

# Georgina Comprehensive Stormwater Management Master Plan



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## List of Acronyms and Abbreviations

ANSI	Area of Natural and Scientific Interest
BMPs	Best Management Practices
CAD	Canadian dollars
CoA	Certificate of Approval
CSWM-MP	Comprehensive Stormwater Management Master Plan
CA	Conservation Authority
CCM	Conveyance Control Measures
CSP	Corrugated Steel Pipe
CVC	Credit Valley Conservation
m <sup>3</sup>	cubic meter
m <sup>3</sup> /ha	cubic metre per hectare
m <sup>3</sup> /s	cubic metre per second
m <sup>3</sup> /yr	cubic metre per year
\$	Dollar
\$/m	Dollars per metre
\$/m <sup>2</sup>	Dollars per square metre
DFO	Fisheries and Oceans Canada
ELC	Ecological Land Classifications
EA	Environmental Assessment
EC	Environment Canada
ECA	Environmental Compliance Approval
EOP	End-Of-Pipe
EPA	Environmental Protection Agency (Unites States)
ESR	Environmental Study Report
ET	Evapotranspiration
E.coli	Escherichia coli
EMC	Event Mean Concentration
GI	Green Infrastructure
GPS	Global Positioning System
ha	hectare
IPZ	Intake Protection Zones
IDF	Intensity-Duration-Frequency
kg	kilograms
kg/m <sup>3</sup>	kilograms per cubic metre
kg/ha	kilograms per hectare
kg/ha/yr	kilograms per hectare per year

kg/km	kilograms per kilometre
kg/km/yr	kilograms per kilometre per year
kg/yr	kilograms per year
LSEMS	Lake Simcoe Environmental Management Strategy
LSPP	Lake Simcoe Protection Plan
LSRCA	Lake Simcoe Region Conservation Authority
LEAP	Landowners Environmental Assistance Program
LOS	Level of Service
LID	Low Impact Development
m	metre
mg/L	milligrams per liter
mm	millimetres
mm/yr	millimetres per year
MMAH	Ministry of Municipal Affairs
MEA	Municipal Engineers Association
MMOP	Municipal Management/Operational Practices
MNRF	Ministry of Natural Resources and Forestry
MOE	Ministry of the Environment (1972 to 1993, 2003 to 2015)
MOECC	Ministry of the Environment and Climate Change (2014 to now)
MOEE	Ministry of the Environment and Energy (1993 to 1997, 2002 to 2003)
NHF	Natural Heritage Features
NDA	New Development Areas
NPS	Non-Point Source
NVCA	Nottawasaga Valley Conservation Authority
n/a	Not Applicable
OP	Official Plan
OPA	Official Plan Area
OGS	Oil and Grit Separator
O&M	Operation and Maintenance
%	percentage
PPM	Pollution Prevention Measures
PPS	Provincial Policy Statement
PSW	Provincially Significant Wetlands
Ptool	Lake Simcoe Phosphorus Loading Development Tool
PWQMN	Provincial Water Quality Monitoring Network
PWQO	Provincial Water Quality Objectives
RBC	Royal Bank of Canada

RSW	Regionally Significant Wetlands
ROW	Right-Of-Way
SPA	Secondary Plan Area
SCM	Source Control Measures
SMP	Salt Management Plan
m <sup>2</sup>	square meters
SWM	Stormwater Management
SWMP	Stormwater Management Practices
SWMPDM	Stormwater Management Planning and Design Manual
STEP	Sustainable Technologies Evaluation Program
SWS	Subwatershed Study
SS	Suspended Solids
t/yr	tonnes per year
TD	Toronto Dominion (Bank)
TP	Total Phosphorus
TRCA	Toronto and Region Conservation Authority
TSS	Total Suspended Solids
WHPA	Wellhead Protection Area
WSC	Water Survey of Canada
yr	year
YPDT-CAMC	York, Peel, Durham, Toronto and The Conservation Authorities Moraine Coalition

# 1. Introduction

The Town of Georgina (the Town) is located at the mouth of six (6) Lake Simcoe subwatersheds. According to the Town's Official Plan (OP) (2010 consolidation), the Town will experience a great deal of growth in the next twenty (20) years, as growth forecasts have been allocated to all municipalities in the Regional Municipality of York (York Region), with the Town forecast to grow from its current estimated population of 43,517 (Statistic Canada, 2011); reaching a population of 66,800 people by the year 2021 (Town of Georgina, 2010).

Resulting from the policies of the Lake Simcoe Protection Plan ("LSPP" - effective June 2, 2009 through the provisions of the *Lake Simcoe Protection Act, 2008*, S.O. 2008, c. 23, as amended), Policy 4.5 of the LSPP states that:

*"within 5 years of the date the Plan comes into effect, municipalities, in collaboration with the LSRCA will prepare and implement comprehensive stormwater management master plans for each settlement area in the Lake Simcoe Watershed"*

The Town is generally located at the mouth of six (6) Lake Simcoe subwatersheds. Numerous human activities and disturbances propagate throughout the system on the way to Lake Simcoe, hence it is critical to address relevant issues that include:

1. Projected Growth and Urban Development Pressure; Secondary Plan Areas (SPAs) and redevelopment areas would increase flooding and erosion risk, decrease groundwater recharge, and cause loss of terrestrial and aquatic habitat;
2. Point and Non-Point Source (NPS) Pollution; pollution including Total Phosphorus (TP) emerges from different land uses including agricultural/rural and urban areas. The control of water quality issues is very limited. See **Table 1.1**; and
3. Policy-Stormwater Management Coordination; while a big body of policy framework exists, the Town needs policy direction as to what is relevant and implementable within any recommended stormwater management (SWM) approach.

**Table 1.1: Communities in the Town of Georgina.**

Communities	Subwatersheds*	Existing Environmental Conditions	Key Issues and Concerns
Keswick	Georgina Creeks (producing 2,110 kg of TP annually), Maskinonge (producing 1,470 kg of TP annually), and East Holland (producing 8,070 kg of TP annually).	Largest urban development within study area.	Escalating growth, higher imperviousness (Schedule F1). Sod farms impact on water quality. Stormwater quality control (27%) according to LSRCA (2007).
Jackson's Point	Georgina Creeks	Lake Simcoe and Waterfront.	Direct water quality and aesthetics issues. Natural heritage protection.

Communities	Subwatersheds*	Existing Environmental Conditions	Key Issues and Concerns
Sutton	Black River (producing 4,820 kg of TP annually) and Georgina Creeks.	Mixed land use. Core area along Black River.	Projected growth with higher imperviousness (Schedule H1). Stormwater quality control (12%).
Pefferlaw	Pefferlaw River (producing 3,440 kg of TP annually).	Rural/Agriculture and Natural. Stable baseflow input and gentle hydrograph.	Projected growth with higher imperviousness (Schedule E1).
Port Bolster	Pefferlaw River (producing 3,440 kg of TP annually).	Rural/Agriculture and Natural. Port Bolster Swamp.	Natural cover including swamp and forest needs to be protected.
Udora	Pefferlaw River (producing 3,440 kg of TP annually).	Rural/Agriculture and Natural. Gentle hydrograph, potential for flashiness.	Sensitive to urban development because of impact from upstream.

\* Annual Loading Values from *Estimation of the Phosphorus Loadings to Lake Simcoe* (LSRCA, 2010b).

## 1.1 Study Objectives

The development of a Comprehensive Stormwater Management Master Plan (CSWM-MP) is an important step to meet the objectives of the LSPP, specifically:

- Reducing loading of phosphorus and other nutrients of concern to Lake Simcoe and its tributaries; and
- Reducing discharge of pollutants to Lake Simcoe and its tributaries.

Therefore, the overarching objective of this study is the development of a CSWM-MP for the Town in accordance with the:

1. LSPP (MOE, 2009);
2. Guidelines for the Development and Implementation of CSWM-MP in the Lake Simcoe Watershed (LSRCA, 2011b);
3. Lake Simcoe Basin Stormwater Management and Retrofit Opportunities (LSRCA, 2007);
4. The Municipal Class Environmental Assessment (Class EA) Master Planning process, as described by the Municipal Engineers Association (2000, as amended 2015); and
5. Keswick Stormwater Management Study (MMM, 2011).

## 1.2 Study Process

The study process will follow the ten (10) steps presented within the LSRCA Guidelines for the Development and Implementation of CSWM-MP in the Lake Simcoe Watershed (April, 2011). Accordingly, the CSWM-MP for the Town shall include, but is not limited to:

- Scoping;
- Determine Study Area;
- Characterization of Study Area;
- Divide the Study Area into Management Units;

- Evaluate Environmental Impact;
- Determine effectiveness of SWM systems;
- Identify and evaluate SWM and Retrofit opportunities;
- Establish Recommended Approach;
- Develop Implementation Plan; and
- Develop Inspection and Maintenance Programs.

The CSWM-MP study is carried out following Approach 1 of the Master Planning process under the Municipal Class EA Process:

- **Phase 1:** Establish the Problem or Opportunity; and
- **Phase 2:** Identify and Assess Alternative Solutions to the Problem, and Select a Preferred Alternative.

### 1.3 The Municipal Class Environmental Assessment Process

The EA Act was legislated by the Province of Ontario in 1980 to ensure that an EA is conducted prior to the onset of development and development related (servicing) projects. Depending on the individual project or Master Plan to be completed, there are different processes that municipalities must follow in order to meet Ontario's EA requirements.

The CSWM-MP study will be prepared following a Master Planning approach under the Municipal Class EA Process. The long range planning approach that is undertaken within the process will enable the Town to identify opportunities and be proactive in addressing issues before they become a problem. It will also allow the Town to implement individual works which, over time, collectively become part of a larger management system.

According to the *Municipal Class EA Document* (MEA, October 2000, amended 2015), Master Plans typically recommend a set of works which are distributed geographically throughout the study area and which are to be implemented over an extended period of time. Master Plans provide the context for the implementation of the specific projects which make up the plan and address, as a minimum, Phases 1 and 2 of the Class EA process (**Figure 1.1**). Notwithstanding that these works may be implemented as separate projects, collectively these works are part of a larger management system. Master Plan studies in essence conclude with a set of preferred alternatives and, therefore, by their nature, Master Plans will limit the scope of alternatives which can be considered at the implementation stage.

Class EAs are prepared for approval by the Minister of the Environment. A Class EA is an approved planning document that defines groups of projects and activities and the EA process which the proponent commits to for each project undertaking. Provided the process is followed, projects and activities included under the Class EA do not require formal review and approval under the EA Act. In this fashion, the Class EA process expedites the EA of smaller recurring projects.

The Municipal Class EA Master Planning process to be followed in this study is comprised of:

- **Phase 1:** Establish the Problem or Opportunity; and

- Phase 2: Identify and Assess Alternative Solutions to the Problem, and Select a Preferred Alternative.

**EXHIBIT A.2**

**MUNICIPAL CLASS EA PLANNING AND DESIGN PROCESS**

NOTE: This flow chart is to be read in conjunction with Part A of the Municipal Class EA

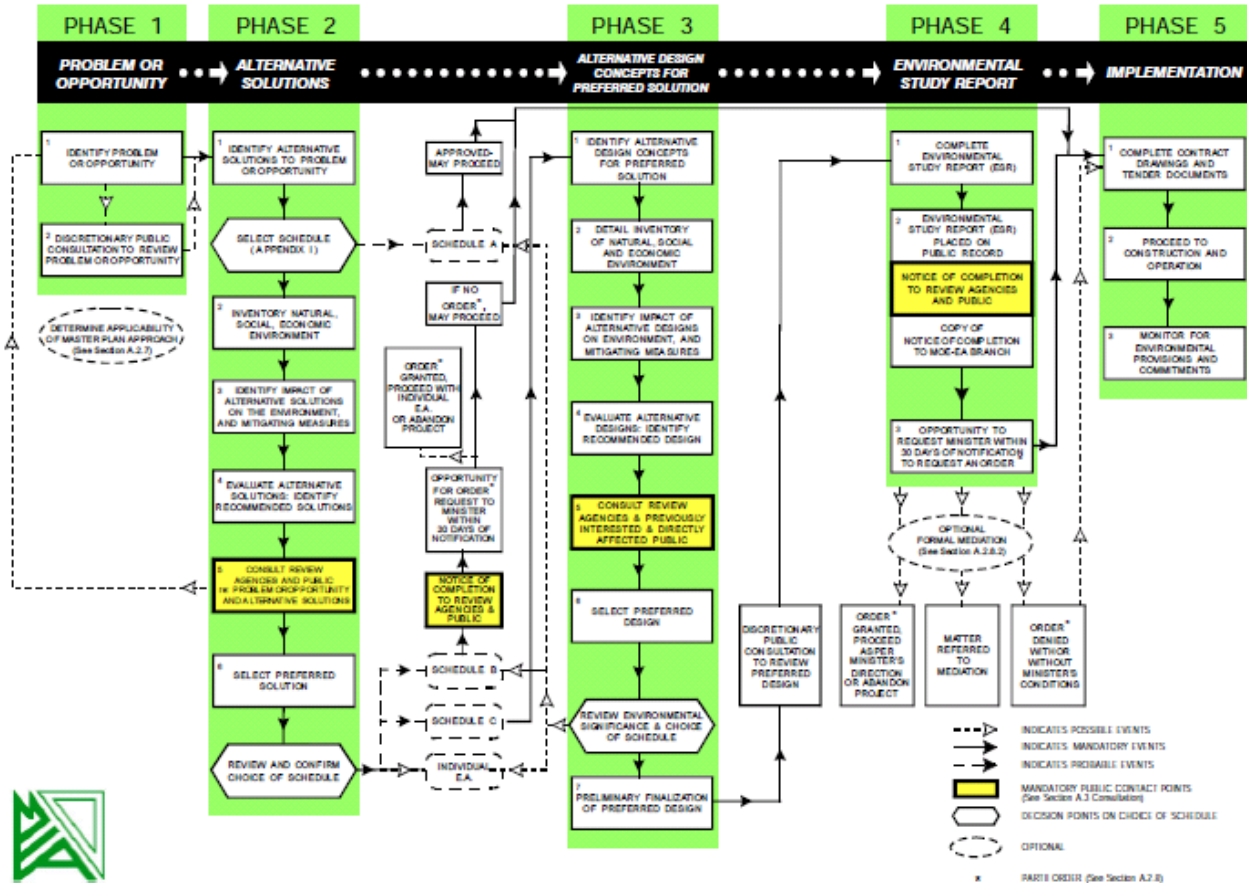


Figure 1.1: Municipal Engineers Association Planning and Design Process.

The Municipal Engineers Association (MEA) Class EA document also identifies four (4) different approaches to completing Master Plans corresponding to different levels of assessment. Regardless of the approach selected, all Master Plans must follow at least the first two (2) phases of the Class EA process.

- Approach 1,
  - This approach involves the preparation of a Master Plan document at the conclusion of Phases 1 and 2 of the Municipal Class EA process. The Master Plan document would be made available for public comment prior to being approved by the municipality;
  - Typically, the Master Plan would be done at a broad level of assessment thereby requiring more detailed investigations at the project-specific level in order to fulfil the Municipal Class EA documentation requirements for the specific Schedule B and C projects identified within the Master Plan; and
  - The Master Plan would therefore become the basis for, and be used in support of, future investigations for the specific Schedule B and C projects identified within it. Schedule B

projects would require the filing of the Project file for public review while Schedule C projects would have to fulfil Phases 3 and 4 prior to filing an Environmental Study Report (ESR) for public review.

- **Approach 2**, involves completion of the work necessary for Schedule 'B' site specific projects at the time they are identified. Using this approach, a municipality would identify everything it needed in the first five (5) years and would complete all the site-specific work required, including public consultation to meet Class EA requirements. The Master Plan in such cases must be completed with enough detail so that the public in site specific locations can be reasonably informed, and so that the approving government Agencies (Conservation Authorities (CAs), the Ministry of Natural Resources and Forestry (MNR), Fisheries and Oceans Canada (DFO), Transport Canada etc.) can be satisfied, in principal, that their concerns will be addressed before construction commences.
- **Approach 3**, is to complete the requirements of Schedule 'B' and Schedule 'C' at the Master Plan stage.
- **Approach 4**, is to integrate approvals under the EA and Planning Acts. For example, the preparation of new or amended OPs could be undertaken simultaneously with Master Plans for water, wastewater and transportation, and approval for both sought through the same process.

**This study uses Approach # 1.** Accordingly, The CSWM-MP would become the basis for, and be used in support of, future investigations for the specific Schedule B and C projects identified within it. Schedule B projects would require the filing of the Project file for public review while Schedule C projects would have to fulfill Phases 3 and 4 prior to filing an ESR for public review.

## 1.4 Document Structure

Based on the CSWM-MP Guidelines (LSRCA, 2011b) and following an approach that is consistent with Problem/Opportunity identification as per the Class EA Master Plan process, this report includes the following Chapters:

- **Chapter 1:** provides background to the project, study objectives, and the Class EA Master Plan process;
- **Chapter 2:** provides an introduction about the study area, watershed context, technical studies that covered the study area, and policy context with special focus on policies and guidelines pertaining to SWM (Water Quality/Quantity);
- **Chapter 3:** discusses acts, regulations, policies and plans that apply to the study;
- **Chapter 4:** provides a summary of the existing land use and future land use, and presents the characterization of the study area in terms of environmental features and functions, including surficial geology, surface water system, groundwater system, and terrestrial and aquatic ecology. SWM issues are discussed in the context of existing, previously planned retrofits and previously planned new opportunities for managing the quantity and quality of stormwater within the Town. In that context, the effectiveness of existing SWM facilities is discussed;

- **Chapter 5:** discusses specific problems and opportunities according to Phase 1 of the Master Plan process, and evaluates environmental impact of development in terms of water balance, water quality, and water quantity. The study goals and objectives are articulated accordingly;
- **Chapter 6:** identifies a list of alternative solutions that fall under the categories of Pollution Prevention, Source Control, Conveyance Control, End-of-Pipe (EOP), and Stream Restoration measures as part of the second phase (Phase 2) of the Class EA process;
- **Chapter 7:** describes the evaluation criteria and evaluation process and prioritizes the works in fulfillment of the Class EA process;
- **Chapter 8:** defines and describes the Recommended Approach and the proposed alternative solutions to provide physical context for the implementation;
- **Chapter 9:** presents key environmental benefits of the Recommended Approach and provides a decision-making tool that can be utilized by the Town to select specific stormwater measures including source control, conveyance control, and EOP control measures;
- **Chapter 10:** provides recommendations on how to implement the CSWM-MP relating to next steps, future study requirements, policy considerations, facilitators and contributors, funding, costs, Operations and Maintenance (O&M) and integration with other documents; and
- **Chapter 11:** summarizes the recommendations and conclusions outlined earlier in the report.

## 2. Study Area

**Figure 2.1** shows the municipal boundary of the Town, based on Steps 1 and 2 of the LSRCA Implementation Guidelines. The area shown in Figure 2.1 represents the general study area and shows subwatershed boundaries. The entire study area is covered by the LSRCA. Accordingly, the study area includes three (3) urban settlement areas which are identified in Figure 4.2:

1. Community of Keswick;
2. Community of Sutton; and
3. Community of Pefferlaw.

### 2.1 Watershed Context

The Town is located within the Lake Simcoe watershed. Creek and river systems within the municipality generally drain north to Lake Simcoe or west towards Cook's Bay (Lake Simcoe). There are six (6) subwatersheds that are at least partially located within the municipality. These are the: Black River Subwatershed, East Holland Subwatershed, Georgina Creeks Subwatershed, Maskinonge River Subwatershed, Pefferlaw Brook Subwatershed, and Uxbridge Brook Subwatershed. The Georgina Creeks Subwatershed is the only subwatershed that is completely located within the municipal boundaries of the Town. Upstream areas of all of the other subwatersheds are located outside of the municipal boundaries of the Town. Evaluating existing and future conditions within the watershed context (i.e. study area characterization) is essential to providing effective and science-based management strategies for water related issues including water quality. Within the watershed context, existing development and New Development Areas demand strong emphasis.

#### **Black River Subwatershed**

The Black River Subwatershed is the largest drainage area in the Town composing 49% of the overall municipal area or 14,148 ha. The subwatershed includes the majority of the community of Sutton and the Hamlets of Virginia and Baldwin. According to the *Black River Subwatershed Plan* (LSRCA, 2010), this subwatershed is one of the healthiest subwatersheds in the Lake Simcoe Basin due to the large valley that spans the central portion of the subwatershed and the early classification of Provincially Significant Wetlands(PSWs) in this area in the 1980s.

#### **East Holland Subwatershed**

The East Holland Subwatershed is the most southwesterly subwatershed in the Town. It is located on the south end of Cook's Bay. The watershed includes the southern portion of the Community of Keswick. According to *East Holland River Subwatershed Plan* (LSRCA, 2010a), this subwatershed is one of the most urbanized in the Lake Simcoe Basin. This subwatershed covers 5% of the Town or 1,329 ha. Urban development and intensive agriculture compromise a significant percentage of the subwatershed area representing 28% ha and 43% respectively.

#### **Georgina Creeks Subwatershed**

The Georgina Creeks Subwatershed is located in the northwest corner of the Town and includes a number of small creek systems flowing into Lake Simcoe. This subwatershed includes the northern portion of the community of Keswick and the western portion of the community of Sutton. The Intake Protection Zones (IPZ) for these communities are located in Lake Simcoe offshore of this subwatershed. This subwatershed covers 17% of the Town or 4,933 ha. Natural Heritage Area compromises a significant percentage of the subwatershed representing 43%.

### **Maskinonge River Subwatershed**

The Maskinonge River Subwatershed is located on the west side of the Town. The Maskinonge River flows into Cook's bay through the Community of Keswick. This subwatershed bounded by the Georgina Creeks Subwatershed to the north and the East Holland Subwatershed to the south. The total area of the watershed within the Town is 4,199 ha. This represents 15% of the municipal area. Within the Town, natural heritage features (NHF) and intensive agriculture compromise a significant percentage of the subwatershed area representing 23% and 59% respectively.

### **Pefferlaw Brook Subwatershed**

The Pefferlaw Brook Subwatershed is located on the east side of the Town. The total area of the watershed within the Town is 3,959 ha. This subwatershed is tributary to the larger Pefferlaw River Subwatershed along with the Uxbridge Brook Subwatershed. The confluence of Pefferlaw Brook and Uxbridge Brook is near the southeast corner of the Town. The most common land use in the Pefferlaw Brook Subwatershed is NHF, with 65% or 2,586 ha. The majority of the community of Pefferlaw is within this subwatershed.

### **Uxbridge Brook Subwatershed**

The Uxbridge Brook Subwatershed is located in the southeast corner of the Town. The confluence of Uxbridge Brook and Pefferlaw Creek is north of the Community of Udora. Only 383 ha of the Uxbridge Creek Subwatershed is within the municipal boundaries. This represents only 1% of the Town. The most common land use within the subwatershed is Intensive Agriculture which represents 40% of the total area followed by NHF which represents 32% of the subwatershed area.

## **2.2 Issues and Concerns**

Key issues related to SWM and water quality management within the Town include:

### **Water Quality Issues**

Key water quality stressors within the Town include urban development and agricultural land use. This finding has been articulated in previous areas with similar features and land use practices within Lake Simcoe watershed where NPS pollutants including phosphorus, Total Suspended Solids (TSS), and Escherichia coli (E.coli) have exceeded the provincial standards and objectives (PWQOs) within rural landscapes. The *Lake Simcoe Basin Stormwater Management and Retrofit Opportunities* (LSRCA, 2007) calculated the TP loading for each subwatershed draining into Lake Simcoe. Table 2.2 identifies the estimated annual phosphorus loading into Lake Simcoe with and without existing stormwater treatment. It should be noted that the loading values represent the entire subwatershed areas and not just the portion located in the Town.

**Table 2.1: Annual Phosphorus Loading from Subwatersheds.**

<b>Subwatersheds</b>	<b>Phosphorus Loading Without Existing Stormwater Treatment (kg/yr)</b>	<b>Phosphorus Loading With Existing Stormwater Treatment (kg/yr)</b>
Black River	734	579
East Holland	10,300	8,170
Georgina Creeks	545	488
Maskinonge River	311	262
Pefferlaw Brook	80.9	32.4
Uxbridge Brook	972	628

Of particular interest to the Town, potential and current activities that would constitute water quality risk include:

- Converting natural areas into agricultural and urban areas (i.e. SPAs: Keswick, Sutton and Pefferlaw);
- Removal of riparian vegetation; and
- Increasing sediment load to watercourses.

