.19	0.015	0.000	0.000	0.000	0.000	0.015	30.60	0.49	200	0.023	0.731	0.698	10.698
Site	CBMH9	MH10	0.08	0.52	0.04	0.09	100.65	0.026	0.000	0.000	0.000	0.000	0.026	20.90	1.00	200	0.033	1.044	0.334	11.032
Site	MH10	CBMH11	0	0.00	0.00	0.09	99.04	0.026	0.000	0.000	0.000	0.000	0.026	43.80	0.50	250	0.042	0.857	0.852	11.884
Site	CBMH11	CBMH12	0.26	0.66	0.17	0.26	95.20	0.070	0.000	0.000	0.000	0.000	0.070	62.50	0.50	375	0.124	1.123	0.928	12.812
Site	CB12	CBMH12	0.04	0.46	0.02	0.02	104.19	0.005	0.000	0.000	0.000	0.000	0.005	17.00	2.00	200	0.046	1.476	0.192	10.192
Site	CBMH12	MH13	0.12	0.74	0.09	0.37	91.37	0.094	0.000	0.000	0.000	0.000	0.094	29.00	0.50	375	0.124	1.123	0.431	13.242
Site	MH13	MH8	0	0.00	0.00	0.37	89.70	0.093	0.000	0.000	0.000	0.000	0.093	4.90	0.50	375	0.124	1.123	0.073	13.315
Site	MH8	STUB	0	0.00	0.00	2.31	89.43	0.575	0.000	0.000	0.000	0.000	0.575	1.73	0.40	750	0.704	1.594	0.018	13.333

Appendix D4

Commercial Plaza Stormwater Management Calculations

URBANDALE CORPORATION
5100 KANATA AVE. - COMMERCIAL BLOCK PLAZA
CITY OF OTTAWA

RUNOFF COEFFICIENTS FOR SUBCATCHMENT AREAS

Subcatchment Area	Total Area, A (ha)	Surface Description	Surface Area (ha)	2 Yr				100 Yr				Flow Allocations	Total Area (ha)	Weighted Runoff Coefficient	
				Runoff Coefficient, C	A x C	Total A x C	Weighted Runoff coefficient	Runoff Coefficient, C	A x C	Total A x C	Weighted Runoff coefficient			2 Yr	100 Yr (1)
Building A		hard	0.041	0.90	0.037			1.00	0.041						
		soft	0.000	0.20	0.000			0.25	0.000						
	0.041	subtotal				0.037	**0.90**			0.041	**1.00**				
Building E		hard	0.053	0.90	0.048			1.00	0.053						
		soft	0.000	0.20	0.000			0.25	0.000						
	0.053	subtotal				0.048	**0.90**			0.053	**1.00**				
CB 508		hard	0.008	0.90	0.007			1.00	0.008						
		soft	0.007	0.20	0.001			0.25	0.002						
	0.015	subtotal				0.009	**0.57**			0.010	**0.65**				
CB 509		hard	0.006	0.90	0.005			1.00	0.006						
		soft	0.009	0.20	0.002			0.25	0.002						
	0.015	subtotal				0.007	**0.48**			0.008	**0.55**				
CBMH 510		hard	0.070	0.90	0.063			1.00	0.070						
		soft	0.007	0.20	0.001			0.25	0.002						
	0.077	subtotal				0.064	**0.84**			0.072	**0.93**				
CB 520		hard	0.038	0.90	0.034			1.00	0.038						
		soft	0.005	0.20	0.001			0.25	0.001						
	0.043	subtotal				0.035	**0.82**			0.039	**0.91**				
CB 521		hard	0.058	0.90	0.052			1.00	0.058			**Area # 1 ICD 53**			
		soft	0.010	0.20	0.002			0.25	0.003						
	0.068	subtotal				0.054	**0.80**			0.061	**0.89**				
CBMH 522		hard	0.126	0.90	0.113			1.00	0.126						
		soft	0.005	0.20	0.001			0.25	0.001						
	0.131	subtotal				0.114	**0.87**			0.127	**0.97**				
CB 530		hard	0.075	0.90	0.068			1.00	0.075						
		soft	0.000	0.20	0.000			0.25	0.000						
	0.075	subtotal				0.068	**0.90**			0.075	**1.00**				
CB 531		hard	0.064	0.90	0.058			1.00	0.064						
		soft	0.000	0.20	0.000			0.25	0.000						
	0.064	subtotal				0.058	**0.90**			0.064	**1.00**				
CB 540		hard	0.058	0.90	0.052			1.00	0.058						
		soft	0.000	0.20	0.000			0.25	0.000						
	0.058	subtotal				0.052	**0.90**			0.058	**1.00**				
CB 541		hard	0.043	0.90	0.039			1.00	0.043						
		soft	0.000	0.20	0.000			0.25	0.000						
	0.043	subtotal				0.039	**0.90**			0.043	**1.00**		0.68	0.86	0.95
Building D		hard	0.106	0.90	0.095			1.00	0.106			**Area # 2 Rooftop Control**			
		soft	0.000	0.20	0.000			0.25	0.000						
	0.106	subtotal				0.095	**0.90**			0.106	**1.00**		0.11	0.900	1.00
CB 552		hard	0.086	0.90	0.077			1.00	0.086						
		soft	0.004	0.20	0.001			0.25	0.001			**Area # 3 ICD 52**			
	0.090	subtotal				0.078	**0.87**			0.087	**0.97**		0.09	0.87	0.97
CBMH 570		hard	0.122	0.90	0.110			1.00	0.122						
		soft	0.024	0.20	0.005			0.25	0.006						
	0.146	subtotal				0.115	**0.78**			0.128	**0.88**	**Area # 4 ICD 71**			
CBMH 571		hard	0.173	0.90	0.156			1.00	0.173						
		soft	0.004	0.20	0.001			0.25	0.001						
	0.177	subtotal				0.157	**0.88**			0.174	**0.98**		0.32	0.84	0.94
CBMH 572		hard	0.023	0.90	0.021			1.00	0.023						
		soft	0.038	0.20	0.008			0.25	0.010						
	0.061	subtotal				0.028	**0.46**			0.033	**0.53**	**Area # 5 ICD 73**			
CBMH 573		hard	0.011	0.90	0.010			1.00	0.011						
		soft	0.000	0.20	0.000			0.25	0.000						
	0.011	subtotal				0.010	**0.90**			0.011	**1.00**		0.07	0.53	0.60
Building B		hard	0.095	0.90	0.086			1.00	0.095			**Area # 6 Rooftop Control**			
		soft	0.000	0.20	0.000			0.25	0.000						
	0.095	subtotal				0.086	**0.90**			0.095	**1.00**		0.10	0.900	1.00
Building C		hard	0.085	0.90	0.077			1.00	0.085			**Area # 7 Rooftop Control**			
		soft	0.000	0.20	0.000			0.25	0.000						
	0.085	subtotal				0.077	**0.90**			0.085	**1.00**		0.09	0.900	1.00
CB 580		hard	0.026	0.90	0.023			1.00	0.026			**Area # 8 ICD 80**			
		soft	0.022	0.20	0.004			0.25	0.005						
	0.048	subtotal				0.028	**0.58**			0.032	**0.66**		0.05	0.58	0.66
Waldon Village (uncontrolled)		hard	0.017	0.90	0.015			1.00	0.017						
		soft	0.029	0.20	0.006			0.25	0.007						
	0.046	subtotal				0.021	**0.46**			0.024	**0.53**	**Walden Village Residential Rear Yards**			
Waldon Village 2 (uncontrolled)		hard	0.006	0.90	0.005			1.00	0.006						
		soft	0.012	0.20	0.002			0.25	0.003						
	0.018	subtotal				0.008	**0.43**			0.009	**0.50**		0.06	0.45	0.52
Retirement Residence		hard	0.012	0.90	0.010			1.00	0.012			**Retirement Residence**			
(uncontrolled)		soft	0.022	0.20	0.004			0.25	0.006						
	0.034	subtotal				0.015	**0.44**			0.017	**0.51**		0.03	0.44	0.51
GFR 1 (uncontrolled)		hard	0.014	0.90	0.012			1.00	0.014			**Golbourn Forced Road**			
		soft	0.014	0.20	0.003			0.25	0.004						
	0.028	subtotal				0.015	**0.55**			0.017	**0.62**		0.03	0.55	0.62
Kanata Ave. (uncontrolled)		hard	0.000	0.90	0.000			1.00	0.000						
		soft	0.022	0.20	0.004			0.25	0.005			**Kanata Ave.**			
	0.022	subtotal				0.005	**0.21**			0.006	**0.26**		0.02	0.21	0.26

Total **1.6500**

Notes: (1) Runoff coefficient for soft surfaces increased by 25% for 100-yr storm calculations

Urbandale Commercial Plaza
5100 Kanata Ave.

JLR No. 23405-003.1

STORMWATER MANAGEMENT CALCULATIONS

Summary of allocated areas outletting uncontrolled offsite:

Uncontrolled Outlet	Total Area (ha.)	C factor 2-Yr/5-Yr	C factor 100-Yr	Allocated Peak Flow: Q_2 with T_c 10 min (L/s)	Q_5 with T_c 10 min (L/s)	Q_{100} with T_c 10 min (L/s)
Retirement Residence (1)	0.03	0.62	0.78	3.97	5.39	11.54
Kanata Avenue	0.07	0.20	0.25	2.99	4.06	8.69
Walden Village Residential Rear Yards (2)	0.12	0.55	0.69	14.09	19.12	40.95
Total	**0.22**			**21.05**	**28.56**	**61.18**

Notes:
(1) As per August 2016 retirement residence design prepared by SCS Consulting Group.
(2) As per 2001 Walden Village subdivision design prepared by IBI (Formerly CCL).

Summary of proposed areas outletting uncontrolled offsite:

Uncontrolled Outlet	Total Area (ha.)	C factor 2-Yr/5-Yr	C factor 100-Yr	Proposed Peak Flow: Q_2 with T_c 10 min (L/s)	Q_5 with T_c 10 min (L/s)	Q_{100} with T_c 10 min (L/s)
Retirement Residence	0.034	0.44	0.51	3.19	4.33	8.55
Kanata Avenue	0.022	0.21	0.26	0.98	1.34	2.84
Goulbourn Forced Road	0.028	0.55	0.62	3.27	4.43	8.64
Walden Village Residential Rear Yards	0.064	0.45	0.52	6.17	8.37	16.51
Total	**0.148**			**13.62**	**18.47**	**36.54**

Minor system allocation for proposed Commercial Plaza = 139.70 L/s
(As per September 2016 Servicing report prepared by JLR)
Uncontrolled Peak Flow to Goulbourn Forced Road = 4.43 L/s

Revised Release Rate for Commercial Plaza = 135.27 L/s

Summary: Areas outletting to proposed minor system:

Area No.	Type or ID. No.	Drainage Area: Total Area	C factor 2-Yr	C factor 100-Yr	Design Flow: Q_2 with T_c 10 min (L/s)	Q_{100} with T_c 10 min (L/s)	1:100 Yr Rest. Restricted Flow (L/s)	ICD Type
1	MH 530 - ICD 53	0.683	0.86	0.95	124.82	323.03	74.0	200 VHV-2
2	Building D	0.106	0.90	1.00	20.37	52.62	7.7	Zurn Control-Flo Roof Drain
3	CB 552 - ICD 52	0.090	0.87	0.97	16.70	43.19	4.0	50 VHV-1
4	CBMH 571 - ICD 71	0.323	0.84	0.94	57.89	149.91	18.0	100 VHV-1
5	CBMH 573 - ICD 73	0.072	0.53	0.60	8.16	21.59	4.0	50 VHV-1
6	Building B	0.095	0.90	1.00	18.26	47.16	7.7	Zurn Control-Flo Roof Drain
7	Building C	0.085	0.90	1.00	16.33	42.19	6.5	Zurn Control-Flo Roof Drain
8	CB 580 - ICD 80	0.048	0.58	0.66	5.95	15.67	13.0	100 VHV-1
	Total	**1.50**			**268.47**	**695.36**	**134.93**	

1 **MH 530 - ICD 53**

Area	**0.683**
C-Factor 1:2Yr	**0.86**
C-Factor 1:100 Yr	**0.95**

Release Rate: 74.0 L/s

Time (min)	Intensity 1:2 Yr (mm/hr)	Qp 1:2 Yr (L/s)	Qp ICD (L/s)	Qp stored (L/s)	Max Volume Requirement (m3)	Intensity 1:100 Yr (mm/hr)	Qp 1:100 Yr (L/s)	Qp ICD (L/s)	Qp stored (L/s)	Max Volume Requirement (m3)
10	76.81	124.82	74.00	50.82	30.49	178.56	323.03	74.00	249.03	149.42
15	61.77	100.38	74.00	26.38	23.75	142.89	258.51	74.00	184.51	166.06
20	52.03	84.56	74.00	10.56	12.67	119.95	217.00	74.00	143.00	171.60
25	45.17	73.40	74.00	N/A	N/A	103.85	187.87	74.00	113.87	170.80
30	40.04	65.08	74.00	N/A	N/A	91.87	166.20	74.00	92.20	165.96
35	36.06	58.60	74.00	N/A	N/A	82.58	149.39	74.00	75.39	158.32
40	32.86	53.41	74.00	N/A	N/A	75.15	135.94	74.00	61.94	148.67
45	30.24	49.14	74.00	N/A	N/A	69.05	124.92	74.00	50.92	137.48
50	28.04	45.57	74.00	N/A	N/A	63.95	115.70	74.00	41.70	125.10
55	26.17	42.53	74.00	N/A	N/A	59.62	107.86	74.00	33.86	111.75

Minimum storage volume requirement = **171.60 m3**

Surface Storage:	CB 521	1.61 m3
	CBMH 522	25.18 m3
	CB 530	23.57 m3
	CB 531	5.85 m3
	CB 540	2.23 m3
	CB 541	3.38 m3
Underground Pipe Storage (including MHs): (MH520-530, CB531-1050øST, CB541-540, CB540-1050øST, CBMH522-MH520, CB521-CBMH522, MH511-520, CBMH510-MH511, MH510-511)		150.54 m3 (refer to Appendix 'D7' for SWMHYMO results and pipe storage calculations)
Total Storage Volume:		**212.36 m3**

***Minimum storage volume requirement met by the design**

Urbandale Commercial Plaza
5100 Kanata Ave.

JLR No. 23405-003.1

STORMWATER MANAGEMENT CALCULATIONS

2 Building D Assumed Rooftop Properties:

Total Area Roof = 0.1060 ha
Unusable roof (20%) = 0.0212 ha
Usable roof (80%) = 0.0848 ha
Depth of Storage = 0.127 m

Rooftop Volume Assuming Sloped Roof (m^3) = Usable rooftop area (m^2) x storage depth (m)/3
Rooftop Volume (m^3) = 848 m² x 0.127 m / 3
Rooftop Volume (m^3) = 35.9 m^3

Controlled roof release rate = 1.29 l/s roof drain x 6 Zurn Control-Flo units (102 mm Rise)
Total controlled roof release rate = 7.74 L/s

Rooftop Area =	**0.106**
C-Factor (1:2 year) =	**0.90**
C-Factor (1:100 year) =	**1.00**

Time (min)	Intensity 1:2 Yr (mm/hr)	Qp (L/s)	Qp roof drain (L/s)	Qp stored (L/s)	Max Volume Requirement (m3)	Intensity 1:100 Yr (mm/hr)	Qp (L/s)	Qp roof drain (L/s)	Qp stored (L/s)	Max Volume Requirement (m3)
10	76.81	20.37	7.74	12.63	7.58	178.56	52.62	7.74	44.88	26.93
15	61.77	16.38	7.74	8.64	7.78	142.89	42.11	7.74	34.37	30.93
20	52.03	13.80	7.74	6.06	7.27	119.95	35.35	7.74	27.61	33.13
25	45.17	11.98	7.74	4.24	6.36	103.85	30.60	7.74	22.86	34.29
30	40.04	10.62	7.74	2.88	5.18	91.87	27.07	7.74	19.33	34.80
35	36.06	9.56	7.74	1.82	3.83	82.58	24.33	7.74	16.59	34.85
40	32.86	8.72	7.74	0.98	2.34	75.15	22.14	7.74	14.40	34.57
45	30.24	8.02	7.74	0.28	0.76	69.05	20.35	7.74	12.61	34.04
50	28.04	7.44	7.74	N/A	N/A	63.95	18.85	7.74	11.11	33.32

Minimum roof storage volume requirement = **34.85 m3**

Roof storage volume provided by design = **35.90 m3**

***Minimum storage volume requirement met by the design**

3 CB 552 - ICD 52

Area	**0.09**
C-Factor 1:2Yr	**0.87**
C-Factor 1:100 Yr	**0.97**

Release Rate: 4.0 L/s

Time (min)	Intensity 1:2 Yr (mm/hr)	Qp 1:2 Yr (L/s)	Qp ICD (L/s)	Qp stored (L/s)	Max Volume Requirement (m3)	Intensity 1:100 Yr (mm/hr)	Qp 1:100 Yr (L/s)	Qp ICD (L/s)	Qp stored (L/s)	Max Volume Requirement (m3)
10	76.81	16.70	4.00	12.70	7.62	178.56	43.19	4.00	39.19	23.51
15	61.77	13.43	4.00	9.43	8.49	142.89	34.56	4.00	30.56	27.50
20	52.03	11.31	4.00	7.31	8.77	119.95	29.01	4.00	25.01	30.01
25	45.17	9.82	4.00	5.82	8.73	103.85	25.12	4.00	21.12	31.67
30	40.04	8.71	4.00	4.71	8.47	91.87	22.22	4.00	18.22	32.79
35	36.06	7.84	4.00	3.84	8.06	82.58	19.97	4.00	15.97	33.54
40	32.86	7.14	4.00	3.14	7.55	75.15	18.17	4.00	14.17	34.02
45	30.24	6.57	4.00	2.57	6.95	69.05	16.70	4.00	12.70	34.29
50	28.04	6.10	4.00	2.10	6.29	63.95	15.47	4.00	11.47	34.40
55	26.17	5.69	4.00	1.69	5.57	59.62	14.42	4.00	10.42	34.39
60	24.56	5.34	4.00	1.34	4.82	55.89	13.52	4.00	9.52	34.27

Minimum storage volume requirement = **34.40 m3**

Surface Storage: CB 552 **40.40 m3**

***Minimum storage volume requirement met by the design**

4 CBMH 571 - ICD 71

Area	**0.323**
C-Factor 1:2Yr	**0.84**
C-Factor 1:100 Yr	**0.94**

Release Rate: 18.0 L/s

Time (min)	Intensity 1:2 Yr (mm/hr)	Qp 1:2 Yr (L/s)	Qp ICD (L/s)	Qp stored (L/s)	Max Volume Requirement (m3)	Intensity 1:100 Yr (mm/hr)	Qp 1:100 Yr (L/s)	Qp ICD (L/s)	Qp stored (L/s)	Max Volume Requirement (m3)
10	76.81	57.89	18.00	39.89	23.93	178.56	149.91	18.00	131.91	79.15
15	61.77	46.55	18.00	28.55	25.70	142.89	119.97	18.00	101.97	91.77
20	52.03	39.21	18.00	21.21	25.46	119.95	100.71	18.00	82.71	99.25
25	45.17	34.04	18.00	16.04	24.06	103.85	87.19	18.00	69.19	103.78
30	40.04	30.18	18.00	12.18	21.92	91.87	77.13	18.00	59.13	106.44
35	36.06	27.18	18.00	9.18	19.27	82.58	69.33	18.00	51.33	107.80
40	32.86	24.77	18.00	6.77	16.25	75.15	63.09	18.00	45.09	108.22
45	30.24	22.79	18.00	4.79	12.94	69.05	57.97	18.00	39.97	107.93
50	28.04	21.13	18.00	3.13	9.40	63.95	53.69	18.00	35.69	107.08
55	26.17	19.72	18.00	1.72	5.69	59.62	50.06	18.00	32.06	105.79

Minimum storage volume requirement = **108.22 m3**

Surface Storage:	CBMH571	71.97 m3	
	CBMH570	26.44 m3	
Underground Pipe Storage (including MHs):	CBMH570 - CBMH571	48.48 m3	(refer to Appendix 'D7' for SWMHYMO results and pipe storage calculations)
Total Storage Volume:		**146.89 m3**	

***Minimum storage volume requirement met by the design**

Urbandale Commercial Plaza
5100 Kanata Ave.

