

Town of Oakville Stormwater Management Facilities: Monitoring, Inspection and Maintenance Guidelines

Community Infrastructure Commission

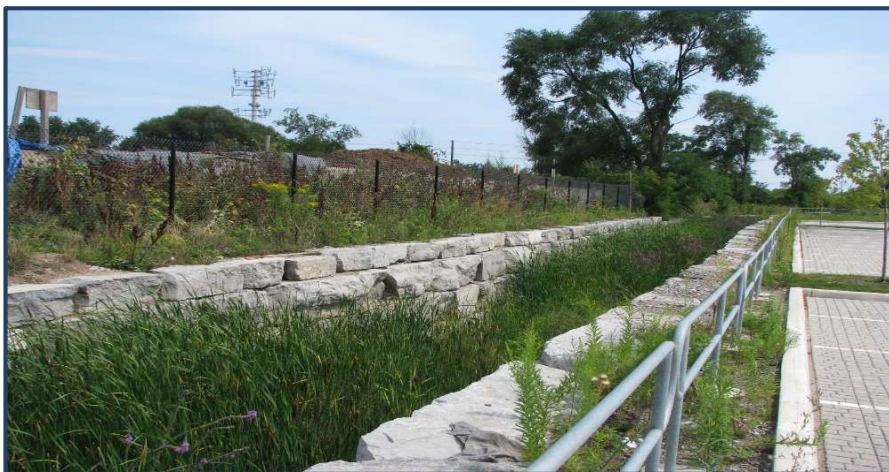
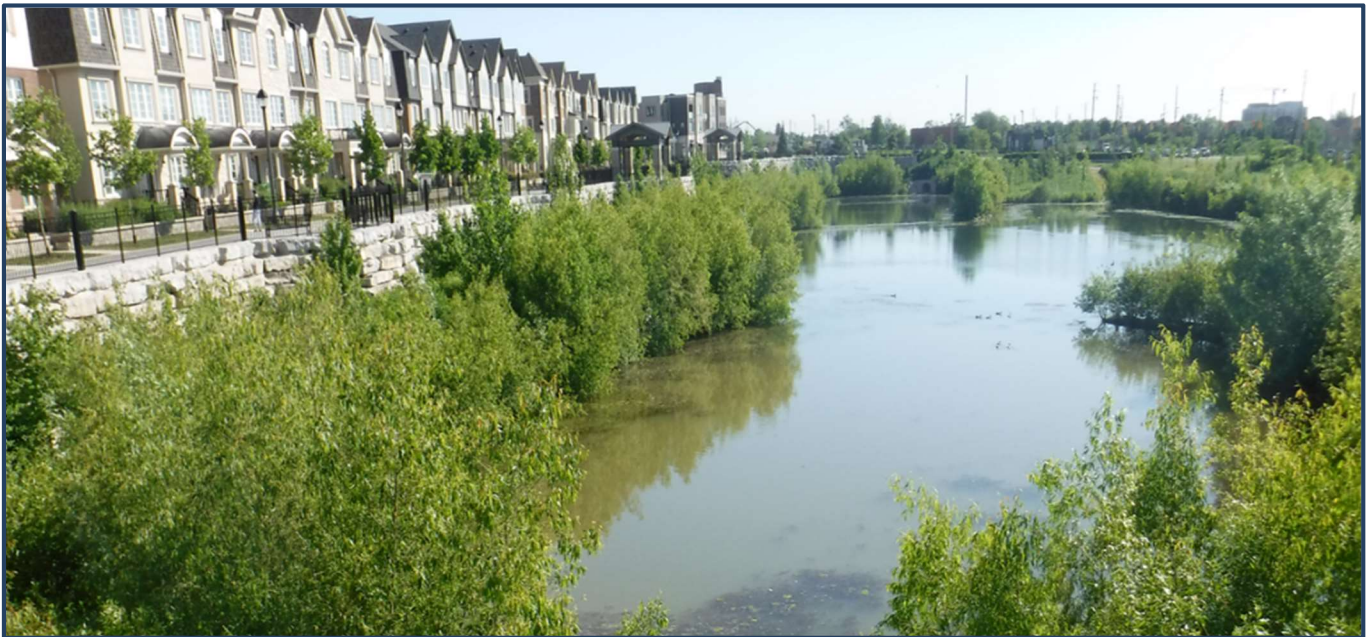


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1. INTRODUCTION

Stormwater management facilities (SWMFs) are manmade infrastructure designed to protect downstream property from flooding and erosion by temporarily storing runoff and improve water quality by holding onto pollutant-laden sediment, preventing its release into the natural environment.

To remain effective, SWMF require regular inspection, maintenance and monitoring so they continue to meet their water quality and quantity design objectives. Regular inspection, maintenance, and monitoring of SWMFs is also key to ensure that acceptable public safety standards are being met.

The purpose of this document is to present guidelines for preparing a comprehensive “monitoring program” of SWMFs including stormwater management ponds (SWMP) and low impact development facilities (LIDs) located in the Town of Oakville. This guide also provides details on the steps required for a smooth transition to assumption of SWMFs by the Town.

This document replaces the Town of Oakville’s *Stormwater Monitoring Guidelines North of Dundas Street, Operation, Maintenance and Monitoring of Stormwater Management Ponds, dated January 2012*, and *Stormwater Monitoring Guidelines South of Dundas Street, Operation, Maintenance and Monitoring of Stormwater Management Ponds, dated January 2011*.

It is the responsibility of the developer to routinely inspect and monitor the SWMFs from construction until final assumption. Town staff will inspect the SWMFs periodically, however it is the developers’ obligation to ensure that the facilities are routinely inspected and maintained and are in good working order.

These guidelines were prepared in accordance with the following:

- Stormwater Management Planning & Design Manual (MOE [now MECP] 2003),
- Low Impact Development Stormwater Management Planning and Design Guide (TRCA, CVCA, 2010),
- Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide (TRCA, 2016)
- “Lessons Learned” CVC Stormwater Management and Low Impact Development Monitoring and Performance Assessment Guide (CVC, 2015),
- Inspection and Maintenance Guide for Stormwater Management Ponds and Constructed Wetland (TRCA, 2018);
- North Oakville Creek Subwatershed Study (NOCSS), OMB Mediation Agreements

For the purposes of this guideline, a SWMF is defined as a treatment facility that provides water quality, water quantity and erosion controls to the receiving watercourse. In some cases, this facility takes the shape of an end-of-pipe treatment technology (i.e. water quality and or quantity pond, extended detention pond, constructed wetland and underground storage tanks), or an LID source control best management practice (LID BMP), e.g. bio-swale, infiltration gallery, green roof, etc.), or a combination of both as part of treatment train. Some facilities are also designed for the purpose of groundwater recharge through infiltration and/or evapotranspiration in order to mimic natural or pre-development hydrology.

