FUNCTIONAL SERVICING & PRELIMINARY STORMWATER MANAGEMENT REPORT

180 ONTARIO STREET

TOWN OF COLLINGWOOD
COUNTY OF SIMCOE

PREPARED FOR:

2374515 ONTARIO CORPORATION

PREPARED BY:

C.F. CROZIER & ASSOCIATES INC.
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COLLINGWOOD, ON L9Y 3Z1

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CFCA FILE NO. 2598-6970

CROZIER
CONSULTING ENGINEERS

Revision Number	Date	Comments
Rev.0	March 28, 2024	Issued for First Submission Zoning By-Law Amendment

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1.0 INTRODUCTION

C.F. Crozier & Associates Inc. (Crozier) was retained by 2374515 Ontario Corporation (Owner) to prepare a Functional Servicing and Preliminary Stormwater Management Report to support the Zoning By-Law Amendment (ZBA) for a proposed 4-storey residential apartment building development located at 180 Ontario Road, in the Town of Collingwood, herein referred to as the "Subject Development". The location of the Subject Development is reflected on the Site Location Plan included as **Figure 1.**

This report provides information about the existing water servicing, sanitary servicing, and stormwater management (SWM) systems within the local area to determine the servicing requirements to support the relevant Planning Applications for the proposed development. This report will demonstrate that the proposed Subject Development can be developed in accordance with the Town of Collingwood (Town) and Nottawasaga Valley Conservation Authority (NVCA) guidelines from a functional servicing and preliminary stormwater management perspective.

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

- "Town of Collingwood Water & Wastewater Capacity Allocation Policy" (Town of Collingwood, January 2023)
- "Town of Collingwood Drinking Water Annual Summary Report" (Town of Collingwood, January 2024)
- "Town of Collingwood Development Charge Background Study" (Hemson, 2019)
- "Staff Report PW2023-15 – Semi-Annual Water and Wastewater Uncommitted Hydraulic Reserve Capacity Update" (Town of Collingwood, 2023)
- "Joint Special Council Meeting – Minutes January 11, 2024" (Town of Collingwood, 2024)
- "Soil Map of Simcoe County" (Canada Department of Agriculture, 1962)
- "Town of Collingwood Development Standards" (Town of Collingwood, 2022)
- "Town of Collingwood Official Plan" (Town of Collingwood, 2023)
- "Town of Collingwood Minnesota Street Storm Sewer Replacement – Phase 2" (Ainley Group, January 2024)
- "Pretty River Flood Hazard Delineation Study" (Stantec, 1999)
- "NVCA Natural Hazards Technical Guide" (NVCA, 2013)
- "NVCA Stormwater Technical Guide" (NVCA, 2013)
- Topographical Plan of Part of North Half of Lot 42 Concession 8 (ZEPT, 2015)
- Ontario Building Code (1999)
- Fire Underwriters Survey (2020)

2.0 SITE DESCRIPTION & BACKGROUND

The Subject Development is located at 180 Ontario Street. in the Town of Collingwood, County of Simcoe. The Subject Development covers an area of approximately 0.52 ha and consists of an existing one-storey Learning Centre, paved parking area, and open space lawn area. The property is bounded by Ontario Street to the North, a Municipal Electricity Utilities (MEU) transformer station and woodlot to the south, residential homes to the east, and a rail trail and paramedic station to the west. Across the site, soils are classified as Kemble clay loam of Hydrologic Soil Groups 'C' per the Soil Survey of Simcoe County, 1962.

The site generally slopes from south to north at approximately 0.5%. The site falls entirely within the two-zone floodplain policy area of the Pretty River Spills Flows within the NVCA regulated zone. As a result, a flood hazard study is mandated to assess the potential risk of flooding within the property. Section 7 of this report provides a detailed account of the process and outcomes of the flood hazard study, offering insights into the identification and evaluation of flood risks associated with the Subject Development in conformance with the NVCA Natural Hazards Technical Guide (2013).

The Town of Collingwood Official Plan Schedule '2' identifies the Subject Development land use designation as existing residential area. Per the Collingwood Zoning By-law, the site is zoned as Deferred Residential (DR). As a part of the ZBA process, the Subject Development is to become classified to the Residential Fourth Density (R4) Zone.

A Site Plan featuring a mid-rise residential apartment development on private roads, dated August 18, 2023, was submitted to the Town for pre-consultation. The analysis contained within this report is based on the Site Plan prepared by Cusimano Architect (August 2023) which has been enclosed as **Figure 2**.

The elements envisioned for this development include:

- A 60-unit, 4-storey residential apartment building.
- An outdoor amenity area.
- Above-ground parking areas.

3.0 ROADWAY & GRADING

Access to the Subject Development will be provided via a private entrance connecting the proposed parking lot and central laneway to Ontario Street. Preliminary parking lot grades have been prepared to demonstrate that the Subject Development can be developed in accordance with Town standards. The preliminary grading design of the parking lot provides positive drainage for minor and major storm. Grading considerations are also made to address floodplain elevation of 182.09m and is further discussed in Section 7.0. The Preliminary Grading Plan is included as **Figure 3**.

4.0 SANITARY SERVICING

The following subsections provide an analysis of the servicing strategy for the proposed sanitary sewage system for the 180 Ontario Street.

4.1 Existing Services

4.1.1 Collingwood Wastewater Treatment Plant (CWWTP)

Sanitary servicing for the Subject Development will be achieved via connection to the Town of Collingwood Wastewater Treatment Plant (CWWTP) and sanitary system. The CWWTP obtained Environment Compliance Approval (ECA) on May 14th, 2020, to operate at a capacity of 24,548 m^3/day. Per the semi-annual water and wastewater uncommitted hydraulic capacity dated September 25th, 2023, Staff Report PW2023-15, the hydraulic reserve capacity is 6,243 m^3/day (25%). The uncommitted hydraulic reserve capacity of the CWWTP is approximately equal to 3,630 Single Dwelling Units (SDUs). Although the Annual Average Daily Influent Flow is below 80% of the Rated Capacity, the Town is monitoring the influent flow rates and anticipates commencing a Municipal Class Environmental Assessment for an expansion of the WPCP in the near future. Accordingly, there is sufficient capacity to accommodate the proposed development which is further discussed in Section 4.2.

4.1.2 Existing Sanitary System

According to the Collingwood Water and Sanitary Sewer Systems Final Master Plan (Cole, 2019) there is no existing sanitary sewage infrastructure on Ontario Street that is fronting the Subject Development. However, on the Minnesota Street Storm Sewer Replacement – Phase 2 drawings completed by Ainley (January 2024) there exists a service for the existing Learning Centre. This is confirmed as a 200mm sanitary lateral on Ainley As-Constructed Drawing 192173-3AC Ontario Street Reconstruction, dated September 1992. The condition and location of the existing service is to be confirmed prior to construction.

4.2 Proposed Sanitary Servicing

The Subject Development will be serviced by connection to the existing sanitary manhole at the intersection of Ontario Street and Minnesota Street via the existing 200mm diameter service as identified on the Ainley drawing 120016 – EP3. The precise location of the existing service connection is currently unknown. Utilizing the available background information and construction drawings, we have made estimations regarding the alignment of the sewer. However, it is essential to note that the accuracy of this alignment will be confirmed during the detailed design phase.

The Town of Collingwood Development Standards (2007) & amendments (2022) and the MECP Design Guidelines for Sewage Works (2008) were used to determine the future sanitary design flows for the Subject Development. Refer to **Figure 4** for the General Site Servicing Plan. The sanitary flows for the of the Subject Development was determined using the following design parameters:

- Average Residential Flow Rate 260 L/cap/day
- Residential Peaking Factor (Harmon Formula) 4.23
- Infiltration 0.23 L/s/ha

Based on these design parameters, the estimated peak sanitary flow from the Subject Development will be 1.57 L/sec based on a max density of 60 units. This peak flow can be used to confirm the downstream capacity through the Town's sanitary model. Refer to sanitary demand calculations in **Appendix A**.

5.0 WATER SERCIVING

Potable water for the Subject Development will be supplied by the Town's municipal water distribution system.

5.1 Existing Water Services

5.1.1 Raymond A. Barker Treatment Plant

Water servicing for the Subject Development will be achieved through connection to the Raymond A. Barker Water Treatment Plant and water distribution system. Per the semi-annual water and wastewater uncommitted hydraulic capacity dated September 25th, 2023, Staff Report PW2023-15, the hydraulic reserve capacity is 5,330 m^3/day. The uncommitted hydraulic reserve capacity of the CWWTP is approximately equal to 1,202 Single Dwelling Units (SDUs).

At the time of this report being prepared, the Town is still in the process of evaluating construction tenders for the water treatment plant expansion upgrade. Per the Joint Special Council meeting held January 11th, 2024, the proposed upgrades are anticipated to be completed in August 2029. Recommendations for future year capacity allocations will be refined after the project is awarded as part of the next uncommitted hydraulic capacity update.

5.1.2 Existing Water System

According to the Collingwood Water and Sanitary Sewer Systems Final Master Plan (Cole, 2019) and Drawing 194182-RC1 completed by Ainley, a 250 mm diameter watermain is located on Ontario Street. The condition and location of the existing service is to be confirmed prior to construction. Depending on the size and condition, the existing domestic and fire services for the existing building can be removed up to the property line and capped.

5.2 Proposed Water Servicing

Water servicing to the Subject Development will be supplied by a connection to the existing 250 mm diameter watermain on Ontario Street. Refer to **Figure 4** for the General Site Servicing Plan.

To estimate the proposed water demands for the Subject Development, Town of Collingwood Development Standards (2007) & amendments (2022), and the MECP Design Guidelines for Drinking-Water Systems (2008) were referenced to determine the average, maximum day and peak hour water demands generated by the future development.

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

- Average Residential Flow Rate (per Town) 260 L/cap/day
- Max Day/Peak Hour Factors (per MECP) 1.77/2.70

It is estimated that the range of water demands for the Subject Development are as follows:

- Average Day 0.34 L/sec
- Max Day 0.61 L/sec
- Peak Hour 0.93 L/sec

5.3 Proposed Fire Flow Demand

Fire flows required to service the Subject Development were calculated based on the Site Plan prepared by Cusimano Architects (August, 2023). The fire flows required for the Subject Development are based on both the Fire Underwrite Survey (FUS) and Ontario Building Code (OBC) and are summarized below:

Table 1: Fire Flows

Fire Flow (FUS)	Fire Flow (OBC)
233 L/s	150 L/s

It should be noted that the fire flow calculated in **Table 1** was based on a number of assumptions for the type of construction for both unit and did not account for the use of fire wall and is based on the latest Site Plan provided by Cusimano Architects (August, 2023).

Based on the above, the total design flows (max day + fire flow) for the Subject Development are 233.61 L/sec. Internal watermain sizing will be subject to a distribution analysis during the detailed design stage and this peak flow can be used to confirm the Town's capacity through the Town's water model.

Refer to **Appendix B** for preliminary water demand and fire flow calculations.

6.0 DRAINAGE AND STORMWATER MANAGEMENT

Stormwater management (SWM) and site drainage for the Subject Development will proceed in conformance with the standards provided by the Town, NVCA, and Ministry of the Environment, Conservation and Parks (MECP). We acknowledge the NVCA is prepared to defer the detailed review of the stormwater and drainage management to the Town per Pre-consultation Comments received October 25th, 2023. The following criteria applies to the proposed internal SWM strategy.

- Water Quantity Control
  - Control of the post development peak flows to pre-development levels for all storms up to and including the 100-yr at the proposed outlet.

- Water Quality and Phosphorous Control
  - "Enhanced Protection" per MECP and NVCA Guidelines (80% removal of total suspended solids).

- Development Standard
  - Lot grading at 2% optimum.
  - Minor/major drainage system to convey frequent rainfall/runoff events.

6.1 Existing Drainage Conditions

The existing site conditions are outlined below in the following sections and provide an overview of internal drainage conditions, and existing outlets affecting stormwater management.

6.1.1 Internal Drainage

To accurately determine the existing internal drainage patterns and catchment areas, a topographic survey from ZEPT (2015) was acquired for the Subject Development. Review of this topography indicates that runoff from the site generally flows from south to north towards Ontario Street with an average slope of approximately 0.5%. Runoff is conveyed across the site through an existing storm sewer system that outlets to an underground culvert that ultimately discharges to Georgian Bay. Based on the topographic survey, three internal catchment areas were delineated.

Catchment PRE-1 consists of approximately 75% impervious area and drains primarily via overland flow to a catchbasin. Catchment PRE-2 consists of 62% impervious area and lawn. Overland flow within Catchment PRE-2 drains to catchbasins located in front of the Learning Centre and at the site entrance. Catchment PRE-3 consists of grassed area and drains primarily via sheet flow offsite at the north property limit. All pre-development catchments discharge to an existing storm culvert that ultimately drains to Georgian Bay. Hydrologic parameter sheets for these internal catchments may be found in **Appendix C**

The internal pre-development catchment areas, and their outlets are summarized in **Table 2.** Refer to **Figure 5** for the pre-development drainage plan and outlet locations.

Table 2: Pre-Development Catchment Areas

Catchment ID	Catchment Area (ha)	Land Use(s)	SCS Curve Number / Percent Impervious
PRE-1	0.20	Building, Driveway, Lawn	79 (CN) / 75%
PRE-2	0.21	Building, Driveway, Lawn	79 (CN) / 62%
PRE-3	0.11	Lawn	79 (CN) / 0%

6.1.2 Minnesota Drain Upgrades

The Minnesota culvert replacement is joint project with the Town and Ainley Group that aims to replace/fill an existing CSP culvert that runs from the train trail across the site just north of the Epcor substation and along the site's east boundary. The proposed 1800mm x 900mm concrete box culvert will run from South to North along the West boundary of the site. With consideration to the upgrades, the culvert will have an associated easement along the West boundary of the Subject Development that ranges from 4.5m to 6.6m.

6.2 Proposed Drainage Conditions

Stormwater runoff produced within the site will be directed to catchbasins throughout the parking lot area and will be stored in a combination of storm sewers, manholes, and catchbasin structures. The Subject Development has been designed and graded to capture and retain minor storm events (up to the 25-year storm) underground pipe storage, and larger storm events up to the 100-year storm within underground pipe storage and aboveground parking lot ponding areas. The underground pipe storage is achieved by the use of 450mm concrete superpipes, where the associated stage storage discharge tables for the superpipe system have been provided in **Appendix C.** Insulation for storm pipes located at a depth of less than 1.5m may be required and to be confirmed in detailed design. Ponding areas graded throughout the parking lot will be utilized to provide above-ground storage to a maximum ponding depth of 0.15m. Flows discharging from the underground and above-ground stormwater storage system will be controlled by a 185mm diameter orifice plate within the outlet control manhole located at the northwest corner of the site. Downstream of the orifice, flows will pass through an Oil/Grit Separator (OGS) for quality treatment prior to discharging to the proposed 1800mm x 900mm Minnesota Drain box culvert running through the proposed easement along the west boundary of the Subject Development. Flows will continue north and ultimately outlet to Georgian Bay. The proposed overland flow route conveys stormwater flows from the Subject Development towards Ontario Street. Two small post-development catchments (POST-2 & POST-3) will drain uncontrolled to Ontario Street, however, the flows are accounted for in quantity and not quality as the areas primarily consist of clean water areas (grassed and pedestrian walkways). Catchment POST-1 consists of approximately 80% impervious area and drains primarily via overland flow to a catchbasin. Hydrologic parameter sheets for these internal catchments may be found in **Appendix C.** The post-development drainage areas are summarized in **Table 3.**

Table 3: Post-Development Catchment Areas

Catchment ID	Catchment Area (ha)	Land Use(s)	SCS Curve Number / Percent Impervious
POST-1	0.28	Roadway, Lawn	79 (CN) / 80%
POST-2	0.24	Building, Roadway, Lawn	79 (CN) / 56%
POST-3	0.01	Roadway, Lawn	79 (CN) / 30%

6.3 Quantity Control Analysis

Modified rational method calculations were completed to determine the storage volumes required to contain the 5-year storm event up to the 100-year storm event through a combination of underground storage and parking lot storage. Flow rates have been calculated based on the Owen Sound Intensity-Duration-Frequency (IDF) curve values identified in the Town's engineering standards. The storage requirements for the 5-year to 100-year storm events are summarized below in **Table 4**.