### **Water Quantity Issues**

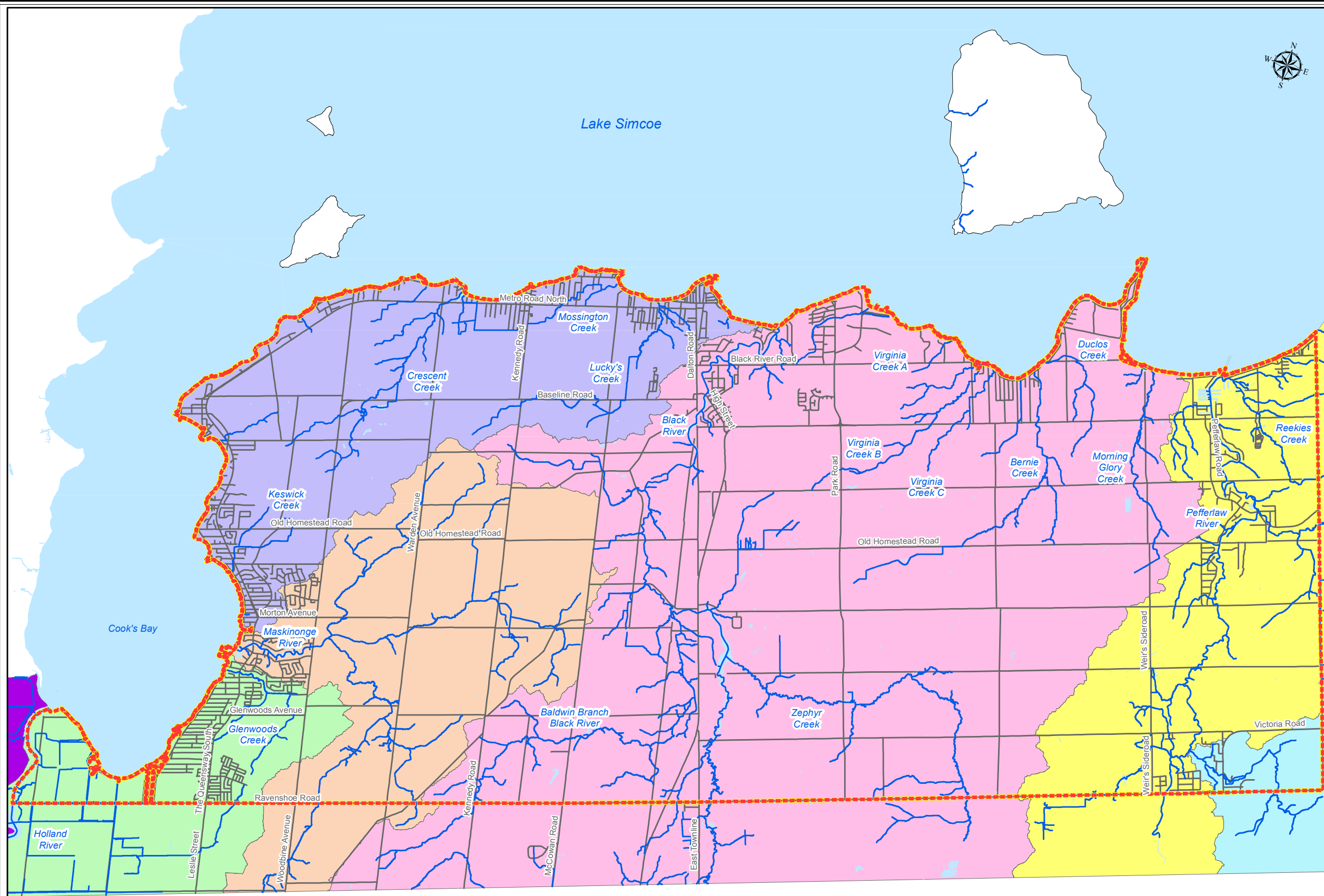
Impacts of urbanization within the Town due to existing and new development include:

- The increase of impervious areas which inhibits infiltration of water into the groundwater system and reducing baseflow input;
- Channel stability issues resulting from uncontrolled stormwater runoff, channelization and tile drainage; and
- Changing the natural hydrology distribution by artificial irrigation systems.

### **Stormwater Infrastructure:**

Based on reports, mapping and permitting information provided by the Town, there are a total of twenty-four (24) existing SWM facilities within the municipal boundaries. These SWM facilities are divided amongst the three (3) urban centers as follows:

- Sixteen (16) SWM facilities in the community of Keswick;
- Five (5) SWM facilities in the community of Sutton; and
- Three (3) SWM facilities in the community of Pefferlaw.



**Legend**

- Study Area
- Waterbody
- Watercourse
- Subwatershed**
- Black River
- East Holland
- Georgina Creeks
- Maskinonge River
- Pefferlaw Brook
- Uxbridge Brook
- West Holland

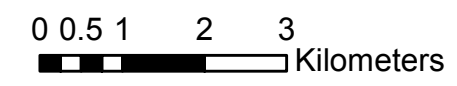
Source: Lake Simcoe Region Conservation Authority, 2014



Georgina Civic Centre  
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 L4P 3G1  
 Phone: (905) 476-4305  
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**Town of Georgina  
 Stormwater Management Master  
 Plan**

Study Area



**FIGURE: 2.1**

DATE: July 2017

### 3. Policy Context and Direction

There are numerous acts, regulations, policies and plans aimed at maintaining or improving environmental features and functions federally, provincially and within the study area (i.e. Town of Georgina). In order to understand the function of each document, it is important to understand the scale of implementation and the key objectives behind each document.

Federal, Provincial, and Municipal policy documents were reviewed with special focus on policies and guidelines pertaining to SWM (Water Quality/Quantity). These documents were categorized as follows:

- Provincial Plans;
- Provincial and CA Guidelines;
- OPs; and
- Watershed and Subwatershed Plans.

#### 3.1 Provincial Plans

##### **Provincial Policy Statement (PPS)**

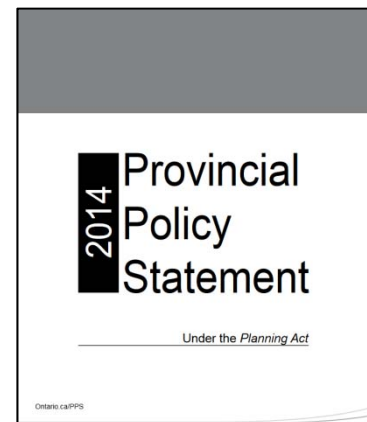
The Provincial Policy Statement (PPS) provides for appropriate development while protecting resources of provincial interest, public health and safety, and the quality of the natural and built environment. The PPS supports improved land use planning and management which contributes to a more effective and efficient land use planning system.

The natural heritage features to be considered in accordance with the PPS include:

- Provincially Significant Wetlands (PSW);
- Significant habitat of endangered and threatened species;
- Significant woodlands;
- Significant valleylands;
- Significant wildlife habitat;
- Areas of natural and scientific interest (ANSIs); and
- Fish habitat

Policy 1.6.6.7 of the PPS states that planning for stormwater management shall:

- a) minimize, or, where possible, prevent increases in contaminant loads;
- b) minimize changes in water balance and erosion;
- c) not increase risks to human health and safety and property damage;
- d) maximize the extent and function of vegetative and pervious surfaces; and
- e) promote stormwater management best practices, including stormwater attenuation and re-use, and low impact development.



Policy 2.2.1 of the PPS covers water and specifically states:

Planning authorities shall protect, improve or restore the quality and quantity of water by:

- a) using the watershed as the ecologic meaningful scale for integrated and long-term planning, which can be a foundation for considering cumulative impacts of development;
- b) minimizing potential negative impacts, including cross-jurisdictional and cross-watershed impacts;
- c) identifying water resources systems consisting of ground water features, hydrologic functions, natural heritage features and areas, which are necessary for the ecological and hydrological integrity of the watershed;
- d) maintaining linkages and related functions and related functions among ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas;
- e) implementing necessary restrictions on development and site alteration to;
  - a. protect all municipal drinking water supplies and designated vulnerable areas; and
  - b. protect, improve or restore vulnerable surface and ground water, sensitive surface water features and sensitive ground water features, and their hydrologic functions;
- f) planning for efficient and sustainable use of water resources, through practices for water conservation and sustaining water quality;
- g) ensuring consideration of environmental lake capacity, where applicable; and
- h) ensuring stormwater management practices minimize stormwater volumes and contaminant loads, and maintain or increase the extent of vegetative and pervious surfaces.

The updated PPS also considers the impacts of climate change with a focus on resiliency and adaption through land use development patterns. Per policy 3.1.3, planning authorities shall consider the potential impacts of climate change that may increase the risk associated with natural hazards.

#### **Lake Simcoe Protection Plan, June 2009**

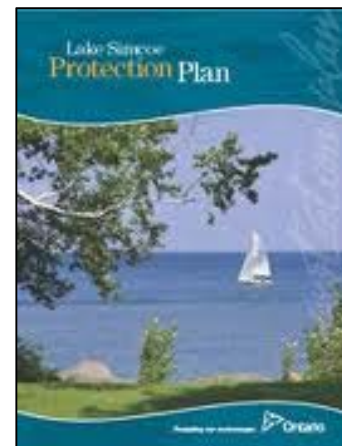
The *LSPP* (MOE, 2009) applies to the Lake Simcoe watershed. The plan is based on the Lake Simcoe Protection Act (2008) which intends to restore and protect the ecological health of the watershed. The act allows policies in relation to research and monitoring of activities that impact ecological health within the watershed. These policies include the following which are relevant to the impact of development on stormwater and measures to address SWM issues within the watershed.

**Policy 4.5-SA** Within five (5) years of the date the LSPP comes into effect, municipalities in collaboration with the LSRCA will prepare and implement CSWM-MPs for each settlement area in the Lake Simcoe Watershed.  
swmp

**Policy 4.6-SA** Municipalities are encouraged to implement a stormwater retrofit prior to the completion of a SWM master plan if a stormwater retrofit opportunity has been identified as a priority for a settlement area and is determined to be economically feasible.

**Policy 4.7-DP** Municipalities shall incorporate into their OPs policies related to reducing stormwater runoff volume and pollutant loadings from major development and existing settlement areas including policies that:

- a) encourage implementation of a hierarchy of source, lot-level, conveyance and EOP controls;



- b) encourage the implementation of innovative SWM measures;
- c) allow for flexibility in development standards to incorporate alternative community design and stormwater techniques, such as those related to site plan design, lot grading, ditches and curbing, road widths, road and driveway surfaces, and the use of open space as temporary detention ponds;
- d) support implementation of programs to identify areas where source control or elimination of cross connections may be necessary to reduce pathogens or contaminants; and
- e) support implementation of source control programs, which are targeted to existing areas that lack adequate stormwater controls.

**Policy 4.8-DP** An application for major development shall be accompanied by a SWM plan.

**Policy 4.9-DP** SWM works that are established to serve new major development in the Lake Simcoe watershed shall not be permitted unless the works have been designed to satisfy the Enhanced Protection level specified in Chapter 3 of the *Stormwater Management Planning and Design Manual (SWMPDM)* (MOE, 2003), as amended from time to time.

**Policy 4.10-DP** Every owner and operator of a new SWM works in the Lake Simcoe watershed shall be required to inspect and maintain the works on a periodic basis.

**Policy 4.11-DP** Every owner and operator of a new priority SWM works in the Lake Simcoe watershed shall be required to monitor the operation of works, including monitoring the quality of the effluent from the works, on a periodic basis.

**Policy 4.12-SA** The Ministry of Environment (MOE) will review the approvals issued under section 53 of the Ontario Water Resources Act in respect of existing priority SWM works within the Lake Simcoe watershed. If a review of an approval for an existing priority SWM works determines that the conditions in the approval are inadequate, having regard to the objectives of the Plan, including the conditions related to inspection, maintenance and monitoring, the approval will be referred to the Director for the purpose of determining whether an amendment to the approval is necessary to assist in meeting the objectives of the Plan.

**Policy 4.24** Implementation of phosphorus reduction measures including an assessment of sources or sectors that contribute to phosphorus loadings.

**Policy 5.6-DP (f) and (g)** Other water conservation technologies (such as rainwater harvesting or reuse of stormwater) will be used to reduce water use; and stormwater treatment facilities are used to capture and treat runoff from areas with impervious surfaces.

**Policy 6.23-DP** Development or site alteration is not permitted within a key NHF, a key hydrologic feature and within a related vegetation protection zone referred to in policy 6.24, except in relation to Retrofits of existing SWM works.

### **Greenbelt Plan**

The Greenbelt Plan (MMAH, 2005) defines a protected 'Greenbelt' as a 'broad band of permanently protected countryside' within the Golden Horseshoe and sets out policies to protect 'key NHF and key hydrologic features' including wetlands, fish habitat and significant valleylands.

Policies relevant to SWM include the following:

**Policy 4.2.3.1** SWM ponds are prohibited in key NHF or key hydrologic features or their vegetation protected zones, except for those portions of the Protected Countryside that define the major river valleys that connect the Niagara Escarpment and Oak Ridges Moraine to Lake Ontario. In these areas, naturalized SWM ponds are permitted provided they are located a minimum of 30 metres away from the edge of the river/stream and in the vegetation protection zones of any abutting key NHF or key hydrologic features.

**Policy 4.2.3.2** Applications for development and site alteration in the Protected Countryside shall be accompanied by a SWM plan.

**Policy 4.2.3.3** The objectives of a SWM plan are to avoid, minimize and/or mitigate stormwater volume, contaminant loads and impacts to receiving water courses.

### **The Growth Plan**

The Growth Plan (MMAH, 2013) is a policy document that has been prepared under the Places to Grow Act (MMAH, 2005). The overarching objective of the document is to provide a framework for implementing the Government of Ontario's vision for "building stronger, prosperous communities by better managing growth in the Greater Golden Horseshoe".

Concerning SWM, **Policy 3.2.5.8** points out that municipalities are encouraged to implement and support innovative SWM actions as part of redevelopment and intensification.

## **3.2 Provincial and Conservation Authority Guidelines**

### **Stormwater Management Planning and Design Manual (MOE, 2003)**

The SWMPDM (MOE, 2003) is a document which updates earlier SWM manuals released by the MOE in 1991 and the Ministry of Environment and Energy (MOEE) in 1994, with an overarching objective to provide guidance for the selection and design of appropriate SWM practices. The key components of the 2003 manual include the following:

- Providing direction for sizing of the stormwater quality control component of SWM facilities in order to achieve water quality objectives which protect fisheries habitat;
- Incorporating in-stream erosion control and water balance objectives in addition to flood and water quality objectives into the selection and design of SWM Practices (SWMPs);
- Providing information on SWMPs such as sand filters, bioretention filters, wet swales and hybrid wet pond/wetlands;
- Providing design examples for SWMPs; and
- Providing an appendix which deals with integrated planning for SWM.

### **LSRCA Technical Guidelines for Stormwater Management Submissions, 2016**

This technical document provides guidance to municipalities and the development community regarding SWM requirements of the LSRCA in accordance with the LSPP and PPS. The document is focused on what should be included in SWM submissions to the LSRCA. A main focus of the document is better site design practices to address the following considerations:

- Open space protection and restoration;
- Reduction of impervious cover;
- Distribution and minimization of runoff
- Runoff utilization; and

- Erosion and sediment control.

The document outlines SWM criteria within the LSRCA watershed with respect to Water Quantity, Water Quality, Stream Erosion, Water Balance/Groundwater Recharge, and Erosion & sediment Control.

**LSRCA Lake Simcoe Watershed Model By-Law for Municipalities, 2015**

This By-Law has been prepared to assist anyone applying for a Permit in accordance with the requirements of the Site Alteration and Fill By-Law. As part of the By-Law land shall not be developed for any use without having provided SWM and erosion control measures that control or manage stormwater runoff from the land area disturbed.

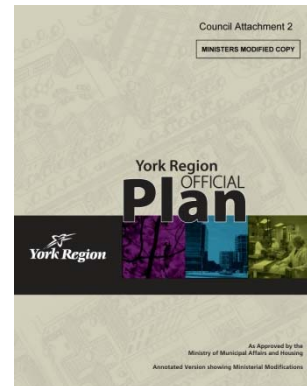
**LSRCA SWM Guidelines for Municipalities, 2015**

The LSRCA SWM Guidelines for Municipalities provide a framework for LID SWM requirements to be defined within the municipal legislative framework. These guidelines are to be used by municipalities within the LSRCA jurisdiction to develop their own stormwater policy. The requirements in the 2016 LSRCA Technical Guidelines for Stormwater Management Submissions supersede the LSRCA SWM Guidelines for Municipalities.

**Hydrogeological Assessment Submissions - Conservation Authority Guidelines**

The Hydrological Assessment Submissions Guidelines propose tools to carry out water balance assessments. Key steps include:

1. Estimate the evapotranspiration component of the hydrologic regime for the Study Area using Thornthwaite (1948) and available climate data, and calculate total water surplus;
2. Define catchment area/Management Unit area, including imperviousness, land cover, and runoff coefficient under pre- and post-development conditions;
3. Pre-development assessment: Estimate inputs (including precipitation, run-on and other inputs) and outputs (including evapotranspiration, infiltration, and surface runoff). Assume evaporation from impervious areas 20% of precipitation;
4. Post-development assessment: Estimate inputs and outputs. Assume evaporation from impervious areas 20% of precipitation;
5. Estimate the output volume deficit between existing and future development (i.e. changes in hydrologic output volumes between pre- and post-development scenarios); and
6. Estimate post-development output with mitigation.



**3.3 Official Plans**

**The Regional Municipality of York Official Plan**

*The Regional Municipality of York Official Plan (York Region’s OP)* (York Region, 2010) indicates that changes in land use must take into account immediate impacts and cumulative changes to watersheds, and off-site impacts, such as increased stormwater runoff or water contamination.

Concerning SWM, York Region’s OP (York Region, 2010, Office Consolidation April 2016) points out that it is the policy of the council:

- To work in partnership with local municipalities, the Province, CAs, and other agencies in the implementation of SWM initiatives;
- To require the preparation of comprehensive master environmental servicing plans, or appropriate technical studies as a component of secondary plans and major development or re-development to minimize stormwater volume and contaminant loads, and maximize infiltration through an integrated treatment approach, which may include techniques such as rainwater harvesting, phosphorus reduction, constructed wetlands, bioretention swales, green roofs, permeable surfaces, clean water collection systems, and the preservation and enhancement of native vegetation cover; and
- To work with local municipalities and the LSRCA in the preparation and implementation of CSWM-MPs for each settlement area within the Lake Simcoe Watershed by June 2014.

### **The Town of Georgina Official Plan**

As a primary tool to direct the actions of local government, shape development decisions, and manage growth in the short and long term, the Town's OP (October, 2010, Office Consolidation November 1, 2013) includes the following key policies that are relevant to SWM within the Town:

Pertaining to SWM within the Town, Section 5.5 indicates that:

- SWM shall be carried out to the satisfaction of the Town, the CA, and York Region on a watershed and/or subwatershed basis;
- BMPs shall be applied to meet or exceed Level 1 protection criteria (or equivalent) as outlined in *Stormwater Management Practices Planning and Design Manual* (MOEE, 1994) or any update of that document;
- Prior to any major development, a SWM and erosion and sediment control study will be required. This study will examine the feasibility of the site, the water table conditions and surface drainage. In addition, the development proposals must be accompanied by a drainage plan that indicates contours, elevations, and the proposed final grade. The drainage plan must be prepared to the specifications of, and be subject to, the approval of the Town; and
- In the consideration of development adjacent or in close proximity to a Provincial Highway, the stormwater plan shall be reviewed and approved by the Ministry of Transportation.

## **3.4 Watershed and Subwatershed Plans**

As noted earlier, the Town is within the jurisdiction of the LSRCA.

Four (4) subwatershed plans and one (1) watershed plan have been completed in support of maintaining, restoring, and improving environmental features and functions within Lake Simcoe Watershed, and all of them are relevant to the CSWM-MP study. The Georgina Creeks Subwatershed is completely confined within the municipal boundaries of the Town. This subwatershed includes several small creeks and watercourses that discharge to the south shore of Lake Simcoe or the northeast shore of Cook's Bay. A subwatershed plan for the Georgina Creeks subwatershed has not been completed.

The five (5) Watershed and Subwatershed Plans are:

**Black River Subwatershed Plan (LSRCA, 2010):** 14,148 ha of the Town is located within the Black River Subwatershed. Headwaters of this river originate from the Oak Ridges Moraine. Upstream of the Town, the Black River and its tributaries flow through the Town of Whitchurch-Stouffville and the Town of East Gwillimbury. The subwatershed includes high value natural areas in addition to agricultural areas, and it is mainly located within the York Region. The *Lake Simcoe Basin Stormwater Management and Retrofit*

*Opportunities* (LSRCA, 2007) estimated that the Black River Subwatershed is responsible for annual phosphorus loadings of 579 kg into Lake Simcoe. This is approximately 3% of the annual sediment loading into the lake.

**East Holland River Subwatershed Plan (LSRCA, 2010a):** 1,329 ha of the Town is located within the East Holland Subwatershed. Headwaters of this river originate from the Oak Ridges Moraine. Upstream of the Town, the East Holland River, its tributaries and headwater areas include parts of the Township of King, the Town of Aurora, the Town of Whitchurch-Stouffville, The Township of Uxbridge, the Town of Newmarket, and the Town of East Gwillimbury. The subwatershed is one of the Lake Simcoe basin's most populated subwatersheds and is estimated to account for 8170 kg of phosphorus loading into Lake Simcoe annually. This is approximately 36% of the annual phosphorus loading into the lake.

**Maskinonge River Subwatershed Plan (LSRCA, 2010c):** 4,199 ha of the Town is located within the Maskinonge River Subwatershed. The Maskinonge River flows into Cook's Bay at the community of Keswick. The subwatershed extends south into the Town of East Gwillimbury. There are three main branches of the Maskinonge River. The most southern branch of the river originates in the Oak Ridges Moraine. The most common land use in the Maskinonge River Subwatershed is intensive agriculture which occupies 2,476 ha of the watershed within the Town. At the mouth of the river, the community of Keswick accounts for the vast majority of the subwatershed's urban development. The Maskinonge River subwatershed is estimated to account for 262 kg of phosphorus loading into Lake Simcoe annually. This is approximately 1% of the annual phosphorus loading into the lake.

**Pefferlaw River Subwatershed Plan (LSRCA, 2012):** Uxbridge Brook and Pefferlaw Brook converge north of the community of Udora to form the Pefferlaw River. Pefferlaw Brook and Uxbridge Brook are normally treated as separate subwatersheds but were combined for subwatershed planning purposes as the Pefferlaw River Subwatershed. This subwatershed originates in the Oak Ridges Moraine and is predominately located in the Regional Municipality of Durham. 383 ha of Uxbridge Brook and 3,959 ha of Pefferlaw Brook are located in the Town. Within this area the most common land use type is NHF followed by intensive agriculture and urban development). The Pefferlaw River watershed is considered to be a rural subwatershed with little change over the last several years. The subwatershed is estimated to account for 32.4 kg of phosphorus loading into Lake Simcoe annually. This is less than 1% of the annual phosphorus loading into the lake.

**Uxbridge Brook Watershed Plan (LSRCA, 1997):** Only 2% of the 17,800 ha Uxbridge Brook Subwatershed is within the Town. Along with a thorough characterization, this plan help develop management alternatives and monitoring strategies. This study provided background for the Pefferlaw River Subwatershed Plan.

Additional to the Subwatershed and Watershed Plans, the Town completed a SWM Study for the community of Keswick in 2011.

**Keswick Stormwater Management Study (MMM, 2011):** The study was prepared within the Class EA framework according to the MEA. The scope of the study included the review and survey of sixteen (16) SWM facilities and forty-five (45) Oil and Grit Separators (OGS). The report focused heavily on improvements to phosphorus loading from the municipality. Opportunities for new SWM facilities in uncontrolled areas and the retrofit of existing facilities were evaluated. A preferred alternative was recommended that included the retrofit of all existing SWM facilities to provide enhanced phosphorus removal and the development of new SWM facilities with phosphorus removal capabilities.

## 4. Characterization of the Study Area

This chapter describes existing environmental conditions within the Town, with special focus on the environmental features and functions that are relevant to stormwater quantity and quality within the study area. The framework of characterizing the existing environmental conditions is based on the CSWM-MP Guidelines (LSRCA, 2011). It starts by defining existing land use and potential land use changes within the study area, and subsequently moves to describe existing environmental features and functions in addition to urban features including the SWM system.

### 4.1 Technical Direction

The characterization of the general study area (Figure 2.1) draws upon work previously completed to obtain an understanding of environmental and infrastructure conditions within the Town. Documentation from LSRCA subwatershed planning documents, Town works, community plan reports and SWM reports related to new development have been compiled and reviewed.

The main objective of the background review of relevant technical studies is to set a framework for understanding of the motives behind this study and establish a foundation for the “Problem/Opportunity” component as this study is prepared as a Master Plan EA study (**Section 1.3**).

Technical studies reviewed include but are not limited to the following:

- Keswick Stormwater Management Study (MMM Group, 2011);
- Annual Water Balances and TP Loads to Lake Simcoe (2007-2009) (LSRCA, 2013a);
- Lake Simcoe Basin Stormwater Management and Retrofit Opportunities (LSRCA, 2007);
- Assimilative Capacity Studies for the Lake Simcoe Watershed and Nottawasaga River (LSRCA and NVCA, 2006);
- Black River Subwatershed Plan (LSRCA, 2010);
- East Holland River Subwatershed Plan (LSRCA, 2010a);
- Maskinonge River Subwatershed Plan (LSRCA, 2010c);
- Pefferlaw River Subwatershed Plan (LSRCA, 2012);
- Uxbridge Brook Watershed Plan (LSRCA, 1997);
- Stormwater Pond Maintenance and Anoxic Conditions Investigation (LSRCA, 2011a);
- York Region Subwatershed Implementation Plan 2013 to 2017 (LSRCA, 2013b); and
- Technical information as part of relevant Subwatershed Plans.

