City of Guelph

Stormwater Management Master Plan

Appendix G – LID Implementation Strategy

March 2023

Prepared for:
The City of Guelph

Stormwater Management Master Plan

Appendix G: LID Implementation Strategy

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1 Introduction

The City of Guelph Stormwater Management Master Plan (SWM-MP) is being completed to establish stormwater management policies and guidelines for the next 20 to 30 years, address stormwater infrastructure needs, and identify and prioritize recommended works. Low impact development (LID) is increasingly becoming a part of the City's stormwater management system, especially in Clair-Maltby and the Guelph Innovation District, both of which have set infiltration targets. However, the City does not have a clear implementation strategy for LID facilities. This report therefore introduces the policy context for LID implementation, provides recommendations for how the City can integrate LIDs into their existing processes, and identifies where additional resources are required.

This report should be read in conjunction with the following reports that have also been developed as part of the SWM-MP:

- Stormwater Infiltration Policy Recommendations (Final Report, November 2022)
- Stormwater Design Criteria and Targets (Final Report, December 2022)

1.1 LID Policy Context

LID implementation is contextualized in numerous existing and forthcoming policies and guidelines, including in the 2003 Stormwater Management Planning and Design Manual which highlighted the importance of a treatment trail approach to stormwater management. Two key documents are especially relevant to the City of Guelph's LID Implementation Strategy, including the following which are discussed in the subsequent sections:

1. Forthcoming LID Stormwater Management Guidance Manual, and
2. The Consolidated Linear Infrastructure Environmental Compliance Approval (CLI ECA)

1.1.1 MECP LID Manual

The Ministry of Environment, Conservation and Parks (MECP) released a draft LID Stormwater Management Guidance Manual for public review on the Environmental Registry of Ontario in January 2022. This manual outlines volume control recommendations for Ontario, including setting a runoff volume control target based on the 90th percentile rain event, and controlling this volume using a hierarchy of stormwater retention, filtration, and conventional mechanisms. In the City of Guelph, the 90th percentile rain event is between 28-29mm. By implementing this hierarchy, the goal is to return precipitation volume to the natural hydrologic pathways of infiltration, evapotranspiration, and runoff. The manual identifies constraints which may prevent retention of the full runoff volume control target, such as shallow bedrock, high groundwater, swelling clays, contaminated soils, etc.

It is expected that when the MECP releases the final manual it will not be mandatory for municipalities to comply with it. However, like the 2003 Stormwater Management Planning and Design Manual, municipalities may choose to integrate the LID Manual into their municipal design guidelines, by-laws, standards and development processes.

1.1.2 Consolidated Linear Infrastructure ECA

In 2020 the MECP announced the intent to modernize Ontario's environmental approval process for low-risk municipal sewage works by implementing a Consolidated Linear Infrastructure Permissions Approach (referred to the CLI ECA process). The proposed approach will consolidate and update the approvals process for these types of works and incorporates measures that will enhance environmental protection.

In order to comply with the CLI ECA, the proposed stormwater treatment train must comply with the requirements outlined in Appendix A of the CLI ECA application. These requirements arose and align with the pending MECP LID Manual (**See Section 1.1.1**).

A key component of the CLI ECA (provided in **Appendix A)** is the control of stormwater, as described below:

> Stormwater volumes generated from the geographically specific 90th percentile rainfall event on an annual average basis from all surfaces on the entire site are targeted for control. Control is in the following hierarchical order, with each step exhausted before proceeding to the next:
>
> 1) retention (infiltration, reuse or evapotranspiration),
> 2) LID filtration, and
> 3) conventional stormwater management.
>
> Step 3, conventional stormwater management, should proceed only once Maximum Extent Possible has been attained for Steps 1 and 2 for retention and filtration.

While the CLI ECA allows for site-specific studies to achieve water balance, erosion control, water quantity, and flood control criteria, water quality treatment of suspended solids requires control (as outlined above) of the 90th percentile storm event; and if conventional methods are necessary, then require 80 per cent suspended solids removal as per the full ETV Canada particle size distribution.

1.2 City Workshops

Two workshops were held with City staff to discuss various aspects of LID implementation. Workshop #1, held on May 31, 2022, provided an overview of LID examples, the Ontario and Guelph policy context, existing LID design standards, manuals and guides, and provided an LID decision matrix to help City staff identify which LID features would be acceptable to the City. The slide deck from this presentation is in **Appendix B**, along with a list of staff who attended the meeting and the departments represented.

Workshop #2 was held on June 2, 2022. This workshop focused on many of the implementation aspects of LIDs, including approvals, tracking, assumption protocols, operations and maintenance, and staffing and financial implications. The slide deck from this presentation is in **Appendix C**, along with a list of staff who attended the meeting and the departments represented.

The purpose of the LID workshops was to:

- Enable staff to identify LID approaches that are acceptable to the City based on the implications of the Infiltration Policy, Clair-Maltby, and Guelph Innovation District in the context of current MECP Policy and other standards/guidelines.
- Enable City staff to provide direction regarding implementation of LIDs (eg. tracking, approvals, inspection, etc.)

The outcome of the first workshop was the development of **Table 2.1** and **Table 2.2**. Staff were provided with a blank version of each table and requested to identify which LID typologies would be accepted for each land use.

The second workshop provided guidance for the development of the LID Implementation Strategy, the recommendations for which are provided below in **Sections 2** through **4.**

2 LIDs Approved in the City

There are many types of LID features that are relevant to a variety of typologies and/or land-uses. From the finalized LID Decision Matrix that was completed after the LID workshops discussed in **Section 1.2**, the City of Guelph staff support the use of LID features according to **Table 2.1** and **Table 2.2**, provided they have been planned, selected, designed, and installed in accordance with approved standards (see **Section 3**). LID features will only be considered if they are one of the permitted types in a location permitted by to **Table 2.1** or **Table 2.2**, comply with the City of Guelph Infiltration Policy, and are provided with adequate pre-treatment, where required.

Table 2.1: Types and Locations of LIDs Permitted within the City of Guelph

	Private Property 1[1]	Private Property 2[2]	Municipal Property	Parks	Local Roads	Collector Roads	Arterial Roads	Comments / Requirements
Reduced Lot Grading	N	N	N					
Roof Leader Discharge to Surface	Y[3]	Y	Y					
Rear Yard Ponding	N	N	N	Y[4]				
Rooftop Storage	Y[3]	Y	Y	Y[4]				
Parking Lot Storage	Y[3]	Y	Y	Y[4]				
Green Roofs	Y[3]	Y	Y	Y[4]				
Rainwater Harvesting	Y[3]	Y	Y	Y[4]				
Infiltration Trenches/ Chambers and Soakaways	Y[3]	Y	Y	Y[4]				
Infiltration Trenches/ Chambers and Soakaways – under driving lanes					Y	Y	Clair Maltby Only	May not be appropriate on streets with many services if system is above SAN.
Infiltration Trenches/ Chambers and Soakaways – under boulevards					Y	Y	Maybe	May not be appropriate on streets with many services if system is above SAN.
Infiltration Trenches/ Chambers and Soakaways – under medians					Y	Y	Maybe	May not be appropriate on streets with many services if system is above SAN.
Perforated Pipes – under driving lanes (Etobicoke Exfiltration)					Y	Y	Clair Maltby Only	May not be appropriate on streets with many services if system is above SAN.
Perforated Pipes – under boulevards (Etobicoke Exfiltration)					Y	Y	Y	May not be appropriate on streets with many services if system is above SAN.
Perforated Pipes – under medians (Etobicoke Exfiltration)					Y	Y	Clair Maltby Only	May not be appropriate on streets with many services if system is above SAN.
Pervious Catchbasins	Y[3]	Y	Y	Y[4]	Y	Y	Y	Overflow option required. Potential to use in concert with other LID typologies.
Bioretention/Bioswales	Y[3]	Y	Y	Y[4]				
Bioretention/Bioswales – ROW planters					Y	Y	Y	
Bioretention/Bioswales – bump-outs					Y	Y	Y	
Bioretention/Bioswales – islands/cul-de-sacs					Y			
Bioretention/Bioswales – boulevard					Y	Y	Y	
Bioretention/Bioswales – median					Y	Y	Y	
Street Trees w/ Soil Cells or open tree pits (if possible)					Y	Y	Y	

[1] Private Property 1: Residential where the private property is owned by a single owner (i.e. detached, semis, freehold townhouses),
[2] Private Property 2: Residential where there is a common governance to achieve maintenance (i.e. condo townhouses, condos, subdivisions with condo management) and ICI properties.
[3] Will not count towards reduced downstream SWM volumes.
[4] Provided the infrastructure does not impact park function.

