# Draft Drainage and Stormwater Management Report–Cosburn Station Integrated Transit Oriented Communities

1002-1028 Pape Ave, 103-109 Cosburn Ave, 1030-1052 Pape Ave

Issued for Rezoning

Contract RFS-2019-NAFC-110

PO 214244

HDR Project 10206938

Ontario Line Technical Advisor

TORONTO, ONTARIO

October 2022

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## Disclaimer

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# Abbreviations

| | |
|---|---|
| BMP | Best Management Practice |
| DRM | Design Requirements Manual |
| HGL | Hydraulic Grade Line |
| HGRA | High Volume Groundwater Recharge Areas |
| IBC | Initial Business Case |
| IDF | Intensity-Duration-Frequency |
| IO | Infrastructure Ontario |
| mbgs | m below ground surface |
| MECP | Ministry of the Environment, Conservation and Parks |
| OGS | Oil and Grit Separator |
| RCD | Reference Concept Design |
| SWM | Stormwater Management |
| TGS | Toronto Green Standard |
| TMC681 | Toronto Municipal Code Chapter 681 |
| TOC | Transit Oriented Communities |
| TSS | Total Suspended Solids |
| TRCA | Toronto and Region Conservation Authority |
| WWFMG | Wet Weather Flow Management Guidelines |

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# 1 Introduction

## 1.1 Project Description

The Province of Ontario is planning to build a new 15.5 km rapid transit line serving the City of Toronto. The development of this line is being managed jointly by Metrolinx, the Provincial Transit Agency responsible for the Greater Toronto and Hamilton Area, and Infrastructure Ontario (IO). The work is based on an Initial Business Case (IBC) published in July 2019, including a representative alignment for the Ontario Line.

The Ontario Line Technical Advisory Services team have been organized into the following segments, as shown in **Figure 1-1**:

- Maintenance Storage Facility (MSF), and
- Four linear geographical segments:
  - Segment 1: Lakeshore (containing both Lakeshore West and Lakeshore East)
  - Segment 2: Downtown
  - Segment 3: Pape
  - Segment 4: Thorncliffe

Transit Oriented Communities (TOC) are proposed at selected Ontario Line Stations to integrate high density, mixed-used developments with the transit infrastructure. This Drainage and Stormwater Management report summarizes the drainage and stormwater management (SWM) requirements for the proposed Cosburn TOC at two separate sites in the East York neighbourhood with respect to drainage conveyance, stormwater quantity control, stormwater quality treatment, and water balance.


**Figure 1-1. Ontario Line Segments**

## 1.2 Cosburn Station TOC

Cosburn station is located at the intersection of Pape Avenue and Cosburn Avenue. There are two proposed developments at the East York neighbourhood, both of which are located west of Pape Avenue.

The north site (1030-1052 Pape Ave) is located at the northwest quadrant of the intersection of Pape Avenue and Cosburn Avenue, with Gamble Avenue bordering its northerly limits. The existing site consists of multiple two-storey mixed-use buildings to south, and an empty fenced off lot to the north (previously a gas station).

The south site (1002-1028 Pape Ave, 103-109 Cosburn Ave) is located at the southwest quadrant of the intersection of Pape Avenue and Cosburn Avenue, with Gowan Avenue bordering its southerly limits. The site is currently being utilized to house multiple two-storey and three-storey mixed-used buildings.

## 1.3 Background Review

In preparation of the Cosburn TOC Drainage and Stormwater Management Report, the following essential documents were obtained and reviewed:

- Drawing 10206938-UT0000-04-BP999, Composite Utility Plan
- Drawing 10206938-TD014A-PAPE-COSBURN – Area Plan (Area-OL-TOC) – ROOF – SITE PLAN, Architectural plan;
- Drawing 10206938-TD014C-PAPE-COSBURN– Area Plan (Area-OL-TOC) – ROOF TOP, Architectural plan; and
- Drawing 10206938-LA0000-04-DI201, Landscape plan

# 2 Existing Conditions

Both north and south sites are situated on flat concrete lots with two- to three-storey buildings occupying either the entirety of the site or part of it. **Figure 2-1** shows an aerial image of the subject sites' location.

- The north site has an approximate area of 0.43 Ha. Multiple mixed use buildings are currently located on the south section of the property (adjacent to Cosburn Ave and Pape Ave), while the north section of the property (adjacent to Gamble Ave and Pape Ave) is a vacant lot.
- The south site is currently a flat concrete lot with an approximate area of 0.43 Ha. The entire site is currently occupied by multiple 2-3 storey mixed-use buildings. A north-south alleyway currently separates the south site from the adjacent property to its west.

The Cosburn TOC is located in the Don River Watershed. Cosburn TOC is within Basement Flooding Study Area 46, study of which was started in 2019, according to the City of Toronto.

