Hamilton Harbour Remedial Action Plan

Urban Runoff Burlington
Report and Recommendations


Grindstone Creek


Indian Creek

Prepared by: Urban Runoff Burlington Task Group
Dated: October 20, 2016

Urban Runoff Burlington Report

Executive Summary

For the first time in 100 years the quality of the water in Hamilton Harbour will soon be determined by its watershed runoff. By 2021 upgrades to wastewater treatment plants will be complete and no longer will impacts from the watershed be masked by wastewater effluent. The hundreds of millions of dollars invested in wastewater treatment upgrades will not on their own be enough to make sustainable changes in Harbour water quality. If Hamilton Harbour is to delist as an Area of Concern, urban runoff will also need to lower phosphorus and sediment levels.

For this reason the Hamilton Harbour Remedial Action Plan (HHRAP) set up Urban Runoff Task Groups for Burlington and Hamilton with municipal, conservation authority, provincial, federal, RBG, and community stakeholder representatives. This report is the collective overview of local stormwater management practice and contains recommendations for opportunities to change. The recommended change is not unique to this area, but is in line with changes already occurring in the understanding, practice, and resourcing of stormwater management throughout Ontario and North America.

Stormwater management is undergoing an evolution. Historically conveyance was the main focus of stormwater management - efficiently collecting rain water and moving it quickly through pipes and channels to enter creeks and larger water bodies. It is now recognized that using ways to mimic a natural landscape and infiltrate rain where it falls will slow it down, provide opportunities for removal of excess nutrients and sediment, and decrease the potential for flooding. This practice is referred to as Low Impact Development or LID.

The key categories of recommendations from the Urban Runoff Burlington Task Group include:

- updating guidance and manuals;
- providing training;
- expanding implementation and maintenance of public and private stormwater facilities; and
- creating a stable and equitable financial model for stormwater.

Underpinning many of the necessary changes will be the need for the City of Burlington to stabilize revenues and ensure sustainability for the municipal stormwater infrastructure including its operations and maintenance requirements through a dedicated, equitable rate structure.

This evolution in stormwater management is in line with the visions of the City of Burlington, Conservation Halton, and the Hamilton Harbour Remedial Action Plan. When stormwater management is done well, flooding will be reduced and nature will thrive with cleaner streams; when it fails, basements flood and streams will struggle to sustain health. **Hamilton Harbour, the City of Burlington and Conservation Halton will benefit from this evolution to stormwater management as the Harbour continues to strive to achieve delisting and become a vibrant centrepiece for the community.**

Recommendations for Evolution of Stormwater Management Approach and Design

REPORTS & MANUALS

B1) It is recommended that the Province of Ontario complete development of the Low Impact Development (LID) Guidance Manual to complement the current MOECC Stormwater Planning and Design Manual.

B2) It is recommended that the Province of Ontario provide guidance with respect to the stormwater volume reduction that may be possible through crediting LID techniques as part of a treatment train approach to stormwater management, particularly implications for designing stormwater management wet ponds.

B3) It is recommended that the Province of Ontario review the existing building code to include recommendations that support and/or promote implementing LID techniques for buildings and structures subject to the building code.

B4) It is recommended that the City of Burlington, in consultation with Conservation Halton, develop or update the stormwater management manual and Master Plans for development in Burlington based on the Province of Ontario's LID Guidance Manual, the 2003 MOECC Stormwater Planning and Design Manual, and other relevant references.

B5) It is recommended that the City of Burlington and the Region of Halton develop LID guidance for reconstruction of urban roads based on LID stormwater management techniques developed by the Province, other municipalities, and Conservation Authorities.

B6) It is recommended that the City of Burlington and Conservation Halton review their watershed basin reports and develop a list to identify updates and priorities.

B7) It is recommended that the City of Burlington adopt a policy to maintain to the greatest extent possible infiltration through the road and swale system in Aldershot for existing, redevelopment, and new development and to utilize LID techniques for stormwater management.

PROGRAMS

B8) It is recommended that the Conservation Halton water quality monitoring program and the associated aquatic monitoring and terrestrial monitoring program continue and be expanded to ensure a thorough understanding of water quality issues from headwaters to Grindstone Creek Marshes/Hamilton Harbour.

TRAINING & EDUCATION

B9) It is recommended that the City of Burlington, the Region of Halton, Conservation Halton, and the Province of Ontario develop a local workshop/conference for the development industry and practitioners to share new LID guidelines, LID construction and design tools, LID maintenance, and resources.

B10) It is recommended that the City of Burlington, with support from the Province of Ontario, create and implement a training program in LID, SWM, and maintenance for municipal

engineers, planners, building department staff, and maintenance operations staff (Parks and Rec, Roads and Parks Maintenance, etc.) involved in all stages of development to ensure full integration of changes/updates to LID and SWM guidelines and manuals.

B11) It is recommended that the Region of Halton, with support from the Province of Ontario, create and implement a training program in LID, SWM, and maintenance for engineers, planners, and maintenance operations staff (Roads and Parks Maintenance, etc.) involved in all stages of development to ensure full integration of changes/updates to LID and SWM guidelines and manuals.

B12) It is recommended that Conservation Halton, with support from the Province of Ontario, create and implement a training program in LID, SWM, and maintenance for its engineers, planners, enforcement, and ecology staff involved in all stages of development to ensure full integration of changes/updates to LID and SWM guidelines and manuals.

Recommendations for Maintenance and Opportunities to Improve the Existing Stormwater System

REPORTS & MANUALS

C1) It is recommended that the Province of Ontario include guidance regarding the frequency of quantity and/or quality monitoring of stormwater management infrastructure.

PROGRAMS

C2) It is recommended that the City of Burlington inventory the area to confirm and update location and ownership of all stormwater management infrastructure and OGS on municipal and where possible private lands.

C3) It is recommended that the City of Burlington, in collaboration with Conservation Halton, develop a monitoring program to examine the functioning of stormwater management facilities to determine if they are addressing water quality requirements, functioning as designed, and if their performance can be optimized.

C4) It is recommended that the City of Burlington, within the Hamilton Harbour watershed, explore increasing frequency of maintenance to improve the efficiency of their catch basin cleaning program and explore addition of catch basin technologies to optimize performance.

C5) It is recommended that the City of Burlington and Conservation Halton continue to update and maintain an inventory of erosion sites within the City and CA owned creek blocks and prioritize appropriate remedial actions.

Recommendations for Evolution of Stormwater Infrastructure Funding

D1) It is recommended that the Province of Ontario provide guidance and direction for new financial models that allow stormwater infrastructure to be separately and predictably funded.

D2) It is recommended that the City of Burlington examine a municipal financial model for stormwater management based on an equitable rate structure for a stable funding source.

Recommendations for Evolution of Stormwater Management on Private Properties

REPORTS & MANUALS

E1) It is recommended that the City of Burlington investigate and explore measures to ensure maintenance is carried out by private industrial, commercial, and institutional landowners to ensure the efficiency of all private stormwater management facilities and private OGS systems are maintained.

E2) It is recommended that the Province of Ontario provide updated guidance for storm sewers and include requirements related to nutrients for incorporation into municipal sewer use bylaws.

E3) It is recommended that the City of Burlington review their Sewer Use Bylaw regarding including a limit for total phosphorus and total suspended sediment discharged into storm sewers.

PROGRAMS

E4) It is recommended that the City of Burlington, the Region of Halton, Conservation Halton, and local community groups provide and/or expand programs for social incentives to recognize community participation in sustainable stormwater management and the adoption of LIDs (e.g. awards, recognition programs).

E5) It is recommended that the numerous existing outreach and education programs being delivered currently by Conservation Halton, the City of Burlington, the Region of Halton, and local non-profit agencies be enhanced and ensure that collaboration in these initiatives occurs.

E6) It is recommended that the City of Burlington, the Region of Halton, and Conservation Halton investigate the opportunity to develop an incentive program encourage the use of LIDs on private lands.

TRAINING & EDUCATION

E7) It is recommended that local government and community groups in the Hamilton Harbour Watershed collaborate on stormwater stewardship outreach and education initiatives to maximize effectiveness of messaging to urban residents to promote acceptance and implementation at the lot level to address urban stormwater runoff.

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Introduction

The delisting of Hamilton Harbour as an Area of Concern under the Great Lakes Water Quality Agreement between Canada and the United States requires that various water quality and natural habitat requirements are achieved for Hamilton Harbour (HH) and its associated coastal wetlands of Cootes Paradise and the mouth of the Grindstone Creek. With upgrades to the Harbour's wastewater treatment plants underway it is anticipated that by 2021 the main determinant of water quality in the Harbour will be runoff from its watersheds (Kim et al., 2014, Ramin et al., 2012, Gudimov et al., 2011). As the two major wetland complexes are located at the mouths of Spencer and Grindstone Creeks the effect of runoff is even more critical to restoring these areas. With this in mind, in April of 2013 the Bay Area Implementation Team (BAIT) hosted a day long watershed workshop to identify rural and urban runoff issues. Recommendations by participants highlighted the need for further work in: a) stormwater management and b) erosion and sediment control on active construction sites.

