

**FUNCTIONAL SERVICING AND
STORMWATER MANAGEMENT
REPORT**

FOR

**HOBIN ARCHITECTURE INC.
770 BROOKFIELD ROAD – PHASE 1**

CITY OF OTTAWA

PROJECT NO.: 17-966

OCTOBER 2017 – REV 1
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HOBIN ARCHITECTURE INC.**

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1.0 INTRODUCTION

David Schaeffer Engineering Limited (DSEL) has been retained by Hobin Architecture Inc. to prepare a Functional Servicing and Stormwater Management report in support of the application for a Site Place Control (SPC) at 770 Brookfield Road.

The subject property is located within the City of Ottawa urban boundary, in the River ward. As illustrated in **Figure 1**, the subject property is located 160m east of the Riverside Drive and Brookfield Road intersection. Comprised of a single parcel of land, the subject property measures approximately **2.47 ha** and is zoned General Mixed Use (GM).



Figure 1: Site Location

The proposed SPC would allow for the first phase of the development consisting of five residential/commercial buildings within **1.39 ha** of the subject site. The proposed first phase of development would include approximately **1,209 m²** of ground level retail with above and underground parking. The residential component consists of 355 units. A copy of the proposed site plan prepared by J. Barry Hobin & Associates is included in ***Drawings/Figures***.

The objective of this report is to provide sufficient detail to demonstrate that the proposed development is supported by existing municipal services.

1.1 Existing Conditions

The existing site contains an undeveloped area formally the location of a two-storey building. The former Hobson Road right-of-way runs along the eastern property line and is subject to easement. The elevations range between 77.94m and 79.70m with an elevation change of 1.76m from the Northeast to the Southwest corner of the property.

Annis, O'Sullivan, Vollebekk Ltd. completed a topographical survey of the site on November 20th, 2003 and updated on October 5th, 2017. A reduced plot of the survey is included in ***Drawings/Figures***.

Sewer and watermain mapping collected from the City of Ottawa indicate that the following services exist across the property frontages within the adjacent municipal right-of-ways:

Watermains:

- 300mm diameter local service within Brookfield Road

Storm Sewers:

- 750mm diameter local sewer within Brookfield Road tributary to the Sawmill Creek sub-watershed

Sanitary Sewers:

- 250mm diameter local sewer within Brookfield Road tributary to the Rideau River Trunk Collector

1.2 Required Permits / Approvals

The proposed development is subject to the site plan control approval process. The City of Ottawa must approve the engineering design drawings and reports prior to the issuance of site plan control.

The proposed development is a single parcel; as a result, the stormwater management system qualifies for an exemption under the OWRA. The MOECC has been contacted to confirm the exemption; no response was received at time of publication. Correspondence is included in ***Appendix A***.

The subject property contains large trees, and re-grading the site to accommodate the proposed development may impact or require removal of existing trees. Trees requiring removal will be subject to the City of Ottawa Urban Tree Conservation By-law No. 2009-200.

1.3 Pre-consultation

Pre-consultation with relevant parties, including the City of Ottawa, Rideau Valley Conservation Authority (RVCA) and MOE was conducted either in person or via email for the proposed development.

Pre-consultation correspondence, along with the servicing guidelines checklist, is located in **Appendix A**.

2.0 GUIDELINES, PREVIOUS STUDIES, AND REPORTS

2.1 Existing Studies, Guidelines, and Reports

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

- **Ottawa Sewer Design Guidelines,**
City of Ottawa, *SDG002*, October 2012
(City Standards)
- **Ottawa Design Guidelines – Water Distribution**
City of Ottawa, July 2010.
(Water Supply Guidelines)
 - **Technical Bulletin ISD-2010-2**
City of Ottawa, December 15, 2010.
(ISD-2010-2)
 - **Technical Bulletin ISDTB-2014-02**
City of Ottawa, May 27, 2014.
(ISDTB-2014-02)
- **Design Guidelines for Sewage Works,**
Ministry of the Environment, 2008.
(MOE Design Guidelines)
- **Stormwater Planning and Design Manual,**
Ministry of the Environment, March 2003.
(SWMP Design Manual)
- **Ontario Building Code Compendium**
Ministry of Municipal Affairs and Housing Building Development Branch,
January 1, 2010 Update
(OBC)
- **Water Supply for Public Fire Protection**
Fire Underwriters Survey, 1999.
(FUS)
- **Sawmill Creek Creek Subwatershed Study**
CH2MHILL, May 2003 Update
(Sawmill Creek SS)
- **Geotechnical Investigation**
Paterson Group, PG3275-1, November 28, 2014
(Geotechnical Report)

3.0 WATER SUPPLY SERVICING

3.1 Existing Water Supply Services

The subject property lies within the City of Ottawa 2W2C pressure zone, as shown by the Pressure zone map included in **Appendix B**.

The existing development is serviceable from a local 300mm diameter watermain within the Brookfield Road right-of-way along with a 200mm diameter watermain located in the former Hobson Road right-of-way. The existing site currently contains no facilities that have a water demand as such no existing demand exists.

3.2 Water Supply Servicing Design

The development is proposed to be serviced via a 150mm diameter connection to the existing 300mm diameter municipal watermain within the Brookfield Road right-of-way, as shown by **SSP-1**.

In accordance with City of Ottawa technical bulletin ISDTB-2014-02, redundant service connections will be required due to an anticipated design flow of greater than 50 m³/day, for each phase. In Phase I, a valve box is proposed within the Brookfield Road right-of-way to ensure adequate water supply if a local watermain needs to be closed.

Table 1 summarizes the **Water Supply Guidelines** employed in the preparation of the preliminary water demand estimate.

Table 1
Water Supply Design Criteria

Design Parameter	Value
Residential Average Apartment	1.8 P/unit
Residential Average Daily Demand	350 L/d/P
Residential Maximum Daily Demand	2.5 x Average Daily *
Residential Maximum Hourly	5.5 x Average Daily *
Commercial Retail	2.5 L/m ² /d
Commercial Maximum Daily Demand	1.5 x avg. day
Commercial Maximum Hour Demand	1.8 x max. day
Minimum Watermain Size	150mm diameter
Minimum Depth of Cover	2.4m from top of watermain to finished grade
During normal operating conditions desired operating pressure is within	350kPa and 480kPa
During normal operating conditions pressure must not drop below	275kPa
During normal operating conditions pressure must not exceed	552kPa
During fire flow operating pressure must not drop below	140kPa
*Daily average based on Appendix 4-A from Water Supply Guidelines ** Residential Max. Daily and Max. Hourly peaking factors per MOE Guidelines for Drinking-Water Systems Table 3-3 for 0 to 500 persons. -Table updated to reflect ISD-2010-2	

Table 2 summarizes the anticipated water supply demand and boundary conditions for the proposed development based on the **Water Supply Guidelines**.

Table 2
Water Demand and Boundary Conditions
Proposed Conditions – Phase 1

Design Parameter	Anticipated Demand ¹ (L/min)	Boundary Condition ² (m H ₂ O / kPa)
Average Daily Demand	157.4	56.3 / 552.3
Max Day + Fire Flow	391.4 + 17,000 17,391.4	28,020 L/min @ 140 kPa
Peak Hour	859.9	46.2 / 453.2
1) Water demand calculation per Water Supply Guidelines . See Appendix B for detailed calculations. 2) Boundary conditions supplied by the City of Ottawa for the demands indicated in the correspondence; assumed ground elevation 78.4m. See Appendix B .		

Fire flow requirements are to be determined in accordance with Local Guidelines (**FUS**), City of Ottawa **Water Supply Guidelines**, and the Ontario Building Code.

Using the **FUS** method a conservative estimation of fire flow had been established. The following assumptions were assumed:

- Type of construction – Non-Combustible Construction
- Occupancy type – Non-Combustible
- Sprinkler Protection – Supervised Sprinkler System

Table 3 summarizes the estimated fire flows for Building A, Building B and Building C. Detailed calculations can be found in **Appendix B**.

Table 3: FUS Estimated Fire Flow Summary

Phase	Anticipated Demand (L/min)
Building A	17,000
Building B	13,000
Building E1	5,000
Building E2	5,000

As shown by **Table 3**, the above assumptions result in an estimated maximum fire flow of approximately **17,000 L/min**, actual building materials selected will affect the estimated flow. A certified fire protection system specialist would need to be employed to design the building fire suppression system and confirm the actual fire flow demand.

The City of Ottawa was contacted to obtain boundary conditions associated with the estimated water demand as indicated in the boundary request correspondence included in **Appendix B**.

Initial boundary conditions obtained indicate residual pressures during average day demands exceed the required pressure range as specified in **Table 1** and the **Water Supply Guidelines**; as a result, buildings may need to be equipped with pressure reducing valves.

Based on the updated Site Plan, the anticipated water demand for the site increased by approximately 25%. An updated water boundary request has been sent to the City of Ottawa. No response was received at the time of publication.

3.3 Water Supply Conclusion

Anticipated water demand under proposed conditions was submitted to the City of Ottawa for establishing boundary conditions.

The anticipated water demand under proposed conditions was submitted to the City of Ottawa for establishing boundary conditions. As demonstrated by **Table 2**, based on the City's model, pressures during average day demands exceed the required pressure range, as a result, buildings may need to be equipped with pressure reducing valves.

The proposed water supply design conforms to all relevant City Guidelines and Policies.

4.0 WASTEWATER SERVICING

4.1 Existing Wastewater Services

The subject site lies within the Rideau River Collector Sewer catchment area, as shown by the City sewer mapping included in **Appendix C**. An existing 250 mm diameter sanitary sewer within Brookfield Road is available to service the proposed development.

4.2 Wastewater Design

The development is proposed to be serviced via an independent 200mm diameter connection to the existing 250 sanitary sewer within the Brookfield Road right-of-way, as shown by the **SSP-1**.

Table 4 summarizes the **City Standards** employed in the design of the proposed wastewater sewer system.

Table 4
Wastewater Design Criteria

Design Parameter	Value
Residential Average Apartment	1.8 P/unit
Average Daily Demand	350 L/d/per
Peaking Factor	Harmon's Peaking Factor. Max 4.0, Min 2.0
Commercial Floor Space	5 L/m ² /d
Infiltration and Inflow Allowance	0.28L/s/ha
Sanitary sewers are to be sized employing the Manning's Equation	$Q = \frac{1}{n} AR^{\frac{2}{3}} S^{\frac{1}{2}}$
Minimum Sewer Size	250mm diameter
Minimum Manning's 'n'	0.013
Minimum Depth of Cover	2.5m from crown of sewer to grade
Minimum Full Flowing Velocity	0.6m/s
Maximum Full Flowing Velocity	3.0m/s
Extracted from Sections 4 and 6 of the City of Ottawa Sewer Design Guidelines, October 2012.	

Table 5 demonstrates the anticipated peak flow from the proposed development. See **Appendix C** for associated calculations.

Table 5
Summary of Estimated Peak Wastewater Flow – Phase 1

Design Parameter	Total Flow (L/s)
Estimated Average Dry Weather Flow	2.7
Estimated Peak Dry Weather Flow	10.3
Estimated Peak Wet Weather Flow	10.7

The estimated sanitary flow based on the site plan provide in ***Drawings/Figures*** anticipates a peak wet weather flow of **10.7 L/s**.

A sanitary analysis was conducted for the local municipal sanitary sewers located across the frontage of the subject property in order to assess the available capacity. The analysis was conducted from the site to the upstream extents of the drainage area located near the intersection of Hobson Road and Springland Drive, as shown by the sanitary drainage plan in ***Appendix C***.

City of Ottawa Sewer Design Guidelines (2004) Figure 4.3 'Peak Flow Design Parameters' were employed to generate a conservative estimate of the existing wastewater flow conditions within the sewer.

Based on the sanitary analysis, the controlling section of the local sewer system is located at the intersection of Brookfield Road and Hobson Road (nodes 2-3) with an available residual capacity of **15.8 L/s**; detailed calculations are included in ***Appendix C***.

The analysis above indicates that sufficient capacity is available in the local sewers to accommodate the proposed development.

4.3 Wastewater Servicing Conclusions

The site is tributary to the Rideau River Collector sewer; based on the sanitary analysis sufficient capacity is available to accommodate the anticipated **10.7 L/s** peak wet weather flow from the proposed development.

The proposed wastewater design conforms to all relevant ***City Standards***.

5.0 STORMWATER MANAGEMENT

5.1 Existing Stormwater Services

Stormwater runoff from the subject property is tributary to the City of Ottawa sewer system located within the Sawmill Creek sub-watershed. As such, approvals for proposed development within this area are under the approval authority of the City of Ottawa.

Flows that influence the watershed in which the subject property is located are further reviewed by the principal authority. The subject property is located within the Ottawa River watershed, and is therefore subject to review by the Rideau Valley Conservation Authority (RVCA). Consultation with the RVCA is located in **Appendix A**.

It was determined that the existing development contained no stormwater management controls for flow attenuation. The estimated pre-development peak flows for the 2, 5, and 100-year are summarized in **Table 6**:

Table 6
Summary of Existing Peak Storm Flow Rates – Phase 1

City of Ottawa Design Storm	Estimated Peak Flow Rate (L/s)
2-year	218.0
5-year	295.8
100-year	633.7

5.2 Post-development Stormwater Management Target

Stormwater management requirements for the proposed development were reviewed with the City of Ottawa, where the proposed development is required to:

- Meet an allowable release rate based on a Rational Method Coefficient of 0.50, employing the City of Ottawa IDF parameters for a 2-year storm with a time of concentration equal to or greater than 10 minutes.
- Attenuate all storms up to and including the City of Ottawa 100-year design event on site.
- Provide quality controls to an enhanced level of treatment due to the site's distance from the outlet and the current Site Plan; correspondence with the RVCA is included in **Appendix A**.

Based on the above the allowable release rate for the proposed development is **148.8 L/s**.

5.3 Proposed Stormwater Management System

It is proposed that the stormwater outlet from the proposed development will be to the 750 mm diameter storm sewer within the Brookfield Road right-of-way.

To meet the stormwater objectives the proposed development may contain a combination of roof top flow attenuation along with subsurface storage.

Flow from rooftops will be controlled before discharging to the existing storm sewer system. The release rate and storage calculations for roof top attenuation were estimated based on Zurn Industries Ltd. design guidelines for Model Z-105-5 Control-Flo Single Notch drains. According to the Control-Flo Roof Drainage System Specification Drainage sheets notch ratings, each notch releases 5 G.P.M. per inch of head relevant literature is provide in **Appendix D**. Other products may be specified provided that the restricted release rate and sufficient storage is provided to meet or exceed the values in **Appendix D**.

Area A, as shown by drawing **SWM-1**, is tributary to the storm sewer within Brookfield Road. Approximately **203.0 m³** of underground storage via two Triton S-29 or an approved equivalent storage system and will be attenuated by a **160 mm** ICD located in **STM102**. Detailed calculations are located in **Appendix D**.

To meet stormwater quality criteria specified by RVCA, an oil/grit separator will be installed downstream of **STM102** and the catchbasins collecting runoff from the parking areas, as shown by **SSP-1**. This will provide and enhanced level of quality control (80% TSS removal) in accordance with the RVCA requirement. Stormceptor sizing has been included in **Appendix D**.

Table 7 summarizes post-development flow rates.

Table 7
Stormwater Flow Rate Summary

Control Area	5-Year Release Rate	5-Year Storage	100-Year Release Rate	100-Year Required Storage	100-Year Available Storage
	(L/s)	(m ³)	(L/s)	(m ³)	(m ³)
Unattenuated Areas	27.0	0.0	57.8	0.0	0.0
Attenuated Areas	60.4	81.8	90.3	202.5	203.0
Total	87.4	81.8	148.0	202.5	203.0

It is anticipated that approximately **202.5 m³** of storage will be required on site to attenuate flow to the established release rate of **148.8 L/s**; storage calculations are contained within **Appendix D**.

