PROPOSED CONDOMINIUM

233, 249, 261 COLDWATER ROAD

ORILLIA, ON

Servicing and Stormwater Management Report

PROJECT No. n 2123

Prepared By:

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Version History

Version Number	Date of Update	Comments
02	September 30, 2022	Issued For SPA 1
01	June 17, 2022	Draft For Review

REFERENCES

The Engineering Design Criteria, City of Orillia (Revision #3: February, 2015) remains as primary guiding document for SWM criteria and submissions.

The preferred stormwater management for the proposed development utilizes the criteria and guidelines provided in the following reference documents:

- MOE Stormwater Planning and Design Manual;
- MTO Drainage Management Manual,(Online);
- LSRCA Phosphorus Offsetting Policy
- LSRCA Technical Guidelines for Stormwater Management Submissions

Some technical reports further provide data while selecting appropriate procedure in SWM:

- Plan and Profile, Coldwater Road
- Survey Report for the site by 'Young & Young Surveying Inc, dated August 20, 2021
- Geotechnical Investigation Report, Prepared by Palmer

1 INTRODUCTION

n Engineering Inc. was retained by the the client to undertake the servicing and Storm Water Management (SWM) design for the proposed property development. The purpose of this report is to present the proposed storm connections, and the SWM plan to be undertaken to mitigate the impact of increased storm runoff from the proposed development. The site falls under the jurisdiction of the Orilia, Ontario (Municipality).

Proposed site grading, servicing and storm drainage plans are submitted separately as full-size drawings with this report.

2 STUDY AREA

The subject site has a street address of 233, 249, 261 Coldwater Road West, Orilia, ON. The property is located on Coldwater Rd W between Emily St and Collegiate Dr. The location of the subject site is shown below in Figure 1.

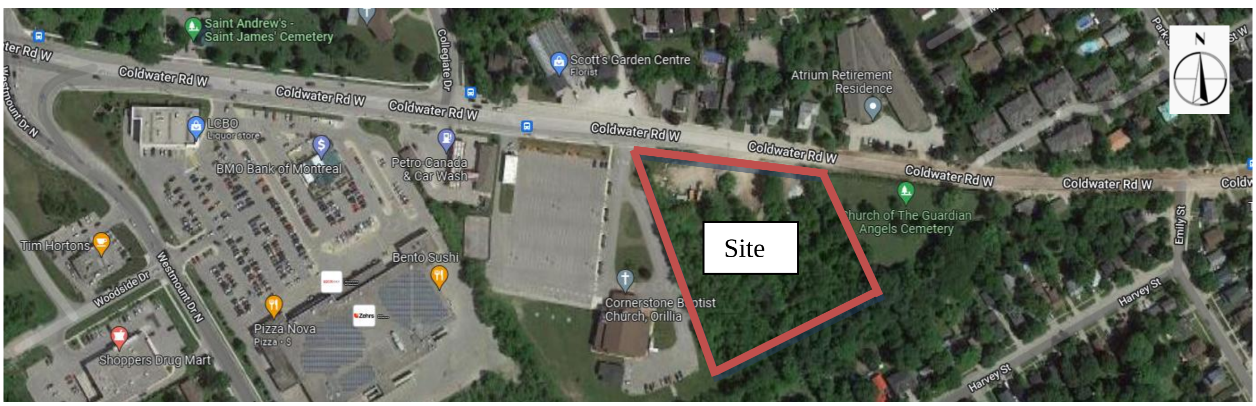

Figure 1 - Key Plan

3 OBJECTIVES OF STUDY

The SWM strategies to mitigate any potential impacts and ensure that the hydraulic design comply with the current municipal guidelines required an investigation of the following:

a. Identifying existing runoff pattern and quantity of runoff discharge from existing undeveloped areas; and

b. Identifying post-development runoff from the site towards the existing municipal right of way.

4 EXISTING TOPOGRAPHY AND DRAINAGE PATTERN

A topographic information plan has been prepared by Young & Young Surveying Incorporated, dated August 20, 2021, which identifies the site as Part of Lot 7 Concession 4, City of Orillia, County of Simcoe. Please refer to Appendix A for the topographical survey information.

The site is approximately 1.5 ha in area. The property is not currently being used nor any development built. The property is covered with grass and trees. A photo of the site at present time is shown below as Figure 2.

Figure 2 – Existing Site Conditions

The topographical information indicates that the site is sloped from the north to the south. The lowest elevation of the site is at the South side of the property, and the highest at the North side of the property.

Low elevations near the boundary indicate that currently runoff flows to the south west and east corner of the site to a storm and sanitary easement. Please refer to the pre-development site drainage plan Figure DR-101 and the certification of registration of the easement with the province of Ontario in Appendix A.

5 PROPOSED DEVELOPMENT AND GRADING

The subject site is proposed to be developed as a residential 8 story Apartment building with 225 units with a proposed finished floor elevation of 273.29. The proposed parking lot will consist of a total of 265 parking spots with a single entrance at Coldwater road.

The proposed grade at the entrance is 274.72 m. Grades around the site were proposed to match the boundary limits. Overland flows under developed conditions during large storms up to 100 year will pond within the site before outletting the property to the sanitary easement near the South-West corner of the site. Please refer to Appendix A for the post-development site drainage plan DR-102 and Drawing No. C1: Grading Plan.

6 STORMWATER MANAGEMENT CRITERIA

The SWM Criteria for the proposed development site was determined based on the criteria set by the City of Orillia:

The proposed development shall follow the criteria/guidelines presented in Engineering Design Criteria, City of Orillia (Revision #3: February, 2015) and LSRCA Technical Guidelines for Stormwater Management Submission, April 2022. The criteria are summarized below:

- **Water Quantity Control** –Peak post-development flow rates must not exceed pre-development for storms with return periods ranging from 2 through 100 years;
- **Linear Development Volume Control –** As per volume control criteria from LSRCA for linear development, the direct runoff volume from 25 mm rainfall from the net increase in impervious area shall capture and retain on site.
- **Water Quality Control** – Water quality control should meet a minimum 80% TSS removal or an enhanced (Level 1) removal as referenced in the MOE SWMPD Manual and LSCRA standards;
- **Erosion and Sediment Control –** The erosion potential of the study area to assessed using methods described in the MOECP Manual, OPSS and OPSD of temporary erosion and sediment control measures suitable for construction sites close to major roads;
- **Phosphorous Balance:** Phosphorus reduction is required to meet pre development conditions in the post development scenario as per City of Orillia and the LSRCA Phosphorus Offsetting Policy.

7 STORMWATER MANAGEMENT STUDY

The following sections describe the steps taken to ensure that the above mentioned criteria of the City of Orillia will be satisfied.

7.1 Comparison between Existing and Proposed Landuse Conditions

Landuse characteristics under the proposed development were compared to landuse under existing conditions to assess the changes in runoff from the site. The comparison is presented below in Table 1.

Table 1 – Comparison between Existing and Proposed Landuse

LAND USE TYPE	PAVED/GRAVEL AREA	ROOF AREA	GREEN ROOF	GRASS AREA	TOTAL AREA
Existing Condition (m^2)	108.77	0.00	0.00	14967.41	15076.18
Existing Condition (%)	1%	0%	0%	99%	
Proposed Condition (m^2)	7551.77	2143.12	1247.73	4133.56	15076.18
Proposed Condition (%)	50%	14%	8%	27%	
Increase/Decrease (%)	49%	14%	8%	-72%	

As can be seen above in Table 1, there will be an overall increase of 63% (49% and 14%) in imperviousness under the proposed development conditions in contrast of about 64% decrease in grassed area. An increase in imperviousness is expected under most urban developments.

7.2 Runoff Coefficients

Catchments that have more than one land use or soil type are represented by composite runoff coefficients determined by using area breakdowns of the different land cover as weighting factors. The composite runoff coefficients were calculated for the site under both existing and proposed conditions using coefficients designated for particular land-use characteristics based on LSRCA Technical Guidelines for Stormwater Management SubmissioN, April 2022. The designated Runoff Coefficients are shown in Table 2 below.

Table 2 – Runoff Coefficients

Land Use	Runoff Coefficient
Landscape, Green Roof	0.25
Building	0.90
Paved Area	0.90

Pre- and Post development composite runoff coefficients were calculated based on existing and proposed landuse, respectively, and are presented in Appendix B (Calculation Sheets 1&2, respectively). The pre- and post development composite runoff coefficients are summarized below in Table 3.

Table 3 – Composite Runoff Coefficients

Drainage Area	Pre-development Runoff Coefficient C	Post development Runoff Coefficient C
Site	**0.25**	**0.7**

7.3 Peak Flow Rates

Given the size and characteristics of the site and catchment (or drainage) areas, the Rational Method was used to determine the peak flows from the subject site under pre- and post development conditions. The rainfall-runoff relationship is as follows:

$$Q = 0.0028(C)(i)(A)$$

Where:
Q = Design flow (l/sec);
C = Runoff coefficient (Table 3);
i = Average rainfall intensity (mm/hr).
A = Catchment (or Drainage) area (ha);

Hydrograph time of concentration was determined as per the Municipalities Criteria and is based on the Airport Method for catchments with a runoff coefficient less than 0.40 or the Bransby-Williams Equation for catchments with a runoff coefficient greater than 0.40. The detailed analysis is available in Appendix B.

Rainfall intensities were based on data published in the City of Orillia Engineering design Criteria (Revision #3: February, 2015). The rainfall data for the site is Table 4.

Table 4 – IDF Curve Parameters

Return Period	2 -Year	5-Year	10 -Year	25 -Year	50 -Year	100-Year
A	22.5	29.9	34.8	40.9	45.5	50
B	-0.728	-0.725	-0.724	-0.723	-0.722	-0.722

7.4 Pre-development Peak Flows

Catchment areas and hydrological parameters were determined using the available landuse information and topographic maps (as shown in Figures DR-101 in Appendix A). Pre-development peak flows were calculated based on existing landuse and presented in Appendix B titled Calculation Sheet 1. The results are summarized below in Table 5.

Table 5 – Pre-development Peak Flows (l/sec)

Return Period	2 -Years	5-Years	10 -Years	25 -Years	50 -Years	100-Years
Peak Flow	56.45	74.76	86.91	102.02	113.36	124.57

7.5 Post Development Peak Runoff Flow Rate

Under post development conditions, the site has been divided into subcatchments as shown in Figure DR-102 (Appendix A). The subcatchment areas and hydrological parameters were determined using the available land use information and proposed grading (as shown in Figure DR-102 in Appendix A and Drawing C1: Site Grading Plan). Due to grading limitation, the landscape strip on the south property line is considered to be uncontrolled flow. Surface runoff from the remaining will flow through the proposed inlets as presented in Site Servicing Plan (Drawing C2).

Post development peak flows for the entire site were calculated using the Rational Method based on proposed landuse and presented in Appendix B titled Calculation Sheet 2. Peak flows from the uncontrolled area were also calculated and presented in Appendix B titled Calculation Sheet 3. The results from Calculation Sheets 2 & 3 are summarized below in Table 6.

Table 6 – Post Development Peak Flows (l/sec)

Return Period	2 -Year	5-Year	10 -Year	25 -Year	50 -Year	100-Year
Peak Flow	245.03	323.88	376.28	485.59	588.25	673.37
Uncontrolled Flow	6.25	8.27	9.60	12.39	15.01	17.19

7.6 Comparison of Existing and Proposed Runoff Rates

The primary goal of the hydrological analysis was to examine the effect of the proposed development on local storm drainage. This analysis was used to create goals for the SWM design. Table 7 presents the comparison between the calculated peak flow rates for both existing and proposed conditions for the entire site.

Table 7 – Comparison between Pre- and Post Development Peak Flows (l/sec)

Return Period	2 -Year	5-Year	10 -Year	25 -Year	50 -Year	100-Year
Pre-development Flow	56.45	74.76	86.91	102.02	113.36	124.57
Post Development Flow	245.03	323.88	376.28	485.59	588.25	673.37
Increase/Decrease	188.58	249.12	289.37	383.57	474.89	548.79

Please note that the post development flows in Tables 6 and 7 represent the impact of the development only, and do not represent the final SWM design flows from the site. The design controlled stormwater discharge calculations are described in Section 7.7 and presented in Table 8.

7.7 Quantity Control Measure

As mentioned in Section 6, surface runoff from the proposed site under all storms, including the 100-year storm, will need to be controlled to the pre-development flow rate as per municipality guidelines. To achieve the quantity control criteria, drainage from the surface will be controlled with an orifice reducer pipe at the inlet of Manhole MH3 (Refer: Drawing No. C2).

Allowable Discharge = Pre-development Flow –Uncontrolled Flow

7.7.1 Orifice Pipe Control

Post-developemnt flow will be controlled to the allowable discharge rate with the help of a Orifice Pipe (120 mm diameter Eccentric Orifice Reducer) installed at the inlet of MH3 (Drawing No. C2). Detailed orifice sizing calculations are presented in Appendix C as Table 1.

The allowable discharge rates as well as the orifice controlled flows are tabulated below in Table 8.

Table 8 – Orifice Controlled Flows (l/sec)

Return Period	2 -Year	5-Year	10 -Year	25 -Year	50 -Year	100-Year
Allowable Flows	50.20	66.49	77.30	89.63	98.35	107.39
Orifice Flows	49.87	50.19	50.67	50.67	50.67	50.67

7.7.2 Storage for Quantity Control

The required detention storage was calculated based on the controlled flow at MH3 and is presented in Appendix C (Tables 2A to 2F). For the 100 year design storm event, the proposed controlled flow requires a maximum of 350.31m^3 storage. To achieve the required detention storage 4 Hydro-Break Optimuims are proposed to control flow on the multi-level parking. Tables 2G to 2J in Appendix C, present the maximum available storage caused by each Hydro-Break Optimuim for each level. A total of 358.73m^3 storage has been proposed comprising of catch basin, manholes, roof and ponding. However, in the event of a 100 year storm event 354.82m^3 of detention storage will be available.

The proposed detention storage calculations for the 100 year storm are presented as Table 3 in Appendix C. A summary of the required and proposed detention storage for the 100-year storm event is presented below in Table 9.

Table 9 - Summary of 100-yr Detention Storage (m^3)

Required Detention Storage	**350.31**
Manhole and Catch Basin	52.01
Pipes	129.90
Roof Storage	62.81
Ponding	114.01
Total Proposed Storage	**358.73**
Available Storage (At 100 years)	**354.82**

7.7.3 Roof Control

Flow from the roof proposed to be detained by installing parabolic weirs (Zurn Z105 Control Flo Roof Drain). The roof top detention calculations attached in Appendix D, and summarized in Table 10.

Table 10 – Roof Control

Location	Area (m^2)	No. of Drains	Flow/Drain (L/sec)	Total Flow (L/sec)	100 yrs Rainfall Volume (m^3)	Design Ponding Depth (mm)
R1	2107.68	6	1.48	8.9	29.36	42
R2	906.10	3	1.48	4.4	25.79	86
R3	130.17	1	1.48	1.48	2.68	62
R4	124.56	1	1.48	1.48	2.52	61
R5	122.34	1	1.48	1.48	2.46	61

Roof drain specs (to be detailed by mechanical engineer) are attached in Appendix D

7.8 Water Quality Control

Long term average removal of 80% of Total Suspended Solids (TSS) on an annual basis from all runoff leaving the site is required. To substantially improve the water quality of the water leaving the site, a StormFilter SFPD0818 device has 36 Phosphosorb Cartridges (27") has been proposed that will be installed for water quality treatment. (Detail Sizing Report, Operaaion and Maintenance Plan and Qualification Certification are attached in Appendix E).

7.8.1 Phosphorus Loading

A Phosphorus Loading analysis has carried out using the 'Low Impact Development Treatment Train Tool (LID TTT)' developed by Lake Simcoe Region Conservation Authority (LSRCA). The proposed StormFilter SFPD0818 device has 36 Phosphosorb Cartridges (27") with an accepted LSRCA rating for 80% Phosphorus removal. The target is to reduce phosphorus loading under proposed conditions to meet pre development conditions. A summary of the phosphorus loading analyses under and pre and post development scenarios have been presented in Appendix F. The output of the LID TTT model is summarized below in Table 11. Under the post development scenario a decrease in phosphorus loading is observed.

The target is to reduce phosphorus loading under proposed conditions by means LID features such as the proposed StormFilter SFPD0818 unit. Land use without LIDs is considered as 'Pre-Development Scenario' and post-development land use with LIDs as 'Post-Development Scenario'. A summary of the phosphorus loading analyses under both scenarios have been presented in Appendix E. The output of the LID TTT model is summarized below in Table 11.

Table 11 – Phosphorus Loading

Description	Total Load
Pre-Development (kg)	0.527
Post-development with LID (kg)	0.424
Total Reduction with LID (kg)	0.103
% Reduction	19.54

7.9 Volume Control

In accordance to LSRCA's Technical Guidelines for Stormwater Management the site shall retain 25 mm of runoff from new or partially new impervious areas.

The total impervious area of the development is 9694.89 m^2 which includes pavement, concrete and roof structures. Calculation of the required volume to be retained on site is shown below:

Required Volume to be retained on site: (Area: 9694.89 m^2) x (0.025 m) = 242.37 m^3

Based on the value of Hydraulic Conductivity from the Geotechnical Report of the surrounding native soil = 1.1 * 10^{-6} m/s. As per the TRCA Stormwater Management Criteria, the Percolation rate is 14.30 with a safety factor of 3.5.

According to Ministry of Environment`s Stormwater Management and Planning Manual the required bed area for the required volume to be infiltrated with 24 hours is calculated by applying the following equation:

$$A = \frac{1000V}{Pn\Delta t}$$

Where:

A = Bottom area of the infiltration trench (m^2)
V = Runoff volume to be infiltrated (m^3)
P = Percolation rate of surrounding native soil (mm / hr.)
n = Porosity of the storage media (0.40 for storm chambers)
Δt = Retention time (48 hours)

Substituting the known values in the above equation:

A = (1000 x 242.37 m^3) / (14.30 mm per hour x 0.40 x 48 hours) = 882.77 m^2

The required bed area cannot be accommodated due to the limited space on site. The landscaped area to the north of the Apartment building has insufficient groundwater depth to facilitate infiltration. As per section 3.2.6 of the LSRCA's guideline if the proponent attempts to meet the previously mentioned criteria and was unable to achieve full compliance, three alternatives may be implemented. As per the guideline, preference is given to alternative 1. Alternative 1 states that the site shall retain 12.5 mm of runoff from new or partially new impervious areas. Calculation of the required volume to be retained on site as per the criteria is shown below:

Required volume to be retained on site: (Area: 9694.89 m^2) x (0.0125 m) = 121.19 m^3

7.9.1 Permeability and Drawdown Calculation of Infiltration Chamber (SC-160LP)

As previously mentioned the Percolation rate of the surrounding native soil is 14.30m/hr.

According to Ministry of Environment`s Stormwater Management and Planning Manual the bottom area required to meet alternative 1 is calculated by applying the following equation:

$$A = \frac{1000V}{Pn\Delta t}$$

Where:

A = Bottom area of the infiltration trench (m^2)
V = Runoff volume to be infiltrated (m^3)
P = Percolation rate of surrounding native soil (mm / hr.)
n = Porosity of the storage media (0.40 for storm chambers)
Δt = Retention time (48 hours)

Substituting the known values in the above equation:

A = (1000 x 121.19 m^3) / (14.30 mm per hour x 0.40 x 48 hours) = 441.38m^2

To accommodate the necessary retention storage an infiltration chamber (SC-160LP) is proposed. Sizing and outlet location of the infiltration chamber was selected in a manner to ensure that sufficient retention volume is provided. The provided retention volume of the proposed infiltration chamber is 123.73 m^3 with a bed area of 448.68, refer to Appendix G. The draw down time for the proposed Infiltration Chamber (SC-160LP) is 47.22 hrs.

8 EROSION AND SEDIMENT CONTROL (ESC) DURING CONSTRUCTION

During site construction, various temporary measures will be implemented to prevent the discharge of sediment laden stormwater from the site. Please refer to Drawing No. C3, for the ESC Plan. These proposed measures include the installment of a mud-mat, silt fencing, and catch basin/catchbasin manhole sediment traps. In addition, the following ‘good housekeeping’ measures are recommended:

- All exposed soil shall be stabilized as soon as possible with a seed and mulch application as directed by the Engineer;
- All construction vehicles shall leave the site via the designated location (mud mat) as shown on the ESC plan (Drawing No. C3)
- No construction activity or machinery shall intrude beyond the silt/snow fence or limit of construction area;
- Cleaning and repairs of the mud mat and any other temporary sediment control measures shall be completed as deemed necessary through regular inspection;

- Sediment/silt shall be removed from the sediment control devices after storm events and deposited in areas as approved by the engineer; and

- All re-graded areas within the development which will not be occupied by roadways, and parking spots shall be top-soiled and sodded/seeded immediately after completion of final grading operations as directed by the engineer.

9 MINOR SYSTEM DRAINAGE

The minor storm drainage system was designed to convey stormwater to the Storm Draianage Easement. As mentioned in Sections 7.7 and 7.8, the proposed storm sewer system includes an orifice control as well as a SFPD0818 with 36 Phosphosorb cartridges (27”). Please refer to Appendix I for the Storm Sewer Design Chart and refer to the Site Servicing Plan (Drawing No. C2) for the layout of the proposed storm sewer network.

10 MAJOR SYSTEM DRAINAGE

The overland flow will not impact the existing adjacent structures since the grading of the site ensures storm flows greater than 100 years will be able to flow overland through the site without any impact to adjacent areas. Overland flow direction during storm events greater than the 100 year rainfall event has been shown on the Grading Plan (Drawing No. C1).

11 SERVICE CONNECTION

11.1 Sanitary

According to record drawings (as-built information) obtained from the City of Orillia, the site proposed be connected to an existing 200 mm diameter sanitary sewer on Coldwater Rd. through proposed 150mm diameter sanitary service connections . (Refer DWG. C2).

11.2 Water

Following the record drawings (as-built information) obtained from the City of Orillia, the site will be connected to the existing 200mm watermain on Coldwater Rd. through proposed 150 mm water service line for the site. (Refer DWG. C2).

12 SANITARY SEWAGE FLOW

The total peak flow design flow for the sanitary system has been calculated using the Engineering Design Criteria, City of Orillia. The total peal flow design flow for the sanitary system was determined to be 4.25 L/sec, the detailed analysis is available in Appendix H.

13.0 WATER DEMAND

The estimated water consumption for the proposed development was calculated based on the Engineering Criteria of City of Orilia, July 2012.

13.1 Domestic Water Demand

The domestic water demand was determined and is presented in Appendix H.

a) Maximum Day Demand 1.80 L/sec
b) Maximum Hour Demand 5.07 L/sec

13.2 Fire Water Demand

Fire Water Demand calculated as per Fire Underwriter Survey is 33 L/sec. The analysis is presented in Appendix H.

12.3 Maximum Water Demand

The total water demand is based on the required fire flow plus maximuim day flow or peak hour flow, whichever is greatest. The water demand is 35.80 L/sec.

a) Maximuim Day Demand Plus Fire Flow 34.80 L/sec
b) Maximuim Hour Demand 5.07 L/sec

14 SUMMARY & CONCLUSIONS

This analysis presents a detailed stormwater management control plan addressing both quantity and quality controls required to meet all design criteria. Drainage boundaries were established to estimate flows for the proposed drainage collection system of the site in order to develop a comprehensive surface drainage and SWM plan. There will be no negative impacts or increase in stormwater peak flows under the proposed controlled conditions.

A summary of the findings and drainage analyses for the subject property is as follows:

- The hydrological and hydraulic analyses presented in this report addresses the existing and proposed site conditions;
- SWM criteria of external agencies were collected and reviewed during the course of the study and all other available information have been retrieved and reviewed;
- Impervious areas were calculated under both existing and proposed conditions and a significant increase in impervious areas was found;
- A proposed storm sewer network has been designed to convey the minor system;
- Recommended quantity control measures for the site will be achieved through the installation of a 120 mm diameter orifice pipe;
- Adequate stormwater runoff storage for large design storms will be achieved through pipes and manhole/catchbasins;
- A SFPD0818 with 36 Phosphosorb cartridges (27") unit has been recommended to ensure water quality control; and

We trust that this proposed stormwater management plan will provide appropriate service for the proposed site.

Respectfully Submitted,

n Engineering Inc.

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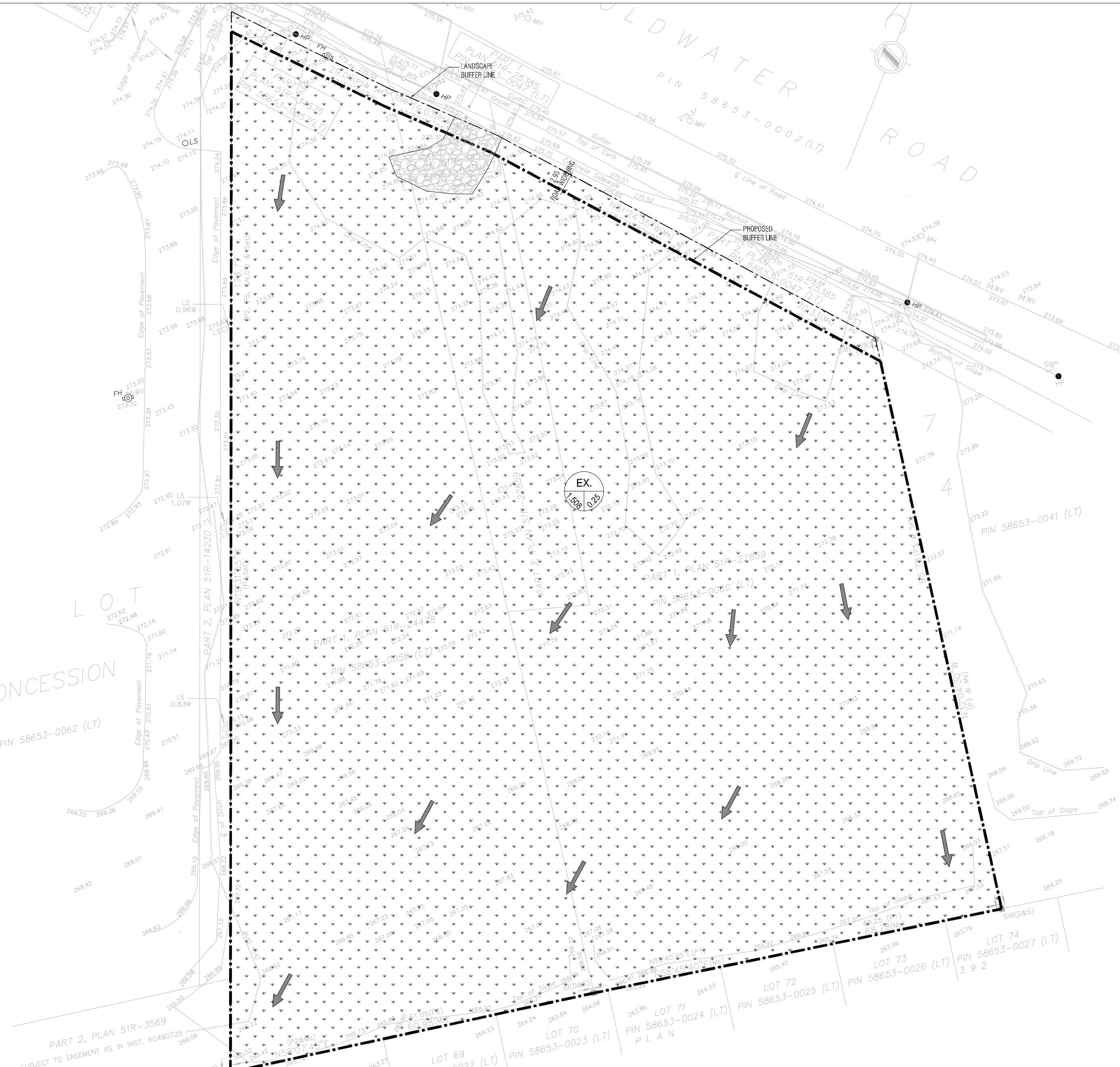
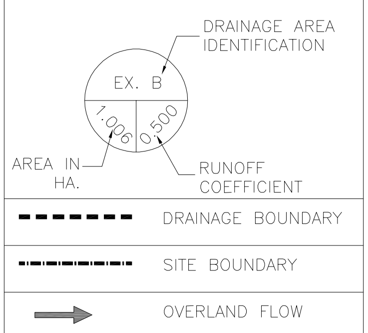
Appendix A

Pre- & Post Development Drainage Plans



LOT(SITE) AREA (m²)	15426.96 (3.81 ACRE)
ROAD WIDENING	350.78 SQM.
NET LOT AREA	15076.18 SQM. (3.72 ACRE)

LEGEND



PRE DEVELOPMENT LAND USE TABLE

LAND COVER	HATCH	AREA (SQ.M.)	RUNOFF CO-EFFICCIENT
ROOF		–	0.95
CONCRETE/ ASPHALT		–	0.95
GRAVEL		108.77	0.95
LANDSCAPING		14967.41	0.25

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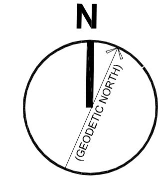
PROJECT:

CONDOMINIUM
233,249,261
COLDWATER ROAD, WEST, ORILLIA

DRAWING TITLE:

PRE-DEVELOPMENT
SITE DRAINAGE PLAN

DRAWN BY: AZ	DATE: 29 MARCH 2022
CHECKED BY: AZ	SCALE: NTS
PROJECT NO.: **21-23**	DRAWING NO.: **DR-101**



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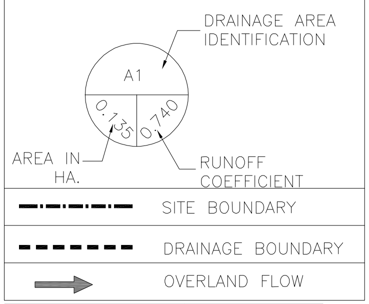


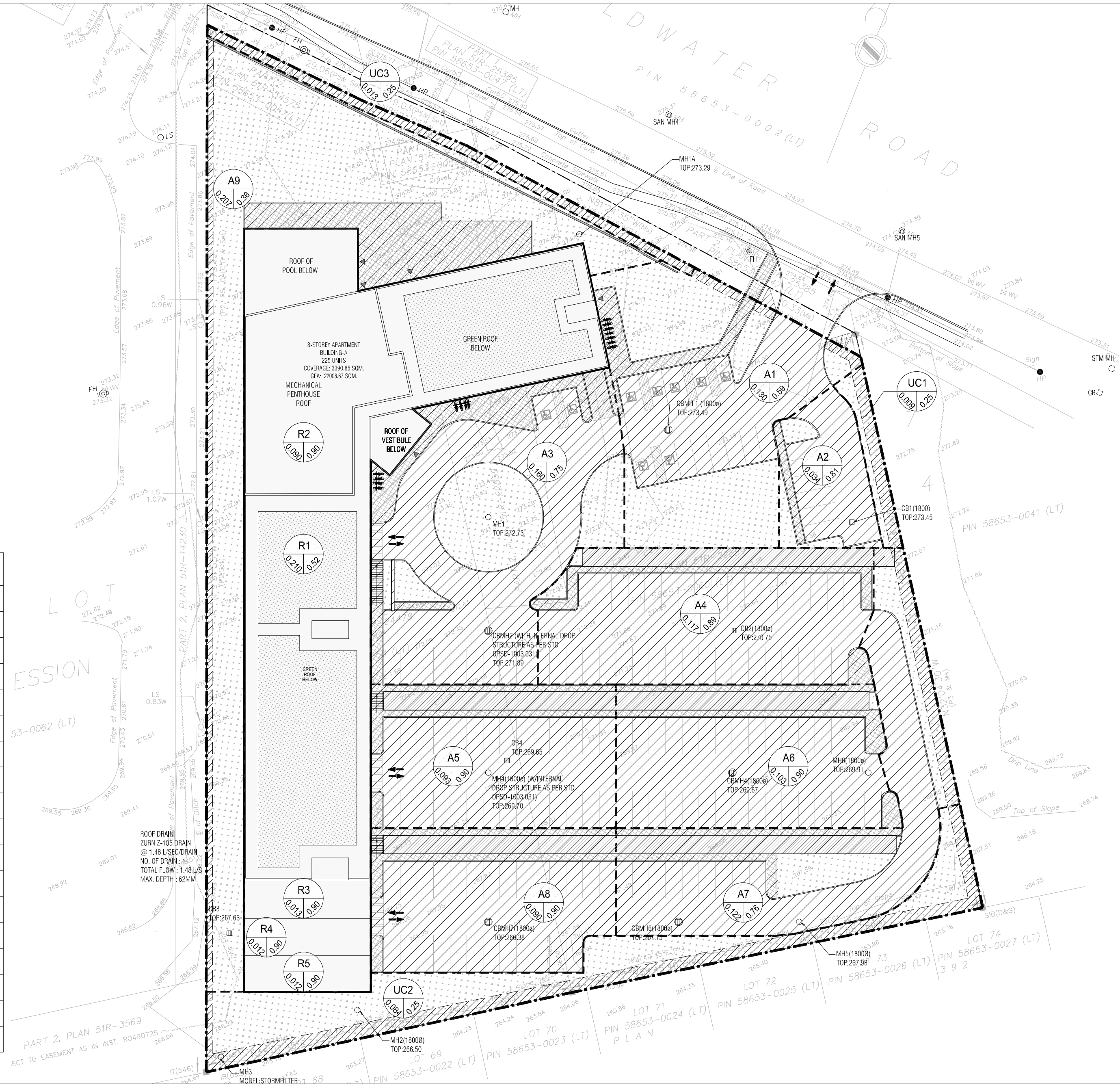
LOT(SITE) AREA (m^2)	15426.96 (3.81 ACRE)
ROAD WIDENING	350.78 SQM.
NET LOT AREA	15076.18 SQM. (3.72 ACRE)

POST DEVELOPMENT LAND USE TABLE

LAND COVER	HATCH	AREA (SQ.M.)	RUNOFF CO-EFFICCIENT
ROOF		2143.12	0.95
CONCRETE/ ASPHALT		7551.77	0.95
LANDSCAPING		4133.56	0.25
GREEN ROOF		1247.73	0.25

SUBCATCHMENT AREA

SUBCATCHMENT	ROOF	ASPHALT/ CONCRETE	GREEN	TOTAL
A1	0.00	677.03	628.97	1306.00
A2	0.00	297.71	48.71	346.42
A3	0.00	1224.45	380.02	1604.47
A4	0.00	1157.49	17.29	1174.78
A5	0.00	934.80	0.00	934.80
A6	0.00	1027.38	3.40	1030.78
A7	0.00	965.25	262.92	1228.17
A8	0.00	909.40	0.00	909.40
A9	0.00	358.26	1714.79	2073.05
R1	859.95	0.00	1247.73	2107.68
R2	906.10	0.00	0.00	906.10
R3	130.17	0.00	0.00	130.17
R4	124.56	0.00	0.00	124.56
R5	122.34	0.00	0.00	122.34
UC1	0.00	0.00	95.94	95.94
UC2	0.00	0.00	849.15	849.15
UC3	0.00	0.00	132.37	132.37
TOTAL	2143.12	7551.77	5381.29	15076.18



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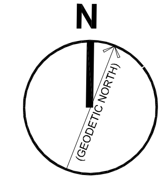
DRAWING TITLE:

POST-DEVELOPMENT
SITE DRAINAGE PLAN

DRAWN BY: AZ	DATE: 29 MARCH 2022
CHECKED BY: AZ	SCALE: NTS
PROJECT NO.: **21-23**	DRAWING NO.: **DR-102**



PLAN OF SURVEY
SHOWING TOPOGRAPHIC FEATURES

PART OF LOT 7, CONCESSION 4

(FORMERLY IN THE TOWNSHIP OF SOUTH ORILLIA)
CITY OF ORILLIA
COUNTY OF SIMCOE

SCALE 1:500
10 0 10 20 Metres

YOUNG & YOUNG SURVEYING INC.
© 2021

METRIC

DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

BEARING NOTE

BEARINGS ARE UTM GRID, BY REAL TIME NETWORK (TOPNET) OBSERVATIONS, UTM ZONE 17, NAD83 (ORIGINAL)(1997.0).