JLR No. 23405-003.1

STORMWATER MANAGEMENT CALCULATIONS

5 **CBMH 573 - ICD 73**

Area	**0.072**
C-Factor 1:2Yr	**0.53**
C-Factor 1:100 Yr	**0.60**

Release Rate: 4.0 L/s

Time (min)	Intensity 1:2 Yr (mm/hr)	Qp 1:2 Yr (L/s)	Qp ICD (L/s)	Qp stored (L/s)	Max Volume Requirement (m3)	Intensity 1:100 Yr (mm/hr)	Qp 1:100 Yr (L/s)	Qp ICD (L/s)	Qp stored (L/s)	Max Volume Requirement (m3)
10	76.81	8.16	4.00	4.16	2.49	178.56	21.59	4.00	17.59	10.56
15	61.77	6.56	4.00	2.56	2.30	142.89	17.28	4.00	13.28	11.95
20	52.03	5.53	4.00	1.53	1.83	119.95	14.51	4.00	10.51	12.61
25	45.17	4.80	4.00	0.80	1.19	103.85	12.56	4.00	8.56	12.84
30	40.04	4.25	4.00	0.25	0.45	91.87	11.11	4.00	7.11	12.80
35	36.06	3.83	4.00	N/A	N/A	82.58	9.99	4.00	5.99	12.57
40	32.86	3.49	4.00	N/A	N/A	75.15	9.09	4.00	5.09	12.21
45	30.24	3.21	4.00	N/A	N/A	69.05	8.35	4.00	4.35	11.75
50	28.04	2.98	4.00	N/A	N/A	63.95	7.73	4.00	3.73	11.20
55	26.17	2.78	4.00	N/A	N/A	59.62	7.21	4.00	3.21	10.59

Minimum storage volume requirement = **12.84 m3**

Surface Storage:	CBMH572	9.28 m3	
Underground Pipe Storage (including MHs):	CCMH572 - CBMH573	23.36 m3	(refer to Appendix 'D7' for SWMHYMO results and pipe storage calculations)
Total Storage Volume:		**32.64 m3**	

***Minimum storage volume requirement met by the design**

6 **Building B** **Assumed Rooftop Properties:**

Total Area Roof = 0.0950 ha
Unusable roof (20%) = 0.0190 ha
Usable roof (80%) = 0.0760 ha
Depth of Storage = 0.127 m

Rooftop Volume Assuming Sloped Roof (m^3) = Usable rooftop area (m^2) x storage depth (m)/3
Rooftop Volume (m^3) = 760 m^2 x 0.127 m / 3
Rooftop Volume (m^3) = 32.2 m^3

Controlled roof release rate = 1.29 l/s roof drain x 6 Zurn Control-Flo units (102 mm Rise)
Total controlled roof release rate = 7.74 L/s

Rooftop Area =	**0.095**
C-Factor (1:2 year) =	**0.90**
C-Factor (1:100 year) =	**1.00**

Time (min)	Intensity 1:2 Yr (mm/hr)	Qp (L/s)	Qp roof drain (L/s)	Qp stored (L/s)	Max Volume Requirement (m3)	Intensity 1:100 Yr (mm/hr)	Qp (L/s)	Qp roof drain (L/s)	Qp stored (L/s)	Max Volume Requirement (m3)
10	76.81	18.26	7.74	10.52	6.31	178.56	47.16	7.74	39.42	23.65
15	61.77	14.68	7.74	6.94	6.25	142.89	37.74	7.74	30.00	27.00
20	52.03	12.37	7.74	4.63	5.55	119.95	31.68	7.74	23.94	28.73
25	45.17	10.74	7.74	3.00	4.49	103.85	27.43	7.74	19.69	29.53
30	40.04	9.52	7.74	1.78	3.20	91.87	24.26	7.74	16.52	29.74
35	36.06	8.57	7.74	0.83	1.74	82.58	21.81	7.74	14.07	29.54
40	32.86	7.81	7.74	0.07	0.17	75.15	19.85	7.74	12.11	29.05
45	30.24	7.19	7.74	N/A	N/A	69.05	18.24	7.74	10.50	28.34
50	28.04	6.67	7.74	N/A	N/A	63.95	16.89	7.74	9.15	27.45
55	26.17	6.22	7.74	N/A	N/A	59.62	15.75	7.74	8.01	26.42

Minimum roof storage volume requirement = **29.74 m3**

Roof storage volume provided by design = **32.17 m3**

***Minimum storage volume requirement met by the design**

Urbandale Commercial Plaza
5100 Kanata Ave.

JLR No. 23405-003.1

STORMWATER MANAGEMENT CALCULATIONS

7 **Building C** **Assumed Rooftop Properties:**

Total Area Roof = 0.0850 ha
Unusable roof (20%) = 0.0170 ha
Usable roof (80%) = 0.0680 ha
Depth of Storage = 0.127 m

Rooftop Volume Assuming Sloped Roof (m^3) = Usable rooftop area (m^2) x storage depth (m)/3
Rooftop Volume (m^3) = 680 m² x 0.127 m / 3
Rooftop Volume (m^3) = 28.8 m^3

Controlled roof release rate = 1.29 l/s roof drain x 5 Zurn Control-Flo units (102 mm Rise)
Total controlled roof release rate 6.45 L/s

Rooftop Area =	**0.085**
C-Factor (1:2 year) =	**0.90**
C-Factor (1:100 year) =	**1.00**

Time (min)	Intensity 1:2 Yr (mm/hr)	Qp (L/s)	Qp roof drain (L/s)	Qp stored (L/s)	Max Volume Requirement (m3)	Intensity 1:100 Yr (mm/hr)	Qp (L/s)	Qp roof drain (L/s)	Qp stored (L/s)	Max Volume Requirement (m3)
10	76.81	16.33	6.45	9.88	5.93	178.56	42.19	6.45	35.74	21.45
15	61.77	13.14	6.45	6.69	6.02	142.89	33.77	6.45	27.32	24.58
20	52.03	11.07	6.45	4.62	5.54	119.95	28.34	6.45	21.89	26.27
25	45.17	9.61	6.45	3.16	4.73	103.85	24.54	6.45	18.09	27.13
30	40.04	8.52	6.45	2.07	3.72	91.87	21.71	6.45	15.26	27.47
35	36.06	7.67	6.45	1.22	2.56	82.58	19.51	6.45	13.06	27.43
40	32.86	6.99	6.45	0.54	1.29	75.15	17.76	6.45	11.31	27.14
45	30.24	6.43	6.45	N/A	N/A	69.05	16.32	6.45	9.87	26.64
50	28.04	5.96	6.45	N/A	N/A	63.95	15.11	6.45	8.66	25.99

Minimum roof storage volume requirement = **27.47 m3**

Roof storage volume provided by design = **28.79 m3**

***Minimum storage volume requirement met by the design**

8 **CB 580 - ICD 80**

Area	**0.048**
C-Factor 1:2Yr	**0.58**
C-Factor 1:100 Yr	**0.66**

Release Rate: 13.0 L/s

Time (min)	Intensity 1:2 Yr (mm/hr)	Qp (L/s)	Qp ICD (L/s)	Qp stored (L/s)	Max Volume Requirement (m3)	Intensity 1:100 Yr (mm/hr)	Qp (L/s)	Qp ICD (L/s)	Qp stored (L/s)	Max Volume Requirement (m3)
10	76.81	5.95	13.00	N/A	N/A	178.56	15.67	13.00	2.67	1.60
15	61.77	4.78	13.00	N/A	N/A	142.89	12.54	13.00	N/A	N/A
20	52.03	4.03	13.00	N/A	N/A	119.95	10.52	13.00	N/A	N/A
25	45.17	3.50	13.00	N/A	N/A	103.85	9.11	13.00	N/A	N/A
30	40.04	3.10	13.00	N/A	N/A	91.87	8.06	13.00	N/A	N/A
35	36.06	2.79	13.00	N/A	N/A	82.58	7.25	13.00	N/A	N/A
40	32.86	2.54	13.00	N/A	N/A	75.15	6.59	13.00	N/A	N/A

Minimum storage volume requirement = **1.60 m3**

Surface Storage: CB 580 4.35 m3

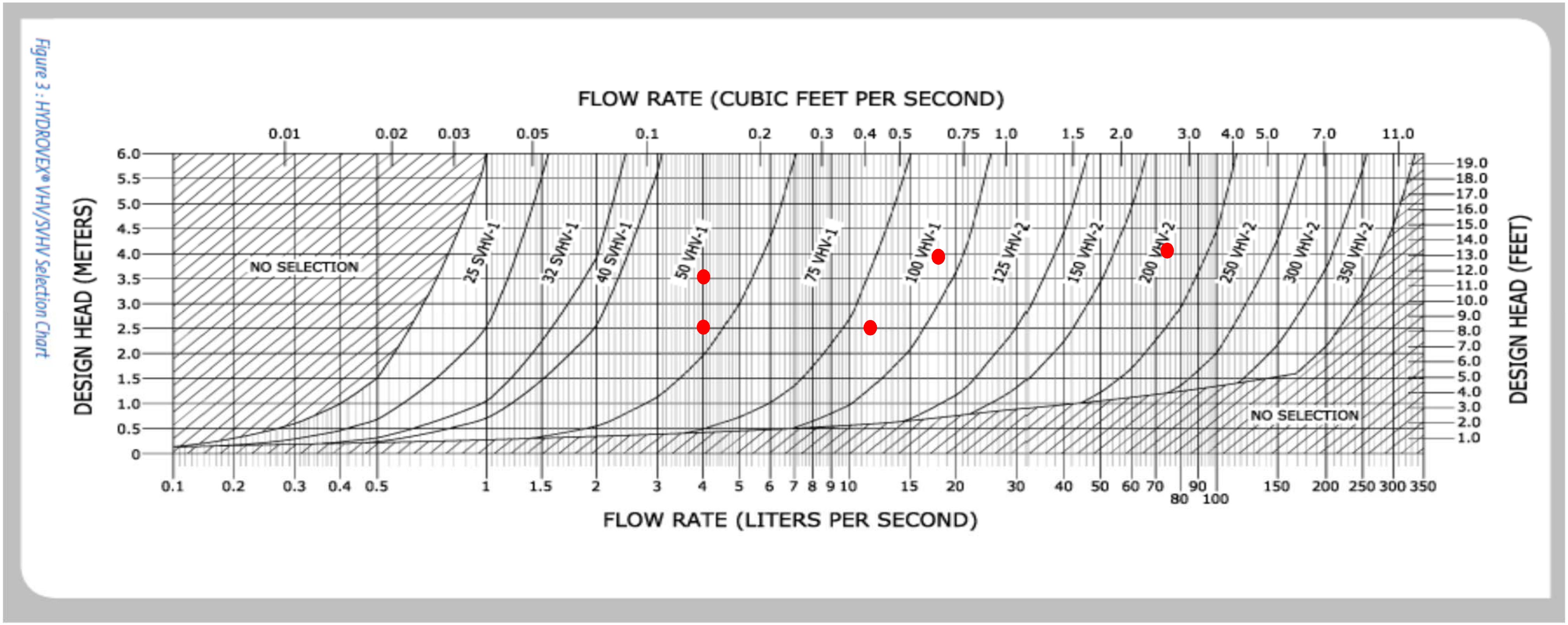
***Minimum storage volume requirement met by the design**

Urbandale Commercial Plaza

5100 Kanata Ave.

JLR No. 23405-003.1

INLET CONTROL DEVICE (ICD) TABLE



ICD TABLE							
ICD #	**Qr (L/s)**	**Outlet Diameter**	**Outlet Invert**	**Top of Grate**	**Max Ponding**	**Design Head**	**Hydrovex**
MH 530 - ICD 53	74.0	525	103.03	107.45	107.20	4.10	200 VHV-2
CB 552 - ICD 52	4.0	200	104.75	107.05	107.35	2.50	50 VHV-1
CBMH 571 - ICD 71	18.0	250	103.48	107.00	107.30	3.79	100 VHV-1
CBMH 573 - ICD 73	4.0	200	103.76	107.30	107.25	3.47	50 VHV-1
CB 580 - ICD 80	13.0	200	104.40	106.70	107.00	2.50	100 VHV-1

Appendix D5

Commercial Plaza Storm Sewer Design Sheet

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

Urbandale Commercial Plaza

5100 Kanata Ave.

JLR No. 23405-003.1

STORM SEWER DESIGN SHEET

Manning's Coefficient n =	0.013	
IDF CURVE =	2	year

(grey)	Per SCS consulting group retirement residence design dated August 2016
(blue)	Building Service Laterals

Designed by: A.W.
Checked by: H.M.
Date: May 2018

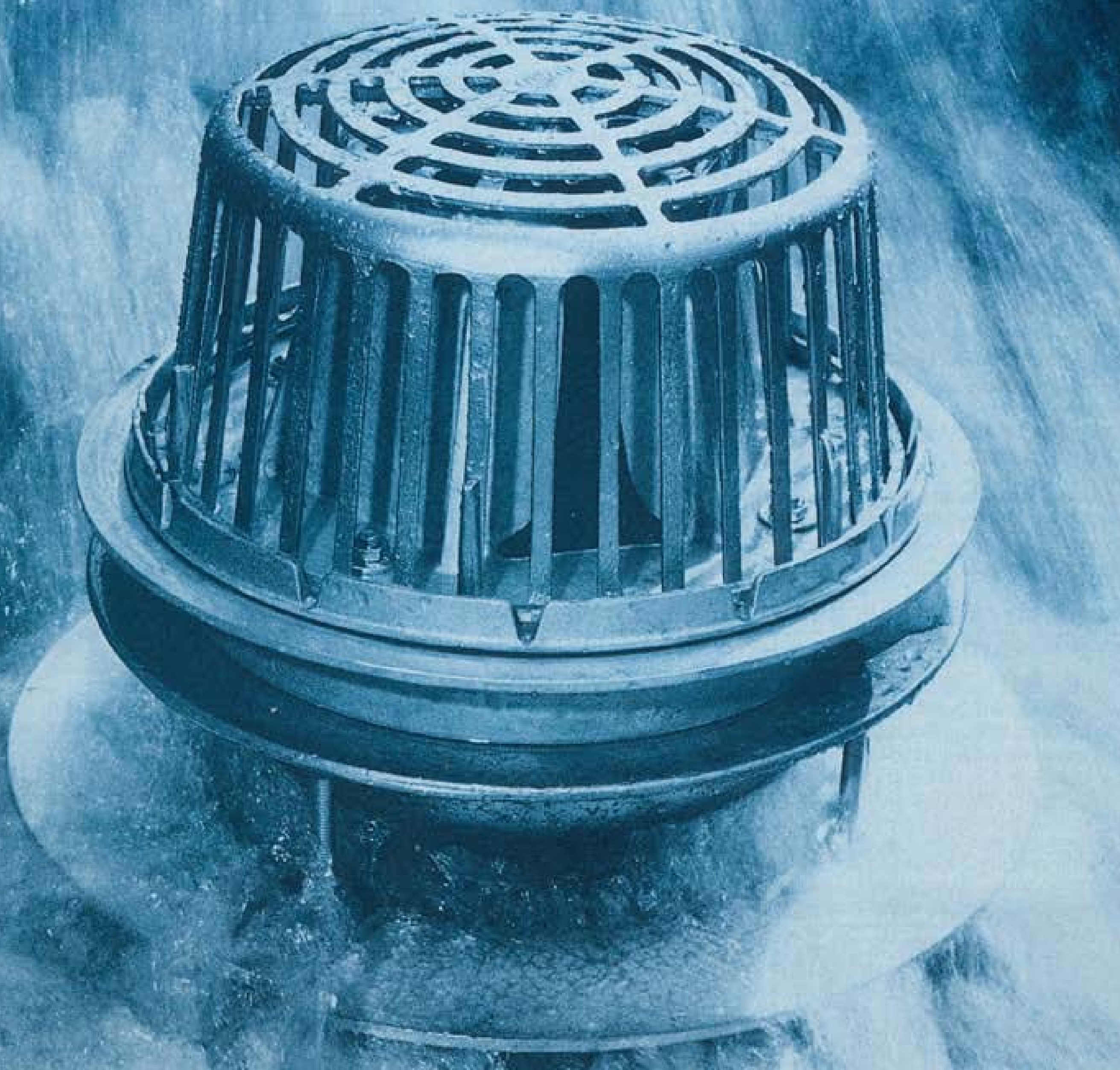
M.H.			AREA		1:2 YR PEAK FLOW COMPUTATION					SEWER DATA						UPSTREAM				DOWNSTREAM				
FROM	TO	C-factor	Total Area (ha)	CUM. Area (ha)	2.78AR	2.78AR (CUM.)	TIME (min.)	INTENS. (mm/hr)	PEAK FL. (L/s)	DIA. (mm)	SLOPE (%)	CAPAC. (L/s)	VEL. (m/s)	LENGTH (m)	FL.TIME (min.)	Center Line	Obvert	Invert	Cover	Center Line	Obvert Drop	Obvert	Invert	Cover
Building A	MH 510	0.90	0.04	0.04	0.10	0.10	10.00	76.81	7.88	150	3.00	27.5	1.51	4.60	0.05	108.15	105.85	105.70	2.30	107.92	0.86	105.72	105.56	2.20
MH510	MH 511	0.00	0.00	0.04		0.10	10.05	76.61	7.86	1050	0.70	2383.5	2.67	23.50	0.15	107.92	104.86	103.79	3.06	107.50	0.00	104.69	103.62	2.81
							10.20																	
CBMH 510	MH 511	0.75	0.11	0.11	0.22	0.22	10.00	76.81	17.17	750	0.95	1132.0	2.48	29.60	0.20	107.40	105.26	104.50	2.14	107.50	0.29	104.98	104.22	2.52
							10.20																	
MH 511	MH 520	0.00	0.00	0.15		0.33	10.20	76.05	24.81	1050	0.70	2383.5	2.67	24.40	0.15	107.50	104.69	103.62	2.81	107.33	0.16	104.52	103.45	2.81
							10.35																	
CBMH 522	MH 520	0.84	0.24	0.24	0.57	0.57	10.00	76.81	43.48	250	1.00	62.0	1.22	20.30	0.28	106.97	104.56	104.31	2.41	107.33	0.00	104.36	104.11	2.97
							10.28																	
Building E	MH 520	0.90	0.05	0.05	0.13	0.13	10.00	76.81	10.18	150	4.50	33.7	1.85	7.00	0.06	107.82	105.52	105.37	2.30	107.33	0.85	105.21	105.06	2.12
							10.06																	
MH 520	MH 530	0.90	0.24	0.68	0.60	1.63	10.35	75.48	122.68	1050	0.15	1103.3	1.23	28.20	0.38	107.33	104.36	103.29	2.97	107.45	0.75	104.32	103.25	3.13
MH 530	MH 540	0.00	0.00	0.68		1.63	10.73	74.10	120.45	525	0.30	245.7	1.10	20.10	0.30	107.45	103.57	103.03	3.88	107.29	0.03	103.51	102.97	3.78
							11.04																	
Building D	MH 550	0.90	0.11	0.11	0.27	0.27	10.00	76.81	20.37	150	3.00	27.5	1.51	10.50	0.12	107.72	105.42	105.27	2.30	107.30	0.45	105.11	104.96	2.19
MH 550	MH 540	0.87	0.09	0.20	0.22	0.48	10.12	76.36	36.87	250	1.10	65.1	1.28	21.80	0.28	107.30	104.66	104.40	2.64	107.29	0.94	104.42	104.16	2.87
							10.40																	
MH 540	MH 570	0.83	0.32	1.20	0.75	2.86	11.04	73.04	208.74	525	0.30	245.7	1.10	66.50	1.01	107.29	103.48	102.94	3.81	107.27	0.06	103.28	102.74	3.99
							12.04																	
Building B	MH 570	0.90	0.10	0.10	0.24	0.24	10.00	76.81	18.26	150	3.00	27.5	1.51	10.00	0.11	107.67	105.37	105.22	2.30	107.27	1.85	105.07	104.92	2.20
							10.11																	
CBMH 572	CBMH 573	0.46	0.06	0.06	0.08	0.08	10.00	76.81	5.99	600	1.00	640.6	0.82	55.60	1.13	106.95	104.95	104.35	2.00	107.30	0.43	104.40	103.79	2.90
CBMH 573	MH 570	0.90	0.01	0.07	0.03	0.11	11.13	72.73	7.67	200	1.00	34.2	0.82	14.90	0.30	107.30	103.97	103.76	3.33	107.27	0.60	103.82	103.61	3.45
							11.43																	
MH 570	EX. MH 14	0.58	0.05	1.4	0.08	3.28	12.04	69.76	228.69	525	0.30	245.7	0.82	34.70	0.70	107.27	103.22	102.68	4.05	107.06	0.16	103.11	102.58	3.95
							12.75																	
Building C	EX. MH 14	0.90	0.09	0.09	0.21	0.21	10.00	76.81	16.33	150	4.50	33.7	0.82	11.30	0.23	107.72	105.36	105.21	2.36	107.06	1.90	104.85	104.70	2.21
							10.23																	
EX. MH 14	EX. MH 7			1.50		3.49	12.75	67.65	236.17							107.06	102.95	102.34						