5.4 Stormwater Servicing Conclusions

Post development stormwater runoff will be required to be restricted to the allowable target release rate for storm events up to and including the 100-year storm in accordance with City of Ottawa **City Standards**. The post-development allowable release rate was calculated as **148.8 L/s** based on consultation with the City of Ottawa. It is estimated that **202.5 m³** will be required to meet this release rate.

Based on consultation with the RVCA, stormwater quality controls to an enhanced level of treatment are required.

The proposed stormwater design conforms to all relevant **City Standards** and Policies for approval

6.0 UTILITIES

Gas, Hydro services currently exist within the Brookfield Road right-of-way. Utility servicing will be coordinated with the individual utility companies prior to site development.

7.0 EROSION AND SEDIMENT CONTROL

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

Prior to topsoil stripping, earthworks or underground construction, erosion and sediment controls will be implemented and will be maintained throughout construction.

Silt fence will be installed around the perimeter of the site and will be cleaned and maintained throughout construction. Silt fence will remain in place until the working areas have been stabilized and re-vegetated.

Catch basins will have SILTSACKS or an approved equivalent installed under the grate during construction to protect from silt entering the storm sewer system.

A mud mat will be installed at the construction access in order to prevent mud tracking onto adjacent roads.

Erosion and sediment controls must be in place during construction. The following recommendations to the contractor will be included in contract documents.

- Limit extent of exposed soils at any given time.
- Re-vegetate exposed areas as soon as possible.
- Minimize the area to be cleared and grubbed.
- Protect exposed slopes with plastic or synthetic mulches.
- Install silt fence to prevent sediment from entering existing ditches.
- No refueling or cleaning of equipment near existing watercourses.
- Provide sediment traps and basins during dewatering.
- Install filter cloth between catch basins and frames.
- Plan construction at proper time to avoid flooding.

Establish material stockpiles away from watercourses, so that barriers and filters may be installed.

The contractor will, at every rainfall, complete inspections and guarantee proper performance. The inspection is to include:

- Verification that water is not flowing under silt barriers.
- Clean and change filter cloth at catch basins.

8.0 CONCLUSION AND RECOMMENDATIONS

David Schaeffer Engineering Ltd. (DSEL) has been retained by Hobin Architecture Inc. to prepare a Functional Servicing and Stormwater Management report in support of the application for a Site Plan Control (SPC) at 770 Brookfield Road. The preceding report outlines the following:

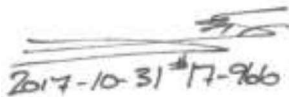
- Based on boundary conditions provided by the City, average day demands exceed the required pressure range as specified by the City of Ottawa, therefore buildings may require pressure reducing valves;
- The FUS method for estimating fire flow indicated **17,000 L/min** is required for the proposed development;
- The contemplated development is anticipated to have a peak wet weather flow of **10.7 L/s**; Based on the sanitary analysis conducted the existing municipal sewer infrastructure has sufficient capacity to support the development;
- Based on pre-consultation with the City of Ottawa, the proposed development will be required to attenuate post development flows to an equivalent release rate of **148.8 L/s** for all storms up to and including the 100-year storm event;
- It is proposed that stormwater objectives may be met through storm water retention via roof top and subsurface storage, it is anticipated that **203 m³** of onsite storage will be required to attenuate flow to the established release rate above;
- Based on consultation with the RVCA, stormwater quality controls to an enhanced level of treatment are required;
- The MOECC was contacted to confirm the proposed development is exempt from an ECA, however no response was received at time of publication.

Prepared by,
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Per: Alison J. Gosling, EIT.

Reviewed by,
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Per: Adam D. Fobert, P.Eng

Prepared by,
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Per: Robert D. Freel, P. Eng.

APPENDIX A

Pre-Consultation

DEVELOPMENT SERVICING STUDY CHECKLIST

17-966

30/10/2017

4.1 General Content

<input type="checkbox"/>	Executive Summary (for larger reports only).	N/A
<input checked="" type="checkbox"/>	Date and revision number of the report.	Report Cover Sheet
<input checked="" type="checkbox"/>	Location map and plan showing municipal address, boundary, and layout of proposed development.	Drawings/Figures
<input checked="" type="checkbox"/>	Plan showing the site and location of all existing services.	Figure 1 / EX-1
<input checked="" type="checkbox"/>	Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to applicable subwatershed and watershed plans that provide context to which individual developments must adhere.	Section 1.0
<input checked="" type="checkbox"/>	Summary of Pre-consultation Meetings with City and other approval agencies.	Section 1.3
<input checked="" type="checkbox"/>	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 defensible design criteria.	Section 2.1
<input checked="" type="checkbox"/>	Statement of objectives and servicing criteria.	Section 1.0
<input checked="" type="checkbox"/>	Identification of existing and proposed infrastructure available in the immediate area.	Sections 3.1, 4.1, 5.1
<input checked="" type="checkbox"/>	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).	Section 5.1
<input checked="" type="checkbox"/>	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.	GP-1
<input type="checkbox"/>	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
<input checked="" type="checkbox"/>	Proposed phasing of the development, if applicable.	GP-1, SSP-1
<input checked="" type="checkbox"/>	Reference to geotechnical studies and recommendations concerning servicing.	Section 1.4
<input checked="" type="checkbox"/>	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	GP-1, SSP-1

4.2 Development Servicing Report: Water

<input type="checkbox"/>	Confirm consistency with Master Servicing Study, if available	N/A
<input checked="" type="checkbox"/>	Availability of public infrastructure to service proposed development	Section 3.1
<input checked="" type="checkbox"/>	Identification of system constraints	Section 3.1
<input checked="" type="checkbox"/>	Identify boundary conditions	Section 3.1, 3.2
<input checked="" type="checkbox"/>	Confirmation of adequate domestic supply and pressure	Section 3.3

<input checked="" type="checkbox"/>	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.	Section 3.2
<input type="checkbox"/>	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.	N/A
<input type="checkbox"/>	Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design	N/A
<input type="checkbox"/>	Address reliability requirements such as appropriate location of shut-off valves	N/A
<input type="checkbox"/>	Check on the necessity of a pressure zone boundary modification	N/A
<input checked="" type="checkbox"/>	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	Section 3.2, 3.3
<input checked="" type="checkbox"/>	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.	Section 3.2, 3.3
<input type="checkbox"/>	Description of off-site required feeder mains, 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
<input checked="" type="checkbox"/>	Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.	Section 3.2
<input type="checkbox"/>	Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.	N/A

4.3 Development Servicing Report: Wastewater

<input checked="" type="checkbox"/>	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).	Section 4.2
<input type="checkbox"/>	Confirm consistency with Master Servicing Study and/or justifications for deviations.	N/A
<input type="checkbox"/>	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
<input checked="" type="checkbox"/>	Description of existing sanitary sewer available for discharge of wastewater from proposed development.	Section 4.1
<input checked="" type="checkbox"/>	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)	Section 4.2
<input checked="" type="checkbox"/>	Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix 'C') format.	Section 4.2, Appendix C
<input checked="" type="checkbox"/>	Description of proposed sewer network including sewers, pumping stations, and forcemains.	Section 4.2
<input type="checkbox"/>	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

<input type="checkbox"/>	Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development.	N/A
<input type="checkbox"/>	Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity.	N/A
<input type="checkbox"/>	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
<input type="checkbox"/>	Special considerations such as contamination, corrosive environment etc.	N/A

4.4 Development Servicing Report: Stormwater Checklist

<input checked="" type="checkbox"/>	Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property)	Section 5.1
<input checked="" type="checkbox"/>	Analysis of available capacity in existing public infrastructure.	Section 5.1, Appendix D
<input checked="" type="checkbox"/>	A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern.	Drawings/Figures
<input checked="" type="checkbox"/>	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.	Section 5.2
<input checked="" type="checkbox"/>	Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.	Section 5.2
<input checked="" type="checkbox"/>	Description of the stormwater management concept with facility locations and descriptions with references and supporting information	Section 5.3
<input type="checkbox"/>	Set-back from private sewage disposal systems.	N/A
<input type="checkbox"/>	Watercourse and hazard lands setbacks.	N/A
<input checked="" type="checkbox"/>	Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.	Appendix A
<input type="checkbox"/>	Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.	N/A
<input checked="" type="checkbox"/>	Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period).	Section 5.3
<input type="checkbox"/>	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
<input checked="" type="checkbox"/>	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.	Section 5.1, 5.3
<input type="checkbox"/>	Any proposed diversion of drainage catchment areas from one outlet to another.	N/A
<input type="checkbox"/>	Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities.	N/A
<input type="checkbox"/>	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
<input type="checkbox"/>	Identification of potential impacts to receiving watercourses	N/A
<input type="checkbox"/>	Identification of municipal drains and related approval requirements.	N/A

<input checked="" type="checkbox"/>	Descriptions of how the conveyance and storage capacity will be achieved for the development.	Section 5.3
<input type="checkbox"/>	100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.	N/A
<input type="checkbox"/>	Inclusion of hydraulic analysis including hydraulic grade line elevations.	N/A
<input checked="" type="checkbox"/>	Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.	Section 6.0
<input type="checkbox"/>	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
<input type="checkbox"/>	Identification of fill constraints related to floodplain and geotechnical investigation.	N/A

4.5 Approval and Permit Requirements: Checklist

<input checked="" type="checkbox"/>	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.	Section 1.2
<input type="checkbox"/>	Application for Certificate of Approval (CofA) under the Ontario Water Resources Act.	N/A
<input type="checkbox"/>	Changes to Municipal Drains.	N/A
<input type="checkbox"/>	Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation etc.)	N/A

4.6 Conclusion Checklist

<input checked="" type="checkbox"/>	Clearly stated conclusions and recommendations	Section 8.0
<input type="checkbox"/>	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.	
<input type="checkbox"/>	All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario	



MEMO

December 16, 2014

To /
Destinataire Simon Deiaco, Planner

From /
Expéditeur Cody Oram, Project Manager, Infrastructure Approvals

Subject /
Objet **Pre-Application Consultation** File No. PC2014-0288
770 Brookfield Rd. & Ward No. 16,
Proposed apartment complex (student housing).
Phased development with multiple buildings, mixed use.

Please note the following information regarding the engineering design submission for the above noted site:

1. The Servicing Study Guidelines for Development Applications are available at the following address: <http://ottawa.ca/en/development-application-review-process-0/servicing-study-guidelines-development-applications>
2. Servicing & site works shall be in accordance with the following documents:
 - ⇒ Ottawa Sewer Design Guidelines (2013)
 - ⇒ Ottawa Design Guidelines – Water Distribution (2010)
 - ⇒ Geotechnical Investigation and Reporting Guidelines for Development Applications in the City of Ottawa (2007)
 - ⇒ City of Ottawa Slope Stability Guidelines for Development Applications (2004)
 - ⇒ City of Ottawa Environmental Noise Control Guidelines (2006)
 - ⇒ City of Ottawa Park and Pathway Development Manual (2012)
 - ⇒ City of Ottawa Accessibility Design Standards (2012)
 - ⇒ Ottawa Standard Tender Documents (2013)
 - ⇒ Ontario Provincial Standards for Roads & Public Works (2013)
3. Record drawings and utility plans are also available for purchase from the City (Contact the City's Information Centre by email at InformationCentre@ottawa.ca or by phone at (613) 580-2424 x.44455).
4. The Stormwater Management Criteria, for the subject site, is to be based on the following:

- i. The City's downstream storm system outfalls to Sawmill Creek. Please contact Jocelyn Chandler, Planner, RVCA (jocelyn.chandler@rvca.ca) regarding the Sawmill Creek Subwatershed Study requirements applicable to this development.
 - ii. Flows to the storm sewer in excess of the 2-year storm release rate, calculated using the pre-development runoff coefficient or a maximum equivalent 'C' of 0.5, whichever is less, up to and including the 100-year storm event, must be detained on site.
 - iii. Calculate the time of concentration (Cannot be less than 10 minutes).
- 5. Services (Storm, Sanitary & Water Supply)
 - i. Services should be grouped in a common trench to minimize the number of road cuts and connected to the existing infrastructure within Brookfield Road.
 - ii. Connections to easement sewers are typically not permitted.
- 6. Water Boundary condition requests must include the location of the service and the expected loads required by the proposed development. Please provide the following information:
 - i. Location of service
 - ii. Type of development and the amount of fire flow required.
 - iii. Average daily demand: ____ l/s.
 - iv. Maximum daily demand: ____ l/s.
 - v. Maximum hourly daily demand: ____ l/s.

Should you have any questions or require additional information, please contact me directly at (613) 580-2424, x 13422 or by email at cody.oram@ottawa.ca .

Robert Freel

From: Jocelyn Chandler <jocelyn.chandler@rvca.ca>
Sent: December-17-14 2:40 PM
To: Robert Freel
Subject: RE: 770 Brookfield - RVCA Pre-consult

Hello Bobby,
As discussed:

The stormwater from this site will be connected to the municipal sewers on either Brookfield or Hobson Rd which outlet 500 or 1000 metres respectively downstream to Sawmill Creek with no quality treatment. Sawmill Creek requires 80% TSS removal for travelled surfaces. The rooftops and landscaped areas do not require quality treatment for surface water quality objectives.

Jocelyn

Jocelyn Chandler M.Pl. MCIP, RPP

Planner, RVCA

t) 613-692-3571 x1137

f) 613-692-0831

jocelyn.chandler@rvca.ca

www.rvca.ca

mail: Box 599 3889 Rideau Valley Dr., Manotick, ON K4M 1A5

courier: 3889 Rideau Valley Dr., Nepean, ON K2C 3H1

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From: Robert Freel [<mailto:rffree@dsel.ca>]
Sent: Wednesday, December 17, 2014 2:16 PM
To: Jocelyn Chandler
Subject: 770 Brookfield - RVCA Pre-consult

Hi Jocelyn,

As discussed please find attached conceptual site plans for the Brookfield development Phase 1 and ultimate. It is contemplated that servicing would occur from both Brookfield and Hobson Roads. Can you provide any criteria that maybe required with regards to quality.

If you would like to discuss please feel free to contact me.

Thanks,

Bobby Freel, EIT.

DSEL

david schaeffer engineering ltd.

120 Iber Road, Unit 203
Stittsville, ON K2S 1E9

phone: (613) 836-0856 ext.258

cell: (613) 314-7675

email: rfreel@DSEL.ca

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Alison Gosling

From: Alison Gosling
Sent: Monday, October 30, 2017 12:19 PM
To: 'MOECCOttawaSewage (MOECC)'
Subject: 770 Brookfield Road
Attachments: ODO - Pre-Submission Consultation Request Fill-in Form-May 2017 v4r.pdf

Good afternoon,

We just wanted to touch base with you regarding a proposed Phase I development we are working on located at 770 Brookfield Road.

Currently comprised a single parcel of land, the existing 2.5ha site currently an above ground parking lot and is zoned General Mixed Use. The development proposes to construct 5 residential/commercial buildings. It appears that the existing site currently directs flow towards the private catch basin system within the subject site and is tributary to the Sawmill Creek sub-watershed.

As the proposed sewage works and stormwater management facility will be servicing a single parcel of land which will be owned and operated by a single entity, does not discharge to a combined sewer system, and is not proposed to be used for industrial purposes, it is assumed this falls within the exemption requirements for an Environmental Compliance Approval as per O.Reg 525/98, Section 3 (a) & Ontario Water Resources Act Section 53. 6 (c).

I hope you could comment on my assumption that this property would be exempt from requiring an ECA. Please feel free to call to discuss this further.



