



Technical Requirements for Municipal Non-Conventional Stormwater Management Facilities

March 2026



Technical Requirements for Municipal Non-Conventional Stormwater Management Facilities

CITY OF MARKHAM

MARCH 2026



TABLE OF CONTENTS

1.0	Introduction	1
1.1	Submission Materials Overview	1
2.0	Design Criteria, Standards and Specifications	3
2.1	General Stormwater Management Criteria	3
2.2	List of Acceptable Technologies	3
2.3	Overall NCSWMF Design Requirements	5
2.3.1	Parks, SWMF Block, Open Space Block and Greenway System Specific Requirements	8
2.3.1.1	General	8
2.3.1.2	Operations & Maintenance Design Requirements	12
2.3.1.3	Access Route Design	13
2.3.2	Right-of-Way Specific Requirements.....	14
2.3.2.1	General	14
2.3.2.2	Operations & Maintenance Design Requirements	16
2.4	Quantity Control Sizing and Modelling	16
2.5	Extended Detention	17
2.6	Permanent Pool / Quality Control	17
2.7	Emergency Flow Routes.....	17
2.8	Infiltration Facility	18
2.9	Pre-Treatment Facility Options	18
2.10	Inlet Structures.....	19
2.11	Design Drawings and Details.....	19
2.12	Delivery and Installation (Pre-Cast Facilities).....	19
2.13	Structural Design Assessment Report with Supporting Investigations	20
3.0	Operations & Maintenance Manual	21
3.1	General Requirements.....	22
3.2	Inspection & Monitoring	23
3.2.1	Stormwater Quantity Monitoring	24
3.2.2	Stormwater Quality Monitoring	25
3.3	Sediment Removal Maintenance.....	26
3.4	Life Cycle Maintenance	26
4.0	Construction Phase Considerations	27
5.0	Acceptance for Maintenance Requirements	28
6.0	Assumption Requirements.....	29

LIST OF TABLES

Table 1: Submission Material Summary	1
Table 2: List of Acceptable Product Types	4
Table 3: Park Facility Acceptance.....	9
Table 4: Creditable for Water Quality Pre-Treatment Alternatives	18
Table 5: Non-Creditable for Water Quality Pre-Treatment Alternatives	18
Table 6: Sediment Loading	26

CONCEPTUAL DRAWING DETAILS

<u>DRAWING ID</u>	<u>DESCRIPTION</u>
SWMF-01A	Typical Conceptual Non-Conventional SWMF (Outlet to Watercourse) (Plan)
SWMF-01B	Typical Conceptual Non-Conventional SWMF (Outlet to Pipe) (Plan)
SWMF-02	Typical Conceptual Non-Conventional SWMF Cross-Sections (With Outlet Control Structures)
SWMF-03	Emergency Spillway and Overland Flow Route Above Non-Conventional SWMFs
SWMF-04	Maintenance Access Road Above Non-Conventional SWMF
SWMF-05	Maintenance Access Road Above Non-Conventional SWMF (Paved)
SWMF-06	Multi-Use Pathway Over Non-Conventional SWMF
SWMF-07	Maintenance Hole Bump Out from Pedestrian Path for Non-Conventional SWMF
SWMF-08	Tree Planting Above Non-Conventional SWMFs
SWMF-09	Typical Cut-Off Swale Detail Above Non-Conventional SWMFs
SWMF-10	Typical Footing Over Non-Conventional SWMFs
SWMF-11	Typical Non-Conventional SWMF Bypass Structure
SWMF-12	Plan View Schematic of a Stormwater Management Pond with Retaining Wall

1.0 INTRODUCTION

While conventional stormwater management facilities, including stormwater management ponds, remain the standard approach in the City of Markham, Non-Conventional Stormwater Management Facilities (NCSWMFs) can offer an alternative suite of practices that broaden the range of stormwater management solutions to support development. This document provides the City of Markham (the City) design criteria, standards and specifications for the implementation, operation and maintenance of Non-Conventional Stormwater Management Facilities (NCSWMFs), such as underground storage tanks, super pipes or Stormwater Management Ponds with single sided vertical retaining walls, within park blocks, open space blocks, greenway systems, or rights-of-way (ROW), which are or will become City owned infrastructure and lands. In addition, details on the required Operations & Maintenance (O&M) requirements are also provided. The Applicant shall indicate their intention to implement NCSWMFs at the time of the Pre-Consultation Submission to the City.

1.1 Submission Materials Overview

Table 1 below is a summary of the reports and materials that must be submitted to provide sufficient information for the review of the proposed Non-Conventional SWMFs, as well as the development stage at which they must be submitted. The table is intended to delineate additional or enhanced documentation or background studies that are not already required as part of the City of Markham's submissions standards or are specific to NCSWMFs. Please refer to ANNEX 2 of the City of Markham's Engineering Design Criteria for Submission Outlines for Various Engineering Reports/Studies for a comprehensive list of what might be required in a submission.

It is noted that the Non-Conventional SWMF Justification Report is to be sealed by a P.Eng. and should be submitted with any first official submission to the City, regardless of the specific planning stage.

TABLE 1: SUBMISSION MATERIAL SUMMARY

Deliverable	Level of Design	Development Stage
Expression of Intent to use Non-Conventional SWMFs	n/a	Pre-Consultation Submission
Non-Conventional SWMF Justification Report	Conceptual level of detail which demonstrates viability of facility.	Draft Plan of Subdivision (PLAN) / Functional Servicing (Can include MESP, Block Plan, Secondary Plan, and OPA/ZBA submissions, as well as Draft Plan Submissions if none of the above apply)

Deliverable	Level of Design	Development Stage
Functional Servicing Report (FSR)	- FSR level detail for Non-Conventional SWMF and associated facilities, grading, servicing, and modelling. - FSR level detail for site specific conditions (ex. Hydrogeological, geotechnical etc.) - Justification for product choice for Non-Conventional SWMF. - Park Facility Fit Plan	Draft Plan of Subdivision Submission (PLAN) / Functional Servicing
SWM Report / Stormwater Management Facility Design Report	- Detailed design for all SWMFs and surface design - Detailed modelling - Shop drawings - Detailed sections - Engineering drawings - Refer to Annex 1 and 2 of existing City Engineering Design Criteria	Technical Review of Plan of Subdivision (TEC) / Detailed Design Submission
Structural Design Assessment Report	- Structural assessment of proposed detailed design of NCSWMF against design criteria - Review of geotechnical conditions, requirements, and applicability of proposed materials (e.g., bedding material) - Review of structural assumptions	Technical Review of Plan of Subdivision (TEC) / Detailed Design Submission
Operations & Maintenance Report	Refer to Section 3.0	Technical Review of Plan of Subdivision (TEC) / Design Submission
Stormwater CLI-ECA Approval (Form SW2 Part 2 and 3)	- Description of stormwater management facility (SW2 Part 2) - Verification by Licenced Engineering Practitioner (SW2 Part 3)	CLI-ECA approval before construction (pre-authorized works)
Schedule C application to MECP Director	- Application to amend Stormwater CLI-ECA - Standard ECA Application Form and process and supporting documentation requirements that are currently in place	CLI-ECA approval before construction (non-pre-authorized works)
Stormwater CLI-ECA Approval (Form SW2 Part 5)	Inspection records before operation to ensure that the works as constructed will continue to	CLI-ECA approval after construction

Deliverable	Level of Design	Development Stage
	conform to the Design Criteria and the Stormwater CLI-ECA • Inspection results • Post-construction Verification by Owner for Inspection (SW2 Part 5)	

2.0 DESIGN CRITERIA, STANDARDS AND SPECIFICATIONS

The following criteria guide the design of NCSWMFs in conjunction with the City of Markham's Engineering Design Criteria (July 2019, as amended or superseded), City of Markham's Storm Water Management Guidelines (October 2016, as amended or superseded), City of Markham's Low Impact Development Guidelines (November 2018, as amended or superseded) and MECP's Stormwater Management Planning and Design Manual (March 2003, as amended or superseded). Refer to ANNEX 1 and 2 of the City's Engineering Design Criteria for a complete list of all requirements for an Engineering Submission. All submissions must adhere to the City's overall criteria, applicable Environmental Compliance Approvals, and must not conflict with any other legislative requirements.

2.1 General Stormwater Management Criteria

The proposed stormwater management solution shall be developed in accordance with the City's Engineering Design Criteria and Standard Drawings (July 2019, as amended or superseded), City of Markham's Storm Water Management Guidelines (October 2016, as amended or superseded), City of Markham's Low Impact Development (LID) Guidelines (November 2018, as amended or superseded), TRCA's Stormwater Management Criteria (April 2012, as amended or superseded), TRCA & CVC Low Impact Development Stormwater Management Planning and Design Guide (2010, as amended or superseded), MECP's Stormwater Management Planning and Design Manual (2003, as amended or superseded), and Schedule D and E of the Stormwater Consolidated Linear Infrastructure Environmental Compliance Approval (CLI-ECA) including MECP's Design Criteria for Sanitary Sewers, Storm Sewers and Force mains for Alterations Authorized under Environmental Compliance Approval (July 2022 or most recent version) (where applicable and where pre-authorization is required). Additional studies, including but not limited to Subwatershed Studies, Stormwater Management Master Plans, Master Environmental Servicing Plans, Environmental Impact Studies, and Monitoring programs should be reviewed on a site-by-site basis to ensure the SWM design goals are refined as needed.

It should be noted that these criteria represent a minimum requirement that may be superseded by the results of further studies and local constraints. Where CLI-ECA standards are not met, an application to the Director of MECP is required to secure a "Schedule C Notice" amendment to the Stormwater CLI-ECA. Director's approval is issued pursuant to clause 20.3(1) of the Environmental Protection Act (EPA) that imposes terms and conditions in respect of the Authorized System after consideration of the application by the Director. The Applicant will be responsible for any and all permitting and Operations & Maintenance (O&M) requirements as determined by other applicable agencies, which should be confirmed at an early stage of the application/project.

2.2 List of Acceptable Technologies

Table 2 below outlines acceptable Non-Conventional SWMFs that will be considered. Criteria specific to each technology type are also provided to inform product choice. It should be noted

that this document is subject to future review/changes, which may result in the addition or deletion of other acceptable technologies. Applicants shall provide sufficient documentation to show that the proposed Non-Conventional SWMF product is in accordance with the applicable standard. The below list of product types is not in order of preference.

TABLE 2: LIST OF ACCEPTABLE PRODUCT TYPES

Acceptable Product Type	Criteria
Cast-in-Place Concrete Chamber	• Provided concrete must meet CSA A23.1 (Concrete Materials and Methods of Concrete Construction). • Is in accordance with CSA S269.1 (Falsework and Formwork) and CSA G30.18 (Rebar) • Structural design supported by stability analyses to be sealed by P.Eng.
Pre-Cast Concrete Chamber	• Provided concrete must meet CSA A23.4 (Precast Concrete Materials Construction). • Structural design supported by stability analyses to be sealed by P.Eng.
Stormwater Pond with Retaining Wall	• Not permitted on property lines. • Offset from property lines required considering end of service life replacement requirements. • Height and material of the wall shall be supported by applicable geotechnical/structural studies, based on site conditions. • Masonry structures must meet CSA S304-24 (Design of Masonry Structures). • Concrete walls must meet CSA A23.1 (Concrete Materials and Methods of Concrete Construction). • If applicable based on location and material, walls must meet CSA S6-19 (Canadian Highway Bridge Design Code). • Reinforced concrete wall material not permitted below extended detention water level to avoid exposure to chlorides. • Wall is generally permitted on only one side of the stormwater pond. • Structural design supported by stability analyses to be sealed by P.Eng. • Retaining wall design shall be supported by applicable Geotechnical Studies.
Superpipes (HDPE)	• In accordance with CSA B182.6 (Profile polyethylene (PE) Sewer Pipe and Fittings for Leak-Proof Sewer Applications) • Only dual wall pipes will be considered. • Standard strength class must be specified and shall be selected in accordance with OPSD 807.010 for Height of Fill. • Structural design supported by stability analyses to be sealed by P.Eng.
Superpipes (Concrete)	• Must meet CSA A257 (Standards for concrete pipe and manhole sections). • Standard strength class must be specified and shall be selected in accordance with OPSD 807.010 for Height of Fill

Acceptable Product Type	Criteria
	• Structural design supported by stability analyses to be sealed by P.Eng.
Polymeric (plastic) Chamber	• Meets CSA B184 Series of Standards for Polymeric subsurface stormwater management structures and/or be approved by the City. • Meets ASTM F2787 (Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chamber) <u>OR</u> ASTM F2418 (Standard Specification for Polypropylene Corrugated Stormwater Collection Chambers). • To be completely lined with minimum two layers of woven geotextile with minimum 1400 N grab tensile strength, 533 N tear resistance and 4600 N Puncture CBR. • Structural design to be sealed by P.Eng.

2.3 Overall NCSWMF Design Requirements

The following is a list of overall principles and design criteria for the implementation of all NCSWMF Types. The Stormwater Management Report and/or Stormwater Facility (SWMF) Design Report must address each item listed below. Any product specific requirements shall be adhered to by the Applicant. For requirements specific to different use cases (i.e., locations), please refer to the relevant sections below:

Land Use and Placement Restrictions

- The proposed NCSWMF component's location shall respect existing guidelines for setbacks from natural heritage and/or hydrologic features, as outlined in the Stormwater Management Facility Location Guidelines (Nov. 2017, as amended or superseded) for components.
- A separate pond block must be provided for stormwater ponds with retaining walls.

Regulatory Approval & Ownership

- Outlet locations shall be approved by the City of Markham and the Toronto and Region Conservation Authority (TRCA) where applicable.
- Where a NCSWMF is proposed within or abutting the Greenway System or Greenbelt Plan Area, an Environmental Impact Study shall be required to demonstrate conformity with the applicable policies of the Official Plan and/or the Greenbelt Plan. A detailed analysis of grading limits, including outlet locations and design shall be required.
- The proposed NCSWMF must be entirely located on municipally owned lands and shall not discharge to non-municipally owned land without the express written consent of the landowner receiving the drainage.

Structural and Material Design Considerations

- The proposed NCSWMF must only collect, receive, and control stormwater runoff, not groundwater, sanitary or combined sewage. Foundation drains may be connected to storm sewers located upstream of the NCSWMF, but they shall not be connected directly to the NCSWMF. Stormwater from these drains may ultimately discharge to the facility, subject to approval and design constraints.
- Service life of chosen NCSWMF product must be a minimum of 100 years for concrete facilities, and 50 years for plastic facilities. This opinion must be documented by a qualified Professional Engineer.

- Where possible, facilities are preferred to be positively sloped to at 0.30% facilitate complete gravity drainage and flushing. A minimum slope for NCWMFs of 0.5% is preferred. Facilities that require pumping of active storage volumes (outside of operations and maintenance) will not be approved.
- Proposed facilities must be able to withstand a load equivalent to the minimum traffic rating of the Canadian Highway Bridge Design Code (CHBDC) CL-625ONT, which will be sufficient for support of proposed park features, as permitted by **Table 3** in **Section 2.3.1**.
- A stone layer is required above and below the proposed facility to facilitate drainage around the facility and shall be consistent with product supplier specifications.
- "Hybrid" facilities (e.g., the combined use of a NCSWMF with above-ground storage e.g. dry ponds) will be considered provided the following criteria is met:
 - Above ground storage for quantity storage shall not be located within the Park Block and must be in a discrete pond block. Any accompanying pond block must meet all existing City and MECP criteria.
 - Quality Control criteria must be met prior to any runoff entering the active storage component of the NCSWMF.

Professional Certification

- The proposed stormwater management solution and design of the NCSWMF must be sealed by a Professional Engineer licensed to practice in Ontario and documented in a design report appropriate to the stage of development.
- The proposed landscape design and trail design associated with NCSWMF must be sealed by a Licensed Landscape Architect in good standing with the Ontario Association of Landscape Architects and documented in a design report appropriate to the stage of development.
- Other supporting studies or design components not explicitly listed but required to support the proposed NCSWMF must be prepared and sealed by a qualified professional, in accordance with their discipline-specific regulatory standards.