Appendix D6

ZURN Control-Flo Roof Drainage System Technical Manual

ZURN CONTROL-FLO

ROOF DRAINAGE SYSTEM



ZURN | *a step ahead of tomorrow*

ZURN Control-Flo...Today's Successful Answer to More

THE ZURN "CONTROL-FLO CONCEPT"

Originally, Zurn introduced the scientifically-advanced "Control-Flo" drainage principle for dead-level roofs. Today, after thousands of successful applications in modern, large dead-level roof areas, Zurn engineers have adapted the comprehensive "Control-Flo" data to **sloped roof** areas.

WHAT IS "CONTROL-FLO"?

It is an advanced method of removing rain water off dead-level or sloped roofs. As contrasted with conventional drainage practices, which attempt to drain off storm water as quickly as it falls on the roof's surface, "Control-Flo" drains the roof at a controlled rate. Excess water accumulates on the roof under controlled conditions . . . then drains off at a lower rate after a storm abates.

CUTS DRAINAGE COSTS

Fewer roof drains, smaller diameter piping, smaller sewer sizes, and lower installation costs are possible with a "Control-Flo" drainage system because roof areas are utilized as temporary storage reservoirs.

REDUCES PROBABILITY OF STORM DAMAGE

Lightens load on combination sewers by reducing rate of water drained from roof tops during severe storms thereby reducing probability of flooded sewers, and consequent backflow into basements and other low areas.

THANKS TO EXCLUSIVE ZURN "AQUA-WEIR" ACTION

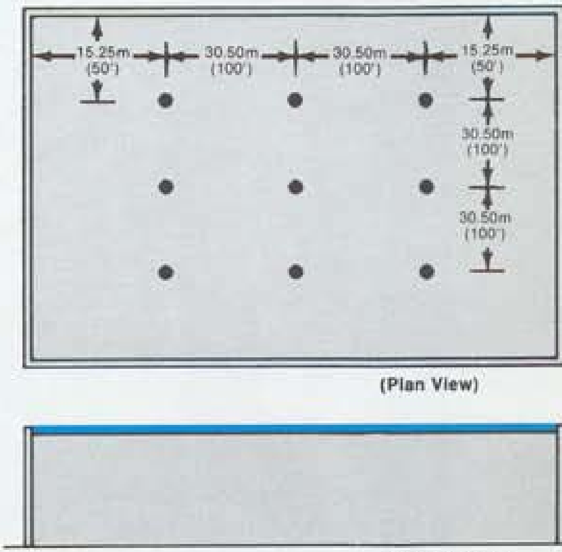
Key to successful "Control-Flo" drainage is a unique, scientifically-designed weir containing accurately calibrated notches with sides formed by parabolic curves which provide flow rates directly proportional to the head. Shape and size of notches are based on predetermined flow rates, and all factors involved in roof drainage to assure permanent regulation of drainage flow rates for specific geographic locations and rainfall intensities.

DEFINITION

DEAD LEVEL ROOFS

DIAGRAM "A"

A dead-level roof for purposes of applying the Zurn "Control-Flo" drainage principle is one which has been designed for zero slope across its entire surface. Measurements shown are for maximum distances.



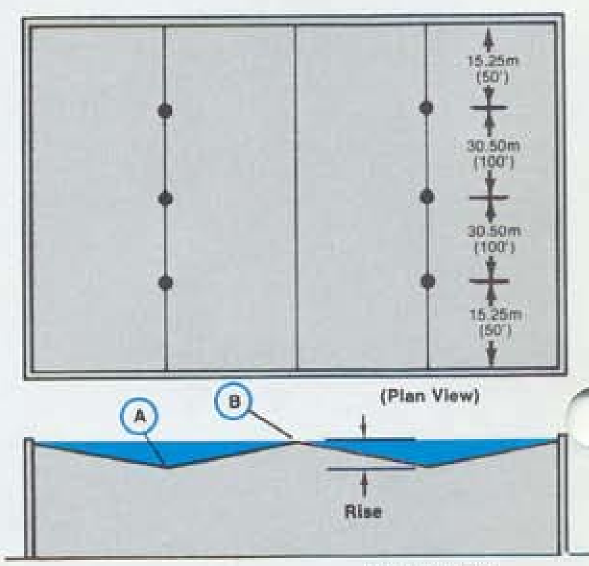
SLOPED ROOFS

DIAGRAM "B"

A sloped roof is one designed commonly with a shallow slope. The Zurn "Control-Flo" drainage system can be applied to any slope which results in a total rise up to 152mm(6").

The total rise of a roof as calculated for "Control-Flo" application is defined as the vertical increase in height in inches, from the low point or valley of a sloping roof (A) to the top of the sloping section (B). (Example: a roof that slopes 3mm(1/8") per foot having a 7.25m(24') span would have a rise of 7.25m x 3mm or 76mm (24' x 1/8" or 3")).

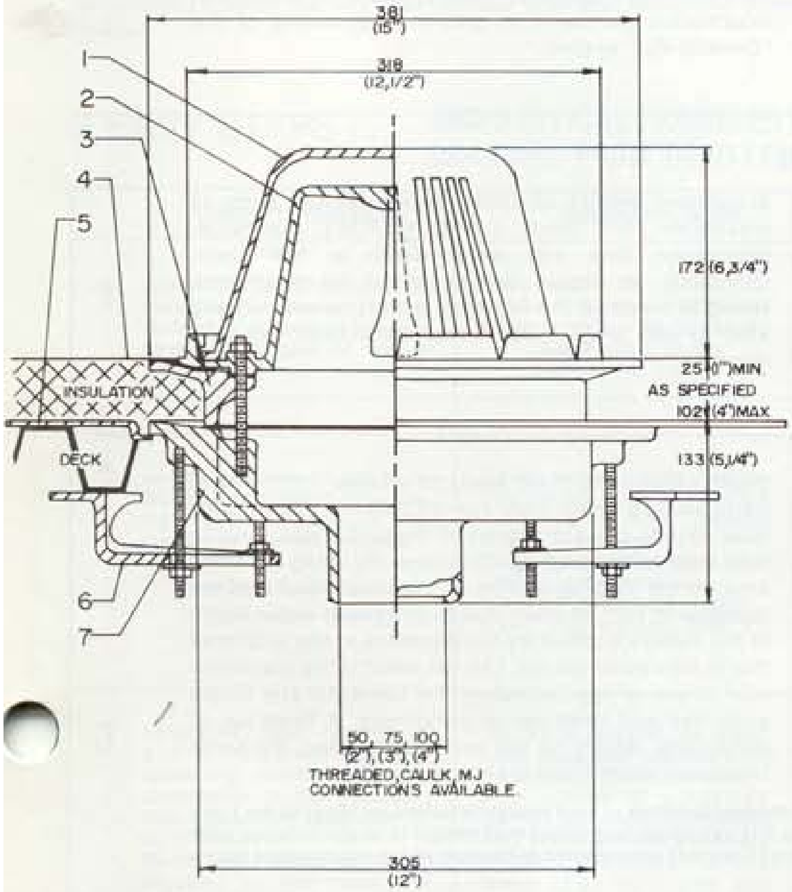
Measurements shown are for maximum distances.



Dimensions and other measurements given in metric and imperial forms.

Economical Roof Drainage Installations

SPECIFICATION DATA



PART	DESCRIPTION
1	POLY-DOME
2	CONTROL FLO WEIR WITH INTEGRAL CLAMP COLLAR AND GRAVEL GUARD
3	E-EXTENSION WITH GASKET (WHEN SPECIFIED)
4	ROOFING MEMBRANE (BY OTHERS)
5	R-ROOF SUMP RECEIVER (WHEN SPECIFIED)
6	C-UNDERDECK CLAMP (WHEN SPECIFIED)
7	BODY

Z-105-5-ERC "Control-Flo" Dura-Coated Cast Iron Body, Aluminum Parabolic Weir With Integral Clamping Collar And Gravel Guard, Poly Dome. Extension, Roof Sump Receiver, Under Deck Clamp, Aluminum Dome Available When Specified.

ROOF DESIGN RECOMMENDATIONS

Basic roofing design should incorporate protection that will prevent roof overloading by installing adequate overflow scuppers in parapet walls.

GENERAL INFORMATION

The "Control-Flo" roof drainage data is tabulated for four areas (232.25m²(2500 sq. ft.), 464.50m²(5000 sq. ft.), 696.75m²(7500 sq. ft.), 929m²(10,000 sq. ft.) notch areas ratings) for each locality. For each notch area rating the maximum discharge in L.P.M.(G.P.M.) — draindown in hours, and maximum water depth at the drain in inches for a dead level roof — 51mm(2 inch) rise — 102mm(4 inch) rise and 152mm(6 inch) rise — are tabulated. The rise is the total change in elevation from the valley to the peak. Values for areas, rise or combination thereof other than those listed, can be arrived at by extrapolation. All data listed is based on the fifty-year return frequency storm. In other words the maximum conditions as listed will occur on the average of once every fifty years.

NOTE: The tabulated "Control-Flo" data enables the individual engineer to select his own design limiting condition. The limiting condition can be draindown time, roof load factor, or maximum water depth at the drain. If draindown time is the limiting factor because of possible freezing conditions, it must be recognized that the maximum time listed will occur on the average of once every 50 years and would most likely be during a heavy summer thunder storm. Average winter drain down times would be much shorter in duration than those listed.

GENERAL RECOMMENDATIONS

On sloping roofs, we recommend a design depth referred to as an equivalent depth. An equivalent depth is the depth of water attained at the drains that results in the same roof stresses as those realized on a dead-level roof. In all cases this equivalent depth is almost equal to that attained by using the same notch area rating for the different rises to 152mm(6"). With the same depth of water at the drain the roof stresses will decrease with increasing total rise. Therefore, it would be possible to have a depth in excess of 152mm(6") at the drain on a sloping roof without exceeding stresses normally encountered in a 152mm(6") depth on a dead-level roof. However, it is recommended that scuppers be placed to limit the maximum water depth on any roof to 152mm(6") to prevent the overflow of the weirs on the drains and consequent overloading of drain piping. In the few cases where the data shows a flow rate in excess of 136 L.P.M.(30 G.P.M.) if all drains and drain lines are sized according to recommendations, and the one storm in fifty years occurs, the only consequence will be a brief flow through the scuppers or over-flow drains.

NOTE: An equivalent depth is that depth of water attained at the drains at the lowest line or valley of the roof with all other conditions such as notch area and rainfall intensity being equal. For Toronto, Ontario a notch area rating of 464.50m²(5,000 square feet) results in a 74mm(2.9 inch) depth on a dead level roof for a 50-year storm. For the same notch area and conditions, equivalent depths for a 51mm(2"), 102mm(4") and 152mm(6") rise respectively on a sloped roof would be 86mm(3.4"), 104mm(4.1") and 124mm(4.9"). Roof stresses will be approximately equal in all cases.

ZURN Control-Flo Drain Selection is Quick and Easy . . .

The exclusive Zurn "Selecta-Drain" Chart (pages 8, 9, 10, 11) tabulates selection data for 34 localities in Canada. Proper use of this chart consitutes your best assurance of sure, safe, economical application of Zurn "Control-Flo" systems for your specific geographical area. If the "Selecta-Drain" Chart does not cover your specific design criteria, contact Zurn Drainage and Control Systems Ltd., Weston, Ontario, for additional data for your locality. Listed below is additional information pertinent to proper engineering of the "Control-Flo" system.

ROOF USED AS TEMPORARY RETENTION

The key to economical "Control-Flo" is the utilization of large roof areas to temporarily store the maximum amount of water without overloading average roofs or creating excessive draindown time during periods of heavy rainfall. The data shown in the "Selecta-Drain" Chart enables the engineer to select notch area ratings from 232.25m²(2,500 ft.²) to 929m²(10,000 ft.²) and to accurately predict all other design factors such as maximum roof load, L.P.M. (G.P.M.) discharge, draindown time and water depth at the drain. Obviously, as design factors permit the notch area rating to increase the resulting money saved in being able to use small leaders and drain lines will also increase.

ROOF LOADING AND RUN-OFF RATES

The four values listed in the "Selecta-Drain" Chart for notch area ratings for different localities will normally span the range of good design. If areas per notch below 232.25m²(2,500 ft.²) are used considerable economy of the "Control-Flo" concept is being lost. The area per notch is limited to 929m²(10,000 square feet) to keep the draindown time within reasonable limits. Extensive studies show that stresses due to water load on a sloping roof for any fixed set of conditions are very nearly the same as those on a dead-level roof. A sloping roof tends to concentrate more water in the valleys and increase the water depth at this point. The greater depth around the drain leads to a faster run-off rate, particularly a faster early run-off rate. As a result, the total volume of water stored on the roof is less, and the total load on the sloping roof is less. By using the same area on the sloping roof as on the dead-level roof the increase in roof stresses due to increased water depth in the valleys is offset by the decrease in the total load due to less water stored. The net result is the maximum roof stress is approximately the same for any single span rise and fixed set of conditions. A fixed set of conditions, would be the same notch area, the same frequency storm, and the same locality.

SPECIAL CONSIDERATIONS FOR STRUCTURAL SAFETY: Normal practice of roof design is based on 18kg(40 lbs.) per 929cm²(square ft.) (subject to local codes and by-laws.) Thus it is extremely important that design is in accordance with normal load factors so deflection will be slight enough in any bay to prevent progressive deflection which could cause water depths to load the roof beyond its design limits.

ADDITIONAL NOTCH RATINGS

The "Selecta-Drain" Chart along with Tables I and II enables the engineer to select "Control-Flo" Drains and drain pipe sizes for most Canadian applications. These calculations are computed for a proportional flow weir that is sized to give a flow of 23 L.P.M. (5 G.P.M.) per inch of head. The 23 L.P.M. (5 G.P.M.) per inch of head, notch opening, is selected as the basis of design as it offers the most economical installation as applied to actual rainfall experienced in Canada.

Should you require design criteria for locations outside of Canada, or for special project applications please contact Zurn Drainage and Control Systems Ltd., Weston, Ontario.

LEADER AND DRAIN PIPE SIZING

Since all data in the "Selecta-Drain" Chart is based on the 50-year storm it is possible to exceed the water depth listed in these charts if a 100-year or 1000-year storm would occur. Therefore, for good design it is recommended that scuppers or other methods be used to limit water depth to the design depth and tables I and II be used to size the leaders and drain pipes. If the roof is capable of supporting more water than the design depth it is permissible to locate the scuppers or other overflow means at a height that will allow a greater water depth on the roof. However, in this case the leader and drain pipes should be sized to handle the higher flow rates possible based on a flow rate of 23 L.P.M. (5 G.P.M.) per inch of depth at the drain.

PROPER DRAIN LOCATION

The following good design practice is recommended for selecting the proper number of "Control-Flo" drains for a given area. **On dead-level roofs,** drains should be located no further than 15.25m(50 feet) from edge of roof and no further than 30.50m(100 feet) between drains. See diagram "A" page 2. **On sloping roofs,** drains should be located in the valleys at a distance no greater than 15.25m(50 feet) from each end of the valleys and no further than 30.50m(100 feet) between drains. See diagram "B" page 2. Compliance with these recommendations will assure good run off regardless of wind direction.

Saves Specification Time, Assures Proper Application

QUICK, EASY SELECTION

Using the "Selecta-Drain" Chart (pages 8, 9, 10, 11) in combination with the steps and examples appearing below, should save you countless hours in engineering specification time. This vast compilation of data is related to the proper selection of drains for 34 cities. All cities in alphabetical order by Provinces. If a specific city does not appear in this tabulation, choose the city nearest your area and select the proper drain using these factors.

