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

11-15 Gertrude Place
670-710 Danforth Avenue
1-21 Lipton Avenue
2-16 Eaton Avenue

Toronto Ontario

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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Abbreviations

BMP	Best Management Practice
DMOG	Digital Map Owners Group Database
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
OLTA	Ontario Line Technical Advisor
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 and Storage Facility (OMSF), and
- Four linear geographical segments:
  - Lakeshore (containing both Lakeshore West and Lakeshore East)
  - Downtown
  - Pape
  - Thorncliffe

The Pape Segment is entirely underground and begins at the tunnel portal at the end of the Lakeshore East segment. The Pape segment ends at the tunnel portal at the Don Valley. The Pape Segment consists of two stations:

- Pape Station
- Cosburn Station

Transit Oriented Communities (TOC) are proposed at the 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 Ontario Line TOC at Pape Station located at the intersection of Pape Avenue and Danforth Avenue in the City of Toronto with respect to drainage conveyance, stormwater quantity control, stormwater quality treatment, and water balance.

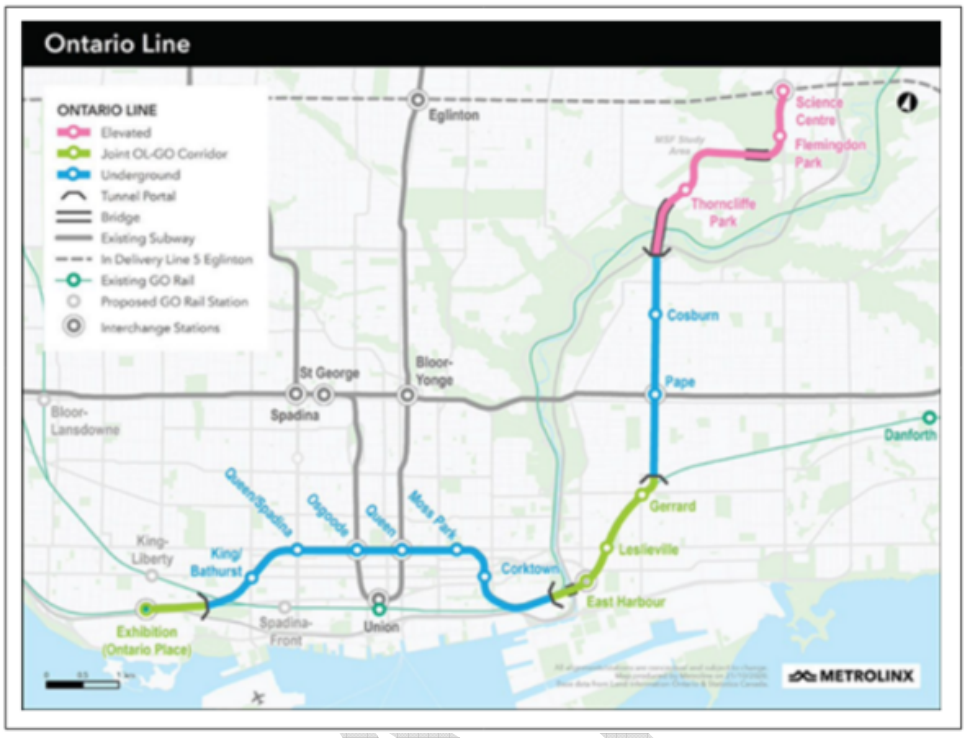

Figure 1-1. Ontario Line Segments

1.2 Pape Station TOC

Pape Station is located at the northeast corner of the intersection of Pape Avenue and Danforth Avenue. Two development sites are proposed, the first site (referred herein as the South Site) is integrated into the proposed Pape Station at Danforth Avenue and Pape Avenue and contains two multi-story buildings. The second site (referred herein as the North Site) is north of the station, on Gertrude Place and contains one multi-story building. The South Site consists of municipal addresses 670-710 Danforth Avenue, 2-16 Eaton Avenue, and 1-21 Lipton Avenue. The North Site consists of municipal addresses 11-15 Gertrude Place.