One of the actions included in the workshop report was the formation of a multi-agency senior staff advisory group. This group, Chaired by the Director of Hamilton Water, City of Hamilton was established in September 2014 and identified four task groups to be formed:

- Urban Runoff – Burlington
- Urban Runoff – Hamilton
- Sediment Control on Active Construction Sites
- Rural Runoff

The terms of reference (Appendix 1) directing the Task Groups identified a process for: sharing information on the transport of nutrients and sediments to HH and its coastal wetlands (Cootes Paradise and mouth of the Grindstone Creek); analysing current stormwater management practices; and providing recommendations for improvement in stormwater management practice and sediment control. This report addresses findings related solely to urban stormwater management. Sediment control on active construction sites is addressed in a separate report. It is not meant to be a comprehensive science document, but a general understanding of the issues.

The following report represents the work of the Urban Runoff Burlington Task Group during 12 meetings from December 2014 through to September 2016. The participating members of the Task Group are listed in Appendix 2 with meeting summaries provided electronically in Appendix 6.

A. Background Information on Hamilton Harbour and its Watershed Inputs

There are two data sets that currently provide watershed analysis of concentrations and loadings of nutrients and sediments relevant to the City of Burlington and its portion of the Hamilton Harbour watershed.

The Hamilton Harbour Contaminant Loadings and Concentrations report was first produced in 1998, with updates in 2004 and 2010, comparing various sources of inputs into the Harbour. The method used in these reports to estimate creek loadings was developed from the Draper Report (1993). In support of the RAP, between November 1991 and April 1992, D. W. Draper and Associates Ltd. monitored seven HH creeks during five wet-weather events, but did not include base flow events. Flows were divided then into high and low with corresponding concentration values assigned to each grouping allowing future estimates to be based on these flow divisions for each creek.

The second data set was from the Ontario Ministry of Environment and Climate Change (MOECC), a rigorous analysis of total phosphorus (TP) and sediment generated within the Hamilton Harbour Watershed based on a peer-reviewed published study (Long et al., 2014 and 2015). The MOECC sampled 87 runoff events including rain, snowmelt, and base flows between July 2010 and May 2012. This spanned both the relatively cold winter of 2010-11 and the mild winter of 2011-12. Sampling was carried out in 1 hour intervals over 24 hour periods for all events that were monitored in order to provide a realistic understanding of nutrient and sediment concentrations during the rising and falling limbs of runoff events (Figure 1).

From the MOECC work, which focused on phosphorus, the following general conclusions can be reached:

- The highest seasonal load of total phosphorus (TP) and sediment often occurs through the spring freshet, falling into either the winter season or the spring season depending on snowpack melt (Figure 2)(*corresponding sediment graphs were not available*);
- Maximum loads of phosphorus are approximately 12 times greater than inputs from HH wastewater treatment plants (WWTPs). After WWTP upgrades are fully completed in 2021 the maximum phosphorus loads from creeks, with no improvements, could be as much as 20 times greater than wastewater effluent (Table 1);

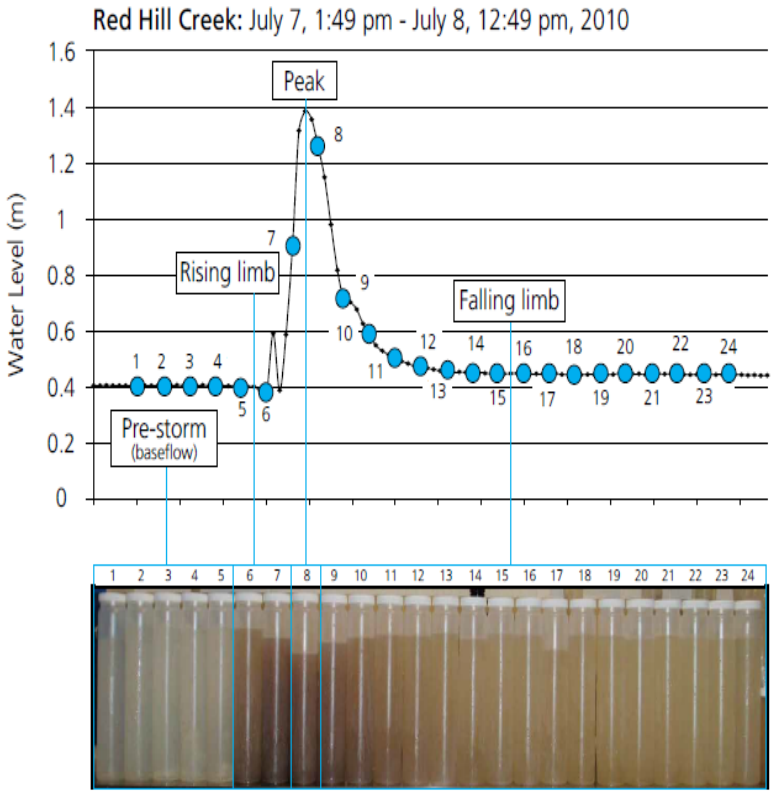


Figure 1: Example of results from the once per hour sampling over 24-hours of a storm on Red Hill Creek. Source: T. Long, MOECC

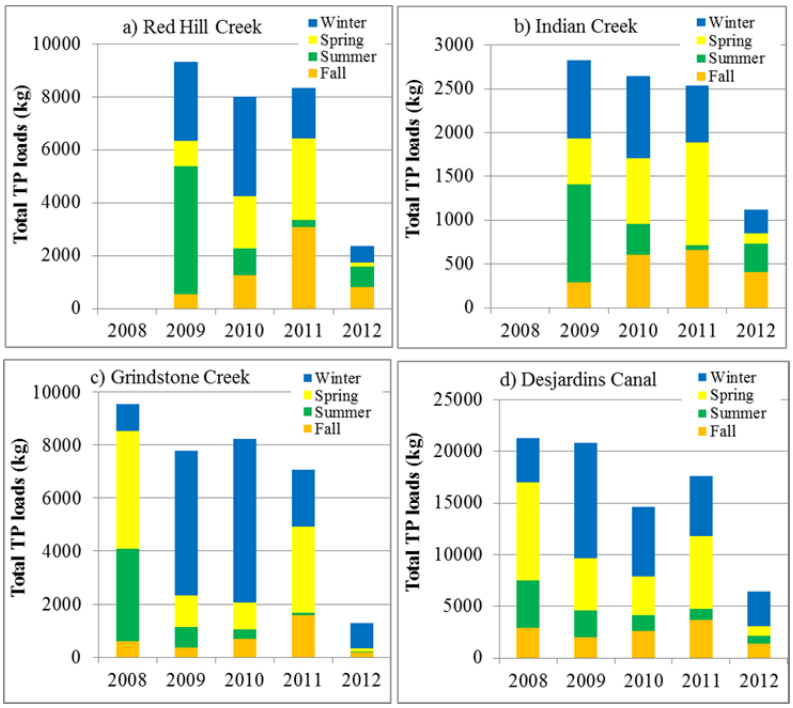


Figure 2: Largest seasonal phosphorus loads often occurs in winter and spring. Source: T. Long, MOECC

CREEKS	Min daily load (kg/d)	Max daily load (kg/d)	Event of maximum loading
Red Hill Creek	0.1	841	Sep 28-29, 2010 (54.8 mm)
Indian Creek	0.1	152	Nov 29-30, 2011 (40.2 mm)
Grindstone Creek	0.2	334	Mar 10-11, 2011 (22.1 mm + melt)
Desjardins Canal	1.8	704	Mar 11-12, 2011 (9.6 mm + melt)
Total	**2.2**	**2031**	

WWTPs	Skyway	Woodward + CSO	**Total**	**Max creek loads** (2031 kg/d) **relative to WWTP loads**
Current load (kg/d)	20	156	**176**	12 times greater
Final load (kg/d)	17	82	**99**	20 times greater

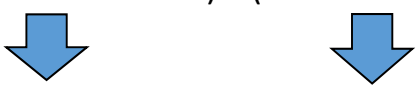
Table 1: Comparison of potential maximum daily loads from HH Creeks vs WWTPs. Source: T. Long, MOECC

In the past, phosphorus from combined sewer overflows (CSOs) and wastewater treatment plants (WWTPs) tended to mask the effect of phosphorus coming from creeks flowing into Hamilton Harbour. The upgrades to tertiary treatment will reduce levels of phosphorus and sediment in WWTP effluent to as low as technologically possible. Once upgrades to the Woodward WWTP are completed in 2021, for the first time in about 100 years the quality of water in Hamilton Harbour will be dictated by inflow from the watershed, both urban and rural, rather than the WWTPs that discharge to the Harbour.