2. BACKGROUND

2.1. SWMFs North of Dundas Street.

The North Oakville Creeks Subwatershed Study” or NOCSS outlines the goals and objectives for the management of natural heritage and water resources including stormwater for lands located north of Dundas Street up to the Highway 407 corridor and between Tremain Road and Ninth Line. Environmental Implementation Reports and Functional Servicing Studies (EIR-FSS) are prepared for watershed sub-areas that are to be impacted by development plans, ensuring that the requirements of NOCSS are being met and provides specific direction on a stormwater management strategy, targets, goals, etc. The SWMF monitoring program designed must demonstrate compliance with the respective EIR/FSS report and NOCSS

2.2. SWMF South of Dundas (New and Infill Development).

The majority of creeks within the boundaries of Oakville, south of Dundas Street have been assessed via subwatershed studies. An EIR-FSS or equivalent level of study is prepared referring back to the originating subwatershed study when analyzing drainage impacts and developing stormwater management criteria within the delineated subwatershed boundary. Similar to lands north of Dundas, development south of Dundas is proceeded based upon an approved subwatershed study and EIR-FSS or equivalent level of study. SWMF monitoring program designed must demonstrate compliance with the respective higher level study.

3. MONITORING PROGRAM OBJECTIVES

It is the intent of the monitoring program is to answer the following questions prior to the Town's assumption of SWMF operations:

- I. *Is it built as approved?* A qualified engineer shall certify that the stormwater management facility is constructed in accordance with the approved engineering drawings and approved EIR/FSS or equivalent study. Staff will also evaluate whether the plantings are installed as per the approved drawings.
- II. *Does it operate as intended?* Functional and Inspection Monitoring is needed to ensure that all structural components of the stormwater facility are in good working condition and maintains its required storage volume.
- III. *Does it meet the design targets?* Performance Monitoring is needed to determine the SWMF pollutant removal efficiency, hydraulic response to rainfall events, infiltration target achieved, and overall conformance with the NOCSS, EIR/FSS or other comprehensive study.

4. MONITORING PROGRAM REQUIREMENTS

4.1. Baseline Monitoring

Collection of baseline information is essential to understanding the effectiveness of the stormwater management measures applied within the watershed. Within the NOCSS lands, the Town has undertaken some baseline monitoring, at Dundas Street on East Morrison, Joshua and Fourteen Mile Creeks. Further to these efforts, additional monitoring should be undertaken by the developer once the final locations of the SWMF are known, as follows:

- Baseline temperature and total suspended solids (TSS) monitoring be undertaken in the receiving watercourse upstream and downstream of the anticipated SWMF outlet;
- Temperature monitoring be undertaken during the months of July, August and September or other critical periods as per target fish species lifecycle, prior to construction of the SWMF. Temperature monitoring should be carried out as per Section 5 of the Ontario Stream Assessment Protocol; and
- The TSS monitoring should be undertaken during 3 dry weather sampling events and during at least 4 wet weather events prior to the construction of the SWMF.

In some instances, geomorphological monitoring may be required to assess baseline conditions and potential effects of stormwater discharge on channel form and function. This may include detailed cross-sectional surveys, installation of erosion pins, and rapid stream assessments.

4.2. Erosion and Sediment Controls (ESC)

Requests for site alteration and associated earthworks shall be in keeping with the relevant approvals of the EIR/FSS or equivalent study. The ESC requirements shall follow applicable approved guidelines and bylaws in effect at the time of development. The site alteration design report shall include a schedule for routine inspection, monitoring and reporting. Erosion and sediment measures shall be kept in good working condition at all times and remedial action should be taken to correct deficiencies/blowouts of ESC measures.

A schedule for reporting on site alteration activities and associated monitoring shall be developed in consultation with the Town of Oakville. Monitoring shall consist of the following:

- Routine inspections (see section 4.3 – Inspections During Construction)
- Water quality samples should be taken at pond outlets during four (4) wet weather events;

- Continued stream monitoring upstream and downstream of the pond outlet for TSS and Temperature, as described in Section 3.1.1 for baseline monitoring; and
- Photographic inventory of the erosion and sediment controls.

4.3. Inspections During Construction

Although inspectors cannot be on-site continuously during construction, it is important that the site be inspected during critical milestone such as:

- After every large storm event (e.g., 12 mm rainfall depth or greater) to ensure ESCs and pretreatment or flow diversion devices are functioning and adequately maintained.
- Prior to grading activities to ensure that ESC/barriers are erected and functioning to protect future LID sites.
- Prior to hand-off points in the construction sequence when the contractor responsible for the work changes (i.e., hand-offs between the grading, servicing, paving, building and landscaping contractors).
- At completion of rough grading and excavation of permanent BMPs, prior to installation of pipes/sewers and backfilling to ensure elevations, depths and grades are acceptable.
- Inspection of test results/quality assurance documents for construction materials prior to delivery.
- After placement of sub-drain system pipes and downstream conveyances (e.g., catchbasins, manholes), prior to backfilling to ensure elevations, depths and grades are acceptable.
- After final grading but prior to planting to ensure elevations, depths and grades are acceptable.
- After planting to ensure the right type of plants have been installed in appropriate locations and acceptable quantities.

4.4. Inspections Following Construction

The SWMF should be inspected at the onset of each season (**minimum 4 times per year**) to ensure that the SWMF features (inlet, outlet, spillway etc.) are in good operating condition and following significant rainfall event to ensure proper functioning. Additional monitoring may be required in response to public inquiries.

The following is a broad checklist of concerns applicable to SWM Ponds and/or LID BMPs. 'Inspection Forms' should be tailored to the specific SWMF.

- ✓ Obstruction at the inlet, outlet, diversion structure and emergency spillway.

- ✓ Structural integrity of, inlets, manholes, chambers, outlet control structure, including reversed slope pipe or hickenbottom, spillway, flow spreader, subdrain/perforated pipes
- ✓ Functioning of upstream features key to the function of SWM system (e.g. flow splitter manholes).
- ✓ Monitoring equipment in tact
- ✓ Oil/grease contamination (with an unnatural odour) or evidence of hydrocarbon spills (i.e. gasoline) in the pond or the receiving watercourse.
- ✓ Accumulation of trash in or around the facility
- ✓ Accumulation of algae or other form of choking vegetation.
- ✓ Sediment buildup in sediment forebay, main cell, LID BMP, or in the receiving watercourse at the outlet.
- ✓ Evidence of animal activity such as burrowing or damming within the pond, LID BMP or at the outlet.
- ✓ Evidence of hydraulic malfunctioning such as frequent overtopping of the high water level over emergency spillway, low water levels following significant rainfall events, or bypass of flow without treatment (e.g. flow does not enter the LID BMP as intended).
- ✓ Inappropriate or dead vegetation in and around the facility.
- ✓ Mulch depth is adequate.
- ✓ Evidence of fish stocking.
- ✓ Evidence of community activities, vandalism and encroachment.
- ✓ Status of the safety features and grading (including signage fencing, side slopes, safety grates, retaining walls and other safety features).
- ✓ Erosion at the outlet structures including evidence of scouring at the storm outfall to the creek valley.
- ✓ Erosion of the berm, spillway, overland flow paths, and receiving watercourse.
- ✓ Signs of seepage through berms.
- ✓ Vegetative barriers
- ✓ Exercise movable parts annually to ensure they are free to operate (i.e. maintenance valve, etc.).

Sample inspection forms are provided in Appendix A1 (SWMP) and A2 (LID BMPs)

4.5. Functional Monitoring

The developer shall carry out functional monitoring on the entire SWM system from at-source to end-of-pipe and take remedial actions as necessary. Monitoring should be undertaken from construction to assumption of the SWMFs.