Table 2.2: Types and Locations of Permeable Pavements Permitted within the City of Guelph

	PICP*	Porous PICP*	Turf Stones/ Plastic Grids	Porous Concrete	Porous Asphalt	Permeable Rubbers/Synthetics	Permitted Application
Permeable Pavement – travelled lane	Maybe	Maybe	N	N	N	N	This could be considered for downtown streets, but not for travelled lane within regular local, collector or arterial roads.
Permeable Pavement – on-street parking lane	Maybe	Maybe	N	Maybe	Maybe	N	Applicable for all road types. Approval is dependent on snow control. The snow storage strategy must keep the parking lane free.
Permeable Pavement – parking lay-by	Y	Y	N	N	Y	N	Not acceptable on arterial roads. The snow storage strategy must keep the parking lane free.
Permeable Pavement – bike lanes (or MUPs)	N	N	N	N	Y	N	Applicable for all off-street or separated bike lanes.
Permeable Pavement – sidewalks	Maybe	Maybe	N	Y	N	N	Applicable for all road types. Must ensure that PICP meets AODA.
Permeable Pavement – urban boulevards (i.e. downtown)	Maybe	Maybe	N	Y	Y	N	Applicable for all road types if green boulevards are not achievable (i.e. downtown) or as part of a mix of streetscape (i.e. in furnishing zone).
Permeable Pavement – trails	Maybe	Maybe	N	Y	Y	N	PICP 'Y' on Secondary Trails only. On Primary Trails, PICP not suitable for bike lanes.
Permeable Pavement – private parking lots	Y	Y	N	Y	Y	N	Salt management plan required.
Permeable Pavement – municipal parking lots	Y	Y	N	Y	Y	N	Salt management plan required.
Permeable Pavement – alleys	Y	Y	N	Y	Y	N	
Permeable Pavement – access roads through parks or sites	N	N	N	Y	Y	N	
Permeable Pavement – private driveways	Y	Y	Y	Y	Y	Y	

* PICP: Permeable Interlocking Permeable Pavers

3 Implementation Recommendations

3.1 Update Development Engineering Manual

3.1.1 Design Guidance/Standards to Endorse

There are multiple external design guides that provide detailed guidance for the design, construction, inspection, operations, and maintenance of LID features. It is recommended the City endorse the following documents, and update the Development Engineering Manual accordingly. There are some slight variations between the various documents (e.g., bioretention media mix specifications). Where these variations are identified, it is recommended that City identify which manual take precedence.

1. LID Stormwater Management Planning and Design Guide (2010 and https://wiki.sustainabletechnologies.ca);
2. Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide (2016);
3. Low Impact Development Construction Guide (2012);
4. ASCE/ T&DI/ ICPS 68-18 Permeable Interlocking Concrete Pavement (North American Standard) (2018);
5. NSC/CSA W200 Design of Bioretention Systems – Canadian Standards Association (2018); and
6. NSC/CSA W201 Construction of Bioretention Systems - Canadian Standards Association (CSA).

These design guides include relevant information for pre-design (i.e. site testing requirements), design (including pre-treatment), construction, and operations and maintenance.

3.1.2 Align with Complete Streets Design Guide

The City is in the process of developing a Complete Streets Design Guide. It is recommended that LID integration into the road right of way (ROW) be included as part of this guide. This can include the development of preferred cross-sections for City streets which include LID features, and how LID features will fit with the other infrastructure included in the ROW of local, collector, and arterial streets (where permitted by the Infiltration Policy).

3.1.3 Cash-in-Lieu

It is recommended that the City undertake a study for the development of Cash-in-lieu policy including required by-laws, pricing schedules, internal process and implementation plan.

The Cash-in-lieu policy is intended to focus on sites where the proponent cannot implement the required volume control to the MEP or “maximum extent possible” as confirmed by the City of Guelph Engineering. In such cases, the proponent would contribute to the cash-in-lieu program corresponding to all uncontrolled areas at the current per hectare rate as defined by the City of Guelph as amended from time to time. Collected funds would be collected by the City’s Stormwater Utility and used to implement identified projects within the SWM-MP, prioritized using the subwatershed health analysis.

Note: In areas where a capacity related constraint exists, development must demonstrate no negative impacts. As such, MEP or cash-in-leu would not be permitted and pre to post criteria must be strictly enforced.

3.1.4 Direct Discharge to Receiver

It is recommended that the City undertake a study for the development of Direct Discharge to Receiver policy including required by-laws, internal process and implementation plan.

The Direct Discharge to Receiver policy is intended to focus on sites located in close proximity to surface receivers (eg. watercourse, wetland, etc.) which present unique challenges for stormwater practitioners. The reduction of pollutant loads is essential before stormwater is discharged to these features in order to preserve or enhance ecological habitat.

It is recommended that the policy consider:

- for sites that discharge via private or municipal conveyance systems to a surface receiver that is **within 1,000m of the site**, the proponent will ensure the site achieves complete water quality control of runoff that is generated from all surfaces on the entire site by achieving Enhanced-Level 1 protection.
- For sites that discharge via private or municipal conveyance systems to a surface receiver that is **within 1,000m of the site,** contribution to the cash-in-lieu program (to be developed, if approved) will not be considered as the minimum criteria must be met.

3.2 Approvals Process

City staff will need to review LID submissions, including design and operations and maintenance, to ensure they adhere to City standards. This includes whether the 5mm of Volume Control is achieved. The City's new LID tracking system (**Section 3.3**) should be developed at the same time that all components of the approvals process are developed, to ensure that applications include sufficient detail for the City to track.

The City's existing approvals process can be modified to include approvals of LID BMPs. There are three primary tracks for proponents to apply for City approval of LID BMPs, including:

- Site Plan – A Site Plan is submitted to the City for approval. A stormwater plan is typical in this submission, which should include all LID BMPs. No change to the existing approvals process would therefore be required.

- Municipal Projects – These will typically include LID BMPs installed in the City's rights-of-way, parks or municipal buildings. The City typically works with a consultant who completes the design work, so the City's review and approvals of the LID BMPs will be integrated into the regular design review. No change to the existing approvals process would therefore be required, however inclusion of LID design services within the respective RFP process would be required.

- Other – Not all new construction in the City is approved through the Site Plan process, including "low density residential, including single detached and semi-detached dwellings and buildings or structures accessory thereto, but not including zero lot line dwellings, lodging houses, additional residential dwelling units within a separate building on the same lot as the primary dwelling, garden suites, group homes or other special needs housing." It is recommended that approval of these LID BMPs is integrated into the building permit review process. This would be a new component to the City's approvals process, so the City would need to review and revise all documentation related to the building permit application. In addition, stormwater staff will need to be available to review applications (where applicable) within the appropriate timelines.

When a submission requiring LID BMPs is received, the City will complete a technical review of the submission. At a minimum, the submission should include:

- In-situ testing reports and recommendations, specific to the proposed LIDs (as required by the respective external design guides – see **Section 3.1.1**), but would include at a minimum:
    - Geotechnical investigations
    - In-situ infiltration testing
    - Groundwater level assessment (seasonally high)
- Detailed project and process description;
- Confirmation of ownership, land use and zoning;
- A site plan, including location and typology of proposed LID BMPs;
- A concise and defensible explanation of the SWM design, specifically the rationale for the selection and use of LID BMPs;
- A detailed report summarizing all design elements, analysis and calculations (including modelling approaches as required);
- Justification of use of Maximum Extent Possible (**Section 3.1.3**);
- Operations and maintenance protocols, timing and reporting requirements (see **Section 3.4 and Section 3.6.1.2**); and
- A monitoring plan.

Once the City has reviewed and approved the LID BMP design, it is the responsibility of the constructor and/or developer to monitor and maintain the BMP during construction. Once construction is complete, the BMP will need to be certified. As appropriate for the BMP, the level of certification will be determined by the City, and is described in **Section 3.3.**

Upon certification, the City will either:

- Assume the LID BMP, if it is to be incorporated into the City-owned and operated SWM system; or
- Notify the proponent that the privately-owned and operated facility has passed the certification process and is considered fully operational.

This process is summarized in **Figure 3.1**.

3.2.1 Consolidated Linear Infrastructure Environmental Compliance Approval

The City has received their Consolidated Linear Infrastructure Environmental Compliance Approval (CLI ECA) agreement. The CLI ECA includes all LID BMPs which are part of the City's stormwater network. Prior to construction of the LID BMP, provided the design complies with Appendix A of the CLI ECA, the City shall complete Form SW2 Record of Future Alteration Authorized for Stormwater Management Facilities, which would be incorporated into the City's CLI ECA upon the regular update schedule with the MECP.