BEARING ROTATION NOTE

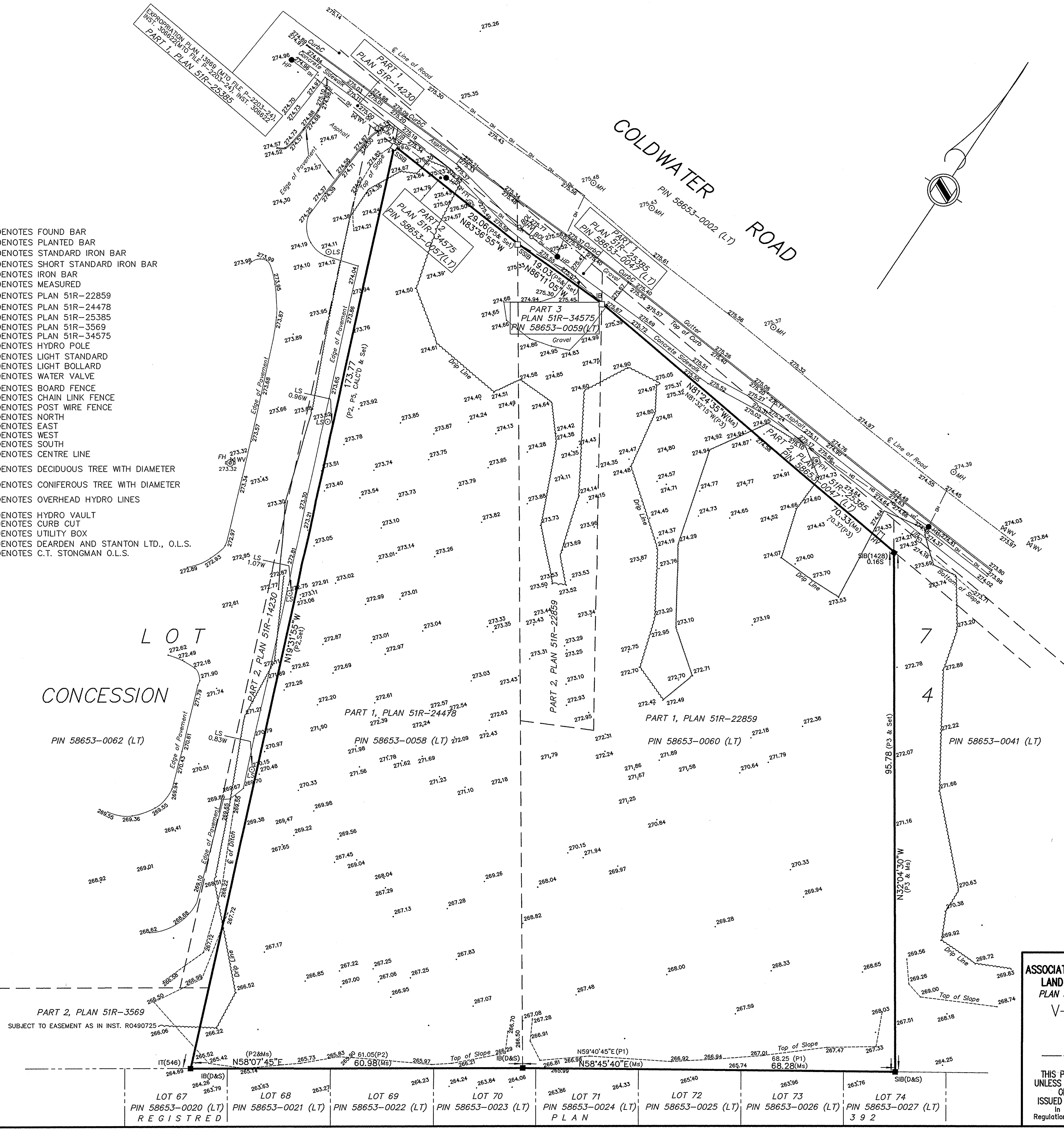
FOR BEARING COMPARISONS, A ROTATION OF 01°07'45" COUNTER CLOCKWISE WAS APPLIED TO (P2) AND A ROTATION OF 01°06'30" COUNTER CLOCKWISE WAS APPLIED TO (P3), (P5) TO CONVERT FROM ASTRONOMIC TO GRID BEARINGS.

BENCHMARK NOTE

ELEVATIONS HEREON ARE GEODETIC IN ORIGIN AND WERE DERIVED FROM FIRE HYDRANT NO. 212 HAVING A VALUE OF 275.647 FROM INFORMATION SUPPLIED BY THE CITY OF ORILLIA ENGINEERING DEPARTMENT

LEGEND

■	DENOTES FOUND BAR
□	DENOTES PLANTED BAR
SIB	DENOTES STANDARD IRON BAR
SSIB	DENOTES SHORT STANDARD IRON BAR
IB	DENOTES IRON BAR
Ms	DENOTES MEASURED
P1	DENOTES PLAN 51R-22859
P2	DENOTES PLAN 51R-24478
P3	DENOTES PLAN 51R-25385
P4	DENOTES PLAN 51R-3569
P5	DENOTES PLAN 51R-34575
● HP	DENOTES HYDRO POLE
○LS	DENOTES LIGHT STANDARD
○BOL	DENOTES LIGHT BOLLARD
WV	DENOTES WATER VALVE
BF	DENOTES BOARD FENCE
CLF	DENOTES CHAIN LINK FENCE
PWF	DENOTES POST WIRE FENCE
N	DENOTES NORTH
E	DENOTES EAST
W	DENOTES WEST
S	DENOTES SOUTH
℄	DENOTES CENTRE LINE
	DENOTES DECIDUOUS TREE WITH DIAMETER
	DENOTES CONIFEROUS TREE WITH DIAMETER
—DH—	DENOTES OVERHEAD HYDRO LINES
HV	DENOTES HYDRO VAULT
CurbC	DENOTES CURB CUT
UB	DENOTES UTILITY BOX
D&S	DENOTES DEARDEN AND STANTON LTD., O.L.S.
1428	DENOTES C.T. STONGMAN O.L.S.



SURVEYOR'S CERTIFICATE

I CERTIFY THAT:

1. THIS SURVEY AND PLAN ARE CORRECT AND IN ACCORDANCE WITH THE SURVEYS ACT, THE SURVEYORS ACT, AND THE REGULATIONS MADE UNDER THEM.
2. THE SURVEY WAS COMPLETED ON THE 18th DAY OF AUGUST, 2021.

AUG 20, 2021
DATE

G. Sundar
GANESH SUNDAR B.Eng.
ONTARIO LAND SURVEYOR

ASSOCIATION OF ONTARIO LAND SURVEYORS
PLAN SUBMISSION FORM
V-15655

THIS PLAN IS NOT VALID UNLESS IT IS AN EMBOSSED ORIGINAL COPY ISSUED BY THE SURVEYOR In accordance with Regulation 1026, Section 29(3).

YOUNG & YOUNG SURVEYING INC.
A Subsidiary of Mauro Group Inc.
2 HOLLAND DRIVE, UNIT 5, BOLTON, ONTARIO L7E 1E1
PHONE 905.951.6000 – FAX 905.857.4811
www.youngsurveying.ca – info@youngsurveying.ca

PARTY CHIEF: DEV	DRAWN BY: LV	CHECKED BY: GS
CLIENT: AURORA, SAGAR		
PATH= F:\PROJECTS\2021\B7689\MSCAD\B7689_SRPR_V2.DWG		

PROJECT No. 21-B7689

Province of Ontario

DYE & DURHAM CO. LIMITED Form No. 985

Document General

Form 4 — Land Registration Reform Act, 1984

D

896271

No. CERTIFICATE OF REGISTRATION

86 MAR 19 AM : 49

SIMCOE No. 51 BARRIE

LAND REGISTRAR

FOR OFFICE USE ONLY

New Property Identifiers — Additional: See Schedule ☐

Executions — Additional: See Schedule ☐

(1) Registry ☒ Land Titles ☐

(2) Page 1 of 17 pages

(3) Property Identifier(s) Block Property — Additional: See Schedule ☐

(4) Nature of Document

Development Agreement

(5) Consideration

Nil---------------------------- Dollars $ nil

(6) Description

Part of the West half Lot 7, Concession 4, City of Orillia, County of Simcoe, designated as Parts 1 and 2, Plan 51R-3569. Formerly South Orillia

SUBJECT TO an easement in favour of the Municipal Corporation of the City of Orillia, registered as Instrument No. 490725 on the 23rd day of August, 1974 over Part 2, Deposit Plan 51R-3569, for the City of Orillia.

(7) This Document Contains: (a) Redescription New Easement Plan/Sketch ☐ (b) Schedule for: Description ☐ Additional Parties ☐ Other ☒

(8) This Document provides as follows:

Development Agreement attached.

Continued on Schedule ☐

(9) This Document relates to instrument number(s)

(10) Party(ies) (Set out Status or Interest)

Name(s)	Signature(s)	Date of Signature Y	M	D
THE CORPORATION OF THE CITY OF ORILLIA (Municipality) by its solicitors, RUSSELL, WAITE, CHRISTIE & MILLER - R. Bruce Waite	R. Bruce Waite	1986	03	17

(11) Address for Service P.O. Box 340, Orillia, Ontario. L3V 6J1

(12) Party(ies) (Set out Status or Interest)

Name(s)	Signature(s)	Date of Signature Y	M	D
FIRST BAPTIST CHURCH, ORILLIA (Developer)				

(13) Address for Service

(14) Municipal Address of Property

265 Coldwater Road West,
Orillia, Ontario.
L3V 3L7

(15) Document Prepared by:

DOUGLAS S. CHRISTIE
RUSSELL, WAITE, CHRISTIE & MILLER
BARRISTERS & SOLICITORS
BOX 158, 78 COLDWATER STREET EAST
ORILLIA, ONTARIO L3V 6J3
(705) 325-1326

FOR OFFICE USE ONLY

Fees and Tax	
Registration Fee	16.00
Total	16.00

10174 (12/84)

DEVELOPMENT AGREEMENT

THIS AGREEMENT made in quadruplicate this the 20th day of February, 1986.

BETWEEN:

FIRST BAPTIST CHURCH, ORILLIA,

hereinafter called the "Developer"

OF THE FIRST PART

AND

THE CORPORATION OF THE CITY OF ORILLIA,

hereinafter called the "Municipality"

OF THE SECOND PART

WHEREAS the lands affected by this Agreement are the lands described in Schedule "A" hereto annexed, and are also shown on a Site Plan attached hereto as Schedule "B" and which lands are collectively referred to herein as the "said lands";

AND WHEREAS the Developer proposes to construct a church hereinafter referred to as the "project" on the said lands;

NOW THEREFORE THIS AGREEMENT WITNESSETH that in consideration of the premises and for other good and valuable consideration, the parties hereto covenant and agree with one another as follows:

1. SCOPE OF AGREEMENT

.1 DESCRIPTION OF LANDS - The lands affected by this Agreement are the lands described in Schedule "A" hereto attached.

.2 CONFORMITY WITH AGREEMENT - The Developer covenants and agrees that all work performed on the said lands shall be in conformity with:

(a) the provisions of this Agreement;
(b) the Site Plan attached as Schedule "B";
(c) all additional Schedules hereto attached;
(d) the Plans and Specifications submitted to and accepted by the Municipal Engineer;
(e) all applicable Municipal By-laws and Provincial Legislation.

2. DEVELOPMENT CHANGES

.1 There shall be no changes in the Schedules attached hereto, or any additional Plans and Specifications filed with respect to this project unless such proposed changes have been first submitted to, and approved by the Municipal Engineer or other authorized representative.

3. CONDITIONS PRIOR TO EXECUTION OF AGREEMENT BY THE MUNICIPALITY

.1 Prior to the execution of this Agreement by the Municipality, the Developer shall:

(a) Taxes - have paid all municipal tax bills issued and outstanding on the said lands,

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(b) Deeds and Easements - have delivered to the Municipality all transfers/deeds, discharges, and easement documents required by Schedule "D" and which shall be free and clear of all encumbrances,

(c) Cash Deposits, Capital Levies & Security - have delivered to the solicitor for the Municipality all cash deposits, capital levies and security required by Schedule "E" attached,

(d) Engineering Plans & Specifications - have supplied to the Municipal Engineer those Plans and Specifications necessary to identify the engineering aspects of the proposed development and have received acknowledgement of conformity with general design concepts of the Municipality;

(e) Hydro - have supplied to, and received the approval of, the applicable hydro officials, to those plans necessary to identify the electrical distribution system, lighting requirements, and power supply to each lot or building or unit, as the case may be, and these are to be to the required hydro standards which includes underground wiring,

(f) Liability Insurance - have filed with the Municipal Solicitor the insurance policies required herein,

(g) Architect and/or Consulting Engineer's Letter - have arranged for the architect and/or consulting engineer to file with the Municipality a letter confirming that he has been engaged by the Developer to perform all those professional services required under this Agreement and finally he will be responsible for issuing a Certificate stating that the development on completion is in conformity with the Grading Plan, Sewer and Water Services Plan, Storm Water Control Plan, and Site Plan,

(h) Private Utilities Confirmation - have obtained a letter from Bell Canada, Northern & Central Gas Corporation Limited, O.W.L.P., and Cable T.V., confirming that they have been advised of the development and that satisfactory arrangements have been made with them for servicing the development without expense or obligation to the Municipality.

(i) Land Ownership - be the registered owner in fee simple of the lands described in Schedule "A", and that there will be no encumbrances registered against the said lands save and except those specifically added hereto as parties to this Agreement.

4. CONDITIONS PRIOR TO THE ISSUANCE OF A BUILDING PERMIT

.1 On any application for a Building Permit and prior to the issuance thereof, the owner, or his agent, shall submit to the Municipality for the approval of the Municipal Engineer and/or the Chief Building Official the following:

(a) Architectural and/or engineering Plans and Specifications with respect to the following aspects of this project:

(i) architectural plans,
(ii) structural plans,
(iii) mechanical/electrical plans,
(iv) grading plan,
(v) exterior finish,
(vi) signs,
(vii) a complete electrical distribution system including transformers, street lighting and individual supply to each lot or unit,
(viii) parking and internal traffic patterns,
(ix) site plan,
(x) a plan showing existing and proposed final elevations and contours referring to a geodetic bench mark, showing area drainage, right-of-way drainage, finished first floor elevations. The Developer shall be responsible for the grading of the development as outlined in said drainage plan,
(xi) internal servicing layout for sanitary sewers, water and storm systems.

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(b) Fire Chief Approval - an Approval from the Fire Chief of the Municipality confirming and approving of the proposed plans for fire protection, and specifying any hydrants, or other equipment or appurtenances required.

(c) Sanitary Sewer - an approved design for a sanitary sewer from Westmount Drive to the said lands.

(d) Storm Drainage System - an approved design for a storm sewer and drainage system to be constructed and it shall include erosion protection and restoration, and shall be controlled to the degree that future discharge from the said lands will not be greater in intensity and quantity than the discharge of storm water coming from the land in its natural state. The storm drainage shall be directed to an outlet approved by the Municipal Engineer.

(e) Sewer and Water Connections - file with the Municipality an application for Sewer and Water Connections.

(f) Certificate of Good Standing - Certificate of good standing from the Workers' Compensation Board.

(g) Compliance With Building By-law

.1 An application prepared and completed in accordance with The Building By-law requirements of the Municipality.

.2 On any Application for a Building Permit on the said lands shall be an implied covenant by the owner and his agent, that they have complied with all the provisions of this Agreement to the date of the issuance of the Building Permit.

(h) Execution of this Development Agreement by the Municipality.

(i) Foundation Forms - before issuing a building permit, the Engineer for the said project, either verbally or in correspondence, shall confirm with the chief building official that the elevation of the foundation forms will be in compliance with the Building Plans accepted by the Municipality, before proceeding with further construction.

5. MUNICIPAL SERVICES - ON MUNICIPAL EASEMENT

.1 The Developer will construct and install at its expense the hereinafter required Municipal Services in an easement of the Municipality being described as follows: Part of Lot 7, Concession IV, City of Orillia (formerly Township of South Orillia) more particularly described in Schedule "A" of Instrument No. 380728 registered in the Registry Office for the County of Simcoe. Such Services shall be constructed and installed in accordance with the Standards and Specifications required by the Municipality and these services may be summarized as follows:

a) sanitary sewer from Westmount Drive to the said lands;
b) a drainage ditch for storm water from Westmount Drive to the said lands.

6. SCHEDULE "C" - ENGINEERING AGREEMENT

.1 The parties hereto agree that Schedule "C" entitled "Engineering Agreement" and which sets out the General Provisions and Standards of the Municipality with respect to Subdivision and Development Agreements, shall be a separate Agreement which is incorporated into and forms part of this Agreement. A Copy of Schedule "C" shall be available at the Office of the Clerk of the Municipality.

.2 For reference purposes only, the following is a list of subject items contained in Schedule "C". Reference should be made to the "Engineering Agreement" for particulars of the items referred to.

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1. Application.
2. Developers Consulting Engineer.
3. Contractor to be Approved.
4. Estimated Cost of Municipal Services.
5. Inspection by Municipality.
6. Incomplete or Faulty Work.
7. Declaration As To Accounts.
8. Certificate of Surveyor and/or Engineer.
9. As Constructed Drawings.
10. Land To Be Free of Debris.
11. Indemnification from Liability and Release.
12. Modification of Services.
13. Construction Liens.
14. Repair of Damage.
15. Notices.
16. Ownership of Municipal Services.
17. Connection to Services Before Occupancy.
18. Work and Inspection Charges to Developer.
19. Access During Construction.
20. Design and Specifications of Municipal Services.
21. Acceptance Dates, Guarantees and Maintenance Periods.
22. Location Plans.
23. Relocation of Services.
24. Requirements as of Execution Date.

7. MUNICIPAL LANDS AND EASEMENTS - SCHEDULE "D"

.1 The Developer agrees to convey to the Municipality in fee simple, free and clear of all encumbrances, the lands and easements more particularly described in Schedule "D" attached.

8. EMERGENCY SITUATION

.1 If as a result of any work undertaken by the Developer, or its servants, or agents, there exists in the opinion of the Municipal Engineer an emergency situation which requires immediate attention to avoid damage to private or public property or services owned by the Municipality, such work may be done immediately by the Municipal Engineer at the expense of the Developer, but notice shall be given to the Developer at the earliest possible time.

9. LIABILITY INSURANCE

.1 The Developer shall lodge with the Municipality on or prior to the execution of the Agreement, an insurance policy with an Insurance Company satisfactory to the Municipality, which said approval shall not be unreasonably withheld or delayed, and insuring for the joint benefit of the Developer and the Municipality, against any liability that may arise out of the construction or installation of any work to be performed pursuant to this Agreement and for a period of 1 year after completion and acceptance of the Municipal Services to be constructed herein.

.2 Such policy shall carry limits of liability in the amount to be specified by the Municipality, but in no event shall it be less than $2,000,000.00 inclusive comprehensive general liability and such policy shall contain a cross-liability clause and shall not have an exclusion pertaining to blasting or completed operations.

.3 The Developer shall from time to time as required by the Municipality provide confirmation that all premiums on such policy or policies of insurance have been paid and that the insurance is in full force and effect, and see that a copy of the policy is filed with the Municipality.

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.4 The issuance of such Policy of Insurance shall not be construed as relieving the Developer from responsibility for other or larger claims, if any, for which it may be held responsible.

.5 This policy of insurance shall include the following additional names as insureds:

(a) The Corporation of the City of Orillia;

10. MODIFICATION OF SERVICES

.1 If at any time and from time to time during the construction of the Project, and at any stage thereof, the Municipal Engineer in his sole discretion, is of the opinion that a modification of design of any services required to be installed under the provisions of this Agreement is occasioned by site conditions, or is necessary to maintain the standard of any of the Municipal Services related thereto the Developer shall construct, install or perform such modifications of services as may be required.

11. REGISTRATION OF AGREEMENT AND OTHER DOCUMENTS

.1 The parties hereto consent to the registration of this Agreement by the Municipality upon the title of the said lands, which registration shall be included as a legal expense to the Developer. The Developer further agrees that he will execute such further and other documents, consents, or applications as may be reasonably required by the solicitor for the Municipality for the purpose of any registration against the said lands, or for the purpose of giving effect to the provisions required under this Development Agreement.

12. EXPENSES TO BE PAID BY DEVELOPER

.1 Every provision of this Agreement by which the Developer is obliged in any way shall be deemed to include the words "at the expense of the Developer" unless the context otherwise requires.

.2 The Developer shall pay such reasonable fees as may be invoiced to the Municipality by its Solicitor, in connection with all work to be performed as a result of the provisions of this Agreement.

.3 All expenses for which demand for payment has been made by the Municipality shall bear interest at the rate of 1½% per month commencing 30 days after demand.

.4 In the event that the Municipality finds it is necessary to engage the services of an engineer or technical personnel not permanently employed by the Municipality, to review the plans of the Developer, and/or carry out onsite inspections of the work performed, the Municipality will advise the Developer accordingly of this need, and the costs of such outside engineers so engaged shall be the responsibility of the Developer. The Municipality may require a deposit for this purpose.

12. CASH DEPOSITS, CAPITAL LEVIES AND SECURITY - SCHEDULE "E"

.1 The Developer shall lodge with the Municipality, those cash deposits, capital levies and security more particularly described in Schedule "E", and at the dates specified therein.

.2 In the event that the expenses of the Municipality exceed the amount of the cash deposits or security set out in Schedule "E" attached, the Developer shall pay such excess charges within 30 days after demand by the Municipality, or if less, such excess deposit shall be refunded upon the acceptance of the Municipal Services.

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13. REALIZATION OF SECURITY

.1 In the event that it becomes necessary for the Municipality to realize on its security, as a result of default by the Developer, then the Municipality, its servants or agents or sub-contractors shall, if it so elects, have at all times the right and privilege to enter upon the lands covered by this Agreement for the purpose of completing any work or services required to be constructed under this Agreement.

.2 If the cost of completing such work or service, exceeds the amounts of security held by the Municipality, such excess shall be paid by the Developer to the Municipality 30 days after invoicing by the Municipality. All overdue accounts shall bear interest at the rate of 1½% per month.

.3 The Developer on behalf of itself, its successors and assigns agrees to indemnify and save harmless the Municipality from and against any and all claims, suits, actions and demands whatsoever which may arise either directly or indirectly by reason of any work or service performed by the Municipality, its servants or sub-contractors in order to complete the work or services required to be completed under this Agreement; provided the subject matter of such action, suits, claims or demands was not caused intentionally or through gross negligence on the part of the Municipality, its servants or agents or sub-contractors.

14. ATTACHED SCHEDULES

.1 It is agreed that everything included in this Agreement and the Schedules attached thereto, together with all engineering drawings, material and undertakings filed by the Developer and accepted by the Municipality shall be included in and form part of this Agreement.

15. COMMENCEMENT OF CONSTRUCTION AND COMPLETION

.1 The Developer agrees to obtain a building permit and commence construction of the said development within 6 months of the execution of this Agreement by the Municipality and to complete the said development within 24 months thereafter. In the event that the Developer does not obtain a building permit or commence construction within the 6 month period or complete construction within 24 months thereafter then the Municipality may at its option terminate this Agreement.

16. APPLICATION FOR REDUCTION OF LETTERS OF CREDIT OR FOR ASSUMPTION OF MUNICIPAL SERVICES

.1 The Developer may make application to the Municipality for a reduction of a Letter of Credit, or for the assumption of a Municipal Service, in the following manner:

(a) he shall file a letter of application with the Clerk of the Municipality;

(b) accompanying the letter of application shall be a letter from the consultants confirming that certain stages of the municipal work had been completed in accordance with the specification requirements of the Development Agreement and that such services are now at a stage for interim or final inspection;

(c) the Municipal Clerk shall then give notice of this application to the various municipal departments concerned and shall reply as quickly as is possible.

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17. COMMENCEMENT OF 2 YEAR MAINTENANCE PERIOD

.1 A two-year maintenance period to guarantee against defects as required by this Agreement, shall commence not on the date that the service is assumed by the Municipality, or in the case of hydro, on the date that the system is energized, but shall commence, unless otherwise agreed upon, on the date that the last service is assumed by the Municipality.

18. APPLICATIONS OF LETTERS OF CREDIT

.1 Any Letter of Credit filed with the Municipality is based upon the estimated cost of completing matters set out in Schedule "F". However, any Letter of Credit given to the Municipality to cover these items, may be held by the Municipality to cover the estimated cost to complete any of the work required to be performed under the terms of this Agreement or for offsetting any cost incurred by the Municipality pursuant to the provisions of this Agreement.

.2 In the event that the amount of security remaining in the Letter of Credit is insufficient to complete the Municipal Services required under this Agreement, or to comply with the provisions of the Construction Lien Act, then the Municipality may give notice to the Developer that it proposes to cash the remaining Letter of Credit and to complete the Municipal Services, and the cost of completing such services in excess of the value of the Letter of Credit, shall be the responsibility of the Developer, and shall be invoiced to the Developer, which invoice shall be due and payable within 30 days of the invoice. All overdue accounts will bear interest at the rate of 1½% per month.

19. PLANS ATTACHED

.1 The Plans attached hereto as Schedules are either photographic or photostatic reductions of the original plans filed and accepted by the Municipality. Where uncertainty exists as to the content or accuracy of these exhibits, the reader should refer to the full scale drawings filed with the Municipality.

20. TIME OF THE ESSENCE

.1 The parties hereto agree that time shall be of the essence in this Agreement.

21. INTERPRETATION

.1 It is hereby agreed that in construing these presents the word "Developer" and the personal pronoun "he" or "his" relating thereto and used therewith, shall be read and construed as "Developer" and "his", "hers", "its" or "their" respectively as the number and gender of the party or parties referred to in each case requires and the number of the verb agreeing therewith shall be so construed as agreeing with the said word or pronoun so substituted.

.2 And that all covenants, rights, advantages, privileges, immunities, powers and things hereby secured to the Municipality shall be equally secured to and exercisable by its successors and assigns as the case may be.

.3 And that all covenants, liabilities and obligations entered into and imposed hereunder upon the Developer, shall be equally binding upon his, her, its or their heirs, executors, administrators and assigns, or successors and assigns as the case may

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be, and that all such covenants and liabilities and obligations shall be joint and several.

THIS AGREEMENT shall enure to the benefit of and be binding upon each of the parties hereto and their respective heirs, executors, administrators, successors and assigns.

IN WITNESS WHEREOF the parties hereto have executed this Agreement on the following dates:

By the Developer on the 2nd day of March, 1986.

FIRST BAPTIST CHURCH, ORILLIA

Per: Harvey Kitchen - Trustee

Per: Gordon Skinner - Committee Chairman

By The Corporation of the City of Orillia on the 11th day of March, 1986.

THE CORPORATION OF THE CITY OF ORILLIA

MAYOR

DEPUTY CLERK

CO.

SCHEDULE "A"

THIS IS SCHEDULE "A" TO THE DEVELOPMENT AGREEMENT BETWEEN THE CORPORATION OF THE CITY OF ORILLIA AND FIRST BAPTIST CHURCH, ORILLIA

DESCRIPTION

ALL AND SINGULAR that certain parcel or tract of land and premises situate, lying and being composed of Part of the West half of Lot 7, Concession 4, in the City of Orillia, in the County of Simcoe, and designated as Parts 1 and 2 on a Reference Description Plan deposited in the Registry Office for the Registry Division of the County of Simcoe as Plan No. 51R-3569.

SUBJECT TO an easement in favour of the Municipal Corporation of the City of Orillia, registered as Instrument No. 490725 on the 23rd day of August, 1974 over Part 2, Deposit Plan 51R-3569, for the City of Orillia.