Hydraulic and Capacity Requirements

- The NCSWMF must be able to accommodate a dual storm drainage system.
- The minimum orifice diameter for the outlet shall be 75 mm, with a preferred diameter of 100mm. The number of orifices should be minimized as much as possible to reduce O&M requirements and costs.
- NCSWMFs must be sized to include major system flows.

Infiltration

- No infiltration credit will be given for end-of-pipe NCSWMFs designed for quality and/or quantity control.
 - Infiltration facilities intended for water balance credit only must be provided separately from the end-of-pipe facility and should be located in a separate area.
 - Infiltration facilities within park blocks are permitted only if they treat runoff exclusively from the park or as approved by the City.

Water Quality and Treatment

- Subject to approval by the City, quality control criteria may be met within the NCSWMF if the following conditions are met:

- For concrete NCSWMFs with permanent pools, or concrete walls in SWM ponds, corrosion mitigation shall be provided by using a chloride-resistant concrete mix and/or epoxy-coated reinforcing steel, or approved equivalent.
- Where applicable, the NCSWMF shall be designed to include a sediment drying area as per Markham SWM guidelines.
- Quality control provided within the SWMF must provide 80% total suspended solids (TSS) removal, based on the Fine PSD (MECP, 2003), and can be accompanied by pre-treatment strategies upstream of the NCSWMF (i.e., a treatment train).

Treatment Train Strategies

- Oil Grit Separator (OGS) units shall only be credited for TSS removal per Markham's SWM Guidelines (2016, as amended or superseded) and CLI-ECA requirements, provided that they have been sized using Environmental Technology Verification (ETV) Canada Particle Size Distribution (PSD).
- Quality controls included in upstream treatment train must be approved by the City of Markham and/or be verified by ETV Canada.
- Quality control facilities (e.g., Oil Grit Separator (OGS) Units) will be designed using the entire range dataset of ETV Canada Particle Size Distribution or distribution otherwise specified by the City of Markham.
- Low Impact Development (LID) facility type and placement shall be determined per the City's LID Guidelines, utilizing the Selection Protocol Flowchart for LIDs in Section 2.2 of the Guideline.
- LIDs on private or public property will not be accepted for water quality credit.
- LID sizing shall be calculated using an applicable redundancy factor as outlined in the City's LID Guidelines (November 2018, as amended or superseded).
- Filters shall be avoided due to high operating cost, except in exceptional circumstances, which will be evaluated on a case-by-case basis at the City's discretion.

Sediment Management & Dewatering

- The NCSWMF will be designed with a forebay-like component (if applicable) or other measures to reduce the area requiring frequent sediment removal.
- Where applicable, the O&M Manual shall specify how sediment removal will be conducted and confirm if a sediment dewatering area is required. Refer to the Markham Stormwater Management Guidelines (October 2016, as amended or superseded) for guidance on sediment dewatering areas.

Plastic (Polymeric) Chamber Design

- Must be lined with double layer of woven geotextile to ensure stability of stone layer and to prevent scour from flushing.
- Manifolds shall be a minimum of 1200 mm in diameter to allow for maintenance access, including human and equipment entry.
- All row connections shall be a minimum of 600 mm in diameter and inverts shall match the chamber bottom elevation to permit flushing.

Geotechnical and Hydrogeology Considerations

- On-site groundwater conditions are to be assessed by a Geotechnical Engineer prior to Detailed Design (or earlier at a planning stage) to confirm groundwater elevations in

relation to the proposed Facility depth, and determine any waterproofing requirements (if applicable).

- A Qualified Engineer will determine whether a buoyancy analysis is required to demonstrate that the system can withstand hydraulic uplift conditions. Hydrogeological investigation and information must be provided to support the use of a NCSWMF.

Inspection and Maintenance Access

- The maximum distance between maintenance access points to the Facility shall be 60 m, or as determined by available maintenance equipment.
- NCSWMFs should be designed to allow full inspection and maintenance access, with a strong preference for configurations that permit human entry. If the tank is too small to safely accommodate human access, the applicant must consult City staff to confirm that equipment-only access will be sufficient for inspection and maintenance needs.
- At least one maintenance access point shall be provided directly above or beside all outlet and inlet structures.
- The maintenance access points to the NCSWMF shall not be used for flow conveyance.
- The proposed NCSWMF design shall ensure public safety by providing lockable access points to discourage entry by non-maintenance personnel.

2.3.1 Parks, SWMF Block, Open Space Block and Greenway System Specific Requirements

NCSWMFs may be implemented within park blocks, SWMF blocks or open space blocks to provide conveyance and detention for a site. The proposed facility shall be designed to ensure that all existing City of Markham criteria for park grading, servicing, programming and facility requirements can be met if parkland dedication is to be achieved for the land above the proposed NCSWMF. Standard levels of services for park programming, facilities, amenities, and structures shall not be compromised to accommodate a NCSWMF.

2.3.1.1 General

Inlets

The proposed on-site storm sewer system will serve as an inlet to the Facility. Inlets and outlet maintenance holes are to be a minimum of 5.0 m away from all property lines.

Sizing

The height, length and width of the NCSWMF will be determined by the storage required to meet target discharge rates for the site, with existing site constraints considered. NCSWMF inverts will be dictated by the requirement for gravity drainage.

Layout & Location

The location of the facility shall be placed so that there is a minimum setback of 5.0 m away from all property lines, and so that safe excavation (as per OSHA) is possible without the use of shoring between the facility and any services or property lines when excavation and facility replacement may be required. Park block services (i.e. storm, sanitary and watermain pipes servicing the park block) shall not cross over the top of the proposed facility. Exceptions will only be considered under rare and special circumstances, and are subject to City approval. A minimum horizontal clearance between the outside wall of adjacent sewer pipes and the NCSWMF shall be 1.0 m. Minimum clearances between the facility and other services shall be provided in

accordance with MECP guidelines. Minimum horizontal and vertical separations between facilities and watermains are established in MECP's Procedure F-6-1.

Additional considerations and consultations shall be required with local service providers to ensure there are no conflicts between other proposed services, utilities, or underground infrastructure.

Consideration of proposed and future park landscaping is required. The Applicant should consult with the Parks Planning, Engineering Department to determine preferred tree planting locations within the park block and where installation should be avoided. This will allow the development of mature tree canopy within the park, which can be preserved if system excavation is required.

Facility and park layout is to demonstrate that on-site stockpiling of overlying materials during replacement is possible, particularly in the case of polymeric (plastic) chamber facilities. Stockpile locations must not interfere with park facilities/features and must be located within open space areas. Topsoil, fill and granular materials shall have separate stockpiles. Generally, Applicants must demonstrate that replacement is achievable without unreasonable disruption to park function.

The City shall provide the proposed park programming to inform the location of the NCSWMF. Park programming shall not be dictated by the design/location of the NCSWMF. **Table 3** outlines various Park Programming options and whether a NCSWMF will be permitted underneath. Any park facilities or features not listed below shall be confirmed with the City that a NCSWMF can be located underneath. Inspections ports and maintenance access points must always be accessible and should not be located underneath any of the Park facilities listed in **Table 3** below. The facility placement, as well as preliminary access route locations, and approximate locations for maintenance access locations and inspection & monitoring ports as determined by minimum spacing criteria, should be reviewed and agreed upon by the City's Parks Planning, Engineering Department prior to Detailed Design submission. It is noted that outside of the NCSWMF area and associated buffers, standard Park's Criteria will still apply.

TABLE 3: PARK FACILITY ACCEPTANCE

Park Facility	Acceptable Feature above Non-Conventional SWMF
Park Facilities	
Playgrounds (Neighbourhood/Urban Park)	Yes
Playgrounds (Community/Destination)	Yes*
Outdoor Fitness	Yes
Water play	Yes**
Seasonal Domes (Slab on Grade)	No
Permanent Domes or field covers	No
Outdoor Swimming Pools	No
Permanent Outdoor Ice Rinks and Ice Skating	No
Skateboard and Wheeled Sports	Yes

Park Facility	Acceptable Feature above Non-Conventional SWMF
Sports Fields (baseball diamond, soccer field, cricket pitch, football field, rugby/multiuse field)	Yes
Structures Requiring Deep Footing (e.g., Baseball backstops, football goal posts etc.)	No
Sports Courts (tennis, basketball, bocce, pickleball, volleyball, ball hockey, multiuse court)	Yes*
Recreational Trails and Pathways	Yes***
Park Buildings (any kind)	No
Shade Structures (on Concrete Pad, cantilevered or standard, no deep footings)	Yes*
Off Leash Dog Areas (Community/Neighbourhood)	Yes
Irrigation	Yes
Amenities, Utilities, and Servicing	
Armourstone Seating	Yes
Waste Receptacles on Concrete Slab	Yes
Electrical Transformers/Panels	No
Sanitary/Watermain Servicing and unrelated Storm Servicing	No
Typical Lighting/Lighting Conduits/Solar Lighting	Yes
Court and Sports Field Lighting	Yes*
Benches/Seating on concrete slab	Yes
Bike Site Furniture (racks, tool stations etc.)	Yes
Signage, bollards, railings	Yes
Retaining Walls	No
Bridge Structures	No

*Facilities require additional design considerations for implementation above Non-Conventional SWMFs. Applicant shall coordinate with City Parks Planning, Engineering Department to determine feasibility of Non-Conventional SWMF beneath feature.

**Water play features (e.g., splash pads) are generally not preferred above NCSWMFs, and underground servicing (e.g., watermain and sewers) should be avoided from crossing over NCSWMFs. Where site constraints exist, water play features may be permitted on a case-by-case basis, subject to City approval. Applicant shall coordinate with City Parks Planning and the Engineering Department to determine design and feasibility.

***Vehicular service routes used for general park operations, as well as emergency access routes, are generally not permitted above the NCSWMF in order to avoid service disruptions during future replacement or rehabilitation activities.

Grading

Grading over the proposed facility shall be designed and constructed to provide positive drainage with no adverse effects on the adjacent properties, and so that the drainage is self contained. The proposed grades shall meet the City's requirements for block and park block grading, which allow for a minimum 2% and maximum 5% slope. Steeper sloping and/or retaining walls shall not be permitted over the facility, however armourstone seating may be provided over the NCSWMF with the height of seating not to exceed 460 mm, if applicable and acceptable based on-site specific conditions. It is recommended that consultation with the City's Parks Planning, Engineering Department be undertaken early in the design process to ensure the proposed seating is acceptable.

Facility Depth

The Facility shall have a minimum of 1.8 m depth of cover from finished grade to top of stone/slab to allow flexibility with potential future Park programming, and to ensure the NCSWMF is below the frost line. However, it is noted that a preferred depth of 2.5 m is recommended if site conditions allow, to better accommodate park facilities and structures installed above the Non-Conventional Facility. The maximum depth of cover specifications shall be dependent on the design of the NCSWMF and shall not be exceeded. Preferably, access points should not exceed a depth of 5.0 m (measured from top of grade to lowest access point within the facility) to minimize the need for safety platforms, which can complicate inspection and maintenance activities.

Facility Bypass

A bypass pipe shall be provided to redirect flows around the Facility during major maintenance. The bypass shall be designed to convey the peak flow that is proposed to be conveyed in the storm pipe and/or capture point directly upstream, without causing adverse effects, and in accordance with the MECP's Stormwater Management Planning and Design Manual ("Maintenance Bypass" in Section 4.7 of 2003 edition). Mechanical valves should be avoided as a bypass option to reduce maintenance requirements and costs. Less maintenance intensive options, such as stop logs or other acceptable methods, should be used.

Loading

The facility shall be constructed per the standards listed in **Section 2.3** to ensure integrity of the system. Maximum cover depth specifications are product dependent and shall not be exceeded. Facility loading calculations shall accompany the Detailed Design submission and shall assume Canadian Highway Bridge Design Code (CHBDC) CL-625ONT loading. Selected native backfill may be used with acceptance from the City and if supported by an opinion from a Geotechnical Engineer. The facility structural design is to be sealed by a Professional Engineer.

Parkland Dedication

Eligibility for parkland dedication credit for lands encumbered by NCSWMFs will be determined by the City in accordance with the Parkland Conveyance By-law 2025-101, as amended, or any successor thereof. The City may consider the extent of encumbrance and its impact on future park programming when evaluating credit eligibility. Additional information may be requested by the City to support this evaluation.

Applicants shall provide sufficient information to support the City's evaluation of potential programming impacts associated with NCSWMF infrastructure. This includes calculating

the percentage of total encumbered parkland over the lifecycle of the facility, to the satisfaction of the City, and addressing the following considerations:

- NCSWMF footprint and relevant associated infrastructure
- Frequency, size and duration of disturbance required for sediment removal maintenance
- Frequency, size and duration of disturbance required for life cycle maintenance

Information to be provided is included but not limited to:

- A plan delineating the extent of unencumbered parkland, encumbered parkland, and associated NCSWMF infrastructure lands, with area take-offs provided.
- A Park Maintenance Plan identifying anticipated disturbance limits related to sediment removal maintenance and life cycle maintenance activities, including soil stockpile areas and temporary closures of pathways or park facilities, where applicable (further information is provided in **Section 3.0**)
- An Overall Park Facility Fit Plan illustrating the proposed interface between unencumbered parkland, encumbered parkland, and NCSWMF infrastructure (e.g., access routes, staging areas). Park facilities must be planned in coordination with the NCSWMF to ensure compatibility.
- Any additional information required to confirm the eligibility of parkland dedication credits, to the satisfaction of the City.

Ponding

The NCSWMF shall be designed to meet required target discharge rates by providing sufficient storage capacity within the facility. Where appropriate and subject to City approval, limited surface ponding may be permitted directly above inlet structures (e.g., DICBs) as part of the major system flow strategy, provided it does not impact park programming or public safety.

2.3.1.2 Operations & Maintenance Design Requirements

The facility should be designed to allow for maintenance while minimizing park use, local traffic and pedestrian disruptions during sediment removal maintenance and life cycle maintenance such as major rehabilitation or replacement. As such, the following criteria should be met at the detailed design submission:

- The location of the facility and associated infrastructure shall be placed so that safe excavation (as per OHSA) is possible without the use of shoring between the facility and any services or property lines when excavation and facility replacement may be required.
- Availability for flow by-pass for infrequent/major maintenance must be considered in the design of the facility. Valves are to be avoided to decrease maintenance requirements. Less maintenance intensive options, such as stop logs, are preferred.
- The maximum distance between access points for maintenance points shall not exceed 60 m.
- Maintenance/inspection ports and maintenance holes shall not be located within field of play, or pedestrian pathways through the park.
- Personnel access points shall be provided at the upstream and downstream ends of the facility, as well as above or directly adjacent to the inlet and outlet structure of the facility.
- The facility is to be designed to prevent scouring during routine flushing.

- A warning system shall be incorporated when installing the facility to provide notice to future excavators of the facility's location. Requirements include:
 - Tracer wire around the perimeter of the facility.
 - Warning layer of orange delineation material (such as snow fence) over the top of the stone layer of the facility.

The Operations & Maintenance (O&M) Manual for the facility must identify frequent and infrequent O&M tasks, related costs, and show clean out options that minimize disruption to the park or open space block. Further requirements and elaboration are provided in **Section 2.12**.

2.3.1.3 Access Route Design

The access routes for maintenance of facilities within a park block, SWMF block or open space block are to be considered as part of the overall system. As such, they should conform to the criteria described below. Access route paving will be dependent on the type of maintenance carried out, and type of vehicles used. Should only one access route be provided, the design shall be in accordance with the "heavy duty" maintenance access requirements. O&M requirements, as well as replacement and rehabilitation for the access routes should be considered in conjunction with the facility. Access route design should be integrated into the overall park design wherever possible.

"Light Duty" Maintenance Access Routes

- "Light Duty" Access Routes shall be designed as dual-purpose access routes/pedestrian pathways and are for inspection purposes only. Routes will be constructed with either limestone screening with a stabilizing/binder agent or asphalt paving.
- Maintenance Access/Inspection Ports should be placed so that they are immediately adjacent to but offset from the pathway. The minimum width of these access routes shall be 4.0 m. A turnaround, pathway loop or hammerhead is to be provided for a standard vehicle.
- Maintenance ports/manholes should not be located where overhead obstructions could occur (e.g., overhead wires).
- Sufficient lighting to be provided to ensure adequate illumination and shall conform to applicable guidelines in the Section N of the existing City Criteria.
- Tree plantings adjacent to the access route shall be offset a minimum of 3.0 m. Additionally, columnar species shall be proposed, to avoid conflict with overhead branches.