4.5.1. Survey and Certifications

Following the construction of the SWMF, a qualified professional is required to certify that the constructed facility and structural details were monitored and inspected routinely during construction and, as such, are built in accordance with the approved design. Further status certificates may be required at the assumption of the first phase(s) of subdivision or as needed following restoration or rehabilitation works.

The **Design Conformance Certificate** must be accompanied by a recent as-built topographic survey of SWMFs and associated features, such as:

- All materials used in construction;
- Dimensions (horizontal and vertical), volume, and orientation;
- Bottom elevation(s), berm elevation(s), inlet(s) and outlet(s) elevations;
- Control orifices/weirs;
- Underground control chambers;
- Sediment forebay and pretreatment features;
- Inlet and outlet structural details;
- Flow splitting structures to divert high flows;
- Emergency spillway;
- Landscaping, including paths;
- Routes for inspection and maintenance access;
- Security features or devices including fencing, grates, warning and/or educational signage;
- Plantings within the SWM Block or LID BMP; and
- Other features as specified by design.

4.5.2. Upstream Features

The proponent shall include upstream features in their assessment of the stormwater management system and report on their function to the overall SWM plan. These features may include, but not limited to, oil/grit separators, infiltration trenches, diversion structures and outlets, rooftop controls, bioswales/ditches.

4.5.3. Storm Outfalls

As it relates to the performance of the SWMF, the storm outfall to the receiving stream or tributary swale, including LID overflow outlets and level spreaders, is to be monitored routinely for evidence of erosion, scouring and deposition of sediment within 2-5 meters downstream of the outfall. The structural integrity of the outfall should be noted at this time. Modifications to the outfall may be regulated by the Conservation Authority, and therefore, direct approval must be obtained from the Authority.

4.5.4. Sediment Accumulations in Stormwater Management Ponds (SWMPs)

To ensure the continued pollutant removal efficiency and storage capabilities of SWMP, sediment depth monitoring to assess sediment accumulation within the facility is required and will be used to determine the need for sediment removal (cleanouts).

Sediment depth monitoring should be completed every 2 years during active construction activities, or as demonstrated based on measured accumulation rates.

Sediment depth monitoring can be carried out using the disc and rod method or approved equivalent. In this method, the disk and rod are lowered into the pond bed to settle on top of the sediment layer, the water depth is recorded with the survey rod and onshore GPS total station. Subsequent, the rod (without the disc) is lowered into the loose sediment until it meets the native soil. The difference between the disc and rod depth readings is then used to determine the depth of accumulated sediment. Results are then compared to previous survey or as-built drawings.

The frequency of sediment removal is based on 5% reduction of TSS removal efficiency or 50% reduction in storage volume of the sediment forebay.

4.5.5. Sediment Removal from SWMP

Upon completion of all construction activities within a subcatchment draining to a SWMF, the developer is required to remove any accumulated sediment from the sediment forebay, main cell, and any at-source features and restore the facilities back to their approved design.

Timing of cleanout operations should be scheduled during longer dry periods in late summer (July, August, September) to prevent delays in dredging operations. This timing is also preferable from an environmental perspective in order to protect hibernating herpetofauna in the winter and breeding wildlife in the spring/early summer.

Should the pond assumption linger for a significant period of time after build-out of the contributing drainage area and pond clean-out, the Town may require an additional sediment survey be conducted to demonstrate that the accumulated sediment volume does not require additional maintenance.

Prior to sediment removal, the developer is required to address the following to the satisfaction of the Town of Oakville:

- A handling, removal and disposal plan for the proposed works
- Written notice to local residents to identify maintenance works and duration.
- Erosion and sediment control plans.
- Dewatering techniques.
- Sediment drying techniques.
- Hauling and access routes
- All necessary permits and/or written consent from external agencies
- Sediment chemistry analysis in accordance with Ontario Regulation 347/90 – General Waste Management and Ontario Regulation 153/04 – Records of Site Conditions

Refer to *Stormwater Pond Cleanout Guidance Document* in Appendix B for additional information.

4.6. Performance Monitoring

Performance Monitoring of the SWMF is required from construction to assumption, with a minimum 2 years of monitoring for SWM ponds post clean out of the facility or additional monitoring beyond assumption (as determined by the Town).

Details on monitoring parameters, methodology, frequency and duration of monitoring are described in Table 1 attached. The locations of monitoring stations for various monitoring components are illustrated on Figure 1 and 2 of Appendix C.

4.6.1. Water Level

Continuous water level readings should be recorded from a secure station near the sediment forebay headwall (for ponds) or within monitoring well ports (for LID BMPs). Water Level monitoring is a good indicator of the SWMFs response to rainfall events. Analysis should yield an estimate of the drawdown time for a particular rainfall event and a rough estimate of the hydrograph. For LID BMPs water level can be used to assess surface ponding, water retention, and estimate groundwater recharge.

Water level must be referenced to a geodetic datum. At least one staff gauge shall also be installed at the facility by the developer, at a location approved by the Town staff.

It is expected that a minimum of 6-8 events will be recorded over each monitoring season (March to November) from as early as construction to the Town's assumption of the facility's operation and maintenance responsibilities, as deemed appropriate by the Town.

4.6.2. Flow

Continuous flow readings are a good indicator of the SWMFs response to rainfall events and should be measured at the inlet(s) and outlet(s) of the pond and/or LID BMP, including the emergency overflow outlet. A minimum of 6-8 events should be recorded each monitoring year and may begin at construction to the Town's assumption of the operations and maintenance responsibilities, or as deemed appropriate by the Town.

Video recordings during rainfall events should be provided for certain LID BMPs to determine if runoff is flowing according to expected drainage design or if bypass of the feature is occurring. Recording runoff and precipitation also provide insight on the volume of water the LID features should be designed to treat.

4.6.3. Water Quality and Temperature

Water quality sampling parameters include Total Phosphorus (TP), Total Suspended Solids (TSS), Temperature and in some cases Dissolved Oxygen and Chloride. Table 1 (Appendix A) provides the monitoring parameters, protocols and targets.

Automated water quality samples should be taken at the SWMF inlet(s) and outlet(s).

The monitoring plan shall also include monitoring of the receiving system for the effectiveness of the SWMF at the location of the outfall for the purpose of water quality and temperature monitoring and at the location or locations downstream of the SWMF at the most sensitive reach as identified in the EIR/FSS or study equivalent.

Water quality and temperature monitoring is required from construction to assumption of the pond and/or LID feature and a schedule shall be determined in consultation with the Town and Conservation Authority.

4.7. Additional Monitoring

4.7.1. Modified Streams

A multidisciplinary monitoring program approved by the Town and Conservation Halton (CH) will be implemented for all stream modifications. The monitoring program will be implemented by the proponent of the stream modification.

Additional monitoring associated with Ministry of Environment, Conservation, and Parks (MECP) and/ or Department of Fisheries and Oceans approvals may be required and shall be the responsibility of the proponent.