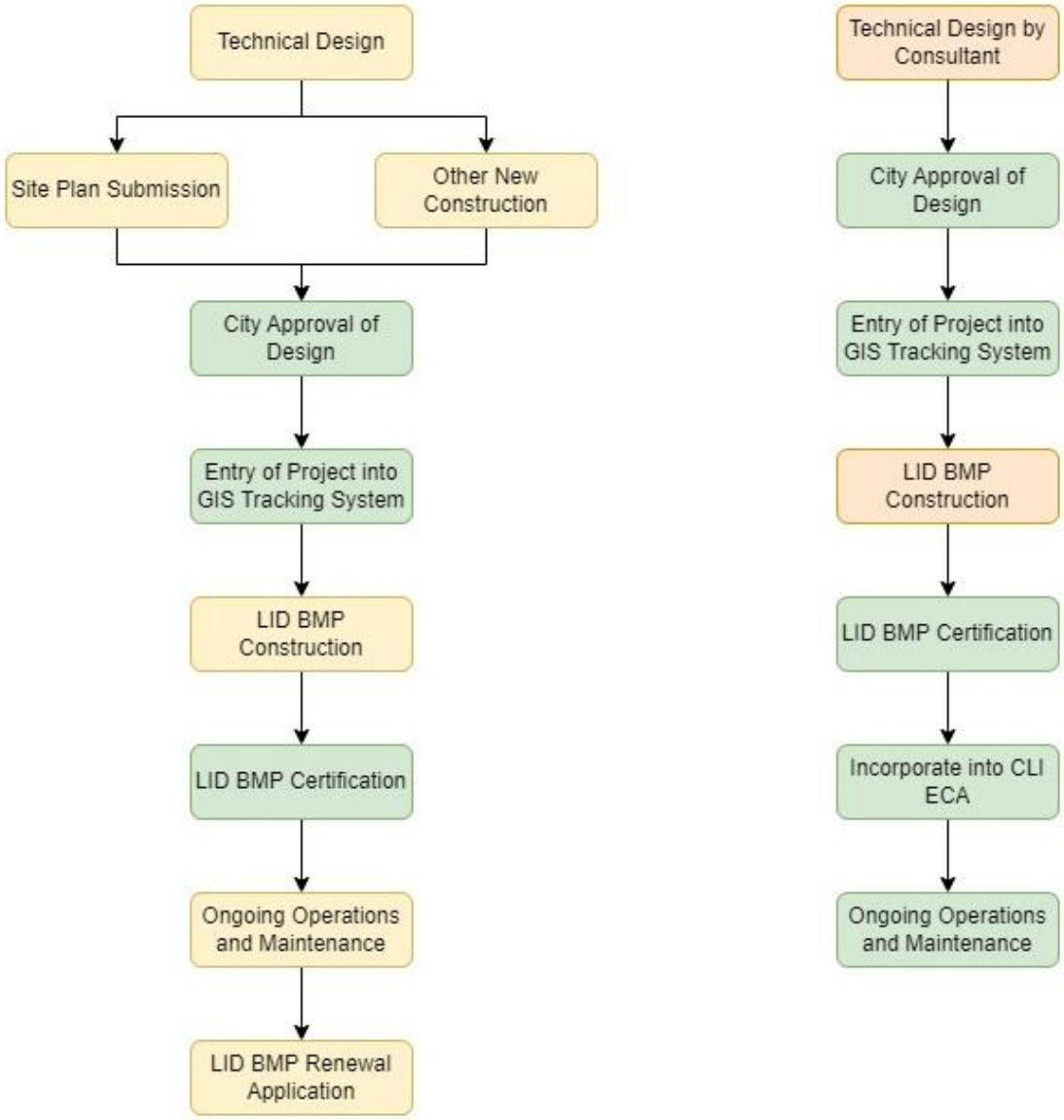


Figure 3.1: Flow chart for private LID BMPs (left) or City LID BMPs (right). Green boxes indicate City tasks; yellow boxes are completed by the private proponent; and orange are completed by the City's consultant.

3.3 Assumption Protocols

For LID BMPs that will be assumed by the City, it is recommended that the site developer be required to complete a Certificate of Completion that verifies LID BMP specifications and performance for approval following the post-construction period of LID BMP stabilization and vegetation establishment but prior to property transfer.

The Stormwater Management Certification Protocols for Low Impact Development (CVC, 2012) document details five (5) levels of SWM Certification Protocols (simple to complex) that can be used to verify a variety of infiltration and filtration practice designs and performance. The certification protocol takes place as a 3rd step, following:

1. Design and Plan Review; and
2. Construction Inspection & Maintenance (up to assumption by the municipality).

Certification protocols ensure that knowledgeable personnel (e.g. inspector, design engineer, or permitting agency) evaluate whether the LID BMPs have been installed properly before the contractor is released of responsibility.

The certification process is the last opportunity to identify issues due to improper construction and/or unforeseen site condition issues. These issues can then be addressed before the owner takes over maintenance responsibilities.

Level 1 Certification - Visual Inspection: Visual inspections require the least effort and minimal cost. It is recommended that visual inspection be used as the initial assessment tool for all LID BMPs. Visual inspection involves inspecting LID BMPs for evidence of malfunction or deviation from the design plans. This can be accomplished with a brief site visit, the original plans and a checklist. Visual inspection can be used to quickly and cost-effectively determine if, and potentially why, an LID practice is not operating properly. Simplified techniques focus on these aspects:

- General confirmation of site draw-down time (hours) and inspection of soil properties;
- Presence of ponded water on site beyond specified time to drain (typically 24- 48 hours following a rainfall event);
- Physical design elements such as verification of inlets, grading, inlets and overflows function including blockages, examination of how flows enter and exit the facility.

Visual inspection alone cannot provide quantitative information about the LID performance and should be done in conjunction with qualitative monitoring and testing.

Level 2 Certification – Capacity Testing: A step beyond visual inspection involves the collection of additional data through testing and measurements including:

- Soil characterization sampling and testing via laboratory analysis. This testing ensures that the installed filter media meets the design specification.
- Elevation surveys of all LID BMP components. This confirms that the depths, storage volumes, and drainage areas correspond to the design plan.
- Sedimentation monitoring and vegetation surveys. These tasks help to establish the necessary maintenance schedules for sediment removal from inlets/pre-treatment areas and vegetation care. Due care to observe preferential flow paths that can be prone to plugging.

- Infiltration testing. A Guelph permeameter test, double-ring or single-ring infiltrometer tests as well as others are tool that is used to measure in-situ saturated hydraulic conductivity. A Guelph permeameter test can be used to determine rates at depth, while double-ring or single-ring infiltrometer test can be used to determine rates at the surface.

This level of certification will establish if the practice was built to the design plan, including the soil composition, the storage volume, and drainage area. The infiltration testing will provide an estimation of expected drawdown times depending on the number of permeameter measurement tests spatially distributed throughout the LID BMP. Capacity testing will not provide the same level of accuracy as the real-world monitoring.

Level 3 Certification – Synthetic Runoff Testing: Synthetic runoff testing uses a clean water source such as a fire hydrant or water truck to generate a known volume of runoff. Level 3 is typically used for individual LID BMPs, but can be used for multiple facilities based on the scale of the project and testing.

The performance of the LID BMP is then monitored and measured under well-controlled conditions (to prevent erosion and scouring of the landscaped surfaces). For filtration or infiltration rate assessment, the following four conditions must be met for synthetic runoff testing to be feasible:

- There must be a water supply that can provide the required discharge and total volume of runoff needed.
- The BMP must be offline and/or no precipitation is expected for at least 48 hours.
- Outflow paths other than infiltration are either measurable or can be temporarily plugged.
- The water surface elevation in the stormwater treatment practice can be measured

Once the stormwater treatment practice is filled with synthetic runoff, the change in water level with time can be used to evaluate the infiltration rate. A perforated observation well which extends to the bottom of the practice is necessary to measure subsurface water level drawdown within a bioretention soil or other subsurface storage area.

Level 4 Certification – Continuous Water Level Monitoring: After infiltration testing (level 2) and synthetic runoff testing (level 3) have been considered and either dismissed or performed, low intensity monitoring can be considered to measure LID performance using continuous water level/temperature data loggers. This type of monitoring provides cost-effective monitoring alternative by tracking temperature and groundwater levels over time including evaluation of seasonal and winter infiltration performance, potentially affected by frozen soils.

Subsurface water levels and temperatures can be continuously monitored with a water level logger installed in an observation port/well. For a continuous water level assessment, the following conditions must be met:

- A perforated observation well (or piezometer) must be installed which extends from the bottom of the practice to 300 mm above the surface.
- Two water level loggers which are small and relatively inexpensive monitoring equipment need to be installed. One logger is installed in the observation well and the other is installed in a protected open-air space to measure the atmospheric pressure.
- A rain gauge must be in the vicinity, onsite is preferable, but within 1 km is acceptable. The rainfall data and known drainage area are necessary to know for comparison to the water level drawdown data.

The water level data in combination with the rainfall data can then be used to determine how long it took the practice to drain down after the end of an event and what size events resulted in overflows.

Level 5 Certification – Comprehensive Monitoring: Level 5 Monitoring is the most comprehensive and expensive assessment technique and can be used to effectively document water volume reduction and peak flow reduction for most stormwater treatment practices by measuring discharge during natural runoff events.

This level of monitoring is recommended for larger demonstration purposes when a stormwater practice is being implemented for the first time in a specific jurisdiction or development context (e.g. pilot testing of a new technology, challenging soil or geologic contexts, unique or hybrid facility design). It is not intended that this level of monitoring be completed for the first installation of each practice in every jurisdiction, rather to ensure that new and innovative approaches are appropriately evaluated and documented.

Another situation where this level of monitoring might be warranted is if the facility has been designed to meet higher standards due to the sensitivity of the receiving water or present of species of concern.

To assess runoff volume and pollutant load reduction, peak flow reduction, or both by monitoring a stormwater treatment practice, the inflow(s) and outflow(s) must be measured or estimated as in conducting a water budget. The summation of the inflows can then be compared to the summation of the outflows to determine the runoff volume reduction, peak flow reduction, or both. Level 5 may also include the collection of water quality samples at both inflow and outflow of an LID BMP to demonstrate that the LID BMPs are not impacting groundwater (i.e. transferring the pollutants into groundwater), and to measure the pollutant loading changes throughout the proposed LID facility.

Typical urban runoff events are flashy (rapid response) and require continuous flow measurement (or estimation). Pollutant loading changes will require state-of-the-art automated sampling devices to obtain flow-weighted or time-weighted sampling that coupled with continuous flows allow estimation of loads and development of Event Mean Concentrations (EMC). Where inflow(s) and outflow(s) are estimated, it is recommended that a verification or assurance process be included such that the estimated flows reflects what is happening in the field. This may include spot measurements, video, photos or field visits during an event.