Therefore, unless improvements are made to also reduce the amount of phosphorus coming in from the creeks, the benefits from the hundreds of millions of dollars invested in WWTP upgrades will not be fully realized. Although improvements at the WWTPs are modelled to bring the Harbour close to the target of 20 µg/L total phosphorus under base flow conditions, rain/snow melt events will continue pushing that value much higher (Kim et al., 2014, Ramin et al., 2012, Gudimov et al., 2011).

The following simple equation for calculating total phosphorus loading can assist in understanding how to reduce TP loading (Source: T. Long, MOECC):

TP Load = (TP concentration) x (runoff volume)



Reduce sediment input, P sources, etc.

Increase infiltration, low impact development (LID)

Reducing sediment inputs and other phosphorus sources will reduce phosphorus supplied to watercourses. Increasing infiltration, evapotranspiration and on-site retention of phosphorous laden waters through source based stormwater management controls generally known as low impact development (LID) techniques can also reduce phosphorous loads. These LID techniques also have the added benefit of reducing runoff volumes and peak flows which may prevent bank erosion (an additional source of phosphorus) in the downstream watercourse.

Note, the Task Group did not explore in detail a number of topics that could continue to inform this discussion: the expected frequency and intensity of major storm events in light of climate change; the relative magnitude of expected impacts on HH water quality resulting from watercourse loadings during such storm events (which may be seasonally dependent); and the average daily loads and the relative magnitude of expected impacts of such day-to-day events on HH water quality.

Targets Required to Restore Hamilton Harbour and its Coastal Wetlands

The total phosphorus water quality target measured within Hamilton Harbour (HH) at Centre Station is <20 µg/L. This target is set at a level required to prevent excessive algal blooms. This is also the MOECC guideline for lakes and represents a mesotrophic or "middle of the road" ecological water quality target.

Major upgrades to the WWTPs discharging to HH are presently being carried out by the Region of Halton and City of Hamilton. Effluent targets for the WWTPs were based on this Harbour target of <20 µg/L. Once WWTP upgrades are complete, the combination of WWTP effluent and creek base-flows is expected to allow < 20 µg/L phosphorus to be achieved in the Harbour (Kim et al., 2014, Ramin et al., 2012, Gudimov et al., 2011). It must be remembered that the flow input to the Harbour is approximately 50% from WWTPs and 50% from the watershed. As a result, if the Harbour is at 20 µg/L under base flow conditions then watershed runoff events from storms can create spikes in the Harbour TP levels leading to algal blooms. As mentioned previously TP increases positively with sediment as much of the TP is attached to sediment.

In a presentation provided by the Royal Botanical Gardens it was pointed out that the situation is amplified for the Cootes Paradise Marsh and mouth of the Grindstone Creek as they are more directly influenced by watershed runoff. The Cootes Grindstone Water Quality Targets Subcommittee is in the process of considering final targets of 30-50 µg/L phosphorus for these marshes down from initial targets of 60-70 µg/L to encourage a diverse marsh plant community. The upper tolerable concentration of suspended sediment identified for fish species is between 25-80 ppm (Birtwell, 1999) and 25 ppm is presently the preliminary level used as a maximum in Cootes Paradise. It should be recognized that this level is frequently greatly exceeded during runoff events, for example the maximum TSS for Cootes Paradise Marsh in 2013 was 97.6 ppm (Gillespie et al., 2014).

B. Evolution of Stormwater Management Approach and Design

Summary of Highlighted Recommendations

- *Provincial guidance on Low Impact Development through creation of manuals, crediting LID techniques, and reviewing the building code*
- *Updates to internal guidance and manuals to incorporate low impact development in new and retrofit construction*
- *Develop LID guideline manual for urban redevelopment/road reconstruction*
- *Provide LID training to staff of a wide range of departments and professions*
- *Encourage LID education for development industry and practitioners*

Evolution of Stormwater Management to Low Impact Development (LID)

Low Impact Development (LID) is considered to represent the next stage in a continuum of improvements to stormwater management practice (SWM) since the 1980s (Figure 3). LID looks to better replicate the natural hydrologic cycle of rain or snowfall, evaporation, infiltration and runoff by allowing precipitation to infiltrate where it falls (Figure 4). This differs from past practice that focused on managing the conveyance of runoff to prevent flooding, reduce erosion and improve water quality. Unfortunately, as progressive as past practice may have been it has not delivered the results required by modern urban areas and met necessary ecological outcomes.

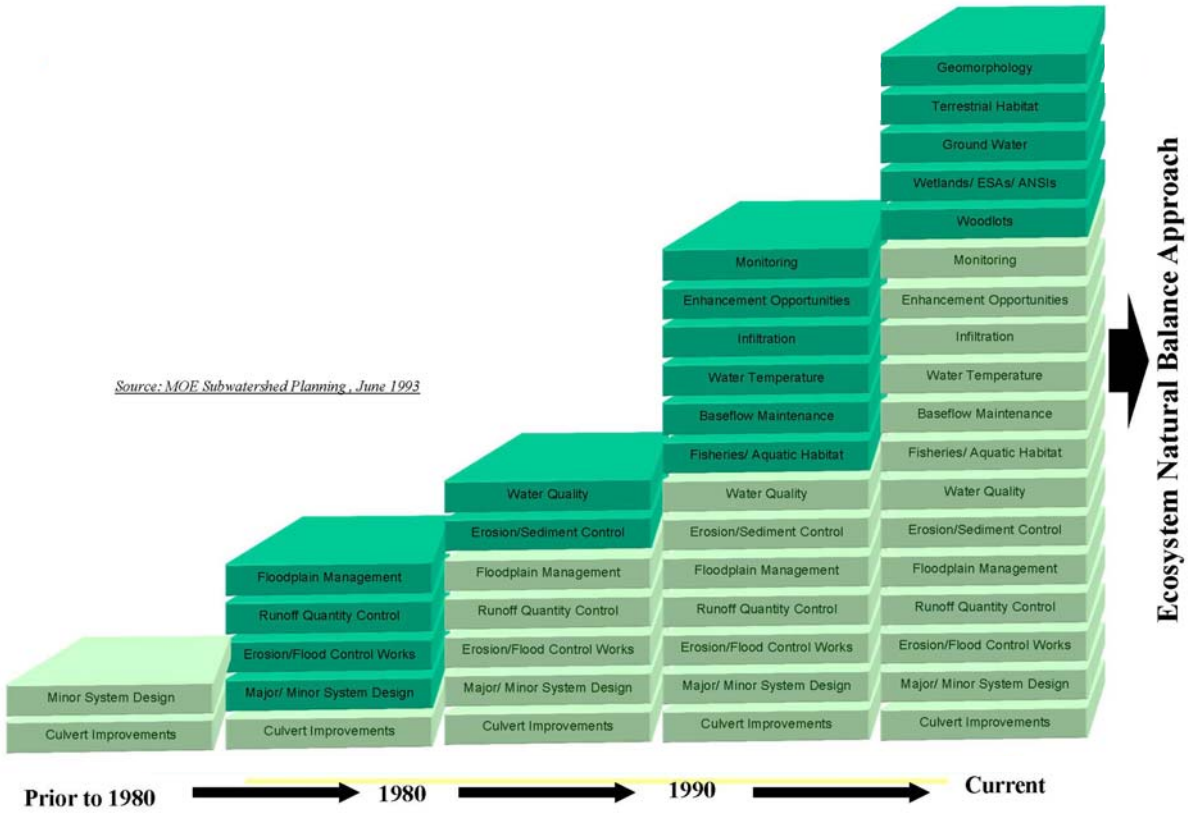


Figure 3: Evolution of Stormwater Management (Source: MOE Subwatershed Planning, 1993)