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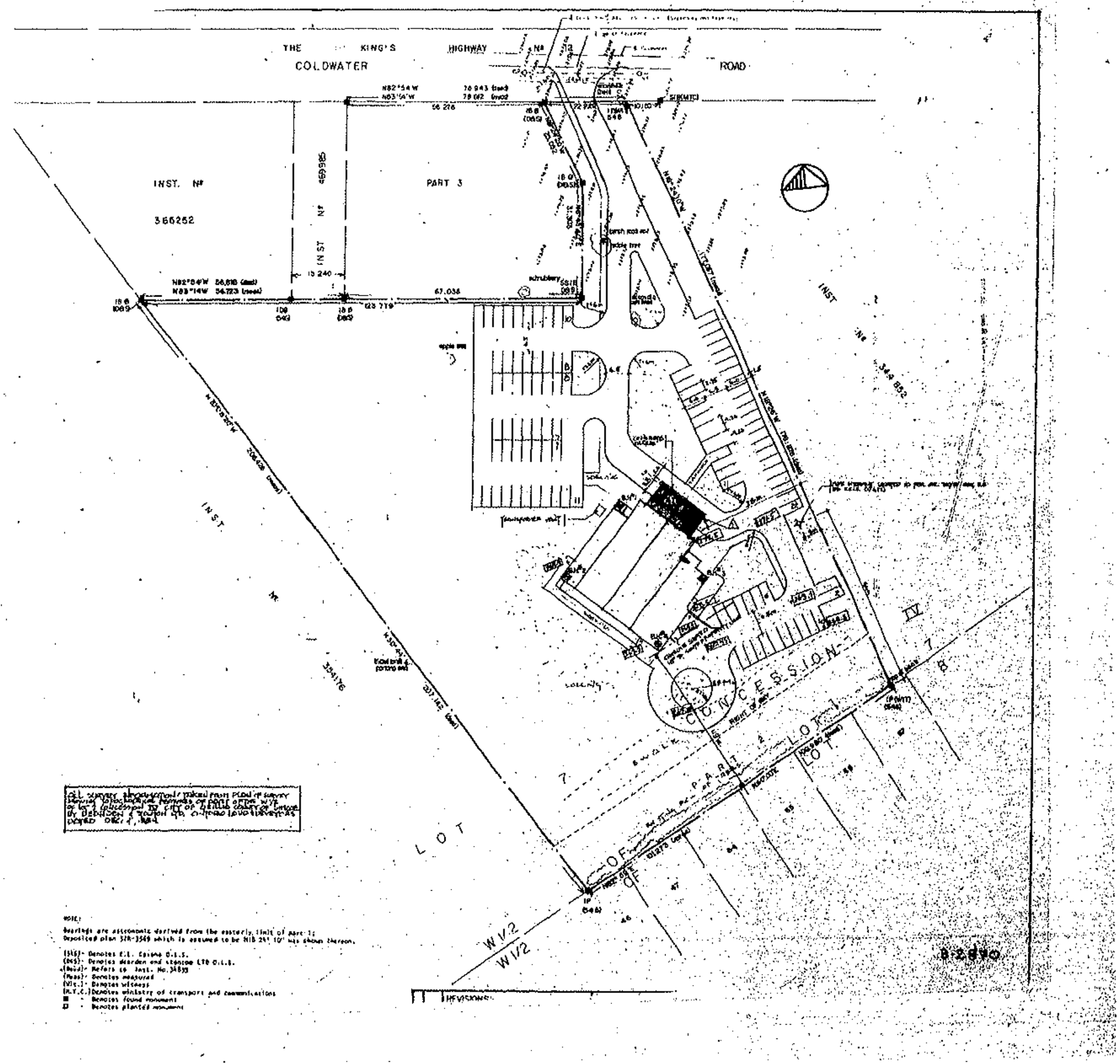
SCHEDULE "B"

THIS IS SCHEDULE "B" TO THE DEVELOPMENT AGREEMENT BETWEEN THE CORPORATION OF THE CITY OF ORILLIA AND FIRST BAPTIST CHURCH, ORILLIA



SCHEDULE "C"

THIS IS SCHEDULE "C" TO THE DEVELOPMENT AGREEMENT BETWEEN THE CORPORATION OF THE CITY OF ORILLIA AND FIRST BAPTIST CHURCH, ORILLIA

ENGINEERING AGREEMENT

The parties hereto agree that Schedule "C" entitled "Engineering Agreement "which sets out the General Provisions and Standards of the Municipality with respect to Subdivision and Development Agreements, shall be a separate Agreement which is incorporated into and forms part of this Agreement. A copy of Schedule "C" shall be available at the Office of the Clerk of the Municipality.

A list of subject items contained referred to in Schedule "C" is hereinbefore set out.

SCHEDULE "D"

THIS IS SCHEDULE "D" TO THE DEVELOPMENT AGREEMENT BETWEEN THE CORPORATION OF THE CITY OF ORILLIA AND FIRST BAPTIST CHURCH, ORILLIA

DEEDS AND EASEMENTS TO BE CONVEYED

All title documents to be exchanged shall:

(a) be properly drawn and executed by the parties;

(b) show a consideration of $2.00;

(c) any Transfer documents to the Municipality shall be prior approved by the solicitor for the Municipality;

(d) the cost of preparation, execution and registration of such documents shall be a financial responsibility of the Developer.

The following lands and easements are required:

1. Lands to be conveyed to the Municipality

a) a 2.942 metre road widening across the frontage of the said lands on Coldwater Road.

2. Easements to the Municipality

a) an easement 9.144 metres in width along the entire easterly boundary of the said lands for municipal sanitary sewer and water services. Such easement shall contain a provision that the Municipality when installing any services will use its best efforts to place the water main along the westerly side of the said easement if first installed leaving the most easterly part for any subsequent installation of a sanitary sewer.

SCHEDULE "E"

THIS IS SCHEDULE "E" TO THE DEVELOPMENT AGREEMENT BETWEEN THE CORPORATION OF THE CITY OF ORILLIA AND FIRST BAPTIST CHURCH, ORILLIA

CASH DEPOSITS, CAPITAL LEVIES AND SECURITY

The Developer shall, on the dates specified herein, lodge with the Municipality the following described cash deposits, capital levies and security.

1. TYPE OF SECURITY

Any security required to be filed under this Agreement shall be in cash, or by Letter of Credit valid for a period of 1 year with extension provisions and prepared in a form provided by the Municipality. It shall be drawn on a Chartered Bank of Canada and shall be for the amount hereinafter set out.

2. REDUCTION OF SECURITY

The Developer may, as portions of the work are completed, make application to the Municipality to reduce the security to such amount as, in the sole discretion of the Municipal Clerk, is sufficient to guarantee the due performance of all the terms of the Development Agreement including but not so as to limit the generality of the foregoing, Municipal Services, services and any other financial obligations required of the Developer under this Agreement, (the costs of which will be estimated by the Municipality for holdback purposes), and to cover any obligations of the Municipality that might arise under the Construction Lien Act, and this amount will also include the security holdback required for the 2 year maintenance period.

3. REFUNDABLE DEPOSITS

.1 Guarantee Of Obligations

A cash deposit or Letter of Credit, to an amount hereinafter set forth, shall be deposited by the Developer with the Municipality as a guarantee that the Developer will duly perform the work and carry out his obligations under this Agreement.

.2 Guarantee Against Defects In Municipal Services

In the event that the Developer by the terms of this Agreement is required to construct Municipal Services, a cash deposit or a Letter of Credit equal to 5% of the total value of the Municipal Services, shall be deposited with and retained by the Municipality for a period of 2 years after acceptance of the services, as a guarantee against any defects in the construction of such services, and also as a guarantee of due compliance of all provisions and obligations of this Agreement.

4. CASH DEPOSITS

The following cash deposits are preliminary estimates only and are to be paid to the Municipality prior to the execution of this Agreement by the Municipality. In the event that the actual costs incurred by the Municipality exceed the deposits, such excess shall be invoiced to the Developer and be due and payable 30 days after demand:

&

(a) For legal expenses and disbursements in connection with all negotiations and documentation prepared with respect to this Development until the matter is completed, a deposit of $ 1,500.00

5. SECURITY SUMMARY

Security to the following amounts shall be deposited with the Municipality to guarantee the due performance of all work and obligations required under this Agreement as follows:

(a) Estimated cost of Municipal Services to be constructed in accordance with Schedule "F" hereto attached. $29,500.00

(b) Amount of above deposit to be withheld by the Municipality as a guarantee against defects in construction of Municipal Services to extend for a period of 2 years after the Acceptance of the Services to cover all performance and obligations under this Agreement and included in Item 3.2 above. $ 1,475.00

6. ADDITIONS TO SECURITY

The parties hereto agree that in the event that the contract price for the Municipal Services set out in Schedule "F" attached, is greater by 10% than the estimates in the said Schedules, then the security provided for in paragraph 8 above shall be increased to an amount equal to the tendered contract price.

a

SCHEDULE "F"

THIS IS SCHEDULE "F" TO THE DEVELOPMENT AGREEMENT BETWEEN THE CORPORATION OF THE CITY OF ORILLIA AND FIRST BAPTIST CHURCH, ORILLIA

WORK COST ESTIMATES

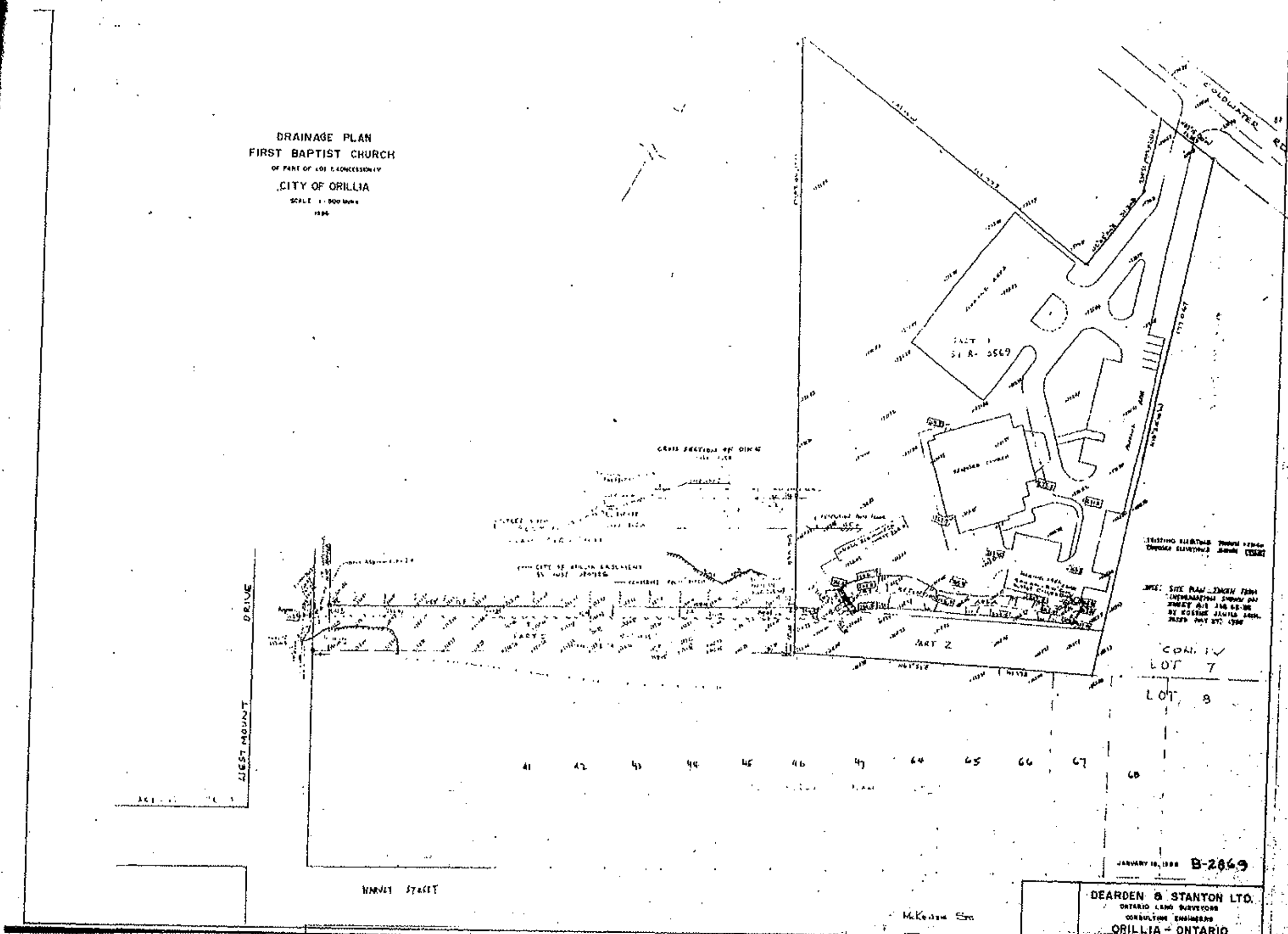
All work cost estimates herein are preliminary only and are subject to an adjustment in the event that the Contract price exceeds the estimate by 10% or more.

1.	Sanitary sewer installation including 200 metres of main and 3 manholes	$19,500.00
2.	Storm water drainage ditch	$10,000.00
	TOTAL	$29,500.00

&

SCHEDULE "G"

THIS IS SCHEDULE "G" TO THE DEVELOPMENT AGREEMENT BETWEEN THE CORPORATION OF THE CITY OF ORILLIA AND FIRST BAPTIST CHURCH, ORILLIA



Appendix B

Pre, Post and Uncontrolled Flows

n Engineering Inc

Calculation Sheet 1

Project:	PROPOSED RESIDENTIAL BUILDING
Address:	233, 249, 261 Coldwater Road
Town/Township/City	Orillia
Project No.	n2123
Proposed Development Area (m^2)	15076.18

PRE-DEVELOPMENT RUNOFF COFFICENT

AREA TYPE	AREA (M^2)	RUNOFF COEFFICIENT "C"	AREA x C
ASPHALT/CONC.	0.00	0.90	0.00
Gravel	108.77	0.90	97.89
LANDSCAPED AREA	14967.41	0.25	3741.85
		ΣAREA X C	3839.75
		WEIGHTED AVERAGE "C"	**0.25**
		AREA "A" (Hectares)	1.51

Rainfall Intensity: $I = AT^B$

Where:
i = Rainfall Intensity (mm/hr)
A = coefficient
B = coefficient
C = coefficient
t =Time of concentration (min) 18.73

Design Flow: Q = 0.0028(C)(I) (A)

Where:
Q= design flow (m3/s)
c = runoff coefficient (dimensionless)
i = average rainfall intensity (mm/hr)
A = drainage area (ha)

Return Period (Years)	2 -Years	5-Years	10 -Years	25 -Years	50 -Years	100-Years
A	22.500	29.900	34.800	40.900	45.500	50.000
B	-0.728	-0.725	-0.724	-0.723	-0.722	-0.722
t (mins)	18.73	18.73	18.73	18.73	18.73	18.73
i (mm/hr)	52.51	69.53	80.83	94.89	105.44	115.87
Weighted Avg. C	0.25	0.25	0.25	0.25	0.25	0.25
Pre-development Flow(l/sec)	56.45	74.76	86.91	102.02	113.36	124.57

n Engineering Inc

Calculation Sheet 2

Project:	PROPOSED RESIDENTIAL BUILDING
Address:	233, 249, 261 Coldwater Road
Town/Township/City	Orillia
Project No.	n2123
Proposed Development Area (m^2)	15076.18

POST DEVELOPMENT RUNOFF COFFICENT

AREA TYPE	AREA (M^2)	RUNOFF COEFFICIENT "C"	AREA x C
ASPHALT/CONC.	7551.77	0.90	6796.59
BUILDING	2143.12	0.90	1928.81
LANDSCAPED AREA	4133.56	0.25	1033.39
GREEN ROOF	1247.73	0.25	311.93
		ΣAREA X C	9758.79
		WEIGHTED AVERAGE "C"	**0.70**
		AREA "A" (Hectares)	1.51

Rainfall intensity: $$I = At^{B}$$

Where:
i = Rainfall Intensity (mm/hr)
A = coefficient
B = coefficient
C = coefficient
t =Time of concentration (min) 10.00

Design Flow: Q = 0.0028(C)(I)(A)

Where:
Q= Design flow (m^3/s)
c = Runoff coefficient (dimensionless)
i = Average rainfall intensity (mm/hr)
A = Drainage area (ha)

Return Period (Years)	2 -Years	5-Years	10 -Years	25 -Years	50 -Years	100-Years
A	22.50	29.90	34.80	40.90	45.50	50.00
B	-0.728	-0.725	-0.724	-0.723	-0.722	-0.722
t (mins)	10.00	10.00	10.00	10.00	10.00	10.00
i (mm/hr)	82.92	109.61	127.34	149.39	165.90	182.30
Weighted Avg. C	0.70	0.70	0.70	0.70	0.70	0.70
Adjustment	1.00	1.00	1.00	1.10	1.20	1.25
C-Adjusted	0.70	0.70	0.70	0.77	0.84	0.88
Q(l/sec)	245.03	323.88	376.28	485.59	588.25	673.37

n Engineering Inc

Calculation Sheet 3

(Uncontrolled Flow)

Project:	**PROPOSED RESIDENTIAL BUILDING**
Address:	**233, 249, 261 Coldwater Road**
Town/Township/City	**Orillia**
Project No.	**n2123**
Proposed Development Area (m^2)	**15076.18**

POST DEVELOPMENT RUNOFF COFFICENT (Uncontrolled)

AREA TYPE	AREA (M^2)	RUNOFF COEFFICIENT "C"	AREA x C
ASPHALT/CONC.	0.00	0.90	0.00
Gravel	0.00	0.90	0.00
LANDSCAPED AREA	1077.46	0.25	269.37
		ΣAREA X C	269.37
		WEIGHTED AVERAGE "C"	**0.25**
		AREA "A" (Hectares)	0.11

Rainfall intensity: $I = AT^B$

Where:
I = Rainfall Intensity (mm/hr)
A = coefficient
B = coefficient
C = coefficient
t =Time of concentration (min) 10.00
Design Flow: Q = 0.0028(C)(I) (A)

Where:
Q= design flow (m3/s)
C = runoff coefficient (dimensionless)
I = average rainfall intensity (mm/hr)
A = drainage area (ha)

Return Period (Years)	2 -Years	5-Years	10 -Years	25 -Years	50 -Years	100-Years
A	22.50	29.90	34.80	40.90	45.50	50.00
B	-0.728	-0.725	-0.724	-0.723	-0.722	-0.722
C	0.781	0.766	0.760	0.757	0.751	0.759
t (mins)	10.00	10.00	10.00	10.00	10.00	10.00
I (mm/hr)	82.92	109.61	127.34	149.39	165.90	182.30
Weighted Avg. C	0.25	0.25	0.25	0.25	0.25	0.25
Adjustment	1.00	1.00	1.00	1.10	1.20	1.25
C-Adjusted	0.25	0.25	0.25	0.28	0.30	0.31
Q (l/sec)	6.25	8.27	9.60	12.39	15.01	17.19

Calculation Sheet: 4

TIME OF CONCENTRATION

Time of Concentration [Tc]

Bransby Equation (for C > 0.40)

$$T_c = \frac{0.057L}{S^{0.2} A^{0.1}}$$

Where:
Tc = time of concentration, minutes
C = Rational method runoff coefficient
L = catchment or watershed length, m
Sw = catchment or watershed slope, %
A = catchment or watershed area, ha
Ref: MTO Drainage Management Manual, 1997 :: Page 4.15

Airport Equation (for C <0.4)

$$T_c = \frac{3.26(1.1 - C)L^{0.5}}{S_w^{\ 0.33}}$$

Where:
Tc = time of concentration, minutes
C = Rational method runoff coefficient
L = catchment or watershed length, m
Sw = catchment or watershed slope, %
A = catchment or watershed area, ha

Pre-Development [Tc]

Length [L] in m =	155.75
Slope [S] in % =	6.18
Area [A] in Ha =	1.51
Rational Mathod Runoff Coefficient C =	0.26
Pre-Dev [Tc] in min =	**18.73**

Post-Development [Tc]

Length [L] in m =	155.75
Slope [S] in % =	6.44
Rational Mathod Runoff Coefficient C =	0.70
Area [A] in Ha =	1.51
Post-Dev [Tc] in min =	**5.87**

Appendix C

Orifice Pipe Sizing & Onsite Detention Storage

n Engineering Inc

Table 1
Orifice Sizing Calculations
PROPOSED COMMUNITY BUILDING

Address:	233, 249, 261 Coldwater Road
Town/Township/City	Orillia
Project No.	n2123
Proposed Development Area (m^2)	15076.18

Orifice Location	MH2	
Orifice Type	Orfice Pipe	
Orifice Invert Elevation	**264.840**	m
Min. Ground Elevation	266.380	m
Orifice Center Elevation	264.900	
Diameter of Orifice Pipe	120	mm
Area of Orifice (A)	0.011304	m^2
Coefficient of Discharge (C_d)	0.8	
Gravitational Constant	9.81	

Orifice Flow Equation: $Q = C_d A_o \sqrt{2gH}$

Where:

Q = Flow (m^3/sec)

A_o = Orifice area (m^{2})

g = Gravitational Constant

H = Center line head (m)

C_d = coefficient of discharge, dimensionless, typically between 0.6 and 0.85, depending on the orifice geometry

	2 years	5 years	10 years	25 years	50 years	100 years
Ponding Depth (m)	0.07	0.09	0.12	0.12	0.12	0.12
Water Elevation	266.45	266.47	266.50	266.50	266.50	266.50
Upstearm Head (m)	1.550	1.570	1.600	1.600	1.600	1.600
Controlled Discharge (L/sec)	**49.87**	**50.19**	**50.67**	**50.67**	**50.67**	**50.67**
Discharge Velocity (m/sec)	4.41	4.44	4.48	4.48	4.48	4.48
Uncontrolled Flow (L/sec)	6.25	8.27	9.60	12.39	15.01	17.19
Pre-development Flow(L/sec) (2 yrs)	56.45	74.76	86.91	102.02	113.36	124.57
Allowable Flow (L/sec)	**50.20**	**66.49**	**77.30**	**89.63**	**98.35**	**107.39**
Detention Storage Required (m^3)	**116.77**	**175.13**	**214.89**	**268.38**	**310.83**	**350.31**
Storage Used in MH (m^3)	52.01	52.01	52.01	52.01	52.01	52.01
Storage Used in Pipe (m^3)	129.90	129.90	129.90	129.90	129.90	129.90
Roof Storage (m^3)	62.81	62.81	62.81	62.81	62.81	62.81
Storage Ponding Used (m^3)	114.01	114.01	114.01	114.01	114.01	114.01
Proposed Available Storage	**358.73**	**358.73**	**358.73**	**358.73**	**358.73**	**358.73**
Maximuim Available Storage (At 100 years)	**354.82**	**354.82**	**354.82**	**354.82**	**354.82**	**354.82**

n Engineering Inc

On-Site Storage Calculator

Project: PROPOSED COMMUNITY BUILDING
Address: 233, 249, 261 Coldwater Road
City/Township/County: Orillia
Project No: n2123

Table 2A - 2 Years Storage

Equation of IDF:

R = 0.70
A = 1.51 ha
$Q_{release}$ = 0.050 m^3/s
49.87 L/s

$$i = \frac{A}{(t+B)^C}$$

I = Rainfall Intensity (mm/hr)
T = Time of Concentration (hr)
A= 22.5
B= -0.728

Max. Storage Required (m^3) **116.77**

t_c (min)	i_2 (mm/hr)	Q_2 (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	Comments
1	443.28	1.299	1.250	74.976	
2	267.63	0.785	0.735	88.160	
3	199.22	0.584	0.534	96.145	
4	161.58	0.474	0.424	101.709	
5	137.35	0.403	0.353	105.830	
6	120.28	0.353	0.303	108.979	
7	107.51	0.315	0.265	111.422	
8	97.55	0.286	0.236	113.326	
9	89.53	0.262	0.213	114.803	
10	82.92	0.243	0.193	115.931	
11	77.36	0.227	0.177	116.769	***
12	72.62	0.213	0.163	117.362	

n Engineering Inc

On-Site Storage Calculator

Project: **PROPOSED COMMUNITY BUILDING**
Address: **233, 249, 261 Coldwater Road**
City/Township/County: **Orillia**
Project No: **n2123**

Table 2B - 5 Years Storage

Equation of IDF:

R = 0.70
A = 1.51 ha
$Q_{release}$ = 0.050 m^3/s
50.19 L/s

$$i = \frac{A}{(t+B)^C}$$

I = Rainfall Intensity (mm/hr)
T = Time of Concentration (hr)
A= 29.9
B= -0.725

Max. Storage Required (m^3) **175.13**

t_c (min)	i_5 (mm/hr)	Q_5 (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	Comments
1	581.88	1.719	1.669	100.153	
2	352.03	1.040	0.990	118.805	
3	262.37	0.775	0.725	130.518	
4	212.98	0.629	0.579	138.996	
5	181.17	0.535	0.485	145.543	
6	158.73	0.469	0.419	150.789	
7	141.95	0.419	0.369	155.090	
8	128.85	0.381	0.331	158.668	
9	118.31	0.350	0.299	161.673	
10	109.61	0.324	0.274	164.211	
11	102.29	0.302	0.252	166.360	
12	96.03	0.284	0.234	168.180	
13	90.62	0.268	0.218	169.716	
14	85.88	0.254	0.204	171.004	
15	81.69	0.241	0.191	172.076	
16	77.95	0.230	0.180	172.955	
17	74.60	0.220	0.170	173.661	
18	71.57	0.211	0.161	174.212	
19	68.82	0.203	0.153	174.622	
20	66.31	0.196	0.146	174.904	
21	64.01	0.189	0.139	175.069	
22	61.88	0.183	0.133	175.125	***

n Engineering Inc

On-Site Storage Calculator

Project: PROPOSED COMMUNITY BUILDING
Address: 233, 249, 261 Coldwater Road
City/Township/County: Orillia
Project No: n2123

Table 2C - 10 Years Storage

Equation of IDF:

R = 0.70
A = 1.51 ha
$Q_{release}$ = 0.051 m^3/s
50.67 L/s

$$i = \frac{A}{(t+B)^C}$$

I = Rainfall Intensity (mm/hr)
T = Time of Concentration (hr)

A= 34.8
B= -0.724

				Max. Storage Required (m^3)	214.89
t_c	i_{10}	Q_{10}	Q_{stored}	Peak Volume	Comments
(min)	(mm/hr)	(m^3/s)	(m^3/s)	(m^3)	
1	674.47	1.993	1.942	116.540	
2	408.33	1.207	1.156	138.712	
3	304.46	0.900	0.849	152.816	
4	247.21	0.730	0.680	163.158	
5	210.33	0.622	0.571	171.255	
6	184.32	0.545	0.494	177.838	
7	164.86	0.487	0.436	183.320	
8	149.67	0.442	0.392	187.961	
9	137.43	0.406	0.355	191.935	
10	127.34	0.376	0.326	195.366	
11	118.85	0.351	0.301	198.343	
12	111.59	0.330	0.279	200.937	
13	105.31	0.311	0.261	203.200	
14	99.81	0.295	0.244	205.176	
15	94.94	0.281	0.230	206.899	
16	90.61	0.268	0.217	208.396	
17	86.72	0.256	0.206	209.693	
18	83.20	0.246	0.195	210.809	
19	80.01	0.236	0.186	211.761	
20	77.09	0.228	0.177	212.564	
21	74.42	0.220	0.169	213.230	
22	71.95	0.213	0.162	213.771	
23	69.67	0.206	0.155	214.195	
24	67.56	0.200	0.149	214.512	
25	65.59	0.194	0.143	214.729	
26	63.76	0.188	0.138	214.853	
27	62.04	0.183	0.133	214.890	***

n Engineering Inc

On-Site Storage Calculator

Project: #REF!

Address: 233, 249, 261 Coldwater Road

City/Township/County: Orillia

Project No: #REF!

Table 2D - 25 Years Storage

Equation of IDF:

R = 0.70

A = 1.51 ha

Q *release* = 0.051 m^3/s

50.67 L/s

$$i = \frac{A}{(t+B)^C}$$

I = Rainfall Intensity (mm/hr)

T = Time of Concentration (hr)

A= 40.9

B= -0.723

Max. Storage Required (m^3): **268.38**

t_c (min)	i_{25} (mm/hr)	Q_{25} (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	Comments
1	789.4537	2.333	2.282	136.927	
2	478.27973	1.413	1.363	163.514	
3	356.7533	1.054	1.004	180.632	
4	289.75924	0.856	0.806	193.332	
5	246.58767	0.729	0.678	203.395	
6	216.13411	0.639	0.588	211.678	
7	193.33958	0.571	0.521	218.668	
8	175.54667	0.519	0.468	224.669	
9	161.21644	0.476	0.426	229.887	
10	149.39177	0.441	0.391	234.465	
11	139.44397	0.412	0.361	238.511	
12	130.94189	0.387	0.336	242.105	
13	123.57927	0.365	0.315	245.310	
14	117.13214	0.346	0.295	248.178	
15	111.43271	0.329	0.279	250.747	
16	106.35255	0.314	0.264	253.053	
17	101.79164	0.301	0.250	255.122	
18	97.670777	0.289	0.238	256.978	
19	93.926428	0.278	0.227	258.641	
20	90.506959	0.267	0.217	260.129	
21	87.369955	0.258	0.208	261.456	
22	84.480225	0.250	0.199	262.634	
32	64.43224	0.190	0.140	268.272	
33	63.014585	0.186	0.136	268.361	
34	61.669071	0.182	0.132	268.383	***
35	60.390061	0.178	0.128	268.340	
36	59.172505	0.175	0.124	268.235	

n Engineering Inc

On-Site Storage Calculator

Project: #REF!

Address: 233, 249, 261 Coldwater Road

City/Township/County: Orillia

Project No: #REF!