The proposed 450mm diameter superpipes, manholes, and catchbasin structures provide stormwater storage to contain the 5-year to 25-year storm events to provide quantity control. During the 50-year storm-event, water begins to pool above-ground and utilizes the sawtooth grading style of the parking lot to provide additional above-ground storage for events up to the 100-year storm. The site grading has been designed to provide a maximum ponding depth of 0.15m. Internal paved areas will be graded with varying slopes typically ranging from 0.5% - 2% to promote stormwater drainage towards proposed catchbasins throughout the parking area as reflected on **Figure 6**. Once max ponding depth is surpassed, overland drainage above the 100-year event will be safely conveyed towards Ontario Street.

The Collingwood Official Plan Schedule '6' Transportation Plan (2023) identifies Ontario Street as a collector road. The Collingwood design standards requires culverts to be sized to convey the 50-year flow rates across all collector roads. However, it is assumed the proposed culvert designed by Ainley can convey flows up to the 25-year storm event. Therefore, the post-development flow release rate target for the Subject Development was calculated to be 0.12 m^3/s. The release rate target accounts for the uncontrolled catchments (POST-2 & POST-3), which is calculated to have a post-development peak flow of 0.011 m^3/s in the 100-year event. The calculations to determine the uncontrolled peak flow are found in **Appendix C.** The actual release rate is achieved by the use of a 185mm orifice plate which was designed below the target flow from the Site in the 5-year to the 100-year storm events. The target flows and actual outflows are summarized below in **Table 4**.

Table 4: Storage Requirement Summary

Return Period (Years)	Target Flow (m^3/s)	Actual Release Rate (m^3/s)	Storage Required (m^3)	Storage Provided (m^3)
5	0.084*	0.064	25.1	25.9
10	0.097*	0.076	27.5	33.3
25	0.116*	0.087	45.1	51.1
50	0.107**	0.097	63.2	73.6
100	0.105**	0.104	77.5	81.2

* Target Flow bounded by respective pre-development peak flow & uncontrolled peak flow from catchments POST-1 & POST-2
** Target Flow bounded by 25-year pre-development flow due to outlet location & uncontrolled peak flow from POST-1 & POST-2

The proposed storm sewers, superpipes and structures upstream of the control manhole provide a total storage volume of 81.2 m^3. **Table 4** demonstrate the 5-year and up to the 100-year storage requirements can be accommodated onsite through underground and parking lot storage and post-development peak flow rates will not exceed the maximum 25-year pre-development target outflow. Refer to **Appendix C** for the orifice sizing calculations, modified rational calculations and storage volumes provided by each structure and pipe.

6.4 Quality Control Analysis

To provide an enhanced level of protection for water quality control, an Oil/Grit Separator (OGS) unit has been provided. The OGS will be located immediately downstream of the control manhole, in order to ensure all stormwater from the controlled impervious areas of the Subject Development are routed through the treatment unit.

To achieve an "enhanced" treatment level for an oil/grit separator, the unit is required to provide an annual total suspended solids (TSS) removal of 80% or greater and treat 90% of the total annual runoff volume. A Stormceptor EFO4 OGS unit has been selected to treat stormwater and to meet 80% removal based on MECP particle distribution guidance. Catchments POST-2 & POST-3 require no quality control due to the catchments being comprised of clean water areas (grassed, walkways). Refer to **Table 5** below for a detailed breakdown of proposed oil/grit separator performance. Refer to **Appendix D** for OGS water quality treatment unit sizing report and specifications.

Table 5: Oil/Grit Separator Specifications

Drainage Area (ha)	Area Runoff Coefficient	Oil/Grit Separator Unit	Total Suspended Solids Removal	Runoff Volume Capture
0.52	0.7	EFO4	86%	>90%

7.0 FLOOD HAZARD ASSESSMENT

The Subject Development is located entirely within the NVCA regulated area for a tributary of the Pretty River Spill flow conveyance system described as the "Pretty River Spill Zone Number 2" in the Pretty River Flood Hazard Delineation Study (Stantec, 1999). Since the Subject Development is located within the Pretty River Spill Flow #2 regulatory floodplain and the NVCA regulated area, a Flood Hazard Assessment is required by the NVCA to support approvals for the development. The proposed Flood Hazard Assessment will identify the Regulatory Floodplain limit within the site. The hydraulic analysis will be verified using the U.S. Army Corps' HEC-RAS program.

The NVCA completed a floodplain analysis for the Pretty River Spill flows, the results found in **Appendix E**, which identify the existing Regional water surface elevation of 182.09m at the Site. Proposed grading within the site is designed such that the elevation of the First Floor Elevation (FFE) are 0.3m higher than the Regional water surface elevation and a swale to convey the Regional storm event.

7.1 Existing Conditions HEC-RAS Model

A HEC-RAS model was provided by the NVCA for the Pretty River Spill Zone Number 2 under maintained conditions as defined in the Pretty River Flood Hazard Delineation Study (Stantec, 1999). Review of "Map 3" in the Stantec report has determined that the Subject Development is located approximately at Station 518 of Cross-section 2050 within the existing model. The floodplain analysis will be limited to the portion of the Pretty River Spill Channel that is adjacent to the Subject Development.

The Subject Development is located within a two-zone policy area of the Pretty River Spill Flows as defined by the NVCA Planning and Regulation Guidelines. The proposed flood hazard study intends to examine the 100-year design storm and the Regional (Timmins) storm event per the two zone policy requirements. The 1999 Stantec Report identified different spill flow rates for Spill Number 2 based on existing and maintained conditions of the main Pretty River Tributary. The flow of 57.6 m^3/s applied in the HEC-RAS model provided by the NVCA is consistent with the maintained spill flow scenario presented in the Stantec Report. As such, the maintained conditions model for the Pretty River Spill Number 2 and Regional peak flow of 57.6 m^3/s from the Stantec Report provided by the NVCA will be used to define the regulatory floodplain within the Subject Development. It should be noted that both models recognized that no spills would occur under the 100-year design storm and as such, the flood hazard study for the purpose of the Subject Development will only examine the Regional (Timmins) storm event. The existing HEC-RAS model identifies flood elevations within the Subject Development at 182.09 meters above sea level (MASL). Floodproofing measures will be explored within the Subject Development to the flood elevations identified in the HEC-RAS model.

The existing maintained conditions HEC-RAS model does not account for existing culverts within the Subject Development which convey the Pretty River Spill flows downstream of the Subject Development to Cross-Section 2030 of the model. These existing culverts are considered as part of the Town of Collingwood's Minnesota Drain conveyance system which conveys urban drainage to Georgian Bay. The Town is currently preparing storm sewer replacement designs to upgrade the conveyance infrastructure for the Minnesota Drain. The proposed culvert upgrades include a 1.8 m x 0.9 m precast concrete box culvert to be constructed within a drainage easement on the west boundary of the Subject Development.

A topographic survey was prepared for the Subject Development by ZEPT Limited Ontario Land Surveyors in 2024. Review of the topographic survey in comparison to the elevations shown at Stations 511.58 to 543.44 of Cross-section 2050 in the NVCA HEC-RAS model proves that the geodetic data is in general conformance with the topographic survey. Therefore, the datum elevations of the existing model do not require adjustment.

7.2 Proposed Conditions HEC-RAS Model

The existing HEC-RAS model has been recently updated to incorporate the proposed Minnesota drain 1.8 m x 0.9 m concrete box culvert upgrade, as well as the intended grading and floodproofing measures for the Subject Development. This comprehensive update ensures that the model accurately reflects the planned modifications, enabling a thorough analysis of the hydraulic impacts and providing valuable insights into the overall flood risk mitigation strategies implemented for the site.

The proposed floodproofing elevation for the Subject Development has been established at 182.40 MASL within the updated HEC-RAS model to determine the impacts of the proposed grading to the floodplain elevation. Following the analysis which includes the addition of the Minnesota drain culvert upgrades and floodproofing measures into the model, it has been determined that the floodplain elevation is reduced from 182.09 MASL to 182.05 MASL. Despite this reduction, to maintain a conservative approach, the floodproof elevation of 182.40 MASL will be retained within the Subject Development.

Due to the uncertainty surrounding the construction timing for the Minnesota drain, we have proceeded with preparing a model for a sensitivity assessment that excludes the upgrades to the Minnesota drain culvert. Our sensitivity assessment indicates that without the culvert upgrades, the flood elevation increases marginally by 0.01cm from existing conditions, resulting in a new elevation of flood elevation of 182.10 masl (meters above sea level). This finding highlights the importance of considering various scenarios and implementing appropriate flood mitigation measures to ensure the resilience of the site against potential flooding events.

It is noteworthy that the proposed finished floor elevation (FFE) of the building is set above the regulatory floodplain elevation at 182.75m MASL. This strategic decision ensures that the Subject Development can be safely developed, providing effective protection against flood hazards. Furthermore, these measures align with the NVCA natural hazards criteria, confirming the property's compliance with safety standards and regulations.

8.0 EROSION AND SEDIMENT CONTROLS

Sediment and erosion controls will be installed prior to the commencement of any construction activities and will be maintained until the Subject Development is stabilized or as directed by the site Engineer and/or the Town and NVCA. Controls shall be inspected after each significant rainfall event and maintained in proper working condition. A summary of proposed controls to be implemented is included below.

- Silt Fencing

Silt fence will be installed where required to intercept sheet flow. Heavy-duty silt fence will be located around the downstream side of the work zone limits. It should be noted that additional silt fencing may be added based on field decisions by the Site Engineer and Contractor prior to, during and following construction.

- Mud Mat

A mud mat will be installed at the entrance to the construction zone to prevent mud tracking from the Subject Development onto the surrounding lands and perimeter roadway network.

- Dust Suppression

During construction activities, the Contractor will ensure that measures for dust suppression are provided as required.

9.0 UTILITES

The Subject Development is proposed to be serviced with natural gas, telephone, cable TV, and hydro. We understand these utilities are available in the Ontario Street right-of-way adjacent the Subject Development as the existing development is currently fully serviced. Coordination with the utilities will be undertaken during the detailed design phases to confirm utility design capacity and connection locations.

10.0 CONCLUSIONS

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

1. Access to the Subject Development will be provided by an entrance into the parking lot with a connection to Ontario Street.
2. A watermain service will enter the proposed development, with a connection to the 250 mm diameter watermain on Ontario Street and separated at the property line for fire and domestic service lines.
3. The proposed sanitary servicing strategy for the new building involves utilizing the existing 200 mm diameter sanitary service lateral connected to the existing sanitary sewers on Minnesota Street.
4. Preliminary grading has indicated that a majority of the development will drain towards the internal parking lot/storm sewer network and stormwater will be conveyed to the proposed Minnesota Drain within the proposed easement on the west side of the property.
5. An Oil/Grit Separator is proposed to service the Subject Development and is adequate to provide water quality and water quantity control of the urban drainage emanating from the Subject Development.
6. The floodplain analysis which includes the addition of the Minnesota drain culvert upgrades and floodproofing determined that the floodplain elevation is reduced from 182.09 MASL to 182.05 MASL. A floodproof elevation of 182.40 MASL will be retained within the Subject Development and an FFE set at 182.75m MASL. A separate sensitivity assessment has shown that the flood elevation increases to 182.10m MASL when the Minnesota culvert upgrades are not considered. The proposed floodproof elevation is suitable under the conditions of the sensitivity assessment.

Based on the above conclusions, we recommend the approval of the Planning Applications for the 180 Ontario Residential Development, from the perspective of functional servicing and stormwater management. Thank you.

Respectfully submitted,

C.F. CROZIER & ASSOCIATES INC.

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C.F. CROZIER & ASSOCIATES INC.

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APPENDIX A

Sanitary Demand Calculations

Servicing Design Flows

File:	2598-6970
Date:	2024/03/12
By:	R.D.M.
Check By:	J.K.

180 Ontario Street Sanitary Demand

Developed Site Area	0.52	ha
Number of Residential Units and Land Usage		
1) Apartment Residential	**60**	**Units**
Person Per Residential Unit		
1) Apartment Residential (per Collingwood Engineering Standards, 2022)	1.9	persons/unit
Total Residential Population	114	Persons
Unit Sewage flows		
Residential (per Collingwood Engineering Standards, 2022)	260	L/C-day
Infiltration (per Collingwood Engineering Standards, 2022)	0.23	L/s/ha
Total Design Sewage Flows		
Infiltration/Inflow Residential	0.12	L/sec
Average Daily Residential Flow	0.34	L/sec
Average Daily Commercial Flow	-	L/sec
Residential Peak Factor (Harmon Formula)	4.23	
Total Peak Daily Flow	**1.57**	**L/sec**

APPENDIX B

Water Demand Calculations

Water Servicing Design Flows

Fire Flow Calculations

File:	2598-6970
Date:	2024/03/12
By:	R.D.M.
Check By:	J.K.

180 Ontario Street Water Demand

Developed Site Area	0.52	ha
Number of Residential Units and Land Usage		
1) Apartment Residential	**60**	**Units**
2) Commercial	**-**	**ha**
Person Per Residential Unit		
1) Apartment Residential (per Collingwood Engineering Standards, 2022)	1.9	persons/unit
Total Residential Population	114	Persons
Domestic Water Design Flows		
Residential (per Collingwood Engineering Standards, 2022)	260	L/C-day
Total Domestic Water Design Flows		
Average Residential Daily Flow	0.34	L/sec
Max Day Peak Factor (per Collingwood Engineering Standards, 2022)	1.77	
Max Day Demand Flow	**0.61**	L/sec
Peak Hour Factor (per Collingwood Engineering Standards, 2022)	2.70	
Peak Hour Flow	**0.93**	L/sec

CROZIER
CONSULTING ENGINEERS

PROJECT NAME: 180 Ontario St
PROJECT NUMBER: 2598-6970
PREPARED BY: JGB
CHECKED BY: JK
DATE: 2024-03-04

Fire Flow Determination Per Fire Underwriters Survey (2020)

Water Supply for Public Fire Protection - 2020
Fire Underwriters Survey
Part II - Guide for Determination of Fire Flows for Public Fire Protection in Canada

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

RFF = 220 * C * sqrt A

where:

RFF = the required fire flow in litres per minute (L/min)
C = the construction coefficient is related to the type of construction of the building
= 1.5 for Type V Wood Frame Construction
= 0.8 for Type IV-A Mass Timber Construction
= 0.9 for Type IV-B Mass Timber Construction
= 1.0 for Type IV-C Mass Timber Construction
= 1.5 for Type IV-D Mass Timber Construction
= 1.0 for Type III Ordinary Construction
= 0.8 for Type II Non-combustible Construction
= 0.6 for Type I Fire Resistive Construction
A = the total effective floor area (effective building area) in square metres (excluding basements at least 50 percent below grade) in the building considered

STEP A: Construction Coefficient (C) 1 Type III Ordinary Construction Assumed

STEP B: Total Effective Floor Area
Proposed Building Mid-rise residential apartment building per Site Plan (Cusimano Architect, August 2023)

	Yes/No/Unknown	
Is basement at least 50% below grade?	No	If yes, basement floor area excluded
Vertical openings protected?	No	*For consideration for effective area calculations

Calculate Effective Floor Area based on the highlighted cell
-C value from 1.0 to 1.5: 100% of all floor areas are used
-C value below 1 and vertical openings are not protected: Consider two largest floors plus 50% of all floor above to a max of eight
-C value below 1 and vertical openings are protected: Consider single largest floor plus 25% of the two immediately adjoining floors

*A building may be subdivided if there is a vertical firewall with a fire-resistance rating greater than 2 hours, and meets the requirements of the National Building Code.