1.3 Background Review

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

- Digital Map Owners Group Database (DMOG), City of Toronto; and Toronto Water Asset Geodatabase (TWAG) (City of Toronto)
- Pape TOC South Site Architecture and Landscape Set – Rezoning (SvN)
- Pape TOC North Site Architecture and Landscape Set – Rezoning (SvN)
- Drainage and Stormwater Management Report Pape Station (Stantec)

2 Existing Conditions

The existing conditions of the South Site are relatively flat terrain occupied by mixed use commercial-residential buildings on Danforth Avenue and Eaton Avenue, and residential buildings on Lipton Avenue. The South Site features a combination of impervious roof and pavement surfaces, and vegetated surfaces. The North Site is located on relatively flat terrain and is occupied by residential buildings along Gertrude Place. The North Site features a combination of impervious roof and pavement surfaces, and vegetated surfaces. Refer to **Figure 2-1** for the existing conditions of the proposed development. Pape Station is located in the Don River Watershed. Pape Station is within Basement Flooding Study Area 32. The study of which was started in 2008, and completed in 2012, according to the City of Toronto.

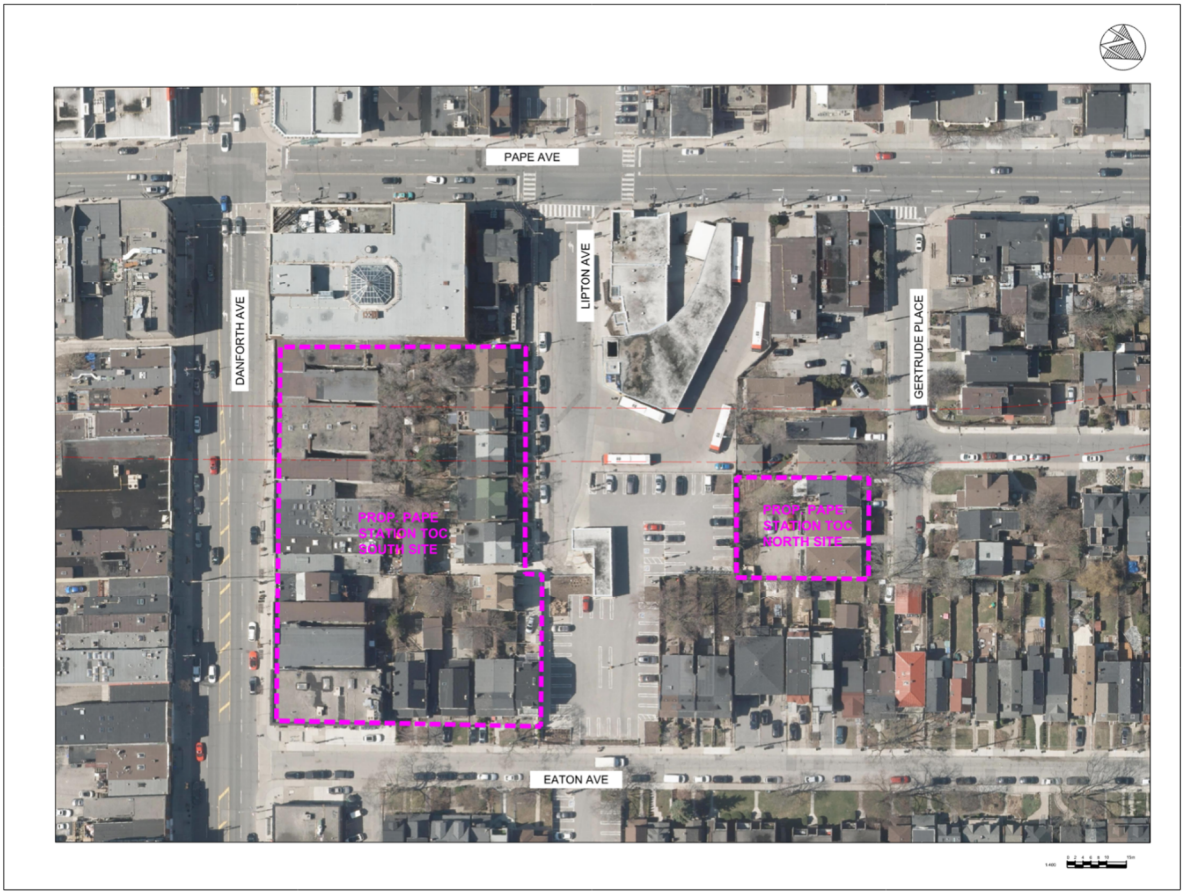

Figure 2-1. Area Plan

2.1 Minor and Major Flows

Existing storm sewers adjacent to the South Site include a 675 mm storm sewer along Eaton Ave, flowing north to south and connecting into the Danforth Ave storm sewer. A 1500 mm X 1200 mm storm sewer flows west to east along Danforth Avenue. A 300 mm combined sewer flows east to west along Lipton Ave and connects into the 450 mm combined sewer on Pape Ave. Existing storm sewers adjacent to the North site include a

450 mm storm sewer flowing east to west along Gertrude Place, connecting to the 1200 mm storm sewer on Pape Ave, flowing south to north. Refer to the attached existing conditions drainage plan in **Appendix A**. With the limited information that is currently available, assumptions for existing stormwater servicing for the proposed development area were made and are summarized in **Table 2-1**.