Thank you,

Alison Gosling, E.I.T.
Project Coordinator / Junior Designer

DSEL

david schaeffer engineering ltd.

120 Iber Road, Unit 103
Stittsville, ON K2S 1E9

phone: (613) 836-0856 ext.542

fax: (613) 836-7183

email: agosling@dsel.ca

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APPENDIX B

Water Supply

Water Demand Design Flows per Unit Count
City of Ottawa - Water Distribution Guidelines, July 2010



Domestic Demand

Type of Housing	Per / Unit	Units	Pop							
Single Family	3.4		0							
Semi-detached	2.7		0							
Townhouse	2.7		0							
Apartment			0							
Bachelor	1.4		0							
1 Bedroom	1.4		0							
2 Bedroom	2.1		0							
3 Bedroom	3.1		0							
Average	1.8	355	639							
				Pop	Avg. Daily		Max Day		Peak Hour	
					m³/d	L/min	m³/d	L/min	m³/d	L/min
Total Domestic Demand				639	223.7	155.3	559.1	388.3	1230.1	854.2

Institutional / Commercial / Industrial Demand

Property Type	Unit Rate	Units	Avg. Daily		Max Day		Peak Hour	
			m ³ /d	L/min	m ³ /d	L/min	m ³ /d	L/min
Commercial floor space	2.5 L/m ² /d	1,206	3.02	2.1	4.5	3.1	8.1	5.7
Office	75 L/9.3m ² /d		0.00	0.0	0.0	0.0	0.0	0.0
Industrial - Light	35,000 L/gross ha/d		0.00	0.0	0.0	0.0	0.0	0.0
Industrial - Heavy	55,000 L/gross ha/d		0.00	0.0	0.0	0.0	0.0	0.0
Total I/CI Demand			3.0	2.1	4.5	3.1	8.1	5.7
Total Demand			226.7	157.4	563.6	391.4	1238.2	859.9

Fire Flow Estimation per Fire Underwriters Survey

Water Supply For Public Fire Protection - 1999



Fire Flow Required

1. Base Requirement

$$F = 220C\sqrt{A} \text{ L/min} \quad \text{Where } F \text{ is the fire flow, } C \text{ is the Type of construction and } A \text{ is the Total floor area}$$

Type of Construction: **Non-Combustible Construction**

C 0.8 Type of Construction Coefficient per FUS Part II, Section 1
A 19230.9 m² Total floor area based on FUS Part II section 1

Fire Flow	24406.9 L/min
	24000.0 L/min rounded to the nearest 1,000 L/min

Adjustments

2. Reduction for Occupancy Type

Non-Combustible -25%

Fire Flow	18000.0 L/min
-----------	----------------------

3. Reduction for Sprinkler Protection

Sprinklered -50%

Reduction	-9000 L/min
-----------	--------------------

4. Increase for Separation Distance

N >45m	0%
S 30.1m-45m	5%
E 0m-3m	25%
W 10.1m-20m	15%
% Increase	45%

value not to exceed 75% per FUS Part II, Section 4

Increase	8100.0 L/min
----------	---------------------

Total Fire Flow

Fire Flow	17100.0 L/min	fire flow not to exceed 45,000 L/min nor be less than 2,000 L/min per FUS Section
	17000.0 L/min	rounded to the nearest 1,000 L/min

Notes:

- Type of construction, Occupancy Type and Sprinkler Protection information provided by _____.
- Calculations based on Fire Underwriters Survey - Part II

Fire Flow Estimation per Fire Underwriters Survey

Water Supply For Public Fire Protection - 1999



Fire Flow Required

1. Base Requirement

$$F = 220C\sqrt{A} \text{ L/min} \quad \text{Where } F \text{ is the fire flow, } C \text{ is the Type of construction and } A \text{ is the Total floor area}$$

Type of Construction: **Non-Combustible Construction**

C 0.8 Type of Construction Coefficient per FUS Part II, Section 1
A 9093.5 m² Total floor area based on FUS Part II section 1

Fire Flow	16783.4 L/min
	17000.0 L/min rounded to the nearest 1,000 L/min

Adjustments

2. Reduction for Occupancy Type

Non-Combustible -25%

Fire Flow	12750.0 L/min
-----------	----------------------

3. Reduction for Sprinkler Protection

Sprinklered -50%

Reduction	-6375 L/min
-----------	--------------------

4. Increase for Separation Distance

N 3.1m-10m	20%
S 30.1m-45m	5%
E 20.1m-30m	10%
W 10.1m-20m	15%

% Increase **50%** value not to exceed 75% per FUS Part II, Section 4

Increase	6375.0 L/min
----------	---------------------

Total Fire Flow

Fire Flow	12750.0 L/min	fire flow not to exceed 45,000 L/min nor be less than 2,000 L/min per FUS Section
	13000.0 L/min	rounded to the nearest 1,000 L/min

Notes:

- Type of construction, Occupancy Type and Sprinkler Protection information provided by _____.
- Calculations based on Fire Underwriters Survey - Part II

Fire Flow Estimation per Fire Underwriters Survey

Water Supply For Public Fire Protection - 1999



Fire Flow Required

1. Base Requirement

$$F = 220C\sqrt{A} \text{ L/min} \quad \text{Where } F \text{ is the fire flow, } C \text{ is the Type of construction and } A \text{ is the Total floor area}$$

Type of Construction: **Non-Combustible Construction**

C 0.8 Type of Construction Coefficient per FUS Part II, Section 1
A 1263.5 m² Total floor area based on FUS Part II section 1

Fire Flow	6256.0 L/min
	6000.0 L/min rounded to the nearest 1,000 L/min

Adjustments

2. Reduction for Occupancy Type

Non-Combustible -25%

Fire Flow	4500.0 L/min
-----------	---------------------

3. Reduction for Sprinkler Protection

Sprinklered -50%

Reduction	-2250 L/min
-----------	--------------------

4. Increase for Separation Distance

N 30.1m-45m	5%
S 3.1m-10m	20%
E 10.1m-20m	15%
W 0m-3m	25%

% Increase	65%	value not to exceed 75% per FUS Part II, Section 4
------------	------------	--

Increase	2925.0 L/min
----------	---------------------

Total Fire Flow

Fire Flow	5175.0 L/min	fire flow not to exceed 45,000 L/min nor be less than 2,000 L/min per FUS Section
	5000.0 L/min	rounded to the nearest 1,000 L/min

Notes:

- Type of construction, Occupancy Type and Sprinkler Protection information provided by _____.
- Calculations based on Fire Underwriters Survey - Part II

Fire Flow Estimation per Fire Underwriters Survey

Water Supply For Public Fire Protection - 1999



Fire Flow Required

1. Base Requirement

$$F = 220C\sqrt{A} \text{ L/min} \quad \text{Where } F \text{ is the fire flow, } C \text{ is the Type of construction and } A \text{ is the Total floor area}$$

Type of Construction: **Non-Combustible Construction**

C 0.8 Type of Construction Coefficient per FUS Part II, Section 1
A 1263.5 m² Total floor area based on FUS Part II section 1

Fire Flow	6256.0 L/min
	6000.0 L/min rounded to the nearest 1,000 L/min

Adjustments

2. Reduction for Occupancy Type

Non-Combustible -25%

Fire Flow	4500.0 L/min
-----------	---------------------

3. Reduction for Sprinkler Protection

Sprinklered -50%

Reduction	-2250 L/min
-----------	--------------------

4. Increase for Separation Distance

N 30.1m-45m	5%
S 3.1m-10m	20%
E 0m-3m	25%
W 10.1m-20m	15%

% Increase **65%** value not to exceed 75% per FUS Part II, Section 4

Increase	2925.0 L/min
----------	---------------------

Total Fire Flow

Fire Flow	5175.0 L/min	fire flow not to exceed 45,000 L/min nor be less than 2,000 L/min per FUS Section
	5000.0 L/min	rounded to the nearest 1,000 L/min

Notes:

- Type of construction, Occupancy Type and Sprinkler Protection information provided by _____.
- Calculations based on Fire Underwriters Survey - Part II

Boundary Conditions Unit Conversion

	Height (m)	Elevation (m)	m H ₂ O	PSI	kPa		L/s	L/min
Avg. DD	134.7	78.4	56.3	80.1	552.3	Fire Flow @ 140kPa	467	28020
Fire Flow			0.0	0.0	0.0			
Peak Hour	124.6	78.4	46.2	65.7	453.2			

Alison Gosling

From: Anthony Temelini
Sent: Monday, October 30, 2017 5:09 PM
To: Oram, Cody
Cc: Robert Freel; Alison Gosling
Subject: RE: 770 Brookfield - Boundary Condition Request
Attachments: 770_Brookfield_key.pdf; 770 Brookfield Oct 2017.pdf; wtr-2017-10-30_966_ajg.pdf

Hi Cody,

As the previous site plan for 770 Brookfield has been updated, we would like to request updated water boundary conditions for the site. Please note that at this time, we only require the updated boundary conditions for Phase 1 (we will request the updated boundary conditions for Phase 2 at a later time), based on the following proposed development demands:

1. Location of Service / Street Number: 770 Brookfield Road
2. Type of development and the amount of fire flow required for the proposed development:
 - Phased development – Phase 1 to have 355 residential units and 1206 m² of commercial space .
 - It is anticipated that the development will have a dual connection to the existing 305 mm diameter watermain within Brookfield Road, as shown by the attached water distribution map.
 - Fire demand based on FUS was used to calculate fire demand. Based on our calculations, we anticipate a maximum fire flow demand of 17 000 L/min.
3. Demands:

Phase 1

	L/min	L/s
Avg. Daily	157.4	2.62
Max Day	391.4	6.52
Peak Hour	859.9	14.33

It you have any questions please feel free to contact me.

Thank you,

Anthony Temelini, E.I.T.
Project Coordinator

DSEL

david schaeffer engineering ltd.

120 Iber Road, Unit 103
Stittsville, ON K2S 1E9

phone: (613) 836-0856 ext.524
email: atemelini@dsel.ca

From: Oram, Cody [mailto:Cody.Oram@ottawa.ca]
Sent: Monday, October 30, 2017 10:29 AM
To: Anthony Temelini
Cc: Robert Freel; Alison Gosling
Subject: RE: 770 Brookfield - Boundary Condition Request

Hi Anthony,

The following are boundary conditions, HGL, for hydraulic analysis at 770 Brookfield St (zone 2C) assumed to be connected to the 305 mm on Brookfield St (see attached PDF for location).

Phase 1 Demands - Connection 1 Only

Minimum HGL = 124.6 m

Maximum HGL = 134.7 m

The maximum pressure is estimated to be above 80 psi. A pressure check at completion of construction is recommended to determine if pressure control is required.

Available fire flow = 467 L/s assuming a residual of 20 psi and a ground elevation of 78.4 m

Phase 2 Demands - Both Connections

Minimum HGL = 124.4 m (Both Connections)

Maximum HGL = 134.5 m (Both Connections)

The maximum pressure is estimated to be above 80 psi. A pressure check at completion of construction is recommended to determine if pressure control is required.

Available fire flow = 461 L/s assuming a residual of 20 psi and a ground elevation of 78.4 m (Connection 1)

Available fire flow = 484 L/s assuming a residual of 20 psi and a ground elevation of 77.7 m (Connection 2)

These are for current conditions and are based on computer model simulation.

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.

Regards,

Cody Oram, P.Eng. Senior Engineer

Development Review, South Services

Planning, Infrastructure and Economic Development Department | Services de planification, d'infrastructure et de développement économique



From: Anthony Temelini [<mailto:ATemelini@dsel.ca>]

Sent: Thursday, October 19, 2017 2:21 PM

To: Oram, Cody <Cody.Oram@ottawa.ca>

Cc: Robert Freel <RFreel@dsel.ca>; Alison Gosling <AGosling@dsel.ca>

Subject: RE: 770 Brookfield - Boundary Condition Request

Hi Cody,

In response to your questions:

- 1) It is not anticipated that the two connections will be looped within the municipal road allowance at this time;
- 2) Is it possible to get boundary conditions for both scenarios (i.e. boundary conditions for Phase 1 demands only and boundary conditions for the total demands)? At this time, there is still some uncertainty as to whether both connections would be installed independently or whether both would be installed as part of Phase 1.

Please let us know if you are able to provide the demands for both scenarios and feel free to contact me if you have any further questions.

Thank you,

Anthony Temelini, E.I.T.
Project Coordinator

DSEL

david schaeffer engineering ltd.

120 Iber Road, Unit 103
Stittsville, ON K2S 1E9

phone: (613) 836-0856 ext.524

email: atemelini@dsel.ca

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From: Oram, Cody [<mailto:Cody.Oram@ottawa.ca>]

Sent: Wednesday, October 18, 2017 4:12 PM

To: Anthony Temelini

Cc: Robert Freel; Alison Gosling

Subject: RE: 770 Brookfield - Boundary Condition Request

Hi Anthony,

Our water modelling group requires clarification on the following;

1. Will the two connections be looped?
2. Does the consultant need boundary conditions for each phase, or just for the total demands? (If for each phase, are both connections to be installed in the first phase or only one?)

Thank you,
Cody

From: Oram, Cody
Sent: Wednesday, October 18, 2017 9:50 AM
To: 'Anthony Temelini' <ATemelini@dsel.ca>
Cc: Robert Freel <RFreel@dsel.ca>; Alison Gosling <AGosling@dsel.ca>; Shillington, Jeffrey <jeff.shillington@ottawa.ca>
Subject: RE: 770 Brookfield - Boundary Condition Request

Hi Anthony,

I've requested the water boundary conditions and will forward them to you as soon as I get them.

Cody

From: Anthony Temelini [<mailto:ATemelini@dsel.ca>]
Sent: Tuesday, October 17, 2017 5:49 PM
To: Shillington, Jeffrey <jeff.shillington@ottawa.ca>
Cc: Oram, Cody <Cody.Oram@ottawa.ca>; Robert Freel <RFreel@dsel.ca>; Alison Gosling <AGosling@dsel.ca>
Subject: RE: 770 Brookfield - Boundary Condition Request

Hi Jeff,

I just wanted to follow up on my e-mail below. Have you had a chance to review the boundary condition request for 770 Brookfield?

Please let me know.

Thanks,

Anthony Temelini, E.I.T.
Project Coordinator

DSEL
david schaeffer engineering ltd.

120 Iber Road, Unit 103
Stittsville, ON K2S 1E9

phone: (613) 836-0856 ext.524
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From: Anthony Temelini
Sent: Wednesday, October 11, 2017 10:19 AM

To: 'jeff.shillington@ottawa.ca'
Cc: cody.oram@ottawa.ca; Robert Freel; Alison Gosling
Subject: FW: 770 Brookfield - Boundary Condition Request

Hi Jeff,

In Cody's absence, can you please review the boundary condition request below for 770 Brookfield?

Please let me know if you have any questions or comments.

Thank you,

Anthony Temelini, E.I.T.
Project Coordinator

DSEL

david schaeffer engineering ltd.

120 Iber Road, Unit 103
Stittsville, ON K2S 1E9

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From: Anthony Temelini
Sent: Friday, October 06, 2017 1:06 PM
To: 'cody.oram@ottawa.ca'
Cc: Alison Gosling; Robert Freel
Subject: 770 Brookfield - Boundary Condition Request

Good afternoon Cody,

We would like to request updated water boundary conditions for 770 Brookfield Road using the following proposed development demands:

1. Location of Service / Street Number: 770 Brookfield Road
2. Type of development and the amount of fire flow required for the proposed development:
 - The phased development proposes approximately 544 total residential units and 550 m² of total commercial space.
 - It is anticipated that the development will have a dual connection to the existing 305 mm diameter watermain within Brookfield Road, as shown by the attached water distribution map.
 - Fire demand based on FUS will be used to calculate fire demand. Sufficient information is unavailable at this time to complete a calculation – we would request that the available fire flow at 140 kPa be provided for later comparison.
3. Demands

Phase 1

	L/min	L/s
Avg. Daily	119.8	2.00
Max Day	346.4	5.77
Peak Hour	514.0	8.57

Phase 2

	L/min	L/s
Avg. Daily	119.4	1.99
Max Day	345.8	5.76
Peak Hour	512.9	8.55

Total

	L/min	L/s
Avg. Daily	239.2	3.99
Max Day	692.2	11.53
Peak Hour	1026.9	17.12

It you have any questions please feel free to contact me.