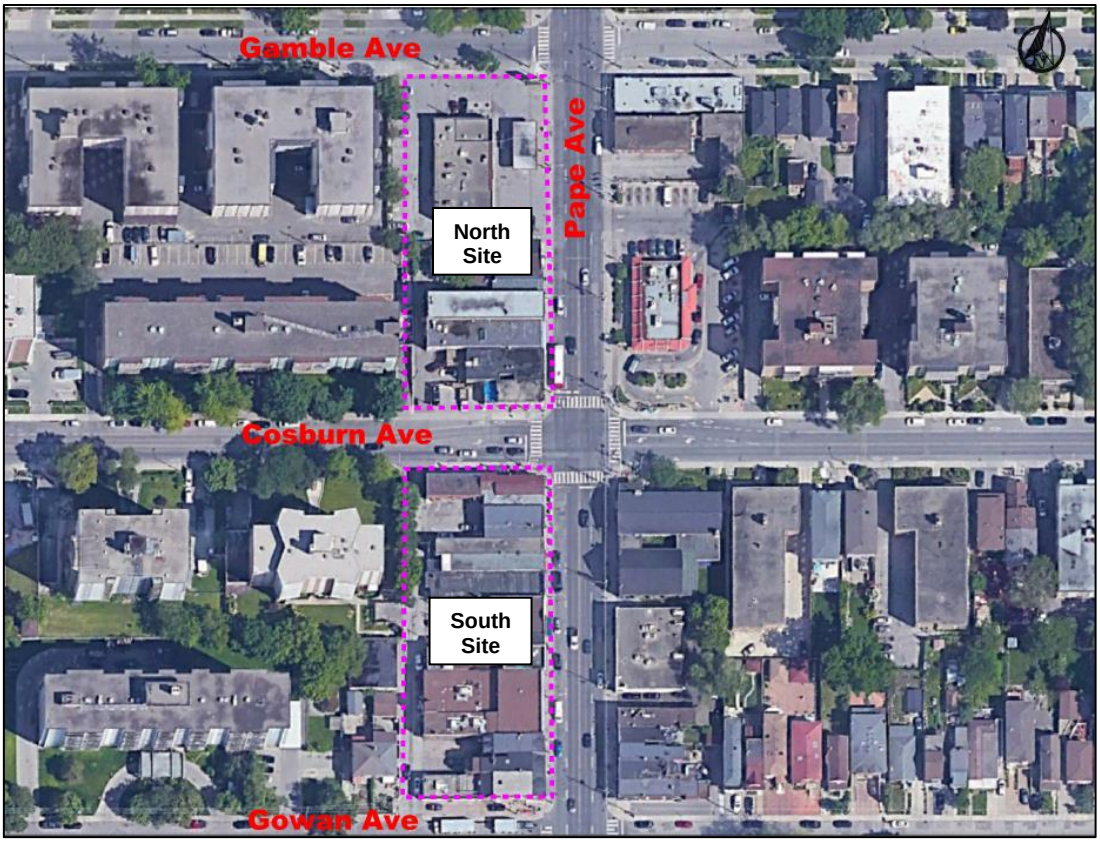


**Figure 2-1. Area Plan**

## 2.1 Minor and Major Flows

Minor flows within the vicinity of the site are captured via a number of catchbasins and conveyed into existing storm sewers, which includes a 1500 mm storm sewer along Pape Avenue and existing storm sewers along Gowan Avenue, Cosburn Avenue, and Gamble Avenue. Please refer to the Existing Conditions Drainage Plan in **Appendix A**.

Pape Avenue slopes continuously from north to south. The major overland flows along Gowan Avenue, Cosburn Avenue, and Gamble Avenue run towards the west.

The City is working on the InfoWorks model for this area. With the limited information that is currently available, it is not possible to further comment on where the existing buildings are draining.

# 3 Stormwater Management Criteria

Stormwater management requirements are specified by the authorities having jurisdiction over the Project. These requirements are applicable to all locations where the proposed design will influence or be influenced by surface water runoff. The stormwater management design criteria are described below and supplemented by the Project Specific Output Specifications (PSOS). Stormwater management criteria for this Project are set by the following documents:

- Stormwater Management Planning and Design Manual (MECP, 2003)

- Drainage Management Manual (MTO, 1997)
- Municipal Code Chapter 681, Sewers 681-1 (City of Toronto, 2019)
- Design Criteria for Sewers and Watermains (City of Toronto, 2021)
- Wet Weather Flow Management Guidelines (City of Toronto, 2006)
- Stormwater Management Criteria (TRCA, 2012)
- Living City Policies (TRCA, 2014)
- Toronto Green Standard (City of Toronto, 2018)
- Low Impact Development Stormwater Management Planning and Design Guide (Credit Valley Conservation and TRCA, 2010)
- Erosion & Sediment Control Guidelines for Urban Construction (TRCA, 2019)
- GO Design Requirements Manual (Metrolinx, 2019)
- Light Rail Transit Design Criteria Manual (Metrolinx, 2016)

The Wet Weather Flow Management Guidelines (WWFMG) provide requirements and guidance on stormwater management for developments within the City of Toronto. Table 7 in the WWFMG provides a summary of applicable design criteria based on the type and size of proposed development. Storm sewer and inlet design requirements for the City of Toronto are provided in the Design Criteria for Sewers and Watermains. The Toronto Green Standard (TGS) provides additional stormwater standards specifically related to sustainable development. The TRCA Stormwater Management Criteria provides design requirements related to stormwater management for developments within the jurisdiction of the Toronto and Region Conservation Authority (TRCA). Requirements vary depending on the watershed in which a proposed development is located. The GO Design Requirements Manual (DRM) supplements the local guidelines and provides guidance to be adhered to in all Metrolinx developments.

## 3.1 SWM Criteria Summary

The key criteria applicable to this Project are summarized in the following sections. Additional criteria and general guidance can be found in the PSOS and the guideline documents listed at the beginning of **Section 3**.

### 3.1.1 Quality Control

- Provide a long-term average removal of 80% of total suspended solids (TSS) from the storm runoff of additional impervious areas (TRCA Guidelines).
- Provide a long-term average removal of 80% of total suspended solids (TSS) on an annual loading basis from all the storm runoff leaving the site (WWFMG, TGS).
    - OGS devices are credited with a maximum of 50% TSS removal (WWFMG, TRCA).

### 3.1.2 Quantity/Flood Control

- Provide protection against surface flooding from ponding on streets during the 100-year event. Consult *Toronto Water – Sewer Asset Planning Section* for developments within the City's chronic basement flooding areas (WWFMG).
- Drainage discharged to the municipal storm sewer must be controlled to the peak release rate from the lower of:

    - The existing conditions peak flow from design event with a 2-year return period assuming a runoff coefficient of 0.5, if the existing imperviousness is greater than 50%; and,
    - The existing capacity of the storm sewer (WWFMG).
- In absence of an approved or adequate overland flow route, all flows from the 2-year up to the 100-year return storm events shall be stored on site and released at the allowable release rate as defined above (WWFMG).
- Peak flows should be calculated using the intensity-duration-frequency (IDF) information in the WWFMG.

### 3.1.3 Water Balance

- Retain all runoff from the 5 mm rainfall event on site through infiltration, evaporation, and/or rainwater reuse (WWFMG, TGS Version 4 - Tier 1).
- For sites located in high volume groundwater recharge areas (HGRA), pre-development groundwater recharge rates should be maintained (TRCA).

### 3.1.4 Erosion Control

- For infill/redevelopment sites (<2 ha), where the site does not drain to a sensitive watercourse, erosion control should be provided through the retention of a small design rainfall event (typically 5 mm). This is often achieved by satisfying the water balance retention requirement (WWFMG, TRCA).

### 3.1.5 Private Water Discharge

Within the City of Toronto, the discharge of water from a private site (Private Water) to a municipal sewer system is regulated under Toronto Municipal Code Chapter 681 (TMC681). TMC681 defines Private Water to include both surface and groundwater. In the case of surface water, compliance with these requirements is generally demonstrated by satisfying the quality and quantity control requirements of the City of Toronto Wet Weather Flow Management Guidelines (WWFMG).