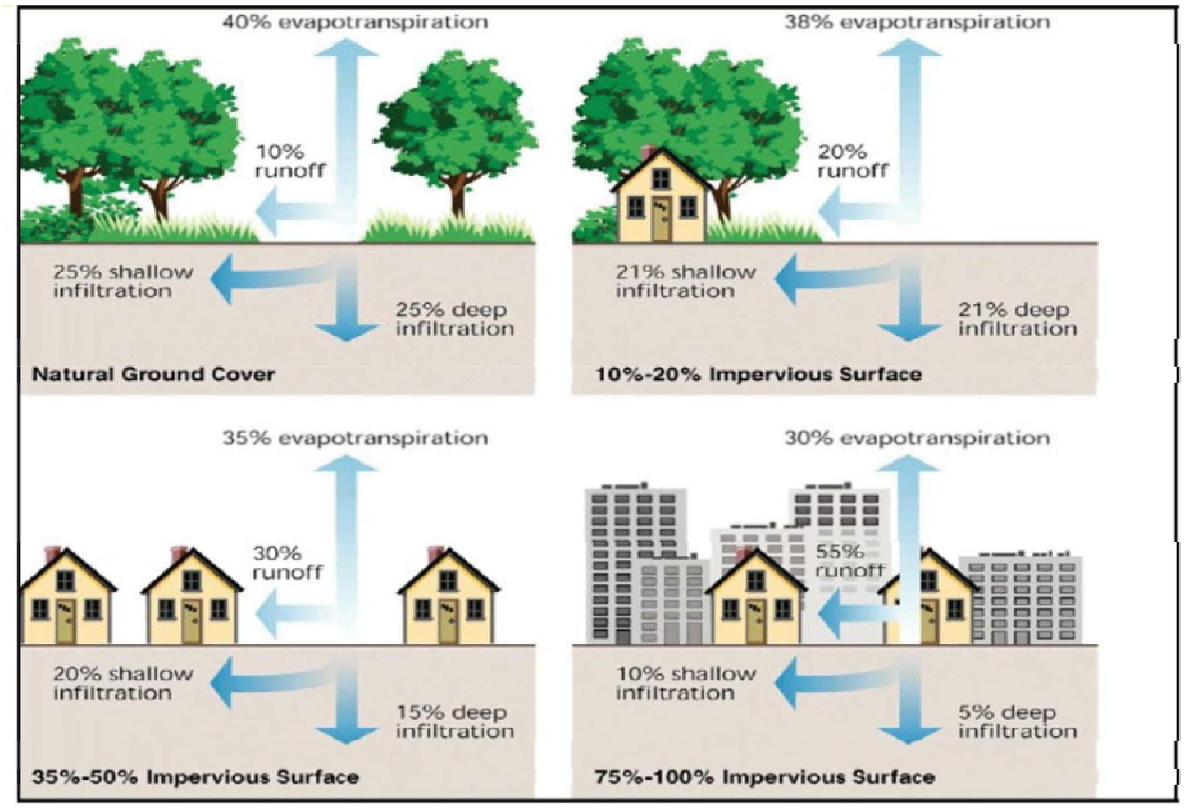


Figure 4: The Impact of Urbanization on the Hydrologic Cycle (Provided by: N. Ghbn, City of Hamilton)

Traditionally, centralized, or end-of-pipe, SWM facilities treat runoff in one area by detaining the water and releasing it slowly. For larger development areas, this is achieved within a SWM pond or treatment wetland. Low flow velocities within the ponds allow pollutants bonded to sediments to settle out in the ponds. The controlled release of stormflows also reduces downstream velocities to better approximate pre-development discharge and prevent excessive streambed erosion. Ponds also provide the opportunity for biological uptake of the nutrients, as well as potential for some filtration. For smaller development sites, treatment is often provided through oil grit separators, which rely on velocity reductions and centrifugal forces to separate and contain oil and sediments in the lower chambers of a manhole-like structure.

Given growing recognition of the impact of SWM on the environment, there has been a strengthening movement to adopt the integrated treatment train approach advocated by MOECC in their 2003 Stormwater Management Planning and Design Manual. The treatment train approach, involving lot level and conveyance controls, as well as end of pipe controls, is encouraged, to increase pollutant removal, and better mimic pre-development hydrology. This allows for a multi-barrier approach that:

- reduces sediment transport and prevents 'first flush' runoff from reaching end of pipe controls;
- reduces the land area required to implement end of pipe solutions only;
- decrease total costs for SWM systems (when land value is factored in); and
- increases public awareness in SWM initiatives.

One of the challenges for municipalities is to define SWM practices that are efficient for meeting flood, erosion and water quality objectives while being socially acceptable and cost effective. As LID practice is proving to meet these varied demands, it is therefore seen as the next logical step in the progression of SWM practice. The control of flooding from various storm frequencies may be improved by utilizing LIDs, but each technique will have its limitations. The combined infiltration of multiple LIDs will reduce the total volume which may reduce maximum flood levels in some storm events. Erosion can be reduced by increasing infiltration into underlying soils thereby reducing the volume of runoff. This is a principal factor in causing erosion and transporting pollutants.

Ontario Based LID Leadership

A growing body of practice and monitoring of results in similar climate zones as Burlington is showing significant benefits from the proper utilization of LIDs. The science has gone beyond the need for smaller scale pilot studies in each municipality.

Examples of leadership in the use and understanding of LIDs in Ontario include: municipalities such as Metro Toronto, Kitchener, Waterloo, Mississauga, London, Lake Simcoe area; and conservation authorities such as Toronto and Region Conservation Authority (TRCA), Credit Valley Conservation Authority (CVC), Lake Simcoe Region Conservation Authority (LSRCA), and Upper Thames River Conservation Authority (UTRCA).

LID Guidance Document and Training

The MOECC 2003 Stormwater Management Planning and Design Manual does address the treatment train approach and refers to LIDs. The 2014 Provincial Policy Statement, pursuant to the Planning Act, does state that stormwater management planning shall promote best practices, including stormwater attenuation and re-use, and low impact development.Now, a separate LID guidance document is being developed by the MOECC and is expected to be released in late 2016. Documents identifying LID current practice are available through TRCA's Sustainable Technologies Evaluation Program website and the CVC's Low Impact Development website. Training in LID design, utilization, and maintenance is also provided through links on these sites and each year a major conference (TRIECA) is held in Toronto hosted by TRCA. Website links are listed within the references of Appendix 3.

Locally, a full day LID workshop was held in Burlington in May 2015. Topics included: LID 101 (TRCA), LID in Ontario (Aquafor Beech), LID Project Examples (City of Mississauga), Stormwater Rate Example (City of Waterloo), and a Development Perspective. Plans are underway to bring to Burlington in 2017 detailed training offered through three Greater Toronto Conservation Authorities (TRCA, CVC, LSRCA) on LID design, construction, maintenance, and monitoring training.

One aspect of LID that became clear to the Task Group was the need to involve a wide variety of departments and professions from the municipality, region, and conservation authorities including: engineers, planners, building department staff, enforcement, ecology, and maintenance operations staff in training. For example, unless sediment is controlled during construction, many LID features may not

work as designed without immediate maintenance. Also, general maintenance for some LID features will be different and something as simple as locating snow piles in a different location from previous years will be key to long term success. Most engineering consultants in Ontario that specialize in stormwater management are familiar with LID techniques and have initiated practice in this area; however, extending training opportunities beyond agency staff to the development industry and practitioners through local workshops or conferences will help to strengthen the uptake and success of LID.

Barriers to LID Implementation

The Task Group identified several stumbling blocks to the implementation of LIDs, including how LID implementation may be credited to developers so that they are not required in addition to traditional SWM techniques? Since LIDs may be integrated into high density and low density development and are part of buildings and landscaping, how can a municipality assure they will be kept and properly maintained? Are there any restrictions in existing building codes to limit the opportunity for incorporating LID? How is training in LIDs to be spread among urban designers, planners and engineers to ensure it is integrated into developments from the beginning and not additive as is now the practice?

Reconstruction and Intensification Incorporating LID

Practice from other Ontario municipalities is showing that LID techniques can often be more easily integrated into "intensification" than traditional SWM options. The integration of LID into road reconstruction, intensification, or community reconstruction represents one of the best possibilities for reducing nutrient and sediment outputs from existing urban areas.

Examples were presented to the Task Group from throughout the province where LIDs have been used to mitigate flooding and drainage problems, where downstream sewer connections lacked capacity, or where fragile ecosystems could be impacted by traditional SWM.

- Sustainable Neighbourhood Retrofit Action Program (SNAP) used by the Upper Thames River Conservation Authority in the City of London (e.g. Glen Cairn community). This program works with the community to retrofit and install new LID features in local neighbourhoods to improve downstream water quality.
- Elm Drive, City of Mississauga. Road right-of-way retrofit includes permeable parking laybys and sidewalks, a series of rain gardens (on school property).
- Central Parkway, City of Mississauga. Incorporation of LID into a major road reconstruction using the centre median for collection and infiltration of runoff. This area feeds into a sensitive redside dace stream (a species at risk).