### 4.2 Land Use

Planning documents regulating land use within the Town, including the Town’s OP (2010) and the York Region’s OP were reviewed to determine land use designations within the study area. The reviewed Town’s OP (2010) Schedules included:

- Schedule “A” Land Use Plan
- Schedule “B” Greenlands System
- Schedule “B1” Core Conservation Lands and Waters
- Schedule “B2” Lake Simcoe and its Tributaries
- Schedule “B3” Significant Woodlands
- Schedule “B4” Evaluated Wetlands

- Schedule “B5” Areas of Natural and Scientific Interest
- Schedule “B6” Environmentally Significant Areas
- Schedule “B7” Significant Natural Corridors and Other Woodlands
- Schedule “C” Aquifer and Recharge Areas
- Schedule “D” Aggregate Resource Priority Area
- Schedule “E1” Pefferlaw Land Use Plan
- Schedule “F1” Keswick Land Use Plan
- Schedule “G1” Sutton Land Use Plan
- Schedule “H” Hamlet Area
- Schedule “I” Roads Plan
- Schedule “J” Willow Beach and Surrounding Lakeshore Residential Area
- Schedule “J1” Sibbald Point Provincial Park Service Area Boundary
- Schedule “K” Community Improvement Areas
- Schedule “L1” Keswick Business Park Land Use and Transportation Plan

**Table 4.1: Secondary Plan Areas and their Subwatershed Coverage within the Town of Georgina.**

Secondary Plan Area (SPA)	Area (ha)	Subwatershed
Keswick SPA	547	Georgina Creeks
Keswick SPA	341	Maskinonge River
Keswick SPA	831	East Holland River
Keswick Business Park SPA	139	Maskinonge River
Keswick Business Park SPA	127	East Holland River
Sutton SPA	615	Georgina Creeks
Sutton SPA	1650	Black River
Pefferlaw SPA	718	Black River
Pefferlaw SPA	1800	Pefferlaw Brook

Based on the breakdown shown in **Table 4.1**, the SPAs (Existing and New Development) within the Town make up 6,762 ha, representing 23% of the total study area (28,954 ha). Rural areas (including Agricultural Area and Significant Environmental Areas) account for 22,192 ha, representing 77% of the study area.

#### 4.2.1 Existing Land Use

**Figure 4.1** shows existing land use within the municipality. As the figure shows, a large portion of the municipality is classified as “NHF”. The western portion of the municipality immediately east of the community of Keswick is primarily classified as “Intensive Agriculture”. There are other large clusters of intensive agriculture including immediately south of the community of Virginia. Areas of existing urban development within the municipality include the three SPAs (Keswick, Sutton and Pefferlaw) as well as the hamlet areas of Virginia, Baldwin, Udora, Belhaven and Ravenshoe.

**Figure 4.2** shows the Town’s OP (2010) – Schedule A Land Use Plan. Outside of the SPAs, 7,440 ha of land is identified as “Agricultural Protection Area” while 22,464 ha is identified as Rural Area. Environmental Protection Areas (EPAs) also occupy a large area of land with EPA 1, EPA 2 and EPA 3 occupying approximately 9,008 ha, 5,294 ha and 2,355 ha respectively. Many of the areas identified as EPA 2 closely follow the creek and river systems as well as the associated valley lands.

## 4.2.2 Future Land Use

An understanding of future growth within the Town is required to determine sustainable stormwater solutions that will function and grow with the municipality. Future growth within the Town is guided by the Town's OP (2010). According to the OP:

*"The countryside, the small communities, the larger centres and the strong relationship with Lake Simcoe combine to provide a high quality of life which is treasured by the residents of Georgina. Georgina can maintain its character and lifestyle, and benefit most from the growth that is expected to occur in the next 20 years, by **directing the majority of the growth to Keswick**, thereby maintaining its role as the largest centre in the municipality. **A more restricted amount of growth will be permitted in Sutton and Pefferlaw**. Limited development is to be permitted in the rural area, hamlets and lakeshore residential areas."*

As such special focus will be given to the community of Keswick as part of the EA part of the study (Chapter 5) to evaluate the impact on the Lake Simcoe watershed.

### Keswick

It is expected that by the year 2021, the community of Keswick will grow to 38,700 residents and 13,700 jobs. The growth will occur within the Urban Service Area Boundary. **Figure 4.2a** identifies land use within the SPA. As the figure shows, neighbourhood residential occupies the largest area within the community. Three (3) urban centres are located along The Queensway adjacent to less intense urban corridor development. Greenlands systems are scattered throughout the community. Commercial employment areas are located along Woodbine Avenue along the community's eastern perimeter. Schedule F1 of the Keswick Secondary Plan identifies the growth plan for Keswick. The three (3) existing urban centres along The Queensway will intensify and grow with mixed use development with higher density and taller buildings generally located adjacent to arterial roads.

Four (4) Development Areas have been identified in the Keswick Secondary Plan. These areas correspond with major areas of undeveloped land. As Keswick's population grows, new low density residential development will occur in Development Areas. As part of the development requirements outlined in the Keswick Secondary Plan, SWM plans are required and must include lands beyond the boundary of the Development Areas and may need to be completed on a watershed or subwatershed basis.

The Development Areas are:

1. Queensway West: shall develop with low density residential land uses. When preparing the design for development of the area, regard shall be given to ensure that the proposed lots are compatible with adjacent lot sizes and patterns. The proposed lots on the perimeter of the development area which abut larger existing lots shall generally have wider frontages than proposed lots within the interior of the development area. Issues related to the nature and extent of the environmental feature bisecting the area will need to be considered. The maximum density in Queensway West shall be 11.0 units per gross residential hectare.
2. Queensway East: will develop primarily with low density residential land uses. The maximum density in Queensway East shall be 11.0 units per gross residential hectare.
3. Glenwoods: will need to refine the boundary of the environmental feature, and has road access issues. It is expected to be a primarily residential area. The maximum density in Glenwoods shall be 12.5 units per gross residential hectare.

4. South Keswick: is the largest development area and is to accommodate a range of housing types as well as a range of commercial and employment uses adjacent to Woodbine Avenue and The Queensway. The maximum average density in the South Keswick Development Area shall be 14.5 units per gross residential hectare with some exceptions as outlined in the Keswick Secondary Plan.

The Keswick Business Park Secondary is projected to accommodate 7,500 to 9,000 new jobs by the year 2026. The business park is planned for a swath of undeveloped land between proposed Highway 404 extensions to the east and Woodbine Avenue to the west. The business park will extend from the Maskinonge River to the north to almost Revenshoe Road to the south. Schedule L1 of the Keswick Business Park Secondary Plan identifies proposed Greenland systems incorporated into the Business Park design. These systems include land adjacent to the Maskinonge River and lands in the southeast corner of the business park. Business park development will be divided into three (3) permitted use areas with uses ranging from offices and retail outlets to warehouses and industrial manufacturing.

**Table 4.2: Future Residential Land Development within the Community of Keswick.**

Secondary Plan Area	Future Land Use	Area (ha)
<b>Keswick</b>	Queensway West	28.5
	Queensway East	86.7
	Glenwoods	47.5
	South Keswick	398
<b>Total</b>		<b>561</b>

### **Sutton**

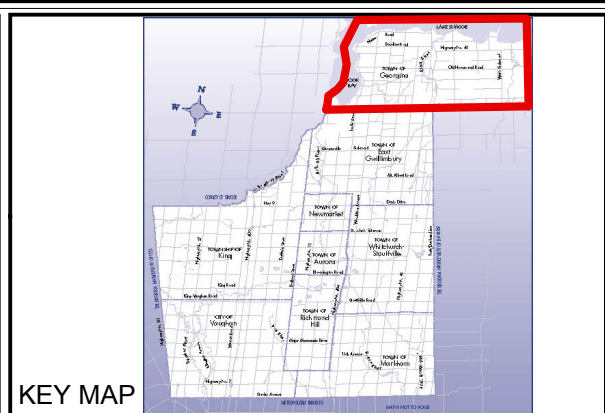
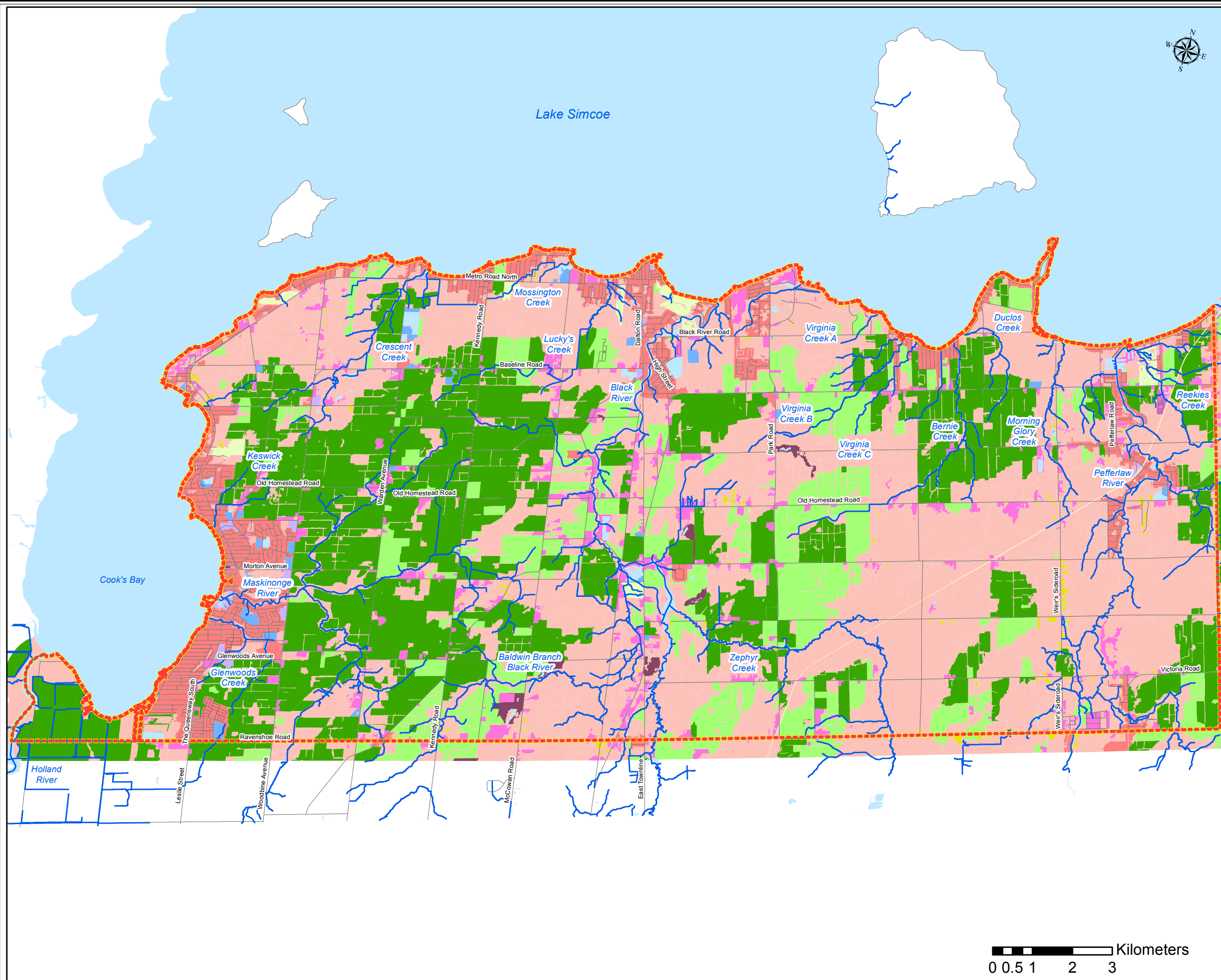
It is projected that future growth in Sutton/Jackson's Point will be modest over the next twenty (20) years, with an additional 8,390 people expected to be living in the SPA by 2031. This represents more than double the estimated 2009 population of 6,760 residents. Land designated as New Residential Area are intended to accommodate the majority of housing needed for growth. Schedule B of the Sutton/Jackson's Point Secondary Plan identifies New Residential Area as well as Redevelopment Opportunity Areas.

### **Pefferlaw**

The Pefferlaw Secondary Plan is older than that of the Sutton and Keswick secondary plans. The Pefferlaw Secondary Plan was developed to guide the growth of the Pefferlaw community area from a population of 2,314 residents in 1991 to an estimated population of 3,000 residents in 2011. Moving forward from the present, development within Pefferlaw is not expected to be as great as that within Keswick and Sutton.

### **4.2.3 Transportation Network and Utility Corridors**

The transportation network for the Town is presented in Schedule I – Roads Plan of the OP. Regional and major arterial roads include Highway 48 which runs east west between Pefferlaw and Sutton and south from Sutton to the Town of East Gwillimbury. A proposed realignment of Highway 404 will connect the east side of Keswick to Pefferlaw in the northeast corner of the municipality.



**Legend**

- Study Area
- Waterbody
- Watercourse

**LANDUSE**

- Active Aggregate
- Commercial
- Estate Residential
- Golf Course
- Institutional
- Intensive Agriculture
- Manicured Open Space
- Natural Heritage Feature
- Non-intensive Agriculture
- Rail
- Road
- Rural Development
- Urban

Source: Town of Georgina Development Services, 2014 Dataset



**GEORGINA**

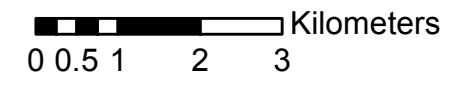
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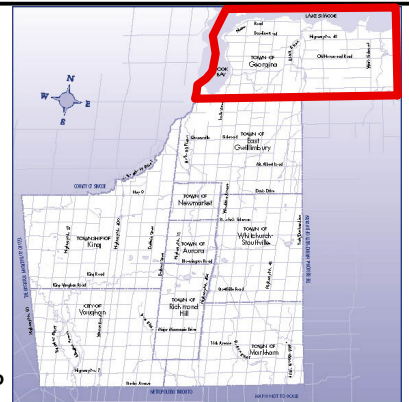
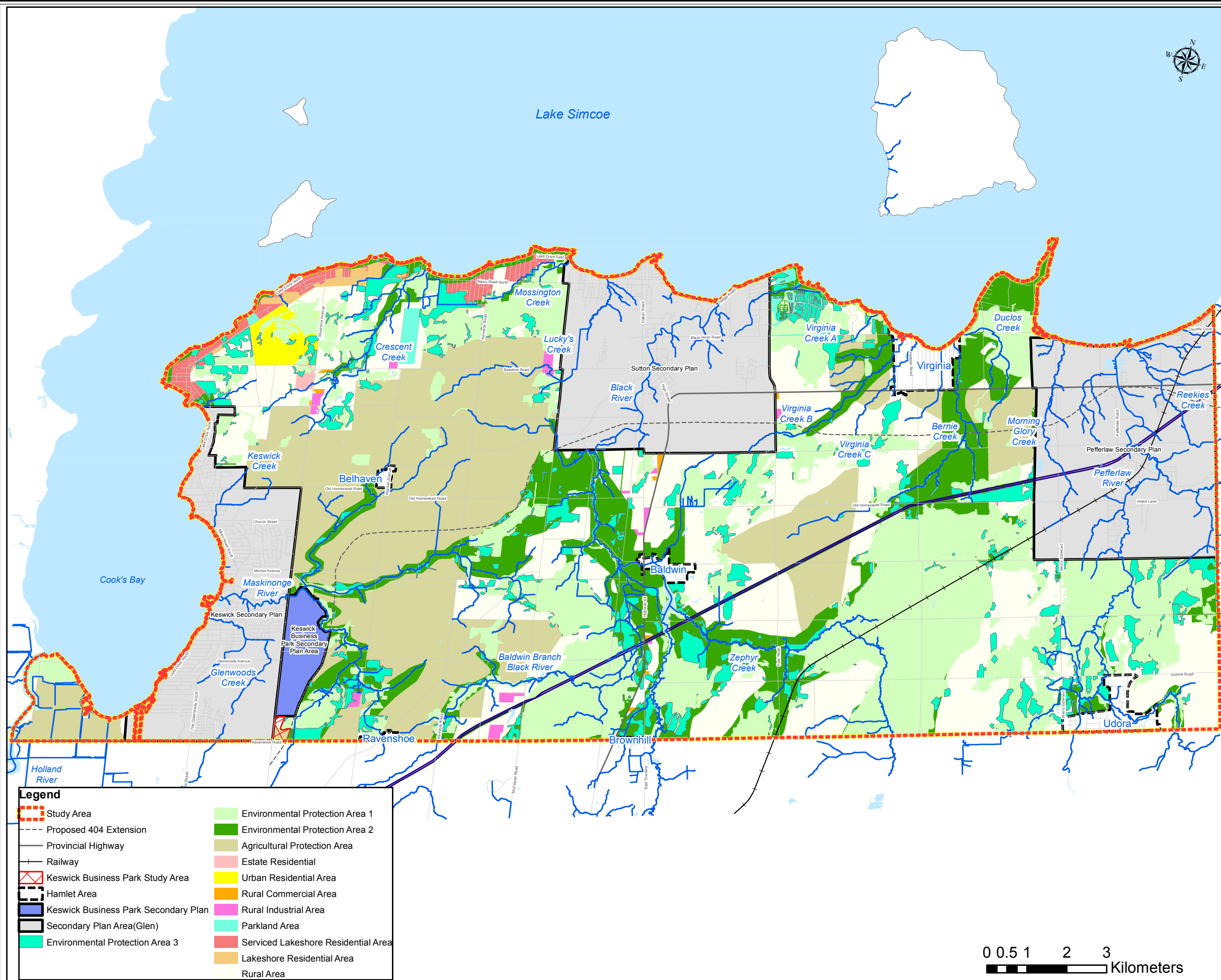
**Town of Georgina  
 Stormwater Management Master  
 Plan**

Existing Landuse

**FIGURE: 4.1**

DATE: July 2017





KEY MAP

Source: Regional Municipality of York, Georgina Official Plan, October 17, 2002.



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## Town of Georgina Stormwater Management Master Plan

Land Use as Designated  
 under the Official Plan

Legend	
	Study Area
	Proposed 404 Extension
	Provincial Highway
	Railway
	Keswick Business Park Study Area
	Hamlet Area
	Keswick Business Park Secondary Plan
	Secondary Plan Area(Glen)
	Environmental Protection Area 1
	Environmental Protection Area 2
	Agricultural Protection Area
	Estate Residential
	Urban Residential Area
	Rural Commercial Area
	Rural Industrial Area
	Parkland Area
	Environmental Protection Area 3
	Serviced Lakeshore Residential Area
	Lakeshore Residential Area
	Rural Area

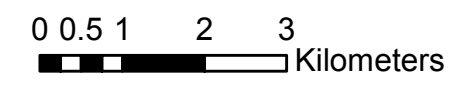
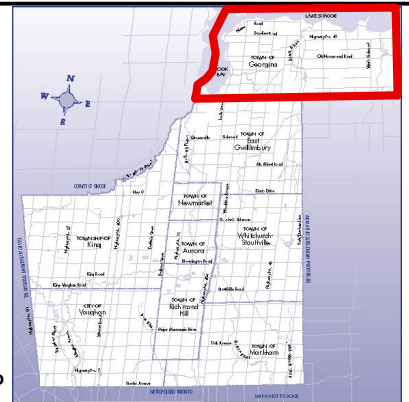
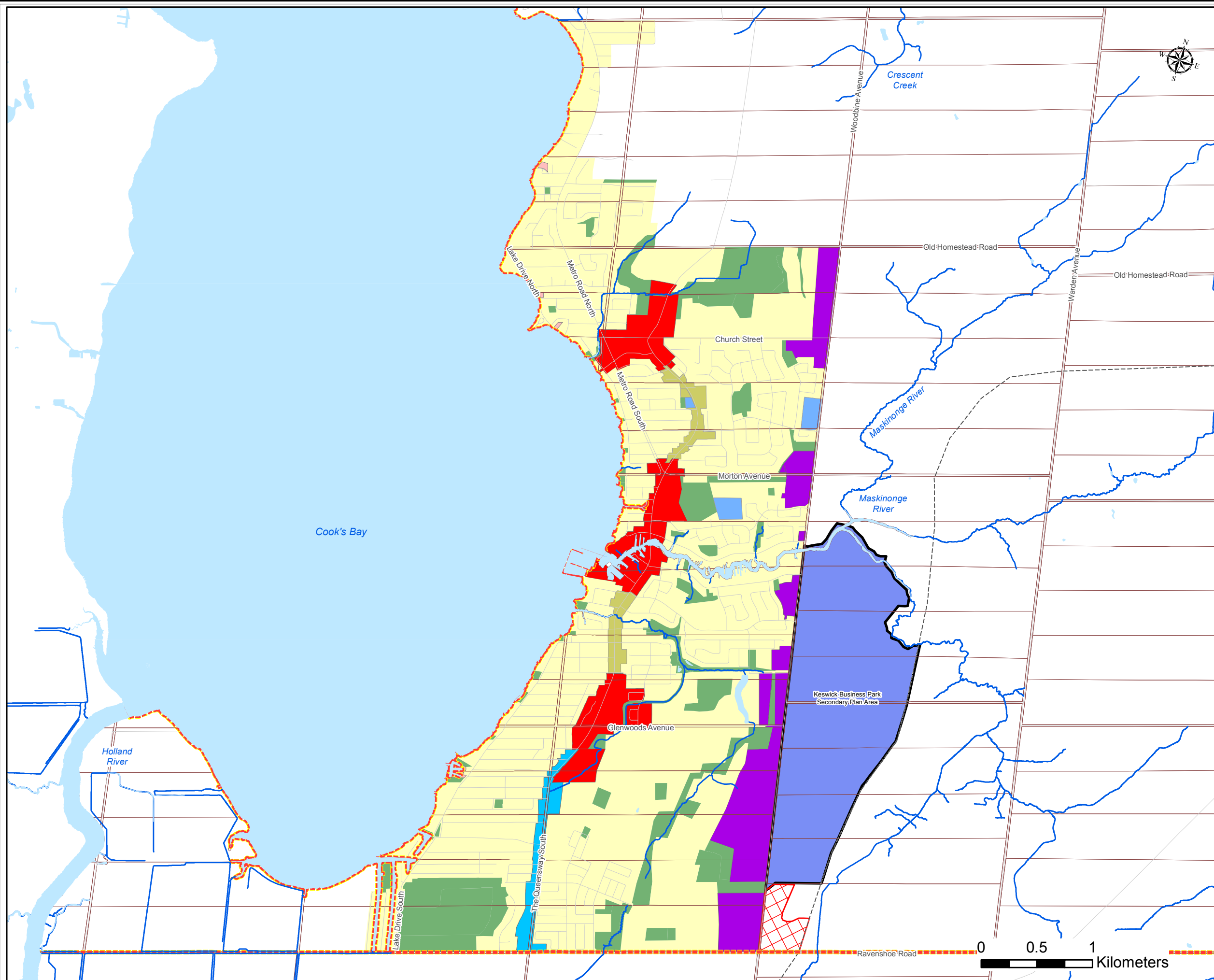


FIGURE: 4.2

DATE: July 2017



**Legend**

- Proposed 404 Extension
  - Provincial Highway
  - + Railway
  - ⊠ Keswick Business Park Study Area
  - Keswick Business Park Secondary Plan
- Zoning**
- Neighbourhood Residential
  - Urban Centres
  - Urban Corridor 1
  - Urban Corridor 2
  - Tourist Commercial
  - Commercial/Employment
  - Institutional/Community
  - Greenlands System

Source: Town of Georgina, Keswick Secondary Plan, October 26, 2004



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**Town of Georgina  
 Stormwater Management Master  
 Plan**  
 Secondary Plan Land Use  
 - Keswick