"Heavy Duty" Maintenance Access Routes

- Access routes for major rehabilitation or sediment clean out shall be separate from all pedestrian pathways, shall be constructed from asphalt and will be consistent with typical road asphalt thicknesses for residential roads, per Section B3 in the City of Markham Engineering Design Criteria.
- Minimum route widths shall be 6.0 m to accommodate large trucks, as determined by the City at the detailed review stage. Curves in the road will have a minimum centreline radius of 15.0 m. A turning circle or hammerhead shall be provided for vehicular ingress/egress.
- Access route should be assessed by a Transportation Engineer to confirm sufficient turning radii at entrances, exits and turning circles within the site.

- The route structure and makeup shall be designed to accommodate the following truck dimensions:
 - Weight: 35,000kg
 - Length: 12.2 m
 - Width: 3.3 m
 - Turning Radius: 15 m
- Sufficient lighting to be provided to ensure adequate illumination for maintenance activities and shall conform to applicable guidelines in the Section N of the existing City criteria.

2.3.2 Right-of-Way Specific Requirements

NCSWMFs will not be permitted within right-of-way's (ROW), except in exceptional circumstances, where site constraints do not allow for any other facility type. The City will review sites on a case-by-case basis, and final acceptance of the proposed design must be signed off by the Director of Engineering.

If considered, proposed NCSWMFs within the ROW will be subject to the criteria outlined below. If considered to be site-appropriate by the City, NCSWMFs can provide conveyance and detention for runoff from the contributing road drainage area only, however in certain circumstances, some additional area may be permitted to contribute runoff to the NCSWMF, which will be reviewed on a case-by-case basis. Only concrete superpipes will be considered for use within the ROW. The NCSWMF design should ensure that all existing City of Markham Design Criteria for Roads can be met and shall not be modified to accommodate a NCSWMF.

2.3.2.1 General

Inlets

The proposed on-site storm sewer system will serve as an inlet to the facility.

Sizing

The length of the pipe and diameter or height and span will be determined by the storage required to meet necessary discharge rates for the site and meet quantity control requirements, with existing site constraints considered.

Layout & Locations

NCSWMFs in ROWs should be located in the typically approved storm sewer alignment under the roadway asphalt. Alternative locations may be acceptable (i.e., under boulevards) provided that separation/offset requirements are satisfied under standard ROW cross-sections. A ROW cross section will be required to confirm the absences of utility and servicing conflicts. The Applicant shall consider all crossings in the design of the system and be responsible for coordination with other utility providers. Plan and Profiles will be required to show all clearances are met.

Facilities should be located within proximity to fire hydrants to supply flushing water for sediment removal.

If located within the asphalt of the right-of-way, the NCSWMF facility must be installed in a separate trench, with the centerline of the pipe offset a minimum of 1.5 m from the roadway centerline. On crescent roads, or roads with multiple bends, the facility position may follow the same relative side of the road allowance. If the NCSWMF is in a common trench, the minimum horizontal clearance between the outside wall of the adjacent sewer

pipes shall be 1.0 m. Common trenching with sanitary sewers will be considered when supported by the recommendations of a Soil Report prepared by a Geotechnical Engineer.

Curvilinear alignment through deflection at joints of the facilities within manufacturer's specifications are permitted with acceptance from the City.

Minimum clearances between the facility and other services shall be provided in accordance with MECF guidelines. Minimum horizontal and vertical separations between facilities and water mains are established in MECF's Procedure F-6-1.

Additional considerations and consultations shall be required with local service providers to ensure there are no conflicts between other proposed services, utilities, or underground infrastructure. The slope of the excavation trench during construction and replacement of the NCSWMF shall not interfere with existing mainline infrastructure and will only be permitted on a case-by-case basis. Lateral servicing connections to the NCSWMF shall not be permitted.

The ROW width shall not be expanded to accommodate facilities. Detailed cross sections shall be required to demonstrate that the facility fits within the proposed ROW, while achieving all required offsets.

Facility Depth

The facility shall have a minimum of 1.2 m cover to the top of the stone layer for frost protection, per City of Markham Engineering Criteria. A minimum cover of 2.50 m between the road centreline and NCSWMF obvert is required to allow for sufficient depth for foundation drains. Maximum depth specifications are product dependent and shall not be exceeded.

Facility Bypass

A bypass pipe should be provided to redirect flows around the Facility during maintenance, where possible. The bypass shall be designed to convey the peak flow that is proposed to be conveyed in the storm pipe and/or capture point directly upstream, and in accordance with the MECF Stormwater Management Planning and Design Manual ("Maintenance Bypass" in Section 4.7 of 2003 edition). Valves should be avoided as a bypass option to reduce maintenance requirements and costs. Less maintenance intensive options, such as stop logs, should be used.

Pipe Loading

Facilities shall be constructed per the standards listed in **Section 2.3** to ensure structural integrity of the system. Pipe loading calculations shall accompany the Detailed Design submission and be completed per City of Markham Engineering Design Criteria. Selected native backfill may be used above the facility with acceptance from the City and if supported by an opinion from a Geotechnical Engineer. Facility structural design is to be sealed by a Qualified Professional Engineer.

Ponding

The Facility shall provide enough storage volume to contain the runoff volume generated by the 100 year storm without causing surface ponding. The maximum depth of ponding/flow during major storm events (to be modelled per existing SWM criteria) shall not exceed 0.25 m above the gutter line of the right-of-way, and the water level shall be contained within the right-of-way.

2.3.2.2 Operations & Maintenance Design Requirements

The facility should be designed so that traffic disruptions will be minimized during maintenance. As such, the following criteria should be met at the detailed design submission:

- The maximum distance between inspection/maintenance access points shall not exceed 60 m.
- Inspection ports and maintenance access points should be located to facilitate inspection/maintenance with closure of one lane on multi lane roads.
- Personnel access points shall be provided at the upstream and downstream ends of the facility.
- A personnel access point shall be provided above or adjacent to the outlet structure for the facility.
- The footprint of the facility and associated infrastructure must be fully located on municipally owned land.

The Operations & Maintenance (O&M) Manual for the facility must identify frequent and infrequent O&M tasks, related costs, and show clean out options that minimize disruption to the ROW. Further requirements and elaboration are provided in **Section 2.12**.

2.4 Quantity Control Sizing and Modelling

Facilities will be sized to meet quantity control requirements in accordance with the Markham Stormwater Management Guidelines Section 5.0 (October 2016 or most recent versions), or any available site-specific studies. Climate change considerations, as outlined by the City's most recent Engineering Criteria are to be considered when sizing the Facility.

Quantity control sizing shall provide either 0.30 m of freeboard to the top of the NCSMWF, or a redundancy factor on the total provided volume of 1.25 for the largest required storm volume. Water surface elevations generated from all storm events (2 through 100-year and Regional, if applicable) must be clearly demonstrated in the Engineering Drawing package. Hydrologic analysis for sizing stormwater management infrastructure shall be completed using computer modelling, per the City's existing Stormwater Management Guidelines (October 2016, as amended or superseded).

Hydrologic analyses for the minor system may be completed using the Rational Method or computer modelling as described in the Guidelines. The proponent should consult with City staff to confirm the acceptance of the Rational Method for sizing SWM facilities (e.g. on-site detention) for small sites (less than 5 ha). Computer modelling using design events shall apply Markham's modified AES distribution, and the current IDF relationships for Markham as per the City of Markham's SWM Guidelines. The analysis is to be fully documented, prepared, and signed by a Professional Engineer.

Runoff Coefficients for contributing areas shall be determined per Section 4.2.2 of the City of Markham's SWM Guidelines. For storms larger than a 5-year return period, runoff coefficients shall be increased per the Return Period Factors also provided in Section 4.2.2 of the City's SWM Guidelines.

When the Rational Method is used, the general format of the City's Standard Storm Sewer and Overland Design Sheets are to be used. When computer modelling is used, the report shall indicate model parameters, assumptions used, outflow hydrographs and hydraulic grade line levels where applicable, flow depths and spreads and any other pertinent information.

2.5 Extended Detention

Extended Detention volume requirements shall be based on the criteria established in the Stormwater Management Planning and Design Manual, the City of Markham's SWM Guidelines, or site-specific requirements as established in an approved Master Environmental Servicing Plan, Master Drainage Plan, or as otherwise established by the City, TRCA or other relevant authorities with jurisdiction. Extended Detention may be provided within the NCSWMF after pre-treatment. Minimum orifice sizes as outlined in **Section 2.3** are applicable.

2.6 Permanent Pool / Quality Control

As described in **Section 2.3**, quality control measures shall be designed and sized to meet an overall TSS removal rate of 80% (using the Fine PSD, MECP 2003) for the overall drainage area. Water quality treatment within the NCSWMF may be considered in the form of a permanent pool volume and shall be based on and sized per the criteria established in the most recent version of MECP's Stormwater Management Planning and Design Manual, the TRCA's Stormwater Management Criteria, and the City of Markham's SWM Guidelines.

In addition, any proposed permanent pool volume within the NCSWMF shall be sized to incorporate a redundancy factor of 1.25x. The permanent pool is to be provided at the inlet of the Facility, where possible, to minimize sediment loading to the remainder of the Facility. It is encouraged that the permanent pool volume is to be separated from the active storage to isolate the maintenance area, however, is not required when space is limited. Where possible, the City encourages innovative designs to minimize and optimize maintenance and sediment cleaning efforts, such as centralized sediment collection.

Pre-treatment facilities (e.g. OGS units, etc.) for quality control will be sized to meet City of Markham and TRCA SWM criteria (80% TSS removal) using the appropriate PSD. OGS units shall be designed to treat the incoming 5-year flows and will be credited as per the City of Markham's SWM Guidelines (2016, as amended or superseded) and CLI-ECA criteria.

The permanent pool volume of the NSWMF shall not be considered as part of the required active storage volume. Maintenance procedures for Facilities with a permanent pool must be outlined in the required Operations and Maintenance (O&M) Manual.

2.7 Emergency Flow Routes

Emergency overland flow routes/spillways shall be provided in all cases and shall be clearly identified and delineated. The proposed flow routes must be contained so that they do not impede on private property. Emergency overland flow routes/spillways shall be sized to safely convey the uncontrolled peak flow from the 100-year storm event or the difference between the uncontrolled peak flow from the Regional Storm event and the controlled 100-year flow, whichever is greater, with a minimum freeboard within the channel of 0.30 m.

If applicable based on emergency overland flow route location (i.e., not within the ROW), erosion protection shall be provided along the entirety of the emergency flow route, which may consist of a soil reinforcement system with a natural vegetated surface treatment, or alternative protection measures as specified by the designing engineer. Side slopes at the top of the spillway shall be a maximum of 3:1, or 10% if used as a roadway. Where the emergency flow route may cross over sidewalks, sidewalk sloping may not exceed 5%, and crossfall may not exceed 2%.

In addition to an emergency overland flow route/spillway, a proposed piped bypass system (as described in **Section 2.3**) shall be provided which will also include an emergency drop structure. Both will be sized as described in **Section 2.3**, using applicable contributing flows,

which will be dependent on the SWMF inlet configuration. This emergency drop structure should connect to the bypass pipe and serve as a backup in the event that the main facility inlet or bypass pipe becomes fully blocked. The invert elevation of this emergency outlet must be no higher than the obvert (top) of the NCSWMF.

In right-of-way applications (accepted on a case-by-case basis), rights-of-way shall provide sufficient conveyance capacity for the major system flows in the event of the outlet failure or blockage, or if the storm event is greater than the facility's design capacity. Major system flows shall be diverted away from surrounding buildings as much as possible, and the overland flow route should be identified on relevant figures and drawings, with sufficient erosion control specifications if required.

2.8 Infiltration Facility

End-of-pipe NCSWMFs designed for quantity control, erosion control and/or water quality are to be closed bottom and should not provide infiltration. A separate infiltration facility may be permitted in another location and is subject to the design requirements outlined in the City's Low Impact Development (LID) Guidelines and Stormwater Management Guidelines. Open-bottom facilities are to be placed downstream of the water quality treatment mechanism to promote infiltration of clean water and minimize clogging of the Facility. Infiltrating facilities are permitted upstream and downstream of the NCSWMF.

2.9 Pre-Treatment Facility Options

A treatment train approach is encouraged to accompany the proposed end-of-pipe NCSWMF to meet water quality and water balance criteria. Pre-treatment can also help reduce peak flows from the development and storage requirements by impacting the overall imperviousness of contributing drainage areas (directly and indirectly connected). Pre-treatment options should also be considered for their ability to control erosion, especially if a site-specific study identifies additional erosion control needs.

The following **Table 4 and 5 provide** a list of possible creditable and non-creditable low impact development (LID) facilities and manufactured treatment devices (MTD's) assessed for pre-treatment, and what criteria each facility can address (which is dependent on the design of the facility). Non-creditable (for water quality) LIDs are encouraged for use in order to meet treatment train guidelines but cannot be used to meet quality control requirements.

TABLE 4: CREDITABLE FOR WATER QUALITY PRE-TREATMENT ALTERNATIVES

Technology/Facility	Examples	Benefit
Separation Manufactured Treatment Devices	ETV Verified OGS Units	Quality – Credit per Markham's SWM Guidelines (2016 as amended or superseded) and CLI-ECA criteria
Isolator Rows	n/a	Quality

TABLE 5: NON-CREDITABLE FOR WATER QUALITY PRE-TREATMENT ALTERNATIVES

Technology/Facility	Examples	Benefit
Infiltration/Filtration	Basins, chambers, trenches, soakaway pits, dry swales, bioswales, grassed/vegetated swales, vegetated filter strips, rain gardens, etc.	Water Balance, Quality, Erosion

Technology/Facility	Examples	Benefit
Exfiltration Trenches/Systems	Perforated pipes, catchbasin exfiltration system	Water Balance, Quality, Erosion
Deep Sump Catchbasins	n/a	Large particle/ debris and garbage removal
Downspout disconnection to Soakaway Pits	n/a	Water Balance, Quantity, Erosion

The following general screening steps should be completed to help select which pre-treatment facility options will be most effective based on-site specific characteristics; however, the ultimate decision of the proposed pre-treatment facility must be acceptable and to the satisfaction of the City.

1. Assess site conditions (hydrogeological, geotechnical, environmental, development regulations etc.).
2. Define design criteria per **Section 2.3**.
3. Screen pre-treatment options (site constraints, opportunities based on land-use types, performance requirements, operations & maintenance requirements)

All pre-treatment facilities should be included in the Operations & Maintenance Manual.

2.10 Inlet Structures

Storm sewer inlets to the NCSWMF shall be designed per Section 6.3.7 of the City of Markham's Stormwater Management Guidelines (October 2016, as amended or superseded)

Inlet pipes shall be designed so that the pipe invert is at or above the permanent pool water surface elevation (where applicable) and shall be sized for the tailwater condition generated by the greater of the extended detention water surface elevation or the operating water surface elevation within the facility corresponding to the design criteria of the inlet pipe (i.e. 5-year storm event or higher).

The upstream storm sewers within the Municipal road right-of-way shall be designed such that all inverts are above the extended detention water surface elevation within the facility in order to facilitate free-flowing conditions upstream of the NCSWMF.

2.11 Design Drawings and Details

Applicants shall refer to ANNEX 1 of the City of Markham's Engineering Design Criteria (December 2012 as amended or superseded) for guidance on requirements for drawing and detail submission requirements.

2.12 Delivery and Installation (Pre-Cast Facilities)

As part of the Detailed Design Report for the proposed NCSWMF, the Applicant shall provide product-specific information describing the manufacturer-recommended requirements for delivery, handling, and installation of pre-cast concrete facility components, to the satisfaction of the City. These requirements shall be in accordance with the product manufacturer's specifications and installation guidelines. The information is to be submitted for review and

coordination purposes and is not intended to prescribe construction means and methods by the design engineer.

The following information should be provided as part of the submission; however, the list is not exhaustive.

- **Delivery and Handling Measures:**

Delivery methodology to minimize damage during transport and handling. Measures should include but are not limited to:

- Designated lifting points or embedded lifting pins, ensuring these are used consistently during loading, unloading, and site placement.
- Provisions to avoid direct contact with machinery forks to prevent chipping or spalling of units, with any on-site repairs approved by the product manufacturer or designated quality control representative.