In the case of groundwater or a mixture of surface water and groundwater, if temporary or permanent discharging is permitted, a “Private Water Discharge Approval Application” must be approved by the City of Toronto (Toronto Water, Environmental Monitoring and Protection Unit). A Private Water Discharge Approval Application is required for all structures that are not waterproofed where the foundation is ≤ 1 m above the seasonally high groundwater elevation.

The following outlines the general requirements that must be satisfied in order to be granted a permit for long-term or short-term discharge of groundwater to a municipal storm, sanitary, or combined sewer.

#### Storm Sewer

*Quality Requirements*

- Water quality tests must demonstrate that the water to be discharged meets the quality requirements specified in TMC681, Table 2.

    - If water quality does not meet TMC681, Table 2 requirements, on-site treatment system may be designed to raise the quality enough to allow the water to be discharged to the storm sewer.
- Design must include provision for water quality testing for the duration of the discharge period through grab sampling.
- Design must include backup plan in case water quality changes and no longer meets TMC681, Table 2.

### *Quantity Requirements*

- Design of discharge system must meet quantity control requirements of the WWFMG. As such, the proposed groundwater discharge rate should be removed from the overall allowable site release rate for the site's stormwater management system.
- Design must include provision for water quantity testing for the duration of the discharge period including continuous monitoring of flows.

## Sanitary or Combined Sewer

### *Quality Requirements*

- Water quality tests must demonstrate that the water to be discharged meets the quality requirements specified in TMC681, Table 1.
    - If water quality does not meet TMC681, Table 1 requirements, on-site treatment system may be designed to raise the quality enough to allow the water to be discharged to the sanitary or combined sewer.
- Design must include provision for water quality testing for the duration of the discharge period through grab sampling.
- Design must include backup plan in case water quality changes and no longer meets TMC681, Table 1.

### *Quantity Requirements*

- Hydraulic analysis of the downstream system up to a trunk sewer must be conducted. The model must be calibrated based on monitoring data and needs to consider:
    - Average wastewater flow with peaking factor
    - Inflow and Infiltration (based on monitoring done by the applicant)
    - Both wet weather and dry weather flows*
- Assessment must compare the downstream Hydraulic Grade Line (HGL) vs the City's basement flooding freeboard requirement which is HGL ≤ 1.8 m below ground surface (mbgs), not a comparison of proposed HGL vs existing HGL (where the 1.8 mbgs criterion is already violated).

  *In some cases, if the HGL criteria are not met during wet weather, it may be possible to provide on-site storage and automated flow monitoring/control to store the Private Water during the wet weather and release it at a controlled rate during dry weather (referred to as a Discharge Management Plan). These plans are evaluated on a case-by-case basis and approved based on an analysis of the modelling sensitivity, risk, and adequacy of contingencies presented.

If the requirements noted above cannot be met, the Private Water must be hauled off site and treated/disposed elsewhere. It should be noted that the process for obtaining approval to discharge Private Water to a municipal sewer is often lengthy as it involves field investigations, coordination between multiple design disciplines, and review by multiple City departments.

## 3.2 Erosion & Sediment Control Guidelines during Construction

On-site temporary erosion and sediment control should be provided during construction as per the Erosion & Sediment Control Guidelines for Urban Construction (TRCA, 2019).

# 4 Proposed Conditions

There are two site developments proposed at the intersection of Cosburn Avenue and Pape Avenue.

The development at the north site consists of a twenty-eight storey mixed use building. The basement levels will utilize transit related infrastructures, mechanical and electrical spaces, with access into the station from the south side of the building. Commercial retail space, visitor parking, and residential facilities will take up the ground level, and residential living spaces occupying the upper levels of the building. The transit station will also take part on the ground level.

The south site will house a twenty-nine storey mixed-use building. The basement levels will be used to accommodate the proposed Ontario Line station and bicycle parking in addition to mechanical and electrical spaces. Commercial retail space, visitor parking, and residential facilities will take up the ground level, and residential living spaces occupying the upper levels of the building.

# 5 Stormwater Management Plan

As per the applicable SWM criteria summarized in **Section 3.1**, it is required to provide water balance, as well as quantity, quality and erosion control for the proposed Cosburn TOC sites. The stormwater best management practices (BMP) considered for the site include a green roof, underground detention/retention tanks, catch basin shields, and oil/grit separator (OGS) units. The Proposed Conditions Drainage Plan is presented in **Appendix A**.

All building openings should be protected from flooding. During detail design, depth of overland flow at these locations should be calculated using dual drainage models to confirm that all openings to the buildings will have sufficient freeboard above the maximum water elevation during the 100-year storm event.

## 5.1 Quantity Control

Drainage discharged to a municipal storm sewer must be controlled to the allowable peak release rate as stated in **Section 3.1.2** of this report. In absence of an adequate overland

flow route, all site runoff from the 2-year up to the 100-year return storm events will be stored on site and released at the allowable release rate (2-yr pre-development rate). The capacity of the receiving sewer systems will need to be calculated during detail design to confirm the allowable release rate.

The quantity control storage volumes were calculated as 104 $m^3$ and 116 $m^3$ for North Site and South Site, respectively, as shown in **Table 5-1**. Detailed calculations are included in **Appendix B**. In concept, storage tanks with orifice controls can be installed in the first underground level to provide the required storage volume. Controlled runoff from both buildings can discharge to the existing 1500 mm storm sewer running along Pape Avenue.

### Table 5-1. Quantity Control Storage

| ID | Area (ha) | | Runoff Coefficient | | | Allowable Release Rate[2] (L/s) | Required Storage Volume ($m^3$) |
|---|---|---|---|---|---|---|---|
| | Exist. | Prop. | Exist. | Exist.[1] (City Criteria) | Prop. | | |
| North Site | 0.43 | 0.43 | 0.55 | 0.5 | 0.66 | 53 | 104 |
| South Site | 0.43 | 0.43 | 0.9 | 0.5 | 0.73 | 53 | 116 |
| | | | | | | Total | 220 |

Note:

[1] Assuming a runoff coefficient of 0.5 if the existing imperviousness is greater than 50%.