Floors Above Grade	Total Floor Area (m^2)	% of Area Considered	Effective Floor Area (m^2)
Basement	0	0%	0.0
Ground Floor	1350	100%	1350.0
Level 2	1350	100%	1350.0
Level 3	1350	100%	1350.0
Level 4	1350	100%	1350.0
Total	**5400**		**5400.0**

Total Effective Floor Area **5400** m^2

STEP C: **Therefore RFF =** **16,000** **L/min (rounded to nearest 1000 L/min)**

STEP D: Occupancy Contents Adjustment Factor

The required fire flow may be reduced by as much as -25% for occupancies having contents with very low fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Occupancy and Contents Adjustment Factor	
Non-Combustible	-25%
Limited Combustible	-15%
Combustible	0%
Free Burning	15%
Rapid Burning	25%

*Refer to Table 3 for recommended Occupancy and Contents Charges by major occupancy examples.

Type of Occupancy	**Adjustment Factor**	
Residential Occupancy	Rapid Burning	25%

Total Reduction % **4,000** **L/min surcharge**

RFF = **20,000** **L/min (not rounded)**

Note: The RFF flow 20000 L/min is used in Step E and F.

CROZIER CONSULTING ENGINEERS

PROJECT NAME:	180 Ontario St
PROJECT NUMBER:	2598-6970
PREPARED BY:	JGB
CHECKED BY:	JK
DATE:	2024-03-04

Fire Flow Determination Per Fire Underwriters Survey (2020)

STEP E: Automatic Sprinkler Protection

Sprinklers - The required fire flow may be reduced by up to 50% for complete automatic sprinkler protection depending upon adequacy of system.

	Yes/No/Unknown	*Possible Reduction Available	Actual Reduction Provided
Automatic sprinkler protection designed and installed in accordance with NFPA 13?	Yes	-30%	-30%
Water supply is standard for both the system and Fire Department hose lines?	Unknown	-10%	0%
Fully supervised system?	No	-10%	0%

*Reduction available assumes complete building coverage
*30% reduction typical for building requiring sprinkler system

Total Reduction % -30% **(reduction)**

Total Reduced Flow -6,000 **L/min (reduction, not rounded)**

STEP F: Exposure Adjustment Charge

Exposure - A percentage of water for the exposures should be added to the required fire flow for the subject building to provide adequate flow rates for hose streams used to reduce the spreading of fire from the subject building to exposed risks. The required fire flow of a subject building may be increased depending on the severity of exposed risks to the subject building and the distance between the exposed risks and the subject building. This charge considers the usage of water supplies to prevent exposed risks from igniting or being damaged during a major fire incident in the subject building.

Separation Distance	Maximum Exposure Adjustment Charge
0 to 3m	25%
3.1 to 10m	20%
10.1 to 20m	15%
20.1 to 30m	10%
Greater than 30m	0%

*If a vertical fire wall is properly constructed and has a rating of no less than 2 hours, then the boundary can be treated as protected with no exposure charge
*The maximum exposure adjustment charge to be applied to a subject building is 75%
*The distance in metres from the subject building facing wall to the exposed building facing wall, measured to the nearest metre, between the nearest points of the buildings. Where either the subject building or the exposed building is at a diagonal to the other building, the shortest distance should be increased by 3 metres and this adjusted value used as exposure distance.

Exposed buildings		Distance	Surcharge Factor	Surcharge (L/min)
North	Adjacent Dwelling	N/A	0%	0
East	Adjacent Dwelling	N/A	0%	0
South	Adjacent Dwelling	N/A	0%	0
West	Adjacent Dwelling	N/A	0%	0

Total Reduced Flow 0 **L/min Surcharge (not rounded)**

STEP G: Final Required Fire Flow

Step D - Occupancy Adjusted Fire Flow Demand	20,000	L/min
Step E - Sprinkler (Reduction)	-6,000	L/min
Step F - Exposure Charge	0	L/min
Final Fire Flow:	**14,000**	**L/min**
	14,000	**L/min (rounded to nearest 1000L/min)**
or	**233**	**L/s**
or	**3,698**	**USGPM**
Required duration:	**2.00**	**hours**

Refer to Table 1 for Duration

Table 1 - FUS 2020

Required Duration of Fire Flow	
Flow Required (L/min)	**Duration (hours)**
2,000 or less	1.00
3,000	1.25
4,000	1.50
5,000	1.75
6,000	2.00
8,000	2.00
10,000	2.00
12,000	2.50
14,000	3.00
16,000	3.50
18,000	4.00
20,000	4.50
22,000	5.00
24,000	5.50
26,000	6.00
28,000	6.50
30,000	7.00
32,000	7.50
34,000	8.00
36,000	8.50
38,000	9.00
40,000 and over	9.50

Interpolate for intermediate figures

APPENDIX C

Hydrologic Calculations

Pre-Development Hydrologic Parameters

Post-Development Hydrologic Parameters

Uncontrolled Catchments Rational Method

Modified Rational Method for Storage

Superpipe Storage Calculations

Stage-Storage-Discharge Table – Conveyance System

CROZIER
CONSULTING ENGINEERS

Project Name:	180 Ontario Street	**D.A. NAME**	**PRE-1**
Project No.:	2598-6970	**D.A. AREA (ha)**	**0.19**
Date:	2024.03.13		
By:	JGB		

Hydrologic Parameters: CALIB STANDHYD Command
Pre Development Drainage Area: Catchment PRE-1

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic	% Area	Area
Kemble Clay Loam	KCL	C	100%	0.19
				0
				0
				0
Total Area Check			1.0	0.19

Impervious Landuses Present:

	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
KCL	0.00	98	0.00	98	0.14	98	0.001	98		98	0.14	13.97
0		98		98		98		98		98	0.00	0.00
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0.00		0.00		0.14		0.00		0			

Pervious Landuses Present:

	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
KCL	0				0		0.05	79	0		0.05	3.75
0	0		0		0		0		0		0	0
0	0		0		0		0		0		0	0
0	0		0		0		0		0		0	0
Subtotal Area	0		0		0		0.05		0			

Pervious Area Calculations	Total Pervious Area	0.05
	Composite Pervious Curve Number	79
	Composite Initial Abstraction	5.00
Impervious Area Calculations	Total Directly Connected Area	0.14
	Total Indirectly Connected Area	0.00
	Total Impervious Area	0.14
	% X imp	74.7
	% T imp	75.0
	Total Area Check	0.19

Initial Abstraction and Tp Calculations

Landuse	IA (mm)	Area (ha)	A * IA
Woodland	10	0	0
Meadow	8	0	0
Wetland	16	0	0
Lawn	5	0.05	0.24
Cultivated	7	0	0

Land Use	IA (mm)	Slope (%)	Travel Length (m)	Manning's n
Pervious	5.0	0.564	43	0.025
Impervious	2.0	0.564	36	0.013

CROZIER CONSULTING ENGINEERS

Project Name:	180 Ontario Street	**D.A. NAME**	**PRE-2**
Project No.:	2598-6970	**D.A. AREA (ha)**	**0.22**
Date:	2024.03.13		
By:	JGB		

Hydrologic Parameters: CALIB STANDHYD Command
Pre Development Drainage Area: Catchment PRE-2

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic	% Area	Area
Kemble Clay Loam	KCL	C	100%	0.22
				0
				0
				0
Total Area Check			1.0	0.22

Impervious Landuses Present:

	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
KCL	0.00	98	0.00	98	0.07	98	0.07	98		98	0.14	13.33
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0.00		0.00		0.07		0.07		0			

Pervious Landuses Present:

	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
KCL	0				0		0.08	79	0		0.08	6.64
0	0		0		0		0		0		0	0
0	0		0		0		0		0		0	0
0	0		0		0		0		0		0	0
Subtotal Area	0		0		0		0.08		0			

Pervious Area Calculations	Total Pervious Area	0.08
	Composite Pervious Curve Number	79
	Composite Initial Abstraction	5.00
Impervious Area Calculations	Total Directly Connected Area	0.07
	Total Indirectly Connected Area	0.07
	Total Impervious Area	0.14
	% X imp	30.0
	% T imp	61.8
	Total Area Check	0.22

Initial Abstraction and Tp Calculations

Landuse	IA (mm)	Area (ha)	A * IA
Woodland	10	0	0
Meadow	8	0	0
Wetland	16	0	0
Lawn	5	0.08	0.42
Cultivated	7	0	0

Land Use	IA (mm)	Slope (%)	Travel Length (m)	Manning's n
Pervious	5.0	0.54	123	0.025
Impervious	2.0	0.54	38	0.013

CROZIER CONSULTING ENGINEERS

Project Name:	180 Ontario Street	D.A. NAME	PRE-3
Project No.:	2598-6970	D.A. AREA (ha)	0.11
Date:	2024.03.13		
By:	JGB		

Hydrologic Parameters: CALIB NASHYD Command
Pre Development Drainage Area: Catchment PRE-3

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic	% Area	Area (ha)
Kemble Clay Loam	KCL	C	100%	0.11
Total Area			100%	0.11

Impervious Landuses Present:

Soils	Roadway Area	Roadway CN	Sidewalk Area	Sidewalk CN	Driveway Area	Driveway CN	Building Area (ha)	Building CN	SWMF Area	SWMF CN	Subtotals Area	Subtotals A*CN
KCL		98		98		98	0.00	98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal	0		0		0		0		0			

Pervious Landuses Present:

Soils	Woodland Area	Woodland CN	Meadow Area	Meadow CN	Wetland Area	Wetland CN	Lawn Area (ha)	Lawn CN	Cultivated Area	Cultivated CN	Subtotals Area	Subtotals A*CN
KCL	0.00		0.00		0.00		0.11	79	0.00		0.11	8.69
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
0	0.00		0.00		0.00		0.00		0.00		0.00	0.00
Subtotal	0.00		0.00		0.00		0.11		0.00			

Composite Area Calculations		
	Total Pervious Area	0.11
	Total Impervious Area	0
	% Impervious	0.00%
	Composite Curve Number	79.0
	Total Area Check	0.11

Initial Abstraction and Tp Calculations

Landuse	IA (mm)	Area (ha)	A * IA	Kemble Clay RC	Kemble Clay Area	0 RC	0 Area	0 RC	0 Area	0 RC	0 Area	A*RC
Woodland	10	0.00	0.00		0.00		0		0		0	0
Meadow	8	0.00	0.00	0.40	0.00		0.00		0		0	0.00
Wetland	16	0.00	0.00		0.00		0		0		0	0
Lawn	5	0.11	0.55	0.13	0.11		0		0		0	0.0143
Cultivated	7	0.00	0.00		0.00		0		0		0	0
Impervious	2	0.00	0.00	0.95	0.00		0		0		0	0
Composite		0.11	5.0	Composite Runoff Coefficient								0.13

Flow Path Description	Length (m)	Drop (m)	Slope (%)	$V/S^{0.5}$	Velocity (m/s)	Uplands Tc (hr)	Uplands Tp(hr)	TOTAL Tp (hr)	Bransby Williams Tc (hr)	Bransby Williams Tp(hr)	Airport Tc (hr)	Airport Tp(hr)
Overland	70.38	0.6	0.85%	2.7	0.25	0.08	0.05	0.05	0.09	0.06	0.47	0.31

Appropriate calculated time to	0.31	Appropriate Method:	Airport

\\Crozier-Files\Projects\2500\2598 - 2374515 Ontario Corporation\6970 - 180 Ontario Street\Design\Civil_Water\SWM\Hydroparameter Sheets\2024.02.13\2024.03.15_Hydrologic Parameter Sheet

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Project Name:	180 Ontario St
Project No.:	2598-6970
Date:	2024.03.13
By:	JGB

D.A. NAME	**POST-1**
D.A. AREA (ha)	**0.41**

Hydrologic Parameters: CALIB STANDHYD Command
Post Development Drainage Area: Catchment POST-1

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic	% Area	Area
Kemble Clay Loam	KCL	C	100%	0.41
				0
				0
				0
Total Area Check			1.0	0.41

Impervious Landuses Present:

	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
KCL	0.20	98	0.03	98		98	0.14	98		98	0.37	36.23
0		98		98		98		98		98	0.00	0.00
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0.20		0.03		0.00		0.14		0			

Pervious Landuses Present:

	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
KCL	0	73		76	0		0.04	79	0		0.04	3.18
0	0		0		0		0		0		0.00	0.00
0	0		0		0		0		0		0	0
0	0		0		0		0		0		0	0
Subtotal Area	0		0		0		0.04		0			

Pervious Area Calculations	Total Pervious Area	0.04
	Composite Pervious Curve Number	79
	Composite Initial Abstraction	5.00
Impervious Area Calculations	Total Directly Connected Area	0.23
	Total Indirectly Connected Area	0.14
	Total Impervious Area	0.37
	% X imp	57.2
	% T imp	90.2
	Total Area Check	0.41

Initial Abstraction and Tp Calculations

Landuse	IA (mm)	Area (ha)	A * IA
Woodland	10	0	0
Meadow	8	0	0
Wetland	16	0	0
Lawn	5	0.04	0.20
Cultivated	7	0	0

Land Use	IA (mm)	Slope (%)	Travel Length (m)	Manning's n
Pervious	5.0	2	20	0.025
Impervious	2.0	0.50	52	0.013

CROZIER CONSULTING ENGINEERS

Project Name:	180 Ontario Street	D.A. NAME	POST-2
Project No.:	2598-6970	D.A. AREA (ha)	0.11
Date:	2024.03.13		
By:	JGB		

Hydrologic Parameters: CALIB STANDHYD Command
Post Development Drainage Area: Catchment POST-2

Curve Number Calculation

Soil Types Present:				
Type	ID	Hydrologic	% Area	Area
Kemble Clay Loam	KCL	C	100%	0.11
				0
				0
				0
Total Area Check			1.0	0.11

Impervious Landuses Present:	Roadway		Sidewalk		Driveway		Building		SWMF		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
KCL	0.00	98	0.00	98	0	98	0.00	98		98	0.00	0.10
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
0		98		98		98		98		98	0	0
Subtotal Area	0.00		0.00		0.00		0.00		0			