**FIGURE: 4.2a**

DATE: July 2017

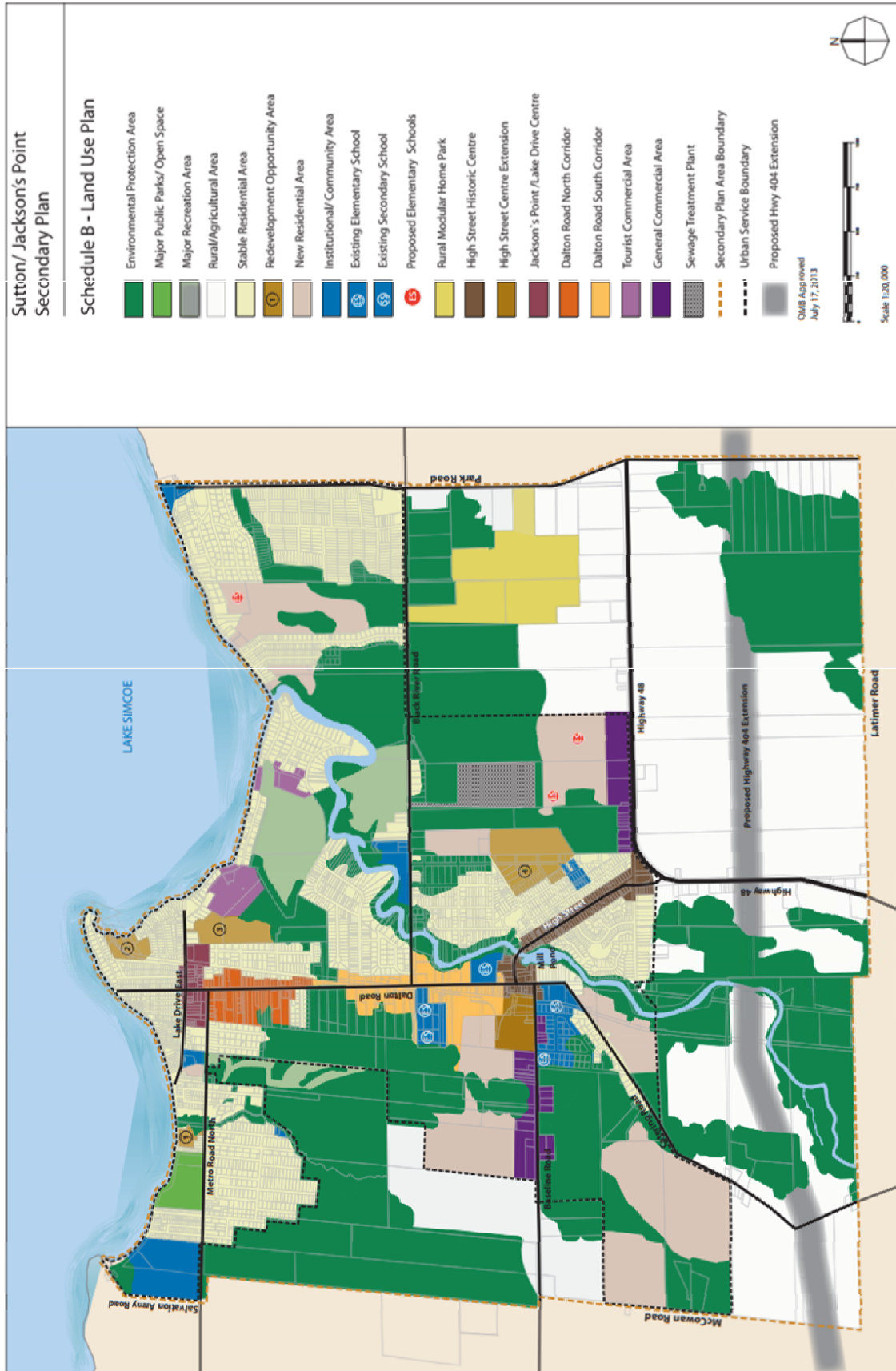



Figure 4.2b: Secondary Plan Land Use -Sutton (Source: Sutton/Jackson's Point Secondary Plan, 2013)

**PEPPERLAW  
SECONDARY PLAN  
SCHEDULE 'E1'  
LAND USE PLAN**

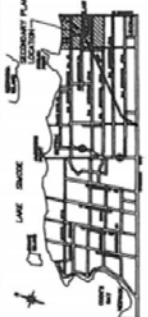
**TOWN OF GEORGINA**



**LEGEND**

- SECONDARY PLAN BOUNDARY LINE
- RURAL
- RURAL SPECIAL DEVELOPMENT AREA
- RESIDENTIAL
- RESIDENTIAL SPECIAL DEVELOPMENT AREA
- COMMERCIAL
- COMMERCIAL SPECIAL STUDY AREA
- INDUSTRIAL
- INDUSTRIAL SPECIAL STUDY AREA
- RECREATIONAL COMMERCIAL SPECIAL STUDY AREA
- INSTITUTIONAL
- PRIVATE OPEN SPACE
- PUBLIC OPEN SPACE

**KEY MAP**



**REVISIONS**

SCALE 1 : 12 500  
0 500 1000 1500m

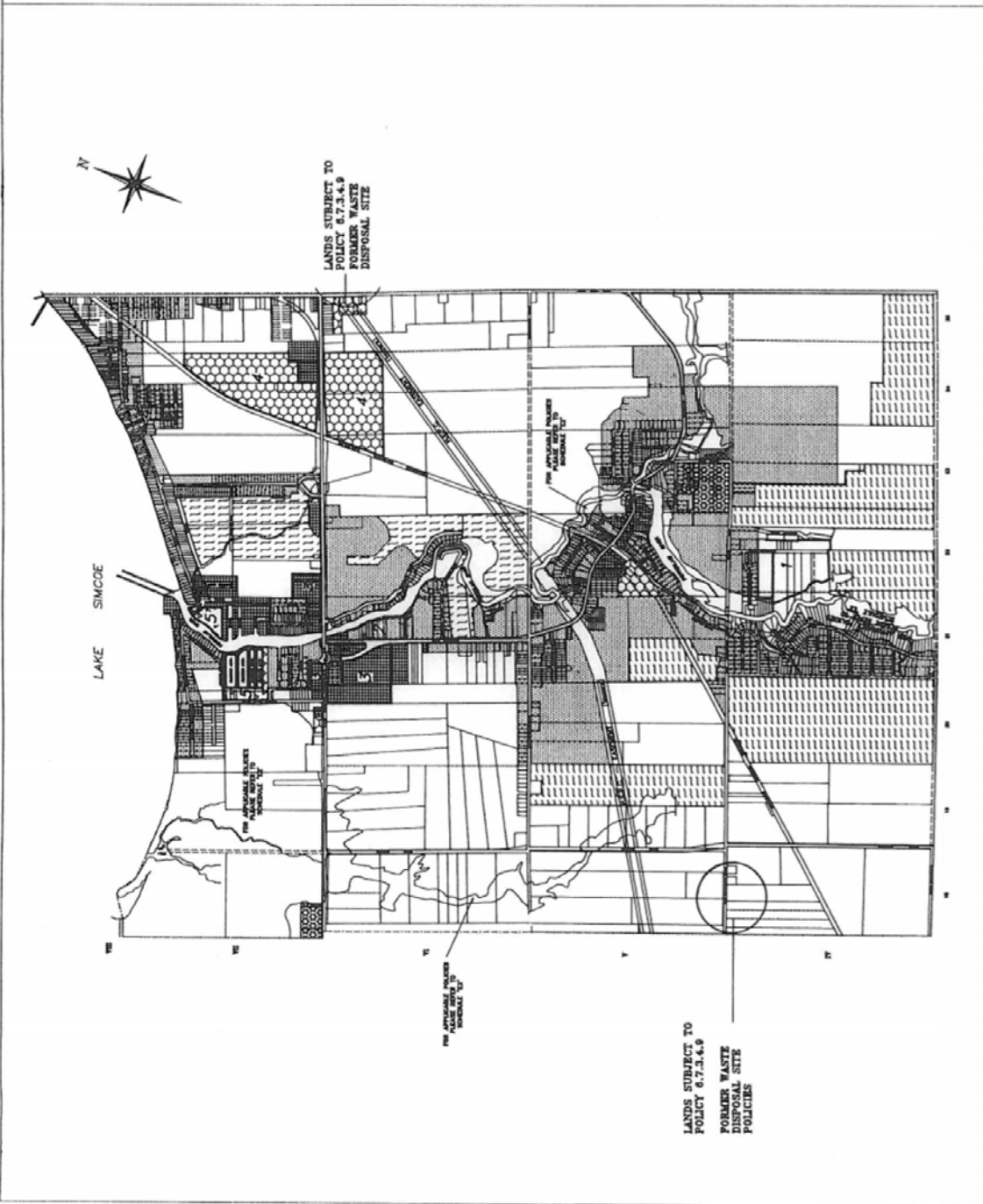


Figure 4.2c: Secondary Plan Land Use -Pefferlaw (Source: Pefferlaw Secondary Plan, 2013)

### 4.3 Soil and Physiography

According to the Subwatershed Plans completed for the Black River, East Holland River, Maskinonge River and Pefferlaw River, local bedrock within the municipality is overlain by unconsolidated sediments, known as the overburden, which was deposited during the Quaternary Period. The surficial deposits within the study area are interpreted to have been deposited by the Laurentide Ice Sheet during the Wisconsin glaciation. The stratigraphy of the surficial deposits within the area is extremely complex.

As shown on **Figure 4.3**, major soil groups found in the municipality include:

- Glacial Lake Deposits;
- Glacial River Deposits;
- Moraine Deposits;
- Newmarket Till;
- Organic Deposits;
- River Deposits;
- River Deposits (modern); and
- Wildfield / Kettleby Till.

### 4.4 Natural Heritage

NHF are common within the Town. Regionally Significant Wetlands (RSW) and PSWs make up approximately 11.3% of the Town while wetlands that are either unclassified or do not contribute to PSW or RSW wetland complexes cover another 1.3% of the Town. Woodlands make up approximately 32.0% of the Town with mid-to-late growth lots that are less than 4.00 ha comprising approximately half (16.6%) of this value.

#### 4.4.1 Terrestrial Ecology

##### Wetlands

Schedule B4 of the Town's OP (2010) identifies Evaluated Wetland complexes across the municipality. **Figure 4.4** identifies evaluated wetlands per Schedule 4 of the OP. Wetlands in the municipality include but are not limited to:

1. Black River Complex # 1;
2. Holland Marsh;
3. Zephyr - Egypt Complex;
4. Morning Glory Swamp;
5. Lower Pefferlaw Brook Complex;
6. Georgina Island Complex;
7. Willow Beach Complex;
8. Maskinonge River Complex;
9. Mossington Park Complex;
10. Paradise Beach Wetland;
11. Riverview Beach Complex;
12. Vachell Swamp Complex;
13. Sod Swamp Complex; and
14. Willow Swamp.

According to the **Black River Subwatershed Plan** (LSRCA, 2010), The Black River Subwatershed has a relatively high proportion of the Lake Simcoe watershed’s swamp (20.6%), owing largely to the wooded valley wetlands. Of note is that it contains some rare fen communities as well as the more scarce bog communities. Of the wetlands within the Black River Subwatershed, approximately 50% are concentrated in two general areas, the Zephyr-Egypt PSW Complex and the Black River PSW Complex #1. These areas make up approximately 80% of the PSWs in the Black River Subwatershed and are large areas of swamp located south of Baldwin and Egypt, running southward to Mount Albert and Zephyr.

According to the **East Holland River Subwatershed Plan** (LSRCA, 2010a), wetlands in the subwatershed are substantially concentrated in the Holland Marsh area, at the northern tip of the subwatershed just south of Cook’s Bay (which includes high quality marshes and rare fen communities).

According to the **Maskinonge River Subwatershed Plan** (LSRCA, 2010c), only two (2) types of wetlands are found in the Maskinonge River Subwatershed. The majority (70%) are swamps, while 25% are marshes. The 8.7% of the Maskinonge River Subwatershed that is currently wetland is substantially concentrated in the general area of Ravenshoe, where the Maskinonge River PSW Complex is located. The remainder of the subwatershed is lacking in wetland communities.

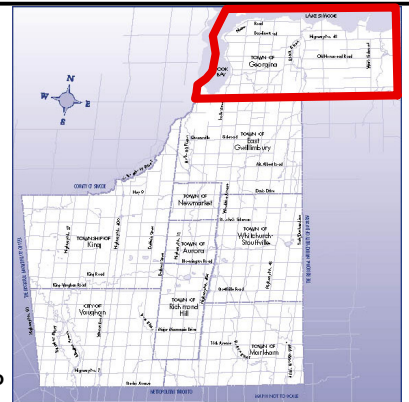
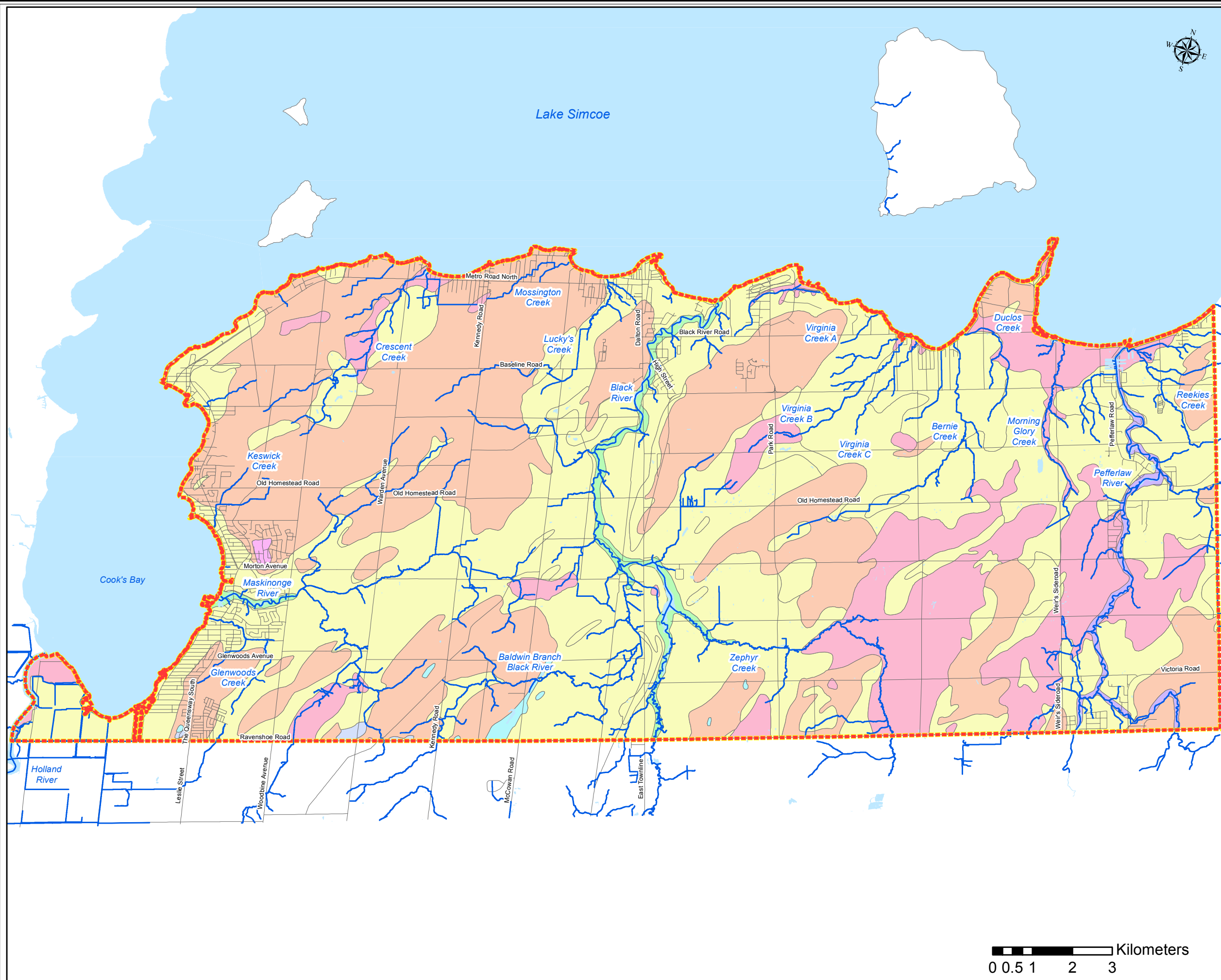
According to the **Pefferlaw River Subwatershed Study** (LSRCA, 2012), There are approximately 7,540 ha of wetland in the Pefferlaw River Subwatershed, which is approximately 16.9% of the landscape. While wetlands can be found throughout the subwatershed, a higher proportion is observed throughout the southern and central reaches of the subwatershed than in the north eastern portion. Many of the subwatershed’s headwater streams are surrounded by wetlands, and much of the main branch on the south-central portion is surrounded by wetland.

**Woodland Cover**

Significant Woodlands are identified in Schedule B3 of the Town’s OP (2010). As shown in **Figure 4.4**, mid-to-late succession forest is the most abundant type of significant woodlands within the municipality. These woodlands can be found across the Town but are more prevalent in the eastern portion than the more agricultural west. Clusters of Old Growth Forest exist within the municipality. This includes significant areas of Old Growth Forest in the Sutton SPA and the Pefferlaw SPA.

**Table 4.3: Terrestrial Ecology Features within the Town of Georgina.**

Category	Area (ha)	Percent of Study Area (%)
Wetlands	364	1.3
Provincially or Regionally Significant Wetlands (PSW or RSW)	3260	11.3
Old Growth	213	0.7
Mid-Late > 4 ha	4800	16.6
Mid-Late < 4 ha	362	1.3
Early-Mid	2510	8.7
Transitional-Unclassified	1360	4.7



**Legend**

- Study Area
- Surficial Geology**
- Glacial Lake Deposits
- Glacial River Deposits
- Moraine Deposits
- Newmarket Till
- Organic Deposits
- River Deposits
- River Deposits (modern)
- Wildfield / Kettleby Till

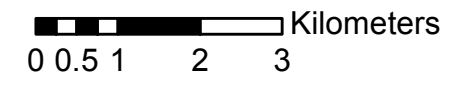
Source: Ministry of Natural Resources, Surficial geology of Southern Ontario, 2012



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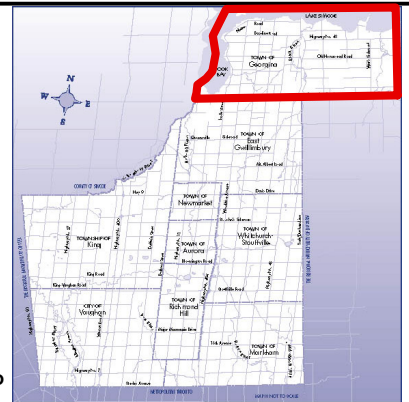
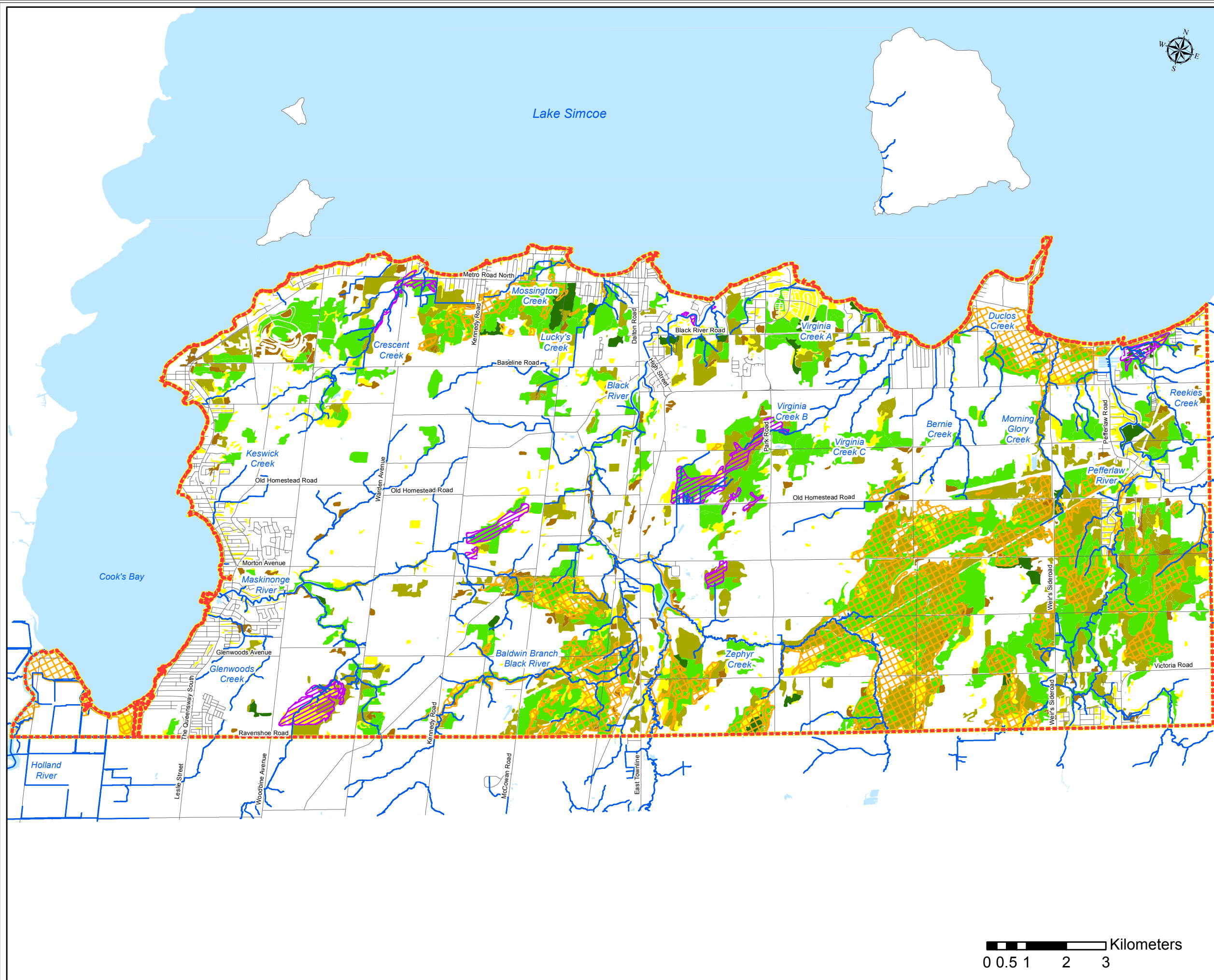
**Town of Georgina  
 Stormwater Management Master  
 Plan**

Surficial Geology



**FIGURE: 4.3**

DATE: July 2017



**Legend**

- Study Area
- Waterbody
- Watercourse
- Wetlands
- Provincially Significant Wetlands
- Old Growth Forest (>100 years)
- Mid to Late Successional Forest (>4ha)
- Mid to Late Successional Forest (<4ha)
- Early to Mid Successional Forest
- Transitional and Unclassified Vegetation

Source: Regional Municipality of York, Town of Georgina Official Plan - Schedule B3, 2015.

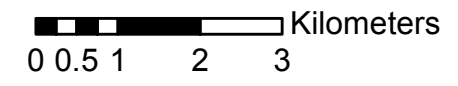


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**Town of Georgina  
 Stormwater Management Master  
 Plan**

Terrestrial Ecology



**FIGURE: 4.4**

DATE: July 2017

#### **4.4.2 Aquatic Ecology**

Within the Town, monitoring of the fish and benthic invertebrate communities is undertaken by the LSRCA at sites throughout the various subwatersheds. Information on aquatic ecology can be found in the individual subwatershed plans and is summarized below.

##### **Black River Subwatershed**

According to the Black River Subwatershed Plan (LSRCA, 2010), thirty-five (35) fish species have been captured in the Black River Subwatershed since 1973. This subwatershed ranges from cold headwater communities featuring such species as brook trout and mottled sculpin to diverse warm large order systems displaying such species as largemouth bass and brown bullhead. Generally, the Black River displays cold to cool water tributaries within larger wetlands and forested areas feeding a warm water Main Branch. Fish communities appear to be fairly healthy, with cold water species being found as would be expected at sites recording cold water temperatures, and warm water species at the sites displaying warm water temperatures. There are no known rare or endangered fish species that reside in the Black River.

##### **East Holland Subwatershed**

According to the East River Holland Subwatershed Plan (LSRCA, 2010a), thirty-five (35) species of fish have been captured from the East Holland River since. The fish communities in the East Holland range from cold headwater communities featuring such species as brook trout and mottled sculpin to diverse warm large order systems containing such species as largemouth bass and brown bullhead. The portion of the subwatershed within the Town is classified as warm water habitat, and warm water species are captured in these areas. The only endangered species found in the subwatershed is the Redside Dace. This was found in the headwater reaches outside of the study area.

##### **Maskinonge River Subwatershed**

According to the Maskinonge River Subwatershed Plan (LSRCA, 2010c), twenty-five (25) species of fish have been captured in the Maskinonge River since 1990. The Maskinonge ranges from cold headwater communities influenced by the Oak Ridges Moraine in the south of the watershed featuring mottled sculpin to diverse warm, large order systems displaying such species as largemouth Bass and brown Bullhead. Generally, the Maskinonge River's northern and main branches which are located in the Town are classified warm water habitat. There are fewer cold headwater streams in the Maskinonge River Subwatershed because less cold groundwater influence from the Oak Ridges Moraine compared to many of Lake Simcoe's other subwatersheds. There are no known rare or endangered fish species that reside in the Maskinonge River.

##### **Pefferlaw River Subwatershed**

According to the Pefferlaw River Subwatershed Plan (LSRCA, 2012), forty-five (45) species of fish have been captured in the Pefferlaw River since 1930. Fish communities in the Maskinonge River range from cold headwater areas containing brook trout and mottled sculpin to diverse warm large order systems containing such species as largemouth bass and brown bullhead. The subwatershed is characterized by cold to cool water tributaries feeding a warmer western main branch, however, most of the system is managed as a cold water fishery. There are no known rare or endangered fish species that reside in the Pefferlaw River.

## 4.5 Groundwater Features and Functions

### 4.5.1 Groundwater Recharge

According to information received from the MNRF, significant recharge areas are mostly located within the western and central portion of the study area (**Figure 4.6**).