Besides having considerable additional costs, comprehensive monitoring has more potential for missed or erroneous data as compared to synthetic runoff tests for the following reasons:

1. Weather is unpredictable and can produce various runoff volumes of various durations with varying pollutant concentrations at various times.
2. In order for a storm event to be monitored correctly and accurately, all the monitoring equipment must be operating correctly and the parameters (water depth, etc.) must be within the quality control limit ranges for the equipment.
3. Equipment malfunction due to rodents, electrical interferences, routine wear, storm damage/loss, or vandalism are common.
4. State-of-the-art continuous monitoring of stormwater runoff is the most expensive of monitoring techniques as it requires trained technicians, proper installation, frequent inspection, runoff flow-gauging, maintenance and adherence to quality control protocols.

It is recommended that the City require certification using a risk based approach, specifically:

Certification Type	Application
Level 1 Certification - Visual Inspection	Prior to assumption for all LID BMPs to be assumed by the City and/or prior to LID BMPs being put into service.
Level 2 Certification – Capacity Testing	Prior to assumption for all LID BMPs to be assumed by the City and/or prior to LID BMPs being put into service.
Level 3 Certification – Synthetic Runoff Testing	For all LID BMPs where specific performance targets are to be met relating to design criteria for the protection of **low sensitivity** environmental feature, function and/or habitats related to **water quality**.
Level 4 Certification – Continuous Water Level Monitoring	For all LID BMPs where specific performance targets are to be met relating to design criteria for the protection of **moderately sensitive** environmental feature, function and/or habitats related to **water quality and flow**.
Level 5 Certification – Comprehensive Monitoring	For all LID BMPs where specific performance targets are to be met relating to design criteria for the protection of **highly sensitive** environmental feature, function and/or habitats related to **water quality and flow**.

3.4 Tracking System

The City has opted to implement a GIS tracking system for LIDs that is separate from the system in place for the existing Stormwater Credit Program. A new GIS tracking system will require the following:

- Transfer of information from the application to the GIS database:
    - Site Plan – Staff will need to transfer the relevant information from AMANDA to the GIS tracking system.
    - Municipal Projects – The City will need to decide at what point in the existing design process to transfer information to the GIS tracking system.
    - Other – The City will therefore need to determine how LID features installed as part of non-Site Plan construction will be added to the GIS tracking system.
- Renewal of Approval: The tracking system should include the frequency with which an LID BMP approval needs to be renewed (**Section 3.5.3**), and should trigger a reminder to the proponent to submit their renewal.

- Inspections: At a minimum, inspections by the City should be triggered when the tracking system indicates deficiencies in maintenance frequency. The City may also consider scheduling Maintenance Verification Inspections on a 5-year interval and/or Performance Verification Inspections on 15-year intervals. These inspections may be completed by the City or by the proponent, as long as the proponent submits the results of the inspection to the City for review. Additional details regarding inspections can be found in **Section 3.3.**

- Operations and Maintenance: The tracking system should indicate the frequency of operations and maintenance requirements as identified by the proponent within the required Operations and Maintenance Manual (see **Section 3.2**), including routine operation inspections. It is recommended that the City implement a mechanism to allow property owners or maintenance contractors to indicate when the required inspections and/or maintenance have been completed. If this maintenance has not completed, the tracking system should notify the City to trigger a Maintenance Verification Inspection. Additional details regarding Operations and Maintenance can be found in **Section 3.6.**

3.5 City Oversight of Private Property LID BMPs

Where an LID BMP is designed to service only one private property, it is recommended that:

- The land required for the LID BMP is to be retained by the owner.
- All costs for constructing and maintaining the LID BMP shall be the responsibility of the owner.
- Where the private LID BMP is required to meet the City's design criteria, the City needs to be able to maintain oversight over these BMPs through an easement, agreement to enter and/or other legal mechanism.
- Specific wording be included in site plan and subdivision conditions (as required), requirements for performance bonds/warrantees that ensure that LID measures are properly designed, constructed and monitored for a sufficient post construction period to ensure that they are functioning effectively

Note that property owners who choose to implement an LID BMP of their own accord are not required to comply with the sections below.

3.5.1 Easement and Right to Enter and Inspect

Where the private LID BMP is required to meet the City's design criteria, it is recommended that an easement be placed over the private facility, including an easement for access from the nearest vehicular entrance off of the City's right-of-way and extending to the facility, and shall be dedicated to the City. This easement (if required) shall be such that it grants the City with the right-to enter and inspect the facility. The easement shall include access to any controls structure(s).

Repairs of private facilities by the City shall be considered a last resort, however should repairs or maintenance be required and undertaken by the City, the costs incurred can be collected through an amendment of the existing property standards by-laws to permit collection of incurred costs through property tax collection. This approach has proven effective in many Ontario municipalities in the collection of maintenance costs for private stormwater facilities and in recommended for consideration.

3.5.2 Registration of the Works on Title

Where the private LID BMP is required to meet the City's design criteria, and where LID BMPs are subject to City approval for design and installation, it is recommended that the City require the

proponent to register the works on title. This will ensure that the BMP is maintained in perpetuity, regardless of whether the property changes ownership over the lifespan of the BMP.

3.5.3 Renewal of Approval

It is recommended that the approval of an LID BMP should be time-limited, and require regular renewals to ensure the BMP is being adequately operated and maintained. To renew an approval, the proponent should submit, at a minimum, the following information:

- Annual inspection and maintenance reports since the previous renewal;
- Evidence that the LID BMP is still present and functioning
- Maintenance logs for all works completed on the LID facility, including any as required by the Operation and Maintenance plan or specific agency approval conditions.

There are several mechanisms which could be used by the City to ensure renewals occur in a timely manner:

1. Business licence renewal – All businesses in the City of Guelph are required to renew their business licence on a regular basis. If the LID BMP renewal application has not been submitted, the City may choose to not renew the business licence until the application has been completed and approved.

2. SWM credits – For proponents who have also registered to receive SWM credits from the City as a result of their LID BMPs, the City may choose to rescind the credit if the proponent does not submit a renewal application.

3. Property standards by-law – If a proponent does not renew the LID BMP approval, the City may enter and inspect the facility, recouping costs for inspection, repairs and/or maintenance can be completed through an amendment of the existing property standards by-laws to permit collection of incurred costs through property tax collection.

3.6 Operations and Maintenance

Like all stormwater management controls, LID and / or conventional stormwater management approaches, adequate maintenance is essential to ensure the long-term stormwater management performance targets are achieved over the life span of the practice or BMP. Site maintenance conducted per the recommendations of a well-designed maintenance plan can also extend the functional life of facilities. To support lifecycle activities, the City and site owners should develop an asset management plan and have a dedicated sustainable funding mechanism to support upgrades, operations and maintenance.

All stormwater BMPs, including LID BMPs are designed to retain pollutants carried by urban runoff and all have a finite capacity to perform this function in the absence of maintenance, until their treatment performance declines or they no longer function as intended. Their functional and treatment performance will only be sustained over the long term if they are adequately inspected and maintained. A proactive, routine inspection and maintenance program will:

- Identify maintenance issues before they significantly affect the function of the LID BMP;
- Help to optimize the use of program resources and reduce O&M costs by providing the feedback needed to determine when structural repairs to the facility are needed and to adjust the

frequency of routine inspection and maintenance tasks where it is warranted to increase efficiency; and
- Help to improve LID BMP design guidance and develop appropriate municipal standards.

While the importance of adequate maintenance cannot be understated, a balance must be struck between the resources and funding available and the risks should the practice fail to achieve targets. The level of maintenance and associated risk of failure is influenced by several factors. These include but are not limited to location of the practice, receiver/ habitat sensitivity, and resulting level of service if there is a failure and its impact to the system. A practice which is integral to the performance of the overall stormwater system or which is preserving the hydrologic function to a sensitive receiver/habitat/feature, may require additional focus and level of effort. Similarly, facilities that transcend stormwater management, such as those with broader community and social objectives including, but not limited to, neighborhood beautification, public education, crime prevention, air quality, climate change and / or represent a significant feature which has been adopted by local residents, may require additional operation and maintenance resources and funding, regardless of its designed function. In this way, operation and maintenance resources can be allocated based on the relative risk of failure and the importance in the community based on the design goals and objectives.

From the above, it is easy to identify that operation and maintenance for LIDs will share some basic activities, but that O&M can also be specialized based on the design itself. It is recommended that an O&M program be developed as part of the design and recorded within the design documentation (Operation and Maintenance Manual), design brief or other) which is:

- Cost effective and efficient;
- Integrated into standard O&M activities and actions (i.e. roadway sweeping, catch basin cleaning, pipe flushing, vegetation maintenance, litter removal, sediment removal etc.)
- Leverages existing staff training, machinery and equipment;
- Includes a basic or standard list of O&M activities for each specific practices or group of practices to streamline standard operating procedures;
- Has the ability to be customized where needed based on risk, community importance or other; and
- Refined and adapted based on a feedback system which informs subsequent plans and activities.

It is recommended that O&M Manuals should be developed per the Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide (2016) and be tailored to the specific design.