Pervious Landuses Present:	Woodland		Meadow		Wetland		Lawn		Cultivated		Subtotals	
Soils	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area (ha)	CN	Area	A*CN
KCL	0				0		0.11	79	0		0.11	8.61
0	0		0		0		0		0		0	0
0	0		0		0		0		0		0	0
0	0		0		0		0		0		0	0
Subtotal Area	0		0		0		0.11		0			

Pervious Area Calculations	Total Pervious Area	0.11
	Composite Pervious Curve Number	79
	Composite Initial Abstraction	5.00
Impervious Area Calculations	Total Directly Connected Area	0.00
	Total Indirectly Connected Area	0.00
	Total Impervious Area	0.00
	% X imp	0.9
	% T imp	0.9
	Total Area Check	0.11

Initial Abstraction and Tp Calculations

Landuse	IA (mm)	Area (ha)	A * IA
Woodland	10	0	0
Meadow	8	0	0
Wetland	16	0	0
Lawn	5	0.11	0.55
Cultivated	7	0	0

Land Use	IA (mm)	Slope (%)	Travel Length (m)	Manning's n
Pervious	5.0	0.54	113	0.025
Impervious	2.0	0.54	27	0.013

CROZIER
CONSULTING ENGINEERS

PROJECT: 180 Ontario St
PROJECT No.: 2598-6970
FILE: Rational Method - Peak Flow
DATE: 2024.03.14
DESIGN: JGB

Rational Method for Collingwood Street

Rational Method Q=0.0028*C*i*A (cms)
Intensity i=A/ (Tc+b)^c (mm/hr)

Frequency -	Owen Sound IDF		
Storm Return	Coef. A	Coef. B	Coef. C
5	1135.4	7.5	0.841
10	1387	7.97	0.852
25	1676.2	8.3	0.858
50	1973.1	9	0.868
100	2193.1	9.04	0.871

Post-Development Uncontrolled Peak Flows

Storm Return	Area (ha)	Runoff Coef. - C	Time of Concentration - Tc	Intensity - i	Peak Flow - Q
5	0.11	0.17	10.0	102.27	0.0053
10	0.11	0.17	10.0	118.36	0.0061
25	0.11	0.19	10.0	138.40	0.0079
50	0.11	0.20	10.0	153.18	0.0095
100	0.11	0.21	10.0	168.45	0.0109

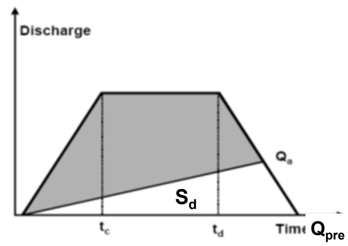
PROJECT: 180 Ontario
PROJECT No.: 2598-6970
DATE: 2024.03.14
DESIGN: JGB
CHECK:

Modified Rational Method Storage Sizing - Theoretical

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

Intensity
$i_{(T_d)} = A^*(T+b)$ ^c

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



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	102.27
Return Period	5 yr		
Time of Concentration (min)	10		
Coeff A	1135.4		
Coeff B	7.5		
Coeff C	0.841		
Runoff Coeff (Unadjusted)	0.60	Flow (m^3/s)	0.089
Runoff Coefficient (Adjusted)	0.60		
Area (ha)	0.52		

Post-Development Scenario Data (Controlled)			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	102.27
Return Period	5 yr		
Time of Concentration (min)	10		
Coeff A	1135.4		
Coeff B	7.5		
Coeff C	0.841		
Runoff Coeff (unadjusted)	0.67	Flow (m^3/s)	0.100
Runoff Coefficient (Adjusted)	0.67		
Area (ha)	0.52		

Target Flow (m^3/s)*	0.084

REQUIRED STORAGE VOLUME:	**10.6**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
0	208.56	0	0.205	-25.2
1	187.72	60	0.184	-16.7
2	170.96	120	0.168	-10.1
3	157.16	180	0.154	-5.0
4	145.58	240	0.143	-1.0
5	135.72	300	0.133	2.2
6	127.21	360	0.125	4.6
7	119.79	420	0.118	6.6
8	113.26	480	0.111	8.0
9	107.46	540	0.106	9.1
10	102.27	600	0.100	9.8
11	97.60	660	0.096	10.3
12	93.37	720	0.092	10.6
13	89.53	780	0.088	10.6
15	82.79	900	0.081	10.1

*Target Flow accounts for uncontrolled peak flow

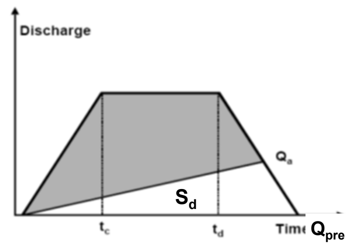
PROJECT: 180 Ontario
PROJECT No.: 2598-6970
DATE: 2024.03.14
DESIGN: JGB
CHECK:

Modified Rational Method Storage Sizing - Actual with Control Structure

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

Intensity
$i_{(T_d)} = A*(T+b)\ \hat{}\ c$

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



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	102.27
Return Period	5 yr		
Time of Concentration (min)	10		
Coeff A	1135.4		
Coeff B	7.5		
Coeff C	0.841		
Runoff Coeff (Unadjusted)	0.60	Flow (m^3/s)	0.089
Runoff Coefficient (Adjusted)	0.60		
Area (ha)	0.52		

Post-Development Scenario Data (Controlled)			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	102.27
Return Period	5 yr		
Time of Concentration (min)	10		
Coeff A	1135.4		
Coeff B	7.5		
Coeff C	0.841		
Runoff Coeff (unadjusted)	0.67	Flow (m^3/s)	0.100
Runoff Coefficient (Adjusted)	0.67		
Area (ha)	0.52		

Release Rate (m^3/s)*	0.064
REQUIRED STORAGE VOLUME:	**25.1**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
0	208.56	0	0.205	-19.2
1	187.72	60	0.184	-10.1
2	170.96	120	0.168	-2.9
3	157.16	180	0.154	2.8
4	145.58	240	0.143	7.4
5	135.72	300	0.133	11.1
6	127.21	360	0.125	14.2
7	119.79	420	0.118	16.7
8	113.26	480	0.111	18.8
9	107.46	540	0.106	20.5
10	102.27	600	0.100	21.8
11	97.60	660	0.096	22.9
12	93.37	720	0.092	23.7
13	89.53	780	0.088	24.4
15	82.79	900	0.081	25.1

*Release Rate accounts for uncontrolled peak flow

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PROJECT: 180 Ontario
PROJECT No.: 2598-6970
DATE: 2024.03.14
DESIGN: JGB
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Modified Rational Method Storage Sizing - Theoretical

Peak Flow

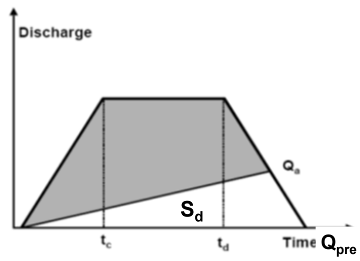
$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(T_d)} \cdot A$

Intensity

$i_{(T_d)} = A / (T+B)$ ^c

Storage

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



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	118.36
Return Period	10 yr		
Time of Concentration (min)	10		
Coeff A	1387		
Coeff B	7.97		
Coeff C	0.852		
Runoff Coeff (Unadjusted)	0.60	Flow (m^3/s)	0.103
Runoff Coefficient (Adjusted)	0.60		
Area (ha)	0.52		

Post-Development Scenario Data (Controlled)			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	118.36
Return Period	10 yr		
Time of Concentration (min)	10		
Coeff A	1387		
Coeff B	7.97		
Coeff C	0.852		
Runoff Coeff (unadjusted)	0.67	Flow (m^3/s)	0.116
Runoff Coefficient (Adjusted)	0.67		
Area (ha)	0.52		

Target Flow (m^3/s)*	0.097
REQUIRED STORAGE VOLUME:	**12.4**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
0	236.61	0	0.232	-29.2
1	213.94	60	0.210	-19.5
2	195.52	120	0.192	-12.0
3	180.23	180	0.177	-6.1
4	167.32	240	0.164	-1.4
5	156.26	300	0.153	2.3
6	146.68	360	0.144	5.2
7	138.29	420	0.136	7.4
8	130.88	480	0.129	9.2
9	124.28	540	0.122	10.5
10	118.36	600	0.116	11.4
11	113.02	660	0.111	12.0
12	108.18	720	0.106	12.3
13	103.77	780	0.102	12.4
15	96.02	900	0.094	11.9

*Target Flow accounts for uncontrolled peak flow

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PROJECT No.: 2598-6970
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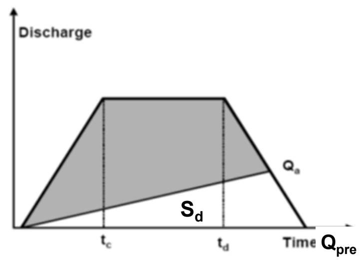
Modified Rational Method Storage Sizing - Actual with Control Structure

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

Intensity
$i_{(T_d)} = A / (T+B)$ ^c

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



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	118.36
Return Period	10 yr		
Time of Concentration (min)	10		
Coeff A	1387		
Coeff B	7.97		
Coeff C	0.852		
Runoff Coeff (Unadjusted)	0.60	Flow (m^3/s)	0.103
Runoff Coefficient (Adjusted)	0.60		
Area (ha)	0.52		

Post-Development Scenario Data (Controlled)			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	118.36
Return Period	10 yr		
Time of Concentration (min)	10		
Coeff A	1387		
Coeff B	7.97		
Coeff C	0.852		
Runoff Coeff (unadjusted)	0.67	Flow (m^3/s)	0.116
Runoff Coefficient (Adjusted)	0.67		
Area (ha)	0.52		

Release Rate (m^3/s)*	0.076

REQUIRED STORAGE VOLUME:	**27.5**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
0	236.61	0	0.232	-22.9
1	213.94	60	0.210	-12.6
2	195.52	120	0.192	-4.5
3	180.23	180	0.177	2.0
4	167.32	240	0.164	7.3
5	156.26	300	0.153	11.6
6	146.68	360	0.144	15.1
7	138.29	420	0.136	18.0
8	130.88	480	0.129	20.4
9	124.28	540	0.122	22.3
10	118.36	600	0.116	23.9
11	113.02	660	0.111	25.1
12	108.18	720	0.106	26.0
13	103.77	780	0.102	26.7
15	96.02	900	0.094	27.5

*Release Rate accounts for uncontrolled peak flow

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PROJECT: 180 Ontario
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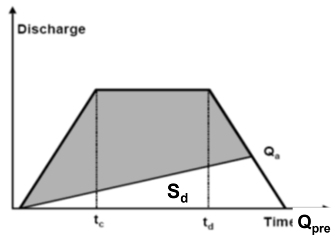
Modified Rational Method Storage Sizing - Theoretical

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

Intensity
$i_{(Td)} = A / (T+B)$ ^c

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



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	138.40
Return Period	25 yr		
Time of Concentration (min)	10		
Coeff A	1676.2		
Coeff B	8.3		
Coeff C	0.858		
Runoff Coeff (Unadjusted)	0.56	Flow (m^3/s)	0.124
Runoff Coefficient (Adjusted)	0.62		
Area (ha)	0.52		

Post-Development Scenario Data (Controlled)			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	138.40
Return Period	25 yr		
Time of Concentration (min)	10		
Coeff A	1676.2		
Coeff B	8.3		
Coeff C	0.858		
Runoff Coeff (unadjusted)	0.67	Flow (m^3/s)	0.150
Runoff Coefficient (Adjusted)	0.74		
Area (ha)	0.52		

Target Flow (m^3/s)*	0.116
REQUIRED STORAGE VOLUME:	**22.2**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
0	272.75	0	0.295	-34.9
1	247.38	60	0.267	-22.4
2	226.63	120	0.245	-12.5
3	209.31	180	0.226	-4.7
4	194.62	240	0.210	1.6
5	182.00	300	0.197	6.6
6	171.02	360	0.185	10.7
7	161.38	420	0.174	13.9
8	152.85	480	0.165	16.4
9	145.24	540	0.157	18.4
10	138.40	600	0.150	19.9
11	132.23	660	0.143	21.0
12	126.62	720	0.137	21.7
13	121.50	780	0.131	22.1
14	116.81	840	0.126	22.2
15	112.50	900	0.122	22.1
16	108.51	960	0.117	21.8
17	104.82	1020	0.113	21.3
18	101.39	1080	0.110	20.6
19	98.20	1140	0.106	19.7
20	95.21	1200	0.103	18.7

*Target Flow accounts for uncontrolled peak flow

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PROJECT: 180 Ontario
PROJECT No.: 2598-6970
DATE: 2024.03.14
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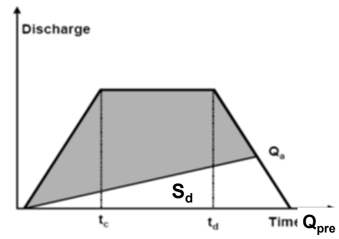
Modified Rational Method Storage Sizing - Actual with Control Structure

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

Intensity
$i_{(T_d)} = A/(T+B)^{\wedge}c$

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



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	138.40
Return Period	25 yr		
Time of Concentration (min)	10		
Coeff A	1676.2		
Coeff B	8.3		
Coeff C	0.858		
Runoff Coeff (Unadjusted)	0.56	Flow (m^3/s)	0.124
Runoff Coefficient (Adjusted)	0.62		
Area (ha)	0.52		

Post-Development Scenario Data (Controlled)			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	138.40
Return Period	25 yr		
Time of Concentration (min)	10		
Coeff A	1676.2		
Coeff B	8.3		
Coeff C	0.858		
Runoff Coeff (unadjusted)	0.67	Flow (m^3/s)	0.150
Runoff Coefficient (Adjusted)	0.74		
Area (ha)	0.52		

Release Rate (m^3/s)*	0.087

REQUIRED STORAGE VOLUME:	**45.1**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
0	272.75	0	0.295	-26.1
1	247.38	60	0.267	-12.7
2	226.63	120	0.245	-2.0
3	209.31	180	0.226	6.7
4	194.62	240	0.210	13.9
5	182.00	300	0.197	19.8
6	171.02	360	0.185	24.7
7	161.38	420	0.174	28.8
8	152.85	480	0.165	32.2
9	145.24	540	0.157	35.1
10	138.40	600	0.150	37.4
11	132.23	660	0.143	39.4
12	126.62	720	0.137	41.0
13	121.50	780	0.131	42.3
14	116.81	840	0.126	43.3
15	112.50	900	0.122	44.0
16	108.51	960	0.117	44.6
17	104.82	1020	0.113	44.9
18	101.39	1080	0.110	45.1
19	98.20	1140	0.106	45.1
20	95.21	1200	0.103	45.0

*Release Rate accounts for uncontrolled peak flow

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PROJECT: 180 Ontario St
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DESIGN: JGB
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Modified Rational Method Storage Sizing - Theoretical

Peak Flow

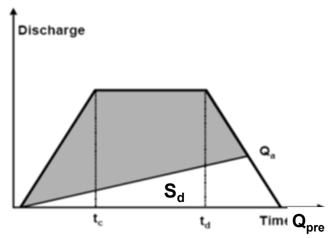
$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(T_d)} \cdot A$