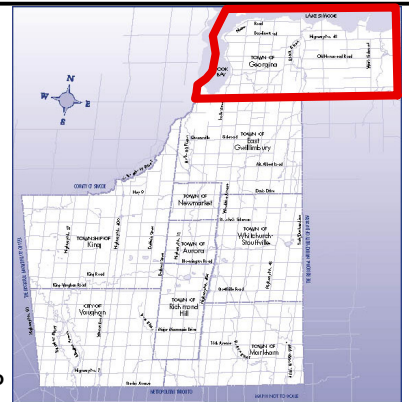
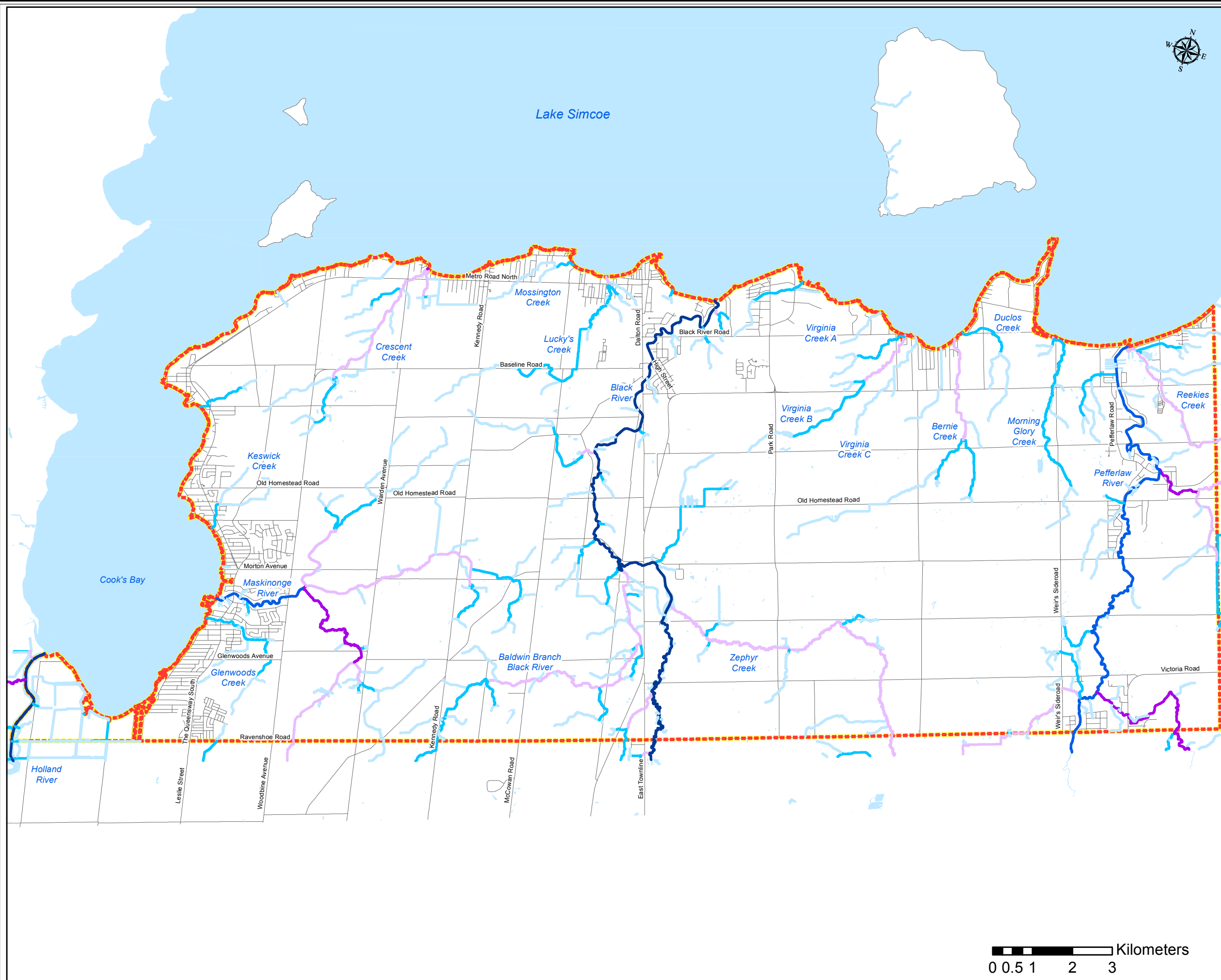
The largest recharge area within the municipality is the eastern portion of the Maskinonge River Subwatershed. Though this area represents the largest recharge area in the municipality, it is responsible for less groundwater recharge than upstream areas outside of the Town in the Oak Ridges Moraine. Significant recharge areas exist in the Black Creek Subwatershed area supporting baseflow in Burnie Creek and the smaller Virginia Creeks.

## 4.6 Surface Water Features and Functions

The main surface water features that drain to Lake Simcoe within the Town include:

1. The Main Branch of East Holland River flowing north to discharge into Cook's Bay at the western limit of the Town;
2. Maskinonge River, flowing north and joining tributaries from the north and east before discharging into Cook's Bay at the Community of Keswick;
3. Crescent Creek and Lucky's Creek, the two (2) largest watercourses in the Georgina Creeks Subwatershed, both flowing into Lake Simcoe;
4. Burnie Creek, the largest of a number of smaller creek that have been included as part of the *Black River Subwatershed Plan* (LSRCA, 2010) but flow into Lake Simcoe around the community of Virginia;
5. Pefferlaw Brook, which flows from its headwaters in the Oak Ridges Moraine and discharges to the Lake Simcoe at the community of Sutton. Uxbridge Brook is a major tributary to this system.

Major surface water features along with smaller named surface water features are illustrated in **Figure 4.5**.



**Legend**

Study Area

**Stream Order**

- 1
- 2
- 3
- 4
- 5
- 6

**Note** - Stream order refers to the relative size of a watercourse. A stream begins as a first-order stream. Where two first-order streams meet, they become a second-order stream, etc.

Source: Lake Simcoe Region Conservation Authority, 2014

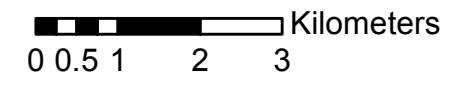


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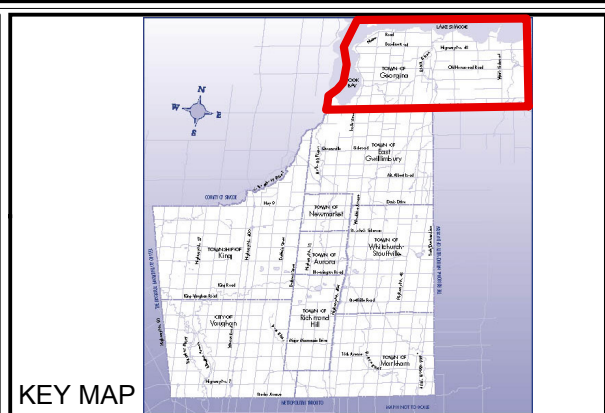
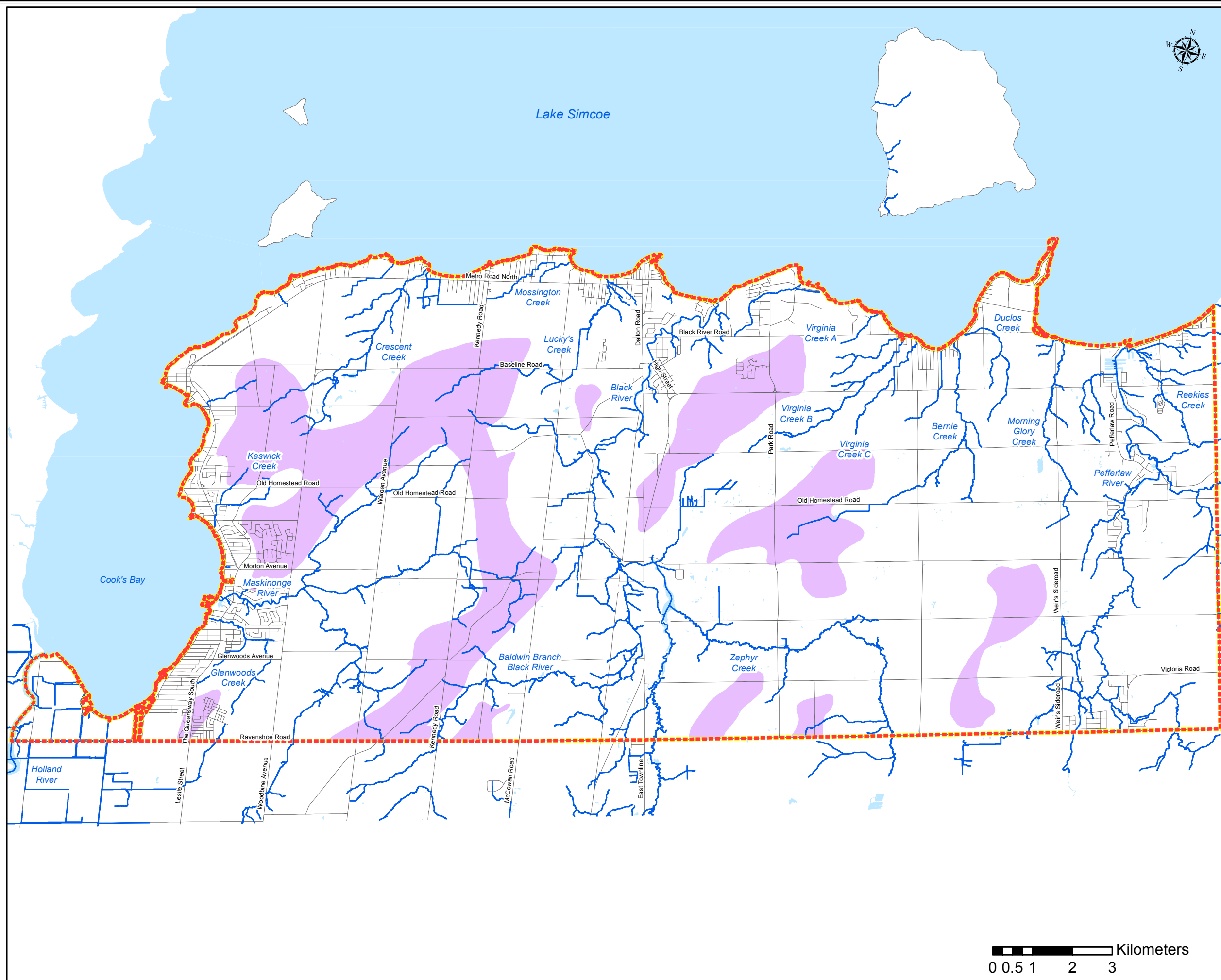
**Town of Georgina  
 Stormwater Management Master  
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Aquatic Recourses



**FIGURE: 4.5**

DATE: July 2017



**Legend**

- Study Area
- Aquifer and Recharge Area

Source: Town of Georgina, 2014.



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Significant Groundwater Recharge Areas

**FIGURE: 4.6**

DATE: July 2017

#### **4.6.1 Flow Monitoring**

Within the Town, the Water Survey of Canada (WSC) operates continuous streamflow monitoring at two (2) stations:

1. Station 02EC018 at Pefferlaw Brook near Udora with a gross drainage area of 347 km<sup>2</sup>. The period of record for this station is 1987-2016; and
2. Station 02EC008 at Black River at Baldwin with a gross drainage area of 272 km<sup>2</sup>. The period of record for this station is 1964-1969 (flow), 1983-1994 (flow), and 2002-2017 (flow and level).

These WSC stations record water level on a 15-minute interval and use a rating curve to determine flow rate.

Historically a third flow monitoring station was operated by the LSRCA:

3. Station LS0105 located at Maskinonge River at Glenwoods

Environment Canada (EC) operates two (2) active precipitation gauges within the Study Area. The first station (EC Climate ID 6110480) is located at the Black River Flow Monitoring station in Baldwin and has a period of record dating back to 2004. The second station (EC Climate ID 6119055) is located in Udora and has a period of record dating back to 1989.

#### **4.6.2 Flow Modeling**

Floodplain modeling has been conducted by the LSRCA to establish development policies within natural hazard areas. Within the Town, floodplain modelling is used to establish floodplain limits along the following creek and river systems:

- Pefferlaw Creek and many of its tributaries including Uxbridge Creek and the Wilfrid Branch;
- Many of the Virginia Creeks including lower Burnie Creek, Virginia Creek B, Virginia Creek C, and Virginia Creek D;
- The Black River including the Zephyr Creek tributary;
- Keswick Creek;
- The Maskinonge River;
- Glenwoods Creek; and
- The East Holland River.

#### **4.6.3 Flood Potential**

Based on the mapping, there are some regions within the Town's urban centers that are prone to flooding. These areas include:

- Areas of Virginia along the downstream reaches of Burnie Creek, Virginia Creek D, Virginia Creek C, and Virginia Creek B;
- Areas of Udora along the Pefferlaw River; and
- Area of Keswick along Keswick Creek.

#### 4.6.4 Water Budget

A water budget characterizes the hydrologic conditions within a subwatershed by quantifying the various elements of the hydrologic cycle, including precipitation, interception, and evapotranspiration.

At a larger scale, water budget components for subwatersheds that are at least partially within the Town are shown in **Tables 4.4** through **4.6**. These tables present values used in subwatershed plans developed by the LSRCA via conceptual and numerical modelling information developed through the Source Water Protection Program and the York, Peel, Durham, Toronto and The Conservation Authorities Moraine Coalition (YPDT-CAMC) groundwater study. According to the tables, evapotranspiration (ET) constitutes the majority of the water budget, followed by groundwater infiltration under all scenarios.

**Table 4.4: Water Budget Estimates for East Holland River Subwatershed.**

Condition	Precipitation (mm/yr)	Evapotranspiration (mm/yr)	Surface Runoff (mm/yr)	Groundwater Infiltration (mm/yr)
Existing	802	517	119	172
2002 Drought	736	465	125	155
2026 Predicted "current climate"	802	507	129	171
2026 Predicted "Drought"	736	458	135	152

Source: East Holland River Subwatershed Plan (LSRCA, 2010a).

**Table 4.5: Water Budget Estimates for Maskinonge River Subwatershed.**

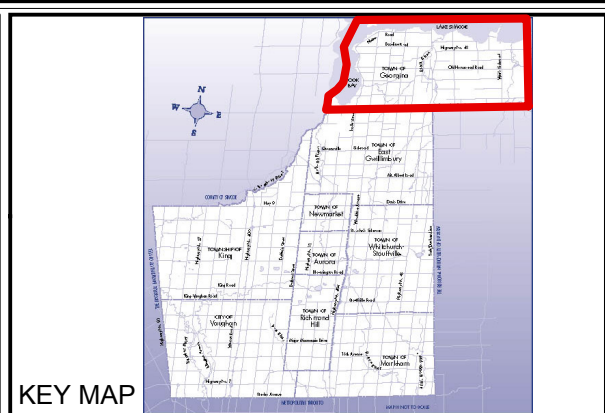
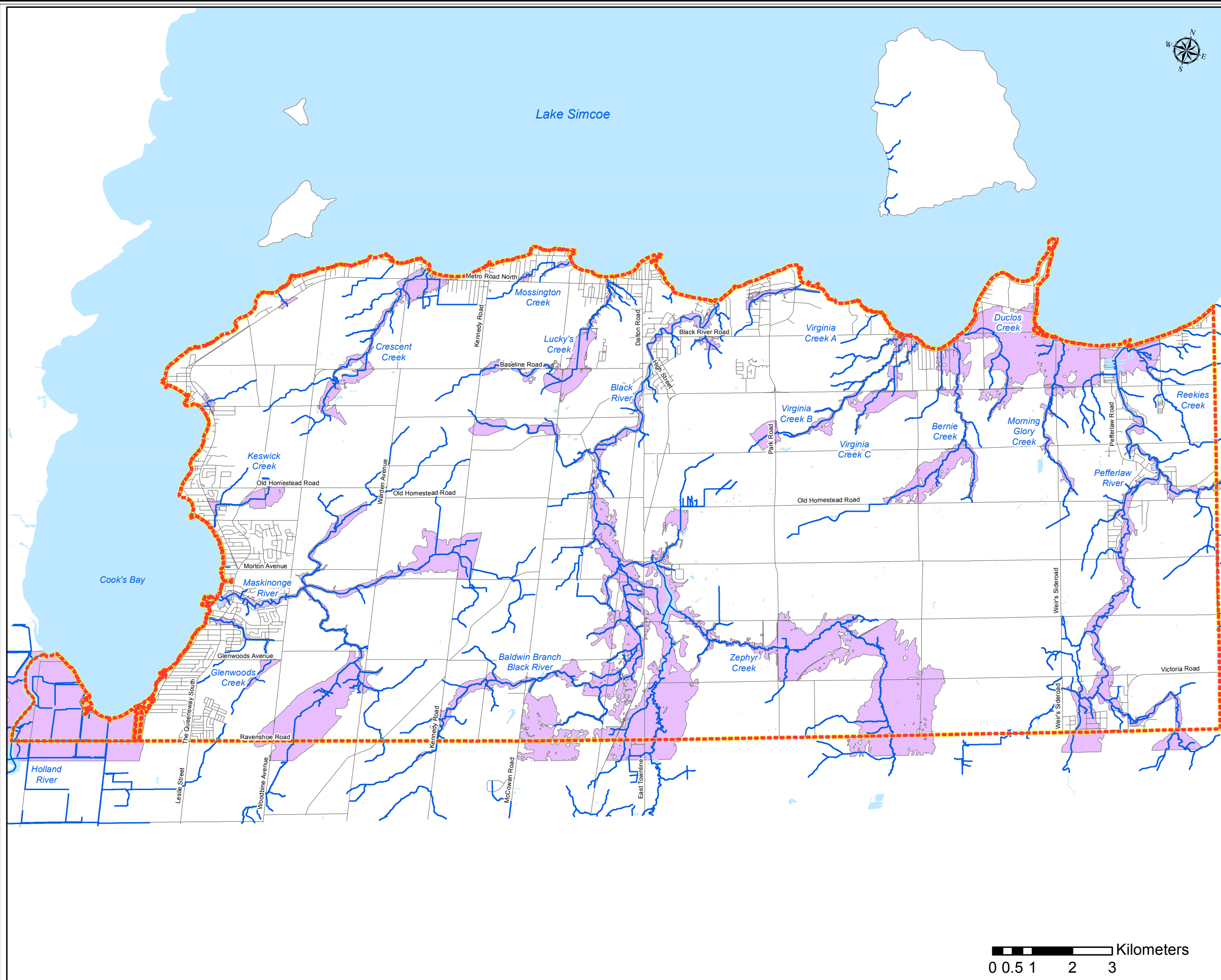
Condition	Precipitation (mm/yr)	Evapotranspiration (mm/yr)	Surface Runoff (mm/yr)	Groundwater Infiltration (mm/yr)
Existing	838	549	112	180
2002 Drought	763	486	116	162
2026 Predicted "current climate"	838	539	123	178
2026 Predicted "Drought"	763	478	126	160

Source: Maskinonge River Subwatershed Plan (LSRCA, 2010c).

**Table 4.6: Water Budget Estimates for Lower Black River Subwatershed.**

Condition	Precipitation (mm/yr)	Evapotranspiration (mm/yr)	Surface Runoff (mm/yr)	Groundwater Infiltration (mm/yr)
Existing	834	558	110	170
2002 Drought	759	491	115	158
2026 Predicted "current climate"	834	554	114	170
2026 Predicted "Drought"	759	488	119	157

Source: Black River Subwatershed Plan (LSRCA, 2010).



- Legend**
- Study Area
  - Floodplain

Source: Lake Simcoe Region Conservation Authority, 2014



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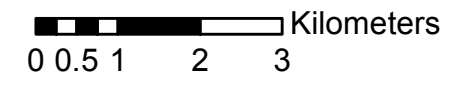
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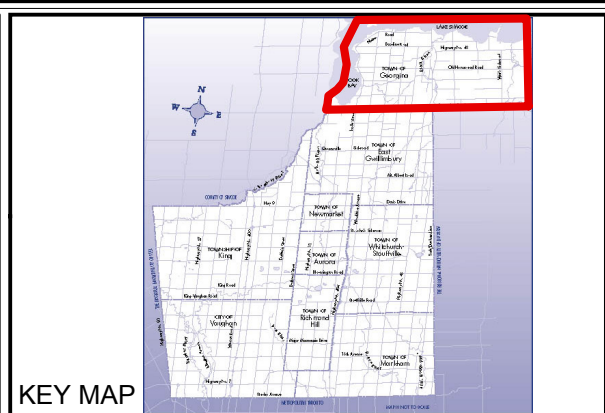
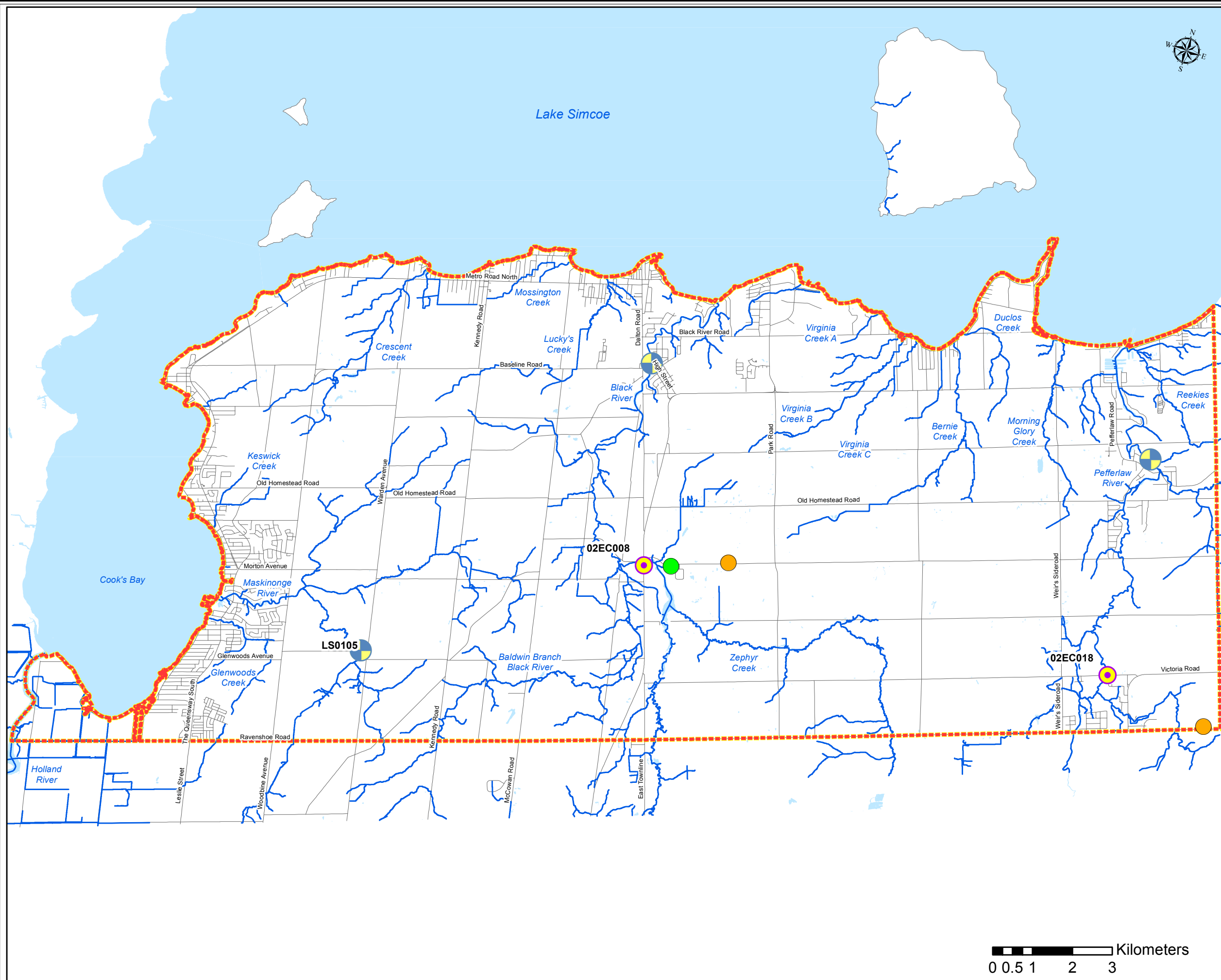
**Town of Georgina  
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 Plan**

Regulatory Floodplain

**FIGURE: 4.8**

DATE: July 2017





**Legend**

- StudyArea
- Monitoring Station**
- Groundwater Quality Station
- Precipitation Monitoring Station
- Flow Monitoring Station**
- Environment Canada
- Water Quality Station**
- PWQMN/LSEMS-Tributaries

Source: Lake Simcoe Region Conservation Authority, 2014



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**Town of Georgina  
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 Plan**

Water Quantity and Quality  
 Monitoring Locations

**FIGURE: 4.7**

DATE: July 2017

## 4.7 Water Quality

### 4.7.1 Key Pollutants

The LSPP identifies excessive phosphorus as the most significant cause of the water quality impairment in Lake Simcoe and its tributaries. Phosphorus is a key nutrient for plant growth in lakes. Excessive input of this nutrient can cause nuisance aquatic plants and algae to grow to levels that result in changes to the types of fish living in the lake. Excess phosphorus in Lake Simcoe is causing oxygen in the lake to drop to levels that are affecting fish and wildlife populations and overall water quality. Phosphorus is the key pollutant analyzed in this study.