Major flows along Danforth Avenue flow west to east. Major flows on Eaton Avenue flow south to north. Major flows along Lipton Ave flow east to west, onto Pape Ave. A portion of major flows along Pape Ave collect at a sag point at the intersection of Pape Ave and Lipton Ave. The remainder of major flows near the proposed development on Pape Ave flow north to south. Major flows on Gertrude Place flow toward a sag point at the intersection of Gertrude Place and Muriel Ave.

Table 2-1. Pre-Development Stormwater Servicing

Address	Subcatchment	Assumed Service
15 Gertrude Pl.	102	Gertrude Place 450 mm R.C.P. Storm Sewer
1-25 Lipton Ave.	101B	Lipton Avenue 300 mm V.P. Combined Sewer
1-20 Eaton Ave 710 Danforth Ave.	101C	Eaton Avenue 375 mm Combined Sewer
670-708 Danforth Ave.	101A	Danforth Avenue 1500 mm x 1200 mm Storm Sewer

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. 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)

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 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

- As a mandatory minimum, 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).
- For residential infill development (between 0.1 ha and 5 ha) where storm/combined sewer infrastructure exists, erosion control is not required unless the site is located in close proximity to natural watercourse (WWFMG).
- For new large development sites (> 5 ha) discharge directly and/or in proximity (within 100 m) of natural watercourses, it is required to complete an Erosion Analysis Report to determine the erosion control criteria for the sites (WWFMG).
- For sites where it is not feasible (this condition must be reviewed and agreed by City staff) to complete an erosion analysis study report, it is typically required that runoff from a 25 mm design storm shall be detained on-site and released over a minimum of 24 hours (WWFMG).

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

Two multi-story development buildings are proposed at the northeast corner of Danforth Avenue and Pape Avenue, comprising the South Site. The North Site is a single multi-story development building on Gertrude Place. Both the South and North Sites are shown on the Proposed Drainage Area Plan **(Appendix A)**. The proposed Pape Station will be located on the first level of the proposed South Site TOC. Stormwater runoff from the South Site will be conveyed to an underground storage and re-use tank, then an OGS unit prior to discharging into the storm sewer on Danforth Avenue. Due to pre-development conditions of the south site having portions of the south site being serviced by Danforth Ave, Eaton Ave, and Lipton Ave storm sewers, orifice controls will limit post-development flows to only that of the pre-development peak flows originally contributing to the Danforth storm sewer. Stormwater runoff from the North Site will be conveyed to an underground storage and re-use tank, then an OGS unit prior to discharging into the storm sewer on Gertrude Place.

Ontario Line Pape TOC site development is as follows:

- Two proposed buildings at the northeast intersection of Pape Avenue and Danforth Avenue with a shared underground complex. This South Site has a total area of 0.62 ha.
- One proposed building at the southeast end of Gertrude Place. The North Site has a total area of 0.09 ha.

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 Pape Station TOC site. The stormwater best management practices (BMP) considered for the site include a green roof, underground storage and reuse tanks, and oil/grit separator (OGS) units. The Proposed Conditions Drainage Plan is presented in **Appendix A**.

All building openings shall 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. For the South Site, allowable peak release rate will be limited to the 2-year pre-development peak flow for catchment 101A,

which is the only pre-development catchment on the south site contributing to the Danforth Avenue storm sewer. 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 192 m^3 for the South Site and 25 m^3 for the North Site, as shown in **Table 5-1** and **Table 5-2**. Detailed calculations are included in **Appendix B**. In concept, a storage tank with orifice control can be installed in the first underground level to provide the required storage volume.