- **Installation Procedures**

Installation methods should be adapted to the product and site conditions, with procedures that address:

- The sequence and orientation of component placement to ensure structural alignment and stability.
- Verification of subgrade and base compaction by a qualified geotechnical engineer before installation.
- Use of appropriate lifting equipment, such as cranes or spreader beams, especially for large components that require tilting or positioning in confined areas.

- **Inspection and Quality Assurance**

Specify inspection protocols aligned with best practices for pre-cast installations, including:

- Visual inspection of each unit upon arrival and before installation to document any transport damage, with corrective actions as needed.
- Continuous monitoring during installation, including checks for component alignment and secure placement.
- Post-installation inspections to confirm that all joints and connections are grouted, and that structural integrity aligns with design specifications.

The City may elect and retain a third-party engineering firm to complete periodic inspection of the precast units/polymeric components and their installation process for quality assurance purposes to ensure installation is performed soundly, with cost to be covered by the Applicant.

2.13 Structural Design Assessment Report with Supporting Investigations

A Structural Design Assessment Report with supporting geotechnical investigations will be required to be submitted, to confirm structural integrity of the proposed NCSWMF. The Assessment shall be submitted at the time of the Detailed Design / Technical Review of Plan of Subdivision (TEC) submission. The Assessment shall verify that the safety and structural integrity of the NCSWMF and identify any potential areas of weakness, which shall be addressed by the Applicant.

Before construction begins, and at the applicable times in the construction process, the contractor shall retain a Geotechnical Engineer to complete the following tasks:

- Provide a quality control plan documenting the procedures to be followed for subgrade and granular base preparation, the tests to be performed, and the frequency of tests;
- Perform a site inspection and review of subgrade material to ensure it is in accordance with the Geotechnical Report and is suitable for tank installation;
- Witness testing proof-rolling of the subgrade;
- Verify groundwater influences are consistent with the Geotechnical/Hydrogeological Report, and confirm any applicable buoyancy analysis or waterproofing requirements (if applicable);
- Review placement and perform compacting testing of granular materials for the tank base; and
- Provide a Structural Design Assessment Report that:
 - Documents the subgrade conditions and confirmation that the subgrade meets the tank installation requirements;
 - Documents the results of testing of granular materials for the tank base and confirmation that the granular base meets the tank installation requirements;
 - Demonstrates the NCSWMF has been designed with sufficient design redundancy to support the applicable loading requirements, in compliance with CHBDC;
 - Demonstrates the NCWMF has been designed to consider and mitigate impacts of local groundwater conditions, including evaluation of hydrostatic pressure and buoyancy where applicable; and
 - Demonstrates potential hydraulic energy effects have been considered, and mitigation measures have been recommended (if applicable).

The City may elect to hire an independent third-party Geotechnical Engineer to conduct periodic quality assurance inspection and testing of the subgrade and granular base, with costs to be covered by the Applicant. Tasks that could be completed by the independent third-party geotechnical engineer may include, but not limited to:

- Perform a site inspection and review of subgrade material to verify the conclusions in the report provided by the contractor's Geotechnical Engineer.
- Witness testing proof-rolling of the subgrade.
- Perform periodic compaction testing of granular materials for the tank base to verify the results obtained by the contractor's Geotechnical Engineer.

Prior to assumption, the Structural Design Assessment Report shall be revised using As-Built information for the NCSWMF. The NCSWMF construction shall be visually assessed again to confirm structural integrity and safety. Any changes or additional studies that are determined to be necessary by the Structural Design Assessment Report will be the responsibility of the Applicant.

3.0 OPERATIONS & MAINTENANCE MANUAL

An Operations & Maintenance (O&M) Manual shall accompany the Detailed Design submission for all proposed facilities included in the SWM solution, which includes the NCSWMF and any pre-treatment facilities intended for municipal assumption. The Manual shall be in accordance with guidelines set by MECP's Stormwater Management Planning and Design Manual (2003, or

most recent version) and requirements in Schedule E of the CLI-ECA (if applicable). The City of Markham Stormwater Management Guidelines (2016, as amended or superseded), the Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide (TRCA, 2016, as amended or superseded), the City of Markham LID Guidelines (2018, as amended or superseded) and other guidance documents from local regulatory agencies shall be referenced in the development of the O&M Manual.

3.1 General Requirements

The manual shall outline the following:

- Facility overview including:
 - Description of the type of facility;
 - NCSWMFs intended function (e.g., quantity, quality, etc.);
 - Description of contributing drainage area;
 - Documentation of design volumes, discharges and events;
 - Key operating elements (e.g., inlets, outlets, bypass, permanent pools, etc.); and
 - Engineering drawings.
- Maintenance frequency for all facilities and pre-treatment devices included in the SWM solution, based on the sediment loading rate from the contributing drainage area.
- Annual maintenance costs calculated through a detailed breakdown of cost/frequency for relevant inspection, monitoring, and maintenance items.
- Calculation of costs associated with sediment disposal per most current Excess Soil Management Regulations.
- Inspection & Monitoring Plan (refer to **Section 3.2**) outlining requirements for:
 - Surface inspections (where applicable), including methods/tests to identify when maintenance is necessary based on factors such as presence of algae or invasive species, sediment depth, water levels, and visual observations.
 - Operational inspections, including frequency of routine checks (e.g., initial, annual and post-major storm events) and parameters to be verified.
 - Structural inspections, including periodic review of structural integrity and the proposed inspection cycle.
- Detailed execution plan for operations & maintenance based on maintenance type (Sediment Removal Maintenance versus Life Cycle Maintenance), including but not limited to:
 - Location of maintenance and monitoring access points and relevant access routes.
 - NCSWMF clean-out plan outlining how the NCSWMF and treatment train is to be cleaned out. Preference is to be given to mechanical clean-out operations instead of hydraulic clean-out operations to reduce drying/consolidation time.
 - Sediment drying or sediment dewatering areas.
 - Disposal techniques.
- Procedures for addressing emergency or unscheduled maintenance, including identification of potential failure scenarios and response protocols.
- Consideration of seasonal/winter operations where applicable (e.g., accessibility, ice management, cold weather impacts etc.).
- Identification of any required personnel, training, and equipment (including dimensions) for all maintenance activities.
- Documentation of product specific loading capacities.

3.2 Inspection & Monitoring

The O&M manual shall provide sufficient detail on inspection and monitoring requirements, as well as the calculation of associated fees for inspection only. Inspection and monitoring plans shall be in compliance with Schedule E of the CLI-ECA (if applicable).

Inspection

The O&M Manual shall outline the inspection schedule for the proposed facilities, to ensure effective performance, as designed. Discharge from the facility is to be free of floating and settleable solids and not contain oil or other substance in amounts sufficient to create a visible film, sheen, foam, or discoloration on receiving waters.

Within the first two years of post construction, facilities will require inspection after every Significant Storm Event (minimum of 25 mm rain in any 24-hour period) to ensure proper functioning, (typically 4 times a year). After the first two years, the facility should be inspected at a minimum of once a year, and after major rainfall events.

Inspection frequency shall also be determined by the recommendations from the chosen facility supplier. Standard inspections will determine what maintenance activities are required and should not require Confined Space Entry or CCTV monitoring. Inspection during and after construction, and pre-assumption shall be paid for by the Applicant and carried by the Applicant or a delegated third-party Qualified Person.

In addition to routine and surface inspections, the O&M Manual shall outline requirements for structural inspections of NCSWMFs to confirm long-term integrity of facility walls, joints, and inlet/outlet connections. The Applicant shall propose an appropriate structural inspection cycle, informed by manufacturer recommendations and industry best practices.

The O&M Manual should provide a template for inspections, which are to be recorded and be available at the Owner's administrative offices. The template should include the following:

- Name of Inspector or person who conducted the maintenance;
- Asset ID and name of the Works inspected;
- Date, time and results of each inspection, maintenance or cleaning;
- Observations from inspection including (where applicable):
 - Hydraulic operation of works (e.g., length of occurrence since the last rainfall event, evidence, or occurrence of overflows.
 - Condition of surface vegetation in and around the Works.
 - Occurrence of obstructions at the inlet and outlet of the Works.
 - Evidence of spills and/or grease/oil contamination.
 - Frequency of surface trash build-up.
 - Measurements of sediment accumulation and water levels.

Monitoring

The O&M Manual shall include a detailed monitoring program for the facility, prepared in accordance with applicable CLI-ECA (Schedule E) and City requirements, to confirm proper functioning of the NCSWMF and identify any corrective measures needed before assumption, to the satisfaction of the Director of Engineering. The monitoring plan shall be reviewed and approved by the City and, at the City's discretion, by a third party to verify its adequacy. The plan shall:

- Be carried out by the Applicant or a delegated third-party Qualified Person, with all monitoring dates recorded in an electronic database.

- Verify that the operational performance of the NCSWMF is consistent with the design.
- Identify the works to be monitored including outlets and facilities providing quantity and/or quality control.
- Identify key receivers and monitoring locations, where applicable and at City's discretion.
- Consider relevant municipal land use and environmental planning documents.
- Identify rainfall gauges to be used.
- Develop a program that provides:
 - Characterization of water quantity conditions as described in **Section 3.2.1.**
 - Characterization of water quality conditions as described in **Section 3.2.2.**
 - Assessment of other hydrological, chemical, physical, and biological parameters, as appropriate.
 - Monitoring methodology, including frequency and protocols for sampling, analysis, and data recording, with consideration of wet- and dry-weather events, timing of sampling during storm events, and documentation of sampling date and time.
- Identify the duration of monitoring program and schedule for implementation
- Provide a report summarizing monitoring data, analysis, findings, and recommendations.
- Identify adaptive measures, where applicable, based on monitoring results.

Monitoring plans shall be updated following any alterations to the NCSWMF and made available to the public upon request. All monitoring plans shall comply with the City's Stormwater Management Guidelines.

The duration of the monitoring program shall be established in consultation with City staff and in accordance with approval conditions issued by other agencies, if applicable. At a minimum, stormwater quality monitoring is required for the first three years of operation, or as otherwise directed by the City. Stormwater quantity monitoring shall be undertaken for a period adequate to obtain the data required to verify the NCSWMF rating curve and confirm overall system performance.

3.2.1 Stormwater Quantity Monitoring

Stormwater quantity monitoring required by Markham shall be carried out to verify the performance of the NCSWMF. Flow measurements at these locations shall be completed using methods acceptable to the City. Depth probes shall be installed at the inlet and outlet to measure water surface elevations and determine operating water levels during storm events. The stage-storage-discharge rating curve, established from the as-built survey following cleanout, shall be validated against the measured water level and flow data to confirm that the facility is operating as designed. Sufficient field data shall be collected to develop the rating curve for the hydraulic outlet control structure, to verify its performance.

Available rainfall data shall be used to determine the return period of each storm event for comparison with observed operating water levels. Where required by Markham, approved hydrologic models shall be updated to reflect the as-built condition of the NCSWMF and its contributing drainage area, and hydrologic analyses shall be completed to verify facility performance.

Where feasible and appropriate, monitoring of stormwater quantity control performance should be coordinated with holistic monitoring programs that collect flow data along the receiving watercourse. Integration of NCSWMF stormwater quantity control requirements into such programs shall be at the discretion of Markham.

3.2.2 Stormwater Quality Monitoring

Water quality monitoring to verify NCSWMF performance shall confirm that the facility is providing the required level of stormwater quality treatment in accordance with applicable standards and shall characterize the treated effluent relative to water quality conditions in the receiving watercourse. Monitoring shall be conducted at the facility inlet, at the outlet downstream of the control structure (i.e., not within the facility's water column) and, where applicable and requested by the City, at upstream and downstream locations within the receiving watercourse. Sampling locations along the watercourse shall be selected to allow safe access during both wet and dry weather conditions, including during and outside business hours.

All water quality samples shall be collected in accordance with the Protocols Manual for Water Quality Sampling in Canada (CCME, 2011). The sampling method (e.g., grab, composite, or continuous monitoring) shall be selected based on the contaminants of interest and the required analyses.

Water quality monitoring shall be completed for a minimum of three storm events per year and should, where possible, capture one representative event in each monitored season (spring, summer, and fall).

The select water quality parameters to be monitored shall be determined in consultation with the City and, where applicable, the TRCA, MNRF, and MECP. These parameters may include, but are not limited to, the following general parameters:

- Ammonia
- Anions (Nitrate, Nitrite, Phosphate, Chloride)
- BOD5
- Conductivity
- Dissolved Oxygen
- Hardness as CaCO₃
- Metals (Al, Sb, As, Ba, Be, B, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, P, K, Se, Si, Ag, Na, Sr, Tl, Sn, Ti, W, U, V, Zr)
- Oil and Grease
- pH/alkalinity
- PAH
- Salinity
- Total Kjeldahl Nitrogen (TKN)
- Total Solids (TS)
- Total Suspended Solids (TSS)
- Total Phosphorus
- Total Coliforms/Fecal Coliforms/E.Coli
- Turbidity
- Temperature – Ambient Air
- Temperature - Water

The approved monitoring program shall be implemented, and all required reports prepared and submitted to Markham. If the monitoring results are deemed unsatisfactory by Markham and regulating agencies, additional investigation shall be undertaken to identify opportunities to address deficiencies in the performance of the NCSWMF. The preferred approach for addressing such deficiencies shall be determined in consultation with Markham and the relevant agencies. The City may also require adjustments to the monitoring plan, as necessary, to the satisfaction of the Director of Engineering.

3.3 Sediment Removal Maintenance

Sediment removal maintenance involves sediment removal and visual verification of system functionality. Sediment removal frequency should be calculated for any component of the treatment train that accumulates sediment. Sediment removal procedure shall be outlined in the O&M Manual. Overall sediment loading rates and frequency will be calculated based on the loading rates per impervious area outlined in Section 6.0 of the MECP Stormwater Management Planning and Design Manual, also shown below in **Table 6**.

The manual shall provide a detailed execution plan for sediment removal, which considers the following:

- Sediment removal construction drawings to demonstrate feasibility
- Frequency of maintenance
- Identification of access routes and paving requirements (heavy duty vs. light duty)
- Identification of staging locations
- Sediment removal technique and identification of sediment dewatering area
- Assessment and plans for restoration requirements
- Identification of confined space entry requirements (and applicable certifications)
- Equipment requirements
- Flow diversion strategies
- Traffic management considerations
- Consideration of impact on park and trail uses
- Plan for facility entry
- Identification of Emergency Overland Flow Route

TABLE 6: SEDIMENT LOADING

Catchment Imperviousness	Annual Loading (kg/ha)	Wet Density (kg/m ³)	Annual Loading (m ³ /ha)
35%	770	1,230	0.60
55%	2,300	1,230	1.9
70%	3,495	1,230	2.8
85%	4,680	1,230	3.8

*Source: MECP Table 6.3 in MECP Stormwater Management Planning and Design Manual (2003)

3.4 Life Cycle Maintenance

Maintenance activities throughout the life cycle of the proposed facilities, such as major maintenance to ensure structural stability, facility replacement, and minor maintenance activity such as trash removal, shall be outlined in the Manual, including frequency for each

maintenance activity. Required maintenance activities shall be determined through visual surface inspections of all facilities included in the SWM solution. The Manual must consider the following life cycle maintenance items of the proposed facilities, and provide detailed plans where applicable:

- Frequency of maintenance
- Identification of access routes and paving requirements (heavy duty vs. light duty)
- Identification of stockpiling locations
- Identification of staging locations
- Sediment removal technique
- Assessment and plans for restoration requirements
- Identification of confined space entry requirements (and applicable certifications)
- Equipment requirements
- Flow diversion strategies
- Traffic management considerations
- Consideration of impact on park and trail uses
- Plan for facility entry
- Identification of Emergency Overland Flow Route

4.0 CONSTRUCTION PHASE CONSIDERATIONS

Regulatory Approvals

All required permits from the applicable regulatory agencies should be secured before any work begins. Obtaining these approvals in advance ensures compliance with applicable legislation and prevents delays once construction is underway.