4.7.2. Geomorphological Monitoring

Fluvial geomorphological monitoring is required downstream of the proposed SWMF outlet in order to assess pre- to post construction conditions for the receiving watercourse. Geomorphological monitoring should include, but not limited to:

- Monumented channel cross-section to measure change in bankfull geometry and bank conditions.
- Installation of erosion pins to measure change in bank conditions
- Bank and bed material characterization and banks stability observations
- Rapid stream assessments
- Monumented photographs at each location.

Geomorphological monitoring locations used for baseline monitoring is recommended to be carried forward to post-construction monitoring.

4.7.3. Natural Heritage Features Monitoring (woodlot, wetland etc.)

A separate monitoring program may be required for municipal services such as roads, watermains, sanitary sewers, stormwater management works or trails within the Natural Heritage System. The monitoring program approved by the Town and Conservation Halton is to be developed based on the natural features and functions that may be impacted by the specific works within the NHS. The details of the monitoring program are to be included in the EIR-FSS or equivalent study, and,

monitoring shall be implemented by the landowner installing the stormwater management works, municipal services or trails.

5. COMPLIANCE, ADAPTIVE MANAGEMENT, AND CORRECTIVE ACTIONS

The expectation is that the SWMF will meet performance targets in accordance with the higher level study (subwatershed study or equivalent study).

It is understood that the efficiencies calculated from multiple storm events will vary significantly, depending on the season and storm size (volume and intensity).

Accordingly, it is expected that the overall pollutant removal efficiency of the SWM facility will be based on an average efficiency rating over the total sampling period post construction of the contributing drainage area. Performance of individual SWMF will be compared to the established targets with consideration for the results of similar facilities. The town may wish to revisit targets to ensure they are current, specific and effective in working towards agreed upon goals.

If the SWMF performance meets the objectives of the Monitoring Program and high-level study targets, the SWMF may be considered for assumption by the Town, subject to the other conditions of assumption.

However, if the performance of the SWMF does not meet targets, the following actions will be considered by the Town in consultation with the owner:

- Review of conformance reports to see if the SWMF was sized and designed appropriately
- Review of maintenance practices to ascertain if maintenance is required, especially focusing on sediment build-up and removal.
- Consideration of other factors that could explain high TSS levels in the outlet, such as berm erosion, or short circuiting of flows
- Consideration that efficiency of removal is low due to lower than expected TSS concentrations and loadings to the facility.
- Modifications to the inlet or outlet works if these are considered contributing to the high TSS.
- Adaptive management or corrective actions for facilities that exceed quantity and infiltration targets (in the case of LID).
- Additional years of monitoring by the owner before assumption by the Town.
- Other, as may be needed.

6. REPORTING AND DELIVERABLES

6.1. Terms of Reference (TOR)

A Terms of Reference (TOR) for monitoring of the SWMFs and/or LID BMPs shall be prepared by the landowner in accordance with this document and in consultation with Development Engineering and Conservation Halton. The TOR shall set out the monitoring requirements, schedule and deliverables at each stage of monitoring. The TOR should also provide details on the preferred equipment and protocols for sampling and reporting. The TOR should also set out a contingency plan in the event that the SWMF and/or LID BMPs do not meet design targets and/or do not function as designed.

6.2. Annual Reporting

The annual monitoring report should provide the status of the SWMF and/or LID BMPs over the operating year, summarizing the monitoring tasks that were completed, the results of inspections, functional monitoring, performance monitoring, and additional monitoring results as required.

Modifications to the performance monitoring component may be considered annually and may include changes to the frequency of sampling, monitoring parameters or methodology applied to monitoring. Such recommendations should be put forward for consideration in the Annual Report.

Reports are to be submitted to the Town and Conservation Halton within **two months** following the end of the yearly monitoring period.

6.3. Report Format

Monitoring results should be presented comprehensively and in formats that permit visualization and interpretation of the data by the reader. Wherever possible, summary graphs, tables or illustrations should be used. A standard list of information that should be included in all monitoring reports as a minimum is provided in Table 1. Projects with unique or highly specific goals and objectives may require additional discussion. Each monitoring report should follow the same format as the previous ones to facilitate comparison between monitoring years.

Table 1: Report Format

Section	Content	Figures
Introduction	<ul style="list-style-type: none"> • Brief description of storm water management strategy/design with reference to relevant design reports and approved monitoring TOR • Current status of development (i.e. 100% build out) • Description of monitoring targets 	<ul style="list-style-type: none"> • Drainage plans, SWM design drawings, etc.
Methodology	<ul style="list-style-type: none"> • Description of all monitoring activities being reported • Details on monitoring site setup • Description and rationale for any deviations from the approved TOR for monitoring • Description of any new or moved monitoring locations 	<ul style="list-style-type: none"> • Map illustrating monitoring locations and any new or modified monitoring locations
Monitoring results and Analysis	<ul style="list-style-type: none"> • Dates of all monitoring activities in period being reported • Comparison of monitoring data to design criteria, as-built information and previous monitoring results. • Inclusion of previous years monitoring data, if applicable to easily identify trends 	<ul style="list-style-type: none"> • Tables and graphs illustrating temporal and spatial change • Photos illustrating current conditions and changes observed.
Interpretation and Evaluation	<ul style="list-style-type: none"> • Summary of observations where current condition and / or changes observed are do not conform to design criteria. • Details on trends based on previous years of monitoring results. • Association of non-conformance to design criteria due to external environmental influences and / or unforeseen circumstances. • Projection of expected future conditions with respect to nonconformance without corrective action. • Details of corrective actions to address non-conformance if evaluation of results indicates necessity • Recommendations should also be made regarding aspects of the design and / or construction approaches that could be modified for future projects to improve results, based on the analysis. 	<ul style="list-style-type: none"> • Tables and graphs showing comparisons to design criteria.
Modification to Monitoring Plan	<ul style="list-style-type: none"> • Recommendations for modifications to monitoring TOR if required to address areas of concern 	<ul style="list-style-type: none"> • Map illustrating location of proposed new or modified measurements
Appendices	<ul style="list-style-type: none"> • Field data collection sheets, data summaries, tables, photos, etc., 	

7. Assumption Process

7.1. Assumption Checklist

The following Checklist shall be used to track the eligibility of the SWMF

- ✓ 100% build-out of contributing drainage area to facility
- ✓ All functional components of the facility have been certified by a qualified professional(s)
- ✓ Accumulated sediment has been removed from the sediment forebay(s) and main cell, LID BMP, and any at source treatment features.
- ✓ As-constructed drawings have been submitted.
- ✓ Monitoring requirements per approved SWMF Monitoring Program TOR have been satisfied.
- ✓ Final site inspection has been conducted with Town Staff
- ✓ All plantings, landscaping features and restoration works have been accepted by Parks & Open Spaces Department.
- ✓ MECP Environmental Compliance Approval (ECA) for the facility has been provided. Transfer of ECA to the Town is required at final assumption
- ✓ The facility complies with safety requirements set out in the Town's SWM Pond Policy MS-ENG-001.
- ✓ Operation and Maintenance Manual has been accepted by Town Staff.
- ✓ Owner has satisfied all conditions of the Subdivision Agreement with respect to the facilities operation, monitoring and maintenance.