[2] Based on the 2-yr pre-development flow rate

## 5.2 Water Balance and Erosion Control

The water balance criterion of TGS Version 4 Tier 1 requires the retention of 5 mm of runoff over the proposed area, which is equivalent to the retention of 21 $m^3$/event and 22 $m^3$/event for the north site and south site respectively. Total proposed green roof for the north site is 1626 $m^2$ and 1009 $m^2$ for the south site. In concept, initial abstractions on the various surfaces will achieve a retention of 16 $m^3$/event and 12 $m^3$/event for the North and South sites, respectively. To meet the TGS Version 4 Tier 1 criterion, the remaining runoff will be stored in quantity control storage tanks below the tank's orifice controls. In concept, the required tank storage below orifice controls is 6 $m^3$ for the North Site and 9 $m^3$ for the South Site to meet the water balance criterion. Reuse volumes of 26 $m^3$ and 37 $m^3$, for the north and south sites respectively, are proposed to meet quality control criterion as discussed in **Section 5.3**, thus exceeding the water balance requirements for both sites. By satisfying the water balance retention criterion, the erosion control criterion will be achieved for the sites, since they have a drainage area less than 2 ha. Refer to **Table 5-2** and **Table 5-3** for water balance storage summary and **Appendix B** for detailed calculations.

### Table 5-2. North Site Water Balance Storage

| ID | Land-Cover Type | Area (ha) | Initial Abstraction | | Reuse | | | Total[2] ($m^3$) |
|---|---|---|---|---|---|---|---|---|
| | | | Depth (mm) | Volume ($m^3$) | Depth (mm) | Required Volume ($m^3$) | Proposed Volume[1] ($m^3$) | |
| North Site | Impervious Area | 0.15 | 1 | 2 | 4 | 6 | 26 | 42 |
| | Landscape | 0.02 | 7 | 1 | 0 | 0 | | |
| | Green Roof | 0.16 | 5 | 8 | 0 | 0 | | |
| | Permeable Roof | 0.10 | 5 | 5 | 0 | 0 | | |

Notes:

[1] The greater of the required water balance volume or quality control volume

[2] The sum of initial abstraction and proposed reuse volume

### Table 5-3. South Site Water Balance Storage

| ID | Land-Cover Type | Area (ha) | Initial Abstraction | | Reuse | | | Total[2] ($m^3$) |
|---|---|---|---|---|---|---|---|---|
| | | | Depth (mm) | Volume ($m^3$) | Depth (mm) | Required Volume ($m^3$) | Proposed Volume[1] ($m^3$) | |
| South Site | Impervious Area | 0.23 | 1 | 2 | 4 | 9 | 37 | 49 |
| | Landscape | 0.02 | 7 | 1 | 0 | 0 | | |
| | Green Roof | 0.11 | 5 | 5 | 0 | 0 | | |
| | Permeable Roof | 0.08 | 5 | 4 | 0 | 0 | | |

Notes:

[1] The greater of the required water balance volume or quality control volume

[2] The sum of initial abstraction and proposed reuse volume

## 5.3 Quality Control

Quality control will be required to provide long-term average removal of 80% of total suspended solids (TSS) from all runoff leaving the site as per WWFMG. In concept, combination of a green roof, landscaping, catch basin shields, water reuse, and an OGS units will provide the required quality control to the runoff leaving the site. Reuse volumes of 26 $m^3$ and 37 $m^3$, for the north and south sites respectively, are proposed to meet quality control criterion as shown in **Table 5-3.** Detailed calculations are provided in **Appendix B**.

### Table 5-4. North Site Quality Control Storage

| Land Use | Area (ha) | TSS Produced[1] (g) | Source TSS Removed (g) | CB Shield TSS Removed (g) | Reqd. Reuse Storage in Tank ($m^3$) | Water Reuse TSS Removed (g) | OGS TSS Removed (g) | TSS Removal |
|---|---|---|---|---|---|---|---|---|
| At-Grade Imperv. | 0.05 | 325 | 0 | 163 | 26 | 120 | 103 | 80% |
| Imperv. Roadway | 0.06 | 282 | 0 | 141 | | 104 | 89 | |
| Imperv. Roof | 0.04 | 260 | 0 | 0 | | 96 | 82 | |
| Perv. Roof | 0.10 | 623 | 0 | 0 | | 230 | 197 | |
| Green Roof | 0.16 | 1057 | 846 | 0 | | 78 | 67 | |
| Landscape | 0.02 | 130 | 104 | 13 | | 10 | 8 | |

Notes:
[1] Assumed 0.65g/$m^2$ TSS produced for High-Density Residential land use, and 2.82kg/curb-km per 5- day build-up (EPA Reference Manual III – Water Quality)

### Table 5-5. South Site Quality Control Storage

| Land Use | Area (ha) | TSS Produced[1] (g) | Source TSS Removed (g) | CB Shield TSS Removed (g) | Reqd. Reuse Storage in Tank ($m^3$) | Water Reuse TSS Removed (g) | OGS TSS Removed (g) | TSS Removal |
|---|---|---|---|---|---|---|---|---|
| At-Grade Imperv. | 0.13 | 845 | 0 | 423 | 37 | 396 | 225 | 80% |
| Imperv. Roadway | 0.06 | 282 | 0 | 141 | | 132 | 75 | |
| Imperv. Roof | 0.04 | 260 | | 0 | | 122 | 69 | |
| Perv. Roof | 0.08 | 498 | 0 | 0 | | 233 | 132 | |
| Green Roof | 0.11 | 697 | 557 | 0 | | 65 | 37 | |
| Landscape | 0.02 | 130 | 104 | 13 | | 12 | 7 | |

Notes:
[1] Assumed 0.65g/$m^2$ TSS produced for High-Density Residential land use, and 2.82kg/curb-km per 5- day build-up (EPA Reference Manual III – Water Quality)

## 5.4 Dewatering

There will be a need for dewatering during construction. Watertight structures should be specified as much as possible to minimize long-term dewatering requirements. The anticipated quantity and quality of the water will need to be specified at each site to support potential discharge management plan. Water quality will determine if dewatering effluent

will require treatment and be directed toward the municipal storm sewer or sanitary sewer (likely sanitary). Please refer to **Subsection 3.1.5** for further details

# 6 Conclusions and Recommendations

This Stormwater Management Report is prepared in support of the Rezoning Application and Reference Concept Design (RCD) for the Proposed Cosburn TOC Development Sites. The RCD satisfies SWM and drainage requirements for the Proposed Corktown Sites as follows:

- **Quantity Control:**

  Storage tank units with orifice control are proposed in the first underground level to provide quantity control. The north site will have a 104 $m^3$ storage tank with an allowable release rate of 53 L/s. The south site will have a 116 $m^3$ storage tank with an allowable release rate of 53 L/s.

- **Quality Control:**

  Quality control for each site will be provided via the proposed green roof, catch basin shields, the water captured in the storage tanks for reuse and Oil Grit Separator units. For the north site, a 26 $m^3$ reuse volume is required to meet quality requirements. For the south site, a 37 $m^3$ reuse volume is required to meet quality requirements.