Table 2E - 50 Years Storage

Equation of IDF:

R = 0.70

A = 1.51 ha

$Q_{release}$ = 0.051 m^3/s

50.67 L/s

$$i = \frac{A}{(t+B)^C}$$

I = Rainfall Intensity (mm/hr)

T = Time of Concentration (hr)

A= 45.5

B= -0.722

Max. Storage Required (m^3) **310.83**

t_c (min)	i_{50} (mm/hr)	Q_{50} (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	Comments
1	874.65	2.585	2.534	152.033	
2	530.26	1.567	1.516	181.947	
3	395.69	1.169	1.119	201.342	
4	321.48	0.950	0.899	215.826	
5	273.64	0.809	0.758	227.376	
6	239.89	0.709	0.658	236.948	
7	214.62	0.634	0.584	245.082	
8	194.90	0.576	0.525	252.115	
9	179.01	0.529	0.478	258.277	
10	165.90	0.490	0.440	263.727	
11	154.86	0.458	0.407	268.584	
12	145.43	0.430	0.379	272.939	
13	137.27	0.406	0.355	276.861	
14	130.12	0.384	0.334	280.407	
15	123.79	0.366	0.315	283.621	
16	118.16	0.349	0.298	286.541	
17	113.10	0.334	0.284	289.198	
18	108.53	0.321	0.270	291.618	
19	104.37	0.308	0.258	293.822	
20	100.58	0.297	0.247	295.832	
21	97.09	0.287	0.236	297.662	
22	93.89	0.277	0.227	299.327	
23	90.92	0.269	0.218	300.841	
24	88.17	0.261	0.210	302.213	
25	85.61	0.253	0.202	303.455	
26	83.22	0.246	0.195	304.575	
27	80.98	0.239	0.189	305.581	
28	78.88	0.233	0.182	306.480	
29	76.91	0.227	0.177	307.279	
30	75.05	0.222	0.171	307.984	
31	73.29	0.217	0.166	308.599	
32	71.63	0.212	0.161	309.130	
33	70.06	0.207	0.156	309.582	
34	68.57	0.203	0.152	309.958	
35	67.15	0.198	0.148	310.262	
36	65.79	0.194	0.144	310.498	
37	64.51	0.191	0.140	310.669	
38	63.28	0.187	0.136	310.777	
39	62.10	0.183	0.133	310.827	***
40	60.97	0.180	0.130	310.820	

n Engineering Inc

On-Site Storage Calculator

Project: **PROPOSED COMMUNITY BUILDING**
Address: **233, 249, 261 Coldwater Road**
City/Township/County: **Orillia**
Project No: **n2123**

Table 2F - 100 Years Storage

Equation of IDF:

R = 0.70
A = 1.51 ha
$Q_{release}$ = 0.051 m^3/s
50.67 L/s

$$I = AT^{B}$$

I = Rainfall Intensity (mm/hr)
T = Time of Concentration (hr)
A= 50
B= -0.722

Max. Storage Required (m^3) **350.31**

t_c (min)	i_{100} (mm/hr)	Q_{100} (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	Comments
1	961.16	2.818	2.767	166.017	
2	582.71	1.708	1.658	198.904	
3	434.82	1.275	1.224	220.322	
4	353.27	1.036	0.985	236.385	
5	300.70	0.882	0.831	249.252	
6	263.61	0.773	0.722	259.961	
7	235.85	0.691	0.641	269.102	
8	214.17	0.628	0.577	277.044	
9	196.71	0.577	0.526	284.035	
10	182.30	0.534	0.484	290.251	
11	170.18	0.499	0.448	295.820	
12	159.82	0.469	0.418	300.842	
13	150.84	0.442	0.392	305.392	
14	142.99	0.419	0.368	309.532	
15	136.04	0.399	0.348	313.310	
16	129.84	0.381	0.330	316.767	
17	124.28	0.364	0.314	319.938	
18	119.26	0.350	0.299	322.850	
19	114.69	0.336	0.286	325.528	
20	110.52	0.324	0.273	327.993	
21	106.70	0.313	0.262	330.262	
22	103.17	0.302	0.252	332.352	
23	99.91	0.293	0.242	334.276	
24	96.89	0.284	0.233	336.047	
25	94.08	0.276	0.225	337.675	
26	91.45	0.268	0.217	339.170	
27	88.99	0.261	0.210	340.541	
28	86.69	0.254	0.203	341.795	
29	84.52	0.248	0.197	342.940	
30	82.47	0.242	0.191	343.982	
35	73.79	0.216	0.166	347.837	
40	67.01	0.196	0.146	349.815	
45	61.54	0.180	0.130	350.306	**MAX**

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	2.920	1.150
Flush-Flo™	0.038	0.177
Kick-Flo®	0.038	0.177
Mean Flow		0.794

Hydro-Brake® Optimum Flow Control including:

- **3 mm** grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet
- Indicative Weight: 2 kg

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

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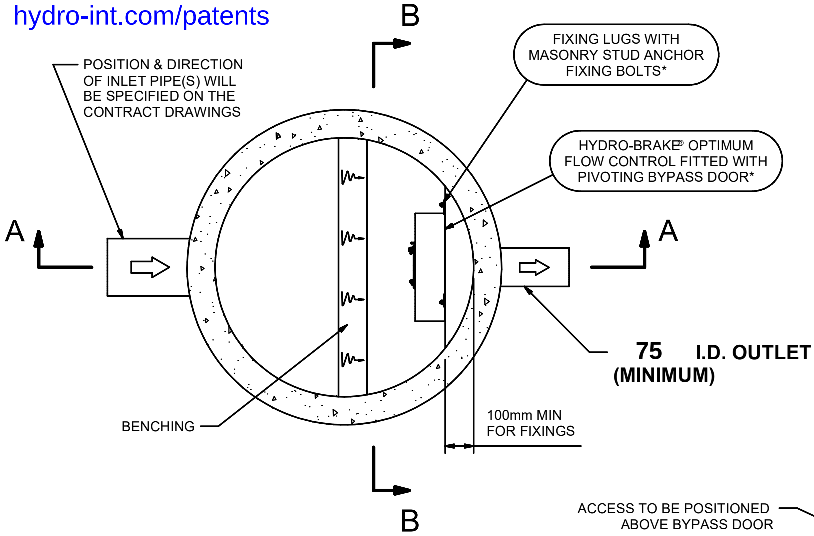
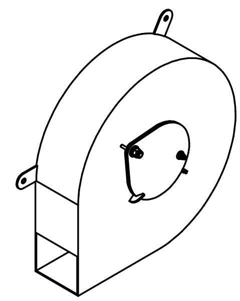
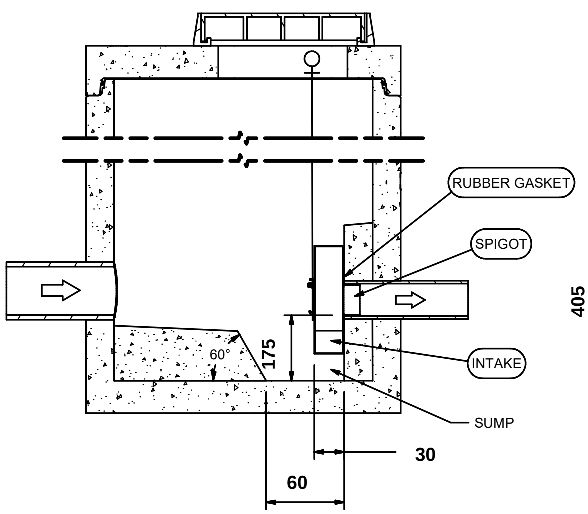
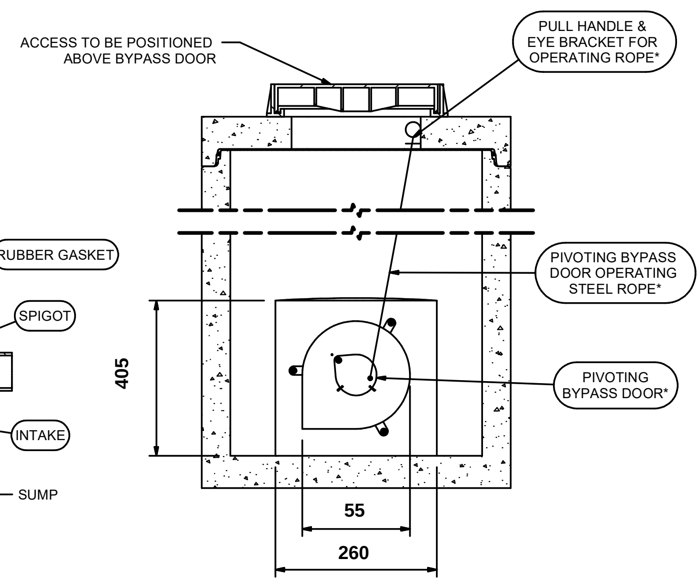






SECTION A-A



SECTION B-B

IMPORTANT: (oval symbol) LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
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* WHERE SUPPLIED
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DESIGN ADVICE !

The head/flow characteristics of this SCU-0025-1150-2920-1150 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

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DATE	6/16/2022 6:15 PM
SITE	233, 249, 261 Coldwater Road
DESIGNER	**Erfan Haidari**
REF	**1 / 22_12_2280**

SCU-0025-1150-2920-1150

Hydro-Brake® Optimum

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eh@nengineering.com

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	2.920	1.150
Flush-Flo	0.038	0.177
Kick-Flo®	0.038	0.177
Mean Flow		0.794

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CERTIFICATE No 08/4596

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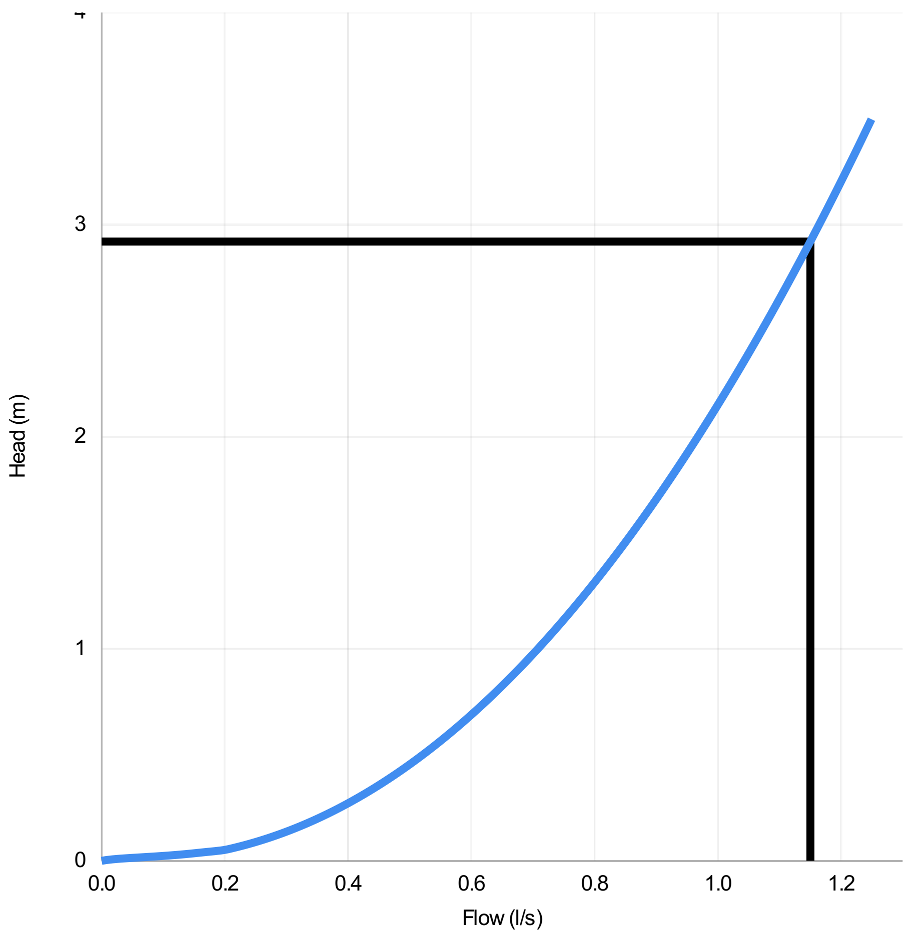

Head (m)	Flow (l/s)
0.000	0.000
0.101	0.263
0.201	0.352
0.302	0.419
0.403	0.474
0.503	0.523
0.604	0.566
0.705	0.606
0.806	0.643
0.906	0.677
1.007	0.710
1.108	0.741
1.208	0.770
1.309	0.799
1.410	0.826
1.510	0.852
1.611	0.877
1.712	0.901
1.812	0.925
1.913	0.948
2.014	0.970
2.114	0.992
2.215	1.013
2.316	1.034
2.417	1.055
2.517	1.074
2.618	1.094
2.719	1.113
2.819	1.132
2.920	1.150

DESIGN ADVICE

!

The head/flow characteristics of this SCU-0025-1150-2920-1150 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modeling evaluates the full head/flow characteristic curve.

The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International®

DATE	6/16/2022 6:15 PM
Site	233, 249, 261 Coldwater Road
DESIGNER	Erfan Haidari
Ref	1 / 22_12_2280

SCU-0025-1150-2920-1150

Hydro-Brake Optimum®

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Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	1.920	1.200
Flush-Flo™	0.042	0.230
Kick-Flo®	0.042	0.230
Mean Flow		0.830

Hydro-Brake® Optimum Flow Control including:

- 3 mm grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet
- Indicative Weight: 2 kg

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

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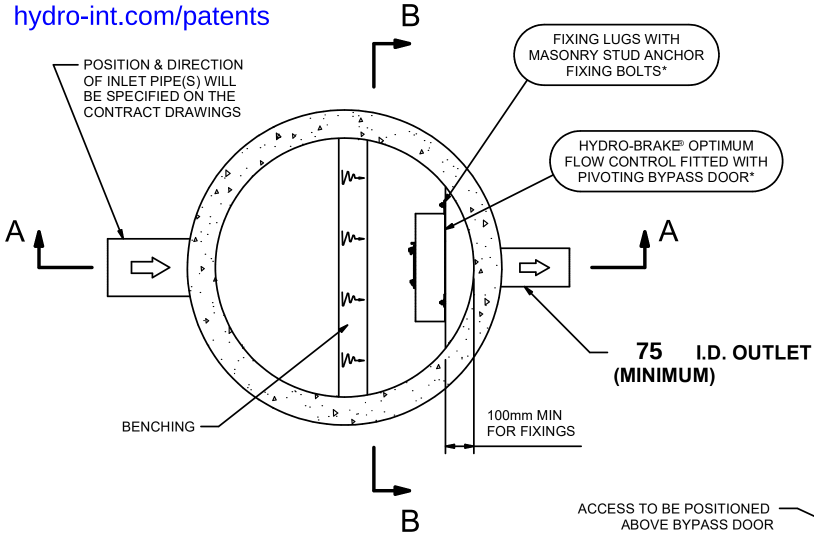
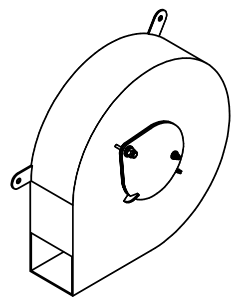
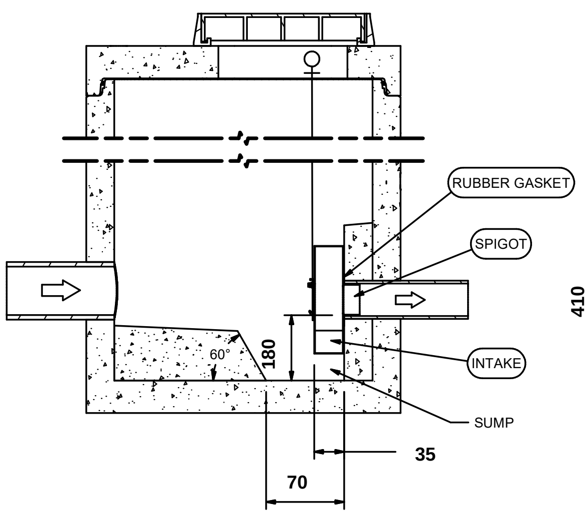
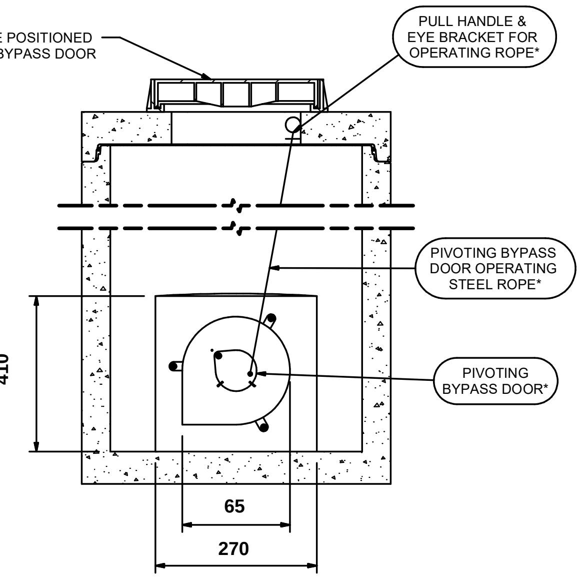






SECTION A-A



SECTION B-B

IMPORTANT: (oval symbol) LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
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THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE !

The head/flow characteristics of this SCU-0028-1200-1920-1200 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International®

DATE	6/16/2022 6:19 PM
SITE	233, 249, 261 Coldwater Road
DESIGNER	**Erfan Haidari**
REF	**2 / 22_12_2280**

SCU-0028-1200-1920-1200

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eh@nenengineering.com

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	1.920	1.200
Flush-Flo	0.042	0.230
Kick-Flo®	0.042	0.230
Mean Flow		0.830

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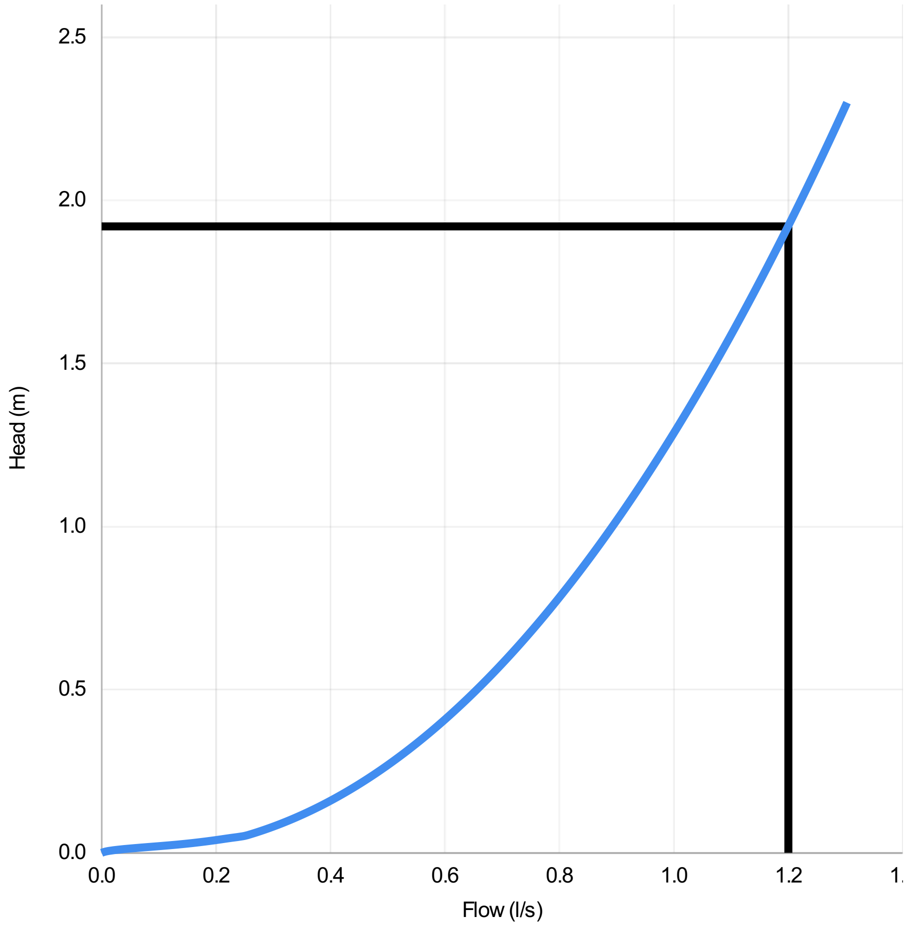

Head (m)	Flow (l/s)
0.000	0.000
0.066	0.277
0.132	0.369
0.199	0.439
0.265	0.497
0.331	0.547
0.397	0.592
0.463	0.634
0.530	0.672
0.596	0.708
0.662	0.742
0.728	0.774
0.794	0.805
0.861	0.834
0.927	0.863
0.993	0.890
1.059	0.916
1.126	0.941
1.192	0.966
1.258	0.990
1.324	1.013
1.390	1.036
1.457	1.058
1.523	1.079
1.589	1.100
1.655	1.121
1.721	1.141
1.788	1.161
1.854	1.180
1.920	1.199

DESIGN ADVICE

!

The head/flow characteristics of this SCU-0028-1200-1920-1200 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modeling evaluates the full head/flow characteristic curve.

The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International®

DATE	6/16/2022 6:19 PM
Site	233, 249, 261 Coldwater Road
DESIGNER	Erfan Haidari
Ref	2 / 22_12_2280

SCU-0028-1200-1920-1200

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Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	2.820	0.930
Flush-Flo™	0.034	0.141
Kick-Flo®	0.034	0.141
Mean Flow		0.645

Hydro-Brake® Optimum Flow Control including:

- **3 mm** grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet
- Indicative Weight: 2 kg

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

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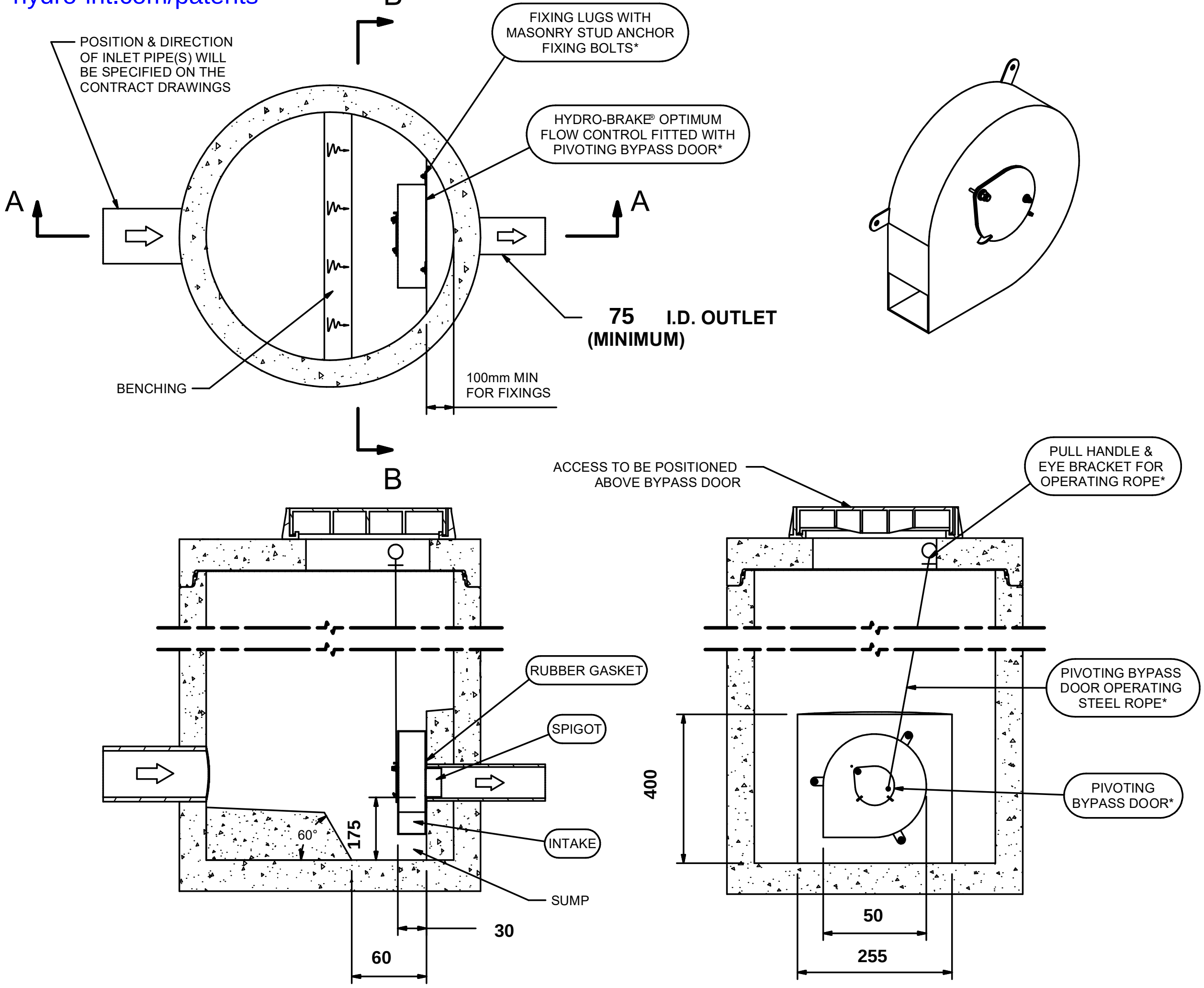

SECTION A-A

SECTION B-B

IMPORTANT: ⬭ LIMIT OF HYDRO INTERNATIONAL SUPPLY
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DESIGN ADVICE !

The head/flow characteristics of this SCU-0022-9300-2820-9300 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

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SITE	233, 249, 261 Coldwater Road
DESIGNER	**Erfan Haidari**
REF	**3 / 22_12_2280**

SCU-0022-9300-2820-9300

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eh@nengineering.com

Technical Specification		
Control Point	Head (m)	Flow (l/s)
Primary Design	2.820	0.930
Flush-Flo	0.034	0.141
Kick-Flo®	0.034	0.141
Mean Flow		0.645

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CERTIFICATE No 08/4596

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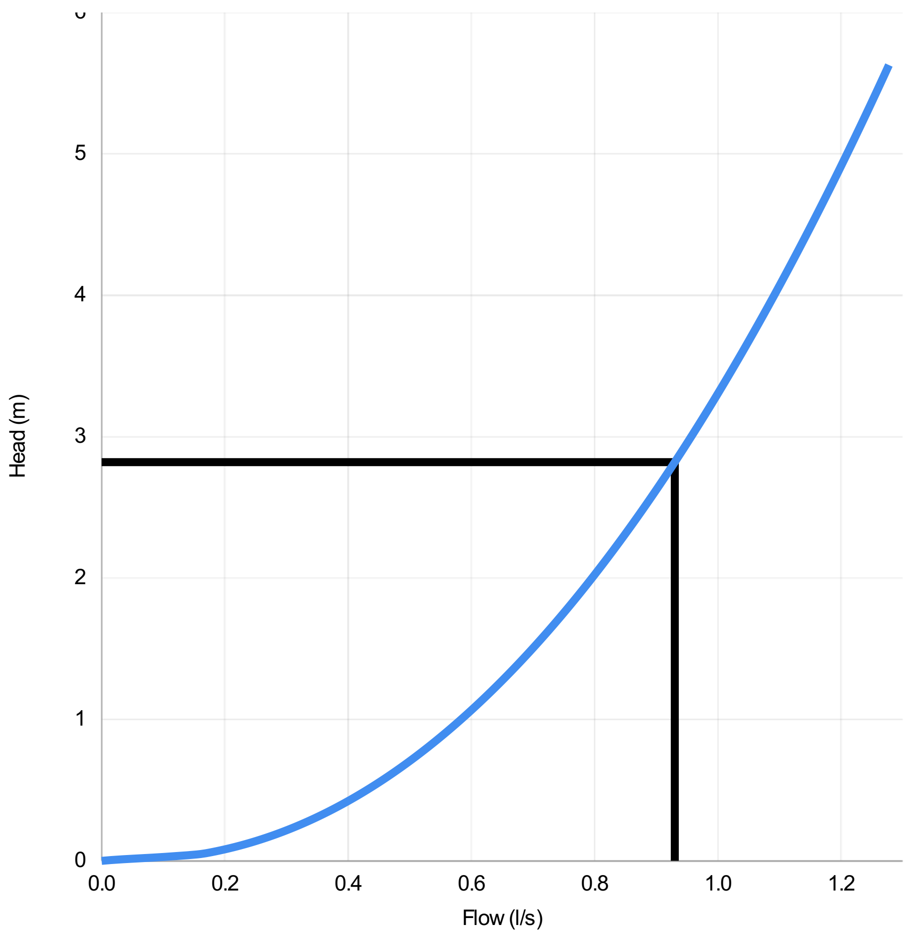

Head (m)	Flow (l/s)
0.000	0.000
0.097	0.215
0.194	0.287
0.292	0.341
0.389	0.386
0.486	0.425
0.583	0.460
0.681	0.492
0.778	0.522
0.875	0.550
0.972	0.576
1.070	0.601
1.167	0.625
1.264	0.647
1.361	0.669
1.459	0.690
1.556	0.710
1.653	0.730
1.750	0.749
1.848	0.768
1.945	0.786
2.042	0.803
2.139	0.820
2.237	0.837
2.334	0.853
2.431	0.869
2.528	0.885
2.626	0.900
2.723	0.915
2.820	0.930

DESIGN ADVICE

!

The head/flow characteristics of this SCU-0022-9300-2820-9300 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modeling evaluates the full head/flow characteristic curve.

The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

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DATE	6/16/2022 6:24 PM
Site	233, 249, 261 Coldwater Road
DESIGNER	Erfan Haidari
Ref	3 / 22_12_2280

SCU-0022-9300-2820-9300

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Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	2.090	3.800
Flush-Flo™	0.076	0.851
Kick-Flo®	0.076	0.851
Mean Flow		2.597

Hydro-Brake® Optimum Flow Control including:

- 3 mm grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet
- Indicative Weight: 6 kg

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

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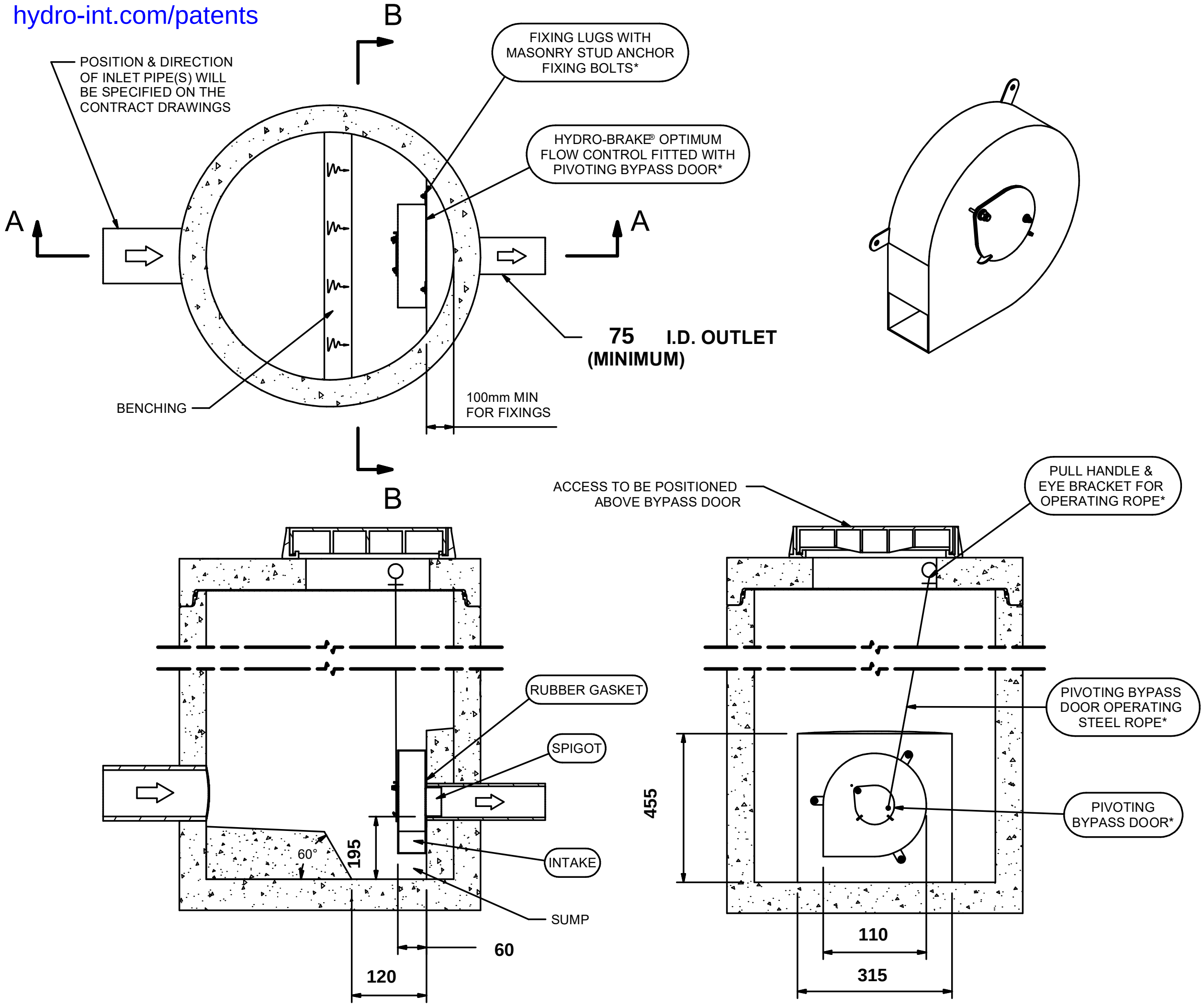

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DESIGN ADVICE !