Record Drawings and Certification

- The NCSWMF shall be constructed in accordance with City approved engineering drawings.
- Once construction is complete and prior to Acceptance for Maintenance, the Landowner shall submit sealed record drawings and documents from the Qualified Engineer of Record, which will be prepared per PEO's Preparing As Built and Record Documents Guideline and be provided in a format acceptable to the City.
- The Landowner should establish a predetermined plan for preparing record drawings, ensuring that as constructed infrastructure is documented at critical stages and for key components during construction, before any elements are concealed, in accordance with PEO Guideline.
- A professional engineer shall provide a certification that all components of the NCSWMF have been constructed and installed in accordance with the approved engineering drawings.

Construction Phasing and Observation

Construction shall proceed in clearly defined phases. An Observation Report shall be prepared by the Owner's qualified professional at the completion of each major construction phase and submitted prior to proceeding to the next phase. Typical phases may include excavation, subgrade preparation and compaction, placement of facility components or systems (or equivalent), backfilling, and installation of inlet and outlet structures.

The Observation Report shall document that construction activities for the applicable phase have been completed in general conformance with the approved drawings, design intent, and the

manufacturer's installation requirements. At a minimum, the report should include a brief description of the works completed, the date(s) of observation, confirmation of compliance or identification of deficiencies, photographs of key construction elements, and any required corrective actions.

Observation Reports shall be completed at the conclusion of each construction phase, or at another frequency deemed appropriate by the City where phasing differs from the examples listed above. This phased observation process is intended to confirm proper installation and performance readiness before the facility advances to subsequent stages of construction.

Erosion and Sediment Control

The approval ESC plan must remain in place, and be updated, if necessary, for the full duration of construction to prevent sediment from entering the NCSWMF or downstream watercourses. The NCSWMF should be adequately isolated during construction and after completion, until it becomes operational, to prevent construction-related sediment from entering the facility.

5.0 ACCEPTANCE FOR MAINTENANCE REQUIREMENTS

In addition to the requirements in Appendix 21 of the City's Municipal Inspection and Construction Guideline and the City's Stormwater Management Guidelines, the Landowner shall submit the following information, along with a certificate of conformance from a Qualified Engineer, before initiating the Acceptance for Maintenance process (including all pre-treatment facilities) to the satisfaction of the Director of Engineering.

- **Record Drawings:**
 - At Acceptance for Maintenance, the Landowner shall submit sealed Record Drawings and documents from the Qualified Engineer of Record. These record drawings must follow PEO's Preparing As-Built and Record Documents Guideline and be provided in a format acceptable to the City.
- **Clean Facility Condition:**
 - Evidence that the facility is clean and free of sediment and debris, verified through CCTV or other City-approved methods to the satisfaction of the City.
 - Cleanout documentation including a dewatering and discharge plan and a sediment sampling report with laboratory results confirming proper disposal in accordance with environmental regulations.
- **Operational Performance:**
 - Confirmation of proper function demonstrating that the facility and all components are in good condition and operating as intended, including inlet and outlet control structures.
 - Performance verification shall be demonstrated through flow monitoring or other City-approved methods, including development of a rating curve for the hydraulic outlet control structure and confirmation that applicable water quality criteria are being met. The monitoring program shall collect sufficient field data to support development of the rating curve in accordance with the City's NCSWMF Design Criteria.
- **Maintenance Records**
 - Documentation and records are required showing that inspection and maintenance activities have been completed in accordance with the accepted O&M manual and applicable CLI-ECA requirements.
- **Structural Stability**

- Completion of a structural inspection by a professional engineer, using methods acceptable to the Director of Engineering. The structural inspection report shall be submitted, confirming that all structural components (including inlets, outlets, weirs, columns, and berms) are in good condition, free of damage or settlement, and that the NCSWMF complies with the requirements of the Structural Design Assessment submitted at the Detailed Design stage, where applicable.
- The City also reserves the right to retain qualified personnel to conduct the inspection the works to City's satisfaction, with all associated costs borne by the Landowner.
- **CLI-ECA Compliance**
 - Landowner shall provide record to confirm that the NCSWMF is meeting all applicable CLI-ECA requirements and provide all completed CLI-ECA document prior to Acceptance for Maintenance.
- **Monitoring Program**
 - The Landowner shall complete a monitoring program as per the accepted monitoring plan and provide all associated records in accordance with **Section 3.2** and, where applicable, CLI-ECA monitoring requirements. Based on the monitoring results, remedial works may be required to the satisfaction of the City. The City reserves the right to require additional monitoring until the facility is performing to its satisfaction.
- **Vegetation and Landscaping Design Acceptance**
 - The Landowner shall confirm that vegetation and landscaping design is not impeding the function of the NCSWMF and shall submit a copy of an acceptance letter from the City's Urban Design Group for the landscaping plan.
- **Park Design Acceptance**
 - The Landowner shall provide a copy of an acceptance letter issued by the City's Park Planning, Design and Construction Department, confirming that the future park design is acceptable and can be accommodated above the NCSWMF.

The Director of Engineering may also request any additional details or information as necessary.

6.0 ASSUMPTION REQUIREMENTS

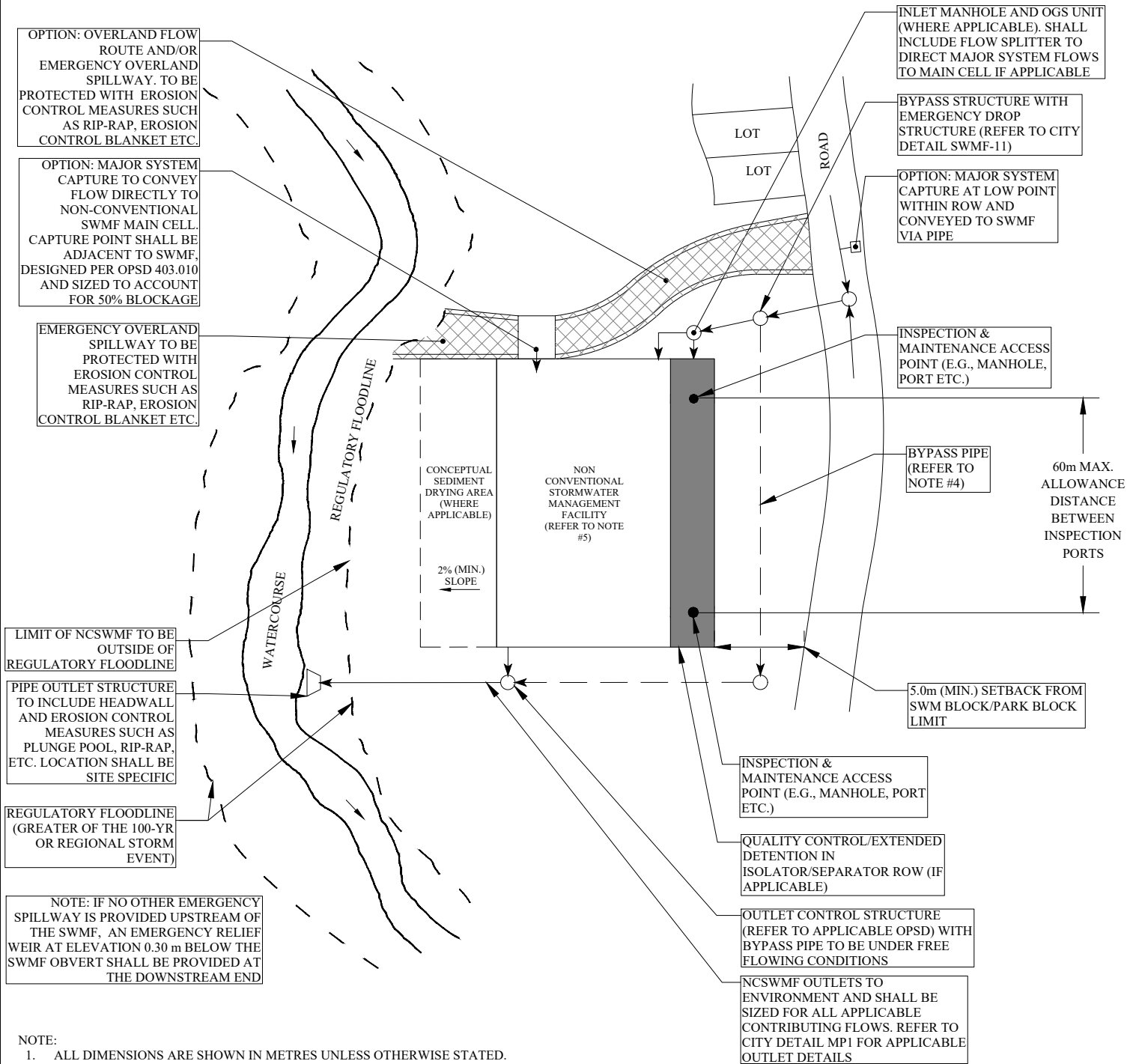
In addition to the requirements in Appendix 21 of the City's Municipal Inspection and Construction Guideline and the City's Stormwater Management Guidelines, the Landowner shall submit the following information:

- **Record Drawings**
 - Prior to Assumption, the Landowner shall submit revised Record Drawings for the NCSWMF, where applicable, sealed by the Qualified Engineer of Record, and prepared per PEO Guidelines.
- **Subdivision Agreement Requirements**
 - Where a Subdivision Agreement applies, the steps to Assumption shall be read in conjunction with that agreement. The Landowner is responsible for ensuring that all Assumption-related obligations under the Subdivision Agreement have been fully satisfied.
- **Clean Facility Condition**
 - Evidence that the facility is clean and free of sediment and debris, verified through CCTV or other City-approved methods to the satisfaction of the City.
- **Structural Inspection**

- The Landowner shall retain a Qualified Engineer to complete a structural inspection of the NCSWMF to the satisfaction of the City. The inspection shall confirm that all structural components—inlets, outlets, weirs, columns, and berms—are in good condition, free of damage or settlement, and compliant with the Structural Design Assessment submitted at Detailed Design, where applicable. The City also reserves the right to retain qualified personnel to conduct the inspection to City's satisfaction, with all associated costs borne by the Landowner.
- **Extended Warranty Documentation**
 - If applicable, the Landowner shall provide documentation or agreements for any extended warranties related to the rehabilitation of any NCSWMF components.
- **Updated O&M Manual**
 - An updated O&M manual shall be submitted at Assumption that incorporates lessons learned during operation, provides recommendations for addressing operational challenges, and includes any revisions to maintenance schedules, frequencies, and resource requirements. All O&M activity records shall accompany the updated manual.

All documentation, including final record drawings, certifications, and updated O&M manual, should be stamped by the Qualified Professional Engineer. The Director of Engineering may also request any additional details or information as necessary.

Conceptual Drawing



NOTE:

1. ALL DIMENSIONS ARE SHOWN IN METRES UNLESS OTHERWISE STATED.
2. THIS TYPICAL DETAIL IS INTENDED TO CONVEY INTENT AND IS FOR REFERENCE ONLY. IT SHALL NOT BE USED AS PART OF A CONSTRUCTION DRAWING PACKAGE OR SITE PLAN APPLICATION.
3. THIS TYPICAL DETAIL IS INTENDED TO DISPLAY CONCEPTUAL LAYOUT INFORMATION FOR THE PLAN VIEW OF A NON-CONVENTIONAL SWMF.
4. SIZING OF EMERGENCY BYPASS / MAINTENANCE PIPE SHALL BE DEPENDENT ON SWMF INLET CONFIGURATION AND SHALL BE SIZED USING APPLICABLE CONTRIBUTING FLOWS.
5. SIZING OF PROPOSED SWMF VOLUME SHALL INCLUDE A DESIGN REDUNDANCY FACTOR. REFER TO CRITERIA FOR INFORMATION.
6. DEVIATION FROM ANY STANDARDS ARE SUBJECT TO CITY'S REVIEW AND APPROVAL.



ENGINEERING DEPARTMENT, CITY OF MARKHAM

REV. 0

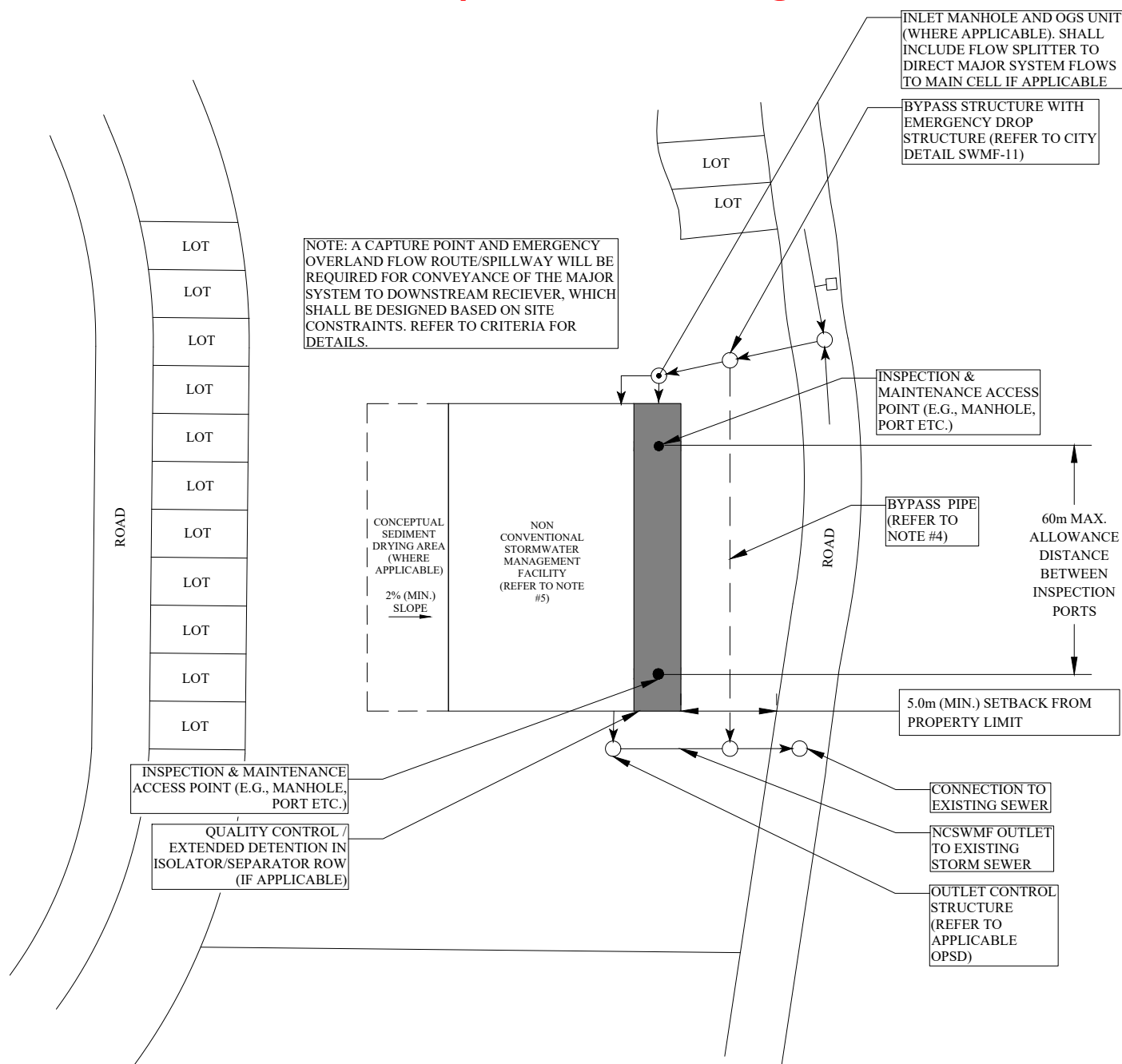
JAN. 2026

PLAN VIEW SCHEMATIC OF NON-CONVENTIONAL
STORMWATER MANAGEMENT FACILITY
(OUTLET TO WATERCOURSE)

SWMF-01A

N.T.S.