3.6.1 Optimizing O&M During Design

To ensure LIDs and all BMPs represent a valued investment of capital dollars and are financially sustainable over their design life, it is important to optimize the design with a focus on long-term operation and maintenance. Consideration should be given to:

- **Standard Products:** Use of standard products such as curbs, inlet, overflows, and catch basins vs. specialized or one-off products. While this may not always be possible, the additional effort to scan and select appropriate standard products can reduce O&M costs and specialized equipment;

- **Warranty Period:** Including a requirement for the contactor to complete an extended warranty period of up to 2-years can be an effective means to ensure that when assumed, O&M activities are minimized. A significant cost is associated with LIDs that are deficient upon assumption;

- **Pre-treatment:** Pre-treatment devices are designed to provide a buffer area or collection system where sedimentation occurs before it can reach the LID BMP. The inclusion of pre-treatment devices can significantly reduce O&M and increase life-expectancy of the facility;

- **Sediment Removal:** Sediment removal techniques will differ by pre-treatment practices but may involve hand tools, or high-pressure washer and vacuum trucks. The frequency of sediment removal will vary depending on pre-treatment practice and catchment conditions, including the particle size distribution of the soil. A soil type where the particle size distribution is predominately clay or silt type could increase the frequency of maintenance, as opposed to a sand dominated particle size distribution. Knowing the particle size distribution of your soil will aid in the design of the LID practice to optimize maintenance needs, as well as help in assessing its life cycle. By selecting pre-treatment devices which have easy assess to the accumulated sediment, are most appropriate for the workforce tasked with undertaking the removals, consider the type of equipment available and which balance the frequency of maintenance with the protection of the facility - O&M can be optimized;

- **4-Season Design:** By designing all LIDs with spring, summer, winter and fall conditions in mind, will reduce O&M costs. Consideration for vegetation deposition in the fall (i.e. blocked inlets, or temporary clogging of narrow jointed permeable pavements), and winter maintenance activities (ploughing, sanding and salting) are considered a mandatory requirement during design. A key optimization strategy can include behavioral change in regards to operation activities (i.e. sanding and salting), but also consideration of where snow if stockpiled during winter months and provisions for additional inlets or overflows for use during winter; and

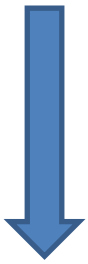
- **Vegetation Selection:** By appropriate selecting vegetation which is suitable for the climate zone, local conditions as well as operational conditions, O&M can be optimized. Selection of salt and drought tolerant species, as well as species which can tolerate inundation will ensure plant survivability. Use of block plantings or limited plant pallets (while ensuring to avoid monocultures which are highly susceptible to disease and or climate induced mortality) can also increase O&M efficiency. The specification of higher planting densities will reduce opportunistic weed growth and reduce plant replacements. Additional detail is provided in the subsequent section.

3.6.1.1 Optimizing O&M and Vegetation

While not all LIDs include vegetation (i.e. permeable pavement, soakaway pits and chambers and perforated pipe systems) many can include turf, native or ornamental plantings (i.e. bioswales, bioretention areas, and green roofs etc.). Maintenance requirements for most LID technologies have little difference from most turf, landscaped, or natural areas and do not typically require new or specialized equipment. However, it is typically the vegetated component of the LIDs which create concern or apprehension in regard to operation and maintenance as opposed to the chambers, the piping networks or other more standard elements of a stormwater system which practitioners are familiar. However, the degree to which vegetation is included, the type of plants, the number of species and their relative costs are all at the discretion of the designer and can be refined for each individual project during the design process. The consideration of long-term O&M during the design stage is a

critical step in the design process and can be used to limit operational and maintenance burdens. Common practices in vegetation selection to limit O&M requirements are detailed in **Table 3.1.**

Table 3.1: Vegetation Selection Strategies to Limit O&M During Design

	Vegetation Selection in Design	Other Considerations
Lower O&M  **Higher O&M**	• Rock mulches • Turf and / or sod • Naturalized plantings (not ornamental). Can include native plants • Trees and shrubs only • Ornamental perennial plants and grasses (lower species diversity - limited number of species) • Ornamental perennial plants and grasses (high species diversity – greater number of species) • Annuals	**Climate change co-benefits, habitat and aesthetics.**

For vegetated LID BMPs, there may be a general requirement for a transfer of 'traditional' SWM maintenance resources and funds (outlet inspections, pond dredging, vacuum trucks to empty OGS systems etc.) to a more landscaped based SWM maintenance program. It is anticipated that the City generally has the required staff and infrastructure within other departments (such as the Parks Department and Operations) including staff with training and expertise in arboriculture, horticultural, and / or landscape architecture.

Private industrial, commercial or multi-residential properties that have implemented LID BMPs as part of a stormwater management plan approved through site planning, may rely on trained service professionals from the landscape industry for site maintenance. These professionals are often equipped for the maintenance of most LID BMPs including those that vegetated or may require additional training on the function and maintenance practices associated with specific LIDs BMPs.

In developing the procedures and methodologies to guide the maintenance and inspection of the landscape components of LID BMPs, it must be recognized that the landscape is a living system that evolves in response to the environment and natural successional processes. Consequently, the maintenance program must be implemented with an understanding of the long-term evolution of the landscape and with a view to the desired state of the landscape in the future. The following are the objectives that served as the basis for developing the landscape maintenance program:

- Acknowledge seasonal influences on vegetation and recognize the increased maintenance requirements typical of spring (and potentially in the fall);
- Promote the succession of naturally occurring species and associations;
- Support the process of natural succession;
- Manage for the control of non-native invasive or undesirable species;
- Manage to ensure public safety with respect to preservation of sightlines, removal of hazards and control of noxious species; and
- Ensure that the primary stormwater management function of the facility is achieved.

3.6.1.2 O&M Manuals and Design Briefs

As a component of any SWM plan to support development, it is recommended that the proponent shall be required to complete and provide a report detailing the maintenance recommendations based on the approved stormwater management BMPs. The report shall include, but is not limited to, the following recommendations:

- Inspection frequency of all structures, apertures and functional design elements (minimum of once annually);
- Sediment removal frequency, technique and equipment;
- Method for the re-stabilization of all disturbed areas;
- Sediments testing protocols and method of disposal (if applicable);
- Effluent sampling protocol (if applicable for novel; or un-tested LID BMP approaches);
- BMP design life expectancy; and
- Replacement/ refurbishment recommendations/ plans at the conclusion of BMPs life cycle.

The costs associated with the maintenance of the various stormwater management plan elements may vary with the type and size. The proponents shall submit a maintenance program estimate for the duration of the anticipated life-cycle of each element of the proposed BMPs. Sources such as the TRCA/CVC LID Planning and Design Guide (2010) and the TRCA/ STEP Assessment of Life Cycle Costs for Low Impact Development Stormwater Management Practices (2013) or most recent should be consulted when developing O&M and life-cycle costs.

3.6.2 Optimizing O&M During Construction

Even with sound design following the various guidance documents and through design optimization strategies (**Section 3.1.1**), LID BMPs may not provide the intended level of treatment if they are not installed properly or protected from damage during construction. Experiences with early applications have shown that failures are often due to:

- Practices not being constructed as designed or with specified materials;
- Lack of erosion and sediment controls (ESCs) during construction; and/or
- Lack of rigorous inspection prior to assumption.

Therefore, it is important to conduct timely inspections during construction and detailed inspection and testing prior to assumption to ensure that LID BMPs are:

- Built according to approved plans and specifications;
- Installed at an appropriate time during overall site construction and with protective measures to minimize risk of siltation or damage; and
- Fully operational and not in need of maintenance or repair at the time of assumption by the City, property owner or manager.

3.6.3 Operation and Maintenance Requirements for LID

As detailed in Section 2.0 of the 2016 Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide (Version 1.0) a critical policy decision facing the City regarding inspection and maintenance of stormwater infrastructure is who will be responsible, and for what types of tasks because the decision affects how the program will be designed. In general, there are three (3) approaches a community can use to implement a stormwater infrastructure inspection and maintenance program:

1. **Property owner approach**: Property owners are responsible for performing all inspection, maintenance and repair/rehabilitation for BMPs on their properties and associated record keeping. The City provides inspection and maintenance plan templates, property owner outreach education resources and inspects, maintains and repairs BMPs on their land and within infrastructure rights-of-way.

2. **Public approach**: The City is responsible for performing or tracking inspection, maintenance and repair/rehabilitation of all BMPs that qualify for inclusion in their stormwater infrastructure program, whether located on public or private land (e.g., could include those implemented as part of a stormwater utility fee credit program or CSO abatement plan).

3. **Hybrid approach:** A hybrid approach consisting of both public and private entities responsible for various inspection, maintenance and repair tasks.

The City has indicated they prefer to pursue a hybrid approach, which is summarized below:

- City inspects and maintains BMPs on public land, and within rights-of-way or easements on private property;
- Property owner responsible for performing some inspection and maintenance tasks and record keeping;
- City responsible for an inventory of all BMPs that qualify for inclusion in their program, and periodic inspections to verify maintenance and performance;
- City responsible for educating property owner about the BMP and inspection and maintenance needs; and
- City responsible for legal tools to require/enforce maintenance of regulated BMPs on private property.

3.6.3.1 O&M for City-Owned Systems

Unlike conventional SWM systems that centralize treatment facilities in few locations on publicly owned land (e.g., detention ponds) an LID design approach involves smaller scale practices distributed throughout the drainage area, potentially on both public and private land. Implementing an LID approach can have major implications on municipalities and property managers with respect to operating and maintaining the stormwater infrastructure they are responsible for, as it increases the number and types of BMPs to be tracked, inspected and maintained. In essence, it is very likely that the current methodology, frequency, software, mapping and procedures will need to be refined and adapted to account for a new type of infrastructure – Green Infrastructure.