Intensity

$i_{(T_d)} = A / (T+B)$ ^c

Storage

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



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	153.18
Return Period	50 yr		
Time of Concentration (min)	10		
Coeff A	1973.1		
Coeff B	9		
Coeff C	0.868		
Runoff Coeff (Unadjusted)	0.56	Flow (m^3/s)	0.150
Runoff Coefficient (Adjusted)	0.67		
Area (ha)	0.52		

Post-Development Scenario Data (Controlled)			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	153.18
Return Period	50 yr		
Time of Concentration (min)	10		
Coeff A	1973.1		
Coeff B	9		
Coeff C	0.868		
Runoff Coeff (unadjusted)	0.67	Flow (m^3/s)	0.181
Runoff Coefficient (Adjusted)	0.81		
Area (ha)	0.52		

Target Flow (m^3/s)*	0.107
REQUIRED STORAGE VOLUME:	**54.1**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	m^3/s	m^3
0	293.00	0	0.345	-32.0
1	267.39	60	0.315	-16.3
2	246.16	120	0.290	-3.6
3	228.25	180	0.269	6.8
4	212.93	240	0.251	15.4
5	199.67	300	0.235	22.5
6	188.06	360	0.222	28.5
7	177.82	420	0.210	33.5
8	168.70	480	0.199	37.8
9	160.54	540	0.189	41.3
10	153.18	600	0.181	44.2
11	146.51	660	0.173	46.7
12	140.43	720	0.165	48.7
13	134.87	780	0.159	50.3
14	129.77	840	0.153	51.6
15	125.06	900	0.147	52.5
16	120.71	960	0.142	53.3
17	116.67	1020	0.137	53.7
18	112.91	1080	0.133	54.0
19	109.40	1140	0.129	54.1
20	106.12	1200	0.125	53.9
21	103.04	1260	0.121	53.7

*Target Flow accounts for uncontrolled peak flow

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PROJECT: 180 Ontario St
PROJECT No.: 2598-6970
DATE: 2024.03.14
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Modified Rational Method Storage Sizing - Actual with Control Structure

Peak Flow

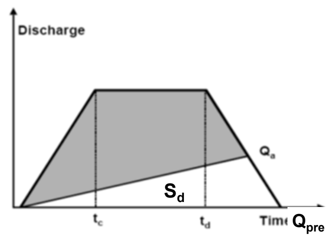
$Q_{post} = 0.0028 \cdot C_{post} \cdot i_{(T_d)} \cdot A$

Intensity

$i_{(T_d)} = A / (T+B) \wedge c$

Storage

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



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	153.18
Return Period	50 yr		
Time of Concentration (min)	10		
Coeff A	1973.1		
Coeff B	9		
Coeff C	0.868		
Runoff Coeff (Unadjusted)	0.56	Flow (m^3/s)	0.150
Runoff Coefficient (Adjusted)	0.67		
Area (ha)	0.52		

Post-Development Scenario Data (Controlled)			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	153.18
Return Period	50 yr		
Time of Concentration (min)	10		
Coeff A	1973.1		
Coeff B	9		
Coeff C	0.868		
Runoff Coeff (unadjusted)	0.67	Flow (m^3/s)	0.181
Runoff Coefficient (Adjusted)	0.81		
Area (ha)	0.52		

Release Rate (m^3/s)*	0.097

REQUIRED STORAGE VOLUME:	**63.2**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
0	293.00	0	0.345	-29.0
1	267.39	60	0.315	-13.0
2	246.16	120	0.290	0.0
3	228.25	180	0.269	10.7
4	212.93	240	0.251	19.6
5	199.67	300	0.235	27.1
6	188.06	360	0.222	33.4
7	177.82	420	0.210	38.7
8	168.70	480	0.199	43.3
9	160.54	540	0.189	47.1
10	153.18	600	0.181	50.3
11	146.51	660	0.173	53.1
12	140.43	720	0.165	55.4
13	134.87	780	0.159	57.3
14	129.77	840	0.153	58.9
15	125.06	900	0.147	60.2
16	120.71	960	0.142	61.2
17	116.67	1020	0.137	62.0
18	112.91	1080	0.133	62.6
19	109.40	1140	0.129	62.9
20	106.12	1200	0.125	63.1
21	103.04	1260	0.121	63.2

*Release Rate accounts for uncontrolled peak flow

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PROJECT: 180 Ontario
PROJECT No.: 2598-6970
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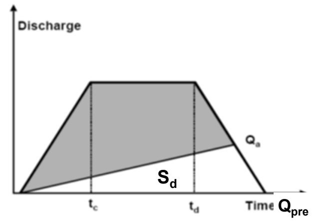
Modified Rational Method Storage Sizing - Theoretical

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

Intensity
$i_{(T_d)} = A / (T+B)$ ^c

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



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	168.45
Return Period	100 yr		
Time of Concentration (min)	10		
Coeff A	2193.1		
Coeff B	9.04		
Coeff C	0.871		
Runoff Coeff (Unadjusted)	0.56	Flow (m^3/s)	0.172
Runoff Coefficient (Adjusted)	0.70		
Area (ha)	0.52		

Post-Development Scenario Data (Controlled)			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	168.45
Return Period	100 yr		
Time of Concentration (min)	10		
Coeff A	2193.1		
Coeff B	9.04		
Coeff C	0.871		
Runoff Coeff (unadjusted)	0.67	Flow (m^3/s)	0.207
Runoff Coefficient (Adjusted)	0.84		
Area (ha)	0.52		

Target Flow (m^3/s)*	0.105

REQUIRED STORAGE VOLUME:	**77.1**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
0	322.28	0	0.396	-31.6
1	294.14	60	0.361	-13.1
2	270.79	120	0.332	1.9
3	251.09	180	0.308	14.4
4	234.23	240	0.288	24.7
5	219.64	300	0.270	33.5
6	206.86	360	0.254	40.8
7	195.58	420	0.240	47.1
8	185.54	480	0.228	52.4
9	176.55	540	0.217	57.0
10	168.45	600	0.207	60.8
11	161.10	660	0.198	64.1
12	154.41	720	0.190	66.9
13	148.29	780	0.182	69.3
14	142.67	840	0.175	71.2
15	137.49	900	0.169	72.8
16	132.69	960	0.163	74.2
17	128.24	1020	0.157	75.2
18	124.10	1080	0.152	76.0
19	120.24	1140	0.148	76.6
20	116.62	1200	0.143	76.9
21	113.24	1260	0.139	77.1
22	110.05	1320	0.135	77.1
23	107.05	1380	0.131	77.0
24	104.23	1440	0.128	76.7
25	101.55	1500	0.125	76.3

*Target Flow accounts for uncontrolled peak flow

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PROJECT: 180 Ontario
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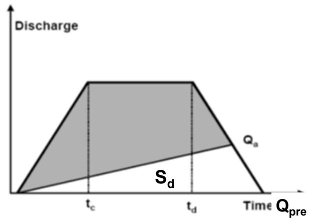
Modified Rational Method Storage Sizing - Actual with Control Structure

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

Intensity
$i_{(T_d)} = A / (T+B)$ ^c

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



Pre-Development Scenario Data			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	168.45
Return Period	100 yr		
Time of Concentration (min)	10		
Coeff A	2193.1		
Coeff B	9.04		
Coeff C	0.871		
Runoff Coeff (Unadjusted)	0.55	Flow (m^3/s)	0.167
Runoff Coefficient (Adjusted)	0.69		
Area (ha)	0.51		

Post-Development Scenario Data (Controlled)			
Inputs		**Outputs**	
IDF Location	Owen Sound	Intensity (mm/hr):	168.45
Return Period	100 yr		
Time of Concentration (min)	10		
Coeff A	2193.1		
Coeff B	9.04		
Coeff C	0.871		
Runoff Coeff (unadjusted)	0.68	Flow (m^3/s)	0.205
Runoff Coefficient (Adjusted)	0.85		
Area (ha)	0.51		

Release Rate (m^3/s)*	0.104

REQUIRED STORAGE VOLUME:	**77.5**

Storage Volume Determination (Detailed)				
T_d	i	T_d	Q_{Uncont}	S_d
min	*mm/hr*	*sec*	*m^3/s*	*m^3*
0	322.28	0	0.393	-31.1
1	294.14	60	0.358	-12.7
2	270.79	120	0.330	2.3
3	251.09	180	0.306	14.7
4	234.23	240	0.285	25.0
5	219.64	300	0.268	33.7
6	206.86	360	0.252	41.0
7	195.58	420	0.238	47.3
8	185.54	480	0.226	52.6
9	176.55	540	0.215	57.1
10	168.45	600	0.205	61.0
11	161.10	660	0.196	64.3
12	154.41	720	0.188	67.1
13	148.29	780	0.181	69.5
14	142.67	840	0.174	71.4
15	137.49	900	0.168	73.1
16	132.69	960	0.162	74.4
17	128.24	1020	0.156	75.5
18	124.10	1080	0.151	76.3
19	120.24	1140	0.146	76.9
20	116.62	1200	0.142	77.3
21	113.24	1260	0.138	77.5
22	110.05	1320	0.134	77.5
23	107.05	1380	0.130	77.4
24	104.23	1440	0.127	77.2
25	101.55	1500	0.124	76.8

*Release Rate accounts for uncontrolled peak flow

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180 ONTARIO ST RESIDENTIAL DEVELOPMENT - SUPERPIPE STORAGE CALCULATIONS

Storm Sewer Network Parameters							
Sewer #	**From**	**To**	**Length (m)**	**Slope (%)**	**US Invert**	**DS Invert**	**Size (mm)**
#0	CBMH100	CBMH101	19.90	1.00	180.85	180.65	450
#1	CBMH101	CBMH102	31.40	0.50	180.57	180.41	450
#2	CBMH102	CBMH103	42.70	0.20	180.38	180.31	450
#3	CBMH103	STMH104	24.20	0.20	180.28	180.22	450

Sewer #	**Water Depth at DS Invert of Sewer (m) for each Storm Event**										**Water Depth at US Invert of Sewer (m) for each Storm Event**									
Event	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Water Level (m)	**180.14**	**180.54**	**180.94**	**181.09**	**181.24**	**181.39**	**181.54**	**181.69**	**181.84**	**182.08**	**180.14**	**180.54**	**180.94**	**181.09**	**181.24**	**181.39**	**181.54**	**181.69**	**181.84**	**182.08**
#0	0.00	0.00	0.29	0.44	0.59	0.74	0.89	1.04	1.19	1.43	0.00	0.00	0.09	0.24	0.39	0.54	0.69	0.84	0.99	1.23
#1	0.00	0.13	0.53	0.68	0.83	0.98	1.13	1.28	1.43	1.67	0.00	0.00	0.37	0.52	0.67	0.82	0.97	1.12	1.27	1.51
#2	0.00	0.23	0.63	0.78	0.93	1.08	1.23	1.38	1.53	1.77	0.00	0.16	0.56	0.71	0.86	1.01	1.16	1.31	1.46	1.70
#3	0.00	0.32	0.72	0.87	1.02	1.17	1.32	1.47	1.62	1.86	0.00	0.26	0.66	0.81	0.96	1.11	1.26	1.41	1.56	1.80

Note: Water Depth in each sewer is calculated as Storm Event Water Elevation - Invert Elevation (DS or US). In cases where the sewer invert is above the storm water elevation, the water depth is equal to 0.

Sewer #	**Water-Filled Area at DS Invert of Sewer (m^2) for each Storm Event**										**Water-Filled Area at US Invert of Sewer (m^2) for each Storm Event**									
Event	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Water Level (m)	**180.14**	**180.54**	**180.94**	**181.09**	**181.24**	**181.39**	**181.54**	**181.69**	**181.84**	**182.08**	**180.14**	**180.54**	**180.94**	**181.09**	**181.24**	**181.39**	**181.54**	**181.69**	**181.84**	**182.08**
#0	0.00	0.00	0.11	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.00	0.00	0.02	0.09	0.15	0.16	0.16	0.16	0.16	0.16
#1	0.00	0.04	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.00	0.00	0.14	0.16	0.16	0.16	0.16	0.16	0.16	0.16
#2	0.00	0.08	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.00	0.05	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
#3	0.00	0.12	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.00	0.10	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16

Note: Water-Filled Areas are calculated using the following equation, where R = Sewer radius (m) and h = Water depth in sewer (m):
In cases where the sewer cross-section is full, the Water-Filled Area is calculated as $\pi * R^2$.

$$\text{Area} = R^2 \cos^{-1}\left(\frac{R-h}{R}\right) - (R-h)\sqrt{2Rh - h^2}$$

Sewer #	**Storage Volume in Sewer (m^3) for each Storm Event**									
Return Period	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Water Level (m)	**180.14**	**180.54**	**180.94**	**181.09**	**181.24**	**181.39**	**181.54**	**181.69**	**181.84**	**182.08**
#0	0.00	0.00	1.30	2.43	3.04	3.16	3.16	3.16	3.16	3.16
#1	0.00	0.60	4.69	4.99	4.99	4.99	4.99	4.99	4.99	4.99
#2	0.00	2.83	6.79	6.79	6.79	6.79	6.79	6.79	6.79	6.79
#3	0.00	2.62	3.85	3.85	3.85	3.85	3.85	3.85	3.85	3.85
TOTAL	**0.0**	**6.0**	**16.6**	**18.1**	**18.7**	**18.8**	**18.8**	**18.8**	**18.8**	**18.8**

Note: Storage Volume is calculated as the Sewer Length multiplied by the average of the DS and US Water-Filled Areas. Total Storage in the system is calculated as the sum of the storage volume in each sewer.