Thank you,

Anthony Temelini, E.I.T.
Project Coordinator

DSEL

david schaeffer engineering ltd.

120 Iber Road, Unit 103
Stittsville, ON K2S 1E9

phone: (613) 836-0856 ext.524

email: atemelini@dsel.ca

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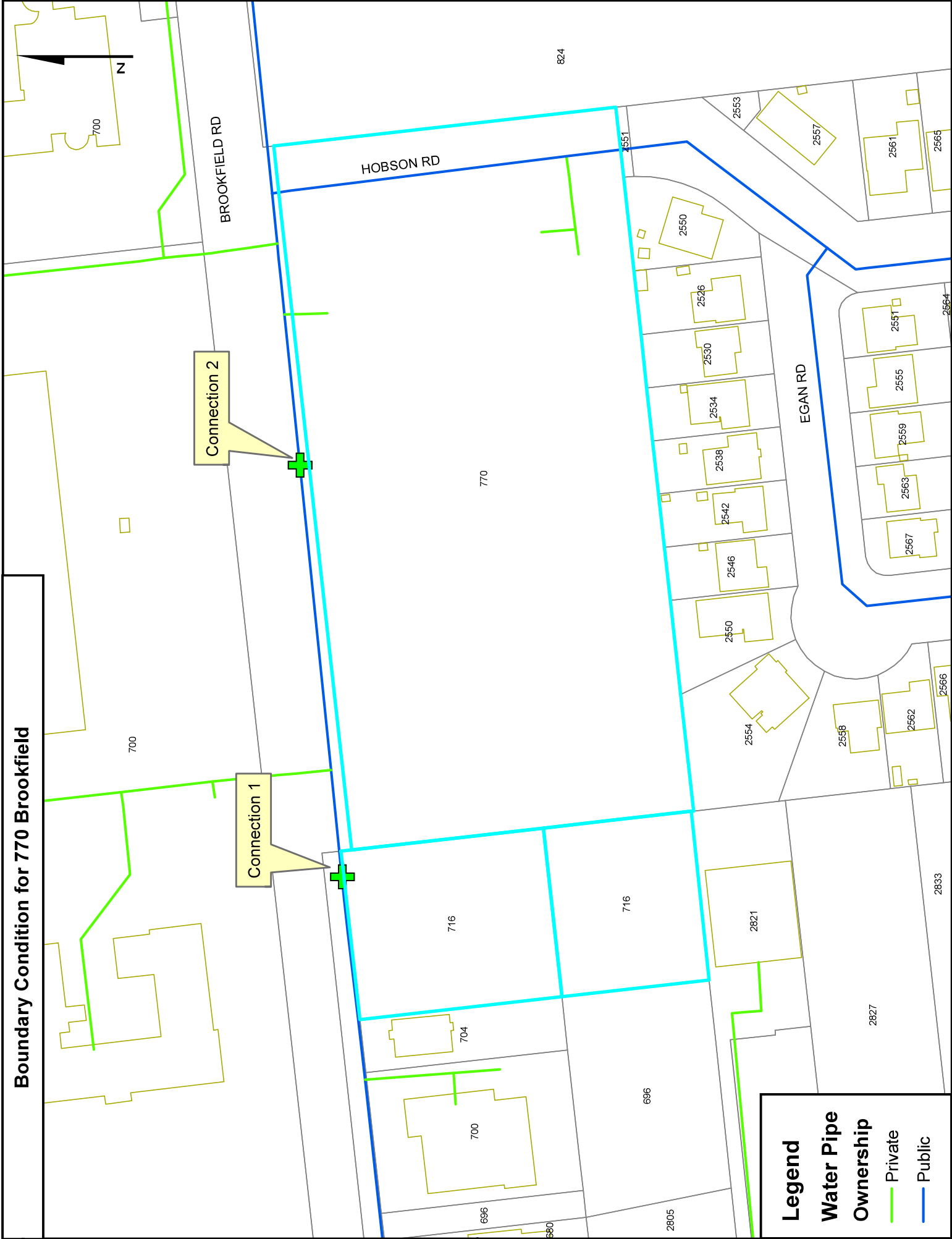
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,

The map displays the area around 770 Brookfield, highlighting water pipe ownership and boundary conditions. The map includes the following features:

- Boundary Condition for 770 Brookfield:** A yellow callout box pointing to the intersection of Brookfield Rd and Hobson Rd.
- Connection 1:** A yellow callout box pointing to the intersection of Brookfield Rd and Hobson Rd.
- Connection 2:** A yellow callout box pointing to the intersection of Brookfield Rd and Hobson Rd.
- Water Pipe Ownership:**
 - Private:** Indicated by green lines.
 - Public:** Indicated by blue lines.
- Legend:** A legend in the bottom right corner defining the colors for water pipe ownership.
- Map Labels:**
 - Brookfield Rd
 - Hobson Rd
 - Egan Rd
 - 770
 - 716
 - 704
 - 700
 - 696
 - 2805
 - 2800
 - 2821
 - 2827
 - 2833
 - 2558
 - 2562
 - 2566
 - 2554
 - 2550
 - 2546
 - 2542
 - 2538
 - 2534
 - 2530
 - 2526
 - 2550
 - 2553
 - 2557
 - 2561
 - 2565
 - 2567
 - 2563
 - 2559
 - 2555
 - 2551
 - 2564



Connection 2

Connection 1

Legend

Water Pipe

Ownership

— Private

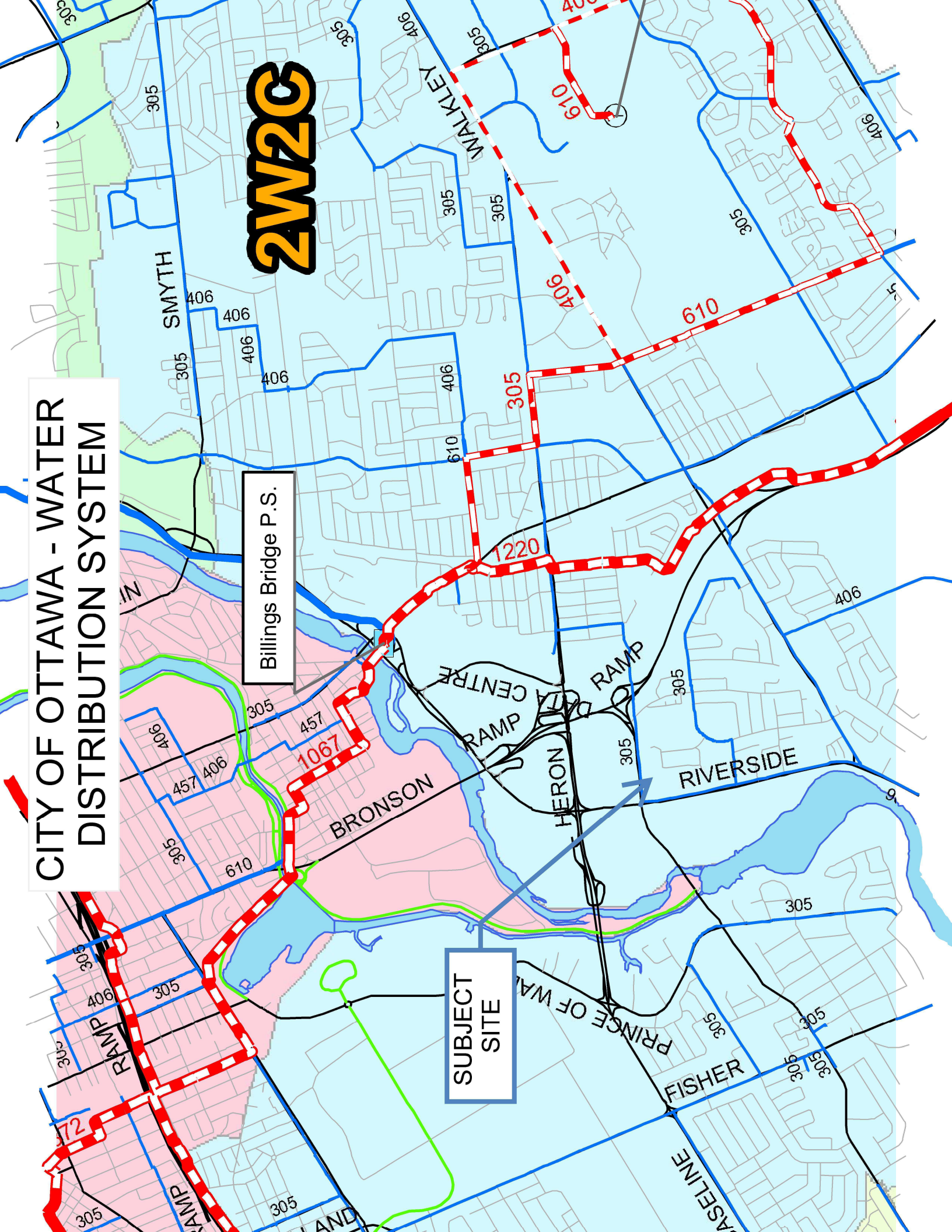
— Public

CITY OF OTTAWA - WATER
DISTRIBUTION SYSTEM

2W2C

Billings Bridge P.S.

SUBJECT
SITE



APPENDIX C

Wastewater Collection

Wastewater Design Flows per Unit Count
City of Ottawa Sewer Design Guidelines, 2004



Site Area 1.39 ha

Extraneous Flow Allowances

Infiltration / Inflow 0.39 L/s

Domestic Contributions

Unit Type	Unit Rate	Units	Pop
Single Family	3.4		0
Semi-detached and duplex	2.7		0
Townhouse	2.7		0
Stacked Townhouse	2.3		0
Apartment			
Bachelor	1.4		0
1 Bedroom	1.4		0
2 Bedroom	2.1		0
3 Bedroom	3.1		0
Average	1.8	355	639

Total Pop 639

Average Domestic Flow 2.59 L/s

Peaking Factor 3.92

Peak Domestic Flow 10.14 L/s

Institutional / Commercial / Industrial Contributions

Property Type	Unit Rate	No. of Units	Avg Wastewater (L/s)
Commercial floor space*	5 L/m ² /d	1,206	0.14
Hospitals	900 L/bed/d		0.00
School	70 L/student/d		0.00
Industrial - Light**	35,000 L/gross ha/d		0.00
Industrial - Heavy**	55,000 L/gross ha/d		0.00

Average I/C/I Flow 0.14

Peak Institutional / Commercial Flow 0.21

Peak Industrial Flow** 0.00

Peak I/C/I Flow 0.21

* assuming a 12 hour commercial operation

** peak industrial flow per City of Ottawa Sewer Design Guidelines Appendix 4B

Total Estimated Average Dry Weather Flow Rate	2.7 L/s
Total Estimated Peak Dry Weather Flow Rate	10.3 L/s
Total Estimated Peak Wet Weather Flow Rate	10.7 L/s

SANITARY SEWER CALCULATION SHEET

CLIENT: HOBIN ARCHITECTURE INC.
 LOCATION: 770 Brookfield Road
 FILE REF: 17-966
 DATE: 30-Oct-17

DESIGN PARAMETERS

Avg. Daily Flow Res.	350	Lpd	Peak Fact Res. Per Harmons: Min = 2.0, Max = 4.0
Avg. Daily Flow Comm	50 000	Uha/d	Peak Fact. Comm.
Avg. Daily Flow Instit.	50 000	Uha/d	Peak Fact. Instit.
Avg. Daily Flow Indust.	95 000	Uha/d	Peak Fact. Indust. per MOE graph

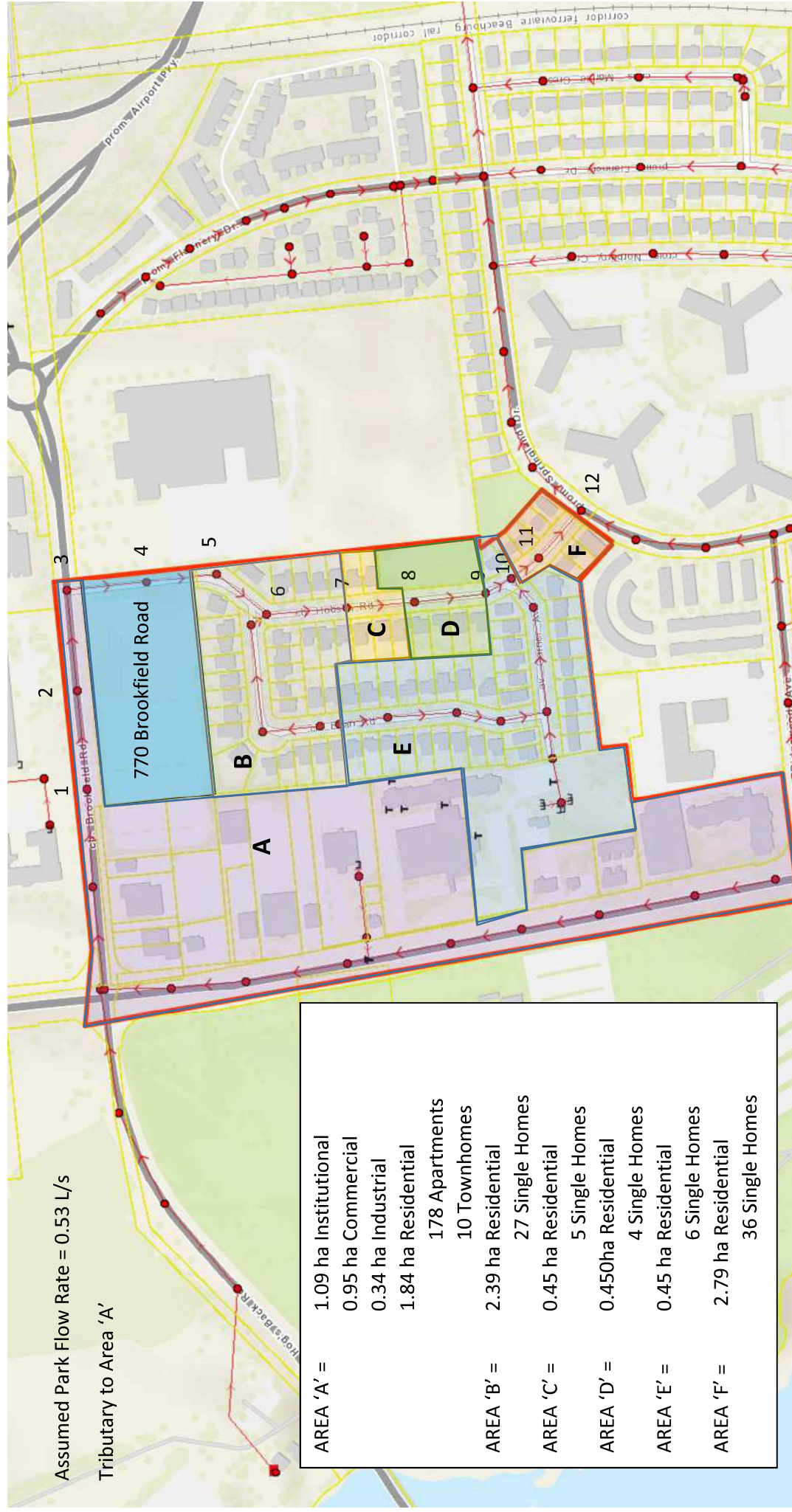
Peak Fact Res. Per Harmonics: Min = 2.0, Max = 4.0	Infiltration / Inflow	0.28 L/s/ha
Peak Fact, Comm., 1.5	Min. Pipe Velocity	0.60 m/s full flowing
Peak Fact, Inlet, 1.5	Max. Pipe Velocity	3.00 m/s full flowing
Peak Fact, Includ. per MDE graph	Mannings N	0.013