### 4.7.2 Surface Water Quality

Previous investigations of surface water quality have been conducted for individual subwatershed. Surface water monitoring within the watershed is primarily conducted as part of two programs; the Provincial Water Quality Monitoring Network (PWQMN) and the Lake Simcoe Environmental Management Strategy (LSEMS). For both programs, water quality monitoring is conducted at the same stations. At these monitoring stations, samples are collected eight (8) times a year on a monthly basis during the ice-free period. Each sample, analyzed for thirty-two (32) chemical parameters. These stations are shown on **Figure 4.7**. The general water quality findings as outlined in the subwatershed plans are summarized below.

**Pefferlaw River:** Water Quality is not a major concern for this subwatershed when compared to other Lake Simcoe tributaries though TP regularly exceeds the objectives. There is also a long-term trend of increasing chloride concentrations within the creek.

**Maskinonge River:** Upstream of Keswick, phosphorus and iron are the main parameters impacting water quality in the Maskinonge River. TSS levels have also been increasing over the years.

**East Holland River:** The majority of water quality data collected within this watershed is upstream of the study area. Phosphorus, TSS, iron, aluminum, and zinc are all water quality parameters that must be improved to meet objectives.

**Black River:** Phosphorus is the main parameter of concern for this subwatershed. There is also a long-term trend of increasing chloride concentrations within the creek.

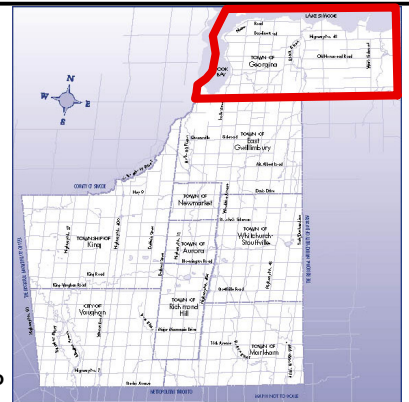
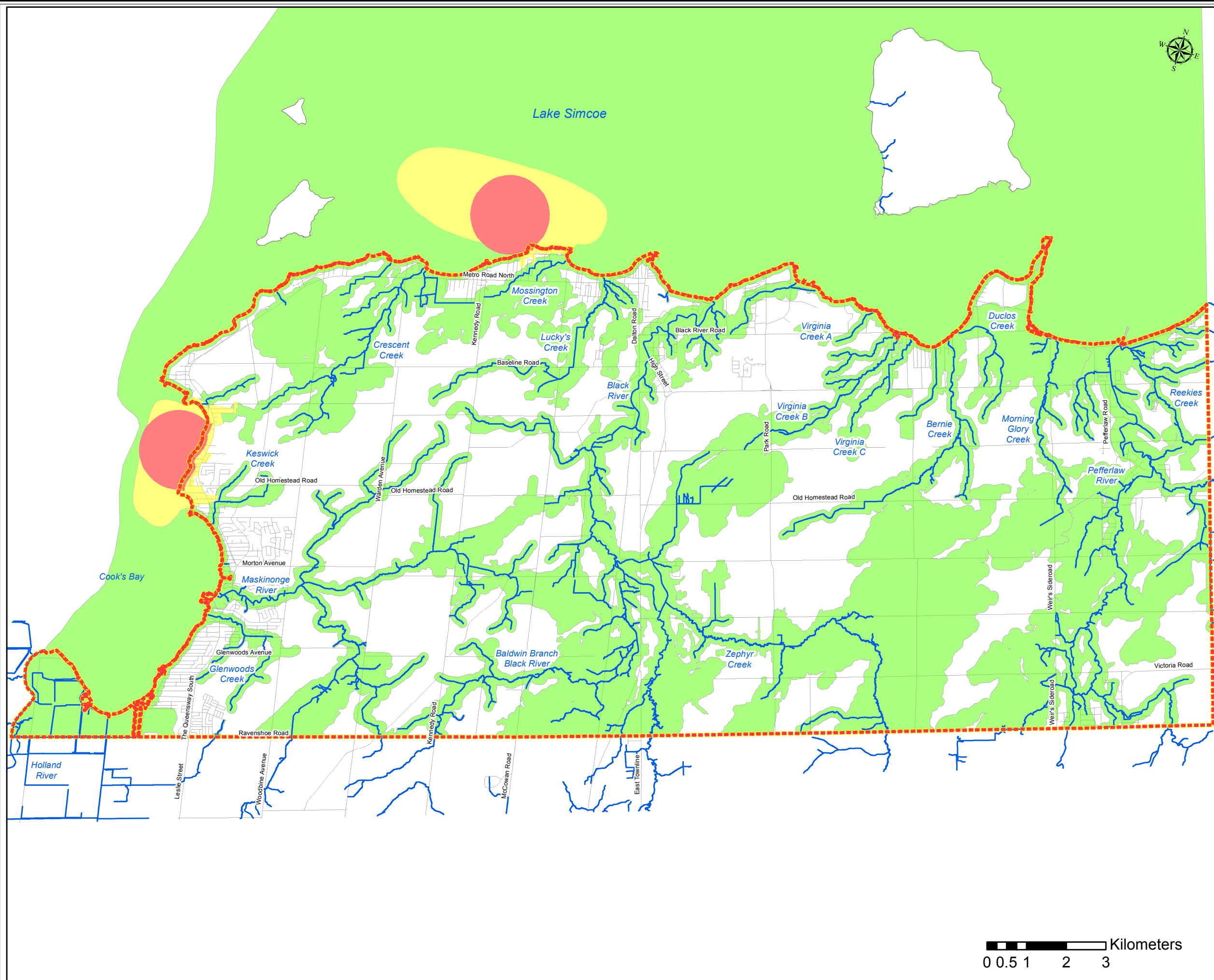
### 4.7.3 Groundwater Quality

One groundwater quality monitoring location is located in the Town. This is in the Community of Sutton in the Black River Subwatershed. The monitoring location generally meets all drinking water guidelines with the exception of some samples which have exceeded the sodium guidelines or restricted diets. This is likely due to the shallow well depth and road salt application close to the monitoring well (LSRCA, 2010).

### 4.7.4 Source Water Protection

Source water protection is undertaken in order to reduce the risk of contamination of the municipal water supply by implementing proper construction and maintenance practices and safeguard intakes and wellheads. **Figure 4.9** shows the two (2) IPZs within the study area. These intakes are located off of the Lake Simcoe shoreline just west of the Sutton SPA and off of Cook's Bay shoreline to the north of the

Keswick SPA. The coverage of IPZs extend within the existing urban area, and would also affect existing and New Development Areas.



**Legend**

- Study Area
- Intake Protection Zone**
- IPZ1
- IPZ2
- IPZ3

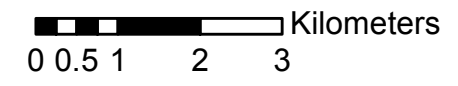
Source: Regional Municipality of York, Town of Georgia Official Plan - Schedule B3, 2015



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Intake Protection Areas



**FIGURE: 4.9**

DATE: July 2017

## 4.8 Fluvial Geomorphology

Much of the fluvial geomorphic changes within the municipality that are identified in the subwatershed plans for the Black River, East Holland River, Maskinonge River, West Holland River or Pefferlaw River are associated with the historical removal of wetlands and forests to accommodate agriculture. This has resulted in some moderate channel widening. Within the study area there are few issues relating to stream discharge, sediment regime, substrate composition and streambank conditions. Subwatershed plans do identify site specific locations with evidence of erosion, basal scour and instream debris jams. The moderate to high fluvial geomorphic issues identified in subwatershed plans are:

### Pefferlaw River

- Moderate erosion west of Lakeridge Road (reach PB 7-4 from subwatershed plan)
- Moderate erosion east of Lakeridge Road (reach PB 7-5 from subwatershed plan)

### Black River

- Moderate erosion south of Black River Road to High Street (reach BKR-3 from subwatershed plan)
- High erosion between Valley View Drive and Ridgeview Road north of Baldwin Road (reach BKR-13 from subwatershed plan)

### Maskinonge River

- Moderate erosion North of Pollock Road (reach MKA3 from subwatershed plan)

## 4.9 Stormwater Management

For the purpose of characterizing existing conditions for SWM within the Town, the following background documents were reviewed:

1. Lake Simcoe Basin Stormwater Management and Retrofit Opportunities (LSRCA, 2007);
2. Stormwater Pond Maintenance and Anoxic Conditions Investigation (LSRCA, 2011a);
3. Annual Water Balances and TP Loads to Lake Simcoe (2007-2009) (LSRCA, 2013a); and
4. Keswick Stormwater Management Study (MMM, 2011).

This section of the report reviews the findings of the LSRCA reports and other relevant reports as part of reviewing the Technical Direction (as stated in the Lake Simcoe CSWM-MP Implementation Guidelines). The section also provides an inventory for existing conditions as part of the characterization of the study area.

Since this study is focused on municipal stormwater and Lake Simcoe Watershed, the characterization of existing conditions will be focused on the SPAs:

1. Keswick SPA;
2. Sutton SPA; and
3. Pefferlaw SPA.

### 4.9.1 Existing Stormwater Management Facilities

Based on the background material available for review, there are twenty-four (24) SWM facilities within the Town (**Figure 4.10**). Retrofit opportunities as identified in the *Lake Simcoe Basin Stormwater Management and Retrofit Opportunities* (LSRCA, 2007) are shown in **Figure 4.11**. There are also forty-nine (49) Oil and Grit Separators (OGS) within the Town. By community the SWM facilities are as follows:

- **Community of Keswick :**
  - Stormwater Quality Control Facilities: 11 SWM Facilities
  - Stormwater Quantity Control Facilities: 5 SWM Facilities
  - OGS: 45 Units
  
- **Community of Sutton:**
  - Stormwater Quality Control Facilities: 1 SWM Facility
  - Stormwater Quantity Control Facilities: 4 SWM Facilities
  - OGS: 4 Units
  
- **Community of Pepperlaw:**
  - Stormwater Quantity Control Facilities: 3 SWM Facilities

**Table 4.7** identifies SWM facilities within the Town. Each facility is classified as a water quality facility or a water quantity facility. Extensive information was available in the Keswick Stormwater Management Study (MMM, 2011) for facilities within the community of Keswick. Mapping and SWM Reports were used to obtain information for the facilities located in the communities of Sutton and Pepperlaw.

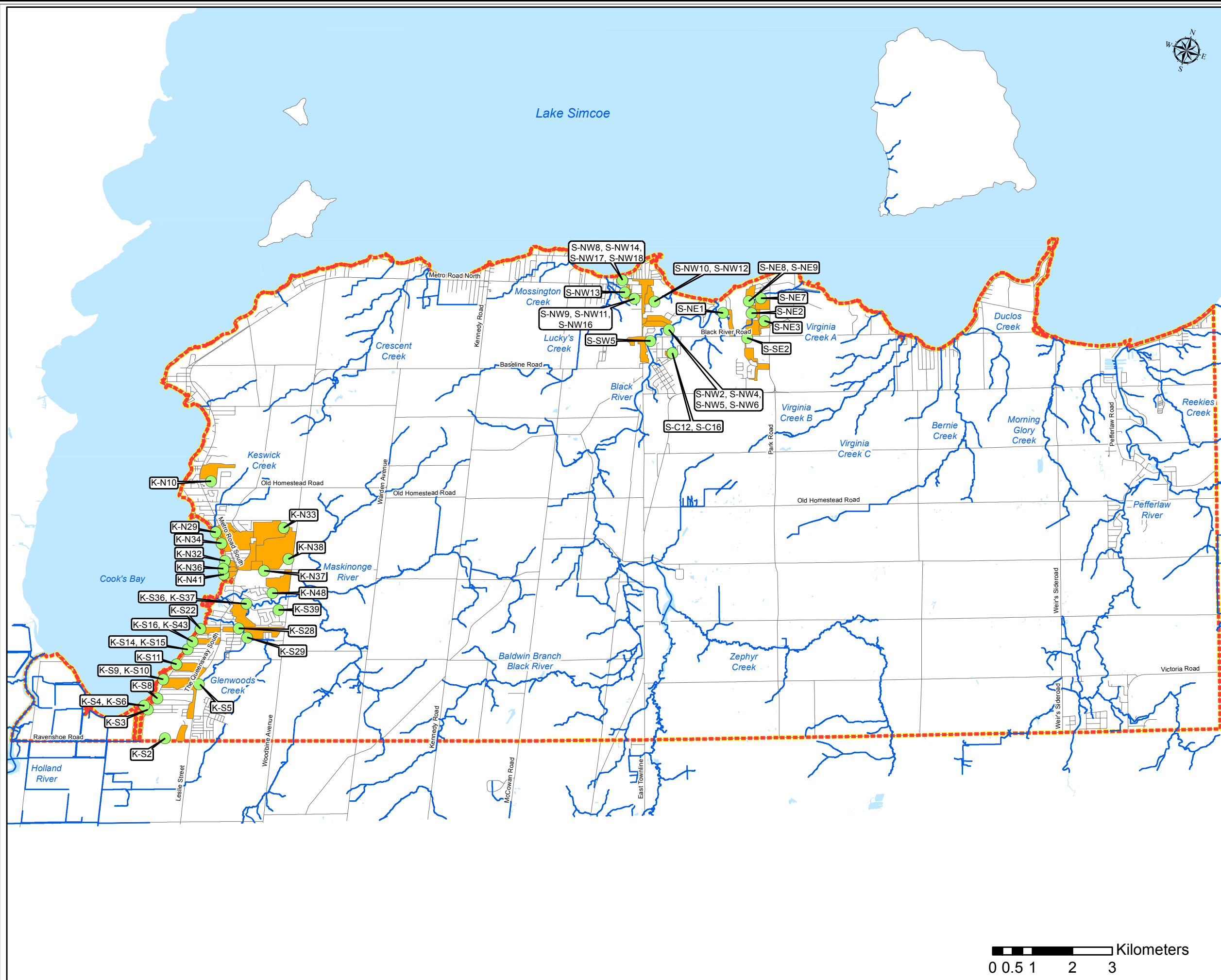
**Table 4.7: Stormwater Management Facilities.**

Facility ID	Development Name	Location	Type	Facility Function	Level of Water Treatment	Type	Adjacent Land Use	LSRCA Pond Name
<b>Keswick SPA</b>								
1	Simcoe Landing (West Pond)	Northeast corner of Thornlodge Drive and Ravenshoe Road	Wet Pond	Quality Control	Normal	Offline	Residential	K-N17
2	Simcoe Landing (East Pond)	East end of Joe Dales Drive	Wet Pond	Quality Control	Enhanced	Offline	Residential	K-S1
3	Our Lady of the Lake High School	Pond access from rear driveway at S & B Motors	Wet Pond	Quality Control	Enhanced	Offline	Institutional / Commercial	K-S47
4	Simcoe Shores	End of Dovedale Drive, also access from Bayview Park	Wet Pond	Quality Control	Enhanced	Offline	Residential	K-S19
5	Amberview	Fairwood Drive, access from entrance to park	Wet Pond	Quality Control	Enhanced	Offline	Residential	K-S29
6	Riverglen Drive	Pond at south side (adjacent to Zehrs), box culvert under Riverglen Drive	Wet Pond	Quantity	Quantity Only	Offline	Residential	KS-39
7	Cedarwood	Southeast corner of Arlington Drive and Richmond Park Drive	Wet Pond	Quality Control	Normal	Offline	Residential	K-N45
8	Cedarwood	Pond located at southwest end of Glendower Crescent	Wet Pond	Quantity Control	Quantity Only	Offline	Residential	K-N48
9	Keswick North	Forebay and pond on south side of Wexford Drive	Wet Pond	Quality Control	Normal	Offline	Residential	K-N38
10	Keswick North	South side of Church Street	Dry Pond	Quantity Control	Quantity Only	Offline	Residential	K-N33
11	Tulip Street	East side of Metro Road North just south of Tulip Street	Wet Pond	Quality Control	Normal	Offline	Residential	K-N17
12	Northdale Heights	Outlet just south of 18 Highcastle Avenue	Dry Pond	Quantity Control	Quantity Only	Offline	Residential	-
13	Oxford Homes	North side of Old Homestead just west of Hattie Court	Dry Pond	Quantity Control	Quantity Only	Offline	Residential	-
14	Lakeshore Estates	West limit of Wolford Court	Wet Pond	Quality Control	Unknown	Offline	Residential	-
15	Hollywood Subdivision	In park east of Camwood Drive	Dry Pond	Quantity Control	Quantity Only	Offline	Residential	-
16	Cheslock Development	End of Mackenzie Court just off Church Street	Dry Pond	Quantity Control	Quantity Only	Offline	Residential	-
<b>Sutton SPA</b>								
S1	Ballymore Homes	North of Baseline Road and John Link Way	Wet Pond	Quality Control	Enhanced	Offline	Residential	-
S2	Fairgrounds Subdivision	Southwest of Black River Road and Scotia Road	Wet Pond	Quantity Control	Quantity Only	Offline	Residential	-
S3	Sutton by the Lake	South of Roxanne Drive and Black River Road	Wet Pond	Quantity Control	Quantity Only	Offline	Residential	-
S4	Hedge Road Landing (Under Construction)	South of Hedge Road	Wet Pond	Quantity Control	Quantity Only	Offline	Residential	-
S5	Cedar Ridge Subdivision	East of Hawkins Street	Wet Pond	Quantity Control	Quantity Only	Offline	Residential	-
<b>Pefferlaw SPA</b>								
S1	Unknown	Highway 48	Dry Pond	Quantity Control	Quantity Only	Offline	Rural	-
S2	Unknown	Pefferlaw Road and Chambers Lane	Dry Pond	Quantity Control	Quantity Only	Offline	Residential	-
S3	Unknown	Hasting Road	Dry Pond	Quantity Control	Quantity Only	Offline	Commercial	-

According to the *Lake Simcoe Basin Stormwater Management and Retrofit Opportunities* (LSRCA, 2007), drainage areas controlled for stormwater within the communities of Keswick and Sutton can be broken down as detailed in **Table 4.8**. Pefferlaw was not analyzed in the 2007 study.

**Table 4.8: Areas controlled for Stormwater in the Communities of Keswick and Sutton.**

Community	Total Urban Areas (ha)	Uncontrolled Area (ha)	Quantity Only (ha)	Level 1 Quality (ha)	Level 2 Quality (ha)	Level 3 Quality (ha)	Level 4 Quality (ha)
Keswick	900	602 (71%)	52.8 (6%)	70.6 (8%)	21.7 (2%)	53.2 (6%)	98.9 (11%)
Sutton	307	269 (88%)	0	37.1 (12%)	0	0	0



KEY MAP

**Legend**

- Study Area
- Stormwater Retrofit Opportunity
- Stormwater Catchments

Source: Lake Simcoe Basin Stormwater Management and Retrofit Opportunities, Lake Simcoe Region Conservation Authority, 2007



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Stormwater Retrofit Opportunity

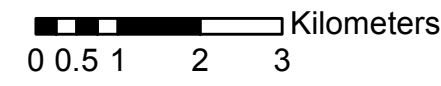


FIGURE: 4.11

DATE: July 2017

## 4.10 Management Units

This study follows a landscape-based approach where landscape patterns, features, and functions are examined within an integrated framework while understanding that areas with shared characteristics can be grouped into discrete management units. A practical and effective approach to handle the division of these management units within the study area while providing bases for environmental impact assessment is to follow the Town's OP (2010) schedules. Accordingly, and within the subsequent tasks of this study, the following management units will be addressed:

### **Management Unit 1 (MU1): Secondary Plan Areas (SPAs)**

- Keswick SPA;
- Sutton SPA;
- Pepperlaw SPA; and
- Keswick Business Park SPA.

### **Management Unit 2 (MU2): Hamlet Areas**

### **Management Unit 3 (MU3): Rural, Agricultural and Natural Land**

The division of the Town into these three (3) management units is justified by shared characteristics such as built-up environment in existing areas (retrofit opportunities), previously planned SWM in New Development Areas, pervious features and sensitive natural areas in the rural, agricultural and natural land. **Figure 4.2** identifies the SPAs, Hamlet Areas as well as the Rural, Agricultural and Natural Land that makes up the management units. The SPAs are shown in greater detail in **Figures 4.2a, 4.2b** and **4.2c**.

In regard to the environmental impact assessment, the focus in the following chapter (Chapter 5) will be on New Development Areas, where most of the impact to stormwater quantity and quality is expected as per the LSRCA implementation guidelines.

## 5. Evaluation of Environmental Impact from New Development

This study has the form of a Master Plan (**Section 1.3**), and has been initiated through the Municipal Class EA Process in order to assess, evaluate, prioritize, and select the preferred SWM alternatives for the Town.

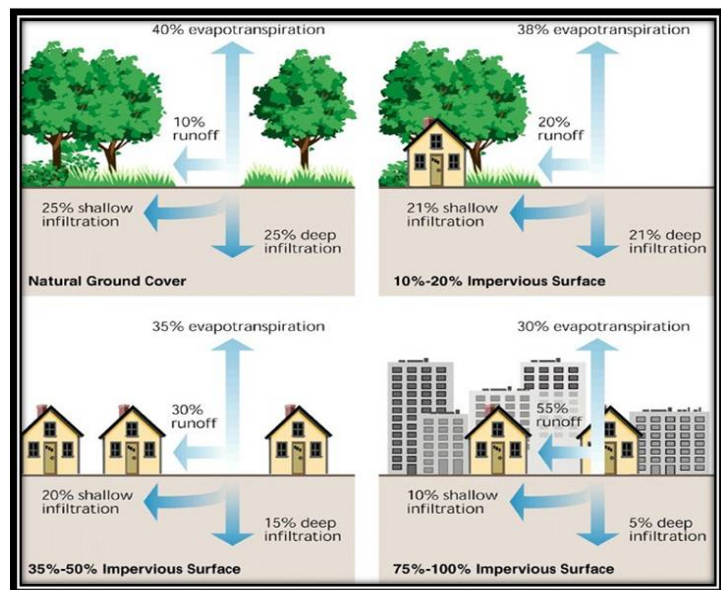
In light of the characterization of the study area carried out in **Chapter 4**, this Chapter will establish the Problem or Opportunity as per the Phase I requirements of the Master Plan, and present the impact assessment results for water balance, water quality, and water quantity. The identification and assessment of alternative solutions to the Problem, and the selection of a Preferred Alternative will be discussed in **Chapter 6** and **Chapter 7**, respectively.

### 5.1 Problems and Opportunities

#### 5.1.1 Problems

As part of land use change and development, pervious land surfaces are converted to impervious surfaces. Runoff from impervious surfaces, including building rooftops, roadways, sidewalks, parking surfaces etc. reduce the volume of precipitation lost to the natural hydrologic pathways such as infiltration and evapotranspiration.

As a result, runoff volumes and peak flows are increased during precipitation events, hydrologic response times to precipitation events are reduced, base flow conditions are impaired, ground water recharge is reduced, and the fluvial geomorphic processes of erosion and deposition are altered. Watersheds with significant development are more prone to both erosion and flooding which can lead to degraded riparian habitat and infrastructure damage. The insert figure illustrates representative changes in the proportion of precipitation entering different flow pathways, when land use changes from native vegetation to an urban landscape. In general, for a given storm event, the total volume of stormwater runoff reaching a stream increases 3 to 5-fold compared to rural or forested watersheds, accompanied with an increase in magnitude and duration of peak runoff and a significant decrease (greater than 50%) in infiltration. Implications of these impacts include flooding issues, property and infrastructure damage, and modifications in stream morphology due to excessive erosion and/or sedimentation. Accordingly, areas of concern under future development scenarios include:



**Figure 5.1: Changes in hydrologic regime with increasing impervious surface (Aquafor Beech)**

1. **Water Balance** - The increase in impervious surfaces within New Development Areas will result in the reduction in infiltration and evapotranspiration due to the reduction in permeable surfaces and natural soil and vegetation cover. Reduction in baseflow contribution to watercourses is also anticipated with specific concern in headwater and first order reaches;

2. **Water Quality** – impacts are anticipated as a result of increasing imperviousness, and changing land use types. Among expected changes are:
  - a. Changes in pollutant loadings: including phosphorus loadings, and TSS loading, and
  - b. Changes in thermal regime in receiving watercourses, consequently affecting cool water fish species;
3. **Water Quantity:**
  - a. **Flooding** – larger runoff volumes and increased peak flows are anticipated as pervious land surfaces are converted to impervious surfaces.
  - b. **Erosion** – without mitigation, the fluvial geomorphic processes of erosion and deposition will be altered and increased rates of erosion can be anticipated.

### 5.1.2 Opportunities

Previous studies have emphasized the need to address stormwater quality and quantity management through several ways including subwatershed management strategies as identified in Subwatershed Plans, stormwater retrofit opportunities (LSRCA, 2007 and MMM, 2011), and new SWM opportunities (MMM, 2011). The evaluation of SWM alternatives (**Chapter 6**) will take into consideration previous findings and recommendations. The Preferred Alternative (**Chapter 7**) includes watershed scale-objectives and the Town scale objectives relating to water balance, water quality, and water quantity concerns.