LID Opportunities in Burlington

It is interesting to note that within Aldershot in Burlington that historical development incorporated a road and swale design to convey runoff through these vegetated ditches. This combined with the fact the entire area is the sand and gravel bottom of Glacial Lake Iroquois has resulted in a perfect setting to advance LID techniques. In fact, the City has taken advantage of LID techniques wherever possible in

Aldershot during road reconstruction, sewer construction, and servicing infill development. These techniques were for the most part chosen because they were the least disruptive to the community and cost effective, but they also contribute towards achieving a hydrologic balance that delays the runoff peak, removal of suspended solids, and mitigation of thermal impacts of runoff from hard surfaces. Road and swale designs should be continued as they represent one of the best opportunities to reduce TP and sediment discharged from the area to the Harbour.

It is important to note that while LID opportunities may be easiest to recognize in sandy soils associated with glacial Lake Iroquois, techniques developed in other jurisdictions across North America allow infiltration into tighter clay soils.

Stream Monitoring Programs

Conservation Halton has an existing Long Term Environmental Monitoring Program within the Grindstone Creek, North Shore, and Indian Creek watersheds. The Royal Botanical Gardens has a long established program of monitoring in the Grindstone Creek Marshes, which as nursery habitat for fish species, are sensitive to inputs from the watershed. All of this information will help provide information on how the environment is responding to this evolution in stormwater management.

Annotated Bibliography of Key Reports

The Task Group reviewed the state of watershed and subwatershed plans, guidance manuals, and studies using an annotated bibliography (Appendix 6). These watershed plans are key to the current and future practice of SWM as they set the approach, criteria and identify particular issues that need to be met for particular watersheds. The intent of the annotated bibliography was for it to become an ongoing working document that staff from the Conservation Authorities and City of Burlington can refer to and update in the future.

C. Maintenance and Opportunities to Improve the Existing Stormwater System

Summary of Highlighted Recommendations

- *Update inventories of stormwater management infrastructure, oil and grit separators, catchbasins, erosion sites*
- *Expand inspection procedures for stormwater management facilities*
- *Increase maintenance frequency*

Any improvements gained in the evolution of stormwater management to low impact development can only be realized in the long term with proper maintenance and opportunities to improve existing stormwater infrastructure.

Current Maintenance Overview

City of Burlington follows a conventional stormwater management approach. The runoff generated within the urban area is captured by catch basins and directed into a vast storm sewer network. In order to reduce impairment of the streams and the receiving water bodies, the majority of the City's storm sewers are routed through several stormwater management detention facilities located across the City. The runoff is retained within the stormwater facilities for an appropriate duration to attenuate flows and to remove as much nutrient-laden sediments as possible. Once the desired quantity and quality targets are achieved, stormwater is discharged back to a receiving watercourse.

For effective and continued functionality it is imperative that all stormwater related infrastructure and features be regularly maintained and cleaned. At the City of Burlington this maintenance task is collaboratively performed by the City's Roads and Parks Maintenance (RPM) Department and the Capital Works Department. The following sections are a brief description of the City's established maintenance practices.

Catchbasins

The City of Burlington has a total of 16,964 catch basins, 1248 of which are located within the Aldershot area. The catch basins are an important component of the stormwater infrastructure which capture urban runoff and partially provide cleaning by allowing settlement of solids within the sump. Over time, the sump collects dirt, grit and floating debris, which needs to be cleaned. The City of Burlington follows a four year cleaning cycle. Thus, each catch basin within the City undergoes cleaning once in four years. Increasing the frequency of maintenance and employing catch basin technologies could improve their efficiency.

Oil & Grit Separators

The City of Burlington's Roads and Parks Maintenance (RPM) department is responsible for the maintenance and inspection of the city owned oil and grit separators (OGS). These are inspected regularly and are cleaned as per the vendor recommendation or more frequently if needed. The actual cleaning operation is contracted to a company specializing in the OGS cleaning services.

Stormwater Management Facilities

The stormwater management facilities (SWMF) accumulate sediment over time which needs to be periodically removed in order to maintain the effectiveness of the treatment process and for continued environmental protection. In addition to consideration for the natural environment, the SWMF owners/operators are also legally bound to maintain the functionality of the facilities in compliance with the "Certificate of Approval" issued by the Ministry of Environment and Climate Change (MOECC) under Section 53 of the Ontario Water Resources Act. Two standard construction conditions included in the "Certificate of Approval" are:

1. "The owner must ensure that sediment is removed from the stormwater management works at such a frequency as to prevent the excessive buildup and potential overflow into the receiving watercourse."

2. "Regular removal of sediment from the approved stormwater management works is required to mitigate the impacts of sediment on the downstream receiving watercourse. It is also required to ensure that adequate storage is maintained in the stormwater management facilities at all times as required by the design."

The City of Burlington has a total of 35 stormwater management facilities. Twenty-seven (27) of these are owned and operated by the City. The rest are either currently under construction or in private ownership. Most of these ponds are designed to provide enhanced-level quality treatment (80% Total Suspended Solids (TSS) removal). The servicing life of a SWMF is determined at the design stage by estimating the number of years it will take for the pond forebay to get half-filled with sediment or the number of years it will take for the quality treatment capability of the pond to be reduced by 5%. Upon reaching the end of the servicing cycle and prior to the dredging operation, the ponds are surveyed for accumulation of sediment. On average, the City completes dredging operation of at least one pond every year. The pond dredgeate is tested for presence of contaminated material prior to disposal. No contamination has ever been encountered in any of the sediment samples obtained from the City-owned ponds. Six SWMF outlet to Hamilton Harbour. The cleaning operation of one of those ponds was completed in 2015.

Stormwater Sewer Outlets

There are a total of 19 direct outlets into Hamilton Harbor from the Aldershot area of Burlington and an additional 40 indirect outlets. The indirect outlets collect stormwater from local drainage systems and discharge into a channel that ultimately outlets into the Harbour. Depending on the size of the catchment area feeding the storm sewer systems and the type of the surface over which the runoff was generated, there may be opportunities to undertake measures to remove contaminants by installing quality control devices at the outlets.

Within the west end of the City (the Aldershot area), which drains directly into Hamilton Harbour and which has sandy soils, large areas are serviced by a network of roadside ditches. As bioretention features, these vegetated roadside ditches provide partial water quality treatment and significantly

promote infiltration. As and when required, these conveyance features are cleaned to maintain their functionality.

To achieve the objectives of the Hamilton Harbour Remedial Action Plan, cleaning of the stormwater management facilities across the City jurisdiction in general and within the Harbour catchment in particular, should continue to be performed in adherence to the regular cleaning cycles and in conformance with the facility maintenance manuals. The catchbasins should be regularly cleaned and a monitoring program devised to inspect and undertake cleaning more frequently if required. As a best management practice, treatment train approach to clean stormwater runoff is strongly recommended. Stormwater infrastructure features such as vegetated swales, bottomless catchbasins and perforated pipes should be integrated into the network for quality enhancement of urban runoff. The large tracts of lands composed of sandy soils draining into Hamilton Harbour are a valuable resource that can be utilized to implement infiltration features and practices in an effort to meet Harbour remediation targets and objectives.

Watercourses

The City of Burlington has ten major watersheds. Figure 5 shows all of the City's watercourses. The watercourses that drain into Hamilton Harbour included: the Aldershot area, which includes three major Creeks (Grindstone, Falcon and Indian Creeks) and several small channels including West Aldershot Creek, LaSalle Creek, Glenwood Creek, Forest Glen Creek Teal Creek, Edgewater Creek and Stillwater Creeks; in addition, the Hager-Rambo diversion has a confluence with the Indian Creek before it is discharged into Hamilton Harbour. The City regularly inspects the creek systems and maintenance is undertaken collaboratively by the City's Capital Works and the RPM departments. The City also carries out a Creek Assessment study to identify any areas of concern. The erosion sites within the creek systems are identified and prioritized for erosion control works. The latest Creek Assessment Study has been recently undertaken and is currently in the draft report stage.