The head/flow characteristics of this SCU-0050-3800-2090-3800 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

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DATE	6/16/2022 6:25 PM
SITE	233, 249, 261 Coldwater Road
DESIGNER	**Erfan Haidari**
REF	**4**

SCU-0050-3800-2090-3800

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eh@nengineering.com

Technical Specification		
Control Point	Head (m)	Flow (l/s)
Primary Design	2.090	3.800
Flush-Flo	0.076	0.851
Kick-Flo®	0.076	0.851
Mean Flow		2.597

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BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4596

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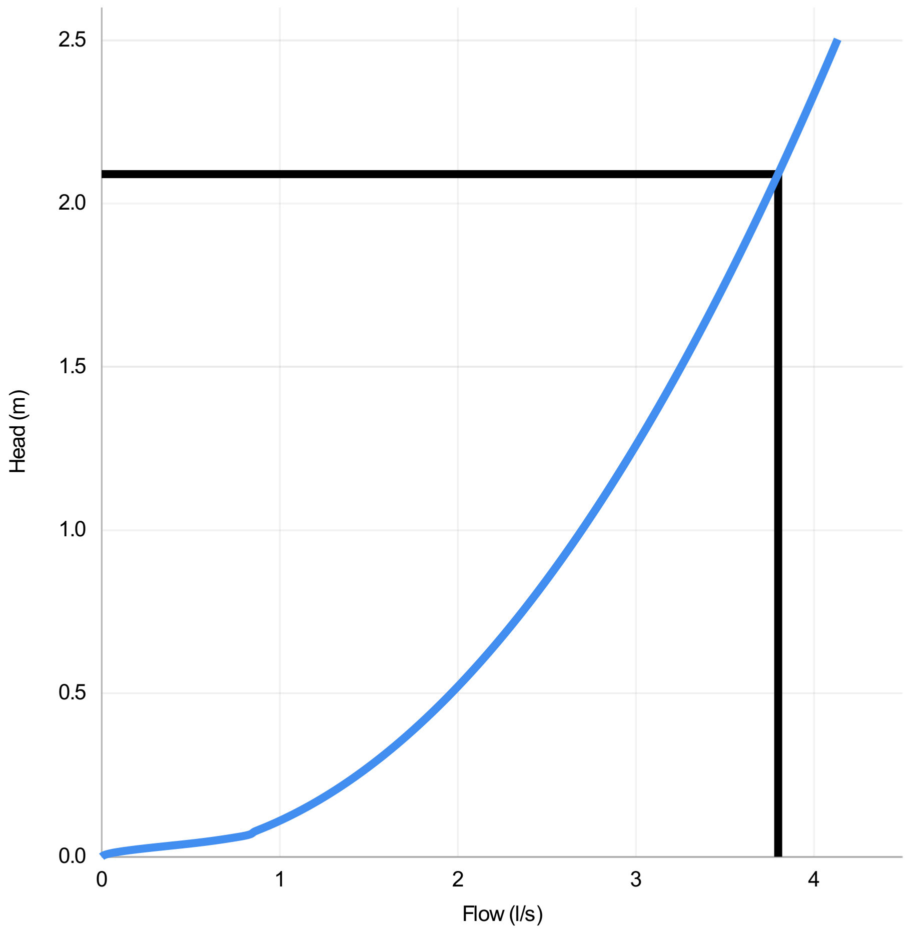

Head (m)	Flow (l/s)
0.000	0.000
0.072	0.847
0.144	1.125
0.216	1.346
0.288	1.531
0.360	1.693
0.432	1.838
0.504	1.971
0.577	2.095
0.649	2.210
0.721	2.320
0.793	2.423
0.865	2.522
0.937	2.617
1.009	2.708
1.081	2.796
1.153	2.881
1.225	2.963
1.297	3.042
1.369	3.119
1.441	3.195
1.513	3.268
1.586	3.339
1.658	3.409
1.730	3.478
1.802	3.544
1.874	3.610
1.946	3.674
2.018	3.737
2.090	3.799

DESIGN ADVICE

!

The head/flow characteristics of this SCU-0050-3800-2090-3800 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modeling evaluates the full head/flow characteristic curve.

The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

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DATE	6/16/2022 6:25 PM
Site	233, 249, 261 Coldwater Road
DESIGNER	Erfan Haidari
Ref	4

SCU-0050-3800-2090-3800

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n Engineering Inc

On-Site Storage Calculator

Project: PROPOSED COMMUNITY BUILDING
Address: 233, 249, 261 Coldwater Road
City/Township/County: Orillia
Project No: n2123

Table 2G - 100 Years Storage (Hydro-Brake Optimum -1)

Equation of IDF:

R = 0.63
A = 0.17 ha
$Q_{release}$ = 0.001 m^3/s
1.15 L/s

$$i = \frac{A}{(t+B)^C}$$

I = Rainfall Intensity (mm/hr)
T = Time of Concentration (hr)
A= 50
B= -0.722

Max. Storage Required (m^3): **61.30**

t_c (min)	i_{100} (mm/hr)	Q_{100} (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	Comments
1	961.16	0.279	0.278	16.698	
2	582.71	0.169	0.168	20.192	
3	434.82	0.126	0.125	22.549	
4	353.27	0.103	0.102	24.375	
5	300.70	0.087	0.086	25.884	
6	263.61	0.077	0.075	27.178	
7	235.85	0.069	0.067	28.317	
8	214.17	0.062	0.061	29.338	
9	196.71	0.057	0.056	30.263	
10	182.30	0.053	0.052	31.112	
11	170.18	0.049	0.048	31.897	
12	159.82	0.046	0.045	32.628	
13	150.84	0.044	0.043	33.312	
14	142.99	0.042	0.040	33.955	
105	33.38	0.010	0.009	53.899	
110	32.28	0.009	0.008	54.349	
115	31.26	0.009	0.008	54.775	
120	30.31	0.009	0.008	55.176	
125	29.43	0.009	0.007	55.555	
310	15.28	0.004	0.003	61.225	
315	15.10	0.004	0.003	61.248	
320	14.93	0.004	0.003	61.267	
325	14.76	0.004	0.003	61.282	
330	14.60	0.004	0.003	61.293	
335	14.44	0.004	0.003	61.301	
340	14.29	0.004	0.003	61.304	**MAX**
345	14.14	0.004	0.003	61.304	
350	14.00	0.004	0.003	61.300	
355	13.85	0.004	0.003	61.292	
360	13.71	0.004	0.003	61.282	
365	13.58	0.004	0.003	61.268	
370	13.44	0.004	0.003	61.250	

n Engineering Inc

On-Site Storage Calculator

Project: PROPOSED COMMUNITY BUILDING
Address: 233, 249, 261 Coldwater Road
City/Township/County: Orillia
Project No: n2123

Table 2H - 100 Years Storage (Hydro-Brake Optimum -2)

Equation of IDF: $i = \frac{A}{(t+B)^C}$

R = 0.89
A = 0.12 ha
$Q_{release}$ = 0.001 m^3/s
1.20 L/s

I = Rainfall Intensity (mm/hr)
T = Time of Concentration (hr)
A= 50
B= -0.722

Max. Storage Required (m^3): 60.26

t_c (min)	i_{100} (mm/hr)	Q_{100} (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	Comments
1	961.16	0.279	0.278	16.685	
2	582.71	0.169	0.168	20.174	
3	434.82	0.126	0.125	22.527	
4	353.27	0.103	0.101	24.348	
5	300.70	0.087	0.086	25.853	
6	263.61	0.077	0.075	27.144	
7	235.85	0.069	0.067	28.279	
8	214.17	0.062	0.061	29.296	
9	196.71	0.057	0.056	30.218	
10	182.30	0.053	0.052	31.064	
11	170.18	0.049	0.048	31.845	
12	159.82	0.046	0.045	32.572	
13	150.84	0.044	0.043	33.252	
14	142.99	0.042	0.040	33.892	
15	136.04	0.040	0.038	34.496	
26	91.45	0.027	0.025	39.582	
27	88.99	0.026	0.025	39.947	
28	86.69	0.025	0.024	40.301	
29	84.52	0.025	0.023	40.644	
30	82.47	0.024	0.023	40.976	
35	73.79	0.021	0.020	42.505	
40	67.01	0.019	0.018	43.848	
45	61.54	0.018	0.017	45.043	
50	57.03	0.017	0.015	46.118	
55	53.24	0.015	0.014	47.093	
60	50.00	0.015	0.013	47.983	
65	47.19	0.014	0.013	48.800	
70	44.73	0.013	0.012	49.553	
75	42.56	0.012	0.011	50.250	
80	40.62	0.012	0.011	50.898	
85	38.88	0.011	0.010	51.501	
90	37.31	0.011	0.010	52.064	
95	35.88	0.010	0.009	52.590	
100	34.58	0.010	0.009	53.084	
105	33.38	0.010	0.008	53.547	
110	32.28	0.009	0.008	53.983	
115	31.26	0.009	0.008	54.392	
120	30.31	0.009	0.008	54.778	
125	29.43	0.009	0.007	55.142	
310	15.28	0.004	0.003	60.246	
315	15.10	0.004	0.003	60.254	
320	14.93	0.004	0.003	60.258	**MAX**
325	14.76	0.004	0.003	60.258	
330	14.60	0.004	0.003	60.253	
335	14.44	0.004	0.003	60.245	

n Engineering Inc

On-Site Storage Calculator

Project: PROPOSED COMMUNITY BUILDING
Address: 233, 249, 261 Coldwater Road
City/Township/County: Orillia
Project No: n2123

Table 2I - 100 Years Storage (Hydro-Brake Optimum -3)

R = 0.90
A = 0.20 ha
$Q_{release}$ = 0.001 m^3/s
0.93 L/s

Equation of IDF:

$$i = \frac{A}{(t+B)^C}$$

I = Rainfall Intensity (mm/hr)
T = Time of Concentration (hr)
A= 50
B= -0.722

Max. Storage Required (m^3) **137.38**

t_c (min)	i_{100} (mm/hr)	Q_{100} (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	Comments
1	961.16	0.472	0.471	28.247	
2	582.71	0.286	0.285	34.206	
3	434.82	0.213	0.212	38.245	
4	353.27	0.173	0.172	41.388	
5	300.70	0.148	0.147	43.995	
6	263.61	0.129	0.128	46.241	
7	235.85	0.116	0.115	48.225	
8	214.17	0.105	0.104	50.007	
9	196.71	0.097	0.096	51.631	
10	182.30	0.089	0.089	53.125	
11	170.18	0.084	0.083	54.510	
29	84.52	0.041	0.041	70.556	
30	82.47	0.040	0.040	71.183	
35	73.79	0.036	0.035	74.095	
40	67.01	0.033	0.032	76.692	
45	61.54	0.030	0.029	79.040	
50	57.03	0.028	0.027	81.185	
55	53.24	0.026	0.025	83.160	
60	50.00	0.025	0.024	84.993	
65	47.19	0.023	0.022	86.701	
70	44.73	0.022	0.021	88.303	
75	42.56	0.021	0.020	89.809	
80	40.62	0.020	0.019	91.232	
915	6.99	0.003	0.003	137.355	
920	6.97	0.003	0.002	137.362	
925	6.94	0.003	0.002	137.368	
930	6.91	0.003	0.002	137.372	
935	6.88	0.003	0.002	137.375	
940	6.86	0.003	0.002	137.378	
945	6.83	0.003	0.002	137.379	
950	6.81	0.003	0.002	137.379	**MAX**
955	6.78	0.003	0.002	137.378	
960	6.75	0.003	0.002	137.376	

n Engineering Inc

On-Site Storage Calculator

Project: **PROPOSED COMMUNITY BUILDING**
Address: **233, 249, 261 Coldwater Road**
City/Township/County: **Orillia**
Project No: **n2123**

Table 2J - 100 Years Storage (Hydro-Brake Optimum -4)

Equation of IDF:

$$i = \frac{A}{(t+B)^C}$$

I = Rainfall Intensity (mm/hr)
T = Time of Concentration (hr)

R = 0.76
A = 0.12 ha
$Q_{release}$ = 0.004 m^3/s
3.80 L/s

A= 50
B= -0.722

Max. Storage Required (m^3) **33.07**

t_c (min)	i_{100} (mm/hr)	Q_{100} (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	Comments
1	961.16	0.249	0.246	14.741	
2	582.71	0.151	0.147	17.695	
3	434.82	0.113	0.109	19.632	
4	353.27	0.092	0.088	21.096	
5	300.70	0.078	0.074	22.276	
6	263.61	0.068	0.065	23.266	
7	235.85	0.061	0.057	24.116	
8	214.17	0.056	0.052	24.861	
9	196.71	0.051	0.047	25.521	
10	182.30	0.047	0.044	26.112	
11	170.18	0.044	0.040	26.647	
12	159.82	0.041	0.038	27.133	
13	150.84	0.039	0.035	27.577	
14	142.99	0.037	0.033	27.984	
15	136.04	0.035	0.032	28.360	
16	129.84	0.034	0.030	28.707	
17	124.28	0.032	0.028	29.029	
18	119.26	0.031	0.027	29.328	
19	114.69	0.030	0.026	29.607	
20	110.52	0.029	0.025	29.866	
21	106.70	0.028	0.024	30.108	
22	103.17	0.027	0.023	30.335	
23	99.91	0.026	0.022	30.546	
24	96.89	0.025	0.021	30.744	
25	94.08	0.024	0.021	30.929	
26	91.45	0.024	0.020	31.103	
27	88.99	0.023	0.019	31.266	
28	86.69	0.023	0.019	31.418	
29	84.52	0.022	0.018	31.560	
30	82.47	0.021	0.018	31.694	
35	73.79	0.019	0.015	32.241	
40	67.01	0.017	0.014	32.622	
45	61.54	0.016	0.012	32.872	
50	57.03	0.015	0.011	33.014	
55	53.24	0.014	0.010	33.066	**MAX**
60	50.00	0.013	0.009	33.043	
65	47.19	0.012	0.008	32.954	
70	44.73	0.012	0.008	32.809	
75	42.56	0.011	0.007	32.613	
80	40.62	0.011	0.007	32.373	
85	38.88	0.010	0.006	32.093	
90	37.31	0.010	0.006	31.778	
95	35.88	0.009	0.006	31.430	
100	34.58	0.009	0.005	31.052	

n Engineering Inc

On-Site Avaiable Storage Calculator

PROPOSED COMMUNITY BUILDING

Table 3 - Available Storage (100 years Proposed)

Address:	**233, 249, 261 Coldwater Road**
Town/Township/City	**Orillia**
Project No.:	**n2123**

CB/CBMH

Description	Length/dia. (m)	Width (m)	HWL	Lowest Invert Elevation	Height (m)	Volume (m^3)
CB1	1.8	1.8	273.56	271.95	1.61	5.22
CBMH1	1.8	1.8	273.56	271.29	2.27	7.35
CB2	1.8	1.8	270.97	268.25	2.72	8.81
CB4	0.6	0.6	269.92	267.13	2.79	1.00
CBMH4	1.8	1.8	269.92	267.50	2.42	7.84
CBMH6	1.8	1.8	267.25	265.31	1.94	4.94
MH 6	1.8	1.8	269.92	267.62	2.30	7.45
MH5	1.8	1.8	267.25	265.41	1.84	4.68
CB3	0.6	0.6	266.62	265.14	1.48	0.53
MH2	1.8	1.8	266.62	264.98	1.64	4.17
TOTAL						52.01

PIPES

FROM MH	TO MH	Length (m)		DIA (mm)	Volume (m^3)
CB1	CBMH1	32.6		900	21.35
CBMH1	MH1	32.6		900	21.35
CBMH2	CB2	40.1		900	26.26
MH4	CBMH4	39.7		900	26.03
CBMH7	CBMH6	29.7		600	8.68
CBMH6	MH5	19.0		900	12.46
CBMH4	MH6	21.0		900	13.77
TOTAL					129.90

PONDING AREA

Ponding Location	Inlet Elevation	Ponding Depth (m)	Ponding Area (m^2)	Ponding Volume (m^3)
CB1	273.45	0.11	38	1.38
CBMH1	273.49	0.07	217.65	5.03
CB2	270.75	0.20	387.45	25.57
CB4	269.62	0.20	570.45	37.65
CBMH4	269.55	0.20	667.55	44.06
CBMH6	267.15	0.10	9.83	0.32
TOTAL				114.01

ROOF STORAGE

Location	Area (m^2)	Depth (mm)	Volume (m^3)
R1	2107.68	42	29.36
R2	906.10	86	25.79
R3	130.17	62	2.68
R4	124.56	61	2.52
R5	122.34	61	2.46
Total			62.81

Total Provided Volume (m^3)	**358.73**
Maximuim Available Storage at (100 yr)	**354.82**
Maximum Required Volume (m^3)	**350.31**

Appendix D
Roof Control

On-Site Storage Calculator

Project: **PROPOSED COMMUNITY BUILDING**

roject No.: **n2123**

Date: **17-Jun-22**

Table 2G - 100 Years Storage (R1)

Equation of IDF:

$$I = AT^{B}$$

R = 0.52

A = 0.21 ha

$Q_{release}$ = 0.009 m^3/s

8.9 L/s

(6 Roof Drains @ 1.48 L/sec flow rate)

I = Rainfall Intensity (mm/hr)

T = Time of Concentration (hr)

A= 50

B= -0.722

Max Storage Required (m^3) **29.36**

t_c (min)	i_{100} (mm/hr)	Q_{100} (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	
1	961.16	0.290	0.281	16.862	
2	582.71	0.176	0.167	20.026	
3	434.82	0.131	0.122	22.010	
4	353.27	0.107	0.098	23.443	
5	300.70	0.091	0.082	24.547	
6	263.61	0.080	0.071	25.429	
7	235.85	0.071	0.062	26.149	
8	214.17	0.065	0.056	26.747	
9	196.71	0.059	0.050	27.246	
10	182.30	0.055	0.046	27.666	
11	170.18	0.051	0.042	28.019	
12	159.82	0.048	0.039	28.315	
13	150.84	0.045	0.037	28.564	
14	142.99	0.043	0.034	28.769	
15	136.04	0.041	0.032	28.938	
16	129.84	0.039	0.030	29.074	
17	124.28	0.037	0.029	29.180	
18	119.26	0.036	0.027	29.260	
19	114.69	0.035	0.026	29.315	
20	110.52	0.033	0.024	29.349	
21	106.70	0.032	0.023	29.363	***
22	103.17	0.031	0.022	29.358	
23	99.91	0.030	0.021	29.336	
24	96.89	0.029	0.020	29.298	
25	94.08	0.028	0.019	29.245	
26	91.45	0.028	0.019	29.179	
27	88.99	0.027	0.018	29.100	
28	86.69	0.026	0.017	29.009	
29	84.52	0.025	0.017	28.907	
30	82.47	0.025	0.016	28.794	
31	80.54	0.024	0.015	28.672	
32	78.72	0.024	0.015	28.539	
33	76.99	0.023	0.014	28.398	
34	75.35	0.023	0.014	28.249	
35	73.79	0.022	0.013	28.091	
36	72.30	0.022	0.013	27.926	
37	70.88	0.021	0.013	27.753	
38	69.53	0.021	0.012	27.573	
39	68.24	0.021	0.012	27.387	
40	67.01	0.020	0.011	27.195	
41	65.82	0.020	0.011	26.996	
42	64.69	0.020	0.011	26.791	
43	63.60	0.019	0.010	26.581	
44	62.55	0.019	0.010	26.366	
45	61.54	0.019	0.010	26.145	
46	60.57	0.018	0.009	25.920	
47	59.64	0.018	0.009	25.689	
48	58.74	0.018	0.009	25.454	
49	57.87	0.017	0.009	25.215	
50	57.03	0.017	0.008	24.971	
51	56.23	0.017	0.008	24.723	
52	55.44	0.017	0.008	24.471	
53	54.68	0.016	0.008	24.215	
54	53.95	0.016	0.007	23.956	
55	53.24	0.016	0.007	23.693	
56	52.55	0.016	0.007	23.426	
57	51.89	0.016	0.007	23.156	
58	51.24	0.015	0.007	22.883	
59	50.61	0.015	0.006	22.606	
60	50.00	0.015	0.006	22.326	
61	49.41	0.015	0.006	22.044	
62	48.83	0.015	0.006	21.758	

On-Site Storage Calculator

Project: PROPOSED COMMUNITY BUILDING
roject No.: n2123
Date: 17-Jun-22

Table 2G - 100 Years Storage (R2)

Equation of IDF:

R = 0.90
A = 0.09 ha
$Q_{release}$ = 0.004 m^3/s
4.4 L/s
(3 Roof Drains @ 1.48 L/sec flow rate)

$$I = AT^{B}$$

I = Rainfall Intensity (mm/hr)
T = Time of Concentration (hr)
A= 50
B= -0.722

Max Storage Required (m^3) **25.79**

t_c (min)	i_{100} (mm/hr)	Q_{100} (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	
1	961.16	0.218	0.213	12.797	
2	582.71	0.132	0.128	15.307	
3	434.82	0.098	0.094	16.931	
4	353.27	0.080	0.076	18.140	
5	300.70	0.068	0.064	19.103	
6	263.61	0.060	0.055	19.899	
7	235.85	0.053	0.049	20.574	
8	214.17	0.049	0.044	21.156	
9	196.71	0.045	0.040	21.665	
10	182.30	0.041	0.037	22.114	
11	170.18	0.039	0.034	22.513	
12	159.82	0.036	0.032	22.869	
13	150.84	0.034	0.030	23.189	
14	142.99	0.032	0.028	23.478	
15	136.04	0.031	0.026	23.738	
16	129.84	0.029	0.025	23.974	
17	124.28	0.028	0.024	24.187	
18	119.26	0.027	0.023	24.381	
19	114.69	0.026	0.022	24.556	
20	110.52	0.025	0.021	24.715	
21	106.70	0.024	0.020	24.859	
22	103.17	0.023	0.019	24.989	
23	99.91	0.023	0.018	25.106	
24	96.89	0.022	0.018	25.212	
25	94.08	0.021	0.017	25.306	
26	91.45	0.021	0.016	25.390	
27	88.99	0.020	0.016	25.465	
28	86.69	0.020	0.015	25.530	
29	84.52	0.019	0.015	25.587	
30	82.47	0.019	0.014	25.636	
31	80.54	0.018	0.014	25.678	
32	78.72	0.018	0.013	25.712	
33	76.99	0.017	0.013	25.740	
34	75.35	0.017	0.013	25.761	
35	73.79	0.017	0.012	25.777	
36	72.30	0.016	0.012	25.786	
37	70.88	0.016	0.012	25.790	***
38	69.53	0.016	0.011	25.789	
39	68.24	0.015	0.011	25.783	
40	67.01	0.015	0.011	25.772	
41	65.82	0.015	0.010	25.757	
42	64.69	0.015	0.010	25.737	
43	63.60	0.014	0.010	25.713	
44	62.55	0.014	0.010	25.685	
45	61.54	0.014	0.010	25.653	
46	60.57	0.014	0.009	25.617	
47	59.64	0.014	0.009	25.578	
48	58.74	0.013	0.009	25.535	
49	57.87	0.013	0.009	25.489	
50	57.03	0.013	0.008	25.439	
51	56.23	0.013	0.008	25.387	
52	55.44	0.013	0.008	25.331	
53	54.68	0.012	0.008	25.273	
54	53.95	0.012	0.008	25.212	
55	53.24	0.012	0.008	25.148	
56	52.55	0.012	0.007	25.081	
57	51.89	0.012	0.007	25.012	
58	51.24	0.012	0.007	24.941	
59	50.61	0.011	0.007	24.867	
60	50.00	0.011	0.007	24.791	
61	49.41	0.011	0.007	24.712	
62	48.83	0.011	0.007	24.631	

On-Site Storage Calculator

Project: **PROPOSED COMMUNITY BUILDING**

roject No.: **n2123**

Date: **17-Jun-22**

Table 2G - 100 Years Storage (R3)

Equation of IDF:

$$I = AT^{B}$$

R = 0.90

A = 0.01 ha

$Q_{release}$ = 0.001 m^3/s

1.5 L/s

(1 Roof Drains @ 1.48 L/sec flow rate)

I = Rainfall Intensity (mm/hr)

T = Time of Concentration (hr)

A= 50

B= -0.722

Max Storage Required (m^3) **2.68**

t_c (min)	i_{100} (mm/hr)	Q_{100} (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	
1	961.16	0.031	0.030	1.788	
2	582.71	0.019	0.017	2.098	
3	434.82	0.014	0.013	2.281	
4	353.27	0.011	0.010	2.404	
5	300.70	0.010	0.008	2.492	
6	263.61	0.009	0.007	2.556	
7	235.85	0.008	0.006	2.602	
8	214.17	0.007	0.005	2.635	
9	196.71	0.006	0.005	2.658	
10	182.30	0.006	0.004	2.672	
11	170.18	0.006	0.004	2.678	
12	159.82	0.005	0.004	2.679	***
13	150.84	0.005	0.003	2.674	
14	142.99	0.005	0.003	2.665	
15	136.04	0.004	0.003	2.652	
16	129.84	0.004	0.003	2.636	
17	124.28	0.004	0.003	2.616	
18	119.26	0.004	0.002	2.593	
19	114.69	0.004	0.002	2.568	
20	110.52	0.004	0.002	2.540	
21	106.70	0.003	0.002	2.510	
22	103.17	0.003	0.002	2.478	
23	99.91	0.003	0.002	2.445	
24	96.89	0.003	0.002	2.409	
25	94.08	0.003	0.002	2.372	
26	91.45	0.003	0.001	2.334	
27	88.99	0.003	0.001	2.294	
28	86.69	0.003	0.001	2.253	
29	84.52	0.003	0.001	2.210	
30	82.47	0.003	0.001	2.167	
31	80.54	0.003	0.001	2.122	
32	78.72	0.003	0.001	2.077	
33	76.99	0.003	0.001	2.030	
34	75.35	0.002	0.001	1.983	
35	73.79	0.002	0.001	1.935	
36	72.30	0.002	0.001	1.885	
37	70.88	0.002	0.001	1.835	
38	69.53	0.002	0.001	1.785	
39	68.24	0.002	0.001	1.733	
40	67.01	0.002	0.001	1.681	
41	65.82	0.002	0.001	1.628	
42	64.69	0.002	0.001	1.575	
43	63.60	0.002	0.001	1.521	
44	62.55	0.002	0.001	1.467	
45	61.54	0.002	0.001	1.411	
46	60.57	0.002	0.000	1.356	
47	59.64	0.002	0.000	1.300	
48	58.74	0.002	0.000	1.243	
49	57.87	0.002	0.000	1.186	
50	57.03	0.002	0.000	1.128	
51	56.23	0.002	0.000	1.070	
52	55.44	0.002	0.000	1.012	
53	54.68	0.002	0.000	0.953	
54	53.95	0.002	0.000	0.893	
55	53.24	0.002	0.000	0.834	
56	52.55	0.002	0.000	0.774	
57	51.89	0.002	0.000	0.713	
58	51.24	0.002	0.000	0.652	
59	50.61	0.002	0.000	0.591	
60	50.00	0.002	0.000	0.530	
61	49.41	0.002	0.000	0.468	
62	48.83	0.002	0.000	0.406	

On-Site Storage Calculator

Project: PROPOSED COMMUNITY BUILDING
roject No.: n2123
Date: 17-Jun-22

Table 2G - 100 Years Storage (R1)

Equation of IDF:

R = 0.90
A = 0.01 ha
$Q_{release}$ = 0.001 m^3/s
1.5 L/s
(1 Roof Drains @ 1.48 L/sec flow rate)

$$I = AT^{B}$$

I = Rainfall Intensity (mm/hr)
T = Time of Concentration (hr)
A= 50
B= -0.722

Max Storage Required (m^3) **2.52**

t_c (min)	i_{100} (mm/hr)	Q_{100} (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	
1	961.16	0.030	0.028	1.707	
2	582.71	0.018	0.017	2.000	
3	434.82	0.014	0.012	2.171	
4	353.27	0.011	0.010	2.285	
5	300.70	0.009	0.008	2.365	
6	263.61	0.008	0.007	2.422	
7	235.85	0.007	0.006	2.463	
8	214.17	0.007	0.005	2.491	
9	196.71	0.006	0.005	2.509	
10	182.30	0.006	0.004	2.518	
11	170.18	0.005	0.004	2.521	***
12	159.82	0.005	0.003	2.518	
13	150.84	0.005	0.003	2.509	
14	142.99	0.004	0.003	2.497	
15	136.04	0.004	0.003	2.481	
16	129.84	0.004	0.003	2.461	
17	124.28	0.004	0.002	2.438	
18	119.26	0.004	0.002	2.412	
19	114.69	0.004	0.002	2.384	
20	110.52	0.003	0.002	2.354	
21	106.70	0.003	0.002	2.322	
22	103.17	0.003	0.002	2.287	
23	99.91	0.003	0.002	2.251	
24	96.89	0.003	0.002	2.214	
25	94.08	0.003	0.001	2.174	
26	91.45	0.003	0.001	2.134	
27	88.99	0.003	0.001	2.092	
28	86.69	0.003	0.001	2.049	
29	84.52	0.003	0.001	2.004	
30	82.47	0.003	0.001	1.959	
31	80.54	0.003	0.001	1.912	
32	78.72	0.002	0.001	1.865	
33	76.99	0.002	0.001	1.817	
34	75.35	0.002	0.001	1.767	
35	73.79	0.002	0.001	1.717	
36	72.30	0.002	0.001	1.666	
37	70.88	0.002	0.001	1.615	
38	69.53	0.002	0.001	1.562	
39	68.24	0.002	0.001	1.509	
40	67.01	0.002	0.001	1.456	
41	65.82	0.002	0.001	1.401	
42	64.69	0.002	0.001	1.346	
43	63.60	0.002	0.001	1.291	
44	62.55	0.002	0.000	1.235	
45	61.54	0.002	0.000	1.178	
46	60.57	0.002	0.000	1.121	
47	59.64	0.002	0.000	1.064	
48	58.74	0.002	0.000	1.006	
49	57.87	0.002	0.000	0.947	
50	57.03	0.002	0.000	0.888	
51	56.23	0.002	0.000	0.829	
52	55.44	0.002	0.000	0.769	
53	54.68	0.002	0.000	0.709	
54	53.95	0.002	0.000	0.648	
55	53.24	0.002	0.000	0.587	
56	52.55	0.002	0.000	0.526	
57	51.89	0.002	0.000	0.464	
58	51.24	0.002	0.000	0.402	
59	50.61	0.002	0.000	0.340	
60	50.00	0.002	0.000	0.277	
61	49.41	0.002	0.000	0.214	
62	48.83	0.002	0.000	0.151	

On-Site Storage Calculator

Project: PROPOSED COMMUNITY BUILDING

roject No.: n2123

Date: 17-Jun-22

Table 2G - 100 Years Storage (R1)

Equation of IDF:

R = 0.90

A = 0.01 ha

$Q_{release}$ = 0.001 m^3/s

1.5 L/s

(1 Roof Drains @ 1.48 L/sec flow rate)

$$I = AT^{B}$$

I = Rainfall Intensity (mm/hr)

T = Time of Concentration (hr)