LID BMPs are 'infrastructure' and do therefore provide a necessary function in communities. The relative importance of this function requires that maintenance personnel and inspectors are well versed in the design, intended function and maintenance requirements of each system. Just as contractor education is critical to ensure proper post-construction function, the education and training of the individuals servicing LID BMPs is vital to their long-continued operation.

Table 3.2 summarizes the various general categories of O&M activities for both conventional SWM practices and LID BMPs. It is not intended to be comprehensive, but rather a comparison which demonstrates where O&M activities differ and where they are similar. Facility refurbishments is not considered operation and maintenance as they typically represent a capital activity, but should and are included in life cycle cost assessments.

Table 3.2: O&M Activities: Conventional SWM Approaches vs. LIDs

Operation or Maintenance Activity	Conventional SWM Practices (Storm sewers, wet ponds, dry ponds, wetland, OGS, end-of-pipe infiltration facility)	LID BMPs (Bioretention, Bioswales, soakaway pits, cisterns, permeable pavements etc.)
Education	■	■
Inspection	■	■
Inlet, outlet, catch basin cleaning	■	■
Pipe / Subdrain Flushing	■	□
Grass Cutting *	■	■
Weed Control	■	■
Vegetation Replanting *	□	□
Removal of Accumulated Sediment	■	■
Removal of Accumulated Sediment from control structures etc.	□	□
Outlet Valve Adjustment	□	□
Trash Removal	■	■
Core Aeration or Basin Floor Tiling	□	□
Irrigation *	□	□
Pruning/ removal of old plant growth*	□	■
Mulch Replacements *	□	■
Soil Replacements *	□	■
■ Normally Required □ May be Required * indicates Operation or Maintenance Activity only required for Vegetative LID BMPs		

(Adapted from: MOE, 2003 and TRCA/STEP, 2016)

3.6.3.2 Private Property O&M – Municipal Tools and Approaches

The approval and subsequent O&M activities of LID BMPs on private property has repeatedly been identified as a common concern for Ontario municipalities. While this concern is valid, many Ontario and neighboring U.S. municipalities have developed solutions to mitigate the risks of O&M non-compliance, facility failure, ability for the City to maintain in the event of non-compliance and associated cost recovery mechanisms.

Table 3.3 provides a summary of the various municipal tools and approaches being employed related to O&M of LID BMPs on private property. Each of the municipal tools can and / or are being applied through municipal by-laws, subdivision agreements, site plan approvals or other such legal mechanism as described below. In many cases, multiple mechanism and/ or approaches can be applied to a specific project or group of projects. It is recommended that the mechanisms and approaches listed within **Table 3.3** be included, modified and / or adapted by the City of Guelph responsible for approval based on the local context and existing legal framework.

Table 3.3: Summary of Municipal Tools and Approaches relating to O&M Activities of LIDs BMPs on Private Property

Mechanism/ Requirement	Outcome	Applied Through
O&M Financial Responsibility • All costs for constructing and maintaining the SWM Facility/LID or structure shall be the responsibility of the owner.	• Designates responsibility and costs	• Approvals (subdivision agreement, site plan or other) • By-law
Easements - Legal Right to Enter and Inspect • An easement shall be placed over the private facility/LID including an easement for access from the nearest vehicular entrance off of the municipal right-of-way and extending to the facility, and shall be dedicated to the City. This easement (if required) shall be such that it grants the City with the right-to enter and inspect the facility. The easement shall include access to any controls structure(s). If easements over parts of the property are not feasible, then the LID should be constructed over the area that can acquire an easement. To be of legal standing, the easement must be shown on the property survey and recorded in the title.	• Ensures the City retains the legal ability to enter and inspect.	• Approvals (subdivision agreement, site plan or other) • By-law
Minimization of Post Construction O&M - Inspection Prior to Occupancy • The proponent's consulting engineer shall supervise and certify the installation prior to occupancy of the affected lot, block or building to the satisfaction of the City.	• Minimizes O&M activities related to improper construction or installation. • Incentivizes proper construction practices.	• Approvals (subdivision agreement, site plan or other)
Definition of O&M Activities Subject to ECA • Where a LID BMP is subject to the Ontario Water Resources Act provincial approvals for SWM facilities and BMPs and require an Environmental Compliance Approval (ECA), the maintenance activity requirements and facility function should be measured against the property specific ECA or CLI ECA.	• Defines O&M activities to be completed and enforced	• ECA

Mechanism/ Requirement	Outcome	Applied Through
Definition of O&M Activities Not Subject to ECA • Where a LID BMPs is not subject to the Ontario Water Resources Act provincial approvals for SWM facilities and BMPs and do not require an ECA from the MECP, the maintenance activity requirements and facility function should be measured against the O&M manual contained within the required design brief.	• Defines O&M activities to be completed and enforced	• Approvals (subdivision agreement, site plan or other)
Annual O&M Reporting & Inspection • An annual report shall be submitted by the property owner to the City verifying that the required maintenance activities as defined with the O&M manual (design brief) and /or ECA has been completed and the facility(ies) are functional and meet the designed performance target. The City shall reserve the right to inspect all such facility(ies) at its discretion provided 48 hours notice is given prior to inspection. For private residential LIDs located on an easement, the City may choose to accept inspection and reporting duties to ensure continued operation.	• Documents O&M activities on private property • City reserves the verify maintenance has occurred	• Approvals (subdivision agreement, site plan or other) • By-law • SWM Utility or SWM Rate Structure if applicable.
Mechanism for Assurance of O&M • For commercial properties, annual O&M and associated reporting requirements as specified, must be received and approved prior to the renewal of 1) SWM change rebates/ credits, 2) Business licenses, 3) Fire Inspection/ Certifications, 4) Public Health Inspections/ Certificates to other.	• Links submission of O&M activities to non-stormwater management related renewals and approvals • Utilizes existing mechanisms to ensure compliance	• SWM Utility or SWM Rate Structure if applicable. • By-law
O&M Non-Compliance when Subject to ECA • Should repairs or maintenance to any LID feature be abandoned by the property owner, the City shall maintain the right to enter and perform the necessary maintenance as described within the ECA. The City shall be obligated, at its discretion, to notify the MECP of non-compliance and shall work with local enforcement officers to enforce the conditions of the ECA. Should the City be forced to undertake the prescribed maintenance activities, all costs shall be recovered through the provisions of the Property Standards By-law or other and collected through property tax.	• Utilizes existing compliance mechanism to enforce O&M • Permits the City to recover costs for maintenance activities through existing or amended by-laws	• MECP Environmental Compliance Approval (ECA) • By-law

Mechanism/ Requirement	Outcome	Applied Through
O&M Non-Compliance when Not Subject to ECA • Should repairs or maintenance to any LID feature be abandoned by the property owner, the City shall maintain the right to enter and perform the necessary maintenance as described within O&M manual contained within the required design brief. Should the City be forced to undertake the prescribed maintenance activities, all costs shall be recovered through the provisions of the Property Standards By-law or other and collected through property tax.	• Permits the City to recover costs for maintenance activities through existing or amended by-laws	• By-law
Minimization of Post Construction O&M - Contingency Areas or Practices • The proponent shall prepare a detailed engineering design for stormwater management facilities including a required amount of contingency stormwater management facilities as specified and shall place such areas under a City easement. The easement(s) over the contingency facilities may be released, in whole or in part, and may occur concurrently with the issuance of building permit(s) for each identified block, lot or building. Release of contingency blocks may be subject to verification through appropriate monitoring as approved and confirmed by the respective approval authority.	• Minimizes O&M activities related to improper construction or installation. • Incentivizes proper construction practices. • Ensures compliance with SWM targets in sensitive environments • Allows for a performance verification mechanism	• Approvals (subdivision agreement, site plan or other)
Minimization of Post Construction O&M – Letter of Credit/ Construction Phasing • The proponent shall provide a letter of credit based on 60% of the estimated cost of approved facilities and any contingency facilities to the satisfaction of the respective approval authority. The letter of credit will be reduced to 15% once 90% of the catchment area is stabilized (meaning buildings are constructed and lots/blocks are sodded or vegetated), and the submission of the first report for post-construction monitoring. The balance of the letter of credit will be reduced after the “post-construction” monitoring program has expired (two years after 90% of the catchment area is stabilized.	• Minimizes O&M activities related to improper construction or installation. • Incentivizes proper construction practices. • Ensures compliance with SWM targets in sensitive environments • Allows for a performance verification mechanism	• Approvals (subdivision agreement, site plan or other)

Mechanism/ Requirement	Outcome	Applied Through
Notice of O&M Responsibility - Notification to Buyers • The proponent agrees to include a statement in all Offers of Purchase and Sales Agreements that advises of lot level facilities requirements and the requirement to maintain such facilities including the any all maintenance requirements. Offers of Purchase and Sales Agreement with builders shall obligate the builder to notify purchasers of the exact location, size and intent of lot level facilities. The wording of the statement shall be to the satisfaction of the respective approval authority.	• Notifies perspective buyers of the presence of the private facilities • Serves to outline maintenance requirements, City contacts and / or resources.	• Approvals (subdivision agreement, site plan or other)
Registration of O&M Agreement • The proponent shall enter willingly and without reservation into a maintenance agreement that is recorded with the property title that identifies the responsible party and the applicable lot(s) and specifies right-of-entry for maintenance and inspections by City staff or their contractors.	• Ensures the City retains the legal ability to enter and inspect. • Legally establishes O&M requirements on the property title.	• Approvals (subdivision agreement, site plan or other)

3.7 Staffing

As the City expands the implementation of LID BMPs, additional staffing will be required to approve, track, and inspect LID BMPs, as well as to complete operations and maintenance tasks for City-owned facilities. Staff are anticipated for, but not limited to, the following roles, although these roles are not confirmed. These roles may be filled by new hires or existing staff with additional roles.