Table 5-1. South Site Quantity Control Storage

ID	Area (ha)		Runoff Coefficient			Allowable Release Rate[3] (L/s)	Required Storage Volume (m^3)
	Exist.[1]	Prop.	Exist.	Exist.[2] (City Criteria)	Prop.		
201	0.26	0.62	0.81	0.50	0.71	32	192

Note:
[1] Post-Development flows limited to pre-development catchment 101A. Refer to **Table 2-1**.
[2] Assuming a runoff coefficient of 0.5 if the existing imperviousness is greater than 50%.
[3] Based on the 2-yr pre-development flow rate

Table 5-2. North Site 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.		
202	0.09	0.09	0.74	0.50	0.82	10	25

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 31.1 m^3/event for the South Site and 4.3 m^3/event for the North Site. The total proposed green roof areas are 2186 m^2 and 135 m^2 for the south and north sites, respectively. In concept, initial abstractions on the various surfaces will achieve a retention of 15.6 m^3/event for the South Site and 1.4 m^3/event for the North Site. To meet the TGS Version 4 Tier 1 criterion, the remaining runoff will be stored in quantity control storage tank below the tank's orifice control. In concept, the required tank storage below orifice controls are 15.4 m^3 for the South Site and 2.9 m^3 for the North Site to meet the water balance criterion. By satisfying the water balance retention criterion, the erosion control criterion will be achieved for the sites, since they have drainage areas less than 2 ha. Refer to **Table 5-3** and **Table 5-4** for water balance storage summary and **Appendix B** for detailed calculations.

Table 5-3. South Site Water Balance Storage

ID	Land Cover Type	Area (ha)	Initial Abstraction		Reuse			Total[1] (m^3)
			Depth (mm)	Volume (m^3)	Depth (mm)	Required Volume (m^3)	Proposed Volume (m^3)	
201	Impervious	0.39	1	3.9	4	15.4	47.7	63.3
	Green Roof	0.22	5	10.9	0	0		
	Landscape	0.02	7	0.8	0	0		

Notes:
[1] The sum of initial abstraction and proposed reuse volume

Table 5-4. North Site Water Balance Storage

ID	Land Cover Type	Area (ha)	Initial Abstraction		Reuse			Total[1] (m^3)
			Depth (mm)	Volume (m^3)	Depth (mm)	Required Volume (m^3)	Proposed Volume (m^3)	
202	Impervious	0.06	1	0.7	4	2.9	9.4	10.8
	Green Roof	0.02	5	0.7	0	0		

Notes:
[1] 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, water reuse, and an OGS units will provide the required quality control to the runoff leaving both South and North sites as shown in **Table 5-5** and **Table 5-6.** Detailed calculations are provided in **Appendix B**.

Table 5-5. South Site Quality Control

Land Use	Area (ha)	TSS Produced[1] (g)	Source TSS Removed (g)	Reqd. Reuse Storage in Tank (m^3)	Water Reuse TSS Removed (g)	OGS TSS Removed (g)	TSS Removal
Imperv.	0.39	2355	0	47.7	1023	666	80%
Imperv. Roadway	0.02	563	0		245	159	
Green Roof	0.19	1421	1137		124	80	
Landscape	0.02	109	87		9	6	

Notes:
[1] Assumed 0.65 g/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 5-6. North Site Quality Control

Land Use	Area (ha)	TSS Produced[1] (g)	Source TSS Removed (g)	Reqd. Reuse Storage in Tank (m^3)	Water Reuse TSS Removed (g)	OGS TSS Removed (g)	TSS Removal
Imperv.	0.07	469	0	9.4	251	109	80%
Green Roof	0.01	88	70		9	4	

Notes:
[1] Assumed 0.65 g/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 requires treatment and be directed toward the municipal storm sewer or sanitary sewer. 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 Pape Station TOC Development Site. The RCD satisfies SWM and drainage requirements for the Proposed Pape Station TOC Site as follows:

- **Quantity Control:**

  A storage tank unit with orifice control is proposed in underground levels for both sites to provide quantity control. The south site will have a 192 m^3 storage tank with an

allowable release rate of 32 L/s. The north site will have a 25 m^3 storage tank with an allowable release rate of 10 L/s.

- **Quality Control:**

  Quality control for each site will be provided via the proposed green roof along with the water captured in the storage tank for reuse and an Oil Grit Separator unit. For the south site, 47.7 m^3 reuse volume is required to meet quality requirements. For the north site, 9.4 m^3 reuse volume is required to meet quality requirements.

- **Water Balance:**

  Green roof and water reuse are proposed to satisfy the 10 mm retention requirement for both sites. Reuse volume for quality control of 47.7 m^3 and 9.4 m^3 for the south and north sites respectively will exceed the water balance requirements.

- **Minor Drainage System:**

  Water captured on the south site will be directed to an underground storage and reuse tank prior to being discharged into the Danforth storm sewer. Water captured on the north site will be directed to an underground storage and reuse tank prior to being discharged into the Gertrude Place storm sewer.