7.2. Operations and Maintenance Manual

The final Operations and Maintained Manual shall be prepared before the Town's assumption of the stormwater management facility. This manual will serve as an instruction manual to the Town and should provide details related to the following:

- Design targets (based on Subwatershed Plan, EIR-FSS or equivalent study and/or MECP requirements)
- Details of the SWMF Design
- Instruction guide for long-term operation and maintenance included details related to specific features of the SWMP or LID BMP
- Performance highlights of the facility based on past monitoring data.
- Budget forecasting based on maintenance activities carried out prior to assumption, including estimates of sediment removal frequency.
- Copy of MECP Environmental Compliance Approval (ECA) and engineer's certifications.
- As-build drawings.
- Bathymetric survey following clean out and subsequent sediment depth and volume survey results.
- Storm drainage plans.
- Stormwater plan schematics.

APPENDIX A1 and A2

Sample Inspection Forms for SWMPs and LID BMPs

STORMWATER POND INSPECTION FORM

1. General Details											
Facility Number:					Facility Name:						
Intersection/Address:					Discharges to:						
Date of Inspection:					Inspectors Name:						
Rainfall in Last 24hr (mm):					Rainfall in Last 72 hours (mm):						
Staff Gauge Reading (m):											
Facility Type (Circle): Wet Pond / Wetland / Hybrid / Dry Pond											
Upstream or Source Controls Present (Yes/No):											
2. General Observations											
		✓			✓			✓			
Water Colour		Clean		Green		Brown		Other:			
Foul Odour		None		Minor		Moderate		High			
Algae		None		Minor		Moderate		High			
Debris		None		Minor		Moderate		High			
Oil Sheen		None		Minor		Moderate		High			
Floatables		None		Minor		Moderate		High			
Sediment Depth (m):											
Is Sediment Visible Above or Below the Water:											
3. Inspection of Structural Components											
N/A – Not Applicable N/I – Not Investigated					0 – Not a problem 1 – Monitor (potential for future problem) 2 – Routine Maintenance Require 3 – Immediate Repair Necessary						
Inlet											
Blockage/Debris					N/A	N/I	0	1	2	3	Notes:
Erosion					N/A	N/I	0	1	2	3	Notes:
Sediment Accumulation					N/A	N/I	0	1	2	3	Notes:
Cracking/Damage Concrete					N/A	N/I	0	1	2	3	Notes:
Damage to Other Components					N/A	N/I	0	1	2	3	Notes:
Seepage					N/A	N/I	0	1	2	3	Notes:
Grate Secured					N/A	N/I	0	1	2	3	Notes:

Other:							
Outlet Control Structure							
Blockage/Debris	N/A	N/I	0	1	2	3	Notes:
Sediment Accumulation	N/A	N/I	0	1	2	3	Notes:
Cracking/Damage Concrete	N/A	N/I	0	1	2	3	Notes:
Damage to Other Components	N/A	N/I	0	1	2	3	Notes:
Grate Secure	N/A	N/I	0	1	2	3	Notes:
Cap locked	N/A	N/I	0	1	2	3	Notes:
Outer Holes Clogged	N/A	N/I	0	1	2	3	Notes:
Inner Holes Clogged	N/A	N/I	0	1	2	3	Notes:
Outer Pipe Rusted	N/A	N/I	0	1	2	3	Notes:
Structural Damage	N/A	N/I	0	1	2	3	Notes:
Valve Exercised and Functioning	N/A	N/I	0	1	2	3	Notes:
Armourstone	N/A	N/I	0	1	2	3	Notes:
Other:							
Emergency Spillway							
Erosion/Backcutting	N/A	N/I	0	1	2	3	Notes:
Evidence of Frequent Overtopping	N/A	N/I	0	1	2	3	Notes:
Obstruction/Debris	N/A	N/I	0	1	2	3	Notes:
Woody Growth or Unauthorized Plantings	N/A	N/I	0	1	2	3	Notes:
Other:							
Pond Berms							
Cracking Bulging or Sloughing	N/A	N/I	0	1	2	3	Notes:
Erosion and/or Loss of Material	N/A	N/I	0	1	2	3	Notes:
Animal Burrows	N/A	N/I	0	1	2	3	Notes:
Soft Spots/Boggy Areas	N/A	N/I	0	1	2	3	Notes:
Woody growth or Unauthorized Plantings	N/A	N/I	0	1	2	3	Notes:
Other:							
Wet Pond Cells (Forebay/Mainbay)							
Visible Pollution	N/A	N/I	0	1	2	3	Notes:
Shoreline and/or Side Slope Erosion	N/A	N/I	0	1	2	3	Notes:

Aquatic Bench/Shelf Inadequately Vegetated	N/A	N/I	0	1	2	3	Notes:
Abnormally high or low water levels	N/A	N/I	0	1	2	3	Notes:
Sediment/Debris/Trash Accumulated	N/A	N/I	0	1	2	3	Notes:
Bathometric Study Recommended:							
Other:							
Dry Storage Areas							
Vegetation Sparse	N/A	N/I	0	1	2	3	Notes:
Undesirable Woody or Vegetative growth	N/A	N/I	0	1	2	3	Notes:
Low flow Channel Obstruction	N/A	N/I	0	1	2	3	Notes:
Standing Water or Spots	N/A	N/I	0	1	2	3	Notes:
Sediment/Debris/Trash Accumulated	N/A	N/I	0	1	2	3	Notes:
Bathometric Study Recommended:							
Other:							
Outlet Channel From Pond							
Blockage/Debris	N/A	N/I	0	1	2	3	Notes:
Erosion	N/A	N/I	0	1	2	3	Notes:
Displaced Rip Rap	N/A	N/I	0	1	2	3	Notes:
Excessive Sediment Deposits	N/A	N/I	0	1	2	3	Notes:
Other:							
4. Vegetation							
Invasive Plants/Noxious Weeds	N/A	N/I	0	1	2	3	Notes:
% Cover:							
Vegetation Matches Landscape Design Plan	N/A	N/I	0	1	2	3	Notes:
Dead or Dying Vegetation	N/A	N/I	0	1	2	3	Notes:
Shore Erosion	N/A	N/I	0	1	2	3	Notes:
Plant Coverage Needs Improvement	N/A	N/I	0	1	2	3	Notes:
Other:							
5. Overall Conditions							
Access Roads	N/A	N/I	0	1	2	3	Notes:
Trails	N/A	N/I	0	1	2	3	Notes:
Pedestrian Bridges	N/A	N/I	0	1	2	3	Notes:

Fences	N/A	N/I	0	1	2	3	Notes:
Gates	N/A	N/I	0	1	2	3	Notes:
Locks	N/A	N/I	0	1	2	3	Notes:
Safety Signage	N/A	N/I	0	1	2	3	Notes:
Public Hazards	N/A	N/I	0	1	2	3	Notes:
Graffiti	N/A	N/I	0	1	2	3	Notes:
Excessive Mosquitoes	N/A	N/I	0	1	2	3	Notes:
Evidence of Encroachments	N/A	N/I	0	1	2	3	Notes:
Evidence of Beaver Activity	N/A	N/I	0	1	2	3	Notes:
Evidence of Fish Stocking	N/A	N/I	0	1	2	3	Notes:

6. Other Comments:

LOW IMPACT DEVELOPMENT BMP INSPECTON FORM

1. General Details									
Facility Number:			Facility Name:						
Intersection/Address:			Discharges to:						
Date of Inspection:			Inspectors Name:						
Rainfall in Last 24hr (mm):			Rainfall in Last 72 hours (mm):						
Staff Gauge Reading – If Applicable (m):									
Facility Type : *Example for Bioretention Facility									
N/A – Not Applicable N/I – Not Investigated			0 – Not a problem 1 – Monitor (potential for future problem) 2 – Routine Maintenance Require 3 – Immediate Repair Necessary						
1. Contributing Drainage Area									
Debris/Trash/Leaf Litter			N/A	N/I	0	1	2	3	Notes:
Sediment Sources			N/A	N/I	0	1	2	3	Notes:
Other:									
2. Pre-treatment									
Debris/Trash/Leaf Litter			N/A	N/I	0	1	2	3	Notes:
Sediment Accumulation			N/A	N/I	0	1	2	3	Notes:
Structural Integrity			N/A	N/I	0	1	2	3	Notes:
Other:									
3. Inlet									
Blockage/Debris/Leaf Litter			N/A	N/I	0	1	2	3	Notes:
Sediment Accumulation			N/A	N/I	0	1	2	3	Notes:
Erosion			N/A	N/I	0	1	2	3	Notes:
Damage to Structural Components			N/A	N/I	0	1	2	3	Notes:
Other:									
4. Boundary Zone									
Boundary Debris and/or Trash			N/A	N/I	0	1	2	3	Notes:
Side Slope Erosion			N/A	N/I	0	1	2	3	Notes:
Facility enclosure			N/A	N/I	0	1	2	3	Notes:

Other:

5. Soil Bed and Vegetation

Evidence Amended Soils Does Not Meet Design	N/A	N/I	0	1	2	3	Notes:
Debris/Trash	N/A	N/I	0	1	2	3	Notes:
Erosion	N/A	N/I	0	1	2	3	Notes:
Sediment Accumulation	N/A	N/I	0	1	2	3	Notes:
Grade Control Structures	N/A	N/I	0	1	2	3	Notes:
Stone	N/A	N/I	0	1	2	3	Notes:
Mulch Depth and Condition	N/A	N/I	0	1	2	3	Notes:
Plant Material Health	N/A	N/I	0	1	2	3	Notes:
Plant Material Density and Coverage	N/A	N/I	0	1	2	3	Notes:
Landscape Aesthetics	N/A	N/I	0	1	2	3	Notes:
Weeds and/or Invasive Species	N/A	N/I	0	1	2	3	Notes:

Other:

6. OUTLET

Underdrain, Clean-outs, Overflows	N/A	N/I	0	1	2	3	Notes:
Obstruction	N/A	N/I	0	1	2	3	Notes:
Outlet Structural Integrity	N/A	N/I	0	1	2	3	Notes:
Erosion Downstream of Outflow and/or Overflows	N/A	N/I	0	1	2	3	Notes:

Others:

7. Facility Wide

Flow is Directed to Inlet	N/A	N/I	0	1	2	3	Notes:
Flow Distribution in Facility Bed	N/A	N/I	0	1	2	3	Notes:
Ponding Depth	N/A	N/I	0	1	2	3	Notes:
Downdown Time and Standing Water	N/A	N/I	0	1	2	3	Notes:
Sediment/Debris/Trash Accumulated	N/A	N/I	0	1	2	3	Notes:

Other:

8. Other Comments:

APPENDIX B

Stormwater Management Pond – Sediment Removal Guidelines

Stormwater Management Pond, Sediment Removal Guidelines

Why Sediment Removal is Important

The effective long-term operation of Stormwater Management Facilities is highly dependent on proper maintenance. Sediment removal is one of the most important maintenance activities because it maintains the design storage volume that is essential to proper stormwater treatment. If sediment removal is not performed, inadequately treated runoff will enter rivers and lakes, degrading the quality of our water supply and harming aquatic ecosystems that depend on it.

Eligibility

The following requirements must be met prior to scheduling maintenance works:

- The contributing drainage is to the stormwater management (SWM) pond is completely built out **OR**;
- The sediment accumulation in the pond has reached the MOE threshold for maintenance and jeopardizes the performance of the SWM pond in treating stormwater quality and providing flood control.
- A comprehensive stormwater management pond monitoring program TOR has been submitted and approved to Development Engineering Department
- A sediment survey (bathymetric survey) has been completed to determine the location and amount of sediment needed to be removed from the pond.

The Town of Oakville Development Engineering Department should be contacted in advance of tendering the works to conduct a site visit and ensure that the sediment removal requirements will be met.

A detailed Handling, Removal and Disposal Plan for the proposed works must be submitted to the Town prior to construction. The following sections provides guidance for the preparation of this plan.

Timing

Sediment removal should be performed during dry weather conditions as rain events can significantly delay dredging operations. Due to the invasive nature of these works, sediment removal should also consider both wildlife impacts, and as such, cleanouts is restricted to July 1st to October 15th to protect wildlife during both breeding and hibernation periods.

Permitting

The following is a list of potential permitting required prior to sediment removal:

- **Licensed to Collect Fish for Scientific Purposes:** Issued under O'Reg.664/98 for the collection, handling and deposition of fish (MECP, formally MNRF)
- **Wildlife Scientific Collector's Authorization:** Issued under the Fish and Wildlife Conservation Act for any collection, handling and deposition of protected wildlife species that may be necessary during a SWMF cleanout (MECP, formally MNRF).
- **Authorization under the Ontario Endangered Species Act** for Species at Risk (MECP, formally MNRF).
- **Sewage Works Environmental Compliance Approval (ECA)** for any modifications to the facility in conjunction with sediment removal operations.
- **Water Management Environmental Compliance Approval (ECA)** for the handling and disposal of pond sediment should it be classified as waste based on contaminant levels.
- **Town Permits:**
 - **Site Alteration Permit under Town of Oakville By-Law 2003-21** for stockpiling/reuse of sediment on lands elsewhere within the Town limits.
 - **Temporary Street Occupation** for placing construction material/equipment within road allowance
 - **Move Objects or Structures Permit**
 - **Tree Permit**, should any Town owned trees be impacted by the sediment removal activities.

Pond Dewatering

Dewatering of the pond should be done by opening the maintenance drain pipe to the fullest extent possible during dry-weather conditions. Where pumps are required to dewater the remainder of water, pump operation should be within permitted working hours and in accordance with the Town Noise By-law 2008-098.

All sediment laden water shall be pumped through dewatering filter bags before discharging to the storm sewer network. It is the owner/contractor's responsibility to ensure that dewatering bags are in good working order.

In the event of heavy rainfall events, the contractor shall be directed by the Town to allow storm flows to enter the pond to avoid the risk of downstream flooding and creek erosion. The outlet structure shall remain closed unless the volume in the pond approaches the normal operating water or as directed by the Town. The contractor shall be responsible for all subsequent dewatering operations.

Sediment Removal, Grading and Disposal

Construction access should utilize the dedicated maintenance access routes wherever possible. Alternative access locations will be considered on a case-by-case basis.

The owner and contractor shall ensure that all sediment removed from the facility must be disposed of according to MECP Regulations. Sediment removed from the pond must be disposed at an approved location or waste facility at the contractor's discretion.