- Water Resources Engineer – needed to review and approve LID BMP designs;
- GIS Technician – needed to run the new City LID tracking system;
- Operations and Maintenance Crew – for vegetated LIDs, this could be completed through a contract with a private contractor until the City has responsibility for more LID BMPs. City staff with Operations and Maintenance experience for vegetated and unvegetated LID BMPs will be needed from the Public Works Group and the Parks Department; and
- Inspector – needed to inspect private LID BMPs to ensure ongoing compliance.

These staffing needs will be considered during the final SWM-MP report, in the context of other staffing needs within the City's SWM program.

4 Implementation Timelines and Budgets

4.1 LID ROW Pilot Projects

The City has identified two streets undergoing reconstruction in 2024, including Nicklin Road and York Road Phase 4. It is recommended that the City consider these two streets as pilot projects for the implementation recommendations outlined in **Section 3**.

4.2 Next Steps

It is recommended that the City proceed with developing an LID policy that builds on the recommendations from within this report. This policy should be prioritized in 2023, as the SWM Criteria will become operational once the SWM-MP is finalized. A budget of approximately $75,000 is recommended for the development of this policy. This policy should include, but not be limited to:

- LID approvals process for private property;
- Assumption protocols for LID BMPs that will become part of the City's SWM system;
- City oversight of private property LID BMPs;
- Operations and maintenance processes for private property;
- City operations and maintenance approach during design, construction, and post-construction for LID BMPs that are part of the City's SWM system; and
- Any updates/revisions to the City's DEM and/or by-laws that arise from the above.

Appendix A: Consolidated Linear Infrastructure Environmental Compliance Approval Appendix A

Appendix A – Stormwater Management Criteria

1.0 Applicability of Criteria

1.1 The criteria listed under Table A1 of this Appendix applies to all drainage areas greater than 0.1 ha, with the construction erosion and sediment control criteria applying also to sites <0.1 ha;

1.2 Despite condition 1.1 of Appendix A, if some or all of the criteria listed under Table A1 of this Appendix have been assessed for and addressed in other adjacent developed lands to the project site through a subwatershed plan or equivalent study, then those criteria may not be applicable to the project site.

Table A1. Performance Criteria

Water Balance [1]	**FOR DEVELOPMENT SCENARIOS** [2] **Assessment Studies:** i) Control [3] as per the criteria identified in the water balance assessment completed in one or more of the following studies [15], if undertaken: a watershed/subwatershed plan; Source Protection Plan (Assessment Report component); Master Stormwater Management Plan, Master Environmental Servicing Plan; Class EA, or similar approach that transparently considers social, environmental and financial impacts; or local site study including natural heritage, Ecologically significant Groundwater Recharge Areas (EGRA), inflow and infiltration strategies. The assessment should include sufficient detail to be used at a local site level and consistent with the various level of studies; OR **IF Assessment Studies in i) NOT completed:** ii) Control [3] the recharge [4] to meet Pre-development [5] conditions on property; **OR** iii) Control [3] the runoff from the 90th percentile storm event. **Lake Simcoe Watershed Municipalities:** iv) Control [3] as per the evaluation of anticipated changes in water balance between Pre-development and post-development assessed through a Stormwater management plan in support of an application for Major Development [6]. The assessment should include sufficient detail to be used at a local site level. If it is demonstrated, using the approved water balance estimation methods **[7]**, that the site's post to Pre-development water balance cannot be met, and Maximum Extent Possible [8] has been attained, the proponent may use Lake Simcoe and Region Conservation Authority's (LSRCA) Recharge Compensation Program [9]. **FOR RETROFIT SCENARIOS** [10] **Assessment Studies:** i) Control as per criteria identified in the water balance assessment completed in one or more of the following studies: a watershed/subwatershed plan, Source Protection Plan (Assessment Report component), Master Stormwater Management Plan, Master Environmental Servicing Plan,

	Class EA, or local site study including natural heritage, EGRA, inflow and infiltration strategies, if undertaken. The assessment should include sufficient detail to be used at a local site level and consistent with the various level of studies; **OR** ii) If constraints [11] identified in i), then control [3] as per Maximum Extent Possible [8] based on environmental site feasibility studies or address local needs[14]. **IF Assessment Studies in i) NOT completed:** iii) Control [3] the recharge [4] to meet Pre-development [5] conditions on property; **OR** iv) Control [3] the runoff from the 90th percentile storm event.
Water Quality [1]	**FOR DEVELOPMENT SCENARIOS** [2] All of the following criteria must be met for development scenarios: **General:** i) Characterize the water quality to be protected and Stormwater Contaminants (e.g., suspended solids, nutrients, bacteria, water temperature) for potential impact on the Natural Environment, and control as necessary, **OR** ii) As per the watershed/subwatershed plan, similar area-wide Stormwater study, or Stormwater management plan to minimize, or where possible, prevent increases in Contaminant loads and impacts to receiving waters. **Suspended Solids:** i) Control [3] 90th percentile storm event and if conventional methods are necessary, then enhanced, normal, or basic levels of protection (80%, 70%, or 60% respectively) for suspended solids removal (based on the receiver). **Phosphorus:** i) Minimize existing phosphorus loadings to Lake Erie and its tributaries, as compared to 2018 or conditions prior to the proposed development, **OR** ii) Minimize phosphorus loadings to Lake Simcoe and its tributaries. Proponents with development sites located in the Lake Simcoe watershed shall evaluate anticipated changes in phosphorus loadings between Pre-development and post-development through a Stormwater management plan in support of an application for Major Development [6]. The assessment should include sufficient detail to be used at a local site level. If, using the approved phosphorus budget tool [12], it is demonstrated that the site's post to Pre-development phosphorus budget cannot be met, and Maximum Extent Possible [8] has been attained, the proponent may use LSRCA's Phosphorus Offsetting Policy [9]. **FOR RETROFIT SCENARIOS** [10] i) Improve the level of water quality control currently provided on site; **AND** ii) As per the 'Development' criteria for Suspended Solids, **OR** iii) **If 'Development' criteria for Suspended Solids cannot be met**, Works are designed as a multi-year retrofit project, in accordance with a rehabilitation study or similar area-wide Stormwater study, such that the completed treatment train will achieve the 'Development' criteria for Suspended Solids or local needs[14], within ten (10) years; **OR**

	iv) If constraints [11] identified in ii) and iii), then control [3] as per Maximum Extent Possible [8] based on environmental site feasibility studies.
Erosion Control (Watershed) [1]	**FOR DEVELOPMENT SCENARIOS** [8] i) As per erosion assessment completed in watershed/subwatershed plan, Master Stormwater Management Plan, Master Environmental Servicing Plan, Drainage Plan, Class EA, local site study, geomorphologic study, or erosion analysis; **OR** ii) As per the Detailed Design Approach or Simplified Design Approach methods described in the Stormwater Management Planning and Design Manual: a. The Detailed Design Approach may be selected by the proponent for any development regardless of size and location within the watershed provided technical specialists are available for the completion of the technical assessments; or considered more appropriate than the simplified approach given the size and location of the development within the watershed and the sensitivity of the receiving waters in terms of morphology and habitat function. b. The Simplified Design Approach may be adopted for watersheds whose development area is generally less than twenty hectares AND either one of the following two conditions apply: 1) The catchment area of the receiving channel at the point-of-entry of Stormwater drainage from the development is equal to or greater than twenty-five square kilometres; or 2) Meets the following conditions: • The channel bankfull depth is less than three quarters of a metre; • The channel is a headwater stream; • The receiving channel is not designated as an Environmentally Sensitive Area (ESA) or Area of Natural or Scientific Interest (ANSI) and does not provide habitat for a sensitive aquatic species; • The channel is stable to transitional; and • The channel is slightly entrenched; **OR** iii) In the absence of a guiding study, detain at minimum, the runoff volume generated from a 25 mm storm event over 24 to 48 hours. **FOR RETROFIT SCENARIOS** [10] i) If approaches i-iii) under 'Development Scenarios' are not feasible as per identified constraints [11], then improve the level of erosion control [3] currently provided on site to Maximum Extent Possible [8] based on environmental site feasibility studies or address local needs[14].
Water Quantity (Minor and Major System) [1]	**i)** As per municipal standards, Master Stormwater Management Plan, Class EA, Individual EA and/or ECA, as appropriate for the type of project [13]
Flood Control (Watershed Hydrology) [1]	**FOR DEVELOPMENT SCENARIOS** [2] i) Manage peak flow control as per watershed/subwatershed plans, municipal criteria being a minimum 100 year return storm (except for site-specific considerations and proximity to receiving water bodies), municipal guidelines and standards, Individual/Class EA, ECA, Master Plan, as appropriate for the type of project [13].