- **Water Balance:**

  Green roof and water reuse are proposed to satisfy the 5 mm retention requirement. Reuse volume for quality control of 26 $m^3$ and 37 $m^3$ for the north and south sites, respectively, will exceed the water balance requirements.

- **Minor Drainage System:**

  Water captured from the roofs of the building will be discharged into the existing storm sewer systems after receiving quality and quantity treatment.

- **Major Drainage System:**

  Major system drainage patterns will be generally maintained under proposed conditions. For the proposed aboveground structures, major system flows will be captured and controlled using underground storage.

# Appendix A. Drainage Area Plans

GOWAN AVE

COSBURN AVE

GAMBLE AVE

EX. STORM SEWER - UNKNOWN SIZE

EX. STORM SERVICES

EX. STORM SERVICES

EX. STORM SERVICES

SOUTH
0.43 | 0.90

NORTH
0.43 | 0.55

PAPE AVE

EX. 750mm CONCRETE STORM SEWER

EX. 1500mm CONCRETE STORM SEWER

EX. STORM SEWER - UNKNOWN SIZE

EX. STORM SERVICE

EX. 1500mm CONCRETE STORM SEWER

EX. 750mm CONCRETE STORM SEWER

## LEGEND:

EXISTING STORM CATCHMENT

101 — DRAINAGE AREA ID
0.98 | 0.9 — RUNOFF COEFFICIENT
DRAINAGE AREA (ha)

OVERLAND FLOW DIRECTION

STM STM — EXISTING STORM SEWER

## NOTES:

1. EXISTING UTILITY INFORMATION SHOWN IS BASED ON SUBSURFACE UTILITY ENGINEERING (SUE) QL-B, QL-C AND QL-D. ALL LOCATIONS AND DEPTH ARE TO BE CONFIRMED BY THE CONTRACTOR PRIOR CONSTRUCTION.
2. FOR PROPOSED PUBLIC UTILITY RELOCATION WITHIN ROW, REFER TO CIVIL RELOCATION PLANS. DRY UTILITY RELOCATIONS TO BE CONFIRMED WITH PRIVATE UTILITY COMPANIES.
3. NOT ALL AERIAL UTILITIES HAVE BEEN IDENTIFIED OR SHOWN ON THIS PLAN.
4. EXHIBIT TO BE UPDATED AS NEW INFORMATION IS MADE AVAILABLE.

| REVISIONS | | REVISIONS | |
|---|---|---|---|
| 1 | | 4 | |
| 2 | | 5 | |
| 3 | | 6 | |

RCD
NOT FOR CONSTRUCTION
DD MONTH YYYY

SCALE(S) 1:300 0 3 6 9 12m

STATUS

ONE TEAM
ONTARIO LINE TECHNICAL ADVISOR

DESIGNED D. NUTTALL
DRAWN M.KHODADADI
CHECKED
APPROVED

ONTARIO LINE SUBWAY

TITLE
COSBURN STATION TOC
EXISTING DRAINAGE PLAN

Plot Date: 28 October 2022

METROLINX
Infrastructure Ontario

Dwg. No.

Sheet No.

FILE: 10206938-dr0300-04-sf002.dwg
PLOTTED BY: KHODADADI, MAHSA

GOWAN AVE

COSBURN AVE

GAMBLE AVE

EX. STORM SEWER - UNKNOWN SIZE

EX. STORM SERVICES

EX. STORM SERVICES

EX. STORM SERVICES

PROPOSED WESTBOUND TRACK CENTERLINE

PROPOSED EASTBOUND TRACK CENTERLINE

SOUTH
0.43 | 0.73

NORTH
0.43 | 0.66

PAPE AVE

EX. 750mm CONCRETE STORM SEWER

EX. 1500mm CONCRETE STORM SEWER

EX. STORM SEWER - UNKNOWN SIZE

EX. STORM SERVICE

EX. 1500mm CONCRETE STORM SEWER

EX. 750mm CONCRETE STORM SEWER

## LEGEND:

- PROPOSED STORM CATCHMENT
- 101 / 0.98 | 0.9 — DRAINAGE AREA ID / RUNOFF COEFFICIENT / DRAINAGE AREA (ha)
- OVERLAND FLOW DIRECTION
- STM STM — EXISTING STORM SEWER

## NOTES:

1. EXISTING UTILITY INFORMATION SHOWN IS BASED ON SUBSURFACE UTILITY ENGINEERING (SUE) QL-B, QL-C AND QL-D. ALL LOCATIONS AND DEPTH ARE TO BE CONFIRMED BY THE CONTRACTOR PRIOR CONSTRUCTION.
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4. EXHIBIT TO BE UPDATED AS NEW INFORMATION IS MADE AVAILABLE.
5. REFER TO THE SERVICING PLAN FOR PROPOSED STORM SEWER AND SERVICE CONNECTIONS.

| REVISIONS | | REVISIONS | |
|---|---|---|---|
| 1 | | 4 | |
| 2 | | 5 | |
| 3 | | 6 | |

RCD
NOT FOR CONSTRUCTION
DD MONTH YYYY

SCALE(S) 1:300 — 0 3 6 9 12m

STATUS

ONETEAM
ONTARIO LINE TECHNICAL ADVISOR

| | |
|---|---|
| DESIGNED | D. NUTTALL |
| DRAWN | M.KHODADADI |
| CHECKED | |
| APPROVED | |

ONTARIO LINE SUBWAY

TITLE
COSBURN STATION TOC
PROPOSED DRAINAGE PLAN

Plot Date: 28 October 2022

METROLINX Infrastructure Ontario

Dwg. No.

Sheet No.