Infiltration / Inflow
Min. Pipe Velocity
Max. Pipe Velocity
Mannings N

0.28 L/s/ha
0.60 m/s full flowing
3.00 m/s full flowing
0.013

[illegible]

† Park flow included as part of the indicated flow rate



CITY OF OTTAWA - SANITARY
TRUNK SEWERS AND
COLLECTION AREAS

AVE CREEK
COLLECTOR

OONEY'S BAY COLLECTOR

SPRINGHURST AV
SEWER & OUTFA

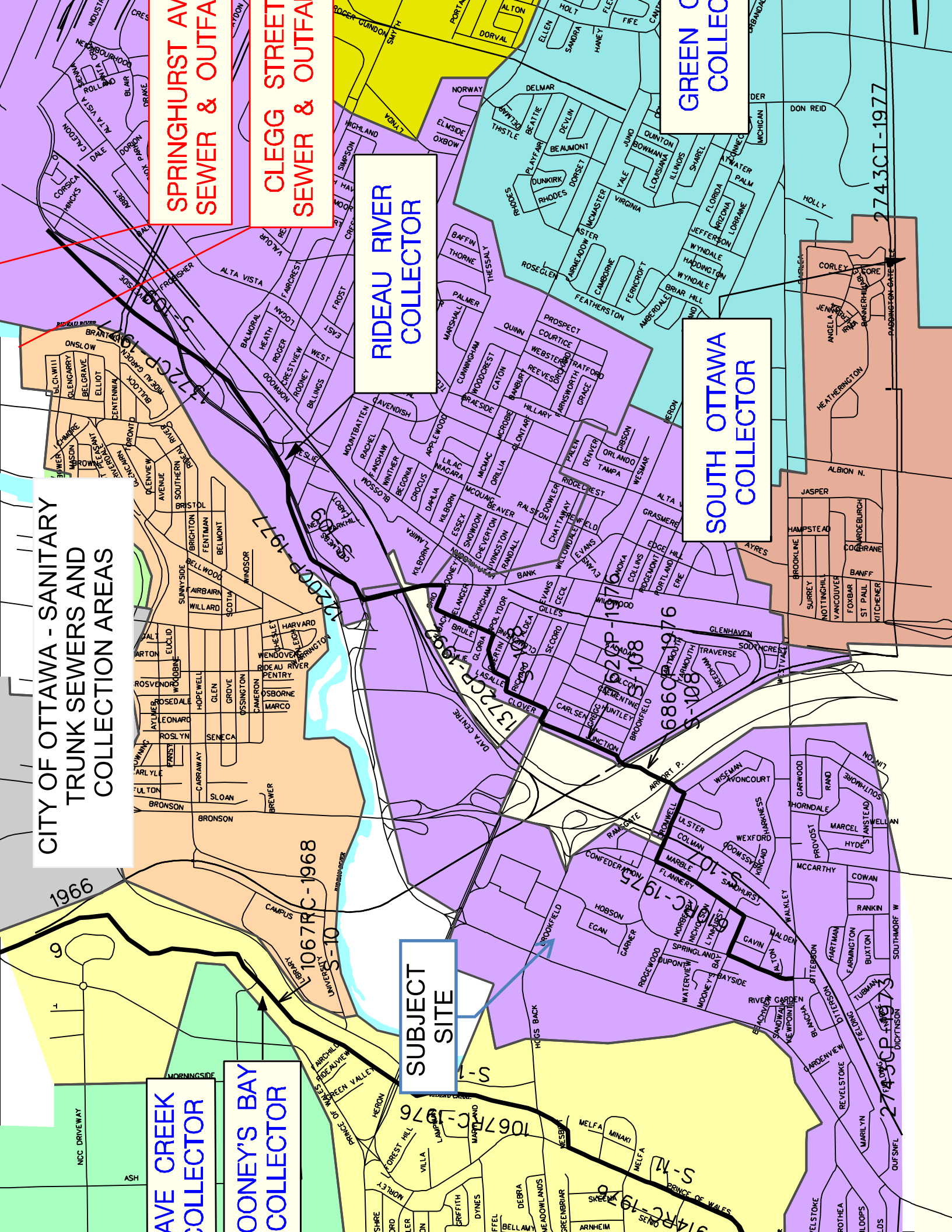
CLEGG STREET
SEWER & OUTFALL

RIDEAU RIVER
COLLECTOR

SUBJECT SITE

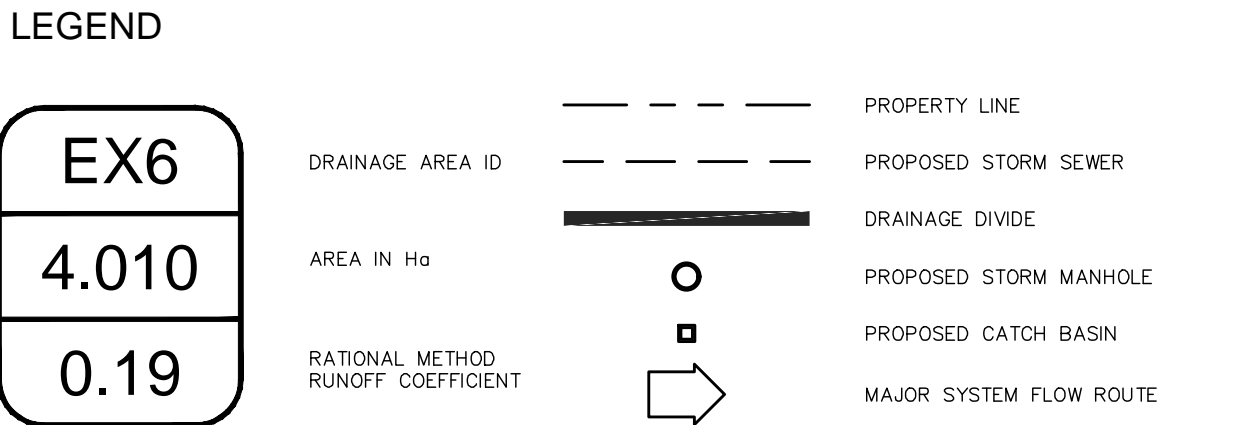
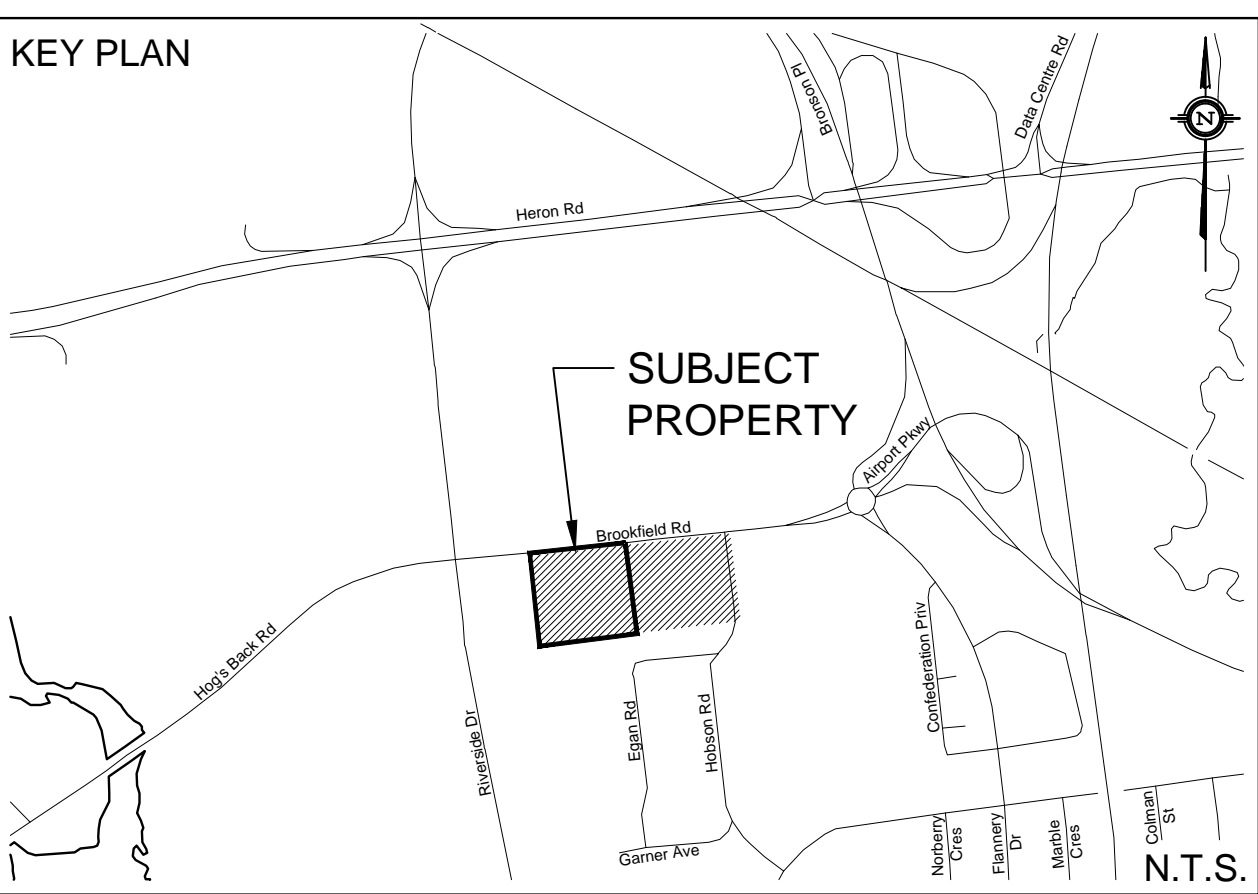
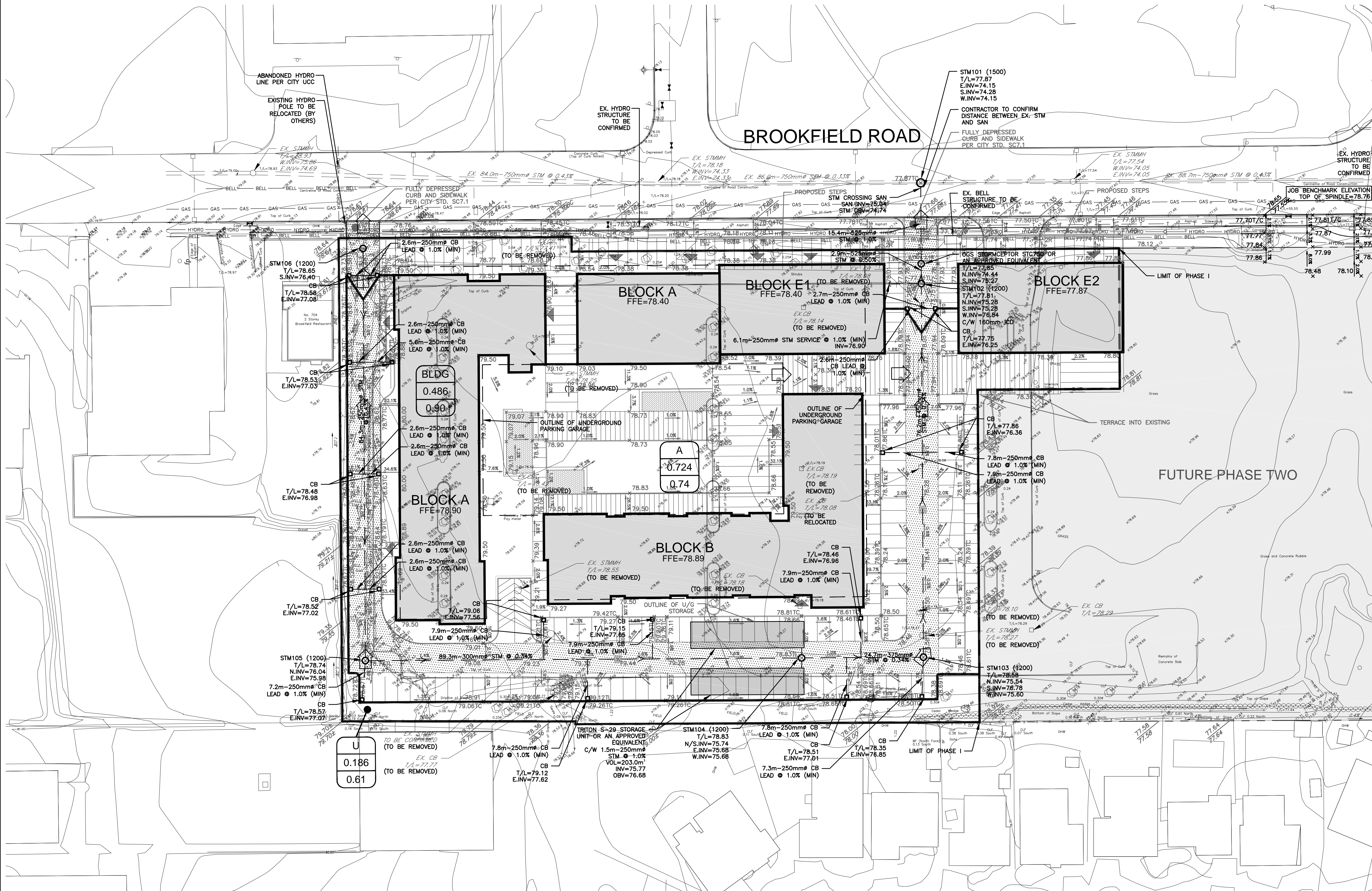
**SOUTH OTTAWA
COLLECTOR**

GREEN COLLEGE



APPENDIX D

Stormwater Management



NOT FOR CONSTRUCTION

TOPOGRAPHIC INFORMATION
TOPOGRAPHIC INFORMATION PROVIDED BY ANNIS O'SULLIVAN VOLLEBEKK LTD.
PROJ. NO. 19746-147
DATED OCTOBER 5, 2017

SITE PLAN INFORMATION
SITE PLAN PROVIDED BY BARRY J. HOBIN & ASSOCIATES ARCHITECTS INC.
PROJ. NO. 17-966
DATED OCTOBER 25, 2017

GEOTECHNICAL STUDY
GEOTECHNICAL RECOMMENDATIONS PROVIDED BY PATERSON GROUP
PROJ. NO. PG3275-1
DATED NOVEMBER 28, 2014

SITE SERVICING AND STORMWATER MANAGEMENT STUDY
SERVICING AND STORMWATER MANAGEMENT RECOMMENDATIONS PROVIDED BY DSEL
PROJ. NO. 17-966
DATED OCTOBER 2017