3 EASY STEPS ...

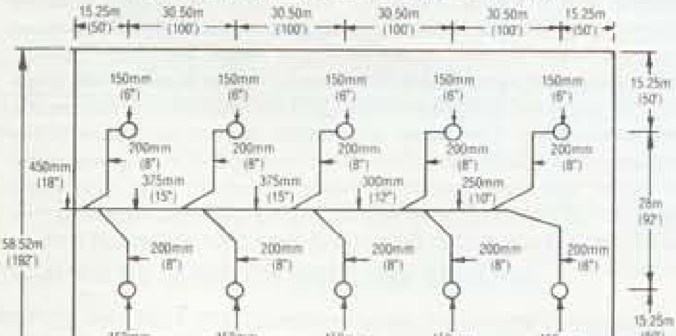
AND 3 TYPICAL EXAMPLES FOR APPLICATION OF SURE, SCIENTIFIC CONTROL OF DRAINAGE FROM DEAD-LEVEL AND SLOPING ROOFS WITH THE ZURN CONCEPT

TORONTO, ONTARIO	DEAD-LEVEL ROOF	102mm(4 INCH) SLOPE	152mm(6 INCH) SLOPE
1 Determine total roof area or individual areas when roof is divided by expansion joints or peaks in the case of sloping roof.	Roof Area: 58.52m x 152.40m = 8918.40m² (192ft x 500ft = 96,000 sq.ft.) (See Z-105-5 layout bottom this page.)	3 Individual Roof Areas: 19.50m x 152.40m = 2972.80m² (64ft. x 500ft. = 32,000 sq.ft.) Valleys 152.40m(500 ft.) long 3 x 2972.80 = 8918.40m² (3 x 32,000 = 96,000 sq.ft.)	2 Individual Roof Areas: 29.87m x 152.40m = 4552m² (98 ft. x 500 ft. = 49,000 sq. ft.) Valleys 152.40m (500 ft.) long 2 x 4552 = 9104m² (2 x 49,000 = 98,000 sq.ft.)
2 Divide roof area or individual areas by Zurn Notch Area Rating selected to obtain the total number of notches required.	Zurn Notch Area Rating selected for Toronto=464.50m² (5,000 sq.ft.) from "Selecta-Drain" Chart, page 11. Total Roof Area= 8918.40m² (96,000 sq.ft.) Entire roof. 464.50m² (5,000 sq.ft.) notch area = 19.2 notches - USE 20	Zurn Notch Area Rating selected for Toronto=464.50m² (5,000 sq.ft.) from "Selecta-Drain" Chart, page 11. Total Roof Area=2972.80m² (32,000 sq.ft.) Each area. 464.50m² (5,000 sq.ft.) notch area = 6.4 notches - USE 7 PER AREA	Zurn Notch Area Rating selected for Toronto=464.50m² (5,000 sq.ft.) from "Selecta-Drain" Chart, page 11. Total Roof Area=4552m² (49,000 sq.ft.) Each area. 464.50m² (5,000 sq.ft.) notch area = 9.8 notches - USE 10 PER AREA
3 Determine total number of drains required by not exceeding maximum spacing dimensions in the preceding instructions. See Diagrams "A" or "B", page 2. Divide total number of notches required to determine the number of notches per drain. Note maximum water depth at drain and use this dimension to determine scupper height. Maximum scupper height to be used is 152mm(6"). *Use this flow rate to size leaders and drain lines.*	*10 drains required. All drains must have two notches each for a total of 20 notches. Flow rate is 66 L.P.M.(14.5 G.P.M.) per notch. Size leaders for 2 notch weirs for a flow rate of 66 L.P.M. (14.5 G.P.M.) 50mm (Two inch) pipe size leaders required. Maximum water depth and scupper height is 74 mm (2.9 inches). Requires 19 hrs. draindown time max. For drain, vertical, and horizontal pipe sizing data see Tables I and II on pages 6 and 7.	**5 drains per area required located in the valleys 15.25m(50 ft.) from each end with 3 in the middle at 30.50m(100ft.) spacings. Two drains on ends with two notches—3 drains in middle one notch each for a total of 7 notches. Maximum flow rate 93 L.P.M. (20.5 G.P.M.) per notch. Leader size 50mm(2") for single notch weirs—75mm(3") notch weirs. Maximum water depth and scupper height is 104mm(4.1 inches). Requires 11 hrs. draindown time max. For drain, vertical, and horizontal pipe sizing data see Tables I and II on pages 6 and 7.	**5 drains per area required located in the valleys 15.25m(50 ft.) from each end with 3 at 30.50m(100 ft.) spacing in the middle. 10 notches are required therefore all drains must have two notches. Flow rate is 111 L.P.M. (24.5 G.P.M.) per notch. Size all leaders for 2 notch weirs. 75mm(3 inch) pipe size required. Maximum water depth and scupper height is 124mm (4.9 inches). Requires 9 hrs. draindown time max. For drain, vertical, and horizontal pipe sizing data see Tables I and II on pages 6 and 7.

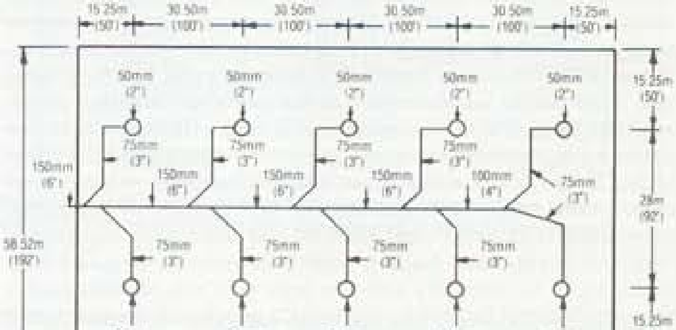
*See Diagram "A" page 2 for recommended drain placement.
**See Diagram "B" page 2 for recommended drain placement.

DEAD LEVEL ROOF
6mm(1/4") PER FT. SLOPE STORM DRAIN

CONVENTIONAL — "UNCONTROLLED" — RUN OFF



Z-105-5 "CONTROL-FLO" — RUN OFF



ZURN Select The Proper Vertical Drain Leaders

ROOF DRAINAGE DATA

The flow rate for any design condition can be easily read from the data contained on the following pages; the tabulations shown below (and on the opposite page) can be used to simplify selection of drain line sizes.

TABLE 1 —SUGGESTED RELATION OF DRAIN OUTLET AND VERTICAL LEADER SIZE TO ZURN CONTROL-FLO ROOF DRAINS (BASED ON NATIONAL PLUMBING CODE ASA-A40.8 DATA ON VERTICAL LEADERS).

No. of Notches in Drain	Max. Flow per Notch in L.P.M. (G.P.M.) — Pipe Size		
	50mm (2")	75mm (3")	100mm (4")
1	136* (30*)	—	—
2	68 (15)	136* (30*)	—
3	45 (10)	136* (30*)	—
4	—	105 (23)	136* (30*)
5	—	82 (18)	136* (30*)
6	—	68 (15)	136* (30*)

*Maximum flow obtainable from 1 notch with 152mm(six inch) water depth at drain.

Table 1 should be used to select **vertical drain** leaders which at the same time establishes the drain outlet size. This table illustrates the maximum flow per notch in L.P.M. (G.P.M.) Since the Z-105-5 drain is available with a minimum of one and a maximum of six notches, calculations have already been made and are listed in this table for any quantity of weir notch openings established in your design. It was determined ten drains with two notches each weir would be required in Dead-Level Roof example on page 5. A 66 L.P.M. (14.5 G.P.M.) discharge per notch flow rate was also established.

Once this design criteria has been determined it will be the key to the proper selection of all drain outlet sizes, vertical and horizontal storm drain sizes in Table I and II. Enter the column "Number of Notches in Drain", Table I, read down the column to the figure 2 which indicates two notches in weir, then read across until you reach a figure equal to or closest figure in excess of 66 L.P.M. (14.5 G.P.M.) You will find fifteen in the column under 50mm(2") which represents the pipe size. Therefore all drain outlets and vertical leaders are 50mm(2") size.

Let us digress for a moment assuming a specific structure requires a total of six drains each containing a weir with a different number of notches. One with 1, one with 2, etc. Table 1 discloses the pipe size for one notch is 50mm(2"), two notch is 50mm(2"), three notch is 75mm(3"), four notch is 75mm(3"), five notch is 75mm(3") and six notch is 75mm(3") as they all equal or closely exceed the 66 L.P.M. (14.5 G.P.M.) design.

NOTE: Although pipe size calculations should be based on accumulated flow rate, local by-laws should be referred to for minimum pipe size requirements and roof drain spacing.

Table II should be used to select **horizontal** storm drain piping. Use the same flow rate 66 L.P.M. (14.5 G.P.M.) used to establish the vertical leaders to size the storm drainage system and main storm drain. Let us assume the ten drains each with two notch weirs were actually on the roof in two separate lines of five drains each and joined at a common point before leaving the building. Since Table II includes 3mm(1/8"), 6mm(¼") and 13mm(½") per foot slope, **let us use 6mm(¼") as our basis for selection** which will take us to the centre section. Starting with the first of five drains we enter the extreme left column in Table II and read down to the figure 2 since this drain has two notches in weir, read across horizontally and the size of first section of horizontal storm drain is 75mm(3") between 1st and 2nd drain, return to left hand column proceed reading down until you reach figure 4 then read across horizontally and the pipe size will be 100mm(4") between 2nd and 3rd drain, 100mm(4") between 3rd and 4th and 125mm(5") (if available) between 4th and 5th. If not available use 150mm(6"). (You may be tempted to use 100m(4") since the capacity is close. We recommend you go to the larger size.) Pipe size leaving 5th drain would be 150mm(6"). The same sizing would hold true for the second line of five drains. Since both columns of five drains each are being joined together before leaving the building there will be a total of twenty notches discharging into the main building storm sewer. Enter left hand column Table II, read down until you reach the figure twenty, then read across horizontally to the 6mm(¼") per 305mm(foot) slope column and you will see a 150mm(6") storm drain will handle the job adequately. The same procedure should be followed for sloped roof installations. The above method of sizing was done to better acquaint you with Table II and its use. The more economical and practical way of laying out and installing this same job is illustrated in the control-flo layout shown on bottom of page 5.

NOTE: Although pipe size calculations should be based on accumulated flow rates, local by-laws should be referred to for minimum pipe size requirements and roof drain spacing.

Select Proper Horizontal Storm Drain Piping

TABLE II —SUGGESTED RELATION OF HORIZONTAL STORM DRAIN SIZE TO ZURN CONTROL-FLO ROOF DRAINAGE

Total No. of Notches Discharging to Storm Drain	MAX. FLOW PER NOTCH IN L.P.M. (G.P.M.) — Storm Drain Size 3mm(1/8") per 305mm(ft.) slope							
	75 (3")	100 (4")	125 (5")	150 (6")	200 (8")	250 (10")	300 (12")	375 (15")
1	136*(30*)	—	—	—	—	—	—	—
2	77(17)	136*(30*)	—	—	—	—	—	—
3	50(11)	118(26)	136*(30*)	—	—	—	—	—
4	36(8)	86(19)	136*(30*)	—	—	—	—	—
5	—	68(15)	127*(28*)	136*(30*)	—	—	—	—
6	—	59(13)	105(23)	136*(30*)	—	—	—	—
7	—	50(11)	91(20)	136*(30*)	—	—	—	—
8	—	—	77(17)	127(28)	136*(30*)	—	—	—
9	—	—	68(15)	114(25)	136*(30*)	—	—	—
10	—	—	64(14)	100(22)	136*(30*)	—	—	—
11	—	—	55(12)	91(20)	136*(30*)	—	—	—
12	—	—	—	82(18)	136*(30*)	—	—	—
13	—	—	—	77(17)	136*(30*)	—	—	—
14	—	—	—	73(16)	136*(30*)	—	—	—
15	—	—	—	68(15)	136*(30*)	—	—	—
16	—	—	—	64(14)	136*(30*)	—	—	—
17	—	—	—	59(13)	127(28)	136*(30*)	—	—
18	—	—	—	55(12)	118(26)	136*(30*)	—	—
19	—	—	—	—	114(25)	136*(30*)	—	—
20	—	—	—	—	109(24)	136*(30*)	—	—
23	—	—	—	—	91(20)	136*(30*)	—	—
25	—	—	—	—	86(19)	136*(30*)	—	—
30	—	—	—	—	73(16)	127(28)	136*(30*)	—
35	—	—	—	—	59(13)	109(24)	136*(30*)	—
40	—	—	—	—	55(12)	95(21)	136*(30*)	—
45	—	—	—	—	—	86(19)	136*(30*)	—
50	—	—	—	—	—	77(17)	123(27)	136*(30*)
55	—	—	—	—	—	68(15)	114(25)	136*(30*)
60	—	—	—	—	—	64(14)	105(23)	136*(30*)
65	—	—	—	—	—	59(13)	95(21)	136*(30*)
70	—	—	—	—	—	55(12)	91(20)	136*(30*)

Total No. of Notches Discharging to Storm Drain	MAX. FLOW PER NOTCH IN L.P.M. (G.P.M.) — Storm Drain Size 6mm(¼") per 305mm(ft.) slope						
	75 (3")	100 (4")	125 (5")	150 (6")	200 (8")	250 (10")	300 (12")
1	136*(30*)	—	—	—	—	—	—
2	109(24)	136*(30*)	—	—	—	—	—
3	73(16)	136*(30*)	—	—	—	—	—
4	55(12)	127(28)	136*(30*)	—	—	—	—
5	—	100(22)	136*(30*)	—	—	—	—
6	—	82(18)	136*(30*)	—	—	—	—
7	—	73(16)	127(28)	136*(30*)	—	—	—
8	—	64(14)	114(25)	136*(30*)	—	—	—
9	—	55(12)	100(22)	136*(30*)	—	—	—
10	—	—	91(20)	136*(30*)	—	—	—
11	—	—	82(18)	132(29)	136*(30*)	—	—
12	—	—	73(16)	118(26)	136*(30*)	—	—
13	—	—	68(15)	109(24)	136*(30*)	—	—
14	—	—	64(14)	100(22)	136*(30*)	—	—
15	—	—	59(13)	95(21)	136*(30*)	—	—
16	—	—	—	91(20)	136*(30*)	—	—
17	—	—	—	82(18)	136*(30*)	—	—
18	—	—	—	77(17)	136*(30*)	—	—
19	—	—	—	73(16)	136*(30*)	—	—
20	—	—	—	68(15)	136*(30*)	—	—
23	—	—	—	64(14)	132(29)	136*(30*)	—
25	—	—	—	59(13)	123(27)	136*(30*)	—
30	—	—	—	—	100(22)	136*(30*)	—
35	—	—	—	—	86(19)	136*(30*)	—
40	—	—	—	—	77(17)	136*(30*)	—
45	—	—	—	—	68(15)	123(27)	136*(30*)
50	—	—	—	—	59(13)	109(24)	136*(30*)
55	—	—	—	—	—	100(22)	136*(30*)
60	—	—	—	—	—	91(20)	136*(30*)
65	—	—	—	—	—	82(18)	136*(30*)
70	—	—	—	—	—	77(17)	127(28)

Total No. of Notches Discharging to Storm Drain	MAX. FLOW PER NOTCH IN L.P.M. (G.P.M.) — Storm Drain Size 13mm(½") per 305mm(ft.) slope						
	75 (3")	100 (4")	125 (5")	150 (6")	200 (8")	250 (10")	300 (12")
1	136*(30*)	—	—	—	—	—	—
2	136*(30*)	—	—	—	—	—	—
3	100(22)	136*(30*)	—	—	—	—	—
4	77(17)	136*(30*)	—	—	—	—	—
5	59(13)	136*(30*)	—	—	—	—	—
6	50(11)	118(26)	136*(30*)	—	—	—	—
7	—	100(22)	136*(30*)	—	—	—	—
8	—	86(19)	136*(30*)	—	—	—	—
9	—	77(17)	136*(30*)	—	—	—	—
10	—	68(15)	123(27)	136*(30*)	—	—	—
11	—	64(14)	114(25)	136*(30*)	—	—	—
12	—	59(13)	105(23)	136*(30*)	—	—	—
13	—	55(12)	95(21)	136*(30*)	—	—	—
14	—	—	86(19)	136*(30*)	—	—	—
15	—	—	82(18)	132(29)	136*(30*)	—	—
16	—	—	77(17)	123(27)	136*(30*)	—	—
17	—	—	73(16)	118(26)	136*(30*)	—	—
18	—	—	68(15)	109(24)	136*(30*)	—	—
19	—	—	64(14)	105(23)	136*(30*)	—	—
20	—	—	59(13)	100(22)	136*(30*)	—	—
23	—	—	55(12)	86(19)	136*(30*)	—	—
25	—	—	—	77(17)	136*(30*)	—	—
30	—	—	—	64(14)	136*(30*)	—	—
35	—	—	—	55(12)	123(27)	136*(30*)	
40	—	—	—	—	105(23)	136*(30*)	—
45	—	—	—	—	95(21)	136*(30*)	—
50	—	—	—	—	86(19)	136*(30*)	—
55	—	—	—	—	77(17)	136*(30*)	—
60	—	—	—	—	68(15)	127(28)	136*(30*)
65	—	—	—	—	64(14)	118(26)	136*(30*)
70	—	—	—	—	59(13)	109(24)	136*(30*)

*Maximum flow obtainable from 1 notch with 152mm(six inch) water depth at drain.

TABLE III —TO BE USED WHEN ROOF STORM WATER RUN OFF AND OTHER SURFACE WATER RUN OFF IS BEING CONSOLIDATED INTO ONE COMMON MAIN HORIZONTAL STORM SEWER.

Flow capacity of vertical leaders litres per minute (gallons per minute)

Pipe Size	Maximum Capacity L.P.M.(G.P.M.)
50mm(2")	136(30)
75mm(3")	409(90)
100mm(4")	864(190)
†125mm(5")	1582(348)
150mm(6")	2550(561)

†In some areas 125mm(5") drainage pipe may not be available.

Flow capacity of horizontal storm sewers litres per minute (gallons per minute).

Pipe Size	Slope per 305mm(Per Foot)		
	3mm(1/8")	6mm(¼")	13mm(½")
75mm(3")	163(36)	232(51)	327(72)
100mm(4")	355(78)	505(111)	714(157)
†125mm(5")	646(142)	914(201)	1291(284)
150mm(6")	1050(231)	1487(327)	2100(462)
200mm(8")	2264(498)	3205(705)	4528(996)
250mm(10")	4100(902)	5796(1275)	8201(1804)
300mm(12")	6669(1467)	9437(2076)	13338(2934)
375mm(15")	12120(2666)	17157(3774)	24239(5332)

Note: Although pipe size calculations should be based on accumulated flow rate, local by-laws should be referred to for minimum pipe size requirements and roof drain spacing.