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Project: 180 Ontario St
Project No.: 2598-6970
Design by: JGB
Date: 2024.03.14

Superpipe Storage Data - Conveyance System (W)

Storm Structure Storage Data

CB Structures	Area (m^2)	T/G Elevation (m)	Inv Elev (m)	Volume (m^3)	Max Ponding Area (m^2)	Max Ponding Volume (m^3)
CBMH100	4.52	181.93	180.85	4.886	111.71	5.90
CBMH101	4.52	181.86	180.57	5.836	172.72	7.56
CBMH102	4.52	181.46	180.38	4.886	216.00	13.45
CBMH103	4.52	181.46	180.28	5.338	268.76	12.92
STMH104	4.52	180.50	180.14	1.629	-	-
Total Structure Storage (m^3)				**22.6**		**39.8**

Pipe Storage Data

From MH#	To MH#	Length (m)	Diameter (mm)	Storage Vol. (m^3)
CBMH100	CBMH101	19.9	450	3.16
CBMH101	CBMH102	31.4	450	4.99
CBMH102	CBMH103	42.7	450	6.79
CBMH103	STMH104	24.2	450	3.85
Total Pipe Storage (m^3) =				**18.8**

Stage-Storage-Discharge Table - Conveyance System

Orifice A | Orifice Invert 180.140 m | Orifice A Diameter 0.185 m

Superpipe Stage-Storage-Discharge Data

Comments	Water Level Elevation	Water Depth above Lower ICD Invert	Total Pipe Storage	Structure Storage					Surface Ponding					Total	Orifice A Discharge	Total Discharge
			CBMH100-STMH104	CBMH100	CBMH101	CBMH102	CBMH103	STMH104	CBMH100	CBMH101	CBMH102	CBMH103	STMH104	Storage		
	(m)	(m)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	ha.m	(m^3/s)	(m^3/s)
	180.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00000**	**0.0000**	**0.0000**
	180.54	0.40	6.04	0.00	0.00	0.72	1.18	1.63	0.00	0.00	0.00	0.00	0.00	**0.00096**	**0.0423**	**0.0423**
5yr Design	180.94	0.80	16.64	0.41	1.67	2.53	2.99	1.63	0.00	0.00	0.00	0.00	0.00	**0.00259**	**0.0641**	**0.0641**
	181.09	0.95	18.07	1.09	2.35	3.21	3.66	1.63	0.00	0.00	0.00	0.00	0.00	**0.00300**	**0.0706**	**0.0706**
10 yr Design	181.24	1.10	18.67	1.76	3.03	3.89	4.34	1.63	0.00	0.00	0.00	0.00	0.00	**0.00333**	**0.0765**	**0.0765**
	181.39	1.25	18.80	2.44	3.71	4.57	5.02	1.63	0.00	0.00	0.00	0.00	0.00	**0.00362**	**0.0820**	**0.0820**
25 yr Design	181.54	1.40	18.80	3.12	4.39	4.89	5.34	1.63	0.00	0.00	5.76	7.17	0.00	**0.00511**	**0.0871**	**0.0871**
	181.69	1.55	18.80	3.80	5.07	4.89	5.34	1.63	0.00	0.00	13.45	12.92	0.00	**0.00659**	**0.0920**	**0.0920**
50 yr Design	181.84	1.70	18.80	4.48	5.75	4.89	5.34	1.63	0.00	0.00	13.45	12.92	0.00	**0.00672**	**0.0966**	**0.0966**
100 yr Design	182.08	1.94	18.80	4.89	5.84	4.89	5.34	1.63	5.90	7.56	13.45	12.92	0.00	**0.00812**	**0.1036**	**0.1036**

**Please refer to Pipe Volume Calculations Spreadsheet

APPENDIX D

Oil and Grit Separator Unit Specifications Report

Stormceptor EF Sizing Report

Imbrium® Systems

ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION 03/04/2024

Province:	Ontario
City:	Collingwood
Nearest Rainfall Station:	OWEN SOUND MOE
Climate Station Id:	6116132
Years of Rainfall Data:	40
Site Name:	180 Ontario St
Drainage Area (ha):	0.52
Runoff Coefficient 'c':	0.70

Project Name:	2598-6790
Project Number:	180 Ontario St
Designer Name:	Julio Gonzalez-Brito
Designer Company:	C.F.Crozier: Consulting Engineers
Designer Email:	jgonzalezbrito@cfcrozier.ca
Designer Phone:	170-544-6313
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0
Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	13.75
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	Yes
Upstream Orifice Control Flow Rate to Stormceptor (L/s):	133.21
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	200
Estimated Average Annual Sediment Load (kg/yr):	421
Estimated Average Annual Sediment Volume (L/yr):	342

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	86
EFO6	94
EFO8	97
EFO10	98
EFO12	100

Recommended Stormceptor EFO Model:	**EFO4**
Estimated Net Annual Sediment (TSS) Load Reduction (%):	**86**
Water Quality Runoff Volume Capture (%):	**> 90**

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

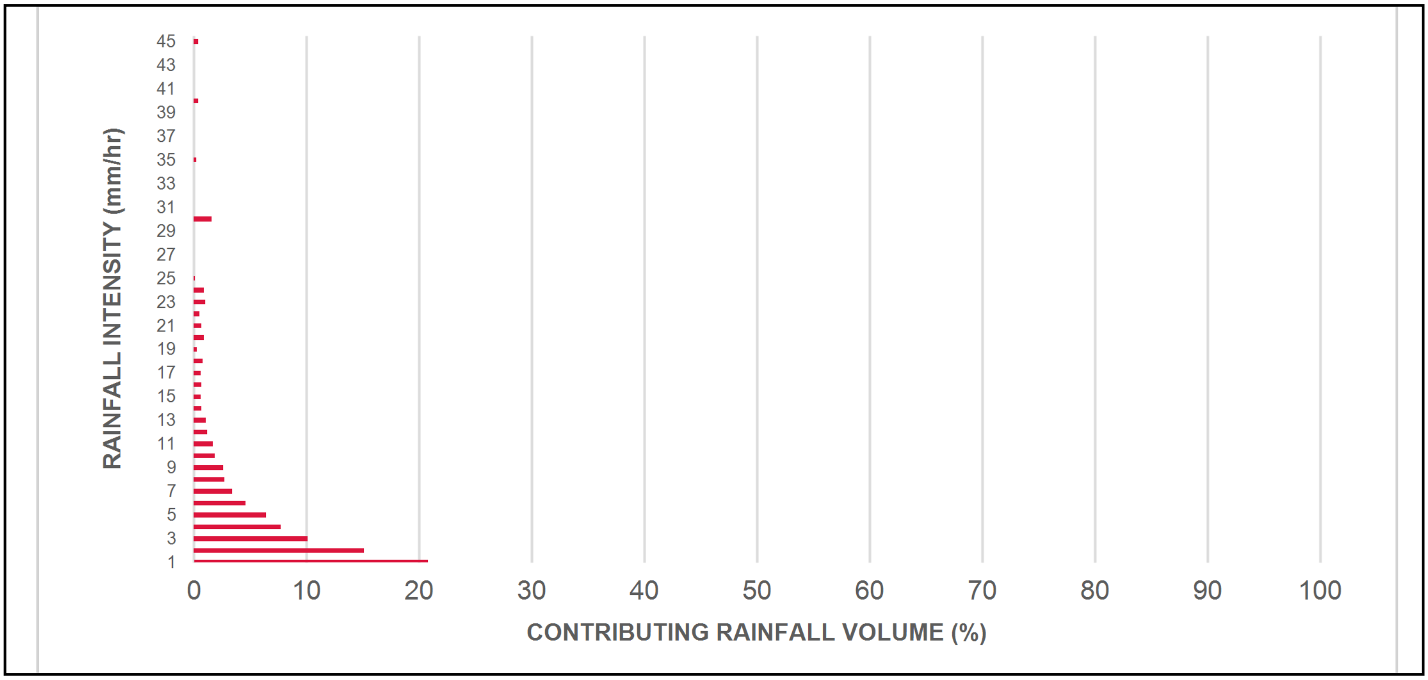
Stormceptor® EF Sizing Report

Upstream Flow Controlled Results

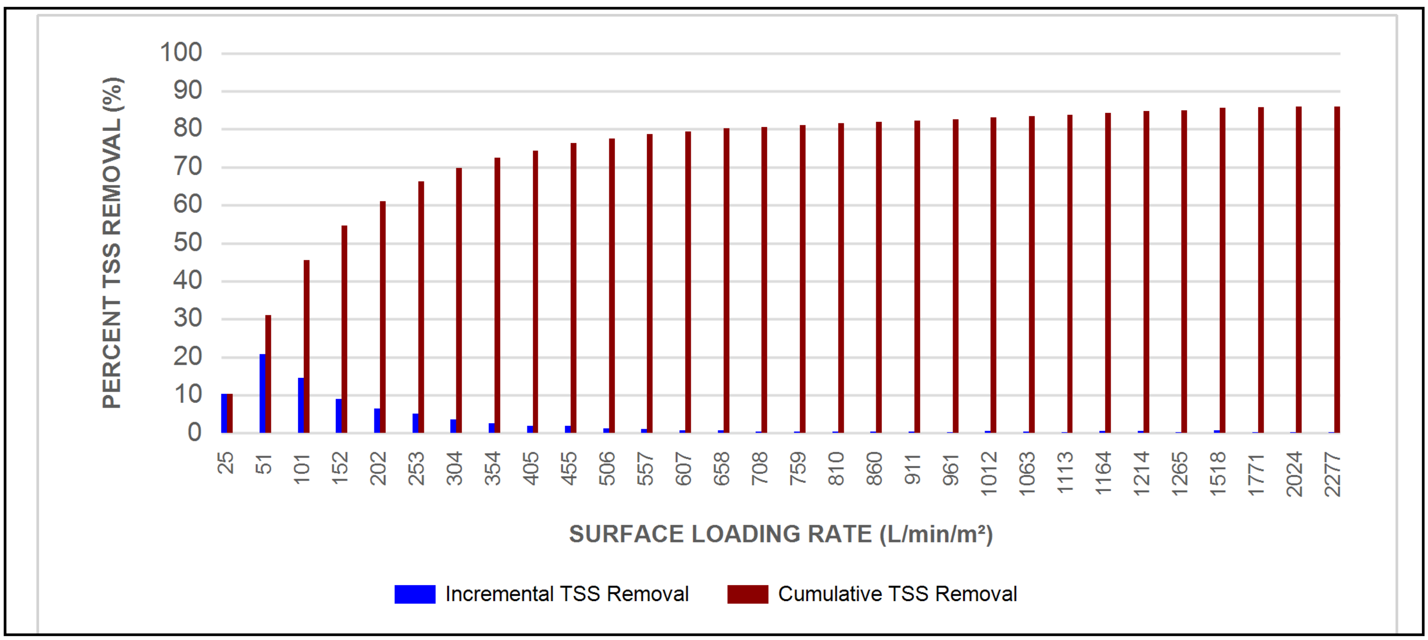
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	10.3	10.3	0.51	30.0	25.0	100	10.3	10.3
1.00	20.8	31.1	1.01	61.0	51.0	100	20.8	31.1
2.00	15.1	46.2	2.02	121.0	101.0	96	14.5	45.6
3.00	10.1	56.3	3.04	182.0	152.0	89	9.0	54.6
4.00	7.7	64.0	4.05	243.0	202.0	83	6.4	61.1
5.00	6.4	70.4	5.06	304.0	253.0	81	5.2	66.2
6.00	4.6	75.1	6.07	364.0	304.0	78	3.6	69.8
7.00	3.4	78.4	7.08	425.0	354.0	76	2.6	72.4
8.00	2.7	81.1	8.10	486.0	405.0	74	2.0	74.4
9.00	2.6	83.7	9.11	546.0	455.0	72	1.8	76.3
10.00	1.9	85.6	10.12	607.0	506.0	69	1.3	77.6
11.00	1.7	87.3	11.13	668.0	557.0	67	1.1	78.7
12.00	1.2	88.5	12.14	729.0	607.0	65	0.7	79.4
13.00	1.1	89.6	13.15	789.0	658.0	64	0.7	80.2
14.00	0.7	90.3	14.17	850.0	708.0	64	0.5	80.6
15.00	0.6	90.9	15.18	911.0	759.0	63	0.4	81.0
16.00	0.7	91.6	16.19	971.0	810.0	63	0.4	81.5
17.00	0.6	92.3	17.20	1032.0	860.0	63	0.4	81.9
18.00	0.8	93.0	18.21	1093.0	911.0	62	0.5	82.3
19.00	0.3	93.3	19.23	1154.0	961.0	62	0.2	82.5
20.00	0.9	94.2	20.24	1214.0	1012.0	61	0.5	83.1
21.00	0.7	94.9	21.25	1275.0	1063.0	60	0.4	83.5
22.00	0.5	95.3	22.26	1336.0	1113.0	59	0.3	83.7
23.00	1.0	96.3	23.27	1396.0	1164.0	58	0.6	84.3
24.00	0.9	97.2	24.29	1457.0	1214.0	57	0.5	84.8
25.00	0.1	97.3	25.30	1518.0	1265.0	56	0.1	84.9
30.00	1.6	98.9	30.36	1821.0	1518.0	48	0.8	85.6
35.00	0.2	99.1	35.42	2125.0	1771.0	41	0.1	85.7
40.00	0.4	99.5	40.48	2429.0	2024.0	36	0.2	85.9
45.00	0.5	100.0	45.54	2732.0	2277.0	32	0.2	86.0
Estimated Net Annual Sediment (TSS) Load Reduction =								**86 %**

Climate Station ID: 6116132 *Years of Rainfall Data*: 40

RAINFALL DATA FROM OWEN SOUND MOE RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL
FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

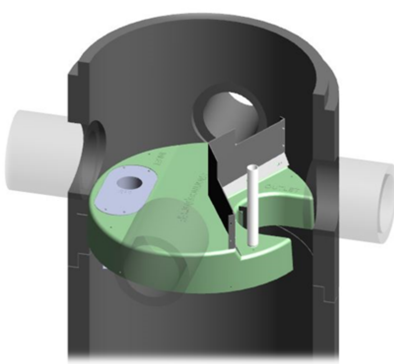
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

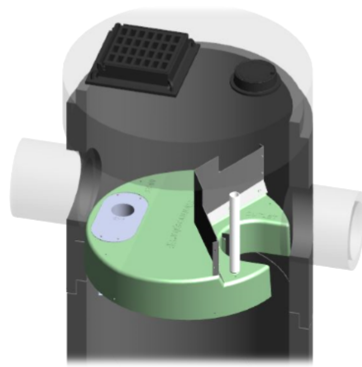
DESIGN FLEXIBILITY

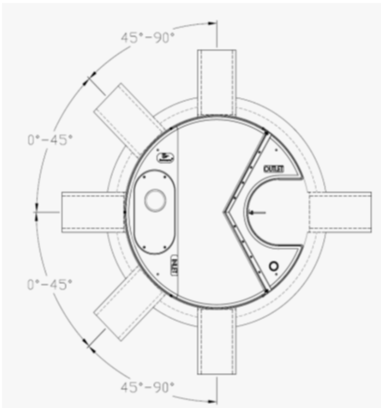
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD PERFORMANCE SPECIFICATION FOR
"OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