Conceptual Drawing



NOTE:

1. ALL DIMENSIONS ARE SHOWN IN METRES UNLESS OTHERWISE STATED.
2. THIS TYPICAL DETAIL IS INTENDED TO CONVEY INTENT AND IS FOR REFERENCE ONLY. IT SHALL NOT BE USED AS PART OF A CONSTRUCTION DRAWING PACKAGE OR SITE PLAN APPLICATION.
3. THIS TYPICAL DETAIL IS INTENDED TO DISPLAY CONCEPTUAL LAYOUT INFORMATION FOR THE PLAN VIEW OF A NON-CONVENTIONAL SWMF.
4. SIZING OF EMERGENCY BYPASS / MAINTENANCE PIPE SHALL BE DEPENDENT ON SWMF INLET CONFIGURATION AND SHALL BE SIZED USING APPLICABLE CONTRIBUTING FLOWS.
5. SIZING OF PROPOSED SWMF VOLUME SHALL INCLUDE A DESIGN REDUNDANCY FACTOR. REFER TO CRITERIA FOR INFORMATION.
6. DEVIATION FROM ANY STANDARDS ARE SUBJECT TO CITY'S REVIEW AND APPROVAL.



ENGINEERING DEPARTMENT, CITY OF MARKHAM

REV. 0

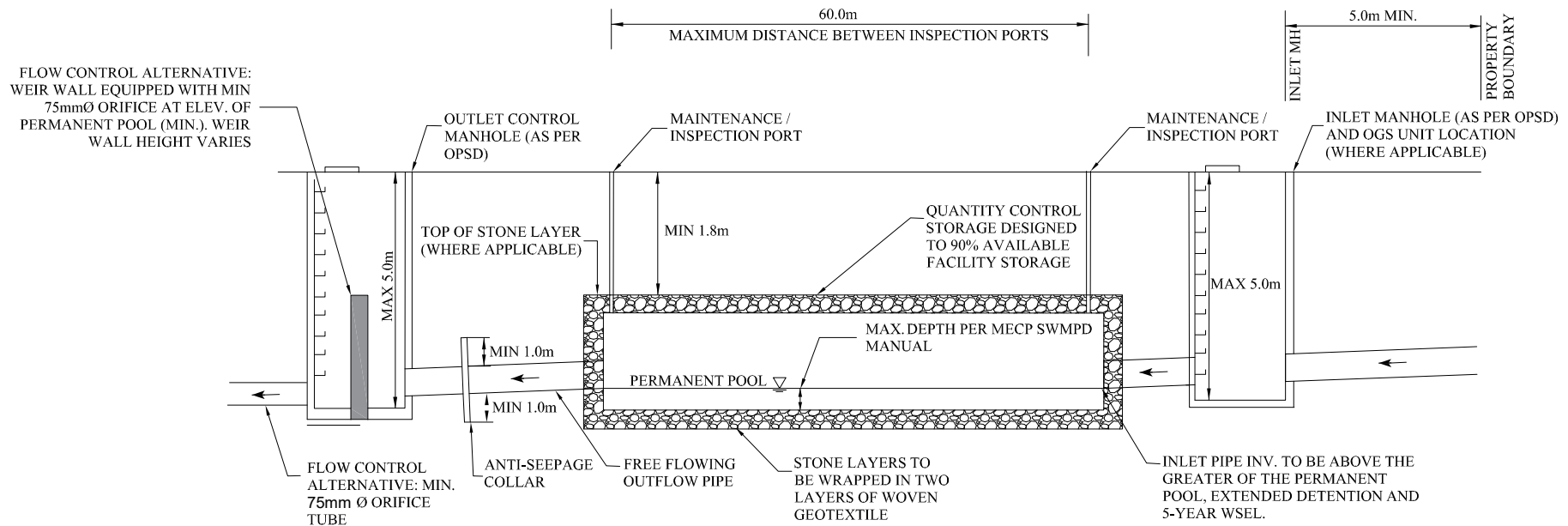
JAN. 2026

PLAN VIEW SCHEMATIC OF NON-CONVENTIONAL
STORMWATER MANAGEMENT FACILITY
(OUTLET TO PIPE)

SWMF-01B

N.T.S.

Conceptual Drawing



NOTE:

1. ALL DIMENSIONS ARE SHOWN IN METRES UNLESS OTHERWISE STATED.
2. THIS TYPICAL DETAIL IS INTENDED TO CONVEY INTENT AND IS FOR REFERENCE ONLY. IT SHALL NOT BE USED AS PART OF A CONSTRUCTION DRAWING PACKAGE OR SITE PLAN APPLICATION.
3. THIS TYPICAL DETAIL IS INTENDED TO DISPLAY A GENERAL CONCEPTUAL CROSS SECTION FOR A NON-CONVENTIONAL SWMF.



ENGINEERING DEPARTMENT, CITY OF MARKHAM

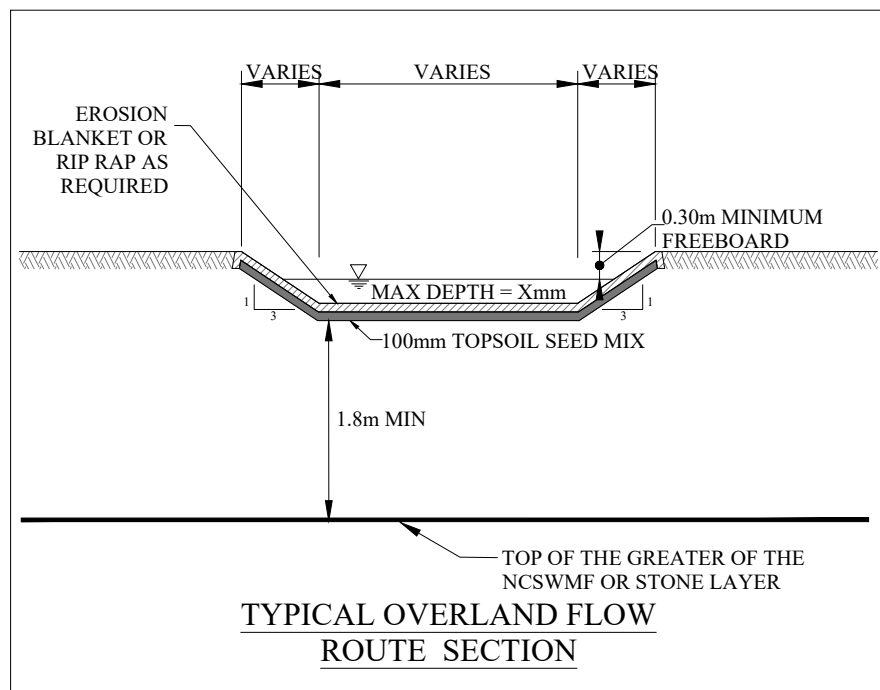
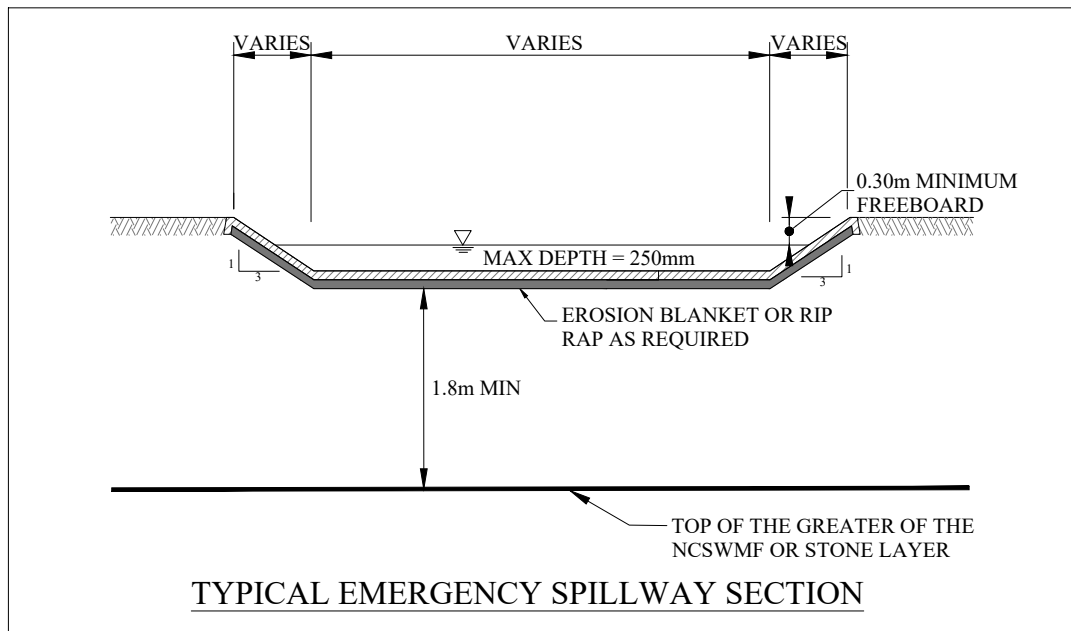
REV. 0

JAN. 2026

TYPICAL NON-CONVENTIONAL SWMF CROSS-SECTIONS
(WITH OUTLET CONTROL STRUCTURES)

SWMF-02

N.T.S.



NOTE:

1. FLOW ROUTES SHALL BE SIZED TO SAFELY CONVEY THE GREATER OF THE UNCONTROLLED PEAK FLOW FROM THE 100-YEAR STORM EVENT OR THE REGIONAL STORM EVENT, WITH A MINIMUM FREEBOARD WITHIN THE CHANNEL OF 0.30m.
2. ALL DIMENSIONS ARE SHOWN IN METRES UNLESS OTHERWISE STATED.
3. THIS TYPICAL DETAIL IS INTENDED TO CONVEY INTENT AND IS FOR REFERENCE ONLY. IT SHALL NOT BE USED AS PART OF A CONSTRUCTION DRAWING PACKAGE OR SITE PLAN APPLICATION.
4. THIS TYPICAL DETAIL IS INTENDED TO DISPLAY DETAILS FOR TYPICAL OVERLAND FLOW ROUTES AND EMERGENCY SPILLWAYS OVER A NON-CONVENTIONAL SWMF. REFER TO CITY STANDARD DETAIL MP3 FOR FURTHER INFORMATION.

**Conceptual
Drawing**



ENGINEERING DEPARTMENT, CITY OF MARKHAM

REV. 0

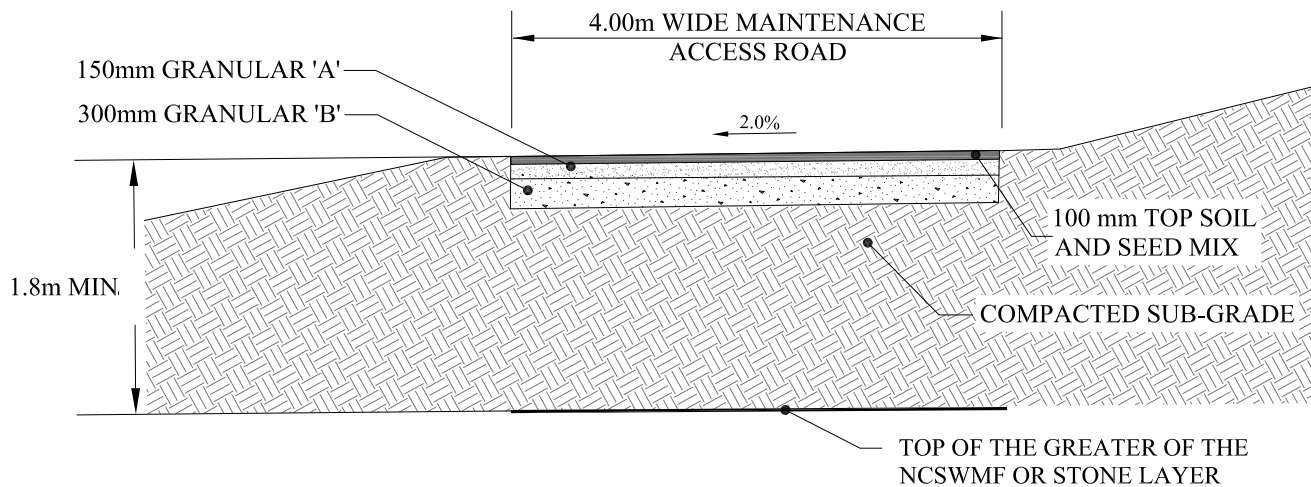
JAN. 2026

**EMERGENCY SPILLWAY AND
OVERLAND FLOW ROUTE ABOVE
NON-CONVENTIONAL SWMFS**

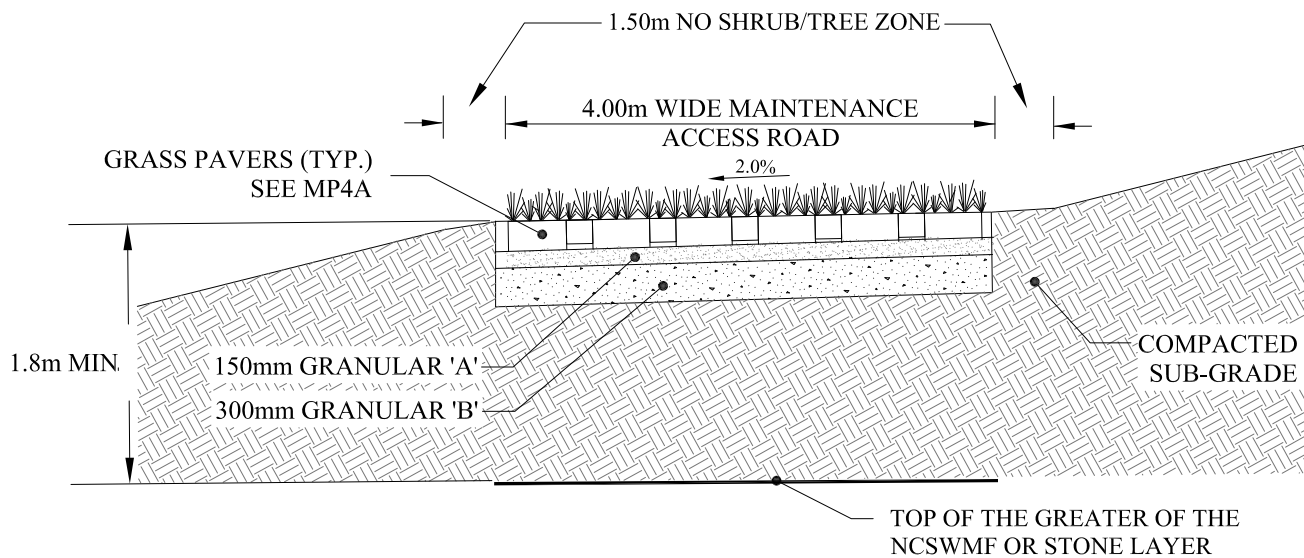
SWMF-03

N.T.S.

Conceptual Drawing



OPTION 1: LOW MAINTENANCE (GENERAL)



OPTION 2: REGULAR MAINTENANCE (PARK/OPEN SPACE)

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED
2. THIS TYPICAL DETAIL IS INTENDED TO CONVEY INTENT AND IS FOR REFERENCE ONLY. IT SHALL NOT BE USED AS PART OF A CONSTRUCTION DRAWING PACKAGE OR SITE PLAN APPLICATION
3. THIS TYPICAL DETAIL IS INTENDED TO DISPLAY DETAILS WITH RESPECT TO PATHWAYS ABOVE NON-CONVENTIONAL SWMF. REFER TO CITY STANDARD DETAILS MP4 - MAINTENANCE ACCESS ROAD FOR PAVING DETAILS AND MP4A - MAINTENANCE ACCESS ROAD WITH CONTINUOUS SIDEWALK.
4. ALL RECREATIONAL (DUAL USE) TRAILS SHALL BE AODA COMPLAINT.