FILE: 10206938-dr0300-04-sf002.dwg
PLOTTED BY: KHODADADI, MAHSA

# Appendix B. Stormwater Management Calculations

| | | | | |
|---|---|---|---|---|
| | Project | OLTA | No.10206938 | |
| | By | M. Khodadadi | Date | 28-Oct-2022 |
| | Checked | D.Nuttall | Checked | 28-Oct-2022 |

**Stormwater Management Calculations**

## Pre-Development Runoff Coefficients & Uncontrolled Peak Flows - North Site

| Catchment | Area, A | 2-10-yr | | 25-yr | | | 50-yr | | | 100-yr | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C | A x C | $C_f$ | C | A x C | $C_f$ | C | A x C | $C_f$ | C | A x C |
| ID | (ha) | | | | | | | | | | | |
| Impervious | 0.20 | 0.90 | 0.18 | 1.10 | 0.95 | 0.19 | 1.20 | 0.95 | 0.19 | 1.25 | 0.95 | 0.19 |
| Landscape | 0.23 | 0.25 | 0.06 | 1.10 | 0.28 | 0.06 | 1.20 | 0.30 | 0.07 | 1.25 | 0.31 | 0.07 |
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| | | | | | | | | | | | | |
| | **0.430** | | **0.24** | | | **0.25** | | | **0.26** | | | **0.26** |

| | | | |
|---|---|---|---|
| Total Drainage Area | | 0.43 | ha |
| Weighted C | 2-10-yr | 0.55 | |
| | 25-yr | 0.59 | |
| | 50-yr | 0.60 | |
| | 100-yr | 0.61 | |

**NOTE:**

1. $C_f$ = Runoff Coefficient Factor
2. Reference of $C_f$ : MTO
3. Use 'C' value as 0.5 if the existing weighted 'C ' value is greater than 0.5 for 2-yr return period

Run off Calculation (using Rational Method):

Q = C * i * A / 360 cms

C = Runoff Coefficient

i = Rainfall Intensity (mm/ [City of Toronto IDF Curve]

A = Watershed Area (ha)

IDF Eqn : i = A * T ^ B

A & B parameter for IDF Curve

| Year | A = | B = |
|---|---|---|
| 2 | 21.800 | -0.780 |
| 5 | 32.000 | -0.790 |
| 10 | 38.700 | -0.800 |
| 25 | 45.200 | -0.800 |
| 50 | 53.500 | -0.800 |
| 100 | 59.700 | -0.800 |

| | |
|---|---|
| $T_c$ (min) | 10 |

Peak Flows

| | Rainfall | Peak Flow | |
|---|---|---|---|
| Year | mm/hr | $m^3/s$ | (L/s) |
| 2 | 88.189 | 0.053 | 53 |
| 5 | 131.792 | 0.087 | 87 |
| 10 | 162.268 | 0.107 | 107 |
| 25 | 189.522 | 0.133 | 133 |
| 50 | 224.324 | 0.161 | 161 |
| 100 | 250.320 | 0.182 | 182 |

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| | | | | |
|---|---|---|---|---|
| | Project | OLTA | No.10206938 | |
| | By | M. Khodadadi | Date | 28-Oct-2022 |
| | Checked | D.Nuttall | Checked | 28-Oct-2022 |

**Stormwater Management Calculations**

## Post-Development Runoff Coefficients - North Site

| Catchment | Area, A | 2-10-yr | | 25-yr | | | 50-yr | | | 100-yr | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C | A x C | $C_f$ | C | A x C | $C_f$ | C | A x C | $C_f$ | C | A x C |
| ID | (ha) | | | | | | | | | | | |
| Impervious | 0.15 | 0.90 | 0.14 | 1.10 | 0.95 | 0.14 | 1.20 | 0.95 | 0.14 | 1.25 | 0.95 | 0.14 |
| Landscape | 0.02 | 0.25 | 0.01 | 1.10 | 0.28 | 0.01 | 1.20 | 0.30 | 0.01 | 1.25 | 0.31 | 0.01 |
| Green Roof | 0.16 | 0.40 | 0.07 | 1.10 | 0.44 | 0.07 | 1.20 | 0.48 | 0.08 | 1.25 | 0.50 | 0.08 |
| Permeable Roof | 0.10 | 0.80 | 0.08 | 1.10 | 0.88 | 0.08 | 1.20 | 0.96 | 0.09 | 1.25 | 1.00 | 0.10 |
| | | | | | | | | | | | | |
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| | | | | | | | | | | | | |
| | **0.43** | | **0.28** | | | **0.30** | | | **0.32** | | | **0.33** |

| | | | |
|---|---|---|---|
| Total Drainage Area | | 0.43 | ha |
| Weighted C | 2-10-yr | 0.66 | |
| | 25-yr | 0.71 | |
| | 50-yr | 0.74 | |
| | 100-yr | 0.76 | |

**NOTE:**
1. $C_f$ = Runoff Coefficient Factor
2. Reference of $C_f$: MTO

Run off Calculation (using Rational Method):

Q = C * i * A / 360 cms

C = Runoff Coefficient

i = Rainfall Intensity (mm/l [City of Toronto IDF Curve]

A = Watershed Area (ha)

IDF Eqn : i = A * T ^ B

A & B parameter for IDF Curve

| Year | A = | B = |
|---|---|---|
| 2 | 21.800 | -0.780 |
| 5 | 32.000 | -0.790 |
| 10 | 38.700 | -0.800 |
| 25 | 45.200 | -0.800 |
| 50 | 53.500 | -0.800 |
| 100 | 59.700 | -0.800 |

| | |
|---|---|
| $T_c$ (min) | 10 |

Peak Flows

| | Rainfall | Peak Flow | |
|---|---|---|---|
| Year | mm/hr | $m^3/s$ | (L/s) |
| 2 | 88.189 | 0.069 | 69 |
| 5 | 131.792 | 0.103 | 103 |
| 10 | 162.268 | 0.127 | 127 |
| 25 | 189.522 | 0.160 | 160 |
| 50 | 224.324 | 0.199 | 199 |
| 100 | 250.320 | 0.227 | 227 |

| | | | | |
|---|---|---|---|---|
| | Project | OLTA | | No.10206938 |
| | By | M. Khodadadi | Date | 28-Oct-2022 |
| | Checked | D.Nuttall | Checked | 28-Oct-2022 |

**Stormwater Management Calculations**

## REQUIRED STORAGE (POST - PRE) 100 yr

### North Site

| | | |
|---|---|---|
| Watershed Area, A | 0.43 | ha |
| Weighted Post Development Runoff Coefficient, C | 0.76 | |

Using Modified Rational Method

Q = C * i * A / 360 cms

C = Runoff Coefficient

i = Rainfall intensity (mm/hr) [ From IDF Curve ]

A = Watershed Area (ha)

| | | |
|---|---|---|
| Allowable Release rate [2 yr Pre-development Flow] | 0.053 | $m^3/s$ |

| Storm Duration (min) | Storm Runoff Rate (cms) | Storm Runoff Volume ($m^3$) | Release Flow Volume ($m^3$) | Required Storage Volume ($m^3$) | Rainfall 100 Yr mm/hr |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10 | 0.227 | 135.99 | 31.60 | 104.39 | 250.320 |
| 20 | 0.130 | 156.21 | 63.20 | 93.01 | 143.771 |
| 30 | 0.094 | 169.40 | 94.80 | 74.60 | 103.944 |
| 40 | 0.075 | 179.43 | 126.40 | 53.03 | 82.575 |
| 50 | 0.063 | 187.62 | 158.01 | 29.62 | 69.075 |
| 60 | 0.054 | 194.59 | 189.61 | 4.99 | 59.700 |
| 70 | 0.048 | 200.68 | 200.68 | 0.00 | 52.774 |
| 80 | 0.043 | 206.12 | 206.12 | 0.00 | 47.427 |
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|---|---|---|
| Maximum Storage (Post - Pre) | 104 | $m^3$ |