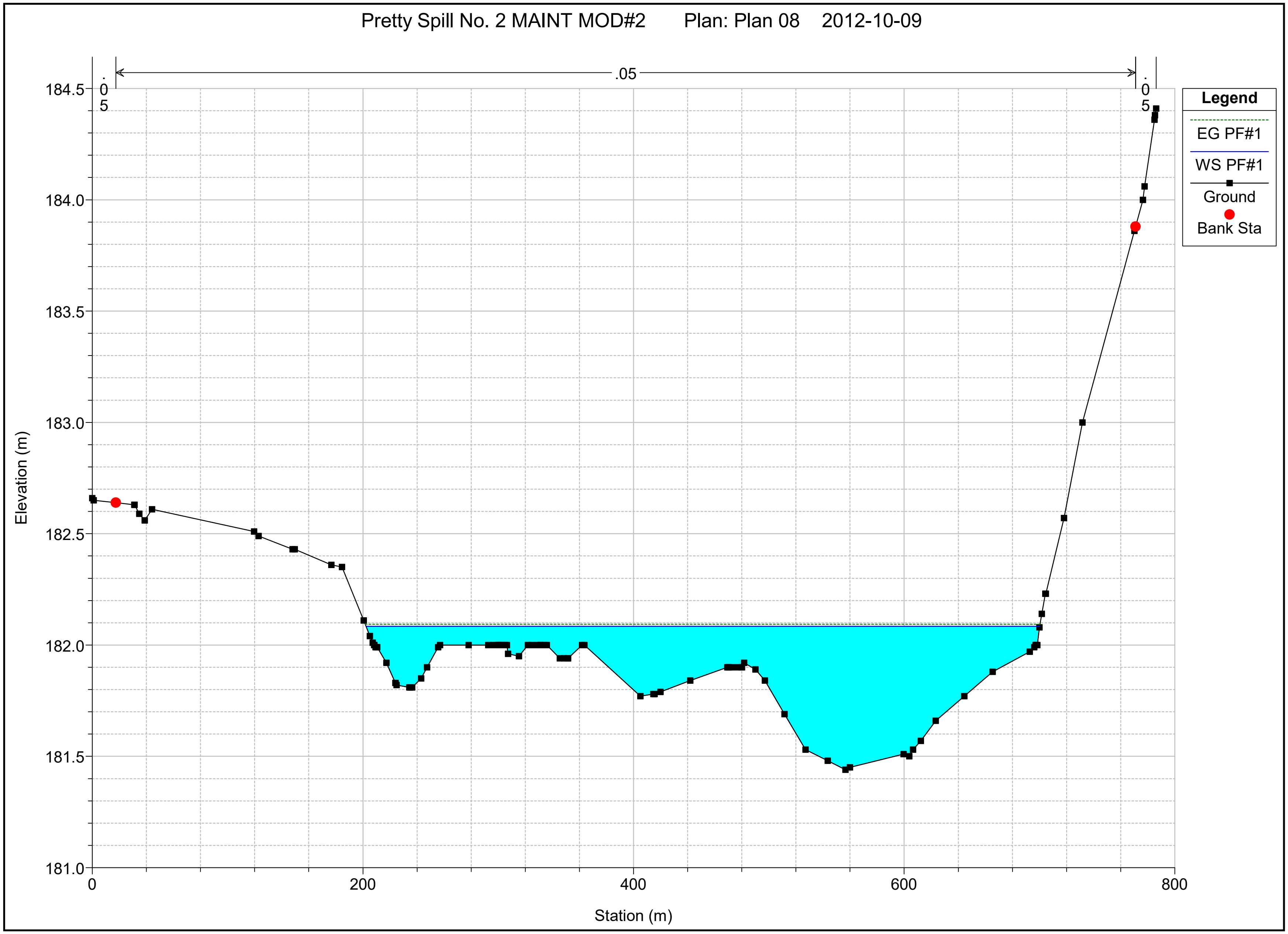
The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

APPENDIX E

NVCA HECRAS Modelling Results

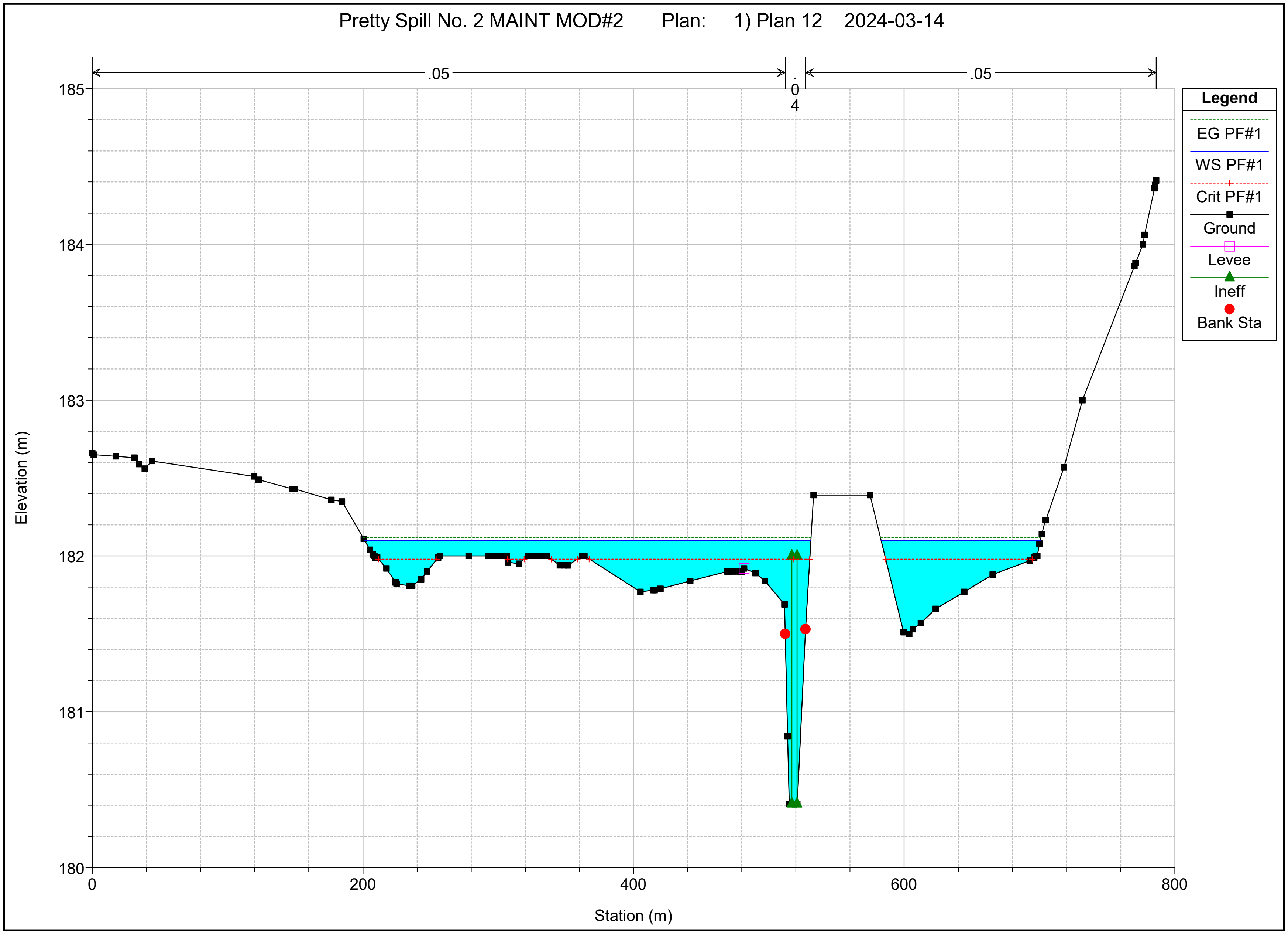
Existing Conditions: Cross-Section 2050



HEC-RAS Plan: Plan 08 River: REACH 2 Reach: REACH 2 Profile: PF#1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
REACH 2	2230	PF#1	45.60	191.85	192.52	192.52	192.57	0.051247	0.97	47.32	526.65	0.98
REACH 2	2220	PF#1	45.60	187.91	188.33		188.34	0.005465	0.61	75.13	285.56	0.38
REACH 2	2210	PF#1	45.60	187.00	187.85	187.53	187.88	0.003949	0.71	64.21	151.15	0.35
REACH 2	2200	PF#1	45.60	187.00	187.39		187.41	0.005143	0.54	84.46	365.58	0.36
REACH 2	2190	PF#1	45.60	186.33	187.12		187.12	0.001752	0.36	127.19	453.78	0.22
REACH 2	2185	PF#1	45.60	186.00	186.63	186.63	186.71	0.044329	1.25	36.35	258.32	0.99
REACH 2	2180	PF#1	45.60	185.00	186.53	186.05	186.53	0.000177	0.20	227.08	512.37	0.08
REACH 2	2170	PF#1	57.60	185.00	186.47	186.15	186.48	0.001435	0.39	148.87	480.89	0.20
REACH 2	2160	PF#1	57.60	185.00	186.07	186.07	186.14	0.046506	1.22	47.40	401.97	1.00
REACH 2	2150	PF#1	57.60	185.00	185.81		185.81	0.001147	0.35	166.36	454.42	0.18
REACH 2	2140	PF#1	57.60	184.00	185.76	185.26	185.77	0.000302	0.19	304.39	833.50	0.10
REACH 2	2130	PF#1	57.60	184.00	185.72		185.72	0.000756	0.28	205.76	566.45	0.15
REACH 2	2120	PF#1	57.60	184.00	185.61	185.19	185.62	0.001711	0.43	133.70	355.65	0.22
REACH 2	2110	PF#1	57.60	184.00	185.42	185.10	185.44	0.004872	0.59	97.31	352.37	0.36
REACH 2	2100	PF#1	57.60	183.00	185.07	184.33	185.11	0.008139	0.96	60.00	154.34	0.49
REACH 2	2090	PF#1	57.60	182.04	184.64		184.72	0.006230	1.25	46.04	64.77	0.47
REACH 2	2080	PF#1	57.60	182.00	184.15		184.17	0.008639	0.66	86.87	407.56	0.46
REACH 2	2070	PF#1	57.60	182.00	183.26	182.97	183.30	0.015102	0.86	66.67	319.85	0.60
REACH 2	2060	PF#1	57.60	181.90	182.38		182.42	0.008370	0.88	65.21	194.44	0.49
REACH 2	2050	PF#1	57.60	181.44	182.08		182.09	0.002512	0.42	136.29	497.76	0.26
REACH 2	2040	PF#1	57.60	180.86	181.70		181.70	0.006408	0.32	181.98	396.86	0.15
REACH 2	2030	PF#1	57.60	180.00	181.13		181.13	0.004757	0.28	207.31	439.36	0.13
REACH 2	2020	PF#1	57.60	179.50	180.53		180.54	0.007735	0.32	182.77	461.99	0.16
REACH 2	2010	PF#1	57.60	178.78	179.95		179.96	0.004228	0.27	211.09	428.57	0.12
REACH 2	2007	PF#1	57.60	178.91	179.55		179.56	0.022380	0.52	111.56	299.13	0.27
REACH 2	2004	PF#1	57.60	178.97	179.48	179.25	179.49	0.023267	0.46	124.52	487.59	0.27
REACH 2	2003	PF#1	57.60	179.00	179.19	179.19	179.25	0.443390	1.11	51.56	409.38	1.00

Proposed Conditions: Cross-Section 2050



HEC-RAS Plan: Plan 12 River: REACH 2 Reach: REACH 2 Profile: PF#1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
REACH 2	2230	PF#1	45.60	191.85	192.52	192.52	192.57	0.050155	0.96	47.68	528.19	0.97
REACH 2	2220	PF#1	45.60	187.91	188.33		188.34	0.005465	0.61	75.13	285.56	0.38
REACH 2	2210	PF#1	45.60	187.00	187.85	187.53	187.88	0.003949	0.71	64.22	151.15	0.35
REACH 2	2200	PF#1	45.60	187.00	187.39		187.41	0.005145	0.54	84.44	365.55	0.36
REACH 2	2190	PF#1	45.60	186.33	187.12		187.12	0.001752	0.36	127.20	453.78	0.22
REACH 2	2185	PF#1	45.60	186.00	186.63	186.63	186.71	0.044355	1.25	36.35	258.29	0.99
REACH 2	2180	PF#1	45.60	185.00	186.53	186.05	186.53	0.000177	0.20	227.10	512.38	0.08
REACH 2	2170	PF#1	57.60	185.00	186.47	186.15	186.48	0.001434	0.39	148.91	480.96	0.20
REACH 2	2160	PF#1	57.60	185.00	186.07	186.07	186.14	0.046716	1.22	47.34	401.94	1.01
REACH 2	2150	PF#1	57.60	185.00	185.81		185.81	0.001148	0.35	166.29	454.38	0.18
REACH 2	2140	PF#1	57.60	184.00	185.76	185.26	185.77	0.000303	0.19	304.22	833.43	0.10
REACH 2	2130	PF#1	57.60	184.00	185.72		185.72	0.000758	0.28	205.58	566.36	0.15
REACH 2	2120	PF#1	57.60	184.00	185.61	185.19	185.62	0.001721	0.43	133.44	355.35	0.22
REACH 2	2110	PF#1	57.60	184.00	185.42	185.10	185.44	0.004790	0.59	97.84	352.69	0.36
REACH 2	2100	PF#1	57.60	183.00	185.01	184.33	185.07	0.011253	1.12	51.60	134.93	0.58
REACH 2	2090	PF#1	57.60	182.04	184.40		184.54	0.008155	1.67	34.56	38.56	0.56
REACH 2	2080	PF#1	57.60	182.00	183.97		184.06	0.005126	1.33	43.18	47.77	0.45
REACH 2	2070	PF#1	57.60	182.00	183.17	182.97	183.26	0.030166	1.35	42.65	175.83	0.88
REACH 2	2060	PF#1	57.60	181.90	182.48		182.50	0.004440	0.68	85.19	235.70	0.36
REACH 2	2050	PF#1	57.60	181.69	182.10	181.98	182.12	0.004675	0.86	103.50	447.37	0.46
REACH 2	2030	PF#1	57.60	180.00	181.13	181.00	181.13	0.004754	0.28	207.35	439.39	0.13
REACH 2	2020	PF#1	57.60	179.50	180.53		180.54	0.007736	0.32	182.76	461.99	0.16
REACH 2	2010	PF#1	57.60	178.78	179.95		179.96	0.004228	0.27	211.09	428.57	0.12
REACH 2	2007	PF#1	57.60	178.91	179.55		179.56	0.022386	0.52	111.54	299.11	0.27
REACH 2	2004	PF#1	57.60	178.97	179.48	179.25	179.49	0.023280	0.46	124.50	487.58	0.27
REACH 2	2003	PF#1	57.60	179.00	179.19	179.19	179.25	0.442093	1.11	51.61	409.39	1.00

FIGURES

Legend

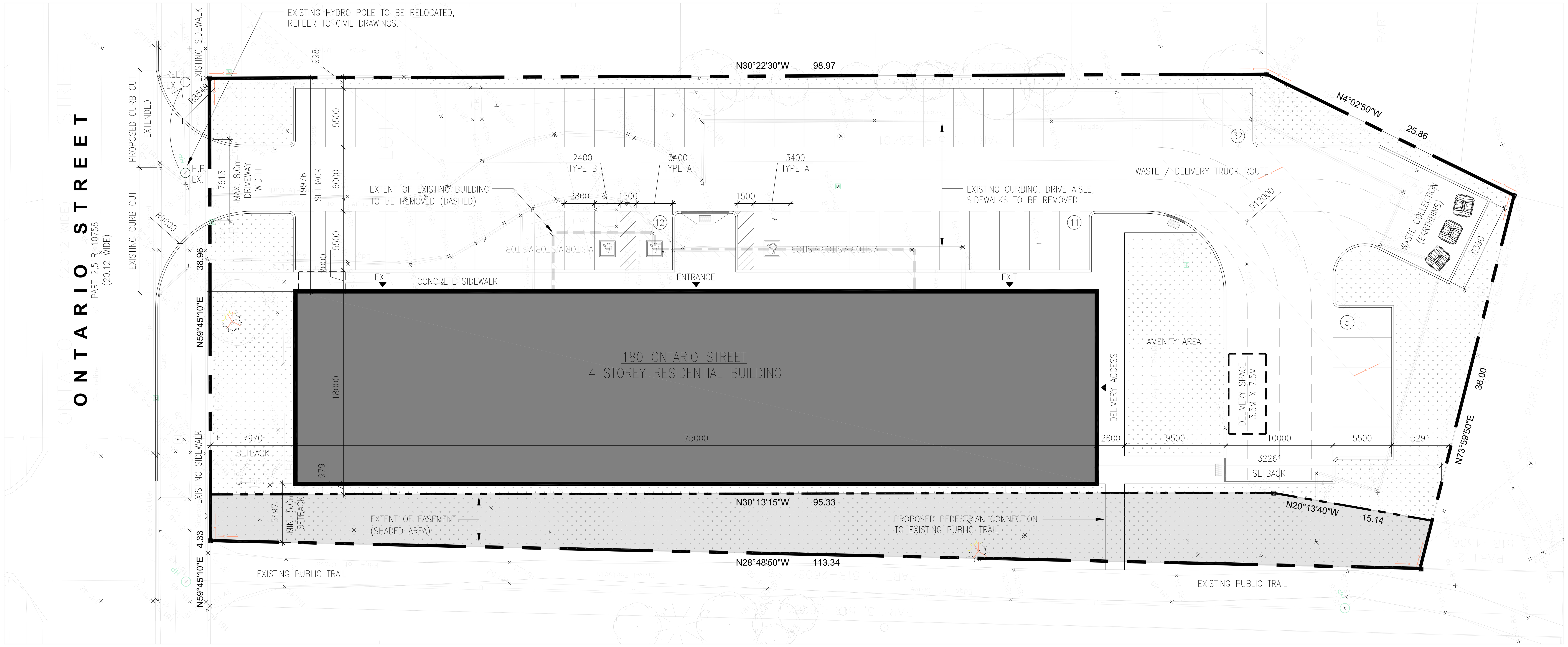
= SUBJECT LANDS

180 ONTARIO STREET
COLLINGWOOD

SITE LOCATION PLAN

CROZIER
CONSULTING ENGINEERS

Drawn By	M.C.	Design By	M.C	Project	2598–6970
Scale	N.T.S.	Date APR/05/2024	Check By R.D.M.	Drawing	FIG. 1