- **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

PAPE AVE

DANFORTH AVE

LIPTON AVE

GERTRUDE PLACE

EATON AVE

450mm VP. COMBINED SEWER
1200mm CIR. CONCRETE STORM SEWER
1500mm x 1200mm HORSESHOE STORM SEWER
450mm V.P. COMBINED SEWER
300mm V.P. COMBINED SEWER

300mm V.P. STORM SEWER
300mm V.P. STORM SEWER

450mm R.C.P. STORM SEWER
375mm V.P. COMBINED SEWER

450mm R.C.P. STORM SEWER
450mm R.C.P. STORM SEWER

375mm V.P. STORM SEWER
375mm V.P. COMBINED SEWER
600mm R.C.P. STORM SEWER

1050mm x 1050mm HORSESHOE STORM SEWER
450mm V.P. COMBINED SEWER
675mm R.C.P. STORM SEWER

101A
0.26 | 0.81

101B
0.23 | 0.62

101C
0.13 | 0.85

102
0.09 | 0.74

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.

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

COMB COMB — EXISTING COMBINED SEWER

REVISIONS		REVISIONS	
1		4	
2		5	
3		6	

RCD
NOT FOR CONSTRUCTION
DD MONTH YYYY

SCALE(S) 1:400 0 2 4 6 8 10 15m

STATUS

ONETEAM
ONTARIO LINE TECHNICAL ADVISOR

DESIGNED N.FEHLINGS
DRAWN N.FEHLINGS
CHECKED D.NUTTALL
APPROVED D.NUTTALL

ONTARIO LINE SUBWAY

TITLE
PAPE STATION
TOC
EXISTING DRAINAGE PLAN

Plot Date: 24 October 2022

METROLINX
Infrastructure Ontario

Dwg. No.

Sheet No.

FILE: 10206938-dr0300-04-sf001.dwg
PLOTTED BY: FEHLINGS, NICHOLAS

PAPE AVE

DANFORTH AVE

LIPTON AVE

GERTRUDE PLACE

EATON AVE

450mm VP. COMBINED SEWER
1200mm CIR. CONCRETE STORM SEWER
1500mm x 1200mm HORSESHOE STORM SEWER
450mm V.P. COMBINED SEWER
300mm V.P. COMBINED SEWER

300mm V.P. STORM SEWER
300mm V.P. STORM SEWER

450mm R.C.P. STORM SEWER
375mm V.P. COMBINED SEWER

PROPOSED EASTBOUND TRACK CENTERLINE
PROPOSED WESTBOUND TRACK CENTERLINE

450mm R.C.P. STORM SEWER
450mm R.C.P. STORM SEWER

375mm V.P. STORM SEWER
375mm V.P. COMBINED SEWER
600mm R.C.P. STORM SEWER

1050mm x 1050mm HORSESHOE STORM SEWER
450mm V.P. COMBINED SEWER
675mm R.C.P. STORM SEWER

201
0.62 | 0.71

202
0.09 | 0.82

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.
5. REFER TO THE SERVICING PLAN FOR THE PROPOSED STORM SEWERS AND SERVICING CONNECTIONS.

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
- COMB COMB — EXISTING COMBINED SEWER
- PROPOSED UNDERGROUND CONCOURSE LEVEL (BY OTHERS)

REVISIONS		REVISIONS	
1		4	
2		5	
3		6	

RCD
NOT FOR CONSTRUCTION
DD MONTH YYYY

SCALE(S) 1:400 — 0 2 4 6 8 10 15m

STATUS

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DESIGNED N.FEHLINGS
DRAWN N.FEHLINGS
CHECKED D.NUTTALL
APPROVED D.NUTTALL

ONTARIO LINE SUBWAY

TITLE
PAPE STATION
TOC
PROPOSED DRAINAGE PLAN

Plot Date: 28 October 2022

METROLINX
Infrastructure Ontario

Dwg. No.

Sheet No.