SCUPPERS AND OVERFLOW DRAINS

Roofing members and understructures, weakened by seepage and rot resulting from improper drainage and roof construction can give away under the weight of rapidly accumulated water during flash storms. Thus, it is recommended, and often required by building codes, to install scuppers and overflow drains in parapet-type roofs. Properly selected and sized scuppers and overflow drains are vital to a well-engineered drainage system to prevent excessive loading, erosion, seepage and rotting.

ZURN Selecta-Drain Chart

LOCATION	SQUARE METRE (SQUARE FOOT) NOTCH AREA RATING	ROOF LOAD FACTOR KGS (LBS.)	TOTAL ROOF SLOPE: DEAD-LEVEL			51mm (2") RISE			102mm (4") RISE			152mm (6") RISE		
			L.P.M. (G.P.M.) Discharge	Draindown Time Hrs.	mm (In.) Water Depth	L.P.M. (G.P.M.) Discharge	Draindown Time Hrs.	mm (In.) Water Depth	L.P.M. (G.P.M.) Discharge	Draindown Time Hrs.	mm (In.) Water Depth	L.P.M. (G.P.M.) Discharge	Draindown Time Hrs.	mm (In.) Water Depth
Calgary, Alberta	232 (2,500)	4.7 (10.4)	45.5 (10)	7	51 (2)	57 (12.5)	6	63.5 (2.5)	72.5 (16)	4	81.5 (3.2)	86.5 (19)	3.2	96.5 (3.8)
	465 (5,000)	5.9 (13)	57 (12.5)	17	63.5 (2.5)	66 (14.5)	14	73.5 (2.9)	82 (18)	9	91.5 (3.6)	97.5 (21.5)	7.5	109 (4.3)
	697 (7,500)	6.4 (14)	61.5 (13.5)	28	68.5 (2.7)	72.5 (16)	22	81.5 (3.2)	88.5 (19.5)	15	99 (3.9)	104.5 (23)	12	117 (4.6)
	929 (10,000)	6.8 (15.1)	66 (14.5)	38	73.5 (2.9)	77.5 (17)	31	86.5 (3.4)	93 (20.5)	22	104 (4.1)	109 (24)	17	122 (4.8)
Edmonton, Alberta	232 (2,500)	4.5 (9.9)	43 (9.5)	7	48.5 (1.9)	57 (12.5)	6	63.5 (2.5)	72.5 (16)	4	81.5 (3.2)	82 (18)	3	91.5 (3.6)
	465 (5,000)	5.9 (13)	57 (12.5)	17	63.5 (2.5)	68 (15)	14.5	76 (3)	84 (18.5)	9.5	94 (3.7)	97.5 (21.5)	7.5	109 (4.3)
	697 (7,500)	6.6 (14.5)	63.5 (14)	28	71 (2.8)	75 (16.5)	24	84 (3.3)	97.5 (21.5)	16	104 (4.1)	107 (23.5)	12	119.5 (4.7)
	929 (10,000)	7.1 (15.6)	68 (15)	38	76 (3.0)	79.5 (17.5)	32	89 (3.5)	100 (22)	22	112 (4.4)	113.5 (25)	18	127 (5.0)
Penticton, British Columbia	232 (2,500)	3.8 (8.3)	36.5 (8)	6	40.5 (1.6)	38.5 (8.5)	4	43 (1.7)	52.5 (11.5)	3	58.5 (2.3)	61.5 (13.5)	2.3	68.5 (2.7)
	465 (5,000)	4.0 (8.8)	38.5 (8.5)	13	43 (1.7)	41 (9)	9	45.5 (1.8)	57 (12.5)	6	63.5 (2.5)	68 (15)	5	76 (3.0)
	697 (7,500)	4.2 (9.3)	41 (9)	21	45.5 (1.8)	43 (9.5)	14.5	48.5 (1.9)	61.5 (13.5)	10.5	68.5 (2.7)	72.5 (16)	8	81.5 (3.2)
	929 (10,000)	4.2 (9.3)	41 (9)	27	45.5 (1.8)	45.5 (10)	20	51 (2.0)	63.5 (14)	14	71 (2.8)	75 (16.5)	11	84 (3.3)
Vancouver, British Columbia	232 (2,500)	3.3 (7.3)	32 (7)	5.5	35.5 (1.4)	38.5 (8.5)	4	43 (1.7)	47.5 (10.5)	2.8	53.5 (2.1)	57 (12.5)	2	63.5 (2.5)
	465 (5,000)	4.0 (8.8)	38.5 (8.5)	13	43 (1.7)	45.5 (10)	10	51 (2)	57 (12.5)	6	63.5 (2.5)	68 (15)	5	76 (3)
	697 (7,500)	4.5 (9.9)	43 (9.5)	22	48.5 (1.9)	50 (11)	17	56 (2.2)	63.5 (14)	11	71 (2.8)	75 (16.5)	8.5	84 (3.3)
	929 (10,000)	4.9 (10.9)	47.5 (10.5)	30	53.5 (2.1)	54.5 (12)	24	61 (2.4)	68 (15)	15	76 (3)	79.5 (17.5)	12	89 (3.5)
Victoria, British Columbia	232 (2,500)	3.3 (7.3)	32 (7)	5.5	35.5 (1.4)	38.5 (8.5)	4	43 (1.7)	43 (9.5)	2.5	48.5 (1.9)	54.5 (12)	2	61 (2.4)
	465 (5,000)	4.0 (8.8)	38.5 (8.5)	13	43 (1.7)	45.5 (10)	10	51 (2)	54.5 (12)	6	61 (2.4)	68 (15)	5	76 (3)
	697 (7,500)	4.5 (9.9)	43 (9.5)	22	48.5 (1.9)	50 (11)	16	56 (2.2)	59 (13)	10	66 (2.6)	75 (16.5)	8	84 (3.3)
	929 (10,000)	4.7 (10.4)	45.5 (10)	30	51 (2)	54.5 (12)	23	61 (2.4)	63.5 (14)	14	71 (2.8)	79.5 (17.5)	12	89 (3.5)
Brandon, Manitoba	232 (2,500)	5.9 (13)	57 (12.5)	8	63.5 (2.5)	68 (15)	7	76 (3)	82 (18)	4.5	91.5 (3.6)	95.5 (21)	3.5	106.5 (4.2)
	465 (5,000)	7.3 (16.1)	73 (16)	20	81.5 (3.2)	84 (18.5)	17	94 (3.7)	97.5 (21.5)	11	109 (4.3)	113.5 (25)	8.5	127 (5)
	697 (7,500)	8.3 (18.2)	79.5 (17.5)	32	89 (3.5)	93 (20.5)	27	104 (4.1)	107 (23.5)	19	119.5 (4.7)	125 (27.5)	15	139.5 (5.5)
	929 (10,000)	9.0 (19.8)	86.5 (19)	43	96.5 (3.8)	100 (22)	38	112 (4.4)	113.5 (25)	26	127 (5.0)	132 (29)	21	147.5 (5.8)
Winnipeg, Manitoba	232 (2,500)	4.7 (10.4)	45.5 (10)	7	51 (2)	57 (12.5)	6	63.5 (2.5)	75 (16.5)	4	84 (3.3)	86.5 (19)	3.2	96.5 (3.8)
	465 (5,000)	5.9 (13)	57 (12.5)	17	63.5 (2.5)	68 (15)	15	76 (3)	84 (18.5)	10	94 (3.7)	100 (22)	7.5	112 (4.4)
	697 (7,500)	6.6 (14.5)	63.5 (14)	28	71 (2.8)	75 (16.5)	24	84 (3.3)	93 (20.5)	16	104 (4.1)	107 (23.5)	12	119.5 (4.7)
	929 (10,000)	7.1 (15.6)	68 (15)	39	76 (3)	82 (18)	32	91.5 (3.6)	97.5 (21.5)	22	109 (4.3)	113.5 (25)	17	127 (5.0)
Campbellton, New Brunswick	232 (2,500)	6.4 (14)	62 (13.5)	9	68.5 (2.7)	70.5 (15.5)	7	78.5 (3.1)	79.5 (17.5)	4.5	89 (3.5)	91 (20)	3.5	101.5 (4.0)
	465 (5,000)	9.0 (19.8)	86.5 (19)	22	96.5 (3.8)	91 (20)	18	101.5 (4)	102.5 (22.5)	12	115 (4.5)	113.5 (25)	9	127 (5.0)
	697 (7,500)	10.4 (22.9)	100 (22)	35	112 (4.4)	102.5 (22.5)	28	114.5 (4.5)	118 (26)	20	132 (5.2)	132 (29)	15	147.5 (5.8)
	929 (10,000)	11.3 (25)	109 (24)	47	122 (4.8)	111.5 (24.5)	40	124.5 (4.9)	127.5 (28)	29	142 (5.6)	141 (31)	22	157.5 (6.2)

LOCATION	SQUARE METRE (SQUARE FOOT) NOTCH AREA RATING	ROOF LOAD FACTOR KGS (LBS.)	TOTAL ROOF SLOPE: DEAD LEVEL L.P.M. (G.P.M.) Discharge	Draindown Time Hrs.	mm (In.) Water Depth	51mm (2") RISE L.P.M. (G.P.M.) Discharge	Draindown Time Hrs.	mm (In.) Water Depth	102mm (4") RISE L.P.M. (G.P.M.) Discharge	Draindown Time Hrs.	mm (In.) Water Depth	152mm (6") RISE L.P.M. (G.P.M.) Discharge	Draindown Time Hrs.	mm (In.) Water Depth
Chatham, New Brunswick	232 (2,500)	4.5 (9.9)	43 (9.5)	7	48.5 (1.9)	52.5 (11.5)	5.5	58.5 (2.3)	63.5 (14)	3.5	71 (2.8)	77.5 (17)	2.9	86.5 (3.4)
	465 (5,000)	5.7 (12.5)	54.5 (12)	16	61 (2.4)	63.5 (14)	13	71 (2.8)	77.5 (17)	9	86.5 (3.4)	91 (20)	7	101.5 (4.0)
	697 (7,500)	6.4 (14)	61.5 (13.5)	27	68.5 (2.7)	68 (15)	22	76 (3)	84 (18.5)	14	94 (3.7)	102.5 (22.5)	12	114.5 (4.5)
	929 (10,000)	6.6 (14.6)	63.5 (14)	37	71 (2.8)	75 (16.5)	30	84 (3.3)	91 (20)	20	101.5 (4.0)	107 (23.5)	16	119.5 (4.7)
Moncton, New Brunswick	232 (2,500)	4.3 (9.4)	41 (9)	7	45.5 (1.8)	54.5 (12)	6	61 (2.4)	63.5 (14)	3.5	71 (2.8)	72.5 (16)	2.7	81.5 (3.2)
	465 (5,000)	5.9 (13)	57 (12.5)	17	63.5 (2.5)	68 (15)	14	76 (3)	82 (18)	9	91.5 (3.6)	93 (20.5)	7	104 (4.1)
	697 (7,500)	6.6 (14.6)	63.5 (14)	28	71 (2.8)	79.5 (17.5)	24	89 (3.5)	93 (20.5)	16	104 (4.1)	104.5 (23)	12	117 (4.6)
	929 (10,000)	7.5 (16.6)	72.5 (16)	39	81.5 (3.2)	84 (18.5)	34	94 (3.7)	100 (22)	23	112 (4.4)	113.5 (25)	17	127 (5.0)
Saint John, New Brunswick	232 (2,500)	5.7 (12.5)	54.5 (12)	8	61 (2.4)	57 (12.5)	6	63.5 (2.5)	75 (16.5)	4	84 (3.3)	86.5 (19)	3	96.5 (3.8)
	465 (5,000)	7.5 (16.6)	72.5 (16)	20	81.5 (3.2)	79.5 (17.5)	16	89 (3.5)	95.5 (21)	11	106.5 (4.2)	104.5 (23)	8	117 (4.6)
	697 (7,500)	8.7 (19.2)	84 (18.5)	32	94 (3.7)	93 (20.5)	27	104 (4.1)	107 (23.5)	19	119.5 (4.7)	118 (26)	13.5	132 (5.2)
	929 (10,000)	9.7 (21.3)	93 (20.5)	44	104 (4.1)	104.5 (23)	38	117 (4.6)	113.5 (25)	27	127 (5.0)	127.5 (28)	20	142 (5.6)
Gander, Newfoundland	232 (2,500)	3.5 (7.8)	34 (7.5)	5.5	38 (1.5)	45.5 (10)	5	51 (2.0)	57 (12.5)	3.5	63.5 (2.5)	68 (15)	2.5	76 (3.0)
	465 (5,000)	4.7 (10.4)	45.5 (10)	15	51 (2.0)	57 (12.5)	12	63.5 (2.5)	72.5 (16)	8	81.5 (3.2)	82 (18)	6.5	91.5 (3.6)
	697 (7,500)	5.7 (12.5)	54.5 (12)	25	61 (2.4)	63.5 (14)	21	71 (2.8)	79.5 (17.5)	13.5	89 (3.5)	93 (20.5)	11	104 (4.1)
	929 (10,000)	6.1 (13.5)	59 (13)	35	66 (2.6)	70.5 (15.5)	29	78.5 (3.1)	84 (18.5)	19	94 (3.7)	100 (22)	15	112 (4.4)
St. Andrews, Newfoundland	232 (2,500)	3.5 (7.8)	34 (7.5)	5.5	38 (1.5)	45.5 (10)	5	51 (2.0)	59 (13)	3.5	66 (2.6)	63.5 (14)	2.5	71 (2.8)
	465 (5,000)	5.2 (11.4)	47.5 (10.5)	15	53.5 (2.1)	59 (13)	13	66 (2.6)	72.5 (16)	8	81.5 (3.2)	79.5 (17.5)	6	89 (3.5)
	697 (7,500)	5.9 (13)	57 (12.5)	26	63.5 (2.5)	66 (14.5)	21	73.5 (2.9)	82 (18)	14	91.5 (3.6)	88.5 (19.5)	10	99 (3.9)
	929 (10,000)	6.6 (14.6)	63.5 (14)	36	71 (2.8)	72.5 (16)	30	81.5 (3.2)	86.5 (19)	20	96.5 (3.8)	95.5 (21)	14.5	106.5 (4.2)
St. John's, Newfoundland	232 (2,500)	5.9 (13)	57 (12.5)	8	63.5 (2.5)	68 (15)	7	76 (3.0)	77.5 (17)	4.5	86.5 (3.4)	86.5 (19)	3.2	96.5 (3.8)
	465 (5,000)	8.5 (18.7)	82 (18)	21	91.5 (3.6)	91 (20)	18	101 (4.0)	100 (22)	11	112 (4.4)	113.5 (25)	9	127 (5.0)
	697 (7,500)	10.6 (23.4)	102.5 (22.5)	34	114.5 (4.5)	109 (24)	29	122 (4.8)	122.5 (27)	21	137 (5.4)	132 (29)	15	147.5 (5.8)
	929 (10,000)	11.8 (26)	113.5 (25)	48	127 (5.0)	129.5 (28.5)	43	145 (5.7)	143 (31.5)	33	160 (6.3)	150 (33)	24	167.5 (6.6)
Torbay, Newfoundland	232 (2,500)	4.9 (10.9)	47.5 (10.5)	7.5	53.5 (2.1)	61.5 (13.5)	6.5	68.5 (2.7)	75 (16.5)	4	84 (3.3)	84 (18.5)	3	94 (3.7)
	465 (5,000)	6.4 (14)	61.5 (13.5)	18	68.5 (2.7)	75 (16.5)	15.5	84 (3.3)	88.5 (19.5)	10	99 (3.9)	102.5 (22.5)	8	114.5 (4.5)
	697 (7,500)	7.3 (16.1)	70.5 (15.5)	29	78.5 (3.1)	84 (18.5)	25	94 (3.7)	100 (22)	17.5	112 (4.4)	113.5 (25)	13	127 (5)
	929 (10,000)	8.0 (17.7)	77.5 (17)	40	86.5 (3.4)	88.5 (19.5)	34	99 (3.9)	107 (23.5)	24	119.5 (4.7)	122.5 (27)	19	137 (5.4)
Halifax, Nova Scotia	232 (2,500)	5.9 (13)	57 (12.5)	8	63.5 (2.5)	68 (15)	7	76 (3.0)	77.5 (17)	4.5	86.5 (3.4)	86.5 (19)	3.2	96.5 (3.8)
	465 (5,000)	8.5 (18.7)	82 (18)	21	91.5 (3.6)	91 (20)	18	101.5 (4.0)	100 (22)	11	112 (4.4)	113.5 (25)	9	127 (5.0)
	697 (7,500)	10.6 (23.4)	102.5 (22.5)	34	114.5 (4.5)	109 (24)	29	122 (4.8)	122.5 (27)	21	137 (5.4)	132 (29)	15	147.5 (5.8)
	929 (10,000)	11.8 (26)	113.5 (25)	48	127 (5.0)	129.5 (28.5)	43	145 (5.7)	143 (31.5)	33	160 (6.3)	150 (33)	24	167.5 (6.6)