A= 50

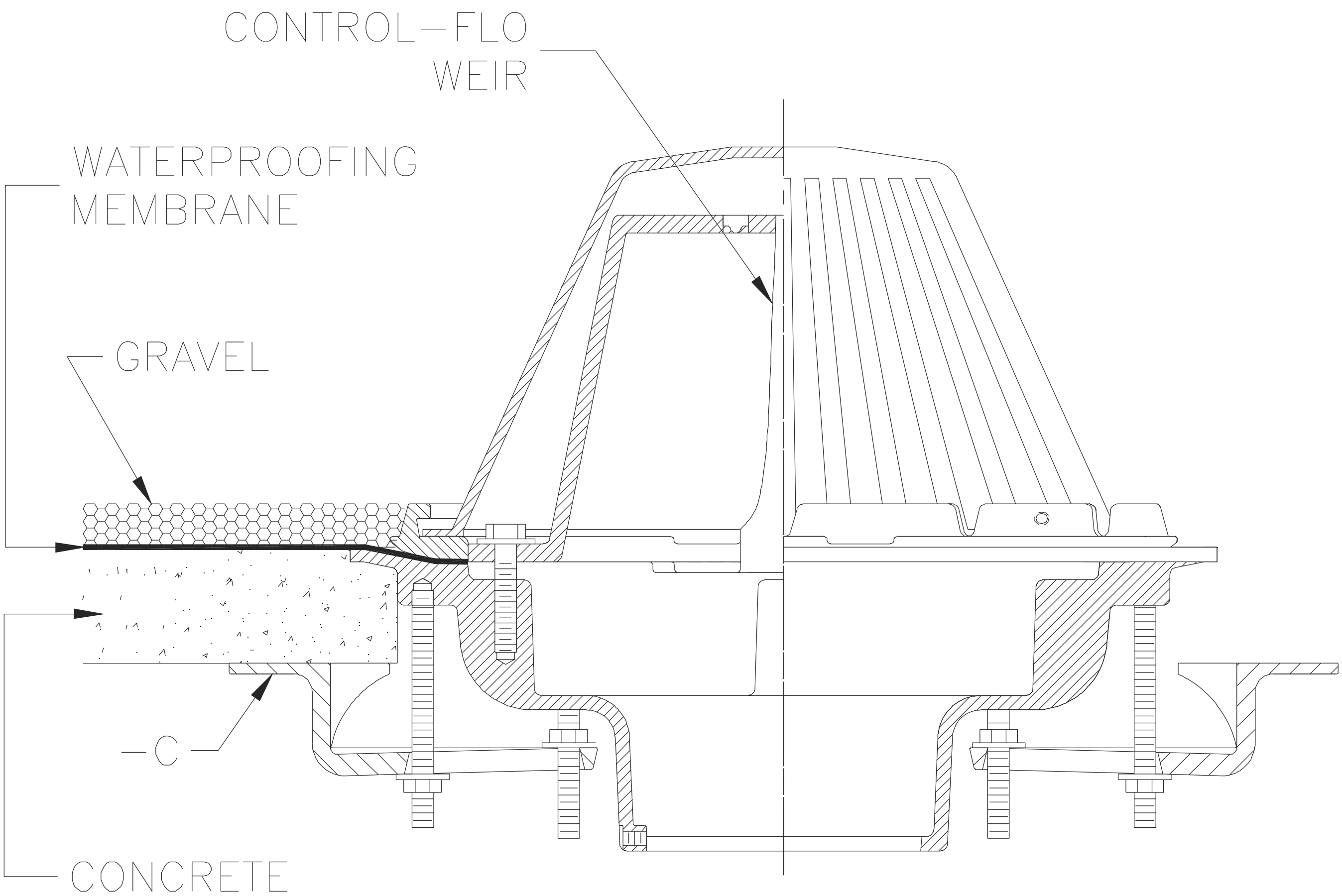
B= -0.722

Max Storage Required (m^3) **2.46**

t_c (min)	i_{100} (mm/hr)	Q_{100} (m^3/s)	Q_{stored} (m^3/s)	Peak Volume (m^3)	
1	961.16	0.029	0.028	1.675	
2	582.71	0.018	0.016	1.961	
3	434.82	0.013	0.012	2.127	
4	353.27	0.011	0.009	2.238	
5	300.70	0.009	0.008	2.315	
6	263.61	0.008	0.007	2.370	
7	235.85	0.007	0.006	2.408	
8	214.17	0.007	0.005	2.434	
9	196.71	0.006	0.005	2.450	
10	182.30	0.006	0.004	2.457	
11	170.18	0.005	0.004	2.458	***
12	159.82	0.005	0.003	2.454	
13	150.84	0.005	0.003	2.444	
14	142.99	0.004	0.003	2.430	
15	136.04	0.004	0.003	2.413	
16	129.84	0.004	0.002	2.392	
17	124.28	0.004	0.002	2.368	
18	119.26	0.004	0.002	2.341	
19	114.69	0.004	0.002	2.312	
20	110.52	0.003	0.002	2.280	
21	106.70	0.003	0.002	2.247	
22	103.17	0.003	0.002	2.212	
23	99.91	0.003	0.002	2.175	
24	96.89	0.003	0.001	2.136	
25	94.08	0.003	0.001	2.096	
26	91.45	0.003	0.001	2.055	
27	88.99	0.003	0.001	2.012	
28	86.69	0.003	0.001	1.968	
29	84.52	0.003	0.001	1.923	
30	82.47	0.003	0.001	1.876	
31	80.54	0.002	0.001	1.829	
32	78.72	0.002	0.001	1.781	
33	76.99	0.002	0.001	1.732	
34	75.35	0.002	0.001	1.682	
35	73.79	0.002	0.001	1.631	
36	72.30	0.002	0.001	1.580	
37	70.88	0.002	0.001	1.527	
38	69.53	0.002	0.001	1.474	
39	68.24	0.002	0.001	1.421	
40	67.01	0.002	0.001	1.366	
41	65.82	0.002	0.001	1.312	
42	64.69	0.002	0.000	1.256	
43	63.60	0.002	0.000	1.200	
44	62.55	0.002	0.000	1.143	
45	61.54	0.002	0.000	1.086	
46	60.57	0.002	0.000	1.029	
47	59.64	0.002	0.000	0.970	
48	58.74	0.002	0.000	0.912	
49	57.87	0.002	0.000	0.853	
50	57.03	0.002	0.000	0.793	
51	56.23	0.002	0.000	0.733	
52	55.44	0.002	0.000	0.673	
53	54.68	0.002	0.000	0.612	
54	53.95	0.002	0.000	0.551	
55	53.24	0.002	0.000	0.490	
56	52.55	0.002	0.000	0.428	
57	51.89	0.002	0.000	0.366	
58	51.24	0.002	0.000	0.303	
59	50.61	0.002	0.000	0.240	
60	50.00	0.002	0.000	0.177	
61	49.41	0.002	0.000	0.114	
62	48.83	0.001	0.000	0.050	

TYPICAL INSTALLATION
Z105-C (CANADIAN MARKET)
CONTROL-FLO INSTALLED-CONCRETE ROOF

Dimensional Data (inches and [mm]) are Subject to Manufacturing Tolerances and Change Without Notice



Z105-C (CANADIAN MARKET)
CONTROL-FLO INSTALLED-CONCRETE ROOF

Control-Flo roof drain. The Zurn Control-Flo roof drain can be used for almost any type roof design or installation where flow rates to the drainage system must be accurately controlled. The drain utilizes a unique weir designed that limits the flow through the drain.

1. Available with 1 to 6 inverted parabolic notches.
2. Allows linear relationship between depth of water on roof and flow rate through drain.
3. Stores water on roof with controlled discharge so that drainage system and roof structural system will not be overloaded.
4. May allow use of smaller diameter piping.

(For sizing, contact Zurn Engineering Department for details)

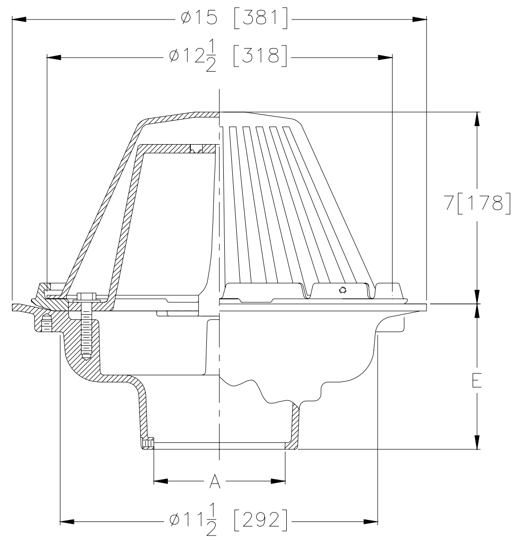
Form # RD100	**Date:** 04/19/13	**C.N. No.** 129165	**Rev.**

SPECIFICATION SHEET

Z-105
CONTROL-FLO ROOF DRAIN w/ Parabolic Weir

TAG________________

Dimensional Data (inches and [mm]) are Subject to Manufacturing Tolerances and Change Without Notice



A Pipe Size Inches / [mm]	Approx. Wt. Lbs. / [kg]	Dome Open Area Sq. In. / [sq cm]
2 - 3 - 4 [51 - 76 - 102]	34 [15]	148 [955]

ENGINEERING SPECIFICATION: ZURN Z-105 "Control-Flo" roof drain for dead -level roof construction, Dura-Coated cast iron body. "Con-trol-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.

OPTIONS (Check/specify appropriate options)

PIPE SIZE	(Specify size/type) OUTLET			E BODY HT. DIM.
2,3,4 [50,75,100]	______	IC	Inside Caulk	5 1/4 [133]
2,3,4 [50,75,100]	______	IP	Threaded	3 3/4 [95]
2,3,4 [50,75,100]	______	NH	No-Hub	5 1/4 [133]
2,3,4 [50,75,100]	______	NL	Neo-Loc	4 5/8 [117]

PREFIXES

____ Z- D.C.C.I. Body with Poly-Dome*
____ ZA- D.C.C.I. Body with Aluminum Dome

SUFFIXES

____ -A Waterproof Flange
____ -AR Acid Resistant Epoxy Coated Finish
____ -C Underdeck Clamp
____ -DP Top Set® Roof Deck Plate (Replaces both the -C and -R)
____ -DR Adjustable Drain Riser Extension Assembly 3-5/8" [92] to 7-1/4" [184]
____ -E Static Extension 1 [25] thru 4 [102] (Specify Ht.)
____ -EA Adjustable Extension Assembly 1 3/4 [44] thru 3 1/2 [89]
____ -EB Elevating Body Plate
____ -G Galvanized Cast Iron
____ -R Roof Sump Receiver
____ -VP Vandal Proof Secured Top
____ -90 90º Threaded Side Outlet Body

*REGULARLY FURNISHED UNLESS OTHERWISE SPECIFIED

REV. A DATE: 09/14/05 C.N. NO. 89837
DWG. NO. 63601 PRODUCT NO. Z-105

ZURN INDUSTRIES LIMITED ♦ 3544 Nashua Drive ♦ Mississauga, Ontario L4V 1L2 ♦ Phone: 905/405-8272 Fax: 905/405-1292
In the U.S.: ZURN INDUSTRIES, INC. ♦ SPECIFICATION DRAINAGE OPERATION ♦ 1801 Pittsburgh Ave. ♦ Erie, PA 16514
Phone: 814/455-0921 ♦ Fax: 814/454-7929 ♦ World Wide Web: www.zurn.com

ZURN CANADA

SPECIFICATION DRAINAGE

Control-Flo

Roof Drainage System

www.zurn.com

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

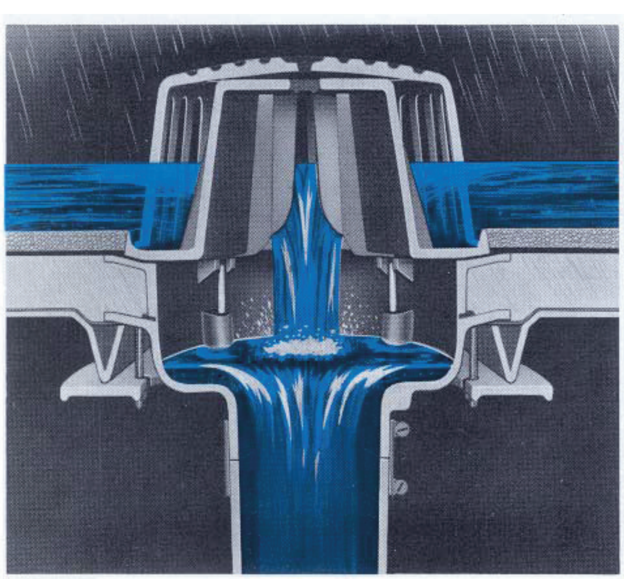
Fewer roof drains, smaller diameter piping, smaller sewer sizes, and lower installation costs are possible with a "Control-Flo" drainage system because roof areas are utilized as temporary storage reservoirs.

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.

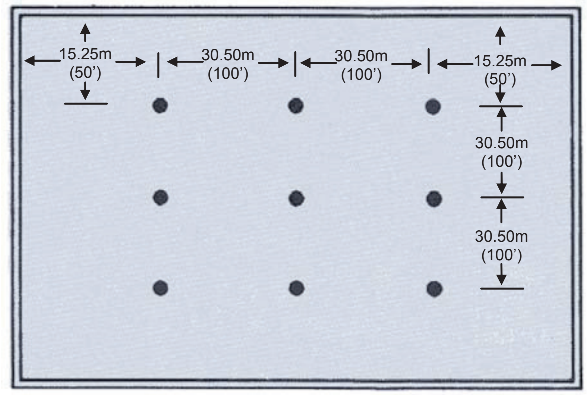


DEFINITION

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)

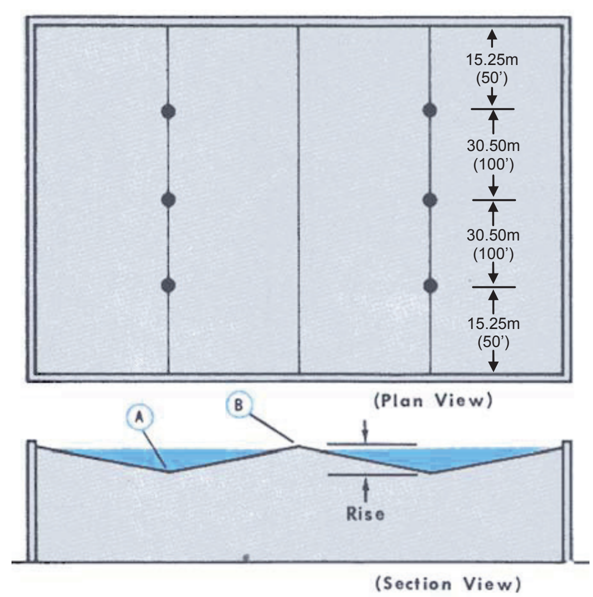
SLOPED ROOFS

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").

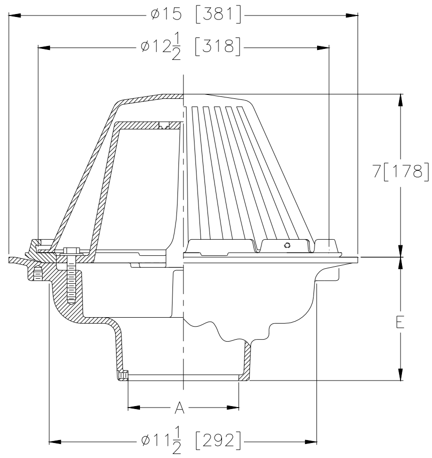
The total rise of a roof as calculated for "Control-Flo" application is defined as the vertical increase in height in inches, from the low point or valley of a sloping roof (A) to the top of the sloping section (B). (Example: a roof that slopes 3mm (1/8") per foot having a 7.25m (24') span would have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

Measurements shown are for maximum distances.



Dimensions and other measurements given in metric and imperial forms.

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 over-flow scuppers in parapet walls.

GENERAL INFORMATION

The “Control-Flo” roof drainage data is tabulated for four areas (232.25m^2 (2500 sq. ft.), 464.502m^2 (5000 sq. ft.), 696.75m^2 (7500 sq. ft.), 929m^2 (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 464.50m^2 (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.

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 m^2 (2,500 $ft.^2$) to 929m^2 (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 232.25m^2 (2,500 $ft.^2$) are used considerable economy of the "Control-Flo" concept is being lost. The area per notch is limited to 929m^2 (10,000 $ft.^2$) to keep the draindown time within reasonable limits. Extensive studies show that stresses due to water load on a sloping roof for any fixed set of conditions are very nearly the same as those on a dead-level roof. A sloping roof tends to concentrate more water in the valleys and increase the water depth at this point. The greater depth around the drain leads to a faster run-off rate, particularly a faster early run -off rate. As a result, the total volume of water stored on the roof is less, and the total load on the sloping roof is less. By using the same area on the sloping roof as on the dead-level roof the increase in roof stresses due to increased water depth in the valleys is offset by the decrease in the total load due to less water stored. The net result 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 cm^2 (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.

Saves Specification Time, Assures Proper Application

QUICK, EASY SELECTION

Using the "Selecta-Drain" Chart (pages 9—13) in combination with the steps and examples appearing below, should save you countless hours in engineering specification time. This vast compilation of data is related to the proper selection of drains for 34 cities. All cities in alphabetical order by province. If a specific city does not appear in the tabulation, chooses the city nearest your area and select the proper drain using these factors.

3 EASY STEPS…

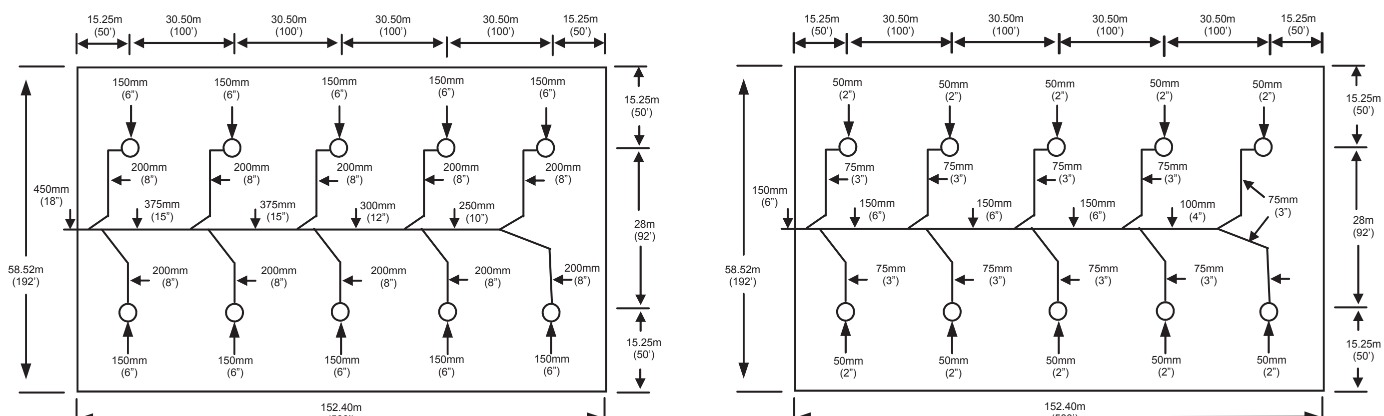
AND 3 TYPICAL EXAMPLES FOR APPLICATION OF SURE, SCIENTIFIC CONTROL OF DRAINAGE FROM DEAD-LEVEL AND SLOPING ROOFS WITH THE ZURN CONCEPT.

NOTE: Where roof area to be drained is adjacent to one or more vertical walls projecting above the roof, then a percentage of the of the wall(s) must be added to the roof area in determining total roof area to be drained.

	TORONTO, ONTARIO	DEAD-LEVEL ROOF	102mm (4 INCH) SLOPE	152mm (6 INCH) SLOPE
1	Determine total roof area or individual areas when roof is divided by expansion joints or peaks in the case of sloping roof.	Roof Area: 56.52m x 152.40m = 8918.40m^2 (192ft x 500ft = 96,000 sq. ft.) (See Z105 layout bottom of this page.)	3 Individual Roof Areas: 19.50m x 152.40m = 2972.80m^2 (64ft x 500ft = 32,000 sq. ft.) Valleys 152.40m (500ft) long 3 x 2972.80 = 8918.40m^2 (3 x 32,000 = 96,000 sq. ft.)	2 Individual Roof Areas: 29.87m x 152.40m = 4552m^2 (98ft x 500ft = 49,000 sq. ft.) Valleys 152.40m (500ft) long 2 x 4552 = 9104m^2 (2 x 49,000 = 98,000 sq. ft.)
2	Divide roof area or individual areas by Zurn Notch Area Rating selected to obtain the total number of notches required.	Zurn Notch Area Rating selected for Toronto = 464.50m^2 (5,000 sq. ft.) from "Selecta-Drain Chart, page 11. Total Roof Area = 8918.40m^2 (96,000 sq. ft.) Entire roof. 464.50m^2 (5,000 sq. ft.) notch area = 19.2 notches—USE 20.	Zurn Notch Area Rating selected for Toronto = 464.50m^2 (5,000 sq. ft.) from "Selecta-Drain Chart, page 11. Total Roof Area = 2972.80m^2 (32,000 sq. ft.) Each area. 464.50m^2 (5,000 sq. ft.) notch area = 6.4 notches—USE 7 PER AREA.	Zurn Notch Area Rating selected for Toronto = 464.50m^2 (5,000 sq. ft.) from "Selecta-Drain Chart, page 11. Total Roof Area = 4552m^2 (49,000 sq. ft.) Each area. 464.50m^2 (5,000 sq. ft.) notch area = 9.8 notches—USE 10 PER AREA.
3	Determine total number of drains required by not exceeding maximum spacing dimensions in the preceding instructions. See Diagrams "A" or "B", page 2. Divide total number of notches required to determine the number of notches per drain. Note maximum water depth at drain and use this dimension to determine scupper height. Maximum scupper height to be used is 152mm (6"). *Use this flow rate to size leaders and drain lines.*	*10 drains required. All drains must have two notches each for a total of 20 notches. Flow rate is 66 L.P.M. (14.5 G.P.M.) per notch. Size leaders for 2 notch weirs for a flow rate of 66 L.P.M. (14.5 G.P.M.) 50 mm (two inch) pipe size leaders required. Maximum water depth and scupper height is 74mm (2.9"). Requires 19 hours draindown time maximum. For drain, vertical and horizontal pipe sizing data see Tables I and II on page 6 and 7.	**5 drains per area required located in the valleys 15.25m (50ft.) from each end with 3 in the middle at 30.50m (100ft.) spacings. Two drains on ends with two notches—3 drains in middle on notch each for a total of 7 notches. Maximum flow rate 93 L.P.M. (20.5 G.P.M.) per notch. Leader size 50mm (2") for single notch weirs—75mm (3") notch weirs. Maximum water depth and scupper height is 104mm (4.1"). Requires 11 hours draindown time maximum. For drain, vertical and horizontal pipe sizing data see Tables I and II on page 6 and 7.	**5 drains per area required located in the valleys 15.25m (50ft.) from each end with 3 in the middle at 30.50m (100ft.) spacing in the middle. 10 notches are required therefore all drains must have two notches. Flow rate is 111 L.P.M. (24.5 G.P.M.) per notch. Size all leaders for 2 notch weirs. 75mm (3") pipe size required. Maximum water depth and scupper height is 124mm (4.9"). Requires 9 hours draindown time maximum. For drain, vertical and horizontal pipe sizing data see Tables I and II on page 6 and 7.

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

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



ROOF DRAINAGE DATA

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

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

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

*Maximum flow obtainable from 1 notch with 152mm (6”) water depth at drain.

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

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

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

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

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

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

Select Proper Horizontal Storm Drain Piping

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

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

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

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

*Maximum flow obtainable from 1 notch with 152mm (6") water depth at drain.

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

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

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

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

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

Pipe Size	Slope per 305mm (1'0")		
	3mm (1/8")	6mm (1/4")	13mm (1/2")
75mm (3")	163 (36)	232 (51)	327 (72)
100mm (4")	355 (78)	505 (111)	714 (157)
†125mm (5")	646 (142)	914 (201)	1291 (284)
150mm (6")	1050 (231)	1487 (327)	2100 (462)
200mm (8")	2264 (498)	3205 (705)	4528 (996)
250mm (10")	4100 (902)	5796 (1275)	8201 (1804)
300mm (12")	6669 (1467)	9437 (2076)	13338 (2934)
375mm (15")	12120 (2666)	17157 (3774)	24239 (5332)

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

SCUPPER AND OVERFLOW DRAINS

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

Selecta-Drain Chart

LOCATION	SQUARE METRE (SQUARE FOOT) NOTCH AREA RATING	ROOF LOAD FACTOR KGS. (LBS.)	TOTAL ROOF SLOPE											
			DEAD LEVEL			51mm (2") RISE			102mm (4") RISE			152mm (6") RISE		
			L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth	L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth	L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth	L.P.M. (G.P.M.) Discharge	**Draindown Time Hrs.**	mm (in.) Water Depth
Ottawa, Ontario	232 (2,500)	4.7 (10.4)	45.5 (10)	**7**	51 (2)	59 (13)	**6.5**	66 (2.6)	77.5 (17)	**4.5**	86.5 (3.4)	86.5 (19)	**3.2**	96.5 (3.8)
	465 (5,000)	5.9 (13)	57 (12.5)	**17**	63.5 (2.5)	68 (15)	**14**	76 (3)	86.5 (19)	**10**	96.5 (3.8)	100 (22)	**7.5**	112 (4.4)
	697 (7,500)	6.4 (14)	61.5 (13.5)	**27**	68.5 (2.7)	75 (16.5)	**23**	84 (3.3)	93 (20.5)	**16**	104 (4.1)	107 (23.5)	**12**	119.5 (4.7)
	929 (10,000)	6.6 (14.6)	63.5 (14)	**36**	71 (2.8)	79.5 (17.5)	**32**	89 (3.5)	97.5 (21.5)	**22**	109 (4.3)	113.5 (25)	**18**	127 (5)
St. Thomas, Ontario	232 (2,500)	5.7 (12.5)	54.5 (12)	**8**	61 (2.4)	68 (15)	**7**	76 (3.0)	86.5 (19)	**5**	96.5 (3.8)	104.5 (23)	**4**	117 (4.6)
	465 (5,000)	6.6 (14.6)	63.5 (14)	**19**	71 (2.8)	77.5 (17)	**16**	86.5 (3.4)	97.5 (21.5)	**11**	109 (4.3)	118 (26)	**9**	132 (5.2)
	697 (7,500)	7.1 (16.6)	68 (15)	**29**	76 (3.0)	82 (18)	**26**	91.5 (3.6)	102.5 (22.5)	**18**	114.5 (4.5)	125 (27.5)	**15**	139.5 (5.5)
	929 (10,000)	7.5 (16.6)	72.5 (16)	**40**	81.5 (3.2)	86.5 (19)	**34**	96.5 (3.8)	107 (23.5)	**24**	119.5 (4.7)	132 (29)	**20**	147.5 (5.8)
Timmins, Ontario	232 (2,500)	4.3 (9.4)	41 (9)	**7**	45.5 (1.8)	57 (12.5)	**6**	63.5 (2.5)	72.5 (16)	**4**	81.5 (3.2)	86.5 (19)	**3.3**	96.5 (3.8)
	465 (5,000)	5.7 (12.5)	54.5 (12)	**16**	61 (2.4)	63.5 (14)	**14**	71 (2.8)	82 (18)	**9**	91.5 (3.6)	97.5 (21.5)	**7.5**	109 (4.3)
	697 (7,500)	6.4 (14)	61.5 (13.5)	**27**	68.5 (2.7)	70.5 (15.5)	**22**	78.5 (3.1)	86.5 (19)	**15**	96.5 (3.8)	104.5 (23)	**12**	117 (4.6)
	929 (10,000)	6.6 (14.6)	63.5 (14)	**36**	71 (2.8)	72.5 (16)	**30**	81.5 (3.2)	91 (20)	**21**	101.5 (4.0)	109 (24)	**17**	122 (4.8)
Toronto, Ontario	232 (2,500)	5.7 (12.5)	54.5 (12)	**8**	61 (2.4)	66 (14.5)	**7**	73.5 (2.9)	82 (18)	**4.5**	91.5 (3.6)	97.5 (21.5)	**3.5**	109 (4.3)
	465 (5,000)	6.8 (15.1)	66 (14.5)	**19**	73.5 (2.9)	77.5 (17)	**16**	86.5 (3.4)	93 (20.5)	**11**	104 (4.1)	111.5 (24.5)	**9**	124.5 (4.9)
	697 (7,500)	8.0 (17.7)	77.5 (17)	**30**	86.5 (3.4)	84 (18.5)	**26**	94 (3.7)	100 (22)	**18**	112 (4.4)	120.5 (26.5)	**14**	134.5 (5.3)
	929 (10,000)	8.7 (19.2)	82 (18)	**42**	91.5 (3.6)	86.5 (19)	**34**	96.5 (3.8)	104.5 (23)	**24**	117 (4.6)	127.5 (28)	**20**	142 (5.6)
Windsor, Ontario	232 (2,500)	6.1 (13.5)	59 (13)	**8.5**	66 (2.6)	70.5 (15.5)	**7.5**	78.5 (3.1)	84 (18.5)	**4.5**	94 (3.7)	107 (23.5)	**4**	119.5 (4.7)
	465 (5,000)	7.1 (15.6)	68 (15)	**20**	76 (3.0)	79.5 (17.5)	**16**	89 (3.5)	97.5 (21.5)	**11**	109 (4.3)	118 (26)	**9**	132 (5.2)
	697 (7,500)	8.0 (17.7)	77.5 (17)	**30**	86.5 (3.4)	86.5 (19)	**26**	96.5 (3.8)	107 (23.5)	**18**	119.5 (4.7)	125 (27.5)	**15**	139.5 (5.5)
	929 (10,000)	8.7 (19.2)	82 (18)	**42**	91.5 (3.6)	91 (20)	**36**	101.5 (4.0)	113.5 (25)	**26**	127 (5.0)	129.5 (28.5)	**20**	145 (5.7)
Charlottetown, Prince Edward Island	232 (2,500)	4.9 (10.9)	47.5 (10.5)	**7.5**	53.5 (2.1)	57 (12.5)	**6**	63.5 (2.5)	68 (15)	**3.8**	76 (3.0)	79.5 (17.5)	**3**	89 (3.5)
	465 (5,000)	6.6 (14.6)	63.5 (14)	**19**	71 (2.8)	75 (16.5)	**15.5**	84 (3.3)	88.5 (19.5)	**10**	99 (3.9)	100 (22)	**7.5**	112 (4.4)
	697 (7,500)	7.8 (17.2)	75 (16.5)	**31**	84 (3.3)	86.5 (19)	**26**	96.5 (3.8)	102.5 (22.5)	**18**	114.5 (4.5)	113.5 (25)	**13**	127 (5.0)
	929 (10,000)	8.7 (19.2)	84 (18.5)	**42**	94 (3.7)	97.5 (21.5)	**37**	106.5 (4.2)	111.5 (24.5)	**26**	124.5 (4.9)	125 (27.5)	**20**	139.5 (5.5)
Montreal, Quebec	232 (2,500)	5.2 (11.4)	50 (11)	**7.5**	56 (2.2)	61.5 (13.5)	**7**	68.5 (2.7)	79.5 (17.5)	**4.5**	89 (3.5)	97.5 (21.5)	**3.5**	109 (4.36)
	465 (5,000)	5.9 (13)	57 (12.5)	**17**	63.5 (2.5)	70.5 (15.5)	**15**	78.5 (3.1)	88.5 (19.5)	**10**	99 (3.9)	109 (24)	**8**	122 (4.8)
	697 (7,500)	6.1 (13.5)	59 (13)	**27**	66 (2.6)	72.5 (16)	**23**	81.5 (3.2)	93 (20.5)	**16**	104 (4.1)	113.5 (25)	**13**	127 (5.0)
	929 (10,000)	6.4 (14)	61.5 (13.5)	**36**	68.5 (2.7)	77.5 (17)	**31**	86.5 (3.4)	95.5 (21)	**22**	106.5 (4.2)	120.5 (26.5)	**19**	134.5 (5.3)
Quebec City, Quebec	232 (2,500)	5.4 (12)	52.5 (11.5)	**8**	58.5 (2.3)	63.5 (14)	**7**	71 (2.8)	79.5 (17.5)	**4.5**	89 (3.5)	97.5 (21.5)	**3.5**	109 (4.3)
	465 (5,000)	6.4 (14)	61.5 (13.5)	**18**	68.5 (2.7)	70.5 (15.5)	**15**	78.5 (3.1)	84 (18.5)	**10**	94 (3.7)	104.5 (23)	**8**	117 (4.6)
	697 (7,500)	6.6 (14.6)	63.5 (14)	**28**	71 (2.8)	72.5 (16)	**23**	81.5 (3.2)	86.5 (19)	**15**	96.5 (3.8)	107 (23.5)	**12**	119.5 (4.7)
	929 (10,000)	7.1 (15.6)	68 (15)	**37**	76 (3.0)	77.5 (17)	**31**	86.5 (3.4)	88.5 (19.5)	**20**	99 (3.9)	109 (24)	**17**	122 (4.8)

ZURN INDUSTRIES LIMITED
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Appendix E