FILE: 10206938-dr0300-04-sf001.dwg
PLOTTED BY: FEHLINGS, NICHOLAS

Appendix B. Stormwater Management Calculations

	Project	OLTA	No.10206938	
	By	N. Fehlings	Date	28-Oct-2022
	Checked	D.Nuttall	Checked	28-Oct-2022

Stormwater Management Calculations

Pre-Development Runoff Coefficients & Uncontrolled Peak Flows - 101A

Catchment	Area, A	2-yr		5-yr		10-yr		25-yr			50-yr			100-yr		
		C	A x C	C	A X C	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	0.23	0.90	0.20	0.90	0.20	0.90	0.20	1.10	0.95	0.22	1.20	0.95	0.22	1.25	0.95	0.22
Pervious	0.04	0.25	0.01	0.25	0.01	0.25	0.01	1.10	0.28	0.01	1.20	0.30	0.01	1.25	0.31	0.01
	0.26		**0.21**		**0.21**		**0.21**			**0.23**			**0.23**			**0.23**

Total Drainage Area		0.26	ha
Weighted C	2-yr	0.81	***Note 3**
	5-yr	0.81	
	10-yr	0.81	
	25-yr	0.86	
	50-yr	0.86	
	100-yr	0.86	

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/h [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	0.032	32
5	131.792	0.078	78
10	162.268	0.096	96
25	189.522	0.119	119
50	224.324	0.141	141
100	250.320	0.158	158

	Project	OLTA	No.10206938	
	By	N. Fehlings	Date	28-Oct-2022
	Checked	D.Nuttall	Checked	28-Oct-2022

Stormwater Management Calculations

Pre-Development Runoff Coefficients & Uncontrolled Peak Flows - 101B

Catchment	Area, A	2-yr		5-yr		10-yr		25-yr			50-yr			100-yr		
ID	(ha)	C	A x C	C	A X C	C	A X C	C_f	C	A x C	C_f	C	A x C	C_f	C	A x C
Impervious	0.13	0.90	0.12	0.90	0.12	0.90	0.12	1.10	0.95	0.12	1.20	0.95	0.12	1.25	0.95	0.12
Pervious	0.10	0.25	0.02	0.25	0.02	0.25	0.02	1.10	0.28	0.03	1.20	0.30	0.03	1.25	0.31	0.03
	0.23		**0.14**		**0.14**		**0.14**			**0.15**			**0.15**			**0.16**

Total Drainage Area		0.23	ha
Weighted C	2-yr	0.62	***Note 3**
	5-yr	0.62	
	10-yr	0.62	
	25-yr	0.66	
	50-yr	0.67	
	100-yr	0.68	

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/h [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	0.028	28
5	131.792	0.052	52
10	162.268	0.064	64
25	189.522	0.080	80
50	224.324	0.096	96
100	250.320	0.108	108

	Project	OLTA	No.10206938	
	By	N. Fehlings	Date	28-Oct-2022
	Checked	D.Nuttall	Checked	28-Oct-2022

Stormwater Management Calculations

Pre-Development Runoff Coefficients & Uncontrolled Peak Flows - 101C

Catchment	Area, A	2-yr		5-yr		10-yr		25-yr			50-yr			100-yr		
		C	A x C	C	A X C	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	0.12	0.90	0.10	0.90	0.10	0.90	0.10	1.10	0.95	0.11	1.20	0.95	0.11	1.25	0.95	0.11
Pervious	0.01	0.25	0.00	0.25	0.00	0.25	0.00	1.10	0.28	0.00	1.20	0.30	0.00	1.25	0.31	0.00
	0.13		**0.11**		**0.11**		**0.11**			**0.11**			**0.11**			**0.11**

Total Drainage Area		0.13	ha
Weighted C	2-yr	0.85	***Note 3**
	5-yr	0.85	
	10-yr	0.85	
	25-yr	0.90	
	50-yr	0.90	
	100-yr	0.90	

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/h [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	0.015	15
5	131.792	0.039	39
10	162.268	0.048	48
25	189.522	0.059	59
50	224.324	0.070	70
100	250.320	0.078	78

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Project	OLTA	No.10206938		
By	N. Fehlings	Date	28-Oct-2022	
Checked	D.Nuttall	Checked	28-Oct-2022	

Stormwater Management Calculations

Post-Development Runoff Coefficients - South Site (201)

Catchment	Area, A	2-yr		5-yr		10-yr		25-yr			50-yr			100-yr		
ID	(ha)	C	A x C	C	A X C	C	A X C	C_f	C	A x C	C_f	C	A x C	C_f	C	A x C
Impervious	0.39	0.90	0.35	0.90	0.35	0.90	0.35	1.10	0.95	0.37	1.20	0.95	0.37	1.25	0.95	0.37
Pervious	0.02	0.25	0.00	0.25	0.00	0.25	0.00	1.10	0.28	0.00	1.20	0.30	0.01	1.25	0.31	0.01
Green Roof	0.22	0.40	0.09	0.40	0.09	0.40	0.09	1.10	0.44	0.10	1.20	0.48	0.10	1.25	0.50	0.11
	0.62		**0.44**		**0.44**		**0.44**			**0.47**			**0.48**			**0.48**