BENCH MARK
TOP OF SPINDLE OF FIRE HYDRANT LOCATED ON SOUTH SIDE OF BROOKFIELD ROAD AT HOBSON ROAD
ELEV=78.76

1	A.J.G.	17.10.31	ISSUED FOR MUNICIPAL REVIEW
No.	BY	YY.MM.DD	DESCRIPTION

REVIEWED BY

PROJECT No. 17-966

STORMWATER MANAGEMENT PLAN

770 BROOKFIELD ROAD - PHASE I

© DSEL

HOBIN ARCHITECTURE INCORPORATED

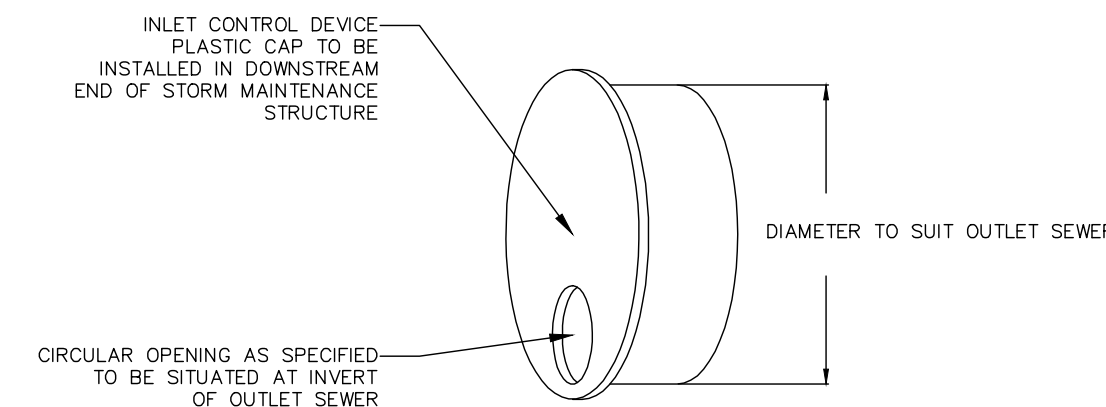
63 PAMILLA STREET
OTTAWA, ON K1S 3K7
(613) 238-7200

DSEL
david schaeffer engineering ltd
SMART SUBDIVISIONS™

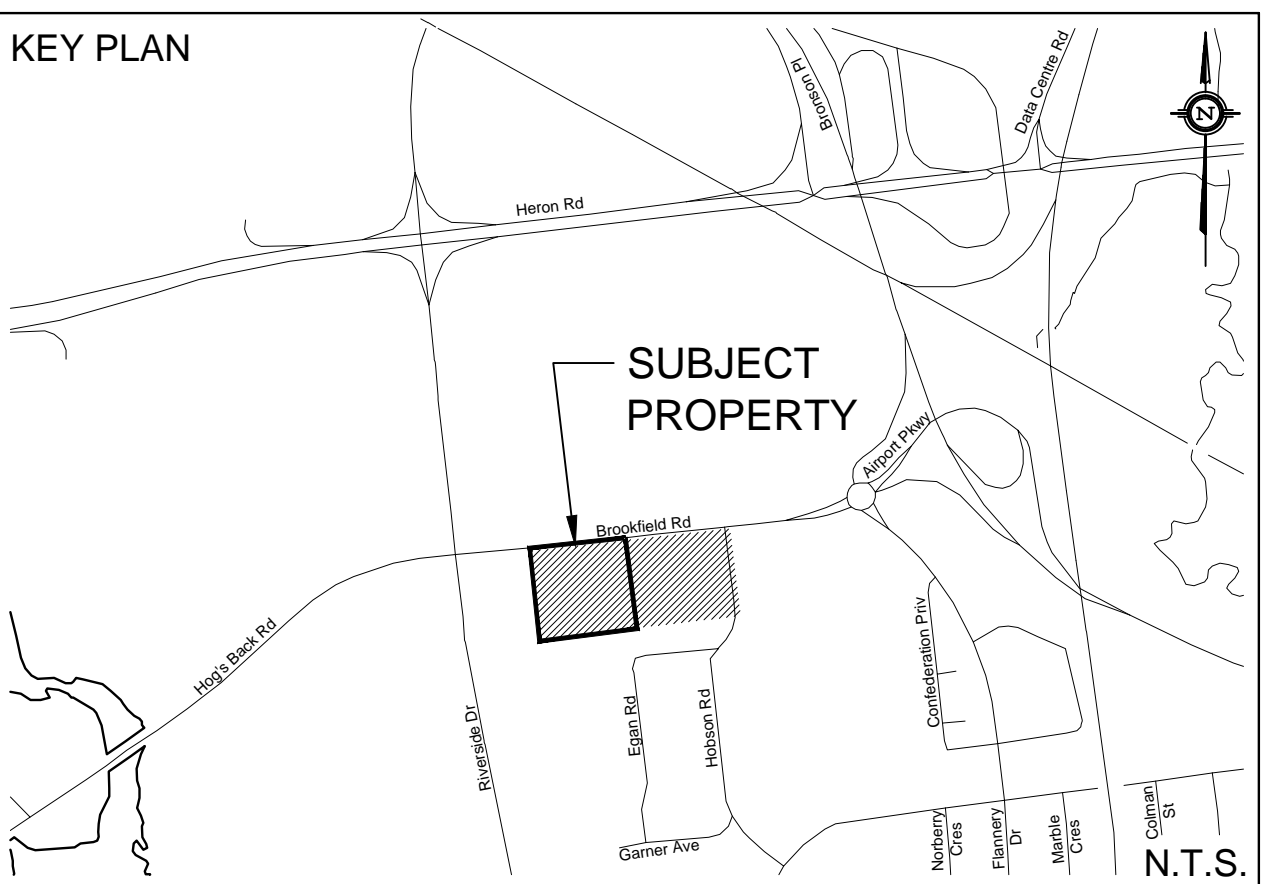
120 Iker Road Unit 103
Stittsville, Ontario, K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

DRAWN BY:	H.J.P.	CHECKED BY:	R.D.F.	DRAWING NO.	SHEET NO.
DESIGNED BY:	H.J.P.	CHECKED BY:	R.D.F.		
SCALE:	1:400	DATE:	OCTOBER 2017	SWM-1	1 of 2





INLET CONTROL DEVICE (ICD) DETAIL PLASTIC "PLUG" STYLE



NOT TO SCALE



EX6
4.010
0.19

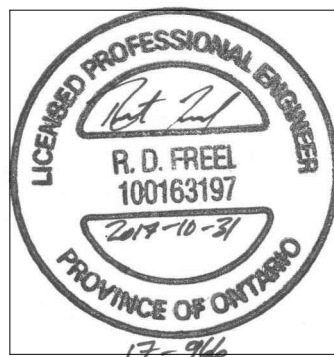
		PROPERTY LINE
DRAINAGE AREA ID		PROPOSED STORM SEWER
		DRAINAGE DIVIDE
AREA IN Ho		PROPOSED STORM MANHOLE
		PROPOSED CATCH BASIN
RATIONAL METHOD RUNOFF COEFFICIENT		MAJOR SYSTEM FLOW ROUTE

NOT FOR CONSTRUCTION

TOP OF SPINDLE OF FIRE HYDRANT LOCATED ON SOUTH SIDE OF BROOKFIELD ROAD AT HOBSON ROAD
ELEV=78.76

[illegible]

1	A.J.G.	17.10.31	ISSUED FOR MUNICIPAL REVIEW
No.	BY	YY.MM.DD	DESCRIPTION

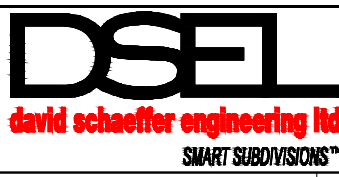


2017-10-31 #17-966

REVIEWED BY

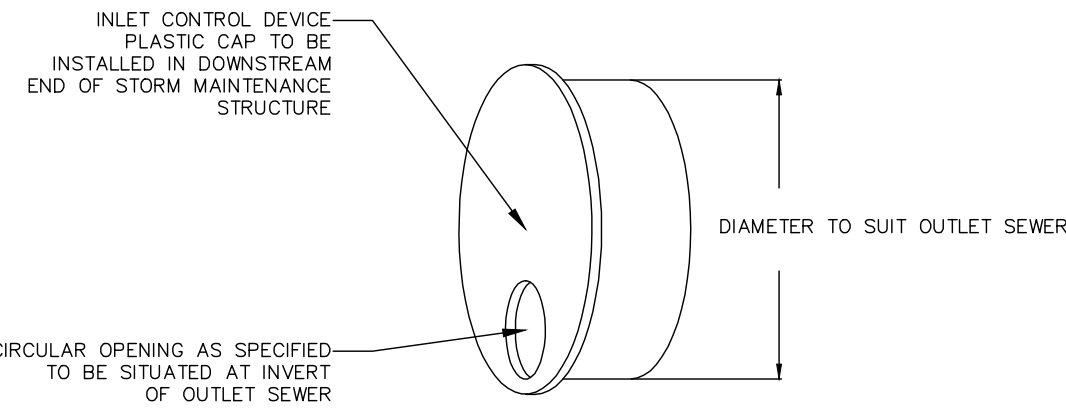
STORMWATER MANAGEMENT PLAN - SUBCATCHMENTS
770 BROOKFIELD ROAD - PHASE I © DSI

63 PAMILLA STREET
OTTAWA, ON K1S 3K7
(613) 238-7200



120 Iber Road Unit 103
 Pittsville, Ontario, K2S 1E9
 Tel. (613) 836-0856
 Fax. (613) 836-7183
www.DSEL.ca

DRAWN BY:	H.J.P.	CHECKED BY:	R.D.F.	DRAWING NO.	SHEET NO.
DESIGNED BY:	H.J.P.	CHECKED BY:	R.D.F.	SWM-2	2 of 2
SCALE:	1: 400	DATE:	OCTOBER 2017		



NOT TO SCALE

Estimated Peak Stormwater Flow Rate
City of Ottawa Sewer Design Guidelines, 2012



Existing Drainage Characteristics From Internal Site

Area	1.39 ha
C	0.72 Rational Method runoff coefficient
L	81 m
Up Elev	79.45 m
Dn Elev	78.25 m
Slope	1.5 %
Tc	9.7 min

	Imp.	Perv.	Total
Area	1.041	0.354	1.394
C	0.9	0.2	0.72

1) Time of Concentration per Federal Aviation Administration

$$t_c = \frac{1.8(1.1 - C)L^{0.5}}{S^{0.333}}$$

tc, in minutes

C, rational method coefficient, (-)

L, length in ft

S, average watershed slope in %

Estimated Peak Flow

	2-year	5-year	100-year
i	77.9	105.7	181.2 mm/hr
Q	218.0	295.8	633.7 L/s

Note:

C value for the 100-year storm is increased by 25%, to a maximum of 1.0 per Ottawa Sewer Design Guidelines (5.4.5.2.1)

Stormwater - Proposed Development
City of Ottawa Sewer Design Guidelines, 2012



Target Flow Rate

Area	1.39 ha	
C	0.50 Rational Method runoff coefficient	
t _c	10.0 min	* Time of Concentration greater or less than 10 minutes

2-year

i	76.8 mm/hr
Q	148.8 L/s

Estimated Post Development Peak Flow from Unattenuated Areas

U	Imp.	Perv.	Total
Area	0.108	0.077	0.186
C	0.9	0.2	0.61

Area ID	U
Total Area	0.186 ha
C	0.61 Rational Method runoff coefficient

5-year						100-year				
t _c (min)	i (mm/hr)	Q _{actual} (L/s)	Q _{release} (L/s)	Q _{stored} (L/s)	V _{stored} (m³)	i (mm/hr)	Q _{actual} (L/s)	Q _{release} (L/s)	Q _{stored} (L/s)	V _{stored} (m³)
14.2	86.1	27.0	27.0	0.0	0.0	147.3	57.8	57.8	0.0	0.0

Note:

C value for the 100-year storm is increased by 25%, to a maximum of 1.0 per Ottawa Sewer Design Guidelines (5.4.5.2.1)

Estimated Post Development Peak Flow from Attenuated Areas

Building ID	BLDG A + BLDG B + BLDG E1 + BLDG E2	
Roof Area	0.486 ha	
Avail Storage Area	0.462	
C	0.90 Rational Method runoff coefficient	Note: Rational Method Coefficient "C" increased by 25% for 100-year calculations
t _c	10 min, t _c at outlet without restriction	

Estimated Number of Roof Drains

Building Length	280.0
Building Width	18.5
Number of Drains	20
m² / Drain	231.1 max 232.25m²/notch as recommended by Zurn for Ottawa

Roof Top Rating Curve per Zurn Model Z-105-5						
d (m)	A (m²)	V _{acc} (m³)	V _{avail} (m³)	Q _{notch} (L/s)	Q _{roof} (L/s)	V _{drawdown} (hr)
0.000	0	0.0	0.0	0.00	0.00	0.00
0.025	288.9	2.4	2.4	0.38	7.60	0.09
0.050	1155.4	16.8	19.3	0.77	15.40	0.39
0.075	2599.7	45.7	65.0	1.14	22.80	0.95
0.100	4621.7	89.1	154.1	1.52	30.40	1.76
0.125	4621.7	115.5	269.6	1.90	38.00	2.61
0.150	4621.7	115.5	385.1	2.28	45.60	3.31

* Assumes one notch opening per drain, assumes maximum slope of 10cm

5-year						100-year				
t _c (min)	i (mm/hr)	Q _{actual} (L/s)	Q _{release} (L/s)	Q _{stored} (L/s)	V _{stored} (m³)	i (mm/hr)	Q _{actual} (L/s)	Q _{release} (L/s)	Q _{stored} (L/s)	V _{stored} (m³)
10	104.2	126.7	23.7	103.0	61.8	178.6	241.3	31.4	209.9	126.0
15	83.6	101.6	23.7	77.9	70.1	142.9	193.1	31.4	161.8	145.6
20	70.3	85.4	23.7	61.7	74.1	120.0	162.1	31.4	130.7	156.9
25	60.9	74.1	23.7	50.4	75.5	103.8	140.3	31.4	109.0	163.5
30	53.9	65.6	23.7	41.9	75.4	91.9	124.1	31.4	92.8	167.0
35	48.5	59.0	23.7	35.3	74.1	82.6	111.6	31.4	80.2	168.5
40	44.2	53.7	23.7	30.0	72.1	75.1	101.5	31.4	70.2	168.5
45	40.6	49.4	23.7	25.7	69.4	69.1	93.3	31.4	62.0	167.3
50	37.7	45.8	23.7	22.1	66.3	64.0	86.4	31.4	55.1	165.2
55	35.1	42.7	23.7	19.0	62.8	59.6	80.6	31.4	49.2	162.4
60	32.9	40.1	23.7	16.4	58.9	55.9	75.5	31.4	44.2	159.1
65	31.0	37.8	23.7	14.1	54.8	52.6	71.1	31.4	39.8	155.2
70	29.4	35.7	23.7	12.0	50.5	49.8	67.3	31.4	35.9	150.9
75	27.9	33.9	23.7	10.2	46.0	47.3	63.9	31.4	32.5	146.3
80	26.6	32.3	23.7	8.6	41.3	45.0	60.8	31.4	29.4	141.4
85	25.4	30.9	23.7	7.2	36.5	43.0	58.0	31.4	26.7	136.1
90	24.3	29.5	23.7	5.8	31.5	41.1	55.6	31.4	24.2	130.7
95	23.3	28.3	23.7	4.6	26.5	39.4	53.3	31.4	21.9	125.1
100	22.4	27.3	23.7	3.6	21.3	37.9	51.2	31.4	19.9	119.2
105	21.6	26.2	23.7	2.5	16.1	36.5	49.3	31.4	18.0	113.2
110	20.8	25.3	23.7	1.6	10.7	35.2	47.6	31.4	16.2	107.1

5-year Q _{roof}	23.70 L/s	100-year Q _{roof}	31.35 L/s
5-year Max. Storage Required	75.5 m³	100-year Max. Storage Required	168.5 m³
5-year Storage Depth	0.078 m	100-year Storage Depth	0.103 m
5-year Estimated Drawdown Time	1.05 hr	100-year Estimated Drawdown Time	1.87 hr