Mechanical dredging/excavation is the most commonly utilized methodology for sediment removal, however the Town is will consider alternative methods such as hydraulic dredging.

Sediment dewatering and consolidation of material is most likely required in order to reduce the water content of the material and pass a 'slump' test before transport. A 'slump test' is a test as described in the Environmental Protection Act, Ontario Regulation 347, Schedule 9 – Test for Determination of Liquid Waste for Solid Waste Landfilling. In order to render sediment dry enough to pass a slump test the most common approach is through dewatering and/or the use of bulking agents (such as sawdust, mulch, straw, and polymers. This bulking agent to be utilized must be approved by the Town prior to its use.

Primary hauling routes should be selected as to minimize disturbance to the neighbourhood. All roadways must remain open at all times and hauling routes must be disclosed to the Town. The proponent may be required to clean the hauling routes from time to time. Refer to the Town's Map of Heavy Truck Prohibitions and Restrictions when selecting a suitable hauling route <https://www.oakville.ca/assets/general%20-%20residents/Heavy-Truck-Prohibitions-and-Restrictions.pdf>

Site Restoration

The proponent is responsible for re-vegetating all disturbed landscape areas to the satisfaction of Development Engineering and Parks & Open Space Departments. Trails and other park features shall also be restored to the Parks & Open Space Department.

Restoration to maintenance access roadways (i.e. Terrafix blocks) down to the water's edge shall be to the satisfaction of the Development Engineering Department.

Topographic Survey

The contractor shall submit to the Town a topographic survey of the excavated pond bottom together with the Engineer's certification to confirm that adequate pond volumes have been restored and side slopes meet the as-built specifications.

Notification to Residents

The owner is required to distribute advance notification to all residents backing onto the pond and along the truck hauling routes. The notification should include a brief explanation of why these works are necessary, description of works, scheduled start and end dates as well as a contact person representing the developer.

Draft notification is to be submitted to Town staff for review and approval. The Town-approved notification should be distributed a minimum seven (7) business days prior to commencing works.

The pathways to the pond should be adequately signed and closed during construction activities. It is the owner's responsibility to coordinate this effort with the parks department.

APPENDIX C

Table 2: Monitoring Parameters, Methodology, Frequency, and Duration

Figure 1: Location of Monitoring Stations for Ponds

Figure 2: Sample Monitoring Location for Bioretention Facility

Table 2 - MONITORING PARAMETERS, METHODOLOGY, FREQUENCY, AND DURATION

PERFORMANCE MONITORING

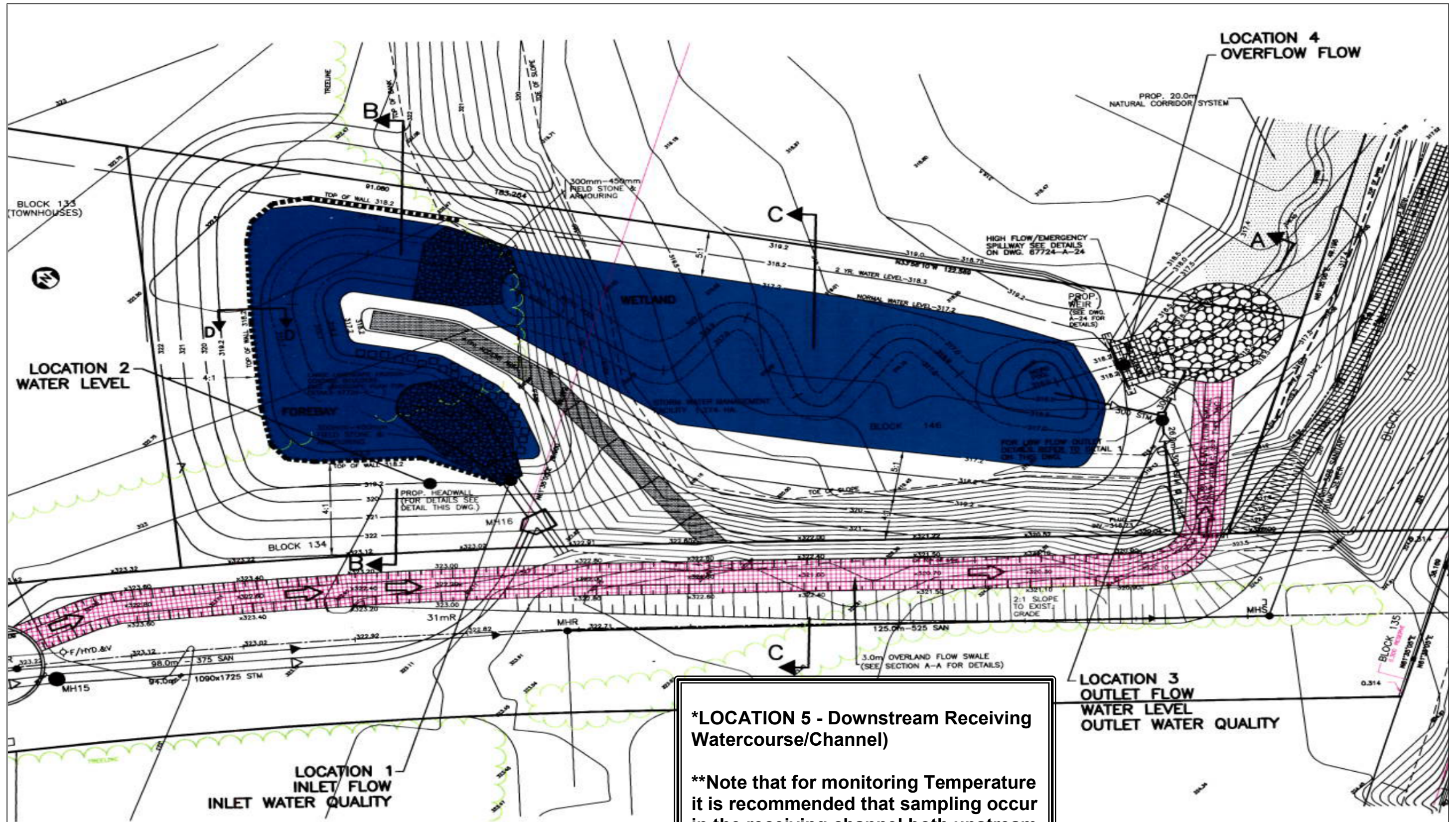
MONITORING PARAMETERS	TARGET	ANALYSIS	METHOD/ EQUIPMENT²	SAMPLE LOCATION⁴	FREQUENCY /DURATION³
Water Level	<ul style="list-style-type: none"> Fluctuation per approved SWM Plan and Engineering Drawings 	<ul style="list-style-type: none"> Drawdown Time Estimate of Outflow Hydrograph LID's - Surface ponding, water retention, and estimate groundwater recharge. 	<ul style="list-style-type: none"> Water Level Meter – Datalogger with pressure transducer (vented) Monitoring wells 	2	<ul style="list-style-type: none"> 6-8 events per year; Construction to Assumption
Flow	<ul style="list-style-type: none"> Meet target flow rates at Dundas Street 	<ul style="list-style-type: none"> Inlet Flow Outlet Flow Response to Storm Events 	<ul style="list-style-type: none"> Flow Meter – Velocity Area Flowmeter; capable of submerged flow accuracy Weir of flume modifications 	1, 3, 4,	<ul style="list-style-type: none"> 6-8 events per year; Construction to Assumption
Water Quality					
<ul style="list-style-type: none"> Total Suspended Solids (TSS) 	<ul style="list-style-type: none"> 80% removal of TSS 	<ul style="list-style-type: none"> Pollutant Removal Efficiency (% Removal). Water Quality Discharge 	<ul style="list-style-type: none"> Automated sampling to capture the rising and falling limbs of the storm (first flush). 	1, 3, 5	<ul style="list-style-type: none"> 6-8 samples collected and analyzed per year; Construction to Assumption
<ul style="list-style-type: none"> Total Phosphors (TP) 	<ul style="list-style-type: none"> No net increase of TP from background levels Provincial Water Quality Objectives (PWQO) 	<ul style="list-style-type: none"> Pollutant Removal Efficiency (% Removal). Water Quality Discharge 	<ul style="list-style-type: none"> Automated sampling to capture the rising and falling limbs of the storm (first flush). 	1, 3, 5	
<ul style="list-style-type: none"> Dissolved Oxygen (DO) 	<ul style="list-style-type: none"> DO not to exceed 6mg/l; 	<ul style="list-style-type: none"> Water Quality Discharge 	<ul style="list-style-type: none"> Multiparameter probe during wet weather event. 	1, 3, 5	
<ul style="list-style-type: none"> Chloride (Cl) 	<ul style="list-style-type: none"> Canadian Water Quality Guidelines (CWQG) and the Provincial Water Quality Objectives (PWQO) 	<ul style="list-style-type: none"> Pollutant Removal Efficiency (% Removal). Water Quality Discharge. 	<ul style="list-style-type: none"> Automated sampling to capture the rising and falling limbs of the storm (first flush). 	1, 3, 5	
<ul style="list-style-type: none"> Temperature 	<ul style="list-style-type: none"> No increase over background temperatures (20°C) 	<ul style="list-style-type: none"> Minimum, average, and maximum water temperatures Correlated to air temperature and precipitation 	<ul style="list-style-type: none"> Temperatures probe or pendants for continuous measurement 	1, 3, 5	
Erosion	<ul style="list-style-type: none"> Meet downstream erosion threshold within 5% of EIR-FSS target 	<ul style="list-style-type: none"> Geomorphologic parameters (e.g. changes in channel cross-sectional geometry overtime). 	<ul style="list-style-type: none"> Survey at monumented channel cross-sections, erosion pins, bed material sampling, RGA and RSAT 	5	<ul style="list-style-type: none"> Spring and Fall Construction to Assumption