ENGINEERING DEPARTMENT, CITY OF MARKHAM

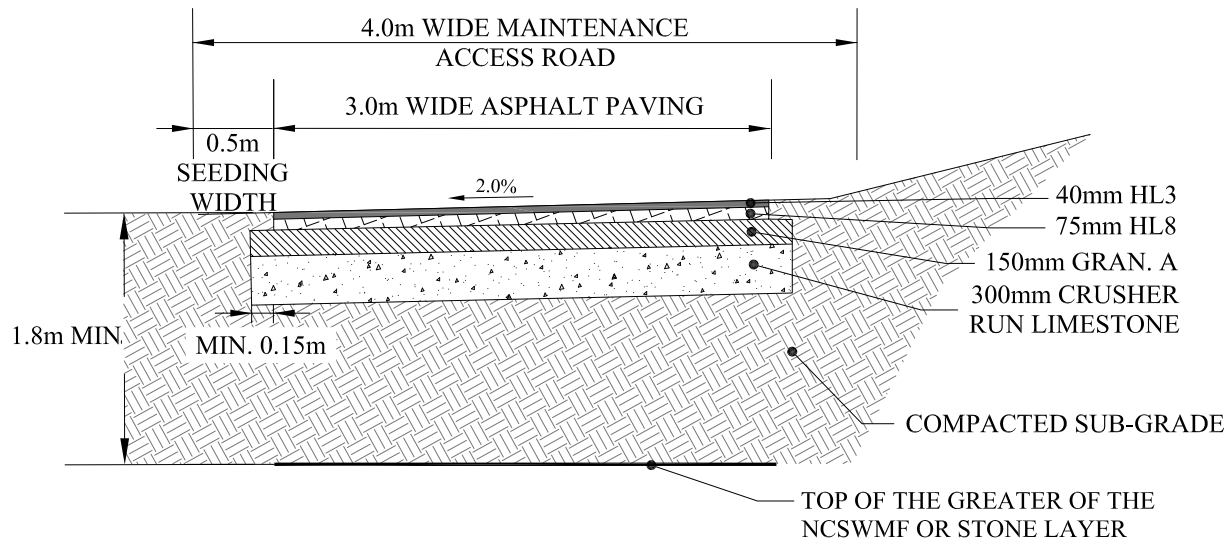
REV. 0 | JAN. 2026

MAINTENANCE ACCESS ROAD
ABOVE NON-CONVENTIONAL SWMF

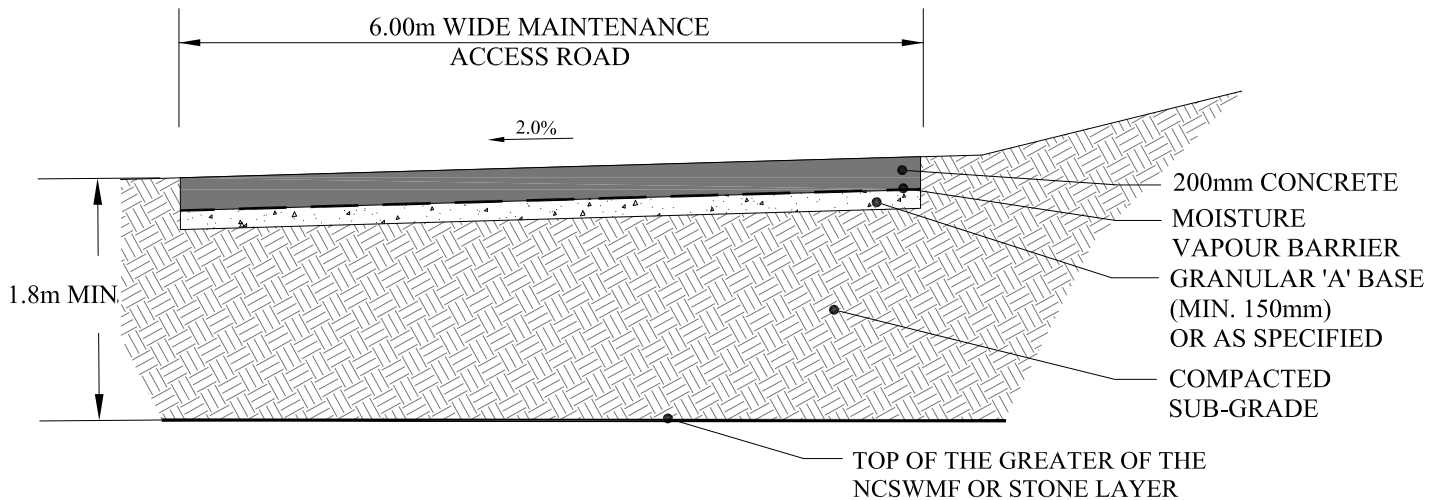
SWMF-04

N.T.S.

Conceptual Drawing



HEAVY ASPHALT DUTY PAVING



HEAVY DUTY CONCRETE PAVING

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE STATED
2. JOINT DETAILS SHALL BE SHOWN WHERE APPLICABLE AS SHOWN ON CITY STANDARD MR20
3. MOISTURE VAPOUR BARRIER SHALL BE MIN. 6.0mm PLASTIC MEMBRANE (IN ACCORDANCE WITH OPSS 351.05.03) AND SHALL BE PLACED ON TOP OF SUB-GRADE
4. THIS TYPICAL DETAIL IS INTENDED TO CONVEY INTENT AND IS FOR REFERENCE ONLY. IT SHALL NOT BE USED AS PART OF A CONSTRUCTION DRAWING PACKAGE OR SITE PLAN APPLICATION.
5. THIS TYPICAL DETAIL IS INTENDED TO DISPLAY DETAILS WITH RESPECT TO ACCESS ROADS ABOVE NON-CONVENTIONAL SWMF.
6. DESIGNS SHALL BE PER GEOTECHNICAL REPORTS AND RECOMMENDATIONS.
7. ALL RECREATIONAL (DUAL-USE) TRAILS SHOULD BE AODA COMPLIANT.



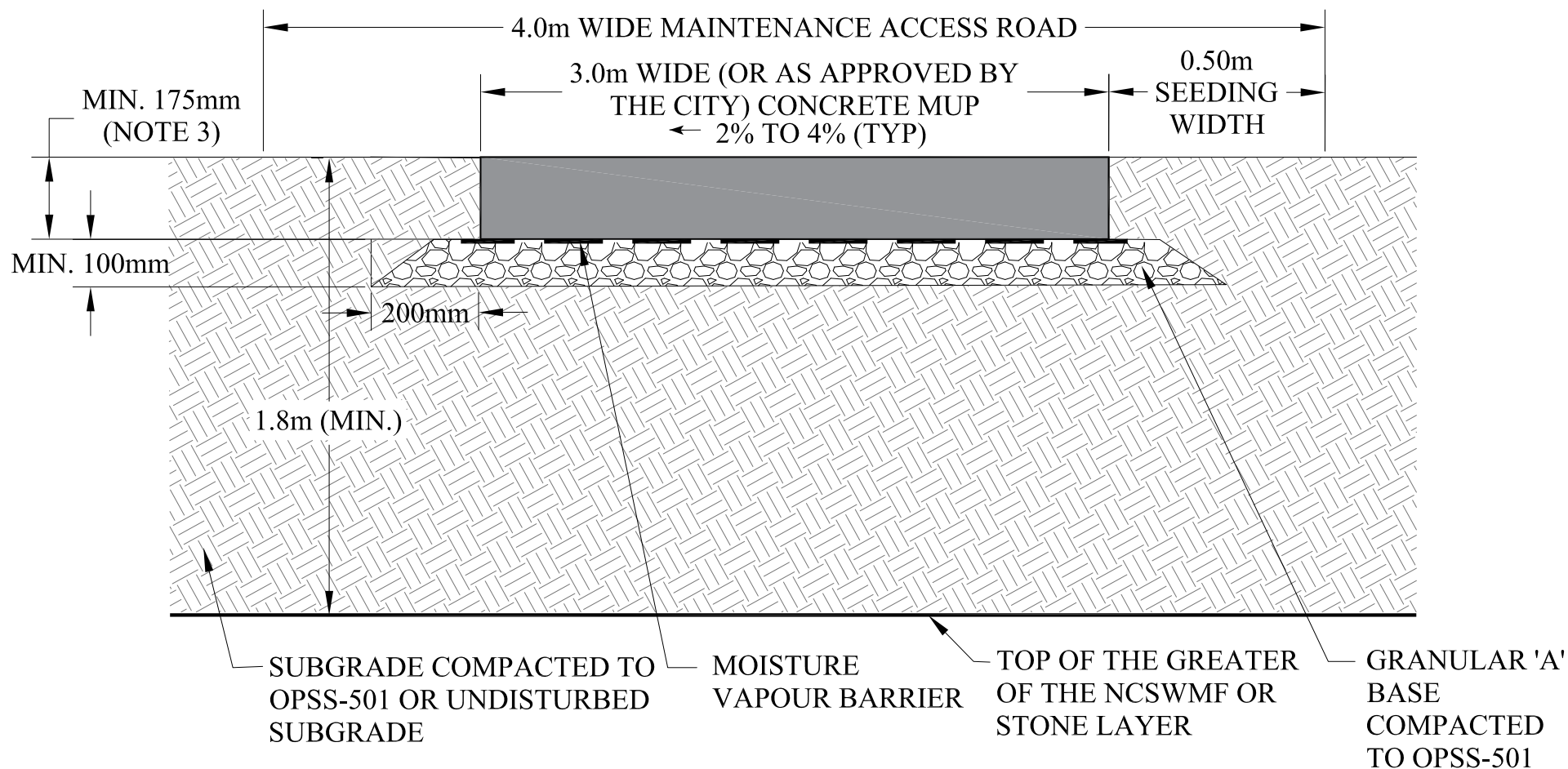
ENGINEERING DEPARTMENT, CITY OF MARKHAM

REV. 0 | JAN. 2026

MAINTENANCE ACCESS ROAD ABOVE
NON-CONVENTIONAL SWMF (PAVED)

SWMF-05

N.T.S.



NOTE:

1. ALL DIMENSIONS ARE SHOWN IN METRES UNLESS OTHERWISE STATED.
2. THIS TYPICAL DETAIL IS INTENDED TO CONVEY INTENT AND IS FOR REFERENCE ONLY. IT SHALL NOT BE USED AS PART OF A CONSTRUCTION DRAWING PACKAGE OR SITE PLAN APPLICATION.
3. THIS TYPICAL DETAIL IS INTENDED TO DISPLAY A MULTI-USE PATHWAY OVER A NON-CONVENTIONAL SWMF. REFER TO CITY STANDARD DETAIL MR20B FOR FURTHER INFORMATION.

Conceptual
Drawing



ENGINEERING DEPARTMENT, CITY OF MARKHAM

REV. 0

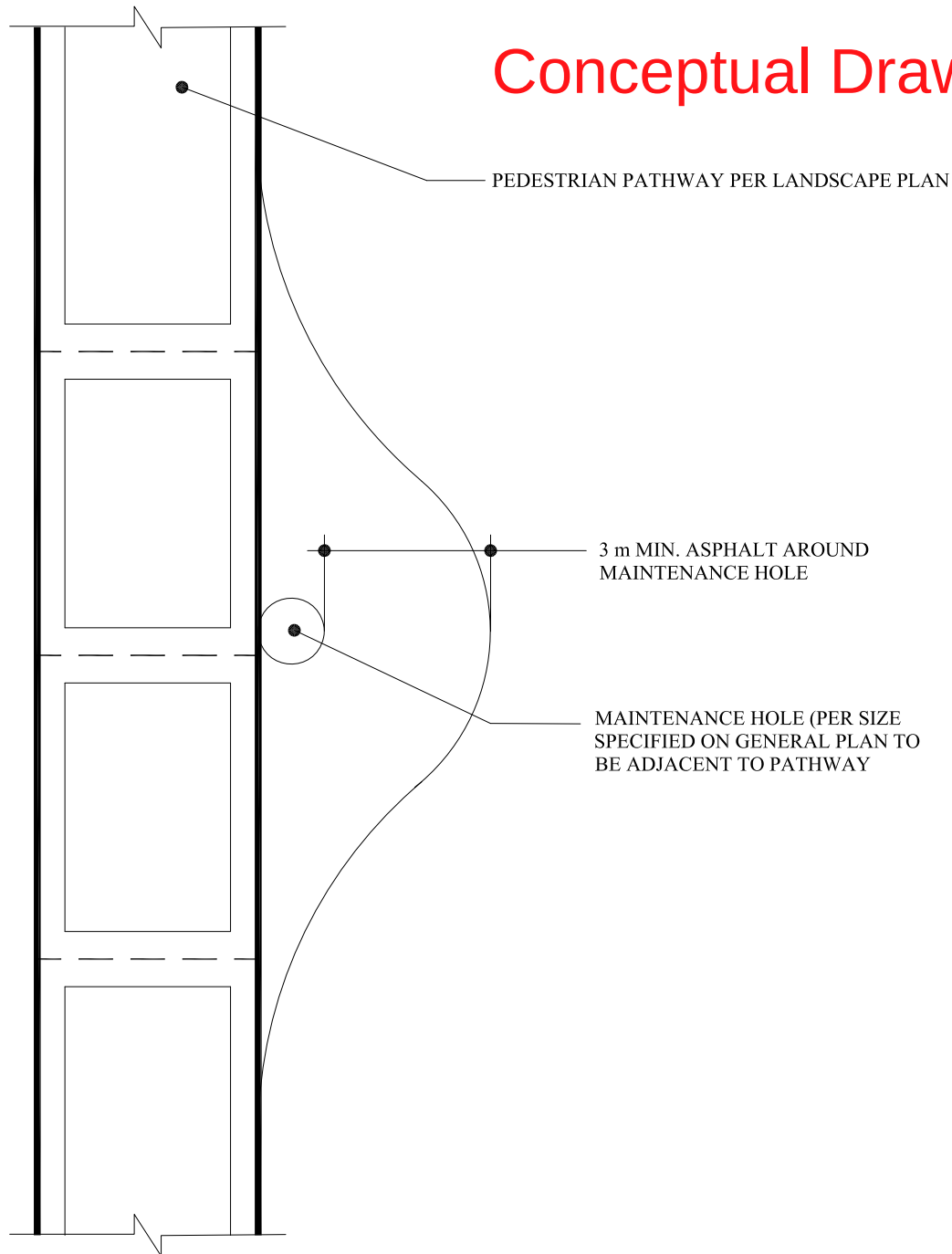
JAN. 2026

MULTIUSE PATHWAY OVER
NON-CONVENTIONAL SWMF

SWMF-06

N.T.S.

Conceptual Drawing



NOTES:

1. PATHWAY TYPE SHALL BE SPECIFIED IN LANDSCAPE PLAN
2. THIS TYPICAL DETAIL IS INTENDED TO CONVEY INTENT AND IS FOR REFERENCE ONLY. IT SHALL NOT BE USED AS PART OF THE CONSTRUCTION DRAWING PACKAGE OR SITE PLAN APPLICATION
3. THIS TYPICAL DETAIL IS INTENDED TO DISPLAY DETAILS WITH RESPECT TO MAINTENANCE HOLES FOR NON-CONVENTIONAL SWMF. REFER TO RELEVANT CITY STANDARDS FOR PAVING/PATHWAY DETAILS



ENGINEERING DEPARTMENT, CITY OF MARKHAM

MAINTENANCE HOLE BUMP OUT
FROM PEDESTRIAN PATH FOR
NON-CONVENTIONAL SWMF

REV. 0 | JAN. 2026

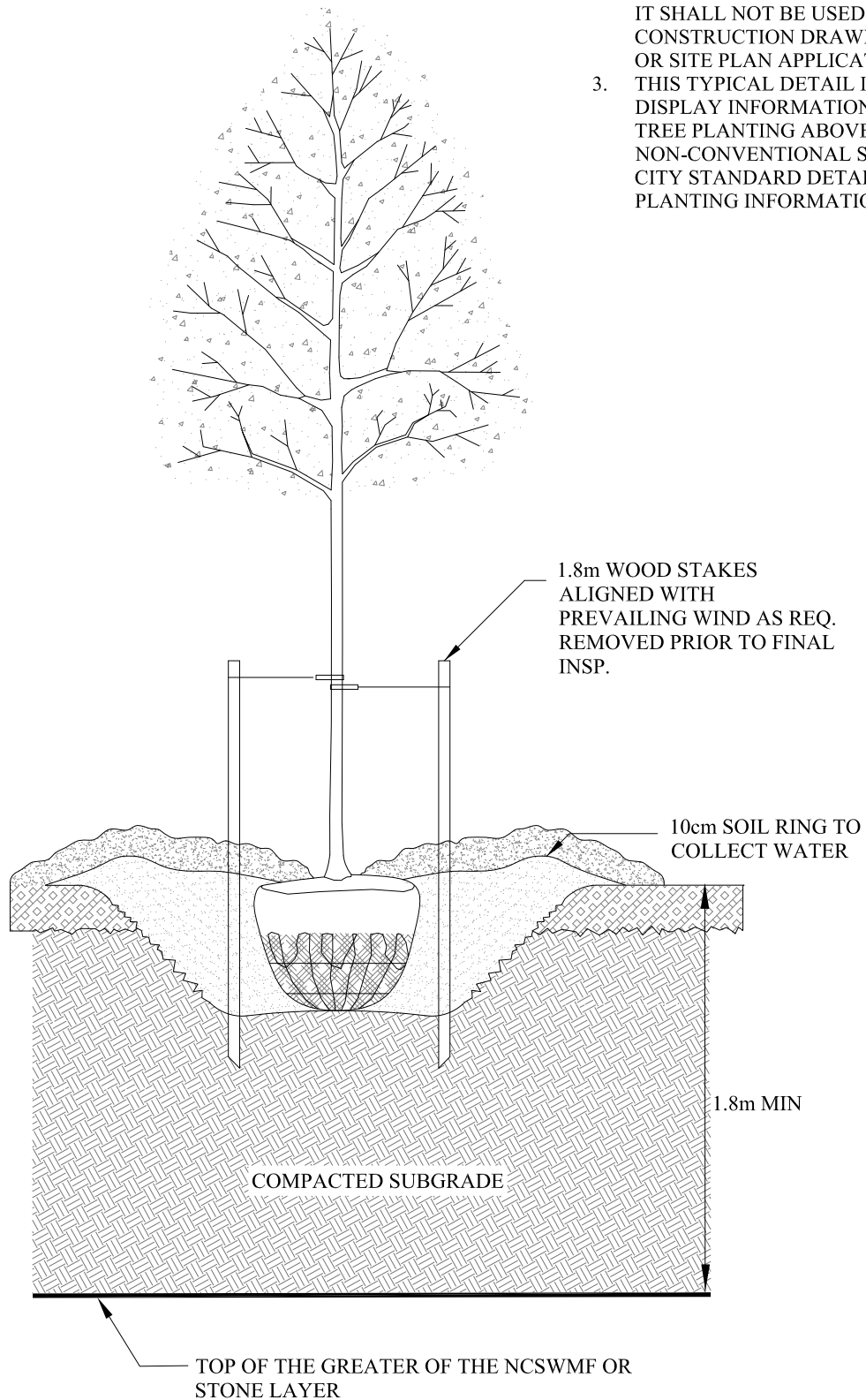
SWMF-07

N.T.S.