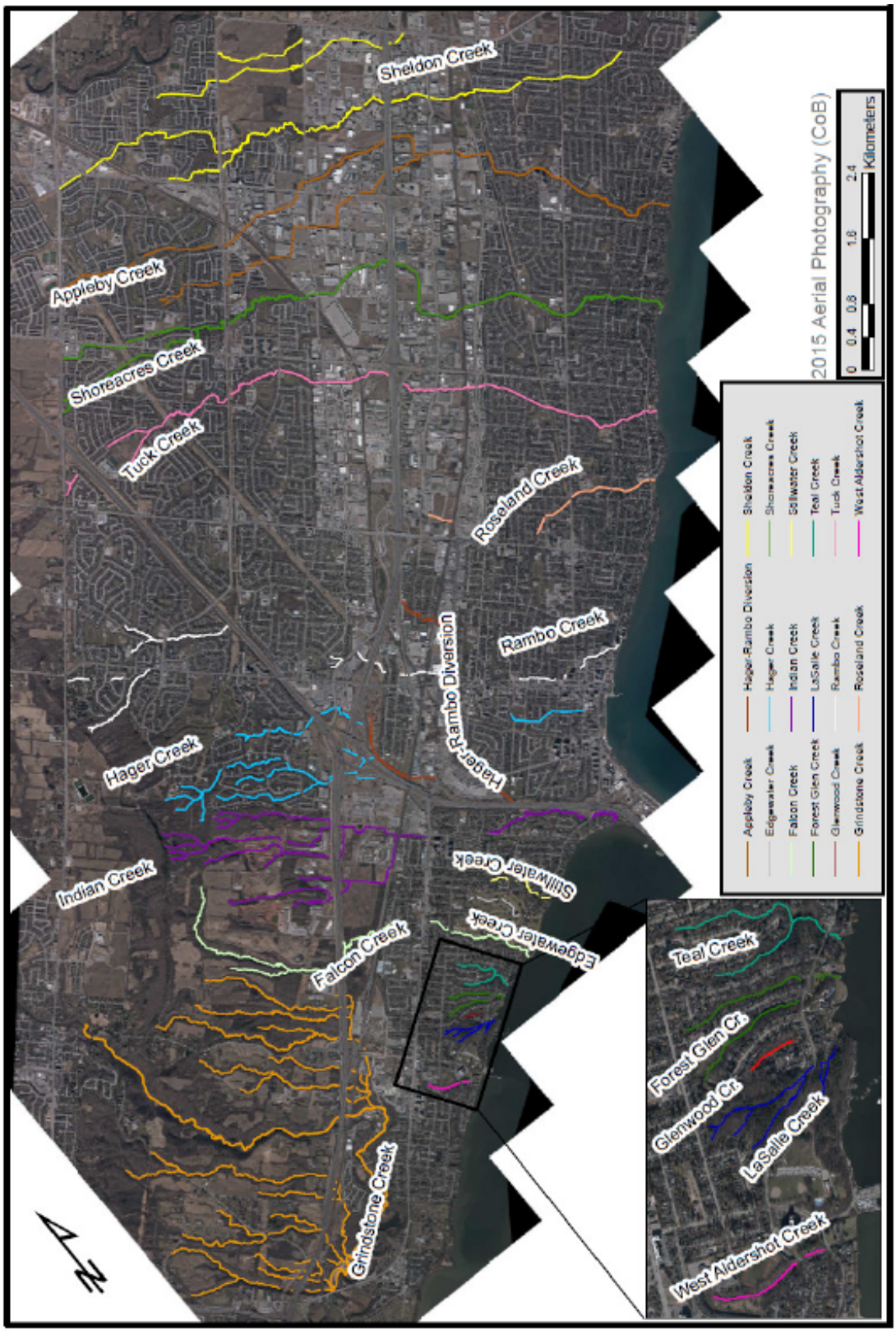


Figure 5: Shaded areas indicate watercourses draining to Hamilton Harbour. Source: City of Burlington

Opportunities to Improve Existing Infrastructure

As most of Burlington's urban area within the Hamilton Harbour watershed is developed, the application of LID techniques is recognized as an opportunity to assist in reducing existing storm sewer capacity issues and local flooding. The integration of LID into intensification or road or community reconstruction represents one of the best possibilities for reducing nutrient and sediment outputs from existing urban areas.

To provide better utilization of the infiltration capacity of the sandy soils within Aldershot, and where feasible, the preference for bottomless catch basins fitted with perforated pipes over conventional catch basins is already a standard City practice. The best examples of these are the King Road catch basins that function independently and are placed on top of infiltration mediums. Similarly, the design for Townsend Avenue, which is due for reconstruction in 2017, includes several roadside catch basins that are equipped with infiltration medium(s) and perforated pipes.

In order for successful incorporation of LID, targeted training and education is required of staff involved in all stages of development such as: municipal engineers, planners, building department staff and maintenance operations staff (Parks and Recreation, Roads and Parks Maintenance).

Stormwater Ponds Example

A 2011 Lake Simcoe Region Conservation Authority investigation into stormwater pond maintenance and anoxic conditions found over 50% of individual ponds were no longer performing as designed and that over 10% were at the lowest level of efficiency. They also discovered that over 40% of all ponds showed daytime hypoxic or anoxic conditions which was turning the pond into a nutrient source instead of a nutrient sink. It is still not known how much effect nutrient releases are having on receiving waters during low oxygen conditions. A number of implementable maintenance and anoxia recommendations were made in this report and are likely transferable to the City of Burlington situation (i.e. requiring as-built drawings accompany ponds upon assumption, enhanced street cleaning, monitoring for low oxygen conditions, etc.).

Recommendations for Maintenance and Opportunities to Improve the Existing Stormwater System

REPORTS & MANUALS

C1) It is recommended that the Province of Ontario include guidance regarding the frequency of quantity and/or quality monitoring of stormwater management infrastructure.

PROGRAMS

C2) It is recommended that the City of Burlington inventory the area to confirm and update location and ownership of all stormwater management infrastructure and OGS on municipal and where possible private lands.

C3) It is recommended that the City of Burlington, in collaboration with Conservation Halton, develop a monitoring program to examine the functioning of stormwater management facilities to determine if they are addressing water quality requirements, functioning as designed, and if their performance can be optimized.

C4) It is recommended that the City of Burlington, within the Hamilton Harbour watershed, explore increasing frequency of maintenance to improve the efficiency of their catch basin cleaning program and explore addition of catch basin technologies to optimize performance.

C5) It is recommended that the City of Burlington and Conservation Halton continue to update and maintain an inventory of erosion sites within the City and CA owned creek blocks and prioritize appropriate remedial actions.

D. Evolution of Stormwater Infrastructure Funding

Summary of Highlighted Recommendations

- *City of Burlington create a stable and equitable financial model for stormwater*
- *Province of Ontario provide guidance and direction for a full cost stormwater program*

The evolution of stormwater management is not limited to the technologies and techniques used. Municipalities across Ontario are adopting new financial models that allow stormwater infrastructure to be separately and predictably funded. This is consistent with the Province of Ontario's goal in the Water Opportunities Act (2010) to enact a full cost stormwater program.

It is understood that implementing a user fee represents additional costs to residents and businesses within the community; however, this issue also presents an opportunity to address stormwater costs.

Current Resource Situation and Challenges

Burlington's management of stormwater is funded through property taxes and development charges. This applies equally to all residential, multi-residential, institutional, commercial and industrial customers despite that this is disproportionate to the load that each property type (within and across types) contributes to the public waste/stormwater system.

Alternative Resourcing in Ontario

Municipalities in Ontario that wish to make the change to an equitable rate structure for stormwater now have the benefit of the experience of other municipalities who have been leaders in this area – Kitchener, Waterloo, Mississauga, London, Aurora, St. Thomas, Richmond Hill, and Markham. Lessons learned can be gathered to help determine which structure will suit the needs of the City of Burlington and its residents and business owners.

A more transparent and fair alternative is to fund the cost of managing stormwater through charges proportionate to the volume of stormwater generated by each property. User fees are typically utilized to finance services that provide a direct benefit to the user and allow consumers to pay for a service in accordance with the benefit that they receive (compared to taxes which do not necessarily hold a direct relationship to the benefits of the goods or services received). A dedicated, sustainable funding mechanism for stormwater management would address both the City of Burlington's fairness and equity objective as well as the financial sustainability objective.

A stormwater rate structure to provide dedicated funding for stormwater management in Burlington would provide a fairer and more transparent method of charging for stormwater management and would create a financial incentive for property owners to increase pervious surfaces on their properties. For example, Kitchener and Waterloo offer a reduction in stormwater fees for both residential and non-residential properties utilizing stormwater LIDs where up to 45% is available for both land uses.

Residential credits are given based solely on stormwater volume reductions, while the non-residential credits are broken down by category.

A user pay approach would stabilize revenues and ensure sustainability for the municipal stormwater infrastructure, and operations and maintenance requirements.

Considerations

Implementing an equitable rate structure in the City of Burlington could also assist in addressing:

- issues surrounding an aging infrastructure system (maintenance, replacement, emergencies) leading to an increase in flooding claims from intense, localized storms occurring more frequently with climate change;
- without funding other recommendations will not have the resources to be implemented; and
- sustained improvements to Hamilton Harbour from the significant investment by the Region of Halton into the Skyway Wastewater Treatment Plant tertiary upgrades will not be fully realized unless watershed inputs are also addressed.

The main goal of this report is to reduce phosphorus and sediment inputs to Hamilton Harbour. A well maintained, upgraded, and sustainable stormwater infrastructure system resulting from stable funding will be key to achieving this goal while at the same time reducing flooding impacts within the City of Burlington.