StormFilter SFPD0816

Determining Number of Cartridges for Flow Based Systems

Date	**6/16/2022**	**Black Cells =**	**Calculation**
Site Information			
Project Name	**233 249 261 ColdWater Rd W**		
Project Location	**Orillia, ON**		
OGS ID	**OGS**		
Drainage Area, Ad	**3.72**	ac	(1.507618 ha)
Impervious Area, Ai	**2.57**	ac	
Pervious Area, Ap	**1.15**		
% Impervious	**69%**		
Runoff Coefficient, Rc	**0.70**		
Treatment storm flow rate, Q_{treat}	**0.89**	cfs	(25.3 L/s)
Peak storm flow rate, Q_{peak}	**1.94**	cfs	(54.9 L/s)
Filter System			
Filtration brand	**StormFilter**		
Cartridge height	**27**	in	
Specific Flow Rate	**1.00**	gpm/ft^2	
Flow rate per cartridge	**11.25**	gpm	

SUMMARY

Number of Cartridges	36
Media Type	Phosphosorb

Event Mean Concentration (EMC)	**150**	mg/L
Annual TSS Removal	**80%**	
Percent Runoff Capture	**90%**	

Recommend SFPD0818 vault or CIP

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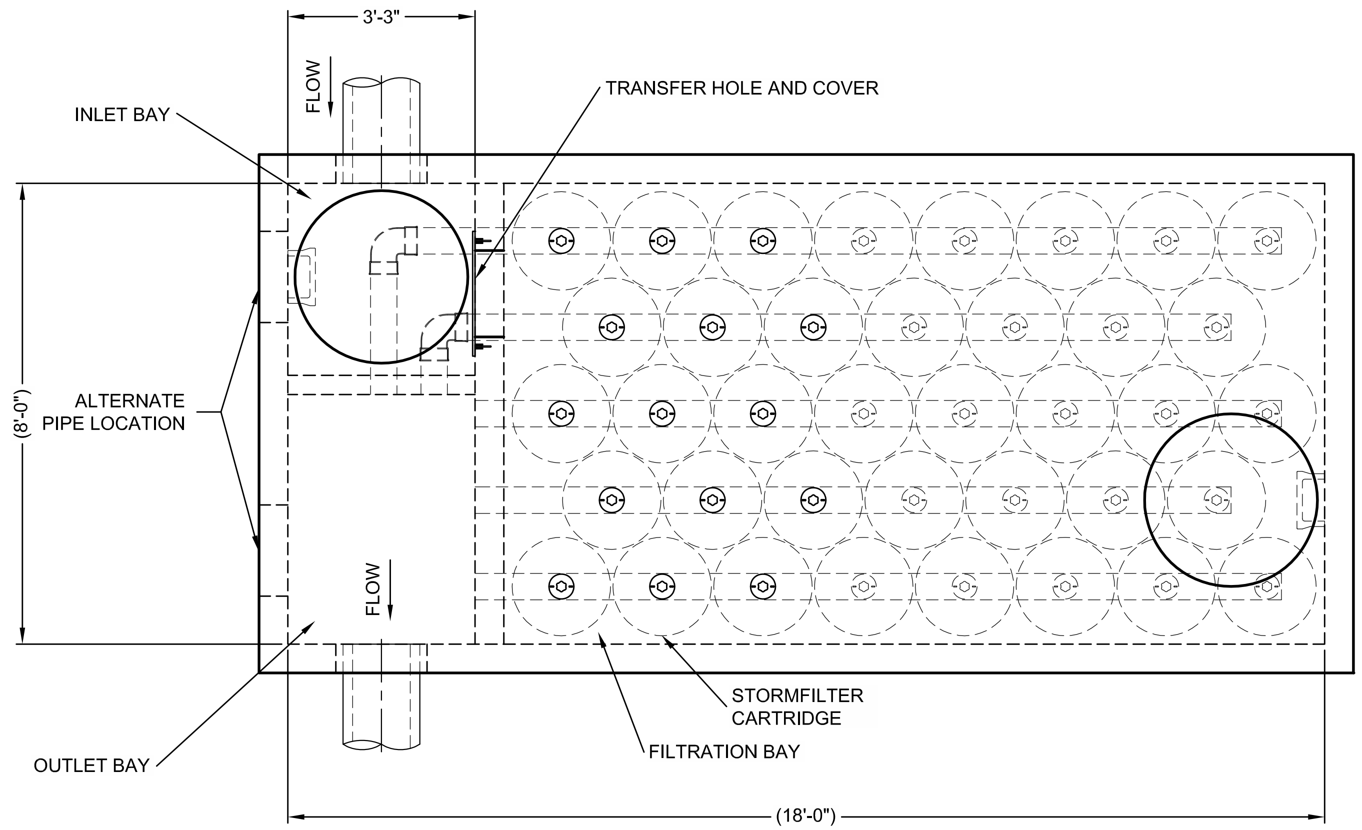
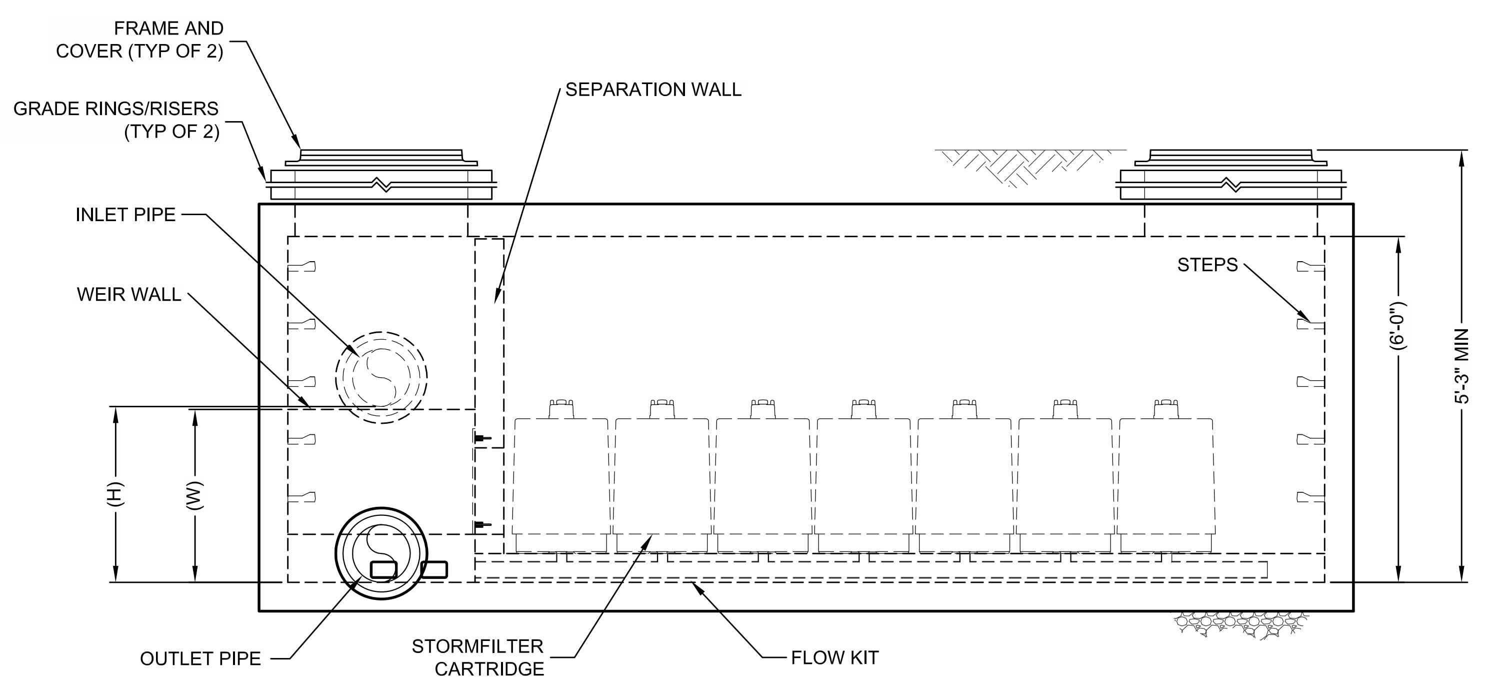
Fax 207-885-9825



PLAN



ELEVATION

The Stormwater Management StormFilter®

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,322,629; 5,524,576; 5,707,527; 5,985,157; 6,027,639; 6,649,048; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

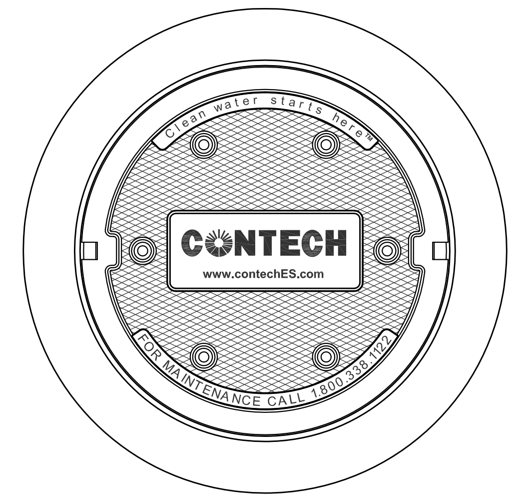
STORMFILTER DESIGN NOTES

- THE 8' x 18' PEAK DIVERSION STORMFILTER TREATMENT CAPACITY VARIES BY CARTRIDGE COUNT AND LOCALLY APPROVED SURFACE AREA SPECIFIC FLOW RATE. PEAK CONVEYANCE CAPACITY TO BE DETERMINED BY ENGINEER OF RECORD.
- THE PEAK DIVERSION STORMFILTER IS AVAILABLE IN A LEFT INLET (AS SHOWN) OR RIGHT INLET CONFIGURATION.
- ALL PARTS AND INTERNAL ASSEMBLY PROVIDED BY CONTECH UNLESS OTHERWISE NOTED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"			18"			LOW DROP		
RECOMMENDED HYDRAULIC DROP (H)	3.05'			2.3'			1.8'		
HEIGHT OF WEIR (W)	3.00'			2.25'			1.75'		
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf
CARTRIDGE FLOW RATE (gpm)	22.5	18.79	11.25	15	12.53	7.5	10	8.35	5

* 1.67 gpm/sf SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB ® (PSORB) MEDIA ONLY



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	*
WATER QUALITY FLOW RATE (cfs)	*
PEAK FLOW RATE (cfs)	*
RETURN PERIOD OF PEAK FLOW (yrs)	*
CARTRIDGE HEIGHT (27", 18", LOW DROP(LD))	*
NUMBER OF CARTRIDGES REQUIRED	*
CARTRIDGE FLOW RATE	*
MEDIA TYPE (PERLITE, ZPG, PSORB)	*

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE	*	*	*
OUTLET PIPE	*	*	*

UPSTREAM RIM ELEVATION	*
DOWNSTREAM RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

PERFORMANCE SPECIFICATION

FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. **RADIAL MEDIA DEPTH SHALL BE 7-INCHES**. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST **38 SECONDS**.
SPECIFIC FLOW RATE SHALL BE **2 GPM/SF (MAXIMUM)**. SPECIFIC FLOW RATE IS THE MEASURE OF THE FLOW (GPM) DIVIDED BY THE MEDIA SURFACE CONTACT AREA (SF). MEDIA VOLUMETRIC FLOW RATE SHALL BE **6 GPM/CF OF MEDIA (MAXIMUM).**

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH REPRESENTATIVE. www.ContechES.com
4. STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
5. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 5' AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STORMFILTER STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH OUTLET PIPE INVERT WITH OUTLET BAY FLOOR.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.
F. CONTRACTOR TO REMOVE THE TRANSFER HOLE COVER WHEN THE SYSTEM IS BROUGHT ONLINE.

CONTECH®
ENGINEERED SOLUTIONS LLC
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THE STORMWATER MANAGEMENT STORMFILTER 8' x 18' PEAK DIVERSION STORMFILTER STANDARD DETAIL

◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

The Stormwater Management StormFilter®

Developed by CONTECH Engineered Solutions LLC
Scarborough, Maine, USA

Registration: GPS-ETV_2020-06-15_TAPE

In accordance with

ISO 14034:2016

**Environmental Management —
Environmental Technology Verification (ETV)**

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

June 15, 2020
Vancouver, BC, Canada

Verification Body
GLOBE Performance Solutions
404 – 999 Canada Place | Vancouver, B.C | Canada |V6C 3E2

Verification Overview

This Environmental Technology Verification (ETV) of The Stormwater Management StormFilter® (StormFilter) is the second part of a two-part verification process and entails the verification of performance claims (#3 – 9) based on field testing data collected in accordance with The Washington State Department of Ecology emerging stormwater treatment technologies, in accordance with guidelines identified by Ecology (2011) in the Technology Assessment Protocol – Ecology (TAPE). This complements the first part of the verification which verifies performance test data collected in accordance with the New Jersey Department of Environmental Protection (NJDEP) *Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device (January, 2013)*.

Technology description and application

The Stormwater Management StormFilter® (StormFilter) is a manufactured treatment device that is provided by Contech Engineered Solutions LLC (Contech). The StormFilter improves the quality of stormwater runoff before it enters receiving waterways through the use of its customizable filter media, which removes non-point source pollutants. As illustrated in **Figure 1,** the StormFilter is typically comprised of a vault or manhole structure that houses rechargeable, media-filled filter cartridges. Stormwater entering the system percolates through these media-filled cartridges, which trap particulates and remove pollutants. Once filtered through the media, the treated stormwater is discharged through an outlet pipe to a storm sewer system or receiving water.

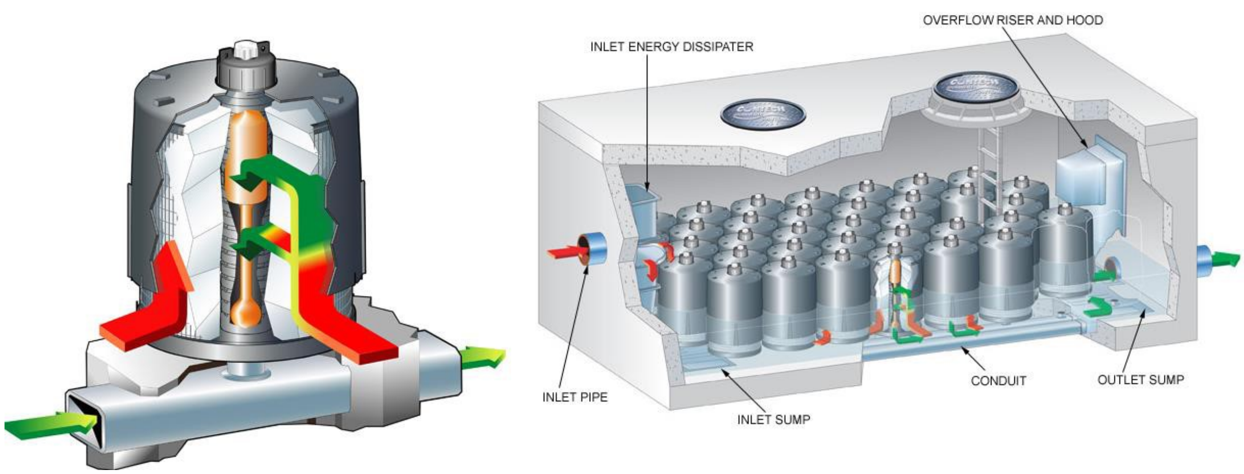


Figure 1 Individual StormFilter Cartridge (Left) and Typical Vault StormFilter Installation (Right)

Depending on the treatment requirements and expected pollutant characteristics at an individual site, the per cartridge filtration flow rate and driving head can be adjusted. The flow rate is individually controlled for each cartridge by a restrictor disc located at the connection point between the cartridge and the underdrain manifold.

Driving head is managed by positioning of the inlet, outlet, and overflow elevations. The StormFilter is typically designed so that the restrictor disc passes the design treatment rate once the water surface reaches the shoulder of the cartridge which is equivalent to the cartridge height. Since the StormFilter uses a restrictor disc to restrict treatment flows below the hydraulic capacity of the media the system typically operates under consistent driving head for the useful life of the media. Site specific head constraints are also addressed by three different cartridge heights (low drop (effective height of 12 inches), 18, and 27 inches) which operate on the same principal and surface area specific loading rates.

The StormFilter requires a minimum of 1.8 ft, 2.3 ft and 3.05 ft of drop between inlet invert and outlet invert to accommodate the low drop, 18 and 27 inch cartridges, respectively, without backing up flow into the upstream piping during operation. When site conditions limit the amount of drop available across the StormFilter then flow is typically backed up into the upstream piping during operation to ensure sufficient driving head is provided. If desirable the StormFilter can be designed to operate under additional driving head.

The StormFilter is offered in multiple configurations including plastic, steel, and concrete catch basins; and precast concrete manholes, and vaults. Other configurations include panel vaults, CON/SPAN®, box culverts, and curb inlets. The filter cartridges operate consistently and act independently regardless of housing which enables linear scaling.

The StormFilter cartridge can house different types of media including perlite, zeolite, granular activated carbon (GAC), CSF® leaf media, MetalRx™, PhosphoSorb® or various media blends such as ZPG™ (perlite, zeolite and GAC). All of the media use processes associated with depth filtration to remove solids. Some media configurations also provide additional treatment mechanisms such as cation exchange, and/or adsorption, chelation, and precipitation. This verification is specific to a field evaluation of the StormFilter with PhosphoSorb® media.

Performance conditions

The data and results published in this Verification Statement were obtained from the field testing conducted on The Stormwater Management StormFilter® device, in accordance with the requirements outlined by the Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) as written by the Washington State Department of Ecology, (WADOE, 2011). Prior to starting the performance testing program, a quality assurance project plan (QAPP) was submitted to and approved by the State of Washington Department of Ecology.

Performance claim(s)

Performance Claim 3 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 23 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 89% removal of total suspended solids at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 4 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 23 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 79% removal of total phosphorus at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 5 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 23 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 56% removal of total nitrogen at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 6 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 21 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 77% removal of total copper at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 7 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 21 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 75% removal of total zinc at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 8 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 21 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 70% removal of total lead at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance Claim 9 (TAPE)

During field testing under the Washington State TAPE Protocol (2011) which was composed of 21 qualifying storm events, The Stormwater Management StormFilter®, with PhosphoSorb® media, demonstrated at least 80% removal of total aluminium at a range of treated flow rates up to the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm. This performance claim was verified at a 95% level of confidence.

Performance results

Performance Claim 3 (TAPE):

Raw data summarizing the percent removal of total suspended solids (TSS) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent TSS (mg/L)	Average Effluent TSS (mg/L)	Percent Removal (%)
LPR021012	182	63.0	65.4
LPR021412	539	32.0	94.1
LPR021712	387	48.0	87.6
LPR022012	246	5.0	98.0
LPR022412	512	43.0	91.6
LPR031012	360	27.0	92.5
LPR031212a	150	18.0	88.0
LPR032912b	370	47.0	87.3
LPR052412	510	43.0	91.6
LPR060112	780	16.0	98.0
LPR060412	580	32.0	94.5
LPR060712	570	120.0	79.0
LPR110612	40.0	10.0	75.0
LPR112312	110	5.0	95.5
LPR113012	230	17.0	92.6
LPR051713	94.0	6.0	93.6
LPR052113	389	24.0	93.8
LPR062513	308	21.0	93.2
LPR013014	170	17.0	90.0
LPR030314	280	95.0	66.1
LPR030814a	173	26.0	85.0
LPR011815	529	72.8	86.2
LPR020215	397	67.0	83.1
Sum	2022		
N (COUNT)	23		
Median	91.6		
STDEV.s	8.99		
VAR.s	80.7		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	89.0		

Performance Claim 4 (TAPE):

Raw data summarizing the percent removal of total phosphorus (TP) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent TP (mg/L)	Average Effluent TP (mg/L)	Percent Removal (%)
LPR021012	0.141	0.104	26.2
LPR021412	0.220	0.062	71.8
LPR021712	0.310	0.067	78.3
LPR022012	0.163	0.026	84.1
LPR022412	0.424	0.070	83.5
LPR031012	0.140	0.049	65.0
LPR031212a	0.150	0.037	75.3
LPR032912b	0.280	0.081	71.1
LPR052412	0.170	0.070	58.8
LPR060112	0.200	0.035	82.5
LPR060412	0.210	0.043	79.5
LPR060712	0.170	0.140	17.6
LPR110612	0.068	0.025	63.2
LPR112312	0.082	0.025	69.5
LPR113012	0.170	0.025	85.3
LPR051713	0.282	0.029	89.9
LPR052113	0.558	0.050	91.1
LPR062513	0.583	0.045	92.2
LPR013014	0.317	0.053	83.3
LPR030314	0.417	0.133	68.1
LPR030814a	0.261	0.051	80.3
LPR011815	0.649	0.124	80.9
LPR020215	0.693	0.100	85.6
Sum	1683		
N (COUNT)	23		
Median	79.5		
STDEV.s	18.5		
VAR.s	343.7		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	79.0		

Performance Claim 5 (TAPE):

Raw data summarizing the percent removal of total nitrogen (TN) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent TN (mg/L)	Average Effluent TN (mg/L)	Percent Removal (%)
LPR021012	1.06	0.265	75.1
LPR021412	1.20	0.531	55.9
LPR021712	1.58	0.638	59.5
LPR022012	0.696	0.265	61.9
LPR022412	1.11	0.265	76.0
LPR031012	1.72	0.265	84.5
LPR031212a	0.760	0.400	47.4
LPR032912b	1.23	0.265	78.5
LPR052412	1.85	0.400	78.4
LPR060112	2.40	0.872	63.7
LPR060412	1.06	0.327	69.1
LPR060712	0.579	0.555	4.1
LPR110612	0.569	0.555	2.5
LPR112312	0.515	0.515	0.0
LPR113012	1.22	0.515	57.6
LPR051713	1.37	0.250	81.8
LPR052113	0.531	0.248	53.4
LPR062513	0.619	0.253	59.2
LPR013014	0.240	0.212	11.8
LPR030314	0.530	0.230	56.6
LPR030814a	0.432	0.080	81.5
LPR011815	0.180	0.110	38.9
LPR020215	2.32	0.370	84.1
Sum	1281		
N (COUNT)	23		
Median	59.5		
STDEV.s	27.0		
VAR.s	727		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	56.0		

Performance Claim 6 (TAPE):

Raw data summarizing the percent removal of total copper (Cu) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent Cu (mg/L)	Average Effluent Cu (mg/L)	Percent Removal (%)
LPR021012	No data	No data	-
LPR021412	No data	No data	-
LPR021712	0.032	0.006	81.3
LPR022012	0.014	0.001	92.9
LPR022412	0.032	0.005	84.4
LPR031012	0.019	0.003	84.2
LPR031212a	0.012	0.003	75.0
LPR032912b	0.023	0.004	82.6
LPR052412	0.050	0.050	0.0
LPR060112	0.040	0.003	92.5
LPR060412	0.021	0.003	85.7
LPR060712	0.028	0.010	64.3
LPR110612	0.006	0.003	50.0
LPR112312	0.006	0.001	83.3
LPR113012	0.016	0.002	87.5
LPR051713	0.016	0.003	81.3
LPR052113	0.027	0.006	77.8
LPR062513	0.029	0.005	82.8
LPR013014	0.021	0.004	81.0
LPR030314	0.019	0.006	68.4
LPR030814a	0.018	0.002	88.9
LPR011815	0.055	0.010	81.8
LPR020215	0.044	0.007	84.1
Sum	1610		
N (COUNT)	21		
Median	82.6		
STDEV.s	20.06		
VAR.s	403		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	77.0		

Performance Claim 7 (TAPE):

Raw data summarizing the percent removal of total zinc (Zn) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent Zn (mg/L)	Average Effluent Zn (mg/L)	Percent Removal (%)
LPR021012	No data	No data	-
LPR021412	No data	No data	-
LPR021712	0.151	0.034	77.8
LPR022012	0.076	0.011	85.8
LPR022412	0.191	0.031	84.0
LPR031012	0.120	0.022	81.7
LPR031212a	0.068	0.017	75.0
LPR032912b	0.160	0.029	81.9
LPR052412	0.250	0.250	0.0
LPR060112	0.230	0.012	94.8
LPR060412	0.130	0.015	88.5
LPR060712	0.170	0.048	71.8
LPR110612	0.022	0.014	36.4
LPR112312	0.049	0.010	79.6
LPR113012	0.110	0.016	85.5
LPR051713	0.068	0.010	85.2
LPR052113	0.126	0.021	83.5
LPR062513	0.120	0.017	85.5
LPR013014	0.108	0.026	76.1
LPR030314	0.095	0.029	69.8
LPR030814a	0.088	0.013	84.8
LPR011815	0.151	0.039	74.4
LPR020215	0.192	0.038	80.2
Sum	1582		
N (COUNT)	21		
Median	81.7		
STDEV.s	20.69		
VAR.s	428		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	75.0		

Performance Claim 8 (TAPE):

Raw data summarizing the percent removal of total lead (Pb) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent Pb (mg/L)	Average Effluent Pb (mg/L)	Percent Removal (%)
LPR021012	No data	No data	-
LPR021412	No data	No data	-
LPR021712	0.013	0.003	73.7
LPR022012	0.005	0.001	79.6
LPR022412	0.015	0.003	77.3
LPR031012	0.009	0.002	78.5
LPR031212a	0.006	0.002	71.9
LPR032912b	0.012	0.003	75.0
LPR052412	0.025	0.025	0.00
LPR060112	0.016	0.005	68.8
LPR060412	0.013	0.001	90.8
LPR060712	0.013	0.005	62.3
LPR110612	0.001	0.001	0.0
LPR112312	0.002	0.001	50.0
LPR113012	0.005	0.001	80.0
LPR051713	0.004	0.001	74.8
LPR052113	0.009	0.009	0.336
LPR062513	0.009	0.002	82.5
LPR013014	0.006	0.001	80.5
LPR030314	0.007	0.003	62.1
LPR030814a	0.005	0.001	71.5
LPR011815	0.015	0.003	81.4
LPR020215	0.011	0.002	81.0
Sum	1342		
N (COUNT)	21		
Median	74.8		
STDEV.s	28.05		
VAR.s	787		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized median	70.0		

Performance Claim 9 (TAPE):

Raw data summarizing the percent removal of total aluminium (Al) by The Stormwater Management StormFilter®, with PhosphoSorb® media, at the design hydraulic loading rate of 1.67gpm/sq ft. of media surface for a standard height cartridge of 45.72 cm for 23 qualifying storm events (bootstrapped data).

Sample ID	Average Influent Pb (mg/L)	Average Effluent Pb (mg/L)	Percent Removal (%)
LPR021012	No data	No data	-
LPR021412	No data	No data	-
LPR021712	9.15	1.86	79.7
LPR022012	2.62	0.319	87.8
LPR022412	9.65	1.99	79.4
LPR031012	6.20	1.10	82.3
LPR031212a	4.30	0.810	81.2
LPR032912b	6.40	1.70	73.4
LPR052412	9.70	1.30	86.6
LPR060112	11.0	0.370	96.6
LPR060412	12.0	1.00	91.7
LPR060712	9.60	4.10	57.3
LPR110612	1.30	0.300	76.9
LPR112312	1.20	0.190	84.2
LPR113012	3.00	0.440	85.3
LPR051713	1.44	0.134	90.7
LPR052113	3.24	0.358	89.0
LPR062513	3.94	0.466	88.2
LPR013014	3.45	0.796	76.9
LPR030314	2.64	1.13	57.2
LPR030814a	1.67	0.342	79.5
LPR011815	5.32	1.17	78.0
LPR020215	3.85	1.20	68.8
Sum	1691		
N (COUNT)	21		
Mean (AVE)	80.5		
STDEV.s	10.13		
VAR.s	103		
Z (alpha)	1.65		
Z (beta)	1.29		
Hypothesized mean	80.0		

Verification

This verification was completed by the Verification Expert, the Centre for Advancement of Water and Wastewater Technologies ("CAWT"), contracted by GLOBE Performance Solutions, applying the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***. Data and information provided by Contech Engineered Solutions LLC to support the performance claim included the following:

- Performance test report "The Stormwater Management StormFilter® - PhosphoSorb® at a Specific Flow Rate of 1.67 gpm/ft^2 – Performance Evaluation Report" prepared by Contech Engineered Solutions, November 8, 2017. This report is based on a field testing program conducted by Contech personnel at a roadway site in Zigzag, Oregon between January 2012 and February 2015. Testing was conducted in accordance with the 2011 version of the Washington Department of Ecology TAPE (TAPE, 2011).

What is ISO14034:2016 Environmental management – Environmental technology verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV) and was developed and published by the International Organization for Standardization (ISO). The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

For more information on the The Stormwater Management StormFilter® please contact:

CONTECH Engineered Solutions LLC
71 US Route 1, Suite F
Scarborough, ME
04074 USA
Tel: 207-885-9830
info@conteches.com
www.conteches.com

For more information on ISO 14034:2016 / ETV please contact:

GLOBE Performance Solutions
404 – 999 Canada Place
Vancouver, BC
V6C 3E2 Canada
Tel: 604-695-5018 / Toll Free: 1-855-695-5018
etv@globeperformance.com
www.globeperformance.com

Limitation of verification - Registration: GPS-ETV_2020-06-15_TAPE

GLOBE Performance Solutions and the Verification Expert provide the verification services solely on the basis of the information supplied by the applicant or vendor and assume no liability thereafter. The responsibility for the information supplied remains solely with the applicant or vendor and the liability for the purchase, installation, and operation (whether consequential or otherwise) is not transferred to any other party as a result of the verification.

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Nonpoint Pollution Control
Division of Water Quality
Mail Code 401-02B
Post Office Box 420
Trenton, New Jersey 08625-0420
609-633-7021 Fax: 609-777-0432
http://www.state.nj.us/dep/dwq/bnpc_home.htm

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

December 14, 2016

Derek M. Berg
Director - Stormwater Regulatory Management - East
Contech Engineered Solutions LLC
71 US Route 1, Suite F
Scarborough, ME 04074

Re: MTD Laboratory Certification
Stormwater Management StormFilter® (StormFilter) by Contech Engineered Solutions LLC
Off-line Installation

TSS Removal Rate 80%

Dear Mr. Berg:

The Stormwater Management rules under N.J.A.C. 7:8-5.5(b) and 5.7(c) allow the use of manufactured treatment devices (MTDs) for compliance with the design and performance standards at N.J.A.C. 7:8-5 if the pollutant removal rates have been verified by the New Jersey Corporation for Advanced Technology (NJCAT) and have been certified by the New Jersey Department of Environmental Protection (NJDEP). Contech Engineered Solutions LLC has requested a Laboratory Certification for the StormFilter System.

This project falls under the "Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advanced Technology" dated January 25, 2013. The applicable protocol is the "New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device" dated January 25, 2013.

NJCAT verification documents submitted to the NJDEP indicate that the requirements of the afore-mentioned protocol have been met or exceeded. The NJCAT letter also included a recommended certification TSS removal rate and the required maintenance plan. The NJCAT Verification Report with the Verification Appendix for this device is published online at http://www.njcat.org/verification-process/technology-verification-database.html.

The NJDEP certifies the use of the StormFilter System by Contech Engineered Solutions LLC at a TSS removal rate of 80%, when designed, operated and maintained in accordance with the information provided in the Verification Appendix and subject to the following conditions:

1. The maximum treatment flow rate (MTFR) for the manufactured treatment device (MTD) is calculated using the New Jersey Water Quality Design Storm (1.25 inches in 2 hrs) in N.J.A.C. 7:8-5.5. The MTFR is calculated based on a verified loading rate of 2.12 gpm/sf of effective filtration treatment area.

2. The StormFilter System shall be installed using the same configuration as the unit tested by NJCAT, and sized in accordance with the criteria specified in item 6 below.

3. This device cannot be used in series with another MTD or a media filter (such as a sand filter), to achieve an enhanced removal rate for total suspended solids (TSS) removal under N.J.A.C. 7:8-5.5.

4. Additional design criteria for MTDs can be found in Chapter 9.6 of the New Jersey Stormwater Best Management Practices (NJ Stormwater BMP) Manual which can be found on-line at www.njstormwater.org.