*1. Storm events should target a minimum 10mm of precipitation or greater.

*2. The Town of Oakville shall approve monitoring equipment and techniques for sampling/measurement.

*3. See Figure 1 for locations for monitoring SWM Ponds and Figure 2 for sample location for Bioretention Facility. Note that monitoring locations will differ from one LID BMP to another

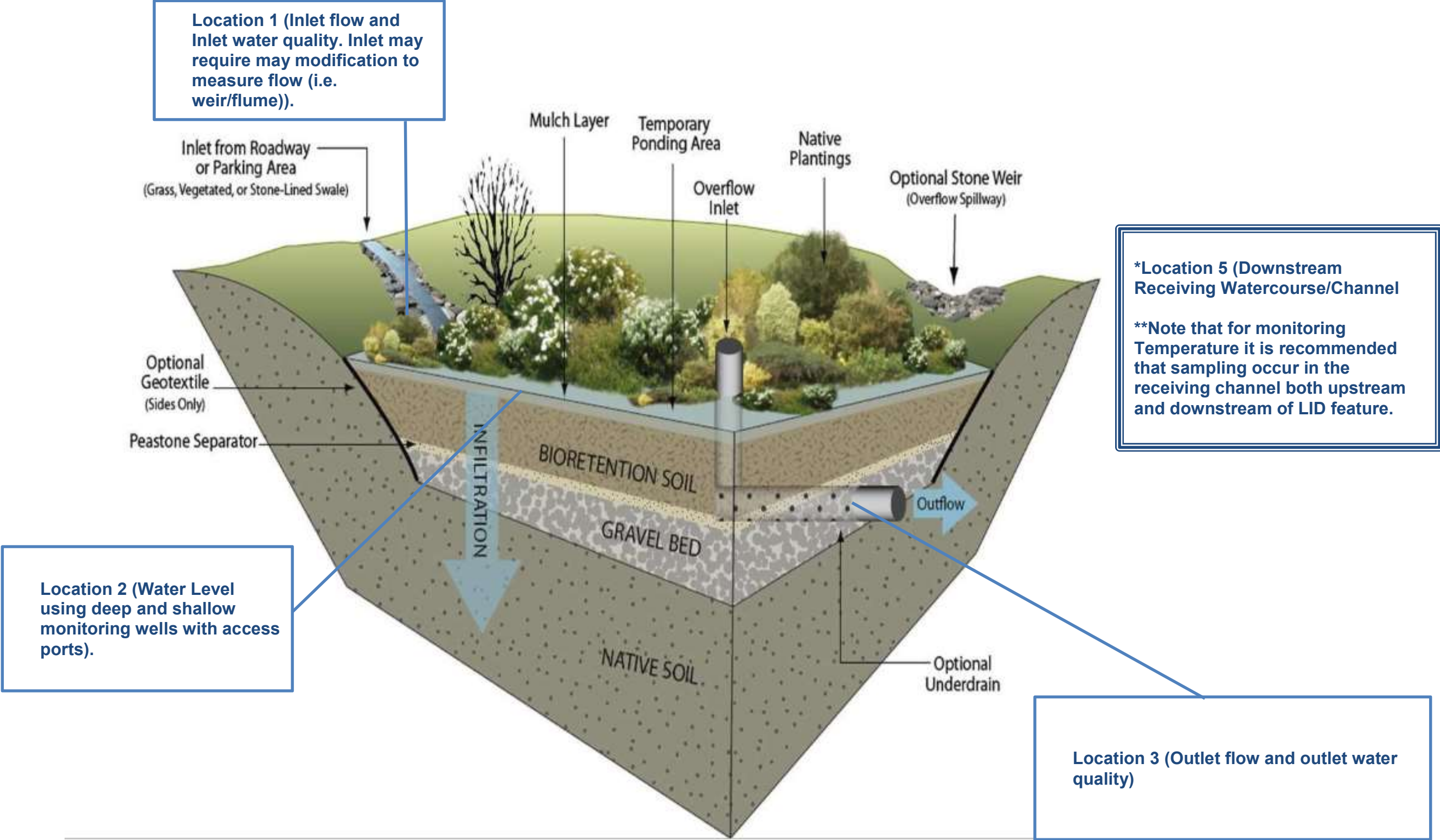
Figure 1: Location of Monitoring Stations for Ponds



*LOCATION 5 - Downstream Receiving Watercourse/Channel)

**Note that for monitoring Temperature it is recommended that sampling occur in the receiving channel both upstream and downstream of pond

Figure 2: Sample Monitoring Location for Bioretention Facility



Bioretention cell detail (image credit: GeoSyntec Consultants)