Recommendations for Evolution of Stormwater Infrastructure Funding

D1) It is recommended that the Province of Ontario provide guidance and direction for new financial models that allow stormwater infrastructure to be separately and predictably funded.

D2) It is recommended that the City of Burlington examine a municipal financial model for stormwater management based on an equitable rate structure for a stable funding source.

E. Evolution of Stormwater Management on Private Properties

Summary of Highlighted Recommendations

- *Implement measures to ensure maintenance on private oil and grit separators and stormwater management facilities*
- *Include limits for nutrients in storm sewers through Sewer Use Bylaw*
- *Programs for neighbourhood based stormwater stewardship, including recognition, outreach and education*

As stormwater management continues to evolve, the use of low impact development (LID) methods and techniques on privately owned lands becomes essential. It is recognized that a substantial portion of nutrient and sediment laden stormwater runoff discharging into Hamilton Harbour originates from private lands. Although individual impacts may be minor, the cumulative impact of multiple actions could be significant. A critical mass of property owners will be needed in order to reduce the quantity and improve the quality of stormwater runoff discharging through the various watersheds into Cootes Paradise Marsh and Hamilton Harbour.

The category of private lands spans many land uses: residential, commercial, industrial, and institutional. Runoff quality and quantity varies greatly amongst and within each land use. Factors which include but are not limited to: lot size, type and amount of impervious surface cover (roads, roofs, driveways, and parking lots), slope / terrain, adjacent land uses, quality and amount of green space all contribute to each sites unique contribution to the larger stormwater management system. This is a complex situation and Ontario municipalities are presently struggling with various approaches to improve runoff conditions from private lands. Policies and programs must be developed or enhanced to educate private property owners about the impact of hardened urban surfaces on the health of Hamilton Harbour with the goal of incentivizing them to take action.

In Burlington, programs to educate and encourage private property owners to adopt LID best practices for stormwater management have already been initiated. The City of Burlington has the benefit of learning from these and a variety of additional programs offered by municipalities across and beyond Ontario. A multi-dimensional and comprehensive approach to urban stormwater management will be required to realize positive changes within privately owned lands.

<u>Community Outreach and Education</u>

The goal of outreach and education is to increase public appreciation of the limitations in the funding and operations of traditional existing stormwater infrastructure, increase the collective need for changes in how we deal with stormwater, and increase public understanding of the benefits of LID installation on private property. These measures will all be necessary to motivate property owners to partner in achieving water quality improvement goals. An informed and motivated community is more likely to undertake LID projects.

Non-profit and government organizations including Conservation Halton, the Bay Area Restoration Council, Green Venture, and Burlington Green already provide public education and support on various aspects of water conservation, installation and maintenance of low impact development (LIDs), climate change links to stormwater management and erosion control, and the reduction of contaminants into water. There are a limited number of education and outreach activities occurring in Burlington that promote the importance of reducing phosphorus and sediment or promote the opportunity to implement LID techniques on private property.

- Halton Region does some education and outreach around the value of having a rain barrel to collect water from your eaves troughs and subsidize the cost for residents to purchase rain barrels.
- Green Venture has recently expanded into Burlington and offers the RAIN program educating residents about the effects of stormwater runoff and ultimately tries to motivate behavioural change amongst private homeowners.
- The Bay Area Restoration Council (BARC) produces report cards that evaluate progress of the Remedial Action Plan and conducts other evaluative techniques and informative forums to increase public understanding.
- BARC provides information about Rain Gardens on their website and has implemented a demonstration rain garden at Princess Point in partnership with the Royal Botanical Gardens to raise awareness of their aesthetic value and functionality.
- Green Venture and BARC have begun a three-year collaboration to install LIDs with institutional partners and provide complementary educational programming and volunteer management. In conjunction with Conservation Halton, they are currently working to develop a high profile LID demonstration project at a private school in the City of Burlington. This project will provide a good example for private homeowners on what measures they could take on their own properties
- Conservation Halton delivers homeowner workshops educating the public about stormwater, watersheds, native gardening as well as LID techniques and how you can go about implementing them. During this workshop, participants are given a Greening Your Grounds workbook and instructed on how they can use this tool to plan their own LIDs. Participants of the workshop receive a free rain barrel as well as free native plants.
- Conservation Halton also provides private landowner consultations where a technician visits a private property with the landowner to make recommendations on techniques that could be applied. With the proper resources, this program could be expanded to include assistance for urban homeowners.
- There are several physical and digital education and outreach tactics (websites, interactive online tools) that can be applied to achieve community education and engagement.

Based on the recommendation of implementing a stormwater rate structure, there will need to be specific outreach and education completed to make the general public aware of the concept and understand why there is a need to move to such a system. Based on the recommendation of

implementing an incentives program for encouraging stormwater, there will need to be specific outreach and education completed to make the general public aware of the opportunity to have projects subsidized.

Financial Incentives

In Burlington, there is currently limited financial incentive for the small "single" users to explore and implement LIDs as a means to manage their storm water. The sole financial incentive program available is the Rain Barrel sales led by Halton Region which offers discounted rain barrels to Halton Region residents at a pick-up event. This program is meant to encourage property owners to disconnect their downspouts from the sewer system, but there is very little education provided on the benefits nor the proper use and maintenance of rain barrels.

Grants

Conservation Halton has a private landowner stewardship granting program from which a program to encourage LID installation could be created. Developing the terms of reference for an LID grant program, including amounts, costing and eligibility, could be undertaken and worked into a program proposal. Funding to support such a program would need to be secured from the upper and/or lower tier municipality (Halton Region and the City of Burlington).

Other municipalities and conservation authorities (CA) have partnered to develop LID grant programs delivered through the CA landowner assistance programs. For example, Lake Simcoe Region Conservation Authority offers funding for homeowners who would like to install a rain garden. The Landowner Environmental Assistance Program (LEAP) will fund up to 60% of the project cost to a maximum grant of $5,000.

Rebates

As outlined in the previous section on the evolution of stormwater infrastructure resources, one way to encourage private landowner buy-in to incorporating LID techniques on their own property is to offer a rebate on their stormwater user rate. This sort of incentive has been shown to be popular in the Cities of Kitchener and Waterloo, but was not used by the City of Mississauga due to perceived low uptake and high implementation costs.

Social Incentives and Recognition

Social incentives are intended to recognize citizen investment in LIDs and commitment to playing an active community role in stormwater management and to demonstrate the versatility and effectiveness of LIDs. It will be important for property owners to not only experience financial benefits but social and environmental benefits as well. Incentives can be effective in overcoming barriers to LID implementation such as tradition, lack of understanding and conflicting social values or preferences. These additional benefits can take the form of public recognition (awards, recognition programs, yard signs, etc.), advancing/sharing of knowledge, and physical improvements in the health of Hamilton Harbour.

Property owners using LID landscaping techniques and practices to reduce the quantity and improve the quality of stormwater leaving their properties may qualify if the measures used should operate to slow, store and/or infiltrate stormwater during wet weather and/or snow melt events.

Existing awards such as the Watershed Stewardship Award acknowledges landowners who are managing their land in a way that protects or enhances the health of their watershed. A similar award which focuses on stormwater management could be created to highlight property owners who are taking proactive steps to manage their stormwater in a way that produced ecological benefits to a specific area. Award winners can help to become ambassadors in their neighbourhood to expand the reach of educational programming.

Maintenance of Stormwater Management Infrastructure on Private Lands

At the present time a disconnect appears to exist between implementing and sustaining treatment train and SWM facilities on private properties. Various planning approvals such as subdivision and site plan controls allow the municipality, through MOECC environmental compliance approval (ECA, formerly certificates of approval), the ability to require SWM infrastructure to be constructed at the time of development. What is less clear is how these same mechanisms ensure the infrastructure operating on private lands is maintained and in fact remains in place over a long period of time.

There are approximately 300 water quality control devices within the City of Burlington. The installation of an Oil and Grit Separator (OGS) is mandatory for any sizeable redevelopment or any infill development application. Once installed, the City requires a certification letter from the Consulting Engineer to confirm that all storm water quality devices, manholes and catch basins have been inspected and cleaned as required, including confirmation of acceptable Mandrel testing and video inspection. The Owner is required to submit proof that they have entered into a maintenance agreement for the oil grit separator and provide a letter that they will provide the City a copy of all future maintenance records.

Additional Pathways for Nutrients from Private Lands

The Task Group discussed some additional pathways for nutrients to enter water from private lands including: cross connections, sewer use bylaws, individual actions (car washing, pet feces, etc), and lawn fertilizer.

Cross Connections

While the Region of Halton is also concerned about cross connections which connect stormwater to sanitary sewers, for example weeper drains around a basement, the Task Group focused only on sanitary sewage cross connected to storm sewers and eventually finding its way untreated into Hamilton Harbour.