	FOR RETROFIT SCENARIOS [10] i) If approaches i) under 'Development Scenarios' are not feasible as per identified constraints [11], then improve the level of flood control [3] currently provided on site to Maximum Extent Possible [8] based on environmental site feasibility studies.
Construction Erosion and Sediment Control	i) Manage construction erosion and sediment control through development and implementation of an erosion and sediment control (ESC) plan. The ESC plan shall: a. Have regard to Canadian Standards Association (CSA) W202 Erosion and Sediment Control Inspection and Monitoring Standard (as amended); OR b. Have regard to Erosion and Sediment Control Guideline for Urban Construction 2019 by TRCA (as amended). ii) Be prepared by a QP for sites with drainage areas greater than 5 ha or if specified by the Owner for a drainage lower than 5 ha. iii) Installation and maintenance of the ESC measures specified in the ESC plan shall have regard to CSA W208:20 Erosion and Sediment Control Installation and Maintenance (as amended). iv) For sites with drainage areas greater than 5 ha, a QP shall inspect the construction ESC measures, as specified in the ESC plan.
Footnote	1. Where the opportunity exists on your project site or the same subwatershed, reallocation of development elements may be optimal for management as described in footnote [3]. 2. Development includes new development, redevelopment, infill development, or conversion of a rural cross-section into an urban cross-section. 3. Stormwater volumes generated from the geographically specific 90th percentile rainfall event on an annual average basis from all surfaces on the entire site are targeted for control. Control is in the following hierarchical order, with each step exhausted before proceeding to the next: 1) retention (infiltration, reuse, or evapotranspiration), 2) LID filtration, and 3) conventional Stormwater management. Step 3, conventional Stormwater management, should proceed only once Maximum Extent Possible [8] has been attained for Steps 1 and 2 for retention and filtration. 4. Recharge is the infiltration and movement of surface water into the soil, past the vegetation root zone, to the zone of saturation, or water table. 5. Pre-development is defined as the more stringent of the two following scenarios: 1) a site's existing condition, or 2) as defined by the local municipality. 6. Major Development has the same meaning as in the Lake Simcoe Protection Plan, 2009. 7. Currently, the approved tool by LSRCA for calculating the water balance is the Thornthwaite-Mather Method. Other tools agreed upon by relevant approval agencies (e.g., LSRCA, municipality, or Ministry) may also be acceptable, subject to written acceptance by the Director. 8. Maximum Extent Possible means maximum achievable Stormwater volume control through retention and LID filtration engineered/landscaped/technical Stormwater practices, given the site constraints [11]. 9. Information pertaining to LSRCA's Recharge Compensation Program and Phosphorus Offsetting Policy is available on LSRCA's website (lsrca.on.ca), or in "Water Balance Recharge Policy for the Lake Simcoe Protection Plan", dated July 2021, and prepared by Lake Simcoe Region Conservation Authority and "Phosphorus Offsetting Policy", dated July 2021, and prepared by Lake Simcoe Region Conservation Authority.

	10. Retrofit means: 1) a modification to the management of the existing infrastructure, 2) changes to major and minor systems, or 3) adding Stormwater infrastructure, in an existing area on municipal right-of-way, municipal block, or easement. It does not include conversion of a rural cross-section into an urban cross-section. 11. Site constraints must be documented. A list of site constraints can be found in Table A2. 12. Tools for calculating phosphorus budgets may include the Ministry's Phosphorus Tool, the Low Impact Development Treatment Train Tool developed in partnership by TRCA, LSRCA, and Credit Valley Conservation (CVC), or other tools agreed upon by the LSRCA and other relevant approval agencies including the municipality. 13. Possible to look at combined grey infrastructure and LID system capacity jointly. 14. Local needs include requirements for water quality, erosion, and/or water balance retrofits identified by the owner through ongoing operation and maintenance of the stormwater system, including inspection of local receiving systems and the characterization of issues requiring remediation through retrofit controls. 15. All studies shall conform with Ministry policies. If any conclusions in the studies negate policy, then the project will require a direct submission to the Ministry for review through an application pertaining to a Schedule C Notice.

Table A2. Stormwater Management Practices Site Constraints

	Site Constraints
a)	Shallow bedrock [1], areas of blasted bedrock [2], and Karst;
b)	High groundwater [1] or areas where increased infiltration will result in elevated groundwater levels which can be shown through an appropriate area specific study to impact critical utilities or property (e.g., susceptible to flooding);
c)	Swelling clays [3] or unstable sub-soils;
d)	Contaminated soils (e.g., brownfields);
e)	High Risk Site Activities including spill prone areas;
f)	Prohibitions and or restrictions per the approved Source Protection Plans and where impacts to private drinking water wells and /or Vulnerable Domestic Well Supply Areas cannot be appropriately mitigated;
g)	Flood risk prone areas or structures and/ or areas of high inflow and infiltration (I/I) where wastewater systems (storm and sanitary) have been shown through technical studies to be sensitive to groundwater conditions that contribute to extraneous flow rates that cause property flooding / Sewer back-ups;
h)	For existing municipal rights-of-way infrastructure (e.g., roads, sidewalks, utility corridor, Sewers, LID, and trails) where reconstruction is proposed and where surface and subsurface areas are not available based on a site-specific assessment completed by a QP;
i)	For developments within partially separated wastewater systems where reconstruction is proposed and where, based on a site-specific assessment completed by a QP, can be shown to: i Increase private property flood risk liabilities that cannot be mitigated through design; ii Impact pumping and treatment cost that cannot be mitigated through design; or

iii Increase risks of structural collapse of Sewer and ground systems due to infiltration and the loss of pipe and/or pavement support that cannot be mitigated through design.
j) Surface water dominated or dependent features including but not limited to marshes and/or riparian forest wetlands which derive all or a majority of their water from surface water, including streams, runoff, and overbank flooding. Surface water dominated or dependent features which are identified through approved site specific hydrologic or hydrogeologic studies, and/or Environmental Impact Statements (EIS) may be considered for a reduced volume control target. Pre-consultation with the MECP and local agencies is encouraged;
k) Existing urban areas where risk to water distribution systems has been identified through assessments to meet applicable drinking water requirements, including Procedures F-6 and F-6-1, and substantiated by a QP through an appropriate area specific study and where the risk cannot be reasonably mitigated per the relevant design guidelines;
l) Existing urban areas where risk to life, human health, property, or infrastructure has been is identified and substantiated by a QP through an appropriate area specific study and where the risk cannot be reasonably mitigated per the relevant design guidelines;
m) Water reuse feasibility study has been completed to determine non-potable reuse of Stormwater for onsite or shared use;
n) Economic considerations set by infrastructure feasibility and prioritization studies undertaken at either the local/site or municipal/system level [4].
Footnote: 1. May limit infiltration capabilities if bedrock and groundwater is within 1m of the proposed Facility invert per Table 3.4.1 of the LID Stormwater Planning and Design Guide (2010, V1.0 or most recent by TRCA/CVC). Detailed assessment or studies are required to demonstrate infiltration effects and results may permit relaxation of the minimum 1m offset. 2. Where blasting is more localized, this constraint may not be an issue elsewhere on the property. While infiltration-based practices may be limited in blasted rock areas, other forms of LID, such as filtration, evapotranspiration, etc., are still viable options that should be pursued. 3. Swelling clays are clay soils that is prone to large volume changes (swelling and shrinking) that are directly related to changes in water content. 4. Infrastructure feasibility and prioritization studies should comprehensively assess Stormwater site opportunities and constraints to improve cost effectiveness, environmental performance, and overall benefit to the receivers and the community. The studies include assessing and prioritizing municipal infrastructure for upgrades in a prudent and economically feasible manner.

Appendix B: LID Workshop #1

City Attendees

Staff	Department
Colleen Gammie	Design and Construction, Engineering and Transportation Services (ETS)
Mary Angelo	Development and Environmental Engineering, ETS
Jennifer Juste	Transportation Planning, ETS
Benita van Miltenburg	Transportation Planning, ETS
Kyle Gagne	Operations, Public Works
Prasoon Adhikari	Development and Environmental Engineering, ETS
Alexandra Marson	Development and Environmental Engineering, ETS
Jim Hall	Development and Environmental Engineering, ETS
Leah Lefler	Planning & Building Services, Policy Planning (Environmental)
Steven Di Pietro	Design and Construction, ETS
Andrew Miller	Design and Construction, ETS
David Di Pietro	Design and Construction, ETS
Emily Stahl	Water Services, Environmental Services
Daniel Di Pietro	Transportation Planning, ETS
Abby Spielmacher	Water Services, Environmental Services
Ethan Barrand	Development and Environmental Engineering, ETS
Kyle Gibson	Technical Services, ETS

The following departments also provided feedback regarding LID features within the City:

- Facility Design and Construction, Facilities and Energy Management – Accessibility
- Planning and Building Services – Urban Design
- Parks Department (Forestry and Sustainable Landscape and Parks Planning)

Appendix C: LID Workshop #2

City Attendees

Staff	Department
Colleen Gammie	Design and Construction, Engineering and Transportation Services (ETS)
Prasoon Adhikari	Development and Environmental Engineering, ETS
Mary Angelo	Development and Environmental Engineering, ETS
Kevin Nelson	Corporate Asset Management, ETS
Mathew Walden	Corporate Asset Management, ETS
Terry Dooling	Operations, Public Works
Alexandra Marson	Development and Environmental Engineering, ETS