LOCATION	SQUARE METRE (SQUARE FOOT) NOTCH AREA RATING	ROOF LOAD FACTOR KGS (LBS.)	TOTAL ROOF SLOPE: DEAD LEVEL L.P.M. (G.P.M.) Discharge	DEAD LEVEL Draindown Time Hrs.	DEAD LEVEL mm (In.) Water Depth	51mm (2") RISE L.P.M. (G.P.M.) Discharge	51mm (2") RISE Draindown Time Hrs.	51mm (2") RISE mm (In.) Water Depth	102mm (4") RISE L.P.M. (G.P.M.) Discharge	102mm (4") RISE Draindown Time Hrs.	102mm (4") RISE mm (In.) Water Depth	152mm (6") RISE L.P.M. (G.P.M.) Discharge	152mm (6") RISE Draindown Time Hrs.	152mm (6") RISE mm (In.) Water Depth
Sydney, Nova Scotia	232 (2,500)	4.3 (9.4)	41 (9)	6.5	45.5 (1.8)	45.5 (10)	5	51 (2.0)	57 (12.5)	3.5	63.5 (2.5)	68 (15)	2.5	76 (3.0)
	465 (5,000)	5.7 (12.5)	54.5 (12)	16	61 (2.4)	59 (13)	13	66 (2.6)	75 (16.5)	8	84 (3.3)	84 (18.5)	6.5	94 (3.7)
	697 (7,500)	6.4 (14)	61.5 (13.5)	28	68.5 (2.7)	68 (15)	22	76 (3.0)	84 (18.5)	14	94 (3.7)	97.5 (21.5)	11	109 (4.3)
	929 (10,000)	7.1 (15.6)	68 (15)	38	76 (3.0)	75 (16.5)	30	84 (3.3)	91 (20)	20	101.5 (4.0)	104.5 (23)	16	117 (4.6)
Yarmouth, Nova Scotia	232 (2,500)	6.4 (14)	61.5 (13.5)	9	68.5 (2.7)	70.5 (15.5)	7.5	78.5 (3.1)	82 (18)	4.5	91.5 (3.6)	91 (20)	3.5	101.5 (4.0)
	465 (5,000)	8.3 (18.2)	79.5 (17.5)	21	89 (3.5)	88.5 (19.5)	18	99 (3.9)	104.5 (23)	12	117 (4.6)	116 (25.5)	9	129.5 (5.1)
	697 (7,500)	9.4 (20.8)	91 (20)	34	101.5 (4.0)	102.5 (22.5)	29	114.5 (4.5)	118 (26)	21	132 (5.2)	132 (29)	15	147.5 (5.8)
	929 (10,000)	10.4 (22.9)	100 (22)	45	112 (4.4)	109 (24)	41	122 (4.8)	129.5 (28.5)	29	145 (5.7)	141 (31)	22	157.5 (6.2)
Thunder Bay, Ontario	232 (2,500)	4.9 (10.9)	47.5 (10.5)	7.5	53.5 (2.1)	61.5 (13.5)	6.5	68.5 (2.7)	75 (16.5)	4	84 (3.3)	88.5 (19.5)	3.5	91.5 (3.6)
	465 (5,000)	6.1 (13.5)	59 (13)	18	66 (2.6)	72.5 (16)	15	81.5 (3.2)	86.5 (19)	9.5	96.5 (3.8)	102.5 (22.5)	7.5	114.5 (4.5)
	697 (7,500)	6.6 (14.6)	63.5 (14)	28	71 (2.8)	77.5 (17)	24	86.5 (3.4)	93 (20.5)	16	104 (4.1)	109 (24)	13	122 (4.8)
	929 (10,000)	7.1 (15.6)	68 (15)	38	76 (3.0)	84 (18.5)	33	94 (3.7)	97.5 (21.5)	22	109 (4.3)	116 (25.5)	18	129.5 (5.1)
Guelph, Ontario	232 (2,500)	5.7 (12.5)	54.5 (12)	8	61 (2.4)	63.5 (14)	7	71 (2.8)	86.5 (19)	5	96.5 (3.8)	100 (22)	3.7	112 (4.4)
	465 (5,000)	6.6 (14.6)	63.5 (14)	19	71 (2.8)	75 (16.5)	15.5	84 (3.3)	97.5 (21.5)	11	109 (4.3)	116 (25.5)	9	129.5 (5.1)
	697 (7,500)	7.3 (16.1)	70.5 (15.5)	29	78.5 (3.1)	82 (18)	25	91.5 (3.6)	104.5 (23)	18	117 (4.6)	125 (27.5)	14	139.5 (5.5)
	929 (10,000)	8.0 (17.7)	77.5 (17)	40	86.5 (3.4)	84 (18.5)	34	94 (3.7)	109 (24)	26	122 (4.8)	132 (29)	20	147.5 (5.8)
Hamilton, Ontario	232 (2,500)	5.9 (13)	57 (12.5)	8.5	63.5 (2.5)	72.5 (16)	7.5	81.5 (3.2)	93 (20.5)	5	104 (4.1)	109 (24)	4	122 (4.8)
	465 (5,000)	6.6 (14.6)	63.5 (14)	19	71 (2.8)	79.5 (17.5)	16	89 (3.5)	104.5 (23)	12	117 (4.6)	122.5 (27)	9	137 (5.4)
	697 (7,500)	6.8 (15.1)	66 (14.5)	28	73.5 (2.9)	84 (18.5)	26	94 (3.7)	111.5 (24.5)	20	124.5 (4.9)	127.5 (28)	15	142 (5.6)
	929 (10,000)	7.1 (15.6)	68 (15)	39	76 (3.0)	86.5 (19)	34	96.5 (3.8)	116 (25.5)	27	129.5 (5.1)	134 (29.5)	21	150 (5.9)
Kingston, Ontario	232 (2,500)	6.4 (14)	61.5 (13.5)	9	68.5 (2.7)	77.5 (17)	8	86.5 (3.4)	91 (20)	5	101.5 (4.0)	109 (24)	4	122 (4.8)
	465 (5,000)	7.5 (16.6)	72.5 (16)	20	81.5 (3.2)	86.5 (19)	18	96.5 (3.8)	104.5 (23)	12	117 (4.6)	122.5 (27)	9.5	137 (5.4)
	697 (7,500)	8.5 (18.7)	82 (18)	31	91.5 (3.6)	93 (20.5)	28	104 (4.1)	111.5 (24.5)	20	124.5 (4.9)	132 (29)	15	147.5 (5.8)
	929 (10,000)	8.7 (19.2)	86.5 (19)	42	96.5 (3.8)	97.5 (21.5)	38	109 (4.3)	116 (25.5)	27	129.5 (5.1)	68 (15)	21	152.5 (6.0)
London, Ontario	232 (2,500)	6.1 (13.5)	59 (13)	8.5	66 (2.6)	72.5 (16)	7.5	81.5 (3.2)	88.5 (19.5)	5	99 (3.9)	107 (23.5)	4	119.5 (4.7)
	465 (5,000)	7.1 (15.6)	68 (15)	20	76 (3.0)	84 (18.5)	17	94 (3.7)	102.5 (22.5)	12	114.5 (4.5)	122.5 (27)	9.5	137 (5.4)
	697 (7,500)	8.0 (17.7)	77.5 (17)	30	86.5 (3.4)	88.5 (19.5)	27	99 (3.9)	109 (24)	19	122 (4.8)	129.5 (28.5)	15	145 (5.7)
	929 (10,000)	8.5 (18.7)	82 (18)	41	91.5 (3.6)	91 (20)	36	101.5 (4.0)	113.5 (25)	27	127 (5.0)	134 (29.5)	21	150 (5.9)
North Bay, Ontario	232 (2,500)	5.7 (12.5)	54.5 (12)	8	61 (2.4)	68 (15)	7	76 (3.0)	86.5 (19)	5	96.5 (3.8)	100 (22)	3.8	112 (4.4)
	465 (5,000)	6.6 (14.6)	63.5 (14)	19	71 (2.8)	79.5 (17.5)	16	89 (3.5)	97.5 (21.5)	11	109 (4.3)	113.5 (25)	9	127 (5.0)
	697 (7,500)	7.5 (16.6)	72.5 (16)	30	81.5 (3.2)	86.5 (19)	26	96.5 (3.8)	107 (23.5)	19	119.5 (4.7)	122.5 (27)	14	137 (5.4)
	929 (10,000)	8.3 (18.2)	77.5 (17)	40	86.5 (3.4)	93 (20.5)	36	104 (4.1)	111.5 (24.5)	26	124.5 (4.9)	127.5 (28)	20	142 (5.6)
Ottawa, Ontario	232 (2,500)	4.7 (10.4)	45.5 (10)	7	51 (2.0)	59 (13)	6.5	66 (2.6)	77.5 (17)	4.5	86.5 (3.4)	86.5 (19)	3.2	96.5 (3.8)
	465 (5,000)	5.9 (13)	57 (12.5)	17	63.5 (2.5)	68 (15)	14	76 (3.0)	86.5 (19)	10	96.5 (3.8)	100 (22)	7.5	112 (4.4)
	697 (7,500)	6.4 (14)	61.5 (13.5)	27	68.5 (2.7)	75 (16.5)	23	84 (3.3)	93 (20.5)	16	104 (4.1)	107 (23.5)	12	119.5 (4.7)
	929 (10,000)	6.6 (14.6)	63.5 (14)	36	71 (2.8)	79.5 (17.5)	32	89 (3.5)	97.5 (21.5)	22	109 (4.3)	113.5 (25)	18	127 (5.0)

LOCATION	SQUARE METRE (SQUARE FOOT) NOTCH AREA RATING	ROOF LOAD FACTOR KGS (LBS.)	TOTAL ROOF SLOPE: DEAD-LEVEL			51mm (2") RISE			102mm (4") RISE			152mm (6") RISE		
			L.P.M. (G.P.M.) Discharge	Draindown Time Hrs.	mm (In.) Water Depth	L.P.M. (G.P.M.) Discharge	Draindown Time Hrs.	mm (In.) Water Depth	L.P.M. (G.P.M.) Discharge	Draindown Time Hrs.	mm (In.) Water Depth	L.P.M. (G.P.M.) Discharge	Draindown Time Hrs.	mm (In.) Water Depth
St. Thomas, Ontario	232 (2,500)	5.7 (12.5)	54.5 (12)	8	61 (2.4)	68 (15)	7	76 (3.0)	86.5 (19)	5	96.5 (3.8)	104.5 (23)	4	117 (4.6)
	465 (5,000)	6.6 (14.6)	63.5 (14)	19	71 (2.8)	77.5 (17)	16	86.5 (3.4)	97.5 (21.5)	11	109 (4.3)	118 (26)	9	132 (5.2)
	697 (7,500)	7.1 (15.6)	68 (15)	29	76 (3.0)	82 (18)	26	91.5 (3.6)	102.5 (22.5)	18	114.5 (4.5)	125 (27.5)	15	139.5 (5.5)
	929 (10,000)	7.5 (16.6)	72.5 (16)	40	81.5 (3.2)	86.5 (19)	34	96.5 (3.8)	107 (23.5)	24	119.5 (4.7)	132 (29)	20	147.5 (5.8)
Timmins, Ontario	232 (2,500)	4.3 (9.4)	41 (9)	7	45.5 (1.8)	57 (12.5)	6	63.5 (2.5)	72.5 (16)	4	81.5 (3.2)	86.5 (19)	3.3	96.5 (3.8)
	465 (5,000)	5.7 (12.5)	54.5 (12)	16	61 (2.4)	63.5 (14)	14	71 (2.8)	82 (18)	9	91.5 (3.6)	97.5 (21.5)	7.5	109 (4.3)
	697 (7,500)	6.4 (14)	61.5 (13.5)	27	68.5 (2.7)	70.5 (15.5)	22	78.5 (3.1)	86.5 (19)	15	96.5 (3.8)	104.5 (23)	12	117 (4.6)
	929 (10,000)	6.6 (14.6)	63.5 (14)	36	71 (2.8)	72.5 (16)	30	81.5 (3.2)	91 (20)	21	101.5 (4.0)	109 (24)	17	122 (4.8)
Toronto, Ontario	232 (2,500)	5.7 (12.5)	54.5 (12)	8	61 (2.4)	66 (14.5)	7	73.5 (2.9)	82 (18)	4.5	91.5 (3.6)	97.5 (21.5)	3.5	109 (4.3)
	465 (5,000)	6.8 (15.1)	66 (14.5)	19	73.5 (2.9)	77.5 (17)	16	86.5 (3.4)	93 (20.5)	11	104 (4.1)	111.5 (24.5)	9	124.5 (4.9)
	697 (7,500)	8.0 (17.7)	77.5 (17)	30	86.5 (3.4)	84 (18.5)	26	94 (3.7)	100 (22)	18	112 (4.4)	120.5 (26.5)	14	134.5 (5.3)
	929 (10,000)	8.7 (19.2)	82 (18)	42	91.5 (3.6)	86.5 (19)	34	96.5 (3.8)	104.5 (23)	24	117 (4.6)	127.5 (28)	20	142 (5.6)
Windsor, Ontario	232 (2,500)	6.1 (13.5)	59 (13)	8.5	66 (2.6)	70.5 (15.5)	7.5	78.5 (3.1)	84 (18.5)	4.5	94 (3.7)	107 (23.5)	4	119.5 (4.7)
	465 (5,000)	7.1 (15.6)	68 (15)	20	76 (3.0)	79.5 (17.5)	16	89 (3.5)	97.5 (21.5)	11	109 (4.3)	118 (26)	9	132 (5.2)
	697 (7,500)	8.0 (17.7)	77.5 (17)	30	86.5 (3.4)	86.5 (19)	26	96.5 (3.8)	107 (23.5)	18	119.5 (4.7)	125 (27.5)	15	139.5 (5.5)
	929 (10,000)	8.7 (19.2)	82 (18)	42	91.5 (3.6)	91 (20)	36	101.5 (4.0)	113.5 (25)	26	127 (5.0)	129.5 (28.5)	20	145 (5.7)
Charlottetown, P.E.I.	232 (2,500)	4.9 (10.9)	47.5 (10.5)	7.5	53.5 (2.1)	57 (12.5)	6	63.5 (2.5)	68 (15)	3.8	76 (3.0)	79.5 (17.5)	3	89 (3.5)
	465 (5,000)	6.6 (14.6)	63.5 (14)	19	71 (2.8)	75 (16.5)	15.5	84 (3.3)	88.5 (19.5)	10	99 (3.9)	100 (22)	7.5	112 (4.4)
	697 (7,500)	7.8 (17.2)	75 (16.5)	31	84 (3.3)	86.5 (19)	26	96.5 (3.8)	102.5 (22.5)	18	114.5 (4.5)	113.5 (25)	13	127 (5.0)
	929 (10,000)	8.7 (19.2)	84 (18.5)	42	94 (3.7)	97.5 (21.5)	37	106.5 (4.2)	111.5 (24.5)	26	124.5 (4.9)	125 (27.5)	20	139.5 (5.5)
Montreal, Quebec	232 (2,500)	5.2 (11.4)	50 (11)	7.5	56 (2.2)	61.5 (13.5)	7	68.5 (2.7)	79.5 (17.5)	4.5	89 (3.5)	97.5 (21.5)	3.5	109 (4.3)
	465 (5,000)	5.9 (13)	57 (12.5)	17	63.5 (2.5)	70.5 (15.5)	15	78.5 (3.1)	88.5 (19.5)	10	99 (3.9)	109 (24)	8	122 (4.8)
	697 (7,500)	6.1 (13.5)	59 (13)	27	66 (2.6)	72.5 (16)	23	81.5 (3.2)	93 (20.5)	16	104 (4.1)	113.5 (25)	13	127 (5.0)
	929 (10,000)	6.4 (14)	61.5 (13.5)	36	68.5 (2.7)	77.5 (17)	31	86.5 (3.4)	95.5 (21)	22	106.5 (4.2)	120.5 (26.5)	19	134.5 (5.3)
Quebec City, Quebec	232 (2,500)	5.4 (12)	52.5 (11.5)	8	58.5 (2.3)	63.5 (14)	7	71 (2.8)	79.5 (17.5)	4.5	89 (3.5)	97.5 (21.5)	3.5	109 (4.3)
	465 (5,000)	6.4 (14)	61.5 (13.5)	18	68.5 (2.7)	70.5 (15.5)	15	78.5 (3.1)	84 (18.5)	10	94 (3.7)	104.5 (23)	8	117 (4.6)
	697 (7,500)	6.6 (14.6)	63.5 (14)	28	71 (2.8)	72.5 (16)	23	81.5 (3.2)	86.5 (19)	15	96.5 (3.8)	107 (23.5)	12	119.5 (4.7)
	929 (10,000)	7.1 (15.6)	68 (15)	37	76 (3.0)	77.5 (17)	31	86.5 (3.4)	88.5 (19.5)	20	99 (3.9)	109 (24)	17	122 (4.8)
Regina, Saskatchewan	232 (2,500)	4.5 (9.9)	43 (9.5)	7	48.5 (1.9)	54.5 (12)	6	61 (2.4)	72.5 (16)	4	81.5 (3.2)	79.5 (17.5)	3	89 (3.5)
	465 (5,000)	6.4 (14)	61.5 (13.5)	18	68.5 (2.7)	68 (15)	14	76 (3.0)	86.5 (19)	10	96.5 (3.8)	97.5 (21.5)	7.5	109 (4.3)
	697 (7,500)	7.3 (16.1)	70.5 (15.5)	29	78.5 (3.1)	77.5 (17)	24	86.5 (3.4)	100 (22)	17	112 (4.4)	109 (24)	12	122 (4.8)
	929 (10,000)	8.3 (18.2)	79.5 (17.5)	40	89 (3.5)	82 (18)	32	91.5 (3.6)	104.5 (23)	24	117 (4.6)	118 (26)	18	132 (5.2)
Saskatoon, Saskatchewan	232 (2,500)	4.0 (8.8)	38.5 (8.5)	6	43 (1.7)	57 (12.5)	6	63.5 (2.5)	66 (14.5)	3.8	73.5 (2.9)	77.5 (17)	2.8	86.5 (3.4)
	465 (5,000)	5.7 (12.5)	54.5 (12)	16	61 (2.4)	68 (15)	14.5	76 (3.0)	82 (18)	9	91.5 (3.6)	95.5 (21)	7	106.5 (4.2)
	697 (7,500)	6.6 (14.6)	63.5 (14)	28	71 (2.8)	75 (16.5)	24	84 (3.3)	91 (20)	16	101.5 (4.0)	104.5 (23)	12	117 (4.6)
	929 (10,000)	7.1 (15.6)	68 (15)	38	76 (3.0)	82 (18)	32	91.5 (3.6)	97.5 (21.5)	22	109 (4.3)	113.5 (25)	18	127 (5.0)

ZURN Control-Flo Roof Drains

the most advanced drainage control available, lets you design roof drainage systems with confidence

Check These ZURN Engineered Features

Large 955cm²(148 Square-Inch) Open Area Dome permits unobstructed flow. Dome is made of lightweight, shock-resistant aluminum and is bayonet-locked to gravel guard on weir. Aluminum Dome supplied when specified. Poly-Dome supplied standard.

Multi-weir Barrier provides flow rates directly proportional to the head. Available with 1 to 6 inverted parabolic notches to meet varying requirements.

Gravel

Insulation

Waterproofing Membrane

Metal Roof Deck

Extension Sleeve Accommodates the Addition of Insulation to a roof deck. Height as required by thickness of insulation.

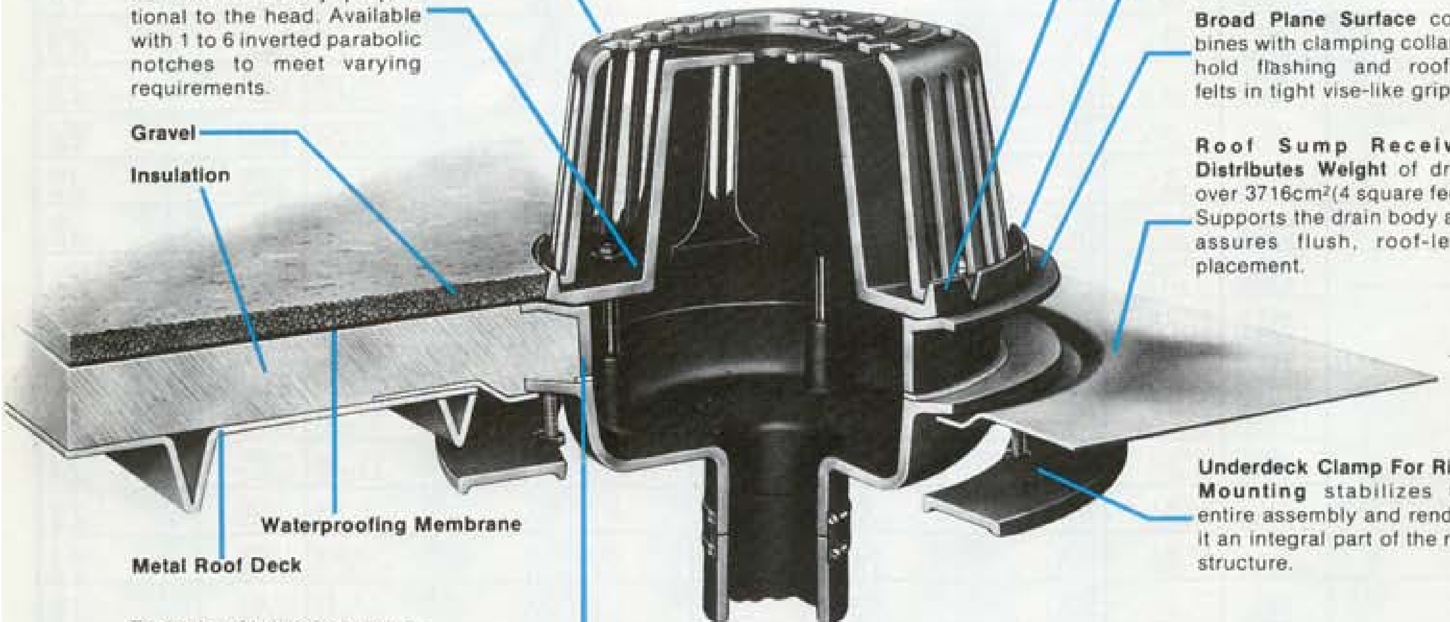
Integral Clamping-Collar at bottom of weir provides positive clamping action without puncturing roof or flashing. Also provides integral gravel guard.