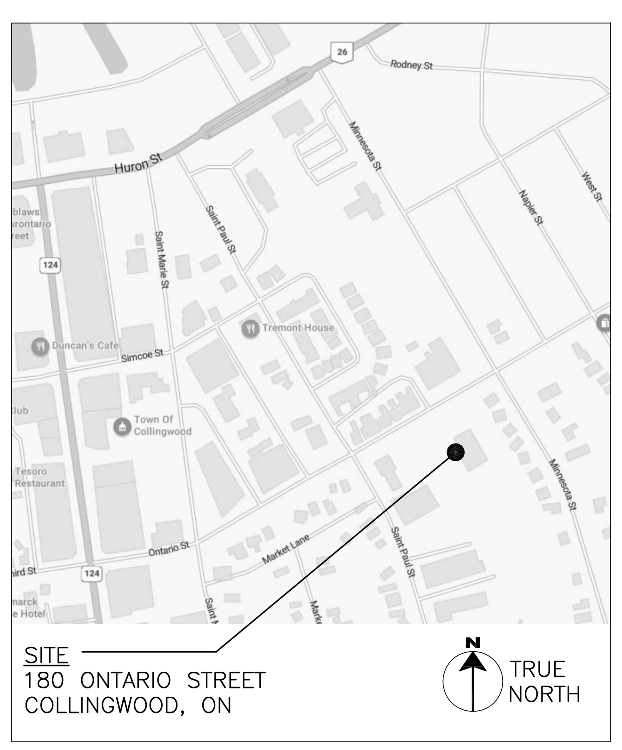
1 A100 PROPOSED SITE PLAN
SCALE: 1:200

ZONING REQUIRENENTS		
ZONING CATEGORY: RESIDENTIAL FOURTH DENSITY (R4) ZONE		
LOT REGULATIONS	REQUIRED	PROVIDED
MINIMUM LOT AREA	NIL	5,193 sqm
MINIMUM LOT FRONTAGE	30.0 m	43.29 m
MINIMUM FRONT YARD	7.5 m	7.97 m
MINIMUM INTERIOR SIDE YARD (WEST)	7.5 m	5.49 m
MINIMUM INTERIOR SIDE YARD (EAST)	7.5 m	19.97 m
MINIMUM REAR YARD	7.5 m	32.26 m
MAXIMUM HEIGHT	18.0 m	18.00 m
MAXIMUM LOT COVERAGE	40 %	26.00 %
MINIMUM LANDSCAPED OPEN SPACE	40 %	(1,529 sqm) 29.44 %
GROSS FLOOR AREA		
TYPICAL FLOOR AREA	1,350 sqm	14,531 sqft
TOTAL GFA (4 FLOORS)	5,400 sqm	58,124 sqft
UNIT COUNT	15± UNITS PER FLOOR	60± UNITS TOTAL
PARKING REGULATIONS	REQUIRED	PROVIDED
RESIDENTIAL USE: 1.00 SPACES PER DWELLING UNIT	60 UNITS 60 X 1.00 = 60 SPACES	60 UNITS 60 X 0.90 = 54 SPACES
RESIDENTIAL USE: VISITOR PARKING 0.25 PER UNIT	60 UNITS 60 X 0.25 = 15 SPACES	60 UNITS 60 X 0.10 = 6 SPACES
TOTAL PARKING SPACES	75 SPACES	60 SPACES
MINIMUM DRIVE ENTRANCE WIDTH	7.50 m	7.61 m
MINIMUM DRIVE AISLE WIDTH	6.00 m	6.00 m
PARKING STALL SIZE (W X L)	2.80 m X 6.00 m	2.80 m X 5.50 m
ACCESSIBLE STALL SIZE (W X L)	4.50 m X 6.00 m	4.50 m X 5.50 m
DELIVERY SPACE SIZE (W X L)	3.50 m X 6.00 m	3.50 m X 6.00 m

LEGEND

- PROPERTY LINE
- PROPOSED EASEMENT
- PROPOSED BUILDING
- LANDSCAPED AREA
  MINIMUM LANDSCAPE OPEN SPACE 25%

SITE PLAN INFORMATION IS TAKEN FROM PLAN OF SURVEY
PREPARED BY ZUBEK, EMO PATTEN & THOMSEN LTD.
DATED: DECEMBER 12, 2022
PLAN 51R-43961
PART OF NORTH HALF OF LOT 43
CONCESSION 8
(FORMERLY TOWNSHIP OF NOTTAWASAGA)
TOWN OF COLLINGWOOD
COUNTY OF SIMCOE



PRINT DATE:
2024-04-04

No.	DESCRIPTION	DATE

REVISIONS

No.	DESCRIPTION	DATE
2	ISSUED FOR 1ST ZONING BY-LAW AMENDMENT REVIEW	2024-04-04
1	ISSUED FOR CLIENT REVIEW	2023-08-18

ISSUED FOR

ONTARIO ASSOCIATION OF ARCHITECTS
DANIEL LOUIS CUSIMANO
LICENCE
4400

CUSIMANO ARCHITECT
185 BRIDGELAND AVENUE, SUITE 107, TORONTO, ONTARIO M6A 1Y7
T (416)783-5193 F (416)783-3100

PROJECT:
PROPOSED RESIDNETIAL BUILDING DEVELOPMENT
180 ONTARIO STREET
COLLINGWOOD, ON L9Y 3S5

DATE:	DWN. BY:	CH'D. BY:
AUGUST 2023	MR	DLC

DRAWING TITLE:
PROPOSED SITE PLAN & SITE STATISTICS

SCALE: AS NOTED
PROJ. NO.: 2024-02
DRAWING No.: A100

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6. DO NOT SCALE DRAWINGS.

BENCH MARK
ELEVATIONS HEREON ARE GEODETIC AND ARE REFFERED TO THE GEODETIC MONUMENT NO. 72U179 HAVING AN ELEVATION OF 188.485 METRES.

SURVEY COMPLETED BY ZUBEK, EMO, PATTEN & THOMSEN LTD. O.L.S. IN 2015. SURVEY RECEIVED FROM KLM PLANNING IN 2023.

COLLINGWOOD

No.	ISSUE	DATE: YYYY/MM/DD
0	ISSUED FOR 1ST SUBMISSION OPA/ZBA	2024/04/05

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Project: 180 ONTARIO STREET
TOWN OF COLLINGWOOD

Drawing: PRELIMINARY GRADING PLAN

CROZIER
CONSULTING ENGINEERS

Drawn By	R.D.M.	Design By	J.K./T.M.	Project	2598–6970
Check By	J.K.	Check By	T.G.	Drawing	FIG 3

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4. THIS DRAWING IS TO BE READ AND UNDERSTOOD IN CONJUNCTION WITH ALL OTHER PLANS AND DOCUMENTS APPLICABLE TO THIS PROJECT.
5. ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.
6. DO NOT SCALE DRAWINGS.

BENCH MARK

ELEVATIONS HEREON ARE GEODETIC AND ARE REFFERED TO THE GEODETIC MONUMENT NO. 72U179 HAVING AN ELEVATION OF 188.485 METRES.

SURVEY COMPLETED BY ZUBEK, EMO, PATTEN & THOMSEN LTD. O.L.S. IN 2015. SURVEY RECEIVED FROM KLM PLANNING IN 2023.

COLLINGWOOD — SINCE 1858 A PLACE TO LIVE WORK & PLAY

No.	ISSUE	DATE: YYYY/MM/DD
0	ISSUED FOR 1ST SUBMISSION OPA/ZBA	2024/04/05

Engineer

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Project: 180 ONTARIO STREET
TOWN OF COLLINGWOOD

Drawing: GENERAL SITE SERVICING PLAN

CROZIER CONSULTING ENGINEERS

Drawn By	R.D.M.	Design By	J.K./T.M.	Project	2598-6970
Check By	J.K.	Check By	T.G.	Drawing	FIG 4

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COLLINGWOOD

No.	ISSUE	DATE: YYYY/MM/DD
0	ISSUED FOR 1ST SUBMISSION OPA/ZBA	2024/04/05

Engineer

Engineer

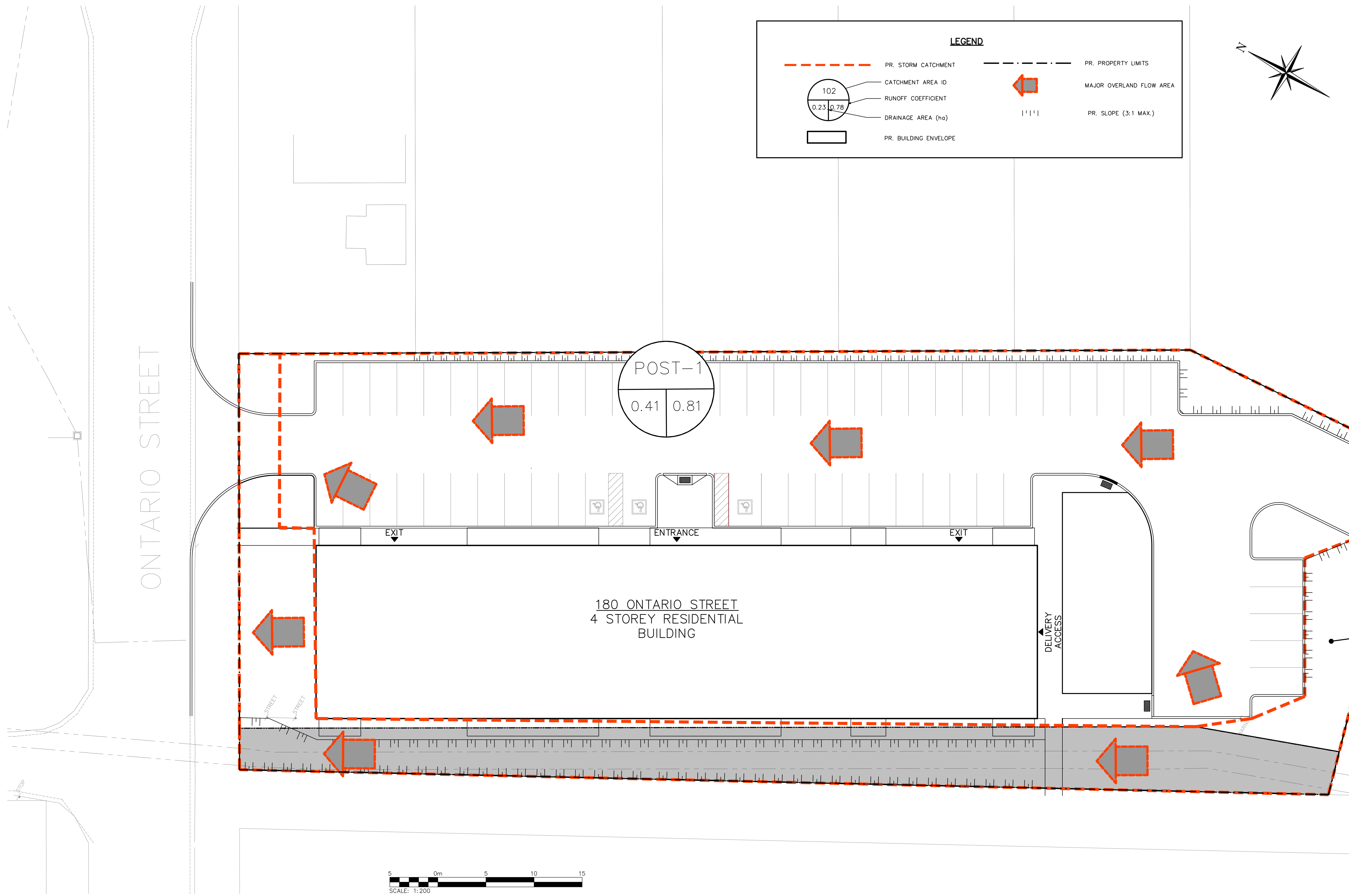
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

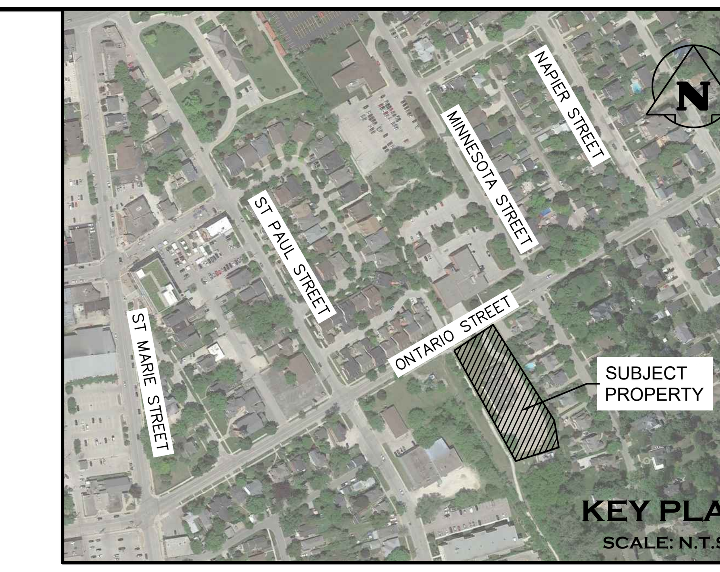
Project: 180 ONTARIO STREET
TOWN OF COLLINGWOOD

Drawing: PRE DEVELOPMENT DRAINAGE PLAN

CROZIER
CONSULTING ENGINEERS

Drawn By R.D.M.	Design By J.K./T.M.	Project 2598–6970
Check By J.K.	Check By T.G.	Drawing FIG 5





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COLLINGWOOD — SINCE 1858 A PLACE TO LIVE WORK & PLAY

No.	ISSUE	DATE: YYYY/MM/DD
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Engineer

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TOWN OF COLLINGWOOD

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CROZIER CONSULTING ENGINEERS

Drawn By	R.D.M.	Design By	J.K./T.M.	Project	2598-6970
Check By	J.K.	Check By	T.G.	Drawing	FIG 6