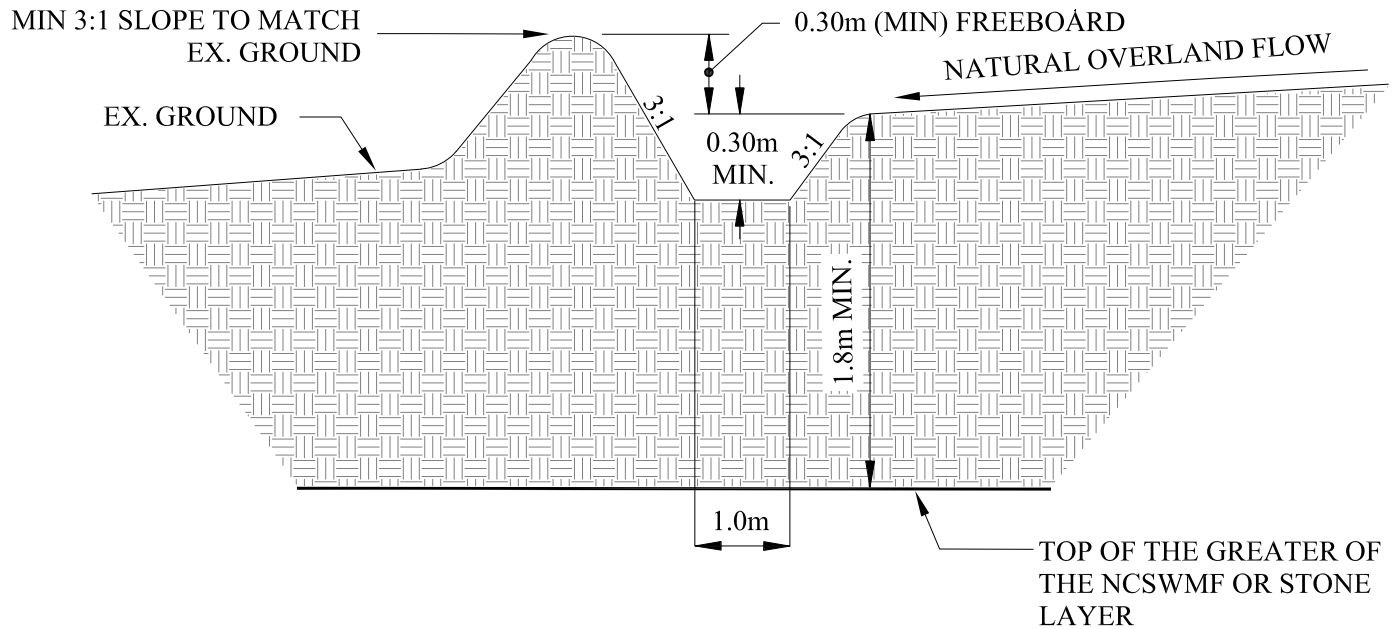
Conceptual Drawing

NOTE:

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN
2. THIS DETAIL IS INTENDED TO CONVEY INTENT AND IS FOR REFERENCE ONLY. IT SHALL NOT BE USED AS PART OF A CONSTRUCTION DRAWING PACKAGE OR SITE PLAN APPLICATION
3. THIS TYPICAL DETAIL IS INTENDED TO DISPLAY INFORMATION REGARDING TREE PLANTING ABOVE NON-CONVENTIONAL SWMF. REFER TO CITY STANDARD DETAIL T2 FOR PLANTING INFORMATION.



Conceptual Drawing



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED
2. THIS TYPICAL DETAIL IS INTENDED TO CONVEY INTENT AND IS FOR REFERENCE ONLY. IT SHALL NOT BE USED AS PART OF THE CONSTRUCTION DRAWING PACKAGE OR SITE PLAN APPLICATION
3. THIS TYPICAL DETAIL IS INTENDED TO DISPLAY DETAILS WITH RESPECT TO PATHWAYS ABOVE NON-CONVENTIONAL SWMF. REFER TO CITY STANDARD DETAILS MP8 - TYPICAL CUT-OFF SWALE DETAIL



ENGINEERING DEPARTMENT, CITY OF MARKHAM

REV. 0

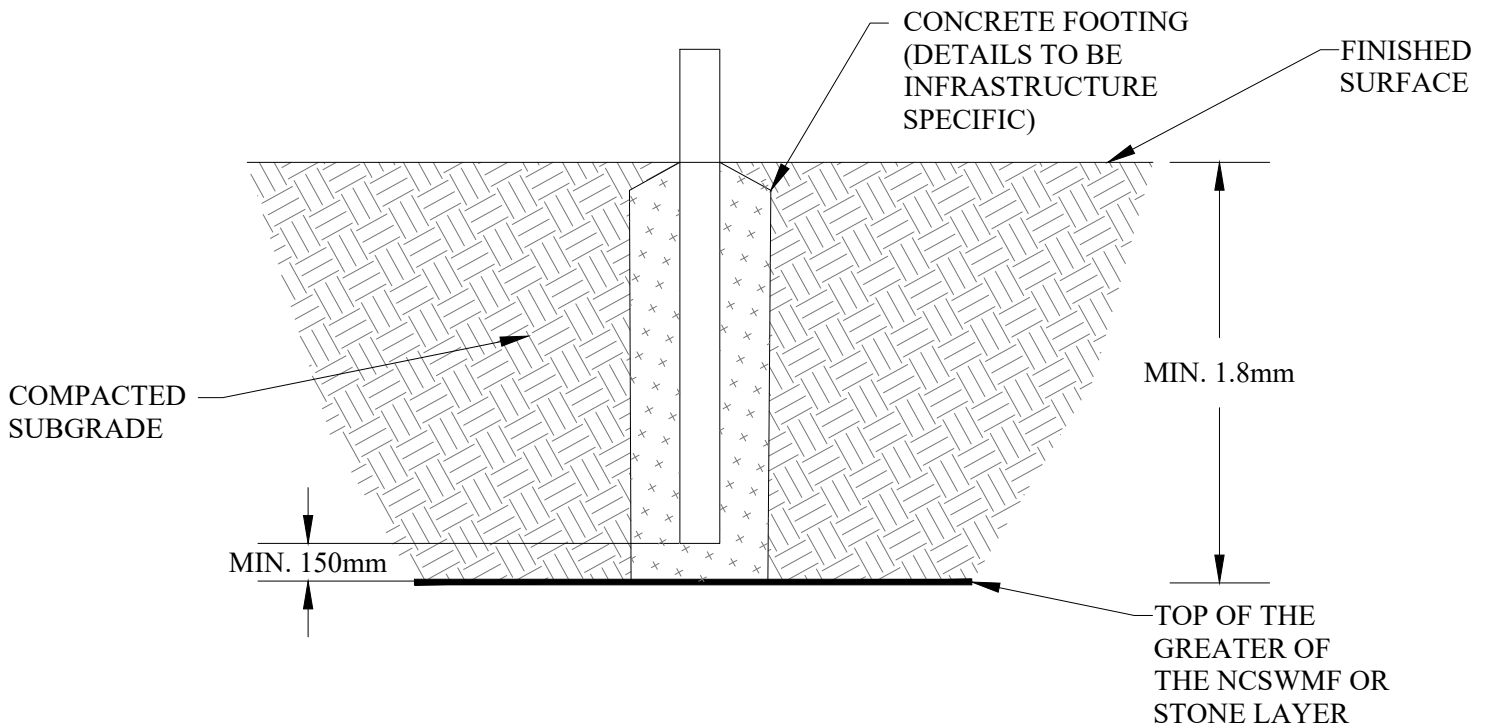
JAN. 2026

TYPICAL CUT-OFF SWALE
DETAIL ABOVE
NON-CONVENTIONAL SWMFS

SWMF-09

N.T.S.

Conceptual Drawing



NOTE:

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS UNLESS OTHERWISE STATED.
2. THIS TYPICAL DETAIL IS INTENDED TO CONVEY INTENT AND IS FOR REFERENCE ONLY. IT SHALL NOT BE USED AS PART OF A CONSTRUCTION DRAWING PACKAGE OR SITE PLAN APPLICATION.
3. THIS TYPICAL DETAIL IS INTENDED TO DISPLAY TYPICAL FOOTING OVER A NON-CONVENTIONAL SWMF.
4. FOOTING MUST BE DESIGNED BY A STRUCTURAL ENGINEER.



ENGINEERING DEPARTMENT, CITY OF MARKHAM

REV. 0

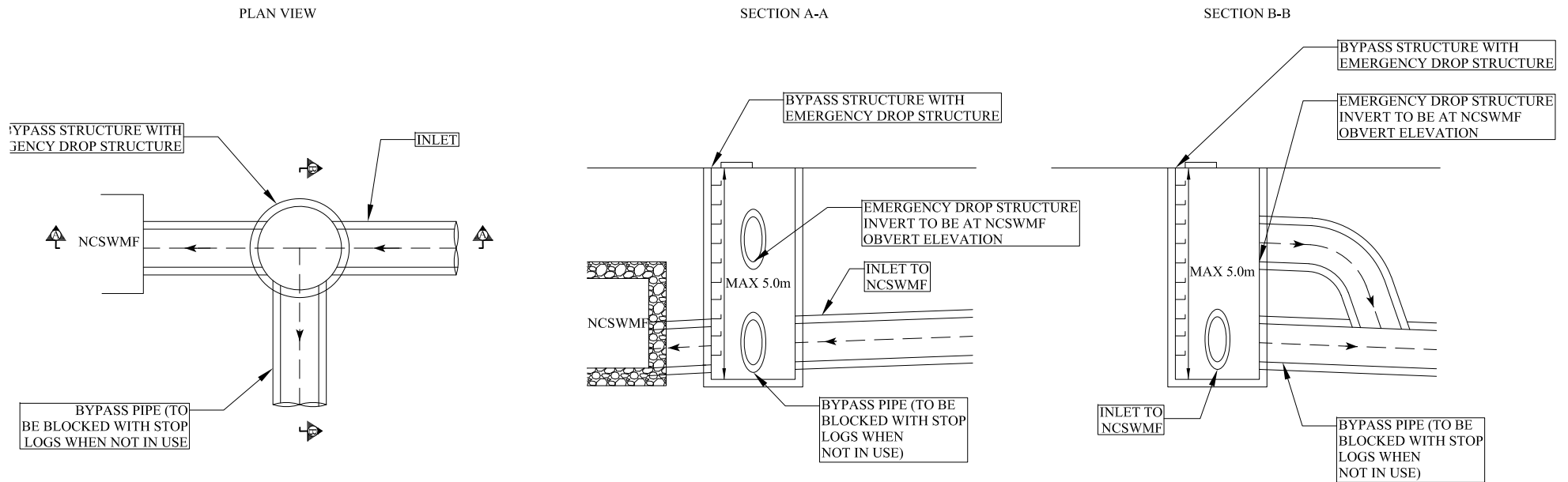
JAN. 2026

TYPICAL FOOTING OVER
NON-CONVENTIONAL SWMFS

SWMF-10

N.T.S.

Conceptual Drawing



NOTE:

1. ALL DIMENSIONS ARE SHOWN IN METRES UNLESS OTHERWISE STATED.
2. THIS TYPICAL DETAIL IS INTENDED TO CONVEY INTENT AND IS FOR REFERENCE ONLY. IT SHALL NOT BE USED AS PART OF A CONSTRUCTION DRAWING PACKAGE OR SITE PLAN APPLICATION.
3. THIS TYPICAL DETAIL IS INTENDED TO DISPLAY A GENERAL CONCEPTUAL CROSS SECTION FOR A NON-CONVENTIONAL SWMF.



ENGINEERING DEPARTMENT, CITY OF MARKHAM

REV. 0

JAN. 2026

TYPICAL NON-CONVENTIONAL SWMF
BYPASS STRUCTURE

SWMF-11

N.T.S.

The diagram illustrates a wet cell treatment system layout. Key features include:

- Watercourse:** Located on the left side of the plan.
- Sediment Drying Area (if feasible):** Indicated at the top left.
- Sediment Forebay:** A central area with a 3:1 MAX slope.
- Wet Cell Aftbay:** A larger area with a 3:1 MAX slope and a 18.0m (MAX) dimension.
- Retaining Wall:** A wall along the right side of the wet cell, with a 2% slope and a 1.2m pedestrian barricade/fencing requirement.
- Development Setback:** A 5.0m minimum setback from the road.
- Maintenance Access:** A 4.0m wide access route with a minimum cross-slope of 2% and a gradient of 10-15%.
- Setback from Top of Wall:** A 0.4m (min) setback from the top of the retaining wall to the maintenance access route.
- Retaining Wall Location and Extent:** Subject to site-specific conditions and must be limited to one side of the pond.
- Retaining Wall Design:** To be designed by a structural engineer.
- Retaining Wall Equipment:** To be equipped with 1.2m pedestrian barricade/fencing, with a height of 1.37m if bicycle access is permitted.

1. ALL DIMENSIONS ARE SHOWN IN METRES UNLESS OTHERWISE STATED.
2. THIS TYPICAL DETAIL IS INTENDED TO CONVEY INTENT AND IS FOR REFERENCE ONLY. IT SHALL NOT BE USED AS PART OF A CONSTRUCTION DRAWING PACKAGE OR SITE PLAN APPLICATION.
3. THIS TYPICAL DETAIL IS INTENDED TO DISPLAY CONCEPTUAL LAYOUT INFORMATION FOR THE PLAN VIEW OF A RETAINING WALL WITHIN A SWM POND.
4. WHERE MAINTENANCE ACCESS ROADS ARE INTENDED TO SERVE A DUAL FUNCTION AS RECREATIONAL TRAILS, THEY SHALL BE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH ACCESSIBILITY REQUIREMENTS SET OUT IN THE ACCESSIBILITY FOR ONTARIANS WITH DISABILITIES ACT (AODA) AND APPLICABLE DESIGN STANDARDS.
5. REFER TO DETAIL MPI FOR THE SWM POND LAYOUT DETAIL.