Bayonet-type Locking Device on dome holds dome firmly in place with weir yet allows dome to be easily removed.

Broad Plane Surface combines with clamping collar to hold flashing and roofing felts in tight vise-like grip.

Roof Sump Receiver Distributes Weight of drain over 3716cm²(4 square feet). Supports the drain body and assures flush, roof-level placement.

Underdeck Clamp For Rigid Mounting stabilizes the entire assembly and renders it an integral part of the roof structure.



Threaded, caulk, M. J. connections available. (Z-105-5-ERC w/Aluminum dome illustrated.)

ZURN

ZURN DRAINAGE AND CONTROL SYSTEMS LTD.

Telephone: (416) 741-8260 Fax: (416) 741-7477

Appendix D7

SWMHYMO Results

Pipe Storage	FROM	TO	Inner Diameter (m)	Length (m)	Volume (m3)	U/S OBV	U/S INV	D/S OBV	D/S INV	H
1050 mm dia. ST	MH 520	MH 530	1.067	28.2	25.22	104.36	103.29	104.32	103.25	1.11
1050 mm dia. ST	MH 511	MH 520	1.067	24.4	21.82	104.69	103.62	104.52	103.45	1.24
1050 mm dia. ST	MH 510	MH 511	1.067	23.5	21.01	104.86	103.79	104.69	103.62	1.24
750 mm dia. ST	CBMH 510	MH 511	0.762	29.6	13.50	105.26	104.50	104.98	104.22	1.04
200 mm dia. ST	CB 509	CBMH 510	0.250	29.4	1.44	105.60	105.35	105.30	105.05	0.55
200 mm dia. ST	CB 508	CBMH 510	0.200	14.5	0.46	105.29	105.09	105.14	104.94	0.35
200 mm dia. ST	CB 519	CB 520	0.200	8.5	0.27	104.88	104.68	104.79	104.59	0.29
200 mm dia. ST	CB 520	CBMH 522	0.200	21.7	0.68	104.76	104.56	104.54	104.34	0.42
200 mm dia. ST	CB 521	CBMH 522	0.200	12.3	0.39	105.05	104.85	104.93	104.73	0.32
250 mm dia. ST	CBMH 522	MH 520	0.250	20.3	1.00	104.56	104.31	104.36	104.11	0.45
150 mm dia. ST	BLDG A	MH 510	0.150	4.6	0.08	105.85	105.70	105.71	105.56	0.29
150 mm dia. ST	BLDG E	MH 520	0.150	7.0	0.12	105.52	105.37	105.21	105.06	0.46
200 mm dia. ST	CB 530	CB 531	0.200	10.5	0.33	104.22	104.02	104.12	103.92	0.30
250 mm dia. ST	CB 531	1200 ST	0.250	21.8	1.07	104.12	103.87	103.90	103.65	0.47
200 mm dia. ST	CB 541	CB 540	0.200	10.5	0.33	104.27	104.07	104.16	103.96	0.31
250 mm dia. ST	CB 540	1200 ST	0.250	11.7	0.57	104.16	103.91	104.04	103.79	0.37

MH / CB Storage	Inner Diameter / Width (m)	Area (m2)	1:100 yr WL or T/G	LOWER INV	H	Volume (m3)
MH 530	1.829	2.6273	107.20	103.03	4.17	10.96
MH 520	1.829	2.6273	107.20	103.29	3.91	10.27
MH 511	2.438	4.6683	107.20	103.62	3.58	16.71
MH 510	1.829	2.6273	107.20	103.79	3.41	8.96
CBMH 510	1.524	1.8241	107.20	104.50	2.70	4.93
CBMH 522	1.219	1.1671	106.97	104.31	2.66	3.10
CB 519	0.610	0.3721	107.20	104.68	2.52	0.94
CB 520	0.610	0.3721	107.20	104.56	2.64	0.98
CB 521	0.610	0.3721	107.05	104.85	2.20	0.82
CB 530	0.610	0.3721	107.00	104.02	2.98	1.11
CB 531	0.610	0.3721	107.05	103.87	3.18	1.18
CB 541	0.610	0.3721	107.05	104.07	2.98	1.11
CB 540	0.610	0.3721	107.10	103.91	3.19	1.19

Elevation (m)	Head (m)	Underground Storage Volume (m3)											STO (ha-m)	Qout (cms)
		MH 530	1050 mm dia. ST (MH 520 - MH 530)	MH 520	1050 mm dia. ST (MH 511 - MH 520)	MH 511	1050 mm dia. ST (MH 510 - MH 511)	MH 510	750 mm dia. ST (CBMH 510 - MH 511)	CB / CBMH	CB Lead	Total U/G Volume		
103.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00000	0.0000
103.30	0.20	0.71	1.14	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.87	0.00019	0.0165
103.70	0.60	1.76	10.25	1.08	4.41	0.37	1.36	0.00	0.00	0.00	0.00	19.23	0.00192	0.0283
104.00	0.90	2.55	17.08	1.87	9.70	1.77	6.46	0.55	0.00	0.00	0.00	39.98	0.00400	0.0346
104.34	1.24	3.44	24.83	2.76	15.70	3.36	12.23	1.45	1.55	0.04	2.30	67.66	0.00677	0.0406
104.69	1.59	4.36	25.22	3.68	21.82	5.00	18.18	2.36	6.09	0.79	3.30	90.79	0.00908	0.0460
104.99	1.89	5.15	25.22	4.47	21.82	6.40	21.01	3.15	9.98	1.69	4.25	103.12	0.01031	0.0501
105.27	2.17	5.89	25.22	5.20	21.82	7.70	21.01	3.89	13.50	2.52	4.64	111.38	0.01114	0.0537
105.97	2.87	7.72	25.22	7.04	21.82	10.97	21.01	5.73	13.50	4.62	6.74	124.37	0.01244	0.0617
106.66	3.56	9.54	25.22	8.85	21.82	14.19	21.01	7.54	13.50	6.68	6.74	135.09	0.01351	0.0688
106.97	3.87	10.35	25.22	9.67	21.82	15.64	21.01	8.35	13.50	7.61	6.74	139.91	0.01399	0.0717
107.10	4.00	10.69	25.22	10.01	21.82	16.25	21.01	8.70	13.50	13.25	6.74	147.18	---	---
107.20	4.10	10.96	25.22	10.27	21.82	16.71	21.01	8.96	13.50	15.36	6.74	150.54	---	---

Surface Storage	Ponding Volume (m3)	1:100 yr WL	T/G	H
CBMH 522	25.18	107.20	106.97	0.23
CB 521	1.61	107.20	107.05	0.15
CB 530	23.57	107.20	107.00	0.20
CB 531	5.85	107.20	107.05	0.15
CB 541	3.38	107.20	107.05	0.15
CB 540	2.23	107.20	107.10	0.10

Elevation (m)	Above-ground Storage Volume (m3)									STO (ha-m)	Qout (cms)
	CBMH 522	CB 521	CB 530	CB 531	CB 541	CB 540	Surface	Underground	Total Volume		
107.10	14.23	0.54	11.78	1.95	1.13	0.00	29.63	147.18	176.81	0.01768	0.0729
107.20	25.18	1.61	23.57	5.85	3.38	2.23	61.82	150.54	212.36	0.02124	0.0738

```
2     Metric units
*#*****************************************************************************
*#  Project Name: [COMMERCIAL PLAZA 5100 KANATA]    Project Number: [23405-003]
*#  Date        : 11-08-2017
*#  Modeller    : [AW]
*#  Company     : J. L. Richards & Associates Limited
*#  License #   :  4418403
*#*****************************************************************************
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[100]
                     ["100yr3h.stm"]
*
READ STORM           STORM_FILENAME=["STORM.001"]
*%-----------------|-----------------------------------------------------------|
DESIGN STANDHYD      ID=[1], NHYD=["AREA1"], DT=[1]min, AREA=[0.688](ha),
                     XIMP=[0.86], TIMP=[0.86], DWF=[0](cms), LOSS=[2], CN=[98],
                     SLOPE=[1.5](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*%-----------------|-----------------------------------------------------------|
ROUTE RESERVOIR      IDout=[2],   NHYD=["STO-1"],  IDin=[1],
                     RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                       (cms) - (ha-m)
                                     [   0.0 ,  0.0 ]
                                    [0.0000, 0.00000]
                                    [0.0165, 0.00019]
                                    [0.0283, 0.00192]
                                    [0.0346, 0.00400]
                                    [0.0406, 0.00677]
                                    [0.0460, 0.00908]
                                    [0.0501, 0.01031]
                                    [0.0537, 0.01114]
                                    [0.0617, 0.01244]
                                    [0.0688, 0.01351]
                                    [0.0717, 0.01399]
                                    [0.0729, 0.01768]
                                    [0.0738, 0.02124]
                                     [   -1  ,  -1  ]  (max twenty pts)
                           IDovf=[3], NHYDovf=["OVF-1"]
*%-----------------|-----------------------------------------------------------|
PRINT HYD            ID=[3],   # OF PCYCLES=[1]
*%-----------------|-----------------------------------------------------------|
FINISH
```

```
================================================================================

  SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO        999    999    =========
  S      W W W  MM MM  H   H   Y Y   MM MM  O   O      9   9  9   9
  SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ##  9   9  9   9   Ver  4.05
      S   W W   M   M  H   H    Y    M   M  O   O       9999   9999   Sept 2011
  SSSSS   W W   M   M  H   H    Y    M   M   OOO           9      9   =========
                                                       9   9  9   9   # 4418403
       StormWater Management HYdrologic Model           999    999    =========

 *******************************************************************************
 ***************************** SWMHYMO Ver/4.05  ******************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                 OTTHYMO-83 and OTTHYMO-89.                  *********
 *******************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 *******************************************************************************

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: J. L. Richards & Associates Limited          +++++++++
 +++++++++                Ottawa                SERIAL#:4418403        +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 *******************************************************************************
 *********            ++++++ PROGRAM ARRAY DIMENSIONS ++++++           *********
 *********            Maximum value for ID numbers  :     10           *********
 *********            Max. number of rainfall points: 105408           *********
 *********            Max. number of flow points    : 105408           *********
 *******************************************************************************


 *********************  D E T A I L E D   O U T P U T  *********************
 *******************************************************************************
 *        DATE: 2018-05-02     TIME: 11:47:11     RUN COUNTER: 000272          *
 *******************************************************************************
 * Input   filename: C:\SWMHYMO\23405-~1\M1-100.dat                            *
 * Output  filename: C:\SWMHYMO\23405-~1\M1-100.out                            *
 * Summary filename: C:\SWMHYMO\23405-~1\M1-100.sum                            *
 * User comments:                                                              *
 * 1:__________________________________________________________________________*
 * 2:__________________________________________________________________________*
 * 3:__________________________________________________________________________*
 *******************************************************************************

---------------------------------------------------------------------------------
-
001:0001-------------------------------------------------------------------------
-
*#******************************************************************************
*#  Project Name: [COMMERCIAL PLAZA 5100 KANATA]    Project Number: [23405-003]
*#  Date        : 11-08-2017
*#  Modeller    : [AW]
*#  Company     : J. L. Richards & Associates Limited
*#  License #   :  4418403
*#******************************************************************************
  ** END OF RUN :  99

*******************************************************************************
```

```
--------------------
| START            |  Project  dir.: C:\SWMHYMO\23405-~1\

--------------------  Rainfall dir.: C:\SWMHYMO\23405-~1\

    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 100
    NSTORM=   1
           #  1=100yr3h.stm
--------------------------------------------------------------------------------------
-
100:0002------------------------------------------------------------------------------
-
*#*******************************************************************************
*#  Project Name: [COMMERCIAL PLAZA 5100 KANATA]    Project Number: [23405-003]
*#  Date        : 11-08-2017
*#  Modeller    : [AW]
*#  Company     : J. L. Richards & Associates Limited
*#  License #   :  4418403
*#*******************************************************************************
--------------------------------------------------------------------------------------
-
100:0002------------------------------------------------------------------------------
-
*
--------------------
| READ STORM       |    Filename: 100yr_3hr CHICAGO STORM - OTTAWA INT. AI
| Ptotal=  71.66 mm|    Comments: 100yr_3hr CHICAGO STORM - OTTAWA INT. AI
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   6.046 |   1.00 178.559 |   1.83  11.059 |   2.67   5.760
               .33   7.542 |   1.17  54.049 |   2.00   9.285 |   2.83   5.280
               .50  10.159 |   1.33  27.319 |   2.17   8.024 |   3.00   4.879
               .67  15.969 |   1.50  18.240 |   2.33   7.080 |
               .83  40.655 |   1.67  13.737 |   2.50   6.347 |

--------------------------------------------------------------------------------------
-
100:0003------------------------------------------------------------------------------
-
----------------------
| DESIGN STANDHYD    |   Area    (ha)=     .69
| 01:AREA1  DT= 1.00 |   Total Imp(%)=   86.00   Dir. Conn.(%)=   86.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .59          .10
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=       1.50         1.50
     Length            (m)=      67.73        40.00
     Mannings n           =       .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       174.11
                over (min)       1.00         8.00
     Storage Coeff.  (min)=       1.42 (ii)    7.58 (ii)
     Unit Hyd. Tpeak (min)=       1.00         8.00
     Unit Hyd. peak  (cms)=        .86          .15
                                                            *TOTALS*
```

```
     PEAK FLOW       (cms)=        .29          .03          .321 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.07         1.000
     RUNOFF VOLUME    (mm)=      70.86        65.34        70.091
     TOTAL RAINFALL   (mm)=      71.66        71.66        71.665
     RUNOFF COEFFICIENT   =        .99          .91          .978

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

----------------------------------------------------------------------------------
-
100:0004--------------------------------------------------------------------------
-
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(AREA1 )   |
| OUT<02:(STO-1 )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .050  .1031E-01
                            .000  .0000E+00   |     .054  .1114E-01
                            .016  .1900E-03   |     .062  .1244E-01
                            .028  .1920E-02   |     .069  .1351E-01
                            .035  .4000E-02   |     .072  .1399E-01
                            .041  .6770E-02   |     .073  .1768E-01
                            .046  .9080E-02   |     .074  .2124E-01

     ROUTING RESULTS            AREA     QPEAK     TPEAK       R.V.
     --------------------       (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (AREA1 )        .69      .321     1.000     70.091
     OUTFLOW<02: (STO-1 )        .69      .074     1.217     70.091
    OVERFLOW<03: (OVF-1 )        .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =         0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=       .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=       .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   22.981
                   TIME SHIFT OF PEAK FLOW         (min)=    13.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.2123E-01

----------------------------------------------------------------------------------
-
100:0005--------------------------------------------------------------------------
-
--------------------
| PRINT HYD        |   AREA      (ha)=     .000
| ID=03 (OVF-1 )   |   QPEAK    (cms)=     .000 (i)
| DT= 1.00 PCYC= 1 |   TPEAK    (hrs)=     .000
--------------------   VOLUME    (mm)=     .000

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
      *** WARNING: This hydrograph is dry.
----------------------------------------------------------------------------------
-
100:0006--------------------------------------------------------------------------
-
      FINISH
----------------------------------------------------------------------------------
```

```
-
*************************************************************************************
*
     WARNINGS / ERRORS / NOTES
     -------------------------
 100:0005 PRINT HYD
      *** WARNING: This hydrograph is dry.
   Simulation ended on 2018-05-02     at 11:47:12
=====================================================================================
=
```

Pipe Storage	FROM	TO	Inner Diameter (m)	Length (m)	Volume (m3)	U/S OBV	U/S INV	D/S OBV	D/S INV	H
600 mm dia. ST	CBMH 572	CBMH 573	0.610	55.6	16.25	104.96	104.35	104.40	103.79	1.17

CB Storage	Inner Diameter (m)	Area (m2)	1:100 yr WL or T/G	LOWER INV	H	Volume (m3)
CBMH 573	1.219	1.1671	107.25	103.76	3.49	4.07
CBMH 572	1.219	1.1671	106.95	104.35	2.60	3.03

Elevation (m)	Head (m)	Underground Storage Volume (m3)				STO (ha-m)	Qout (cms)
		CB 573	600 mm dia. ST (CBMH 572 - 573)	CB 572	Total U/G Volume		
103.78	0.00	0.00	0.00	0.00	0.00	0.00000	0.0000
104.20	0.42	0.51	5.69	0.00	6.21	0.00062	0.0013
104.60	0.82	0.98	11.25	0.29	12.52	0.00125	0.0019
105.00	1.22	1.45	16.25	0.76	18.45	0.00185	0.0023
105.50	1.72	2.03	16.25	1.34	19.62	0.00196	0.0027
105.95	2.17	2.56	16.25	1.87	20.67	0.00207	0.0030
106.95	3.17	3.72	16.25	3.03	23.01	0.00230	0.0036
107.25	3.47	4.07	16.25	3.03	23.36	---	---

Surface Storage	Ponding Volume (m3)	1:100 yr WL	T/G	H
CB 572	9.28	107.25	106.95	0.30