Total Drainage Area		0.62	ha
Weighted C	2-yr	0.71	
	5-yr	0.71	
	10-yr	0.71	
	25-yr	0.75	
	50-yr	0.77	
	100-yr	0.77	

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/h [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	0.108	108
5	131.792	0.161	161
10	162.268	0.198	198
25	189.522	0.246	246
50	224.324	0.297	297
100	250.320	0.335	335

	Project	OLTA		No.10206938
	By	N. Fehlings	Date	28-Oct-2022
	Checked	D.Nuttall	Checked	28-Oct-2022

Stormwater Management Calculations

REQUIRED STORAGE (POST - PRE) 100 yr

South Site (201)

Watershed Area, A	0.62	ha
Weighted Post Development Runoff Coefficient, C	0.77	

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]	0.032	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	0.335	200.78	19.35	181.43	250.320
20	0.192	230.63	38.70	191.93	143.771
30	**0.139**	**250.11**	**58.05**	**192.06**	103.944
40	0.110	264.93	77.40	187.53	82.575
50	0.092	277.02	96.75	180.27	69.075
60	0.080	287.31	116.10	171.21	59.700

Maximum Storage (Post - Pre)	192	m^3

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	Project	OLTA	No.10206938	
	By	N.Fehlings	Date	28-Oct-2022
	Checked	D. Nuttall	Date	28-Oct-2022

Stormwater Management Calculations

Water Balance Calculations - South Site (201)

Site Chracteristics		
Site Area	0.62	ha

Retention Requirements		
Per Event Retain depth of	5	mm
Site requirement	31.1	m^3/event

Catchment Area characteristics		Capture Event Characteristics			Water 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)**	**Reuse Volume (m^3)**		
Impervious	0.39	5	1	3.9	4	15.4	19.3	62%
Landscape	0.02		7	0.8	0	0.0	0.8	3%
Green Roof	0.22		5	10.9	0	0.0	10.9	35%
					Totals	**15.4**	**31.1**	**100%**

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HDR

Project		OLTA	No.10206938		
By		N. Fehlings	Date	28-Oct-2022	
Checked		O.Nuttall	Checked	28-Oct-2022	

Stormwater Management Calculations

Water Quality Treatment Train Calculations - South Site (201)

					Step 1 - Source						Step 2 - Water Reuse				Step 3 - OGS		
Area (ha)	Curb Length (km)	Land Use	Runoff Coefficient	Quality Event (mm)	Relative Sediment Loading[1] (g/m²_5 day)	Roadway Sediment Loading[2] (g/curb-km)	Relative TSS Produced (g)	Source Removal Efficiency	Source TSS Removal (g)	Step 1 Remaining TSS (g)	Runoff to Storage-Reuse Tank (m³)	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)
0.02	0.20	Impervious Roadway	0.9	25	N/A	2815	563	0%	0	563	5.3		245	318		159	159
0.36	N/A	Impervious	0.9	25	0.65	N/A	2355	0%	0	2355	81.5	0.43	1023	1332	50%	666	666
0.22	N/A	Green Roof	0.4	25	0.65	N/A	1421	80%	1137	284	21.9		124	161		80	80
0.02	N/A	Landscape	0.25	25	0.65	N/A	109	80%	87	22	1.1		9	12		6	6
TOTALS							**4448**			**3224**				**1823**			**911**

Proposed Reuse Tank Size (m³)		**47.7**
TOTAL TSS Produced (g)		**4448**
TOTAL TSS Remaining (g)		**911**
TSS Removal Efficiency (%)		**80%**

Notes:

[1] From EPA Reference Manual III High Density Residential Loading Rate
[2] From EPA Reference Manual III Winter Loading Rate on Poor Asphalt

	Project					OLTA	No.10206938	
	By					N. Fehlings	Date	28-Oct-2022
	Checked					D.Nuttall	Checked	28-Oct-2022

Stormwater Management Calculations

Pre-Development Runoff Coefficients & Uncontrolled Peak Flows - 102

Catchment	Area, A	2-yr		5-yr		10-yr		25-yr			50-yr			100-yr		
		C	A x C	C	A X C	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	0.06	0.90	0.06	0.90	0.06	0.90	0.06	1.10	0.95	0.06	1.20	0.95	0.06	1.25	0.95	0.06
Pervious	0.02	0.25	0.01	0.25	0.01	0.25	0.01	1.10	0.28	0.01	1.20	0.30	0.01	1.25	0.31	0.01
	0.09		**0.06**		**0.06**		**0.06**			**0.07**			**0.07**			**0.07**