The Region of Halton which is responsible for sanitary sewers reported that it is not aware of any historical or ongoing problems with cross connections in Burlington. While no formal study of E. coli at sewer outfalls has been carried out it was the consensus of the Task Group that a problem with cross

connection of sanitary sewers does not represent a significant source of TP or E. coli to Hamilton Harbour from urban Burlington.

Sewer Use Bylaw

The Task Group also noted that Burlington's sewer use bylaw does not contain a limit for total suspended solids (TSS) or total phosphorus (TP). This however is consistent with the provincial model sewer use bylaw and CCME (Canadian Council of Ministers of the Environment). Toronto's 2016 bylaw is looked to as a best practice with storm sewer discharge limits of 0.4 mg/L TP and 15 mg/L TSS (City of Toronto, 2016). The Task Group did discuss that a storm sewer limit would be difficult to enforce as it is not monitored except in a complaint based situation.

Individual actions (car washing, pet feces, lawn fertilizer, etc.)

Individual residents are also contributors to nutrients in the watershed. Residential inputs into the stormwater system such as detergents from washing cars in driveways, chemicals such as fertilizers or road salts in storm drains, or pet feces around stormwater systems are contributors to nutrients in the watershed. For example, bags of pet feces have been discarded near stormwater outlets and creeks. Programs like Trout Unlimited's Yellow Fish Road program have helped to educate residents about their impacts on places like Hamilton Harbour.

It was noted that most lawn fertilizer now contains no or little phosphorus in its formulation. This likely has to do with the rising price of phosphorus as a commodity and the realization that most lawns don't really benefit from the excessive phosphorus in past formulations. As a diminishing source of phosphorus it likely represents an unexpected reduction in TP in urban runoff.

Recommendations for Evolution of Stormwater Management on Private Properties

REPORTS & MANUALS

E1) It is recommended that the City of Burlington investigate and explore measures to ensure maintenance is carried out by private industrial, commercial, and institutional landowners to ensure the efficiency of all private stormwater management facilities and private OGS systems are maintained.

E2) It is recommended that the Province of Ontario provide updated guidance for storm sewers and include requirements related to nutrients for incorporation into municipal sewer use bylaws.

E3) It is recommended that the City of Burlington review their Sewer Use Bylaw regarding including a limit for total phosphorus and total suspended sediment discharged into storm sewers.

PROGRAMS

E4) It is recommended that the City of Burlington, the Region of Halton, Conservation Halton, and local community groups provide and/or expand programs for social incentives to recognize community participation in sustainable stormwater management and the adoption of LIDs (e.g. awards, recognition programs).

E5) It is recommended that the numerous existing outreach and education programs being delivered currently by Conservation Halton, the City of Burlington, the Region of Halton, and local non-profit agencies be enhanced and ensure that collaboration in these initiatives occurs.

E6) It is recommended that the City of Burlington, the Region of Halton, and Conservation Halton investigate the opportunity to develop an incentive program to encourage the use of LIDs on private lands.

TRAINING & EDUCATION

E7) It is recommended that local government and community groups in the Hamilton Harbour Watershed collaborate on stormwater stewardship outreach and education initiatives to maximize effectiveness of messaging to urban residents to promote acceptance and implementation at the lot level to address urban stormwater runoff.

Appendix 1: Terms of Reference for Task Group *(dated November 5, 2014)*

TERMS OF REFERENCE AND TASK GROUPS

Watershed Nutrient & Sediment Management Advisory Group (WNSMAG)

It is recognized that reductions in nutrients (principally phosphorus) and sediment concentrations and loads during runoff events from urban and rural watersheds are required to meet Hamilton Harbour Remedial Action Plan (HHRAP) environmental conditions to delist the Harbour as an Area of Concern.

Reporting to the Bay Area Implementation Team (BAIT) the WNSMAG will be developed from the attached list of agencies and groups.

WNSMAG will meet two to three times per year to share information and educate its members, analyze existing conditions and prepare recommendations for actions.

WNSMAG will be composed of senior staff who will direct various task groups to address:

- sedimentation from active construction sites
- urban watersheds and
- rural watersheds

Staff will be assigned to the task groups by the senior staff participants of WNSMAG.

In carrying out their work the groups will recognize the implications of climate change and coordinate, whenever possible, actions to reduce flooding with those actions reducing phosphorus and sediments.

All group members should work in an environment of mutual respect, mutual dependence and adaptive management. Their work should be action-oriented resulting in both short-term and long-term action plans.

Task groups may be established as per the wishes of the WNSMAG as set out below. This includes the option of establishing task groups based on municipal jurisdictions, e.g. an Urban Runoff Task Group for Hamilton and an Urban Task Group for Burlington, etc.

A. Sediment Control on Active Construction Sites Task Group

- audit and better define the existing erosion and sediment control practice utilized in Burlington and Hamilton for public and private sector projects
- develop methods to measure sediment coming from construction sites – need to measure to manage approach
- implement a priority project of ongoing inspection, reporting and enforcement of erosion and sediment control for development sites for the Cootes Paradise watershed

B. Urban Runoff Task Group for Nutrient and Sediment Management

Share information and develop a common understanding of our current knowledge with respect to:

- existing nutrient (phosphorus) and sediment concentrations occurring during runoff events;
- nutrient and sediment targets required to restore Hamilton Harbour and its coastal wetlands;
- existing best management practices in Hamilton Harbour's urban watersheds used to reduce nutrient and sediment discharges;
- potential additional pathways for nutrients to find their way to sewers and watercourses; and
- existing maintenance activities and their effectiveness for reducing nutrients and sediment from the urban storm-water management (SWM) system.

Analyse the Situation to Determine:

- how new practices in SWM and low impact development (LID) may be applied to reduce nutrient and sediment discharges for new development;
- where opportunities may exist to retrofit the SWM system to reduce nutrients and sediment for existing development ;
- where reductions can occur for private properties (homes, commercial, institutional and industries).

Prepare Recommendations for:

- existing maintenance activities to reduce nutrients and sediment from the urban SWM system;
- new development practices in SWM and LID to reduce nutrient and sediment discharges;
- existing development to retrofit the SWM system to reduce nutrients and sediment discharges;
- private properties (homes, commercial, institutional and industries) on how reductions may be implemented effectively and/or enforced.

C. Rural Runoff Task Group for Nutrient and Sediment Management

Share information and develop a common understanding of our current knowledge with respect to:

- existing nutrient and sediment concentrations occurring during runoff events;
- nutrient and sediment targets required to restore Hamilton Harbour and its coastal wetlands;
- existing maintenance activities and their effectiveness for reducing nutrients and sediment from rural roads;
- existing rural land uses and their potential to discharge nutrients and sediments.

Analyse the Situation to Determine:

- where reductions in nutrients and sediment may occur for the rural roads system;
- where reductions in nutrients and sediment may occur for agricultural/rural lands.

Prepare Recommendations for:

- reducing nutrients and sediments from the rural roads system;
- reducing nutrients and sediment from agricultural/rural lands.

Appendix 2: Task Group Participating Membership *(as of Aug 2016)*

Bay Area Restoration Council	Chris McLaughlin
City of Burlington	Umar Malik
Conservation Halton (CH)	Amy Mayes Kent Rundle
Environment and Climate Change Canada	Rimi Kalinauskas
Hamilton Harbour Remedial Action Plan	John Hall *[Chair]* Kristin O'Connor
Ontario Ministry of the Environment and Climate Change	Cheriene Vieira
Region of Halton	Bob Zawislak
Royal Botanical Gardens	Jennifer Bowman

Other key participants over the length of the Task Group included: Diana Friesen (CH)

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E. Evolution of Stormwater Management on Private Properties

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Appendix 4: Acronyms

BAIT	Bay Area Implementation Team
BARC	Bay Area Restoration Council
CA	conservation authority
CCME	Canadian Council of Ministers of the Environment
CSO	combined sewer overflow
CVC	Credit Valley Conservation Authority
ECA	Environmental Compliance Approval
HH	Hamilton Harbour
HHRAP	Hamilton Harbour Remedial Action Plan
LEAP	Landowner Environmental Assistance Program
LID	low impact development
LSRCA	Lake Simcoe Region Conservation Authority
MOECC	Ontario Ministry of Environment and Climate Change
OGS	oil and grit separator
RBG	Royal Botanical Gardens
RPM	Roads and Parks Maintenance
SNAP	Sustainable Neighbourhood Action Program
SWM	stormwater management
SWMF	stormwater management facility
TP	total phosphorus
TRCA	Toronto and Region Conservation Authority
TSS	total suspended solids
UTRCA	Upper Thames River Conservation Authority
WNSMAG	Watershed Nutrient & Sediment Management Advisory Group
WWTP	wastewater treatment plant