Elevation (m)	Above-ground Storage Volume (m3)				STO (ha-m)	Qout (cms)
	CB 572	Surface	Underground	Total Volume		
107.25	9.28	9.28	23.36	32.64	0.00326	0.0038

```
2     Metric units
*#*****************************************************************************
*#  Project Name: [COMMERCIAL PLAZA 5100 KANATA]    Project Number: [23405-003]
*#  Date        : 11-08-2017
*#  Modeller    : [AW]
*#  Company     : J. L. Richards & Associates Limited
*#  License #   :  4418403
*#*****************************************************************************
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[100]
                     ["100yr3h.stm"]
*
READ STORM           STORM_FILENAME=["STORM.001"]
*%-----------------|-----------------------------------------------------------|
DESIGN STANDHYD      ID=[1], NHYD=["AREA1"], DT=[1]min, AREA=[0.072](ha),
                     XIMP=[0.53], TIMP=[0.53], DWF=[0](cms), LOSS=[2], CN=[98],
                     SLOPE=[1.5](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*%-----------------|-----------------------------------------------------------|
ROUTE RESERVOIR      IDout=[2],   NHYD=["STO-1"],  IDin=[1],
                     RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                       (cms) - (ha-m)
                                     [   0.0 ,  0.0 ]
                                    [0.0000, 0.00000]
                                    [0.0013, 0.00062]
                                    [0.0019, 0.00125]
                                    [0.0023, 0.00185]
                                    [0.0027, 0.00196]
                                    [0.0030, 0.00207]
                                    [0.0036, 0.00230]
                                    [0.0038, 0.00326]
                                     [   -1  ,  -1  ]  (max twenty pts)
                           IDovf=[3], NHYDovf=["OVF-1"]
*%-----------------|-----------------------------------------------------------|
PRINT HYD            ID=[3],   # OF PCYCLES=[1]
*%-----------------|-----------------------------------------------------------|
FINISH
```

```
================================================================================

  SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999    999    =========
  S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9  9   9
  SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ## 9   9  9   9   Ver  4.05
      S   W W   M   M  H   H    Y    M   M  O   O      9999   9999   Sept 2011
  SSSSS   W W   M   M  H   H    Y    M   M   OOO          9      9   =========
                                                      9   9  9   9   # 4418403
       StormWater Management HYdrologic Model          999    999    =========

 *******************************************************************************
 ***************************** SWMHYMO Ver/4.05  ******************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors     *********
 *********                 OTTHYMO-83 and OTTHYMO-89.                  *********
 *******************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 *******************************************************************************

 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: J. L. Richards & Associates Limited         +++++++++
 +++++++++                Ottawa                SERIAL#:4418403       +++++++++
 +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 *******************************************************************************
 *********            ++++++ PROGRAM ARRAY DIMENSIONS ++++++          *********
 *********            Maximum value for ID numbers  :     10          *********
 *********            Max. number of rainfall points: 105408          *********
 *********            Max. number of flow points    : 105408          *********
 *******************************************************************************


 **********************   D E T A I L E D   O U T P U T   *********************
 *******************************************************************************
 *         DATE: 2018-03-21     TIME: 15:16:35     RUN COUNTER: 000268        *
 *******************************************************************************
 * Input   filename: C:\SWMHYMO\23405-~1\M2-100.dat                            *
 * Output  filename: C:\SWMHYMO\23405-~1\M2-100.out                            *
 * Summary filename: C:\SWMHYMO\23405-~1\M2-100.sum                            *
 * User comments:                                                              *
 * 1:__________________________________________________________________________*
 * 2:__________________________________________________________________________*
 * 3:__________________________________________________________________________*
 *******************************************************************************

--------------------------------------------------------------------------------
-
001:0001------------------------------------------------------------------------
-
*#******************************************************************************
*#  Project Name: [COMMERCIAL PLAZA 5100 KANATA]    Project Number: [23405-003]
*#  Date        : 11-08-2017
*#  Modeller    : [AW]
*#  Company     : J. L. Richards & Associates Limited
*#  License #   :  4418403
*#******************************************************************************
  ** END OF RUN :  99

******************************************************************************
```

```
--------------------
| START            |  Project  dir.: C:\SWMHYMO\23405-~1\

--------------------  Rainfall dir.: C:\SWMHYMO\23405-~1\

    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 100
    NSTORM=   1
           #  1=100yr3h.stm
--------------------------------------------------------------------------------
-
100:0002------------------------------------------------------------------------
-
*#****************************************************************************
*#  Project Name: [COMMERCIAL PLAZA 5100 KANATA]    Project Number: [23405-003]
*#  Date        : 11-08-2017
*#  Modeller    : [AW]
*#  Company     : J. L. Richards & Associates Limited
*#  License #   :  4418403
*#****************************************************************************
--------------------------------------------------------------------------------
-
100:0002------------------------------------------------------------------------
-
*
--------------------
| READ STORM       |    Filename: 100yr_3hr CHICAGO STORM - OTTAWA INT. AI
| Ptotal=  71.66 mm|    Comments: 100yr_3hr CHICAGO STORM - OTTAWA INT. AI
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   6.046 |   1.00 178.559 |   1.83  11.059 |   2.67   5.760
               .33   7.542 |   1.17  54.049 |   2.00   9.285 |   2.83   5.280
               .50  10.159 |   1.33  27.319 |   2.17   8.024 |   3.00   4.879
               .67  15.969 |   1.50  18.240 |   2.33   7.080 |
               .83  40.655 |   1.67  13.737 |   2.50   6.347 |

--------------------------------------------------------------------------------
-
100:0003------------------------------------------------------------------------
-
----------------------
| DESIGN STANDHYD    |   Area    (ha)=     .07
| 01:AREA1  DT= 1.00 |   Total Imp(%)=   53.00   Dir. Conn.(%)=   53.00
----------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .04          .03
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=       1.50         1.50
     Length            (m)=      21.91        40.00
     Mannings n          =        .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       174.62
                over (min)       1.00         7.00
     Storage Coeff.  (min)=        .72 (ii)    6.88 (ii)
     Unit Hyd. Tpeak (min)=       1.00         7.00
     Unit Hyd. peak  (cms)=       1.27          .16
                                                                *TOTALS*
```

```
     PEAK FLOW       (cms)=        .02          .01           .030 (iii)
     TIME TO PEAK    (hrs)=        .98         1.05          1.000
     RUNOFF VOLUME    (mm)=      70.86        65.34         68.267
     TOTAL RAINFALL   (mm)=      71.66        71.66         71.665
     RUNOFF COEFFICIENT   =        .99          .91           .953
      *** WARNING: Storage Coefficient is smaller than DT!
                   Use a smaller DT or a larger area.

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

----------------------------------------------------------------------------------
-
100:0004--------------------------------------------------------------------------
-
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(AREA1 )   |
| OUT<02:(STO-1 )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .003  .1960E-02
                            .000  .0000E+00   |     .003  .2070E-02
                            .001  .6200E-03   |     .004  .2300E-02
                            .002  .1250E-02   |     .004  .3260E-02
                            .002  .1850E-02   |     .000  .0000E+00

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (AREA1 )         .07      .030     1.000     68.267
     OUTFLOW<02: (STO-1 )         .07      .004     1.533     68.266
    OVERFLOW<03: (OVF-1 )         .00      .000      .000       .000

                   TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                   CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                   PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=   12.656
                   TIME SHIFT OF PEAK FLOW         (min)=    32.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=.3090E-02

----------------------------------------------------------------------------------
-
100:0005--------------------------------------------------------------------------
-
--------------------
| PRINT HYD        |   AREA       (ha)=     .000
| ID=03 (OVF-1 )   |   QPEAK     (cms)=     .000 (i)
| DT= 1.00 PCYC= 1 |   TPEAK     (hrs)=     .000
--------------------   VOLUME     (mm)=     .000

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
      *** WARNING: This hydrograph is dry.
----------------------------------------------------------------------------------
-
100:0006--------------------------------------------------------------------------
-
      FINISH
----------------------------------------------------------------------------------
```

```
-
*******************************************************************************
*
     WARNINGS / ERRORS / NOTES
     -------------------------
 100:0003 DESIGN STANDHYD
      *** WARNING: Storage Coefficient is smaller than DT!
                   Use a smaller DT or a larger area.
 100:0005 PRINT HYD
      *** WARNING: This hydrograph is dry.
   Simulation ended on 2018-03-21     at 15:16:36
===============================================================================
=
```

COMMERCIAL PLAZA - 5100 KANATA AVENUE
MODEL 3 - OUTFLOW-STORAGE RELATIONSHIP

Pipe Storage	FROM	TO	Inner Diameter (m)	Length (m)	Volume (m3)	U/S OBV	U/S INV	D/S OBV	D/S INV	H
975 mm dia. ST	CBMH 570	CBMH 571	0.991	40.0	30.85	104.90	103.91	104.50	103.51	1.39

CB Storage	Inner Diameter (m)	Area (m2)	T/G	LOWER INV	H	Volume (m3)
CBMH 571	1.829	2.6273	107.00	103.48	3.52	9.25
CBMH 570	1.829	2.6273	107.10	103.91	3.19	8.38

Elevation (m)	Head (m)	Underground Storage Volume (m3)				STO (ha-m)	Qout (cms)
		CBMH 571	975 mm dia. ST (CBMH 570 - 571)	CBMH 570	Total U/G Volume		
103.51	0.00	0.00	0.00	0.00	0.00	0.00000	0.0000
103.70	0.19	0.58	4.21	0.00	4.79	0.00048	0.0040
104.05	0.54	1.50	11.98	0.37	13.84	0.00138	0.0068
104.50	0.99	2.68	21.96	1.55	26.19	0.00262	0.0092
105.00	1.49	3.99	30.85	2.86	37.71	0.00377	0.0113
105.50	1.99	5.31	30.85	4.18	40.34	0.00403	0.0130
106.00	2.49	6.62	30.85	5.49	42.97	0.00430	0.0146
106.50	2.99	7.93	30.85	6.80	45.59	0.00456	0.0160
107.00	3.49	9.25	30.85	8.12	48.22	0.00482	0.0173
107.15	3.64	9.25	30.85	8.38	48.48	---	---
107.30	3.79	9.25	30.85	8.38	48.48	---	---

Surface Storage	Ponding Volume (m3)	1:100 yr WL	T/G	H
CBMH 571	71.97	107.30	107.00	0.30
CBMH 570	26.44	107.30	107.10	0.20

Elevation (m)	Above-ground Storage Volume (m3)					STO (ha-m)	Qout (cms)
	CBMH 571	CBMH 570	Surface	Underground	Total Volume		
107.15	35.985	6.61	42.595	48.48	91.08	0.00911	0.0176
107.30	71.97	26.44	98.41	48.48	146.89	0.01469	0.0180

```
2     Metric units
*#*****************************************************************************
*#  Project Name: [COMMERCIAL PLAZA 5100 KANATA]    Project Number: [23405-003]
*#  Date        : 11-08-2017
*#  Modeller    : [AW]
*#  Company     : J. L. Richards & Associates Limited
*#  License #   :  4418403
*#*****************************************************************************
START                TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[100]
                     ["100yr3h.stm"]
*
READ STORM           STORM_FILENAME=["STORM.001"]
*%-----------------|------------------------------------------------------------|
DESIGN STANDHYD      ID=[1], NHYD=["AREA1"], DT=[1]min, AREA=[0.309](ha),
                     XIMP=[0.83], TIMP=[0.83], DWF=[0](cms), LOSS=[2], CN=[98],
                     SLOPE=[1.5](%), RAINFALL=[ , , , , ](mm/hr), END=-1
*%-----------------|------------------------------------------------------------|
ROUTE RESERVOIR      IDout=[2],   NHYD=["STO-1"],  IDin=[1],
                     RDT=[1](min),
                           TABLE of ( OUTFLOW-STORAGE ) values
                                       (cms) - (ha-m)
                                     [   0.0 ,  0.0 ]
                                    [0.0000, 0.00000]
                                    [0.0040, 0.00048]
                                    [0.0068, 0.00138]
                                    [0.0092, 0.00262]
                                    [0.0113, 0.00377]
                                    [0.0130, 0.00403]
                                    [0.0146, 0.00430]
                                    [0.0160, 0.00456]
                                    [0.0173, 0.00482]
                                    [0.0176, 0.00911]
                                    [0.0180, 0.01469]
                                     [   -1  ,  -1  ]  (max twenty pts)
                           IDovf=[3], NHYDovf=["OVF-1"]
*%-----------------|------------------------------------------------------------|
PRINT HYD            ID=[3],   # OF PCYCLES=[1]
*%-----------------|------------------------------------------------------------|
FINISH
```

```
===================================================================================

  SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999   999   =========
  S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9 9   9
  SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ## 9   9 9   9   Ver  4.05
      S   W W   M   M  H   H    Y    M   M  O   O      9999  9999   Sept 2011
  SSSSS   W W   M   M  H   H    Y    M   M   OOO          9     9   =========
                                                      9   9 9   9   # 4418403
       StormWater Management HYdrologic Model          999   999   =========

 ********************************************************************************
 ****************************** SWMHYMO Ver/4.05  ******************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                  OTTHYMO-83 and OTTHYMO-89.                 *********
 ********************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.           *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 ********************************************************************************

 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: J. L. Richards & Associates Limited          +++++++++
 +++++++++                Ottawa                SERIAL#:4418403        +++++++++
 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 ********************************************************************************
 *********            ++++++ PROGRAM ARRAY DIMENSIONS ++++++           *********
 *********            Maximum value for ID numbers  :     10           *********
 *********            Max. number of rainfall points: 105408           *********
 *********            Max. number of flow points    : 105408           *********
 ********************************************************************************


 **********************  D E T A I L E D   O U T P U T  **********************
 ********************************************************************************
 *         DATE: 2018-05-02     TIME: 11:54:47     RUN COUNTER: 000273         *
 ********************************************************************************
 * Input   filename: C:\SWMHYMO\23405-~1\M3-100.dat                              *
 * Output  filename: C:\SWMHYMO\23405-~1\M3-100.out                              *
 * Summary filename: C:\SWMHYMO\23405-~1\M3-100.sum                              *
 * User comments:                                                               *
 * 1:_________________________________________________________________________*
 * 2:_________________________________________________________________________*
 * 3:_________________________________________________________________________*
 ********************************************************************************

-----------------------------------------------------------------------------------
-
001:0001---------------------------------------------------------------------------
-
*#******************************************************************************
*#  Project Name: [COMMERCIAL PLAZA 5100 KANATA]    Project Number: [23405-003]
*#  Date        : 11-08-2017
*#  Modeller    : [AW]
*#  Company     : J. L. Richards & Associates Limited
*#  License #   :  4418403
*#******************************************************************************
  ** END OF RUN :  99

*******************************************************************************
```

```
--------------------
| START            |  Project  dir.: C:\SWMHYMO\23405-~1\

--------------------  Rainfall dir.: C:\SWMHYMO\23405-~1\

    TZERO =   .00 hrs on        0
    METOUT=   2 (output = METRIC)
    NRUN  = 100
    NSTORM=   1
           #  1=100yr3h.stm
---------------------------------------------------------------------------------------
-
100:0002-------------------------------------------------------------------------------
-
*#*****************************************************************************
*#  Project Name: [COMMERCIAL PLAZA 5100 KANATA]    Project Number: [23405-003]
*#  Date        : 11-08-2017
*#  Modeller    : [AW]
*#  Company     : J. L. Richards & Associates Limited
*#  License #   :  4418403
*#*****************************************************************************
---------------------------------------------------------------------------------------
-
100:0002-------------------------------------------------------------------------------
-
*
--------------------
| READ STORM       |    Filename: 100yr_3hr CHICAGO STORM - OTTAWA INT. AI
| Ptotal=  71.66 mm|    Comments: 100yr_3hr CHICAGO STORM - OTTAWA INT. AI
--------------------
              TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
               hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
               .17   6.046 |   1.00 178.559 |   1.83  11.059 |   2.67   5.760
               .33   7.542 |   1.17  54.049 |   2.00   9.285 |   2.83   5.280
               .50  10.159 |   1.33  27.319 |   2.17   8.024 |   3.00   4.879
               .67  15.969 |   1.50  18.240 |   2.33   7.080 |
               .83  40.655 |   1.67  13.737 |   2.50   6.347 |

---------------------------------------------------------------------------------------
-
100:0003-------------------------------------------------------------------------------
-
----------------------
| DESIGN STANDHYD    |   Area    (ha)=     .31
| 01:AREA1  DT= 1.00 |   Total Imp(%)=   83.00   Dir. Conn.(%)=   83.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        .26          .05
     Dep. Storage     (mm)=        .80         1.50
     Average Slope     (%)=       1.50         1.50
     Length            (m)=      45.39        40.00
     Mannings n          =        .013         .250

     Max.eff.Inten.(mm/hr)=     178.56       174.62
                over (min)       1.00         7.00
     Storage Coeff.  (min)=      1.12 (ii)    7.27 (ii)
     Unit Hyd. Tpeak (min)=      1.00         7.00
     Unit Hyd. peak  (cms)=      1.01          .16
                                                                  *TOTALS*
```

```
     PEAK FLOW       (cms)=        .13          .02           .144 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.05          1.000
     RUNOFF VOLUME    (mm)=      70.86        65.34         69.925
     TOTAL RAINFALL   (mm)=      71.66        71.66         71.665
     RUNOFF COEFFICIENT   =        .99          .91           .976

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  98.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------------
-
100:0004----------------------------------------------------------------------------
-
---------------------
| ROUTE RESERVOIR   |    Requested routing time step =  1.0 min.
|  IN>01:(AREA1 )   |
| OUT<02:(STO-1 )   |    =========  OUTLFOW STORAGE TABLE  =========
---------------------    OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
                           (cms)    (ha.m.)   |    (cms)    (ha.m.)
                            .000  .0000E+00   |     .013  .4030E-02
                            .000  .0000E+00   |     .015  .4300E-02
                            .004  .4800E-03   |     .016  .4560E-02
                            .007  .1380E-02   |     .017  .4820E-02
                            .009  .2620E-02   |     .018  .9110E-02
                            .011  .3770E-02   |     .018  .1469E-01

     ROUTING RESULTS             AREA     QPEAK     TPEAK       R.V.
     --------------------        (ha)     (cms)     (hrs)       (mm)
     INFLOW >01: (AREA1 )         .31      .144     1.000     69.925
     OUTFLOW<02: (STO-1 )         .31      .018     1.433     69.925
    OVERFLOW<03: (OVF-1 )         .00      .000      .000       .000

                  TOTAL NUMBER OF SIMULATED OVERFLOWS  =        0
                  CUMULATIVE TIME OF OVERFLOWS  (hours)=      .00
                  PERCENTAGE OF TIME OVERFLOWING    (%)=      .00


                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=   12.433
                  TIME SHIFT OF PEAK FLOW         (min)=    26.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=.1258E-01

------------------------------------------------------------------------------------
-
100:0005----------------------------------------------------------------------------
-
--------------------
| PRINT HYD        |   AREA       (ha)=     .000
| ID=03 (OVF-1 )   |   QPEAK     (cms)=     .000 (i)
| DT= 1.00 PCYC= 1 |   TPEAK     (hrs)=     .000
--------------------   VOLUME     (mm)=     .000

     (i)  PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
      *** WARNING: This hydrograph is dry.
------------------------------------------------------------------------------------
-
100:0006----------------------------------------------------------------------------
-
      FINISH
------------------------------------------------------------------------------------
-
```

```
********************************************************************************
*
     WARNINGS / ERRORS / NOTES
     -------------------------
 100:0005 PRINT HYD
      *** WARNING: This hydrograph is dry.
   Simulation ended on 2018-05-02     at 11:54:47
================================================================================
=
```

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