5. The maintenance plan for a site using this device shall incorporate, at a minimum, the maintenance requirements for the StormFilter, which is attached to this document. However, it is recommended to review the maintenance website at http://www.conteches.com/DesktopModules/Bring2mind/DMX/Download.aspx?EntryId=2813&PortalId=0&DownloadMethod=attachment for any changes to the maintenance requirements.

6. Sizing Requirements:

   The example below demonstrates the sizing procedure for a StormFilter System.

   Example: A 0.25 acre impervious site is to be treated to 80% TSS removal using a StormFilter System. The impervious site runoff (Q) based on the New Jersey Water Quality Design Storm was determined to be 0.79 cfs or 354.58 gpm.

   The calculation of the minimum number of cartridges for use in the StormFilter System is based upon both the MTFR and the maximum inflow drainage area. It is necessary to calculate the required cartridges using both methods and to rely on the method that results in the highest minimum number of cartridges determined by the two methods.

   Inflow Drainage Area Evaluation:

   The drainage area to the StormFilter System in this example is 0.25 acres. Based upon the information in Table 1 below, the following minimum number of cartridges are required in a StormFilter System to treat the impervious area without exceeding the maximum drainage area:

1. Five (5) 12" cartridges,
2. Three (3) 18" cartridges, or
3. Two (2) 27" cartridges

<u>Maximum Treatment Flow Rate (MTFR) Evaluation</u>:

The site runoff (Q) was determined based on the following:

time of concentration = 10 minutes
i=3.2 in/hr (page 5-8, Fig. 5-3 of the NJ Stormwater BMP Manual)
c=0.99 (runoff coefficient for impervious)
Q=ciA=0.99x3.2x0.25=0.79 cfs=0.79x448.83 gpm=354.58 gpm

Based on a flow rate of 354.58 gpm, the following minimum number of cartridges are required in a StormFilter System to treat the impervious area without exceeding the MTFR:

1. Thirty-six (36) 12" cartridges,
2. Twenty-four (24) 18" cartridges, or
3. Sixteen (16) 27" cartridges

The MTFR Evaluation results will be used since that method results in the higher minimum number of cartridges determined by the two methods.

The sizing table corresponding to the available system models are noted below:

TABLE 1 STORMFILTER CARTRIDGE HEIGHTS AND NEW JERSEY TREATMENT CAPACITIES

StormFilter Cartridge Heights and New Jersey Treatment Capacities				
StormFilter Cartridge Height	**Filtration Surface Area (sq.ft)**	**MTFR[1] (GPM)**	**Mass Capture Capacity (lbs)**	**Maximum Allowable Inflow Area[2] (acres)**
Low Drop (12")	4.71	10	36.3	0.061
18"	7.07	15	54.5	0.09
27"	10.61	22.5	81.8	0.136

Notes:
1. *MTFR calculated based on 4.72x10-3 cfs/sf (2.12 gpm/sf) of effective filtration treatment area.*
2. *Based upon the equation found in the NJDEP Filter Protocol Maximum Inflow Drainage Area (acres) = weight of TSS before 10% loss in MTFR (lbs)/600 lbs/acre of drainage area annually.*

Be advised a detailed maintenance plan is mandatory for any project with a Stormwater BMP subject to the Stormwater Management Rules, N.J.A.C. 7:8. The plan must include all of the items identified in Stormwater Management Rules, N.J.A.C. 7:8-5.8. Such items include, but are not limited to, the list of indication of problems in the system, and training of maintenance personnel. Additional information can be found in Chapter 8: Maintenance and Retrofit of Stormwater Management Measures.

If you have any questions regarding the above information, please contact Shashi Nayak of my office at (609) 633-7021.

Sincerely,

James J. Murphy, Chief
Bureau of Nonpoint Pollution Control

Attachment: Maintenance Plan

cc: Chron File
Richard Magee, NJCAT
Vince Mazzei, NJDEP - DLUR
Ravi Patraju, NJDEP - BES
Gabriel Mahon, NJDEP - BNPC
Shashi Nayak, NJDEP - BNPC

Erfan Haidari| nEngineering Inc

From:	Huda Majeed [huda@echelonenvironmental.ca]
Sent:	June 16, 2022 4:54 PM
To:	Erfan Haidari| nEngineering Inc
Cc:	'Abu Ziauddin | NEngineering Inc'; Leann Young
Subject:	RE: n2123 | StormFilter Phosphorus Removal - Phosphosor
Attachments:	SF Design - 233 249 261 ColdWater Rd W.pdf; StormFilter ETV Verification Statement.pdf

Thank you for providing that information Erfan!

Please find your StormFilter sizing report attached. For this site, we are recommending the SFPD0818 (or CIP) with 36 Phosphosorb cartridges (27"). This design is based on the controlled flows as described below, and will yield more than 80% Phosphorus removal. If 79% Phosphorus removal is acceptable, please let me know as we can decrease our footprint by using less cartridges.

Standard StormFilter notes apply: Please note that all StormFilter systems would require a minimum drop of 0.15m between the inlet and outlet pipe inverts, for constructability. Also, these 27" cartridges will require a minimum hydraulic drop of 0.93m for functionality. We would usually choose a smaller cartridge height to prevent flooding upstream, but this would increase the number of cartridges and footprint. Therefore, to keep the sizing reasonable, the 27" is best as long as we consider hydraulic conditions upstream.

I have attached our SF ETV verification for easy reference. Let me know if you need any additional details.

Thank you,

Huda Majeed
Echelon Environmental Inc.
55 Albert Street, Suite #200 | Markham, ON, L3P 2T4
C: 416-702-4282 | T: 905-948-0000 | F: 905-948-0577
huda@echelonenvironmental.ca
www.echelonenvironmental.ca
ECHELON ENVIRONMENTAL

From: Erfan Haidari| nEngineering Inc <eh@nengineering.com>
Sent: Thursday, June 16, 2022 1:39 PM
To: Huda Majeed <huda@echelonenvironmental.ca>
Cc: 'Abu Ziauddin | NEngineering Inc' <az@nengineering.com>
Subject: RE: n2123 | StormFilter Phosphorus Removal - Phosphosor

Hello Huda,

I hope all is well, In the table bellow I have included the flow rates for 2 to 100 year. The total upstream storage volume is 361 m3.

Thank you for your time and help

	2 years	5 years	10 years	25 years	50 years	100 years
Flow rate (l/s)	**54.07**	**54.42**	**54.94**	**54.94**	**54.94**	**54.94**

Appendix F

Phosphorous Budget Summary

Summary

Site	Project Name	Project Title	Storm Type
Pre-Development	n2123	261 Coldwater Rpad	avg-annual
Post-Development	261 Coldwater Rpad	261 Coldwater Rpad	avg-annual

Water Balance Comparison

Site	Site Area	Site Rainfall In	Site Infiltration	Site Evapotranspiration	External Outflow	Rainfall Reduction
		(mm) (m^3)	(mm) (m^3)	(mm) (m^3)	(mm) (m^3)	(mm) (%)
Pre-Development Total	1.54 ha	944.70 mm	171.07 mm	602.16 mm	170.78 mm	773.92 mm
		14,548.38 m^3	2,634.48 m^3	9,273.26 m^3	2,630.00 m^3	81.92 %
Post-Development Total	1.54 ha	944.70 mm	66.76 mm	310.87 mm	5,032.47 mm	-4,087.77 mm
		14,548.38 m^3	1,028.10 m^3	4,787.40 m^3	77,500.00 m^3	-432.71 %
Difference	**0.00 ha**	**0.00 mm**	**-104.31 mm**	**-291.29 mm**	**4,861.69 mm**	**-4,861.69 mm**
		0.00 m^3	**-1,606.37 m^3**	**-4,485.87 m^3**	**74,870.00 m^3**	**-514.63 %**
Difference	**0.00 %**	**0.00 %**	**-60.98 %**	**-48.37 %**	**2846.77 %**	**-628.19 %**

Water Balance | Pre-Development

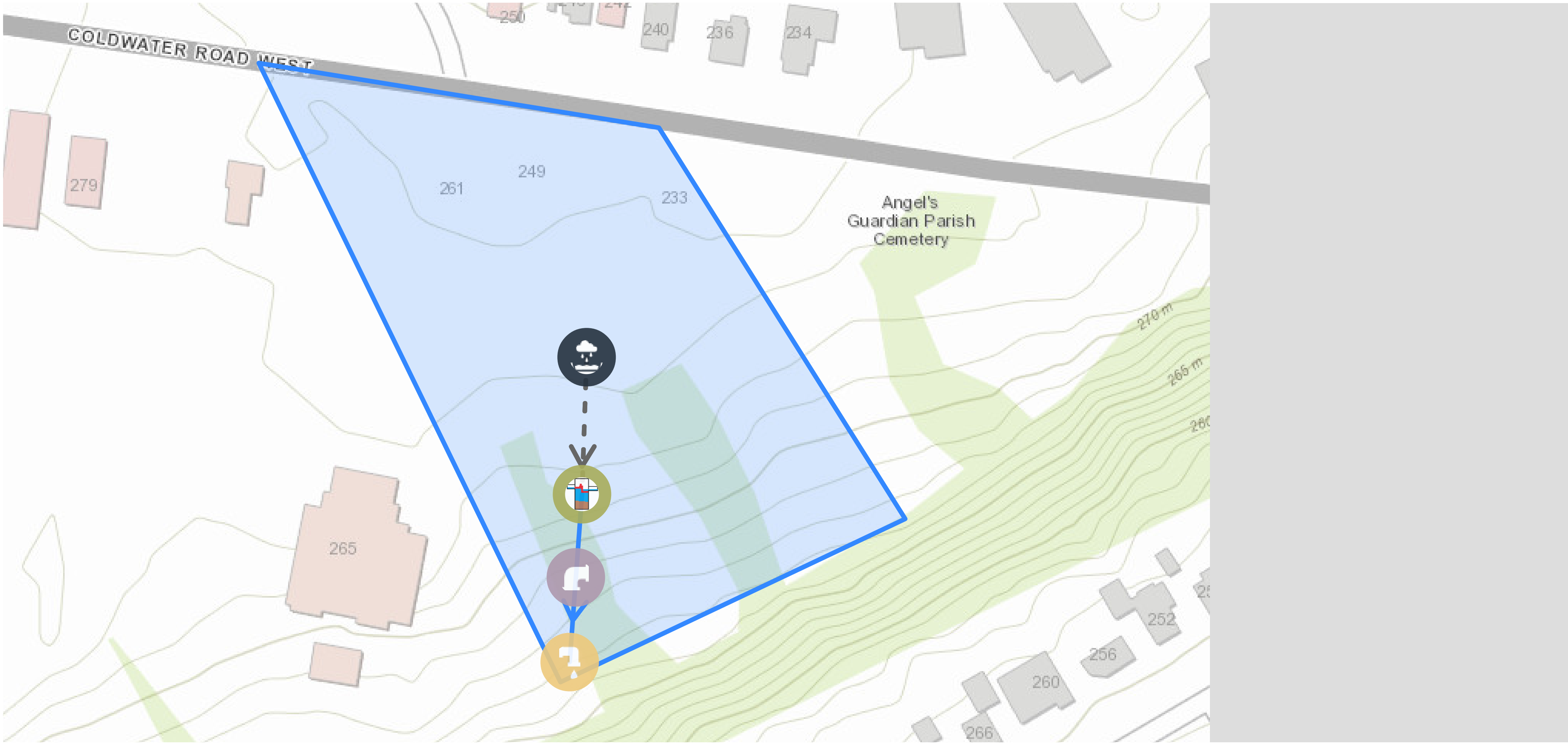
Catchment	Site Area	Site Rainfall In (mm) (m^3)	Site Infiltration (mm) (m^3)	Site Evapotranspiration (mm) (m^3)	External Outflow (mm) (m^3)	Rainfall Reduction (mm) (%)
1	1.54 ha	944.70 mm 14,548.38 m^3	171.07 mm 2,634.48 m^3	602.16 mm 9,273.26 m^3	170.78 mm 2,630.00 m^3	773.92 mm 81.92 %
TOTAL	**1.54 ha**	**944.70 mm** **14,548.38 m^3**	**171.07 mm** **2,634.48 m^3**	**602.16 mm** **9,273.26 m^3**	**170.78 mm** **2,630.00 m^3**	**773.92 mm** **81.92 %**

Water Balance | Post-Development

Catchment	Site Area	Site Rainfall In (mm) (m^3)	Site Infiltration (mm) (m^3)	Site Evapotranspiration (mm) (m^3)	External Outflow (mm) (m^3)	Rainfall Reduction (mm) (%)
1	1.54 ha	944.70 mm 14,548.38 m^3	66.76 mm 1,028.10 m^3	310.87 mm 4,787.40 m^3	5,032.47 mm 77,500.00 m^3	-4,087.77 mm -432.71 %
TOTAL	**1.54 ha**	**944.70 mm** **14,548.38 m^3**	**66.76 mm** **1,028.10 m^3**	**310.87 mm** **4,787.40 m^3**	**5,032.47 mm** **77,500.00 m^3**	**-4,087.77 mm** **-432.71 %**

Map | Pre-Development

Map | Post-Development



LID Summary | Post-Development

Element	Type	LID Area	Drawdown Time	Effective Impervious to Pervious Ratio	FLOW	TSS	TP
					Flow In (m^3) Flow Out (m^3) Actual Reduction (%)	Load In (kg) Load Out (kg) Actual Reduction (%)	Load In (kg) Load Out (kg) Actual Reduction (%)
OGS	Oil-Grit-Separator				8,730.000 m^3 8,730.000 m^3 0.000 %	715.685 kg 143.137 kg 80.000 %	2.120 kg 0.424 kg 80.000 %

Loading Summary TP | Pre Development

Catchment	Total Catchment TP Removal	Peak Outflow	Generated Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Average Concentration (mg/l) Total Load (kg)
Catchment 1	0.000 %	0.069 m^3/s	2,630.000 m^3 0.200 mg/l 0.527 kg	2,632.000 m^3 0.200 mg/l 0.527 kg
Total	**0.000 %**	**0.069 m^3/s**	**2,630.000 m^3** **0.200 mg/l** **0.527 kg**	**2,632.000 m^3** **0.200 mg/l** **0.527 kg**

Loading Summary TP | Post Development

Catchment	Total Catchment TP Removal	Peak Outflow	Generated Total Flow (m^3)	Generated Average Concentration (mg/l)	Generated Total Load (kg)	Outgoing Total Flow (m^3)	Outgoing Average Concentration (mg/l)	Outgoing Total Load (kg)
Catchment 1	80.000 %	29.391 m^3/s	8,730.000 m^3	0.243 mg/l	2.120 kg	77,514.000 m^3	0.005 mg/l	0.424 kg
Total	**80.000 %**	**29.391 m^3/s**	**8,730.000 m^3**	**0.243 mg/l**	**2.120 kg**	**77,514.000 m^3**	**0.005 mg/l**	**0.424 kg**

Peak Flow | Pre-Development

Catchment	Element	Description	Peak outflow
1	site	PEAK RUNOFF FLOW from	0.07 m^3/s
	OUT-POST	MAXIMUM FLOW at	0.069 m^3/s

Peak Flow | Post-Development

Catchment	Element	Description	Peak outflow
1	site	PEAK RUNOFF FLOW from	0.18 m^3/s
	OUT-POST	MAXIMUM FLOW at	29.391 m^3/s
	OGS	MAXIMUM LATERAL INFLOW at	0.184 m^3/s
	PIPE	MAXIMUM FLOW in	29.391 m^3/s

Loading TP | Pre Development

TP - Catchment 1

Name	LID Type	Peak Outflow	Incoming Total Flow (m^3) Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Concentration (mg/l) Total Load (kg)
site	0 %	0.07 m^3/s	14,548.380 m^3 0.200 mg/l 2.914 kg	2,630.000 m^3 0.200 mg/l 0.527 kg
OUT-POST	0 %	0.069 m^3/s	2,632.000 m^3 0.200 mg/l 0.527 kg	2,632.000 m^3 0.200 mg/l 0.527 kg

Loading TP | Post Development

TP - Catchment 1

Name	LID Type	Peak Outflow	Incoming Total Flow (m^3) Concentration (mg/l) Total Load (kg)	Outgoing Total Flow (m^3) Concentration (mg/l) Total Load (kg)
site	0 %	0.18 m^3/s	14,548.380 m^3 0.243 mg/l 3.532 kg	8,730.000 m^3 0.243 mg/l 2.120 kg
OGS	80 %	0.184 m^3/s	8,730.000 m^3 0.243 mg/l 2.120 kg	8,730.000 m^3 0.049 mg/l 0.424 kg
PIPE	0 %	29.391 m^3/s	8,730.000 m^3 0.049 mg/l 0.424 kg	8,730.000 m^3 0.049 mg/l 0.424 kg
OUT-POST	0 %	29.391 m^3/s	77,514.000 m^3 0.005 mg/l 0.424 kg	77,514.000 m^3 0.005 mg/l 0.424 kg

site

Field	Value
Subcatchment name	site
Catchment	1
Total AREA (HA)	1.54
Impervious area (HA)	0.0154
Roof area (HA)	0
Landscaped area (HA)	0
Row Crop area (HA)	0
Open Space / Parkland area (HA)	1.5246
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	76

OUT-POST

Field	Value
Name	OUT-POST
Catchment	1
Outfall Elevation (m)	0

Detailed Report Parameters | Post Development

site

Field	Value
Subcatchment name	site
Catchment	1
Total AREA (HA)	1.54
Impervious area (HA)	0.77
Roof area (HA)	0.2156
Landscaped area (HA)	0.5544
Row Crop area (HA)	0
Open Space / Parkland area (HA)	0
Forest area (HA)	0
Wetland area (HA)	0
Other area (HA)	0
Manning's n for impervious areas	0.01
Manning's n for pervious areas	0.1
Depression storage for impervious areas (mm)	2
Depression storage for pervious areas (mm)	2.54
Weighted Curve Number	82

OUT-POST

Field	Value
Name	OUT-POST
Catchment	1
Outfall Elevation (m)	0

OGS

Field	Value
Name	OGS
Junction Type	oil-grit-separator
Catchment	1
Invert Elevation (m)	264.84
Depth to Surface (m)	1.5

PIPE

Field	Value
Name	PIPE
Catchment	1
Upstream Node	OGS
Downstream Node	OUT-POST
Length (m)	47

Manning's Roughness	0.013
Upstream Invert (m)	0
Downstream Invert (m)	0
Pipe Diameter (m)	0.3

Appendix G

Infiltration Chamber (SC-160LP)

User Inputs

Chamber Model:	SC-160LP
Outlet Control Structure:	Yes
Project Name:	Coldwater Road
Engineer:	Erfan Haidari
Project Location:	Ontario
Measurement Type:	Metric
Required Storage Volume:	200.00 cubic meters.
Stone Porosity:	40%
Stone Foundation Depth:	152 mm.
Stone Above Chambers:	152 mm.
Average Cover Over Chambers:	356 mm.
Design Constraint Dimensions:	(7.50 m. x 64.00 m.)

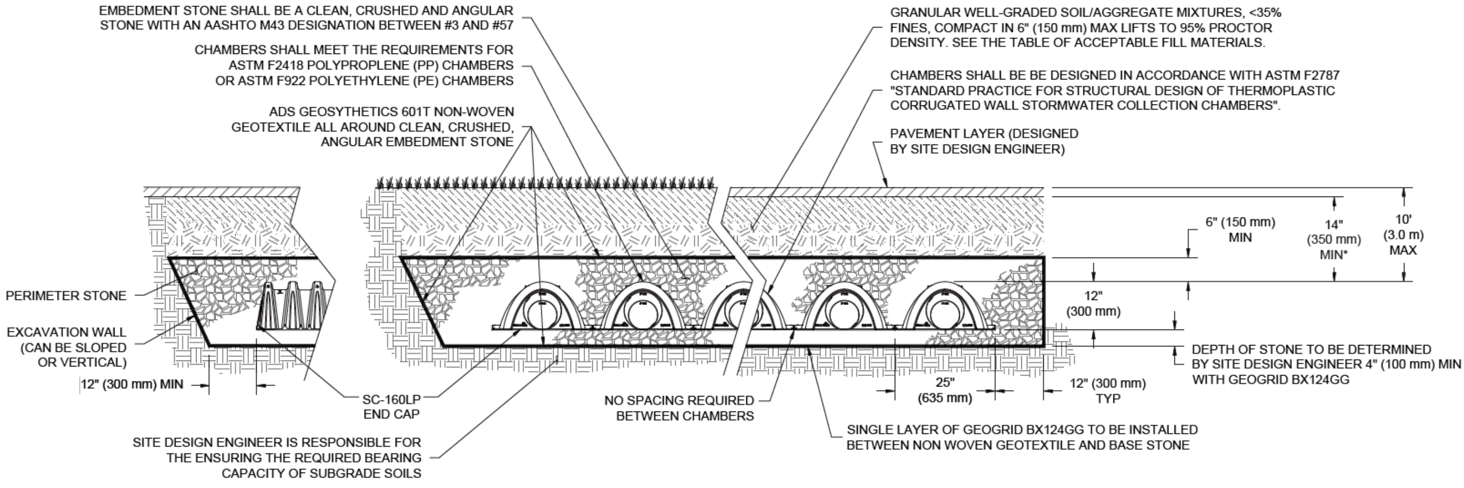
Results

System Volume and Bed Size

Installed Storage Volume:	141.99 cubic meters.
Storage Volume Per Chamber:	0.19 cubic meters.
Number Of Chambers Required:	280
Number Of End Caps Required:	20
Chamber Rows:	10
Maximum Length:	63.72 m.
Maximum Width:	7.14 m.
Approx. Bed Size Required:	448.68 square meters.

System Components

Amount Of Stone Required:	219.20 cubic meters
Volume Of Excavation (Not Including Fill):	273.51 cubic meters
Non-woven Geotextile Required (excluding Isolator Row):	1180.50 square meters
Non-woven Geotextile Required (Isolator Row):	0.00 square meters
Total Non-woven Geotextile Required:	1180.50 square meters
Woven Geotextile Required (excluding Isolator Row):	29.26 square meters
Woven Geotextile Required (Isolator Row):	89.07 square meters
Total Woven Geotextile Required:	118.33 square meters



*MINIMUM COVER TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 20" (510 mm).

Project: **n2132: 828 Innisfil Beach Rd**

Chamber Model -	SC-160	
Units -	**Metric**	Click Here for Imperial
	20	
Number of chambers -	280	
Voids in the stone (porosity) -	40	%
Base of Stone Elevation -	264.22	m
Amount of Stone Above Chambers -	152	mm
Amount of Stone Below Chambers -	100	mm
Area of system -	448.68	sq.meters

☑ Include Perimeter Stone in Calculations

Min. Area - 385.826 sq.meters

StormTech MC-4500 Cumulative Storage Volumes

Height of System *(mm)*	Incremental Single Chamber *(cubic meters)*	Incremental Total Chamber *(cubic meters)*	Incremental Stone *(cubic meters)*	Incremental Ch & St *(cubic meters)*	Cumulative Chamber *(cubic meters)*	Elevation *(meters)*
559	0.00	0.00	4.56	4.56	132.843	264.78
533	0.00	0.00	4.56	4.56	128.287	264.75
508	0.00	0.00	4.56	4.56	123.730	264.73
483	0.00	0.00	4.56	4.56	119.174	264.70
457	0.00	0.00	4.56	4.56	114.618	264.68
432	0.00	0.00	4.56	4.56	110.061	264.65
406	0.00	0.41	4.39	4.80	105.505	264.63
381	0.00	1.07	4.13	5.20	100.705	264.60
356	0.01	2.30	3.63	5.94	95.509	264.58
330	0.01	3.50	3.15	6.66	89.571	264.55
305	0.02	4.27	2.85	7.12	82.912	264.52
279	0.02	4.89	2.60	7.49	75.791	264.50
254	0.02	5.40	2.40	7.79	68.302	264.47
229	0.02	5.83	2.22	8.06	60.508	264.45
203	0.02	6.21	2.07	8.28	52.451	264.42
178	0.02	6.54	1.94	8.48	44.167	264.40
152	0.02	6.82	1.83	8.65	35.687	264.37
127	0.03	7.09	1.72	8.81	27.038	264.35
102	0.00	0.00	4.56	4.56	18.225	264.32
76	0.00	0.00	4.56	4.56	13.669	264.30
51	0.00	0.00	4.56	4.56	9.113	264.27
25	0.00	0.00	4.56	4.56	4.556	264.25

Proposed Outlet

Appendix H

Sanitary, Fire and Water Demand

TABLE 4.1

Sanitary Calculation

PROPOSED COMMUNITY BUILDING

233, 249, 261 Coldwater Road

Project No. n2123

					Notes
1.0	Proposed Site Statistics				Notes
	1.1	No. of Units (Apartment)	110	units	Note 1
2.0	Design Criteria				
	2.1	Population Equivalent			
		Townhouses	2.68	Person/unit	Note 2
3.0	Design Flows				
	3.1	Average wastewater Flow	300	L/day/person	Note 2
	3.2	Total Population	295	Persons	
	3.3	Residential Peaking Factor (Harman Eq.)	4.08		Note 2
		Residential Peaking Factor to be used	4.00		
	3.4	Peak Design Flows	4.09	L/sec	Note 2
4.0	Extraneous Flows		0.1	l/sec/ha.	Note 2
	4.1	Total Area of the Site	1.508	ha.	
	4.2	Infiltration Allowance	0.151	l/sec	
5.0	**Total Peak Design Flow**		**4.25**	**L/sec**	

Note:

1. Site Plan, Preapred by n Architecture Inc.
2. City Of Orilia Engineering Criteria, July 2012

TABLE 4.2

Water Demand Calculation

PROPOSED COMMUNITY BUILDING
233, 249, 261 Coldwater Road
Project No. n2123

Average Consumption Rate	300	L/capita/day	
Max Day Factor	1.6		
Peak Hour Factor	4.5		*Section 4.4 (Note 1)*
Pop: Equivallent	2.95	Person/unit	Section 4.3.2.1 *(Note 1)*
Number of Unit	110		Site Plan *(Note 2)*
Population	324.5	Person	
Average Domestic Water Deamnd	97350.00	l/day	
	1.13	L/sec	
Max Day Demand	1.80	L/sec	
Max Hour Deamd	5.07	L/sec	

Note:
1. City Of Orilia Engineering Criteria, July 2012
2. Site Plan, Preapred by n Architecture Inc.

TABLE 1. **FIRE FLOW CALCULATION as per FIRE UNDERWRITERS SURVEY (1999)**

PROJECT: 233, 249, 261 Coldwater Road
Orillia

1. Fire Flow Equation

F = 220 C √ A

where
F is the required fire flow [LPM]
C is the coefficient determined by type of construction [unitless]
A is the total protection area [sq.m]

2. Architecture Information

Type of Construction	Ordinary
Fire Rating	Limited-Combustible
Sprinkler Provided (Y/N)	Yes
Floor Area (Largest Unit)	
Total Floor Area [sq.m]	461
Coefficient, C [1]	1.0
Fire Flow, F [LPM]	4724

3. Combustible Product Risk

Occupancy Adjustment	85%
Fire Flow, F [LPM]	4015

4. Sprinkler Reduction

Sprinkler Reduction	0.30
Sprinkler Reduction [LPM]	1417

(Note: Sprinkler required for hotel as per OBC 3.2.2.20 - 83)

5. Exposure Adjustment

North	0%
East	0%
South	0%
West	5%
Total	**5%**
Exposure Adjustment [LPM]	236

6. Required Fire Flow, Duration & Volume

Fire Flow, F [LPM]	2834
Sprinkler Reduction [LPM]	1417
Exposure Adjustment [LPM]	236
Required Fire Flow [LPM]	1653
Required Fire Flow [LPM]	**2000**
Required Fire Flow [LPS]	**33**

**Round to 1000*

Appendix I

Storm Sewer Design Sheet

n Engineering Inc

PREPARED BY: G.T.

DATE PREPARED 17-Jun-22

Storm Sewer Design Chart

For Circular Drains Flowing Full

PROPOSED COMMUNITY BUILDING

233, 249, 261 Coldwater Road

Orillia

n2123

IDF CURVE	
Constants	5 -yrs
a	29.9000
b	-0.7250

Tc (start): 10.00 min

Catchments								Hydrology		Hydraulics						Comments
Catchment ID	Total Area (m^2)	Captured By	Outlet to	Runoff Coeff.	A x R	ACC.	t_d (min)	Rainfall Intensity, I (mm/hr)	Peak Flow (m^3/sec)	STORM SEWER DESIGN INFORMATION					TIME	
				"R"		ΣA x R		I_5	$Q_{5\text{-yrs}}$	size (mm)	slope (%)	length (m)	Q full (m^3/s)	V full (m/s)	SECT. (min)	
A2	346.42	CB1	CBMH1	0.81	0.03	0.03	10.00	109.61	0.009	900	2.00	32.55	3.026	4.756	0.11	
A1	1306.00	CBMH1	MH1	0.59	0.08	0.10	10.11	108.71	0.032	900	2.00	32.55	3.026	4.756	0.11	
Conveyance	0.00	MH1	CBMH2	0.00	0.00	0.10	10.23	107.83	0.031	300	0.60	18.50	0.089	1.252	0.25	
A4	1174.78	CB2	CBMH2	0.89	0.10	0.10	10.00	109.61	0.032	900	0.50	40.05	1.513	2.378	0.28	
A3	1604.47	CBMH2	MH4	0.75	0.12	0.33	10.47	105.98	0.097	300	1.00	23.15	0.114	1.617	0.24	
A5	934.80	CB4	900MM Ø PIPE	0.90	0.08	0.08	10.00	109.61	0.026	300	1.00	23.15	0.114	1.617	0.24	
A6	1030.78	CBMH4	MH4	0.90	0.09	0.18	10.24	107.75	0.053	900	1.00	39.70	2.139	3.363	0.20	
Conveyance	0.00	MH4	CBMH7	0.00	0.00	0.51	10.71	104.27	0.147	450	1.00	23.40	0.337	2.118	0.18	
R1, R2, R3, R4, R5	3390.85	Roof Storm Plug	INF. Chamber	0.66	0.22	0.22	10.00	109.61	0.068	300	1.00	22.00	0.114	1.617	0.23	
Conveyance	0.00	INF. Chamber	CBMH6	0.00	0.00	0.22	10.23	107.84	0.067	300	1.00	1.40	0.114	1.617	0.01	
A7	1228.17	CBMH6	CBMH7	0.76	0.09	0.32	10.24	107.73	0.095	600	0.50	29.70	0.513	1.815	0.27	
A8	909.40	CBMH7	MH2	0.90	0.08	0.91	10.99	102.38	0.258	450	0.60	26.20	0.261	1.641	0.27	
A9	2073.05	CB3	900MM Ø PIPE	0.36	0.08	0.08	10.00	109.61	0.023	300	2.00	19.00	0.162	2.286	0.14	
Conveyance	0.00	MH2	MH3	0.00	0.00	0.91	11.25	100.62	0.253	450	0.60	22.50	0.261	1.641	0.23	
Conveyance	0.00	MH3	OUTLET	0.00	0.00	0.98	11.48	99.17	0.270	375	0.50	2.50	0.147	1.326	0.03	CONTROLLED

Appendix J

Statement of Limiting Conditions and Assumptions

Statement of Limiting Conditions and Assumptions

1. This Report/Study (the "Work") has been prepared at the request of, and for the exclusive use of, the Owner, and its affiliates (the "Intended Users"). No one other then the intended users has the right to use and rely on the work without first obtaining the written authorization of n Engineering and its Owners.
2. The comments, recommendations and material in this report reflect n Engineering best judgment in light of the information available to it at the time of preparation of this report. It is not qualified to and is not providing legal or planning advice in this work.
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   b) The surveys and other data supplied to n Engineering by the Owner are accurate;
   c) Market timing, approval delivery and secondary information are within the control of parties other then n Engineering;
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   Investigations have not carried out to verify these assumptions. n Engineering deems the sources of data and statistical information contained herein to be reliable, but we extend no guarantee of accuracy in these respect.
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End of the Statement