Total Drainage Area		0.09	ha
Weighted C	2-yr	0.74	***Note 3**
	5-yr	0.74	
	10-yr	0.74	
	25-yr	0.78	
	50-yr	0.79	
	100-yr	0.79	

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/h [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	0.010	10
5	131.792	0.023	23
10	162.268	0.028	28
25	189.522	0.035	35
50	224.324	0.042	42
100	250.320	0.047	47

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	Project					OLTA	No.10206938	
	By					N. Fehlings	Date	28-Oct-2022
	Checked					D.Nuttall	Checked	28-Oct-2022

Stormwater Management Calculations

Post-Development Runoff Coefficients - North Site (202)

Catchment	Area, A	2-yr		5-yr		10-yr		25-yr			50-yr			100-yr		
ID	(ha)	C	A x C	C	A X C	C	A X C	C_f	C	A x C	C_f	C	A x C	C_f	C	A x C
Impervious	0.07	0.90	0.06	0.90	0.06	0.90	0.06	1.10	0.95	0.07	1.20	0.95	0.07	1.25	0.95	0.07
Green Roof	0.01	0.40	0.01	0.40	0.01	0.40	0.01	1.10	0.44	0.01	1.20	0.48	0.01	1.25	0.50	0.01
	0.09		**0.07**		**0.07**		**0.07**			**0.07**			**0.07**			**0.08**

Total Drainage Area		0.09	ha
Weighted C	2-yr	0.82	
	5-yr	0.82	
	10-yr	0.82	
	25-yr	0.87	
	50-yr	0.88	
	100-yr	0.88	

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/h [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	0.017	17
5	131.792	0.026	26
10	162.268	0.032	32
25	189.522	0.039	39
50	224.324	0.047	47
100	250.320	0.052	52

	Project	OLTA		No.10206938
	By	N. Fehlings	Date	28-Oct-2022
	Checked	D.Nuttall	Checked	28-Oct-2022

Stormwater Management Calculations

REQUIRED STORAGE (POST - PRE) 100 yr

North Site (202)

Watershed Area, A	0.09	ha
Weighted Post Development Runoff Coefficient, C	0.88	

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]	0.010	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	**0.052**	**31.39**	**6.29**	**25.10**	250.320
20	0.030	36.06	12.58	23.48	143.771
30	0.022	39.11	18.87	20.23	103.944
40	0.017	41.42	25.16	16.26	82.575
50	0.014	43.31	31.45	11.86	69.075
60	0.012	44.92	37.74	7.18	59.700

Maximum Storage (Post - Pre)	25	m^3

Project	OLTA	No.10206938	
By	N.Fehlings	Date	28-Oct-2022
Checked	D. Nuttall	Date	28-Oct-2022

Stormwater Management Calculations

Water Balance Calculations - North Site (202)

Site Chracteristics		
Site Area	0.09	ha

Retention Requirements		
Per Event Retain depth of	5	mm
Site requirement	4.3	m^3/event

Catchment Area characteristics		**Capture Event Characteristics**			**Water 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	0.07	5	1	0.7	4	2.9	3.6	84%
Green Roof	0.01		5	0.7	0	0.0	0.7	16%
					Totals	**2.9**	**4.3**	**100%**

	Project	OLTA	No.10206938				
	By	N. Fehlings	Date	28-Oct-2022			
	Checked	D.Nuttall	Checked	28-Oct-2022			

Stormwater Management Calculations

Water Quality Treatment Train Calculations - North Site (202

				Step 1 - Source					Step 2 - Water Reuse				Step 3 - OGS		
Area (ha)	Land Use	Runoff Coefficient	Quality Event (mm)	Relative Sediment Loading[1] (g/m^2-5 day)	Relative TSS Produced (g)	Source Removal Efficiency	Source TSS Removal (g)	Step 1 Remaining TSS (g)	Runoff to Storage-Reuse 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)
0.07	Impervious	0.9	25	0.65	469	0%	0	469	16.2	0.53	251	218	50%	109	109
0.01	Green Roof	0.4	25	0.65	88	80%	70	18	1.4		9	8		4	4
TOTALS					**556**			**486**				**226**			**113**

Proposed Reuse Tank Size (m^3)	**9.4**
TOTAL TSS Produced (g)	**556**
TOTAL TSS Remaining (g)	**113**
TSS Removal Efficiency (%)	**80%**

Notes:

[1] From EPA Reference Manual III High Density Residential Loading Rate