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| | Checked | D.Nuttall | Checked | 28-Oct-2022 |

**Stormwater Management Calculations**

## Pre-Development Runoff Coefficients & Uncontrolled Peak Flows - South Site

| Catchment | Area, A | 2-10-yr | | 25-yr | | | 50-yr | | | 100-yr | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C | A x C | $C_f$ | C | A x C | $C_f$ | C | A x C | $C_f$ | C | A x C |
| ID | (ha) | | | | | | | | | | | |
| Impervious | 0.43 | 0.90 | 0.39 | 1.10 | 0.95 | 0.41 | 1.20 | 0.95 | 0.41 | 1.25 | 0.95 | 0.41 |
| Landscape | 0.00 | 0.25 | 0.00 | 1.10 | 0.28 | 0.00 | 1.20 | 0.30 | 0.00 | 1.25 | 0.31 | 0.00 |
| | | | | | | | | | | | | |
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| | | | | | | | | | | | | |
| | **0.430** | | **0.39** | | | **0.41** | | | **0.41** | | | **0.41** |

| | | | |
|---|---|---|---|
| Total Drainage Area | | 0.43 | ha |
| Weighted C | 2-10-yr | 0.90 | |
| | 25-yr | 0.95 | |
| | 50-yr | 0.95 | |
| | 100-yr | 0.95 | |

**NOTE:**
1. $C_f$ = Runoff Coefficient Factor
2. Reference of $C_f$ : MTO
3. Use 'C' value as 0.5 if the existing weighted 'C ' value is greater than 0.5 for 2-yr return period

Run off Calculation (using Rational Method):

Q = C * i * A / 360 cms

C = Runoff Coefficient

i = Rainfall Intensity (mm/ [City of Toronto IDF Curve]

A = Watershed Area (ha)

IDF Eqn : i = A * T ^ B

A & B parameter for IDF Curve

| Year | A = | B = |
|---|---|---|
| 2 | 21.800 | -0.780 |
| 5 | 32.000 | -0.790 |
| 10 | 38.700 | -0.800 |
| 25 | 45.200 | -0.800 |
| 50 | 53.500 | -0.800 |
| 100 | 59.700 | -0.800 |

| | |
|---|---|
| $T_c$ (min) | 10 |

Peak Flows

| | Rainfall | Peak Flow | |
|---|---|---|---|
| Year | mm/hr | $m^3/s$ | (L/s) |
| 2 | 88.189 | 0.053 | 53 |
| 5 | 131.792 | 0.142 | 142 |
| 10 | 162.268 | 0.174 | 174 |
| 25 | 189.522 | 0.215 | 215 |
| 50 | 224.324 | 0.255 | 255 |
| 100 | 250.320 | 0.284 | 284 |

| | | | | |
|---|---|---|---|---|
| | Project | OLTA | No.10206938 | |
| | By | M. Khodadadi | Date | 28-Oct-2022 |
| | Checked | D.Nuttall | Checked | 28-Oct-2022 |

**Stormwater Management Calculations**

## Post-Development Runoff Coefficients - South Site

| Catchment ID | Area, A (ha) | 2-10-yr C | 2-10-yr A x C | 25-yr $C_f$ | 25-yr C | 25-yr A x C | 50-yr $C_f$ | 50-yr C | 50-yr A x C | 100-yr $C_f$ | 100-yr C | 100-yr A x C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Impervious | 0.23 | 0.90 | 0.21 | 1.10 | 0.95 | 0.22 | 1.20 | 0.95 | 0.22 | 1.25 | 0.95 | 0.22 |
| Landscape | 0.02 | 0.25 | 0.01 | 1.10 | 0.28 | 0.01 | 1.20 | 0.30 | 0.01 | 1.25 | 0.31 | 0.01 |
| Green Roof | 0.11 | 0.40 | 0.04 | 1.10 | 0.44 | 0.05 | 1.20 | 0.48 | 0.05 | 1.25 | 0.50 | 0.05 |
| Permeable Roof | 0.08 | 0.80 | 0.06 | 1.10 | 0.88 | 0.07 | 1.20 | 0.96 | 0.07 | 1.25 | 1.00 | 0.08 |
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| | | | | | | | | | | | | |
| | **0.43** | | **0.32** | | | **0.34** | | | **0.35** | | | **0.35** |

| | | | |
|---|---|---|---|
| Total Drainage Area | | 0.43 | ha |
| Weighted C | 2-10-yr | 0.73 | |
| | 25-yr | 0.78 | |
| | 50-yr | 0.81 | |
| | 100-yr | 0.82 | |

**NOTE:**
1. $C_f$ = Runoff Coefficient Factor
2. Reference of $C_f$: MTO

Run off Calculation (using Rational Method):

Q = C * i * A / 360 cms

C = Runoff Coefficient

i = Rainfall Intensity (mm/l [City of Toronto IDF Curve]

A = Watershed Area (ha)

IDF Eqn : i = A * T ^ B

A & B parameter for IDF Curve

| Year | A = | B = |
|---|---|---|
| 2 | 21.800 | -0.780 |
| 5 | 32.000 | -0.790 |
| 10 | 38.700 | -0.800 |
| 25 | 45.200 | -0.800 |
| 50 | 53.500 | -0.800 |
| 100 | 59.700 | -0.800 |

| | |
|---|---|
| $T_c$ (min) | 10 |

Peak Flows

| Year | Rainfall mm/hr | Peak Flow $m^3/s$ | Peak Flow (L/s) |
|---|---|---|---|
| 2 | 88.189 | 0.077 | 77 |
| 5 | 131.792 | 0.116 | 116 |
| 10 | 162.268 | 0.143 | 143 |
| 25 | 189.522 | 0.178 | 178 |
| 50 | 224.324 | 0.218 | 218 |
| 100 | 250.320 | 0.247 | 247 |

| | | | | |
|---|---|---|---|---|
| | Project | OLTA | | No.10206938 |
| | By | M. Khodadadi | Date | 28-Oct-2022 |
| | Checked | D.Nuttall | Checked | 28-Oct-2022 |