Estimated Post Development Peak Flow from Attenuated Areas

Area ID A
Available Sub-surface Storage
Maintenance Structures

A	Imp.	Perv.	Total
Area	0.561	0.163	0.724
C	0.9	0.2	0.74

Total Subsurface Storage (m³) 203.0

Stage Attenuated Areas Storage Summary

Stage		Surface Storage			Surface and Subsurface Storage			
		Ponding	h _o	delta d	V*	V _{acc} **	Q _{release} †	V _{drawdown}
	(m)	(m²)	(m)	(m)	(m³)	(m³)	(L/s)	(hr)
Orifice INV	75.08		0.00			0.0	0.0	0.00
U/G STORAGE INV	75.77		0.69	0.69	0.0	0.0	45.1	0.00
U/G STORAGE S/L	76.23		1.15	0.46	67.7	67.7	58.2	0.32
U/G STORAGE OBV	76.68		1.60	0.46	67.7	135.3	68.8	0.55
T/L	77.85		2.77	1.17	67.7	203.0	90.4	0.62

* V=Incremental storage volume

**V_{acc}=Total surface and sub-surface

† Q_{release} = Release rate calculated from orifice equation

Orifice Location STM102 Dia 160
Total Area 0.724 ha
C 0.74 Rational Method runoff coefficient Note: Rational Method Coefficient "C" increased by 25% for 100-year calculations

t _c (min)	5-year					100-year				
	i (mm/hr)	Q _{actual} † (L/s)	Q _{release} (L/s)	Q _{stored} (L/s)	V _{stored} (m ³)	i (mm/hr)	Q _{actual} † (L/s)	Q _{release} (L/s)	Q _{stored} (L/s)	V _{stored} (m ³)
10	104.2	179.2	60.4	118.8	71.3	178.6	364.5	90.3	274.3	164.6
15	83.6	148.4	60.4	88.0	79.2	142.9	298.0	90.3	207.7	187.0
20	70.3	128.6	60.4	68.2	81.8	120.0	255.2	90.3	164.9	197.9
25	60.9	114.6	60.4	54.2	81.3	103.8	225.1	90.3	134.9	202.3
30	53.9	104.2	60.4	43.8	78.8	91.9	202.8	90.3	112.5	202.5
35	48.5	96.1	60.4	35.7	75.0	82.6	185.4	90.3	95.2	199.9
40	44.2	89.7	60.4	29.3	70.2	75.1	171.6	90.3	81.3	195.1
45	40.6	84.4	60.4	23.9	64.7	69.1	160.2	90.3	69.9	188.8
50	37.7	79.9	60.4	19.5	58.5	64.0	150.7	90.3	60.4	181.3
55	35.1	76.1	60.4	15.7	51.9	59.6	142.6	90.3	52.3	172.7
60	32.9	72.9	60.4	12.5	44.9	55.9	135.6	90.3	45.4	163.4
65	31.0	70.0	60.4	9.6	37.6	52.6	129.6	90.3	39.3	153.4
70	29.4	67.5	60.4	7.1	30.0	49.8	124.3	90.3	34.0	142.8
75	27.9	65.3	60.4	4.9	22.2	47.3	119.5	90.3	29.3	131.7
80	26.6	63.4	60.4	3.0	14.2	45.0	115.3	90.3	25.0	120.2
85	25.4	61.6	60.4	1.2	6.0	43.0	111.5	90.3	21.2	108.3
90	24.3	60.0	60.0	0.0	0.0	41.1	108.1	90.3	17.8	96.1
95	23.3	58.5	58.5	0.0	0.0	39.4	104.9	90.3	14.7	83.6
100	22.4	57.1	57.1	0.0	0.0	37.9	102.1	90.3	11.8	70.9
105	21.6	55.9	55.9	0.0	0.0	36.5	99.5	90.3	9.2	57.9
110	20.8	54.8	54.8	0.0	0.0	35.2	97.0	90.3	6.8	44.7

5-year Q_{attenuated} 60.40 L/s
5-year Max. Storage Required 81.8 m³
Est. 5-year Storage Elevation 76.32 m

100-year Q_{attenuated} 90.26 L/s
100-year Max. Storage Required 202.5 m³
Est. 100-year Storage Elevation 77.84 m

Summary of Release Rates and Storage Volumes

Control Area	5-Year Release Rate (L/s)	5-Year Required Storage (m ³)	100-Year Release Rate (L/s)	100-Year Required Storage (m ³)	100-Year Available Storage (m ³)
Unattenuated Areas	27.0	0.0	57.8	0.0	0.0
Attenuated Areas	60.4	81.8	90.3	202.5	203.0
Total	87.4	81.8	148.0	202.5	203.0

Area ID	Up	Down	Area (ha)	C (-)	Indiv AxC	Acc AxC	T _c (min)	I (mm/hr)	Q (L/s)	DIA (mm)	Slope (%)	Length (m)	A _{hydraulic} (m ²)	R (m)	Velocity (m/s)	Qcap (L/s)	Time Flow (min)	Q / Q full (-)
B1	STM106	STM105	0.102	0.72	0.07	0.07	10.0	104.2	21.3	250	0.43	84.3	0.049	0.063	0.79	39.0	1.8	0.55
B2	STM105	STM104	0.065	0.89	0.06	0.13	11.8	95.7	35.0	300	0.34	89.3	0.071	0.075	0.80	56.4	1.9	0.62
B3	STM104	STM103	0.128	0.89	0.11	0.24	13.6	88.2	60.0	375	0.34	24.7	0.110	0.094	0.93	102.2	0.4	0.59
B4	STM103	STM102	0.429	0.68	0.29	0.54	14.1	86.7	129.4	450	0.34	76.2	0.159	0.113	1.05	166.2	1.2	0.78
BLDG	BLDG	STM102	0.486	0.90	0.44	0.44	10.0	104.2	31.4	250	1.00	6.1	0.049	0.063	1.21	59.5	0.1	0.53
							10.1											
	STM102	OGS		0.90	0.00	0.98	14.1	86.7	234.8	525	0.50	2.9	0.216	0.131	1.40	304.1	0.0	0.77
	OGS	STM101		0.90	0.00	0.98	14.1	86.5	234.4	525	1.00	15.4	0.216	0.131	1.99	430.1	0.1	0.55
							14.2											

B1			B2		
Area	Imp.	Perv.	Area	Imp.	Perv.
C	0.076	0.026	C	0.064	0.001
	0.9	0.2		0.9	0.2
		0.72			0.89

B3			B4		
Area	Imp.	Perv.	Area	Imp.	Perv.
C	0.125	0.002	C	0.295	0.133
	0.9	0.2		0.9	0.2
		0.128			0.429
		0.89			0.68



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Site Calculator

- [System Builder](#)
- [Field Diagram](#)
- [Summary](#)

Parameters

Units: ▾

Storage Volume: Cu. M

Chamber Selection: ▾ [\[+\]](#)

Header Row Position: ▾

Fill Over Embedment Stone: cm

Embedment Stone:

Over:

15

Under:

15

Porosity: 0.4

Controlled By (in M):

Width ▾

6

Accessories:

Dumpsters: 0 ▾

Bins: 0 ▾

Floors: ☐**Double Stacked**Double Stacked?: ☐

Lower Chamber: S-29 ▾

Stone Between: 15

Note: After making an input change you must hit recalculate to update the Field Diagram and Project Results.

RECALCULATE**SAVE**

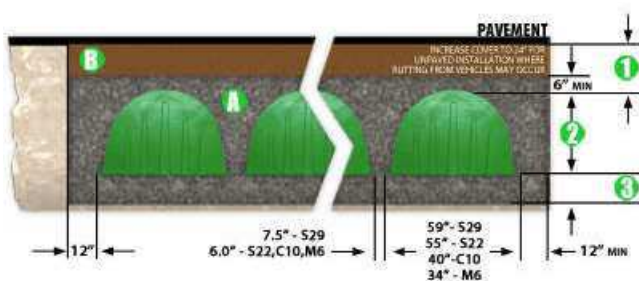
NOTICE: This calculator works best in when used with [Firefox](#) browser. If using Internet Explorer, please be sure to [disable Protected Mode](#). This calculator has shown issues when used in Chrome with AdBlock enabled. If using Chrome, please [disable AdBlock](#).

This calculator is provided for your convenience only and is not meant for final quotation and/or engineering purposes. Please contact Triton



for more information. Need to model out a full system, or need engineering ready calculations? Triton chambers are available for modeling in HydroCAD by clicking on the HydroCAD banner to the left.

Project Results

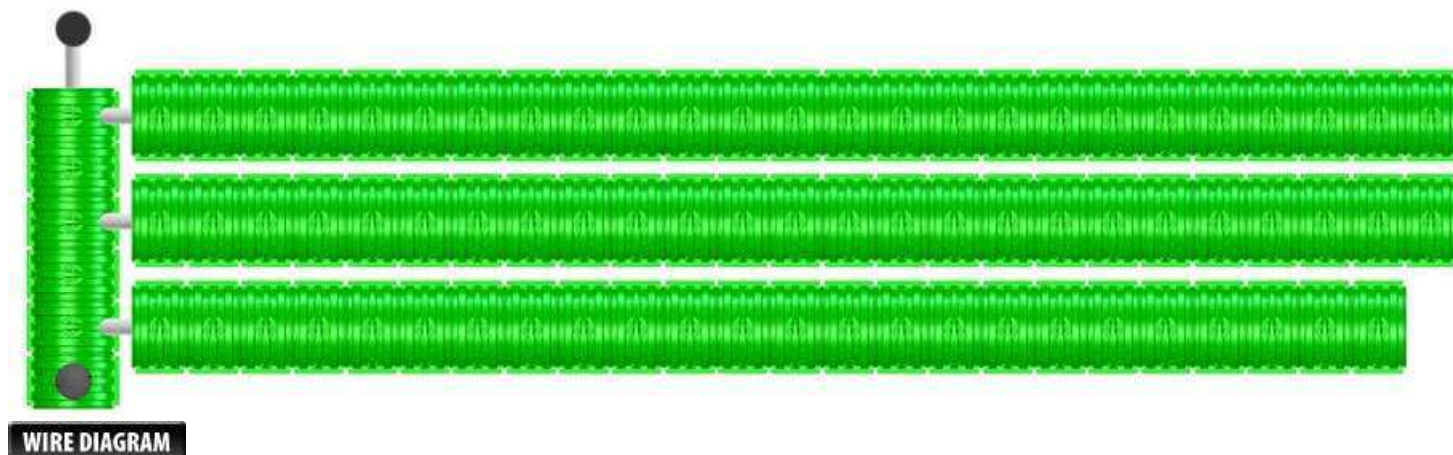


- ① Total Cover Over Chambers: 45.72 cm
- ② Height of Chamber: 91.44 cm
- ③ Embedment Stone Under Chambers: 15.24 cm
- ④ Volume of Embedment Stone Required: 95 Cu. M
- ⑤ Volume of Fill Material Required: 39 Cu. M

Total Storage Provided:	100.2 Cu. M
Type of Distribution Chambers:	S-29
# of Distribution Chambers Required:	74
# of end caps required:	8
Type of header row chambers required:	S-29
# of header row chambers required:	6
Floors:	0
Bins:	0
Dumpsters:	0
Required Bed Size:	129.08 Sq. M
Volume of Embedment Stone Required:	95.23 Cu. M
Volume of Fill Material Required:	39.34 Cu. M
Volume of Excavation:	196.72 Cu. M
Area of Filter Fabric:	199.82 Sq. M

# of Chambers long:	25
# of rows:	3
Actual Trench Length:	23.527 M
Actual Trench Width:	5.486 M

Field Diagram



Chamber Type



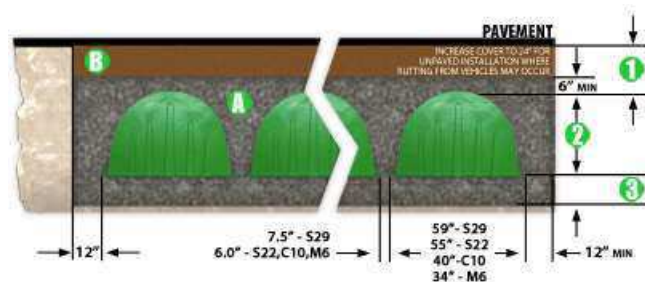
Dimensions 59" x 36" x 35" (WxHxL)

1498.6mm x 914.4mm x 889mm

Weight 32 lbs / 14.5 kg

Bare Chamber Storage 29 ft³ / 0.82 m³

Project Results



- ① Total Cover Over Chambers: 45.72 cm
- ② Height of Chamber: 91.44 cm
- ③ Embedment Stone Under Chambers: 15.24 cm
- A Volume of Embedment Stone Required: 95 Cu. M
- B Volume of Fill Material Required: 39 Cu. M

Total Storage Provided: 100.2 Cu. M

Type of Distribution Chambers: S-29

of Distribution Chambers Required: 74
of end caps required: 8
Type of header row chambers required: S-29
of header row chambers required: 6
Floors: 0
Bins: 0
Dumpsters: 0
Required Bed Size: 129.08 Sq. M
Volume of Embedment Stone Required: 95.23 Cu. M
Volume of Fill Material Required: 39.34 Cu. M
Volume of Excavation: 196.72 Cu. M
Area of Filter Fabric: 199.82 Sq. M
of Chambers long: 25
of rows: 3
Actual Trench Length: 23.527 M
Actual Trench Width: 5.486 M

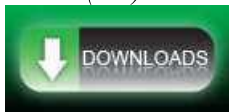




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Zurn Roof Drains



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

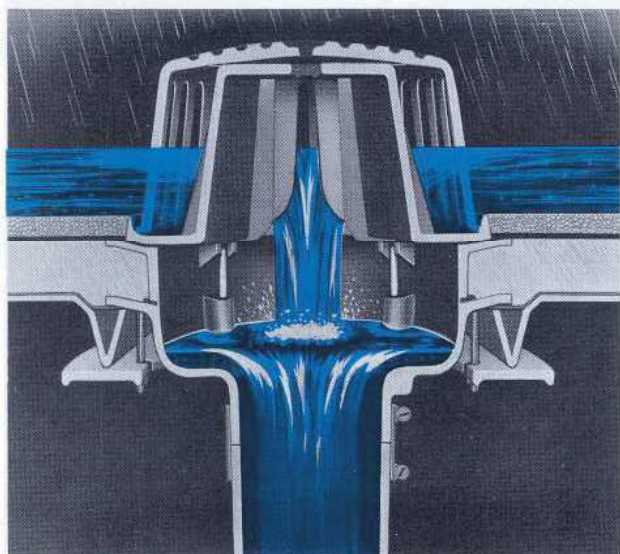
Fewer roof drains, smaller diameter piping, smaller sewer sizes, and lower installation costs are possible with a "Control-Flo" drainage system because roof areas are utilized as temporary storage reservoirs.

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.

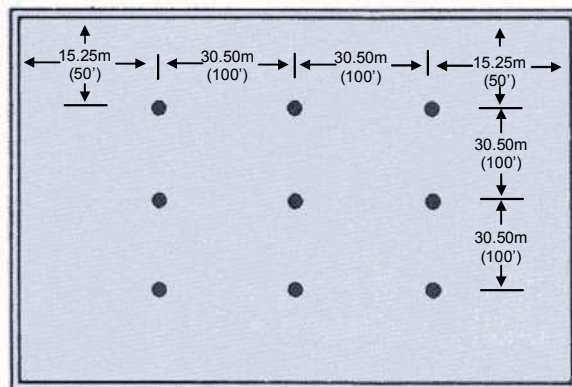


DEFINITION

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.