## 5.2 Impact Assessment

The following summarizes specific impacts associated with future development within the Town. The focus of this analysis is the areas of the Town where new development is planned. Significant development is restricted to MU1, more specifically the Keswick SPA, the Keswick Business Park SPA and the Sutton SPA. As a result, impact analysis is not conducted for MU2 or MU3.

The discussion includes potential impacts to:

- Water Balance;
- Water Quality; and
- Water Quantity.

Development within the study area will also impact peak flow rates and channel erosion. To establish reach-based peak flow and erosion targets, a detailed hydrologic, hydraulic and geomorphic analysis is required. This is beyond the scope of this study and not covered in this section. The stormwater targets identified in section 8.4 of this document are based on existing Town and LSRCA policy. These are:

- Post-to-pre peak flows for 1:2, 1:5, 1:10, 1:25, 1:50 and 1:100-year design storm events;
- No flood risk downstream;
- SPA specific infiltration targets in as specified in section 9.5; and
- SWM pond retention of a 4-hour 25 mm event for 24-hours.

Further study is recommended via development area specific hydrologic, hydraulic and geomorphic analysis where the above targets cannot be achieved or where site specific analyses is deemed necessary by the LSRCA or provincial agencies.

### Keswick Secondary Plan Area (Residential)

Four (4) Development Areas have been identified in the Keswick Secondary Plan. These areas correspond with major areas of undeveloped land. As Keswick's population grows, new low density residential development will occur in Development Areas. As part of the development requirements outlined in the Keswick Secondary Plan, and identified in the Keswick Secondary Plan are:

- a. Queensway West (28.5 ha);
- b. Queensway East (86.7 ha);
- c. Glenwoods (47.5 ha); and
- d. South Keswick (398.0 ha).

### **Commercial / Industrial**

The Keswick Business Park SPA is projected to accommodate 7,500 to 9,000 new jobs by the year 2026. The business park is planned for a swath of undeveloped land between proposed Highway 404 extensions to the east and Woodbine Avenue to the west. The business park will extend from the Maskinonge River to the north to almost Revenshoe Road to the south. Schedule L1 of the Keswick Business Park Secondary Plan identifies proposed Greenland systems incorporated into the Business Park design. These systems include land adjacent to the Maskinonge River and lands in the southeast corner of the business park. Business park development will be divided into three (3) permitted use areas with uses ranging from offices and retail outlets to warehouses and industrial manufacturing.

- e. Keswick Business Park (265 ha)

### **Sutton**

According to the Sutton / Jackson's Point Secondary Plan, 70 to 75% of the new growth (3,170 to 3,395 people) within Sutton is to be accommodated within Greenfield areas. These areas are development lands within the Urban Service Boundary but outside the built boundary. For this analysis the New Development Areas of Sutton have been broken down based on geographical area:

- a. Northwest (North of Baseline Road, West of the Black River) – Includes three (3) new residential development areas totaling 34 ha;
- b. Southwest (South of Baseline Road, West of the Black River) - Includes three (3) new residential development areas totaling 47 ha South Keswick;
- c. Northeast (North of Black River Road, East of the Black River) – includes two (2) residential developments totaling 39 ha; and
- d. Southeast (South of Black River Road, East of the Black River) – includes two (2) residential developments totaling 31 ha.

### **5.2.1 Water Balance**

As explained earlier, urban development is linked to the deterioration of the natural hydrological cycle, where surface runoff increases and infiltration to the ground decreases as a result of increasing imperviousness and decreasing natural cover. This study has developed a water balance estimate module to estimate the decrease in infiltration resulting from development. Calculations were carried out using variables that include soil cover, catchment area, imperviousness, and vegetative cover. For pre-development conditions, water balance data from subwatershed studies and the SWMPDM (MOE, 2003) were consulted for hydrologic cycle component values under different soil conditions and vegetative cover. Under post-development conditions, changes in imperviousness and vegetative cover were estimated and as a result, infiltration values under new development conditions were calculated. There are two

predominant soil types within the Town's existing and New Development Area. These are clay loam and silt loam.

**Tables 5.1, 5.2 and 5.3** present water balance estimates for each New Development Area. Pre-development infiltration volumes used in this analysis are consistent with values from LSRCA Subwatershed Studies (SWs). To estimate future infiltration volumes, runoff coefficients were assigned to the New Development Areas based on land use. The volume of water that is naturally infiltrating under pre-development conditions is expected to decrease dramatically as a result of development. The infiltration deficit, which is a measure of the amount of water lost from the infiltration component of the hydrological cycle due to urban development ranges between 79 mm/yr and 91 mm/yr in the Community of Keswick. In the Keswick Business Park, the deficit is expected to be 118 mm/yr. In development areas of Sutton the infiltration deficit is expected to be 87 mm/yr.

There are many implications for the decrease of water infiltrated into the ground within the study area. More specifically, areas with high imperviousness such as the Keswick Business Park SPA would lose around 70% of its infiltration capacity because of development. As a result, a myriad of environmental consequences would occur, including flooding, water quality, and aquatic habitat issues.

**Tables 5.4, 5.5 and 5.6** present the annual excess runoff for each of the new development areas when compared to undeveloped conditions. Pre-development infiltration volumes were assumed to be consistent with the LSRCA values from subwatershed water budget assessments (Tables 4.4 through 4.6 of this study). In order to estimate infiltration volumes (mm/year) for new development areas it was assumed that water that was no-longer infiltrated as a result of increased impervious cover (infiltration deficit depth) was transferred to runoff.

The volume of water that is naturally infiltrating under pre-development conditions is expected to decrease dramatically. The infiltration deficit, which is a measure of the amount of water lost from the infiltration component of the hydrological cycle due to urban development ranges between 79 mm/year to 91 mm per year for new development areas of Keswick. This corresponds to annual excesses of 26,000 m<sup>3</sup> of runoff in the Queensway West area, 79,000 m<sup>3</sup> in the Queensway East area, 43,000 m<sup>3</sup> in the Glenwoods area and 314,000 m<sup>3</sup> in the South Keswick area. For the Keswick Business Park, the 118 mm/yr deficit corresponds to annual excesses of 313,000 m<sup>3</sup> of runoff across the development. The post-development infiltration deficit for the Community of Sutton is 87 mm/yr. This corresponds to annual excesses of 30,000 m<sup>3</sup> of runoff in the Northwest Sutton area, 41,000 m<sup>3</sup> in the Southwest Sutton area, 34,000 m<sup>3</sup> in the Northeast Sutton area and 27,000 m<sup>3</sup> in the Southeast Sutton area.

**Table 5.1: Water Balance Estimates under Pre-Development and Post-Development Conditions for New Development Areas in the Community of Keswick.**

Development	Soil/ Land Use	Catchment Area (ha)	Pre-Development Conditions		Post- Development Conditions	Infiltration Deficit (mm/yr)
			Infiltration Depth (mm/yr) (LSRCA, 2010)	Infiltration Volume (m <sup>3</sup> /yr)	Infiltration Volume (m <sup>3</sup> /yr)	
<b>Queensway West</b>	Silt Loam/ Cropland	28.5	172	49,000	23,000	91
<b>Queensway East</b>	Clay Loam/ Cropland	86.7	172	149,000	70,100	91
<b>Glenwoods</b>	Clay Loam/ Forest and Pasture	47.5	172	81,700	38,400	91
<b>South Keswick</b>	Clay Loam/ High-Intensity Residential, Forest, Low Intensity Development and Cropland	398	168	684,000	362,000	79

**Table 5.2: Water Balance Estimates under Pre-Development and Post-Development Conditions for New Development Areas in the Keswick Business Park.**

Development	Soil/ Land Use	Catchment Area (ha)	Pre-Development Conditions		Post- Development Conditions	Infiltration Deficit (mm/yr)
			Infiltration Depth (mm/yr) (LSRCA, 2010)	Infiltration Volume (m <sup>3</sup> /yr)	Infiltration Volume (m <sup>3</sup> /yr)	
<b>Keswick Business Park</b>	Clay Loam/ Forest, Low Intensity Development and Cropland	265	169	448,000	134,000	118

**Table 5.3: Water Balance Estimates under Pre-Development and Post-Development Conditions for New Development Areas in the Community of Sutton.**

Development Area	Soil/ Land Use	Catchment Area (ha)	Pre-Development Conditions		Post-Development Conditions	Infiltration Deficit (mm/yr)
			Infiltration Depth (mm/yr) (LSRCA, 2010)	Infiltration Volume (m <sup>3</sup> /yr)	Infiltration Volume (m <sup>3</sup> /yr)	
<b>Northwest</b>	Clay Loam/ Forest and Pasture	34	190	64,600	25,800	87
<b>Southwest</b>	Clay Loam/ Forest and Pasture	47	190	89,300	35,700	87
<b>Northeast</b>	Clay Loam/ Forest, Cropland and Pasture	39	190	74,100	29,600	87
<b>Southeast</b>	Clay Loam/ Forest, Cropland and Pasture	31	190	58,900	23,600	87

**Table 5.4 Excess Runoff under Post-Development Conditions for New Development Areas in the Community of Keswick.**

Development	Soil / Vegetation Type	Area (ha)	Excess Annual Runoff (m <sup>3</sup> )
<b>Queensway West</b>	Silt Loam/ Cropland	28.5	26,000
<b>Queensway East</b>	Clay Loam/ Cropland	86.7	79,000
<b>Glenwoods</b>	Clay Loam/ Forest and Pasture	47.5	43,000
<b>South Keswick</b>	Clay Loam/ High-Intensity Residential, Forest, Low Intensity Development and Cropland	398	314,000

**Table 5.5 Excess Runoff under Post-Development Conditions for New Development Areas in the Keswick Business Park.**

Development	Soil / Vegetation Type	Area (ha)	Excess Annual Runoff (m <sup>3</sup> )
Keswick Business Park	Clay Loam/ Forest, Low Intensity Development and Cropland	265	313,000

**Table 5.6 Excess Runoff under Post-development Conditions for New Development Areas in the Community of Sutton.**

Development	Soil / Vegetation Type	Area (ha)	Excess Annual Runoff (m <sup>3</sup> )
Northwest	Clay Loam/ Forest and Pasture	34	30,000
Southwest	Clay Loam/ Forest and Pasture	47	41,000
Northeast	Clay Loam/ Forest, Cropland and Pasture	39	34,000
Southeast	Clay Loam/ Forest, Cropland and Pasture	31	27,000

### 5.2.2 Water Quality

The MOE's Lake Simcoe Phosphorous Loading Development Tool (Ptool) was utilized to quantify phosphorous loadings within areas where significant development is projected. These areas are confined to the urban SPAs. The model includes Event Mean Concentrations (EMCs) for phosphorous loading from unit areas of the East Holland River Subwatershed, the Maskinonge River Subwatershed, the Georgina Creeks Subwatershed and the Black River Subwatershed for a variety of land uses and represents best available information with respect to existing and future phosphorus loads. **Table 5.7** shows land uses and associated Phosphorus Export Coefficients (kg/ha/yr) used in the model. Phosphorus loading calculations are included as Appendix C - Phosphorus Loading Calculations.

Table 5.7: Land Uses and Associated Phosphorus Export Coefficients (kg/ha/yr) According to the MOE's Ptool.

Land Use	Included LSRCA Land Use(s)	Phosphorus Export Coefficients (kg/ha/yr)				Land Use	Included LSRCA Land Use(s)	Phosphorus Export Coefficients (kg/ha/yr)			
		East Holland River	Maskinonge River	Georgina Creeks	Black River			East Holland River	Maskinonge River	Georgina Creeks	Black River
Hay / Pasture	Non-Intensive Agriculture	0.12	0.07	0.12	0.08	High Intensity Development (Residential)	Urban	1.32	1.32	1.32	1.32
Crop Land	Intensive Agriculture	0.36	0.19	0.36	0.23						
Sod Farm / Golf Course	Sod Farm	0.24	0.12	0.24	0.02	Quarry	Active Aggregate	0.08	0.08	0.08	0.15
	Golf Course	0.24	0.12	0.24	0.02		Inactive Aggregate	0.08	0.08	0.08	0.15
Low Intensity Development	Estate Residential	0.13	0.13	0.13	0.17	Road	Unpaved Road	0.83	0.83	0.83	0.02
	Manicured Open Space	0.13	0.13	0.13	0.17	High Intensity Development (Commercial /Industrial)	Commercial	1.82	1.82	1.82	1.82
	Rail	0.13	0.13	0.13	0.17		Industrial	1.82	1.82	1.82	1.82
	Rural Development	0.13	0.13	0.13	0.17		Institutional	1.82	1.82	1.82	1.82
Transitional	Included Ecological Land Classifications (ELC)	0.16	0.06	0.16	0.06	Forest	Included ELC	0.10	0.10	0.10	0.05
Wetland	Included ELC	0.10	0.05	0.10	0.04	Open Water	Included ELC	0.26	0.26	0.26	0.26

The phosphorus values shown in **Table 5.7**, which were embedded in the Ptool were used to calculate phosphorus load (kg/yr) generated as a result of the new development. Pre- and post-development land cover were based on land use mapping provided by the Town, aerial photography and new development descriptions as outlined in the Town's OP (2010).

Development intensities for the Queensway West, Queensway East, Glenwoods, South Keswick and the Keswick Business Park were based on development policies as outlined in section 9.1.3.2 of the Keswick Secondary Plan.

**Tables 5.8 through 5.10** shows the results under the pre-development conditions and post-development conditions. Accordingly, phosphorus load increases dramatically under future land use. The amount of increase is expected since land uses are planned to change from low phosphorus export land uses (such as low intensity development, forest, and hay-pasture) to a mix of low intensity and high density development with higher phosphorus export.

**Table 5.8: Annual Phosphorus Loads (kg/yr) under Pre-Development and Post-Development Conditions for New Development Areas of Keswick.**

Development	Area (ha)	Soil Type / Pre-Development Land Cover	Pre-Development Load (kg/yr)	Post-Development Land Cover	Post-Development Load (kg/yr)	Post-Development Load with SWM Controls (kg/yr)	Excess Phosphorus Load with SWM Controls (kg/yr)
<b>Queensway West</b>	28.5	Silt Loam/ Cropland	10.3	High Density Residential	37.6	13.9	3.6
<b>Queensway East</b>	86.7	Clay Loam/ Cropland	31.2	High Density Residential	114.4	42.3	11.1
<b>Glenwoods</b>	47.5	Clay Loam/ Forest and Pasture	5.0	High Density Residential	62.7	23.2	18.2
<b>South Keswick</b>	398	Clay Loam/ High-Intensity Residential, Forest, Low Intensity Development and Cropland	201.9	High Density Residential	560.1	207.3	5.4

**Table 5.9: Annual Phosphorus Loads (kg/yr) under Pre-Development and Post-Development Conditions for New Development Areas in the Keswick Business Park.**

Development	Area (ha)	Soil Type / Pre-Development Land Cover	Pre-Development Load (kg/yr)	Post-Development Land Cover	Post-Development Load (kg/yr)	Post-Development Load with SWM Controls (kg/yr)	Excess Phosphorus Load with SWM Controls (kg/yr)
<b>Keswick Business Park</b>	265	Clay Loam/ Forest, Low Intensity Development and Cropland	41.7	Industrial and Commercial Development	389.6	146.5	104.8

**Table 5.10: Annual Phosphorus Loads (kg/yr) under Pre-Development and Post-Development Conditions for New Development Areas in the Community of Sutton.**

<b>Development</b>	<b>Area (ha)</b>	<b>Soil Type / Pre-Development Land Cover</b>	<b>Pre-Development Load (kg/yr)</b>	<b>Post-Development Land Cover</b>	<b>Post-Development Load (kg/yr)</b>	<b>Post-Development Load with SWM Controls (kg/yr)</b>	<b>Excess Phosphorus Load with SWM Controls (kg/yr)</b>
<b>Northwest</b>	34	Clay Loam/ Forest and Pasture	3.6	High Density Residential	44.9	16.6	13.0
<b>Southwest</b>	47	Clay Loam/ Forest and Pasture	4.8	High Density Residential	62.0	23.0	18.1
<b>Northeast</b>	39	Clay Loam/ Forest, Cropland and Pasture	3.45	High Density Residential	51.5	19.1	15.6
<b>Southeast</b>	31	Clay Loam/ Forest, Cropland and Pasture	2.60	High Density Residential	40.9	15.1	12.5

In addition to water quality analysis for phosphorus loads, this study investigated the loadings of TSS under pre- and post-development conditions (**Tables 5.12 to 5.14**). TSS have been cited as a key pollutant within Lake Simcoe watershed. Previous experience and studies were used in order to define EMCs for TSS as a function of pre-development and post-development land uses within the study area. **Table 5.11** shows EMCs applied for each land use.

**Table 5.11: Land Uses and Suggested Event Mean Concentrations (EMCs) for Total Suspended Solids (TSS).**

<b>Land Use</b>	<b>Suggested TSS EMC Values (mg/L)</b>
Residential	131
Commercial	77
Industrial	87
Open Space	216
Agricultural	100
Rural Development	71

**(Aquafor Beech, 2001)**

**Table 5.12: Annual Total Suspended Solids (TSS) Loads under Pre-Development and Post-Development Conditions for New Development Areas in the Community of Keswick.**

Development	Area (ha)	Soil Type / Pre-Development Land Cover	Pre-Development Load (t/yr)	Post-Development Land Cover	Post-Development Load (t/yr)	Post-Development Load with SWM Controls (t/yr)	Excess TSS Load (t/yr)
Queensway West	28.5	Silt Loam/ Cropland	4.57	High Density Residential	12.0	4.91	0.34
Queensway East	86.7	Clay Loam/ Cropland	13.9	High Density Residential	36.4	14.9	1.03
Glenwoods	47.5	Clay Loam/ Forest and Pasture	13.3	High Density Residential	20.0	8.18	-5.16*
South Keswick	398	Clay Loam/ High-Intensity Residential, Forest, Low Intensity Development and Cropland	87.4	High Density Residential	177.0	72.5	-14.9*

\* Reductions in sediment load were predicted for Glenwoods and Keswick South with the implementation of enhanced SWM facilities.

**Table 5.13: Annual Total Suspended Solids (TSS) Loads under Pre-Development and Post-Development Conditions for New Development Areas in the Keswick Business Park.**

Development	Area (ha)	Soil Type / Pre-Development Land Cover	Pre-Development Load (t/yr)	Post-Development Land Cover	Post-Development Load (t/yr)	Post-Development Load with SWM Controls (t/yr)	Excess TSS Load (t/yr)
Keswick Business Park	265	Clay Loam/ Forest, Low Intensity Development and Cropland	49.2	Industrial and Commercial Development	128	52.3	3.09

**Table 5.14: Annual Total Suspended Solids (TSS) Loads under Pre-Development and Post-Development Conditions for New Development Areas in the Community of Sutton.**

<b>Development</b>	<b>Area (ha)</b>	<b>Soil Type / Pre-Development Land Cover</b>	<b>Pre-Development Load (t/yr)</b>	<b>Post-Development Land Cover</b>	<b>Post-Development Load (t/yr)</b>	<b>Post-Development Load with SWM Controls (t/yr)</b>	<b>Excess TSS Load (t/yr)</b>
<b>Northwest</b>	34	Clay Loam/ Forest and Pasture	7.44	High density residential	14.3	5.86	-1.58
<b>Southwest</b>	47	Clay Loam/ Forest and Pasture	10.2	High density residential	19.8	8.10	-2.12
<b>Northeast</b>	39	Clay Loam/ Forest, Cropland and Pasture	7.65	High density residential	16.4	6.72	-0.93
<b>Southeast</b>	31	Clay Loam/ Forest, Cropland and Pasture	7.55	High density residential	13.0	5.34	-2.21

## 6. Identification of Alternative Solutions

Identifying and assessing alternative solutions (i.e. options) to the problems identified earlier (Section 4.1), and selecting a preferred option constitute the second phase (Phase 2) of the Class EA process. In line with the findings of Chapter 3 (Characterization of the Study Area) and the conclusions of Chapter 4 (Evaluation of Environmental Impact), alternative solutions are presented in this Chapter with focus on addressing water balance, water quality, and water quantity issues within the Town. Chapter 6 discusses the evaluation of these alternatives, and Chapter 7 presents the Recommended Approach.

### 6.1 Overview of Stormwater Management

During the past three decades, there has been an evolution in SWM in an effort to address downstream conditions resulting from urbanization (see insert figure below). In the early 1980s, SWM focused solely on controlling the quantity of runoff and providing flood protection through rapid conveyance measures. By the early 1990s, water quality and downstream erosion control were given additional focus. Today, with the systemic improvements in watershed management and our understanding of environmental features and functions at a watershed scale, SWM now addresses a broad suite of issues including stream morphology, the protection of groundwater resources, fish habitat, and terrestrial habitat.

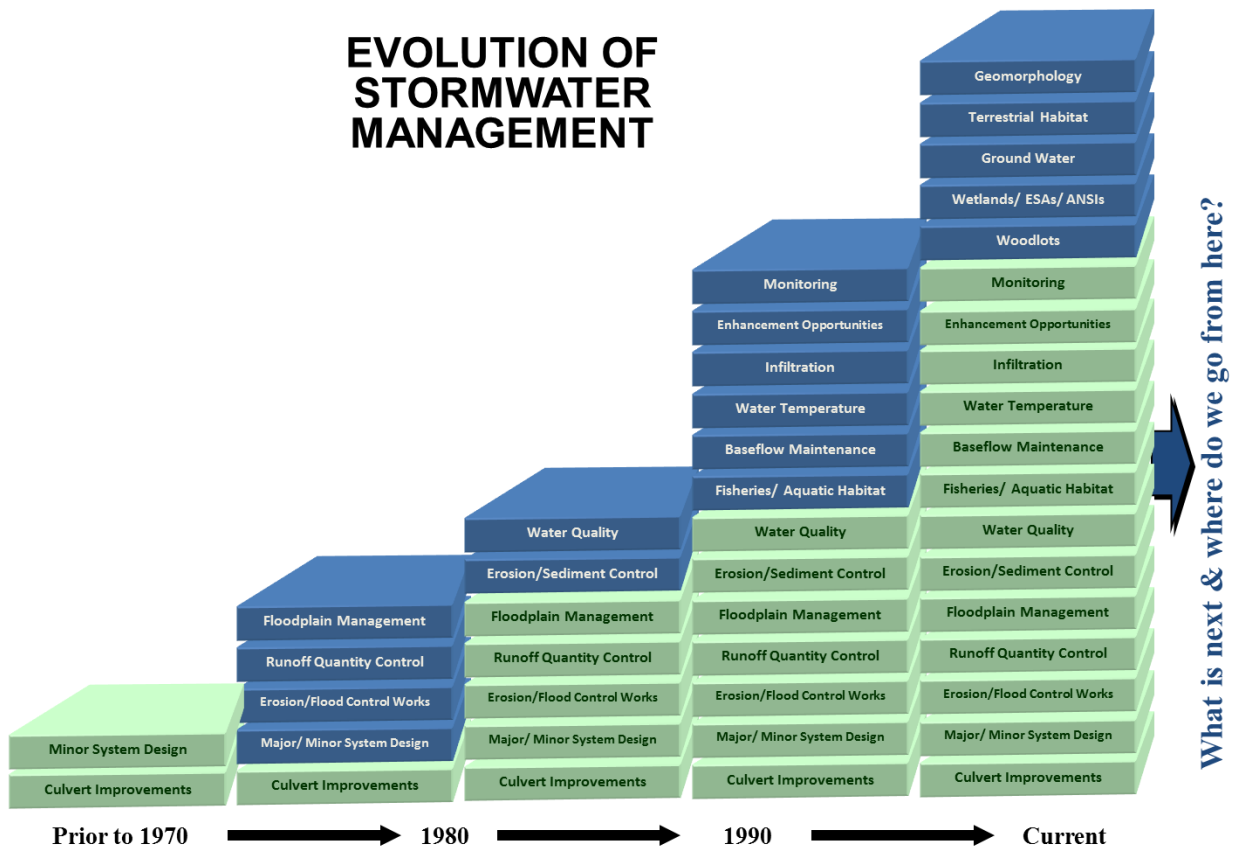


Figure 6.1: The Evolution of Stormwater Management (Adapted from MOE, 1993)

Stormwater runoff from urban areas may degrade the environment both during construction activities and post-development. Post construction pollutant loadings from urbanized areas are significant. Common pollutants include heavy metals from automobiles and air emissions, nutrients, fertilizers, chlorides from road deicers bacterial contamination from animal wastes, and toxic contamination from a variety of commercial and industrial sources. These pollutants, when conveyed to the receiving water bodies, impact the environment in many ways. The particulate (those that can be settled) and dissolved contaminants stress aquatic ecosystems by depleting oxygen, covering habitat or through the bioaccumulation or bio-concentration of contaminants in the tissues of various aquatic species. In addition, receiving waters can also be effected by thermal impacts resulting from an increase in ambient water temperatures.