**Stormwater Management Calculations**

## REQUIRED STORAGE (POST - PRE) 100 yr

### South Site

| | | |
|---|---|---|
| Watershed Area, A | 0.43 | ha |
| Weighted Post Development Runoff Coefficient, C | 0.82 | |

Using Modified Rational Method

Q = C * i * A / 360 cms

C = Runoff Coefficient

i = Rainfall intensity (mm/hr) [ From IDF Curve ]

A = Watershed Area (ha)

| | | |
|---|---|---|
| Allowable Release rate [2 yr Pre-development Flow] | 0.053 | $m^3/s$ |

| Storm Duration (min) | Storm Runoff Rate (cms) | Storm Runoff Volume ($m^3$) | Release Flow Volume ($m^3$) | Required Storage Volume ($m^3$) | Rainfall 100 Yr mm/hr |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10 | 0.247 | 148.09 | 31.60 | 116.48 | 250.320 |
| 20 | 0.142 | 170.11 | 63.20 | 106.90 | 143.771 |
| 30 | 0.102 | 184.47 | 94.80 | 89.67 | 103.944 |
| 40 | 0.081 | 195.40 | 126.40 | 69.00 | 82.575 |
| 50 | 0.068 | 204.32 | 158.01 | 46.31 | 69.075 |
| 60 | 0.059 | 211.91 | 189.61 | 22.30 | 59.700 |
| 70 | 0.052 | 218.54 | 218.54 | 0.00 | 52.774 |
| 80 | 0.047 | 224.45 | 224.45 | 0.00 | 47.427 |
| | | | | | |
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| | | |
|---|---|---|
| Maximum Storage (Post - Pre) | 116 | $m^3$ |

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|---|---|---|---|---|
| | Project | OLTA | No.10206938 | |
| | By | M. Khodadadi | Date | 28-Oct-2022 |
| | Checked | D. Nuttall | Date | 28-Oct-2022 |

**Stormwater Management Calculations**

## Water Balance Calculations - Overall TOC Site

| **Site Chracteristics** | | |
|---|---|---|
| Site Area | 0.86 | ha |

| **Retention Requirements** | | |
|---|---|---|
| Per Event Retain depth of | 5 | mm |
| Site requirement | 43 | $m^3$/event |

| **Catchment Area characteristics** | | **Capture Event Characteristics** | | | **Water Infiltration/ Reuse Characteristics** | | **Total Volume Retained ($m^3$)** | **% of Target** |
|---|---|---|---|---|---|---|---|---|
| **Runoff Source** | **Area (ha)** | **Capture Event (mm)** | **Initial Abstraction** | **Initial Abstraction Volume ($m^3$)** | **Run off Depth (mm)** | **Infiltration/ Reuse Volume ($m^3$)** | | |
| Impervious | 0.38 | 5 | 1 | 4 | 4 | 15 | 19 | 44% |
| Landscape | 0.04 | | 7 | 3 | 0 | 0 | 3 | 6% |
| Green Roof | 0.27 | | 5 | 13 | 0 | 0 | 13 | 31% |
| Permeable Roof | 0.17 | | 5 | 9 | 0 | 0 | 9 | 20% |
| | | | | | **Totals** | **15** | **44** | **102%** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Project | | OLTA | No.10206938 | | | |
| By | | M. Khodadadi | Date | 28-Oct-2022 | | |
| Checked | | D.Nuttall | Checked | 28-Oct-2022 | | |

Stormwater Management Calculations

**Water Quality Treatment Train Calculations - Cosburn TOC (North and South Sites)**

| | | | | | Step 1 - Source | | | | | | Step 2 - Catchbasin Shields | | | Step 3 - Water Reuse | | | | Step 4 - OGS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area (ha) | Curb Length (km) | Land Use | Runoff Coefficient | Quality Event (mm) | Relative Sediment Loading[1] ($g/m^2$) | Roadway Sediment Loading[2] (g/curb-km) | Relative TSS Produced (g) | Source Removal Efficiency | Source TSS Removal (g) | Step 1 Remaining TSS (g) | CB Shield Removal Effeciency | CB Shield TSS Removal (g) | Step 2 Remaining TSS (g) | Runoff to Storage Tank ($m^3$) | Fraction of Runoff Intercepted by Water Re-Use | Reuse TSS Removal (g) | Step 2 - Remaining TSS (g) | OGS Removal Efficiency | OGS TSS Removal (g) | Step 3 - Remaining TSS (g) |
| 0.12 | 0.20 | Impervious Roadway | 0.9 | 25 | N/A | 2819.00 | 564 | 0% | 0 | 564 | 50% | 282 | 282 | 27 | | 258 | 305 | | 153 | 153 |
| 0.28 | N/A | At-Grade Impervious | 0.9 | 25 | 0.65 | N/A | 1820 | 0% | 0 | 1820 | 50% | 910 | 910 | 63 | | 834 | 986 | | 493 | 493 |
| 0.00 | N/A | Impermeable Roof | 0.9 | 25 | 0.65 | N/A | 0 | 0% | 0 | 0 | N/A | 0 | 0 | 0 | | 0 | 0 | | 0 | 0 |
| 0.17 | N/A | Permeable Roof | 0.8 | 25 | 0.65 | N/A | 1121 | 0% | 0 | 1121 | N/A | 0 | 1121 | 35 | 0.46 | 514 | 607 | 50% | 304 | 304 |
| 0.27 | N/A | Green Roof | 0.4 | 25 | 0.65 | N/A | 1754 | 80% | 1403 | 351 | N/A | 0 | 351 | 27 | | 161 | 190 | | 95 | 95 |
| 0.02 | N/A | Landscape | 0.25 | 25 | 0.65 | N/A | 130 | 80% | 104 | 26 | 50% | 13 | 13 | 1 | | 12 | 14 | | 7 | 7 |
| **TOTALS** | | | | | | | **5389** | | | **3882** | | | **2677** | | | | **2103** | | | **1051** |

| | | |
|---|---|---|
| **Proposed Reuse Tank Size ($m^3$)** | | **70** |
| **TOTAL TSS Produced (g)** | | **5388.75** |
| **TOTAL TSS Remaining (g)** | | **1051** |
| **TSS Removal Efficiency (%)** | | **80%** |

Notes

[1] Sediment loading for high density residential land use (EPA Reference Manual III - Water Quality)

[2] Sediment loading for roadway with winter mainenance (EPA Reference Manual III - Water Quality)