(Plan View)

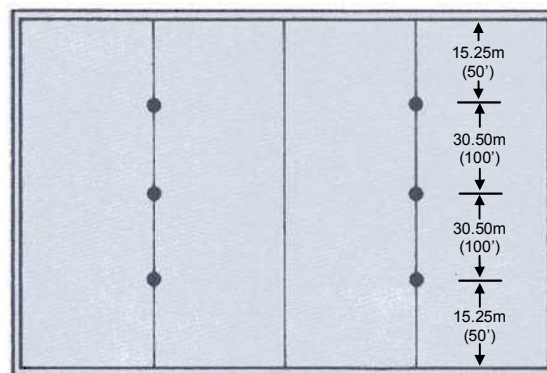


(Section View)

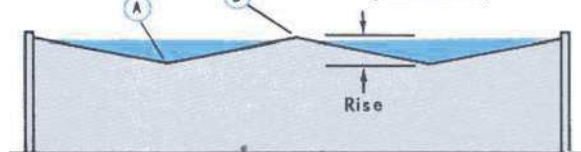
SLOPED ROOFS

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.



(Plan View)

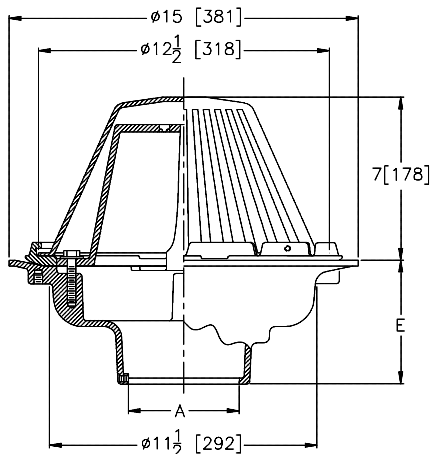


(Section View)

Economical Roof Drainage Installations



SPECIFICATION DATA



ENGINEERING SPECIFICATION: ZURN Z-105 "Control-Flo" roof drain for dead-level or sloped roof construction, Dura-Coated cast iron body. "Control-Flo" weir shall be linear functioning with integral membrane flashing clamp/gravel guard and Poly-Dome. All data shall be verified proportional to flow rates.

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.), 464.502m² (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 draindown 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 sq. ft.) 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.



Control-Flo Drain Selection Is Quick and Easy...

The exclusive Zurn "Selecta-Drain" Chart (pages 8—11) tabulates selection data for 34 localities in Canada. Proper use of this chart constitutes 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 Industries Limited, Mississauga, 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 232.25 m² (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 ft.²) to keep the drain-down 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 of 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 store, and the same locality.

SPECIAL CONSIDERATIONS FOR STRUCTURAL SAFETY: Normal practice of roof design is based on 18kg (40 lbs.) per 929 cm² (sq 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 bases 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 Industries Limited, Mississauga, 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.

Detailed Stormceptor Sizing Report – Ottawa - 0.724ha

Project Information & Location			
Project Name	Ottawa	Project Number	-
City	Ottawa	State/ Province	Ontario
Country	Canada	Date	10/30/2017
Designer Information		EOR Information (optional)	
Name	Brandon O'Leary	Name	Alison Gosling
Company	Forterra	Company	David Schaeffer Engineering Ltd.
Phone #	905-630-0359	Phone #	
Email	brandon.oleary@forterrabp.com	Email	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Ottawa - 0.724ha
Recommended Stormceptor Model	STC 750
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	80
PSD	Fine Distribution
Rainfall Station	OTTAWA MACDONALD-CARTIER INT'L A

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary		
Stormceptor Model	% TSS Removal Provided	% Runoff Volume Captured Provided
STC 300	71	85
STC 750	80	94
STC 1000	81	94
STC 1500	82	94
STC 2000	84	99
STC 3000	86	99
STC 4000	88	100
STC 5000	89	100
STC 6000	90	100
STC 9000	93	100
STC 10000	93	100
STC 14000	95	100
StormceptorMAX	Custom	Custom

Stormceptor

The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.

Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology

Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:

- Site parameters
- Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
- Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
- TSS load
- Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour). Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

State/Province	Ontario	Total Number of Rainfall Events	4819
Rainfall Station Name	OTTAWA MACDONALD-CARTIER INT'L A	Total Rainfall (mm)	20978.1
Station ID #	6000	Average Annual Rainfall (mm)	567.0
Coordinates	45°19'N, 75°40'W	Total Evaporation (mm)	2675.9
Elevation (ft)	370	Total Infiltration (mm)	4806.3
Years of Rainfall Data	37	Total Rainfall that is Runoff (mm)	13495.9

Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

Drainage Area	
Total Area (ha)	0.724
Imperviousness %	77.0

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.0000	0.0000
0.0000	0.0312
0.0066	0.0402
0.0132	0.0475
0.0198	0.0625

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	62.50
Water Quality Flow Rate (L/s)	

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Design Details	
Stormceptor Inlet Invert Elev (m)	
Stormceptor Outlet Invert Elev (m)	
Stormceptor Rim Elev (m)	
Normal Water Level Elevation (m)	
Pipe Diameter (mm)	
Pipe Material	
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	No

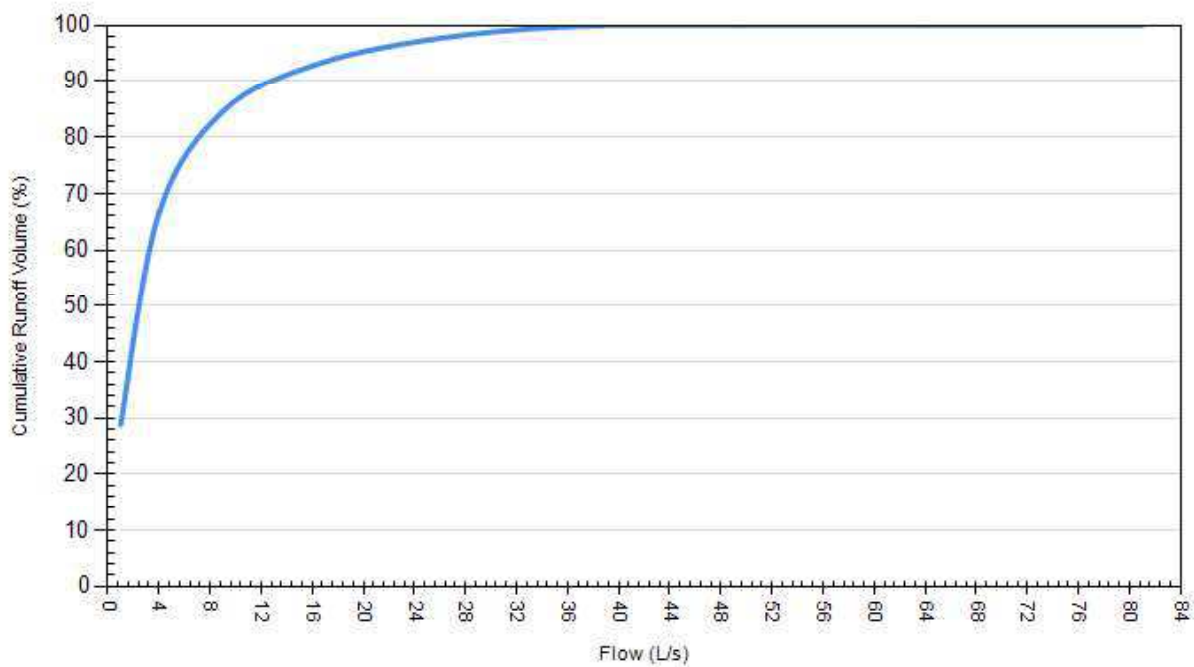
Particle Size Distribution (PSD)		
Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.		
Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Site Name		Ottawa - 0.724ha	
Site Details			
Drainage Area		Infiltration Parameters	
Total Area (ha)	0.724	Horton's equation is used to estimate infiltration	
Imperviousness %	77.0	Max. Infiltration Rate (mm/hr)	76.2
Surface Characteristics		Min. Infiltration Rate (mm/hr)	13.2
Width (m)	170.00	Decay Rate (1/sec)	0.00115
Slope %	2	Regeneration Rate (1/sec)	0.01
Impervious Depression Storage (mm)	1.57	Evaporation	
Pervious Depression Storage (mm)	4.67	Daily Evaporation Rate (mm/day)	2.54
Impervious Manning's n	0.015	Dry Weather Flow	
Pervious Manning's n	0.25	Dry Weather Flow (lps)	0
Maintenance Frequency		Winter Months	
Maintenance Frequency (months) >	12	Winter Infiltration	0
TSS Loading Parameters			
TSS Loading Function		Build Up/ Wash-off	
Buildup/Wash-off Parameters		TSS Availability Parameters	
Target Event Mean Conc. (EMC) mg/L	125	Availability Constant A	0.05
Exponential Buildup Power	0.40	Availability Factor B	0.04
Exponential Washoff Exponent	0.20	Availability Exponent C	1.10
		Min. Particle Size Affected by Availability (micron)	400

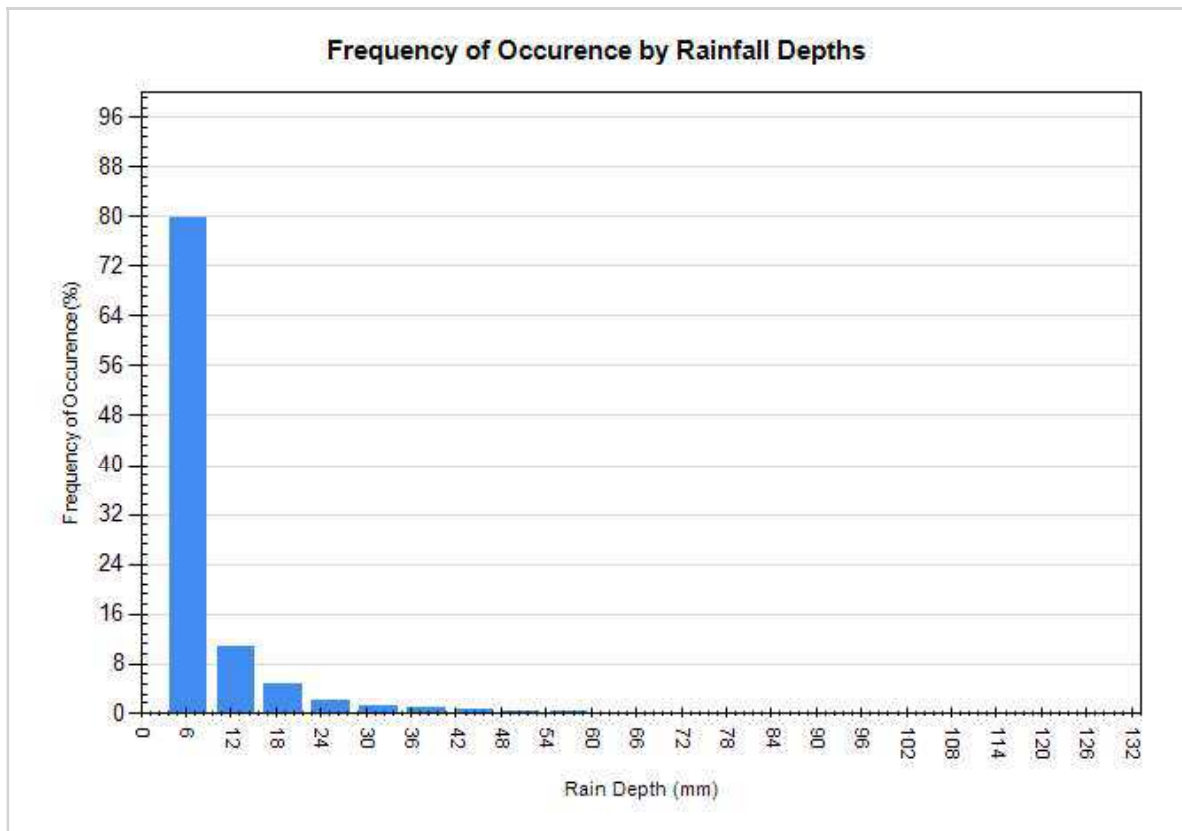
Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (L/s)	Runoff Volume (m³)	Volume Over (m³)	Cumulative Runoff Volume (%)
1	28448	70213	28.8
4	65661	33000	66.6
9	83471	15193	84.6
16	91525	7135	92.8
25	96068	2593	97.4
36	98492	168	99.8
49	98660	0	100.0
64	98660	0	100.0
81	98660	0	100.0

Cumulative Runoff Volume by Runoff Rate

For area: 0.724(ha), imperviousness: 77.0%, rainfall station: OTTAWA MACDONALD-CARTIER INT'L A



Rainfall Event Analysis				
Rainfall Depth (mm)	No. of Events	Percentage of Total Events (%)	Total Volume (mm)	Percentage of Annual Volume (%)
6.35	3843	79.7	5885	28.1
12.70	520	10.8	4643	22.1
19.05	225	4.7	3470	16.5
25.40	98	2.0	2144	10.2
31.75	58	1.2	1639	7.8
38.10	32	0.7	1118	5.3
44.45	24	0.5	996	4.7
50.80	9	0.2	416	2.0
57.15	5	0.1	272	1.3
63.50	1	0.0	63	0.3
69.85	1	0.0	64	0.3
76.20	1	0.0	76	0.4
82.55	0	0.0	0	0.0
88.90	1	0.0	84	0.4
95.25	0	0.0	0	0.0
101.60	0	0.0	0	0.0
107.95	0	0.0	0	0.0
114.30	1	0.0	109	0.5
120.65	0	0.0	0	0.0
127.00	0	0.0	0	0.0



For Stormceptor Specifications and Drawings Please Visit:
<http://www.imbriumsystems.com/technical-specifications>

DRAWINGS / FIGURES

TOPOGRAPHICAL PLAN OF

PART OF BLOCKS B AND C AND
PART OF HOBSON ROAD (As Closed)
REGISTERED PLAN 787 AND
REGISTERED PLAN 788
CITY OF OTTAWA

Prepared by
ANNIS, O'SULLIVAN, VOLLEBECK LTD.
NOVEMBER 30, 2005.

This plan was prepared for the purpose of showing the location of the proposed works and the location of the existing works. It is not intended to show the location of the proposed works in relation to the existing works. The plan is not intended to show the location of the proposed works in relation to the existing works. The plan is not intended to show the location of the proposed works in relation to the existing works.

Scale 1:500

North

DATE: 11/30/05

Drawn by: J. Sullivan

Checked by: J. Sullivan

Notes & Legend

1. LOT 1

2. LOT 2

3. LOT 3

4. LOT 4

5. LOT 5

6. LOT 6

7. LOT 7

8. LOT 8

9. LOT 9

10. LOT 10

11. LOT 11

12. LOT 12

13. LOT 13

14. LOT 14

15. LOT 15

16. LOT 16

17. LOT 17

18. LOT 18

19. LOT 19

20. LOT 20

21. LOT 21

22. LOT 22

23. LOT 23

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25. LOT 25

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27. LOT 27

28. LOT 28

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31. LOT 31

32. LOT 32

33. LOT 33

34. LOT 34

35. LOT 35

36. LOT 36

37. LOT 37

38. LOT 38

39. LOT 39

40. LOT 40

41. LOT 41

42. LOT 42

43. LOT 43

44. LOT 44

45. LOT 45

46. LOT 46

47. LOT 47

48. LOT 48

49. LOT 49

50. LOT 50

51. LOT 51

52. LOT 52

53. LOT 53

54. LOT 54

55. LOT 55

56. LOT 56

57. LOT 57

58. LOT 58

59. LOT 59

60. LOT 60