Rigorous scientific research, evaluating the range of SWM treatment strategies, has produced an overwhelming amount of evidence that pipe and pond stormwater treatment strategies alone do not meet general water quality, water balance, and water quantity objectives, and are resulting in longer periods of elevated flow, thermal enrichment of surface water bodies and increased pollutant loadings. The *West Holland River Subwatershed Plan* (LSRCA, 2010d) recognized the shortcoming of using conventional SWM facilities by stating that the goals of the overall water management strategy was to be achieved by “utilizing new and innovative BMPs, as well as LID practices that will help to achieve further loading reductions in the subwatershed”. Moreover, the SWS calls for stormwater policy development where partner municipalities adopt LID practices and measures throughout the watershed.

## 6.2 Long List of Alternatives

This study has identified a list of conventional and innovative SWM measures, which directly have the potential of addressing water balance, water quality, and water quantity issues within the Town. The list includes the following five (5) general SWM categories:

1. Pollution Prevention Measures (PPM) and Municipal Management/Operational Practices (MMOP);
2. Source Control Measures (SCM);
3. Conveyance Control Measures (CCM);
4. EOP Measures; and
5. Stream Restoration.

In the following sections, these categories are discussed in detail in terms of main features, SWM function, and environmental benefits of implementing each category.

### 6.2.1 Pollution Prevention Measures and Municipal Management/Operational Practices

Applying PPM and MMOP often include changing behavior, current practices and educational programs. These measures and practices are not site-specific and can be generally applied over a watershed or municipal boundary to prevent sources of pollution from entering the drainage system.

***PPM are methods that have the intent to improve O&M of privately and publicly owned land, buildings, and infrastructure that will reduce pollution generation. Certain municipal programs such as road salt management, street sweeping and parks maintenance activities (use of herbicides and pesticides) are known to impact water quality.***

PPM and practices are activities that are generally implemented to fulfill the following objectives:

- Minimize the potential for spills and contaminated run-off into the storm drainage network;
- Reduce chemical loading rates (e.g. road salt);
- Reduce the discharge of stormwater pollutants attributed to vehicle emissions; and
- Promote the use of surface storage and drainage.

Based on consultations and discussions with the Town, it was noted that existing PPM undertaken within the Town include:

- **Street Sweeping** – Annual frequency occurring at the end of winter / beginning of spring;
- **Catch basin clean outs** – Annual frequency following street sweeping; and
- **Salt Management Planning** – The Town Developed a Salt Management Plan (SMP) in 2005.

Accordingly, there is a room to improve PPM and MMOP Practices within the Town. Other measures and practices that were discussed with the Town's staff has included the following:

- Cross Connection Control Program;
- Pool Drainage Control;
- Erosion and Sediment Control;
- Modifying Engineering Standards; and
- Public Education.

### 6.2.2 Source Control Measures

***SCM are small-scale SWM measure located at the beginning of a drainage system where stormwater is captured and treated on-site or close to where the rainfall lands. Due to the relatively small area treated by an individual measure, source controls must be well distributed to treat stormwater runoff effectively.***

SCM are generally installed on private property within residential, commercial, industrial and institutional land uses. In residential areas, SCM provide treatment for the stormwater generated by roof and driveway areas. In commercial areas, these measures may target roof, side-roads, and parking areas.

SCM remove pollutants from stormwater through a variety of mechanisms, including mechanical filtration, biological uptake, adsorption, and settling. These measures exhibit a wide variability in their ability to remove pollutants, generally ranging between 40% and 80% in efficiency depending on the particular measure and the type of pollutant being analyzed.

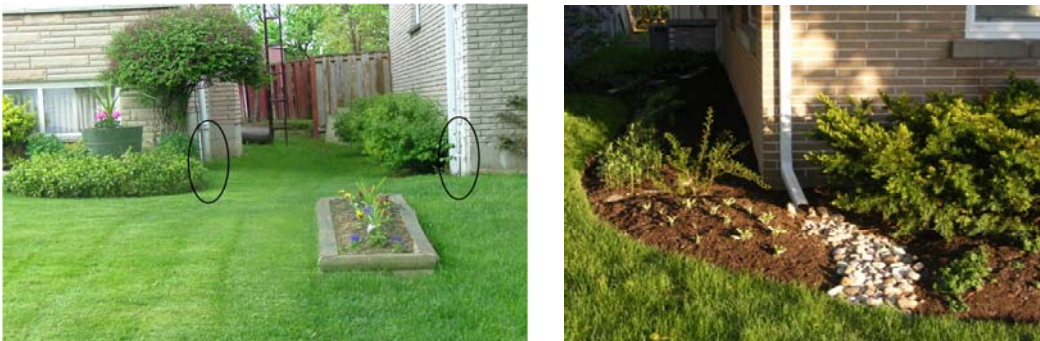
Despite the emphasis on source control in most recent stormwater policy and guidelines documents, systematic implementation of these measures throughout a municipality has not yet occurred in Canada. The implementation of a variety of SCM has however become more common in the last decade. Acceptance and promotion of this approach to SWM offers considerable promise for protecting water resources. SCM include:



**Figure 6.2: Typical Front Yard Residential Source Control.**

**Disconnection of Roof Leader:** Roof leader connections from houses can vary within different areas of the Town depending on when the home was constructed. Typically, if connected, the roof leaders flow into the municipal storm sewer system. These conditions, known as ‘directly connected’, promote a significant inflow of stormwater runoff directly into these systems during a rainfall event.

A relatively simple SCM is to disconnect the roof leader from the municipal sewer so that the relatively clean rooftop drainage can be treated on a permeable ground surface and/or used as a resource for on-site purposes. The simplest forms of roof leader disconnection are to the lawn, to a depressed area in the lawn or to a rain barrel. More advanced systems utilize naturalized gardens and bioretention techniques as discussed below.



**Figure 6.3: Typical Downspout Disconnection.**

**Enhanced Yard Vegetation and Rain Gardens:** In residential land uses rain garden areas can be placed in the front or backyard where they will capture ‘disconnected’ rooftop and yard drainage and in doing so will prevent relatively clean stormwater from entering the conventional stormwater infrastructure system and mixing with more contaminated stormwater.



**Figure 6.4: Typical Rain Gardens.**

**Bioretention Areas:** Bioretention areas are a specialized form of the more generic engineered sand filter class of stormwater control. In commercial land uses, bioretention areas can be used at the base of buildings, in parking lot islands, or at the edge of a parking lot where stormwater is directed to. Bioretention areas are relatively inexpensive to build, easy to maintain, and can add aesthetic value to a site, without consuming large amounts of valuable land area.



**Figure 6.5: Typical Bioretention.**

**Reduced Lot Grading:** Typical grading around buildings ( $\geq 2\%$ ) is reduced to encourage infiltration. When designing for reduced lot grading, the Town's design criteria must be met for all lot types.

**Permeable Driveways:** Driveways can be designed using permeable pavement systems to allow rain water to drain through the pavement and into the ground. This design or other driveway designs could also direct drainage to grassed areas to help remove stormwater pollutants which would otherwise be directed to storm sewers and receiving watercourses.



**Figure 6.6: Typical Permeable Pavement.**

**Soakaway Pits/Infiltration Trenches:** These techniques provide for infiltration of roof drainage into the ground by directing the rain water from roof leaders to an underground infiltration trench referred to as a 'soakaway pit'. These underground units are typically filled with clear stone, sand or pre-manufactured drainage materials (generally plastic grids).

**Oil and Grit Separators:** OGS are used to trap and retain oil and/or sediment in detention chambers. These unit are either located at the beginning of a storm sewer (pretreatment or source control) or at the end of a storm sewer (EOP control).

**Green Rooftop Technology:** Units which are constructed on top of buildings to reduce runoff volume (via increased evapotranspiration), improve water quality and reduce energy usage.



**Figure 6.7: Typical Green Roof.**

### 6.2.3 Conveyance Control Measures

*CCM are measures that are designed to treat stormwater as it travels overland or through pipes on route to the downstream outlet. Traditional conveyance systems comprise curbs, gutters and buried concrete (or other) piping systems that carry stormwater away from a development area to a water body generally along the road network. In appropriate applications, alternative CCM can be used to improve water quality conditions at lower cost to the municipality.*

Like source controls, these systems remove a portion of the total stormwater volume from entering the storm sewer network, slow the erosive velocity of stormwater entering watercourses, and filter out pollutants from stormwater.

CCM can often provide stormwater treatment for the collected drainage concentrated within the Right-Of-Way (ROW) of a municipal road. Because residential streets account for a significant share of a community's impervious surfaces, CCM present an important opportunity to improve downstream water quality conditions (e.g. sediment, nutrient, bacteria, oil/grit, thermal impact reduction, etc.), promote groundwater recharge and minimize watercourse erosion. CCM include:

**Bioretention/ Bioswales:** Along municipal roads, bioretention areas can be placed at the edge of paved areas, either between the curb and sidewalk, or extending into the road in the approximate area of one parking spot. These 'low-tech' water quality treatment systems use plants and soil to trap and treat petroleum products, metals, nutrients, sediments and other pollutants that typically accumulate on asphalt surfaces.



Figure 6.8: Typical Bioswales.

**Exfiltration Trench / Perforated Pipe System:** An exfiltration trench / perforated pipe system can be constructed adjacent to a road in the grassed area between the curb and the sidewalk. These systems promote infiltration of road drainage as it is conveyed along road ROW. Road drainage is first directed to the grassed surface where pollutants such as sediment, oil, grease, or grit, are filtered prior to entering the trench. After water has percolated through the gravels and pollutants have been removed, the water can

then either infiltrate into the native soils or if the volume and rate of incoming water exceeds the infiltrative capacity it is conveyed to a local stormwater drain system.



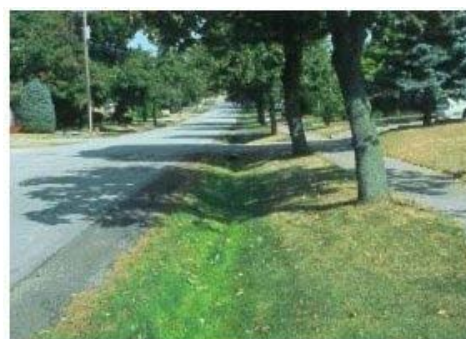
**Figure 6.9: Perforated Pipe within Bioswale.**

**Grass Swales:** Linear channels lined with grass and designed to promote shallow flow conditions. Grassed swales improve water quality through the trapping of sediment. Improvement in water quality is directly correlated to sediment trapping since contaminants typically adhere to or form part of the sediment. Dissolved contaminants, such as salt, are not treated by grassed swales.

**Pervious Catch Basins:** This technique involves a standard catch basin with a large sump which is physically connected to exfiltration storage media to make the walls or bottom of the catch basin pervious.

**Permeable Pavements:** Permeable pavement allows rain to pass through, collecting in the void space of the base course and ultimately draining away by natural infiltration.

**Vegetated Filter Strip:** A densely vegetated (planted) strip of land engineered and constructed to improve water quality by permitting sediment deposition during shallow flow conditions. Pollutant removal efficiency depends largely on the quantity of water as channelized flow conditions do not provide treatment. The type of vegetation and the soil infiltration rate also dictate pollutant removal efficiency. Depending on the amount and type of vegetation planted and the need for replacement or amendment of soils, filter strips can be inexpensive to construct and maintain. When located adjacent to a stream or valley a vegetated filter strip is often referred to as stream or valley buffer strips.



**Figure 6.10: Typical Grass Swale.**



**Figure 6.11: Permeable Pavement and Bioretention Planter.**

## 6.2.4 End-of-Pipe Measures

EOP measures are the most commonly used SWM measure in most municipalities. These measures provide treatment for the collected drainage at the end of conveyance system prior to discharge of stormwater to a watercourse. EOP measures are typically implemented in urbanizing areas as a requirement of development. Typical EOP measures used to treat stormwater include stormwater ponds (dry or wet), wetlands, hybrid facilities and/or infiltration basins.

In many typical EOP measures, it is a permanent pool of water which provides the water quality treatment. This permanent pool promotes the settling of sediments and pollutants to the bottom of the facility as stormwater travels through the facility. Provided the facility is functioning properly and is well maintained, sediments and pollutants will not be transported downstream of the facility. To optimize pollutant removal capacities, design engineers usually aim to maximize the distance that stormwater must travel through these facilities so that a larger percentage of the Suspended Solids (SS) will fall out of suspension.

The results of many monitoring programs indicate that most engineered wet ponds typically achieve 60-80% SS removal and 40-50% TP removal). In general, a larger volume of water utilized for water quality storage will enhance performance; however, SS removal performance becomes asymptotic with increasing design storage (there is a limit to storage beyond which there are negligible increases in SS settling) (MOE, 2003).

It is ideal if EOP measures are designed as large centralized facilities that treat the collected drainage from as much upstream development area as is realistically possible. This will reduce construction, O&M costs.

**Wet Ponds:** These facilities comprise the most common form of EOP SWM facilities. Wet ponds store a specific volume of water to provide water quality treatment and also address issues related to erosion and flooding.

**Wetlands:** Wetlands comprise one of the preferred EOP facilities for water quality enhancement. These facilities may be effective in reducing downstream erosion potential but their role in water quantity control is limited because of their limited storage volume and shallow water depth. As compared with other alternative systems, construction costs for wetlands systems may be high.

**Hybrid Wet Ponds / Wetlands:** A system design using a combination of wet ponds and constructed wetlands. A hybrid facility requires a wet pond to be constructed in series with a wetland. The required permanent pool volume is approximately 50% within each element.

**Upgrade / Retrofit Existing Dry Ponds:** Stormwater dry ponds, which are dry except during rainfall events and are designed for erosion and flood control. These facilities may not provide water quality control.



Figure 6.12: Typical Wet Pond.



Figure 6.13: Hybrid Wetland – Wet Pond.

Dry facilities can be retrofitted so that a permanent pool of water is incorporated into the design to provide water quality treatment,

While recent studies conducted within the LSRCA jurisdiction have concluded that wet ponds become stratified and that the coolest water released from the bottom of the facility may also have the highest chloride concentrations (LSRCA, 2013c), the settlement of suspended solids and associated stormwater constituents that occurs in these facilities, specifically when appropriately designed and maintained, provides an incremental water quality benefit compared to dry ponds.

**Infiltration Basins:** An infiltration basin is a shallow impoundment that is designed to infiltrate stormwater into the soil. Infiltration basins can have high pollutant removal efficiency and can help recharge the groundwater, thus restoring low flows to stream systems. Infiltration basins can be designed as above ground or below ground facilities.

**Filters:** These systems utilize materials such as sand, peat moss or clear stone to filter out pollutants in stormwater runoff.

**Oil and Grit Separators:** These mechanical devices are used for the capture of spills and removal of coarse sediment from stormwater. OGS are intended to remove floatables (debris, gasoline, oil, grease, light petroleum products and other floating liquids) from stormwater runoff. These systems are used for contributing drainage area < 2 ha. Generally, these devices are used for commercial and industrial land use but can also be used for redevelopment and infill areas (where available space is constrained and traditional forms of water quality treatment cannot be implemented).

### 6.2.5 Stream Restoration

*Stream restoration measures include measures designed to address erosion and flooding problems and restore stream functions and stability. They are generally applied on a stream reach basis and include stream rehabilitation using natural or engineered channel design principles and naturalization of stream riparian zones using native materials.*

These measures may include individual structures, such as streambank re-grading, gradient controls and floodplain contouring to address specific erosion and flooding problems.



**Figure 6.14: Stream Restoration Measures.**

## 7. Evaluation of Alternative Solutions

This Chapter describes the evaluation criteria and evaluation process and prioritizes the works in fulfillment of the Class EA process. The study was carried out using Approach 1 for Master Plans in conformity with the MEA Class EA process (MEA 2000, as amended 2007). More specifically, the Master Planning approach as outlined in section A.2.7 of the Class EA document was followed. This Master Plan is intended to address Phases 1 and 2 of the Class EA process, as defined previously in Chapter 1 (Figure 1.2), and is to be used as a basis for future investigations of specific Schedule B and C projects identified within. Schedule B projects would require the filing of the Project file for public review while Schedule C projects would have to fulfill Phases 3 and 4 prior to filing an ESR for public review.

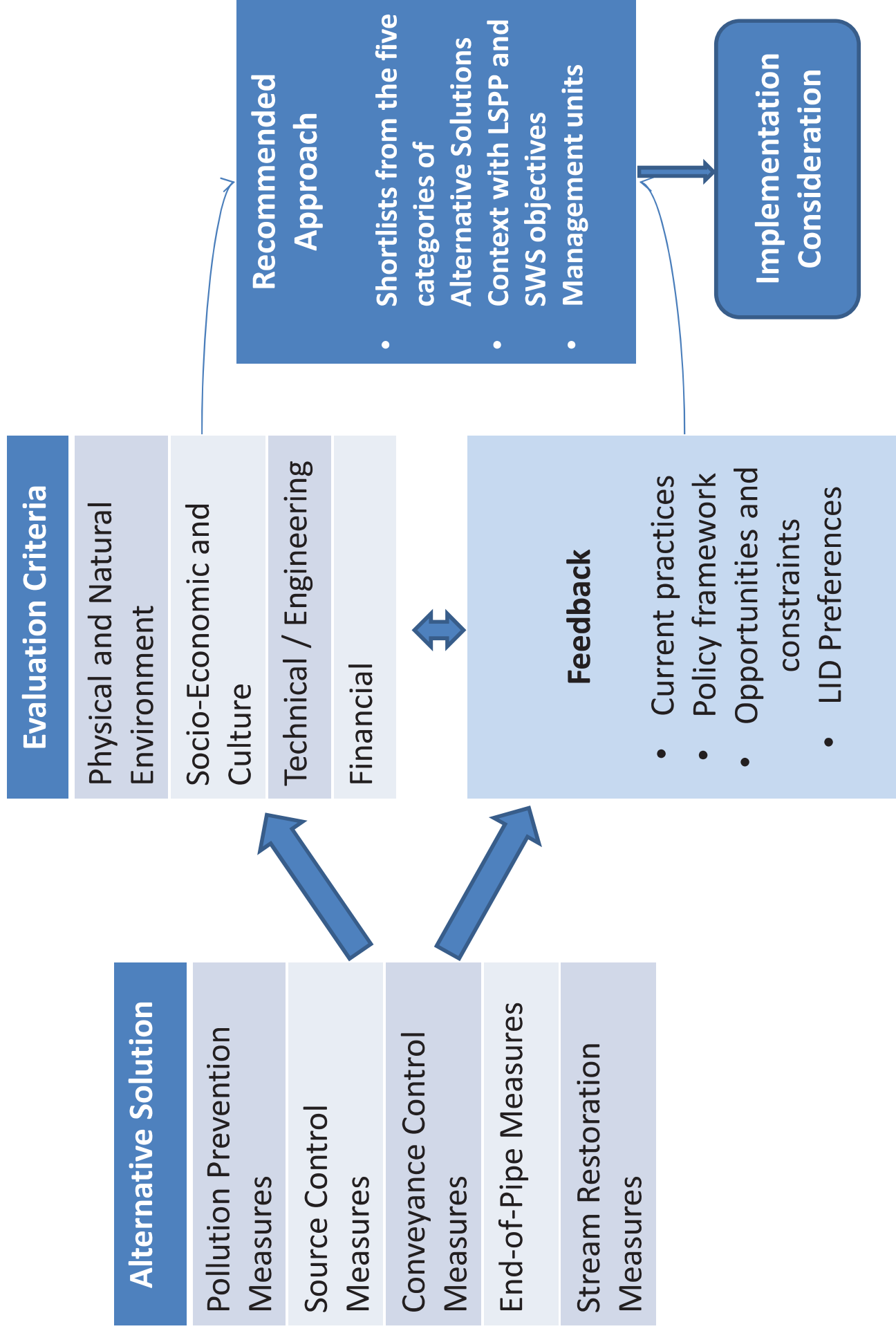
The Master Planning approach is followed for studies where it is expected that a series of measures will be distributed geographically throughout the study area and will be implemented over an extended period of time. This approach explicitly recognizes that there are real benefits in terms of better planning when long range holistic studies are undertaken over logical planning units, such as a subwatershed. This long range planning approach would enable the Town to identify opportunities and be proactive in addressing issues before they become a problem. Moreover, it would allow the Town to implement individual works, which collectively become part of a larger management system.

In the following sections, the evaluation of alternative solutions is proposed following the steps below:

1. Evaluation Criteria;
2. Assessment of Alternatives; and
3. Recommended Approach (illustrated in detail in Chapter 8).

**Figure 7.1** shows the evaluation process and its components.

**Figure 7.1 The Process Applied to Assess Alternative Solutions Propose the Recommended Approach**



## 7.1 Evaluation Criteria

In order to propose a Recommended Approach that is based on understanding the complexity and interconnection between environmental and anthropogenic contexts, and to ensure a transparent selection process that considers all possible alternatives, a detailed evaluation criteria set is presented using eighteen (18) criteria under four (4) general categories:

1. Physical and Natural Environment;
2. Socio-Economic and Cultural;
3. Technical and Engineering; and
4. Financial considerations.

The overarching objective of the evaluation criteria is to generate a “shortlist” of SWM measures that constitute the “Recommended Approach”.

*The evaluation criteria mainly stems from the LSPP as a guiding document, the West Holland River Subwatershed Plan (LSRCA, 2010d) as a detailed environmental characterization report with management strategies, and the analyses done under Chapters 3 and 4 of this document.*

The evaluation criteria set is as follows:

### **Physical and Natural Environment (7)**

- Ability to meet water quality control targets (LSPP and PWQO);
- Ability to meet water budget targets (LSPP and Infiltration Deficit);
- Ability to meet flood control targets (LSPP);
- Ability to meet erosion control targets (LSPP);
- Impacts on terrestrial habitat (connectivity, diversity and sustainability) (LSPP and West Holland River SWS);
- Impacts on aquatic habitat (connectivity, diversity and sustainability) (LSPP and West Holland River SWS); and
- Ability to protect groundwater resources (Source Water Protection) (LSPP).

### **Socio-Economic and Cultural (4)**

- Impacts on existing and future land uses;
- Aesthetic Value;
- Potential benefit to the community and public acceptance; and
- Policy and By-law requirements.

### **Technical and Engineering (4)**

- Level of service (LOS) / proven effectiveness;
- Regulatory agency acceptance;
- Impact on existing infrastructure; and
- Constructability.

**Financial (3)**

- Capital costs;
- O&M costs; and
- Cost avoidance.

Tables 7.1 through 7.4 present the individual evaluation criteria with description of each group. In conjunction with the evaluation criteria, discussions with the Town’s staff were carried out in order to arrive to the Recommended Approach.

**Table 7.1: Description of the Physical and Natural Environment Criteria.**

Criteria	Description of Criteria
<b>Ability to meet targets for Water Quality</b>	<ul style="list-style-type: none"> <li>• Reduce phosphorus loadings and other nutrients of concern <b>(LSPP)</b>;</li> <li>• Reduce pathogen loading to eliminate beach closures <b>(LSPP)</b>;</li> <li>• Reduce contaminants to levels that achieve Provincial Water Quality Objectives (PWQO) or better <b>(LSPP)</b>;</li> <li>• Ability of the SWM alternative to meet water quality criteria as per the SWMPDM (MOE, 2003); and</li> <li>• Ability to improve water quality conditions for identified contaminants of concern as identified within the <i>West Holland River Subwatershed Plan</i> (LSRCA, 2010d) and Chapter 5 of this study.</li> </ul>
<b>Ability to meet targets for Water Budget</b>	<ul style="list-style-type: none"> <li>• Ability of the SWM alternative to mitigate undesired impacts to the pre-development water balance and prevent adverse changes to site hydrology (surface drainage, groundwater, and soils);</li> <li>• Maintain existing recharge and discharge areas;</li> <li>• Maintain hydrological and hydrogeological functions within the landscape including wetlands and woodlots;</li> <li>• Maintain in-stream flow regime <b>(LSPP)</b>;</li> <li>• Effective water conservation <b>(LSPP)</b>; and</li> <li>• Maintain pre-development infiltration (Refer to Chapter 5).</li> </ul>
<b>Ability to meet targets for Flooding</b>	<ul style="list-style-type: none"> <li>• Ability of the SWM alternative to meet flood control criteria. Alternative must control peak post development runoff to pre-development from the 2-year through 100-year event (per the relevant stormwater polices of the Town and as identified in the hydrologic model, Chapter 5);</li> <li>• Cannot increase flooding risks to infrastructure and private property; and</li> <li>• Address climate change issues and incorporate adaptations <b>(LSPP)</b>.</li> </ul>
<b>Ability to meet targets for Erosion</b>	<ul style="list-style-type: none"> <li>• Ability of the SWM alternative to control water course erosion in accordance with the SWMPDM (MOE, 2003) and identified erosion thresholds as identified within the respective SWS;</li> <li>• Prevent down cutting of streambeds; and</li> <li>• Potential to reduce sediment sources.</li> </ul>

Criteria	Description of Criteria
<b>Impact on Terrestrial Habitat (Connectivity, Diversity and Sustainability)</b>	<ul style="list-style-type: none"> <li>• Potential for the SWM alternative to mitigate impacts to terrestrial habitat; and</li> <li>• Ability for the SWM alternative to provide opportunities for connectivity, diversity and sustainability for terrestrial habitats.</li> </ul>
<b>Impact on Aquatic Habitat (Connectivity, Diversity and Sustainability)</b>	<ul style="list-style-type: none"> <li>• Potential to restore a self-sustaining cold water community (LSPP);</li> <li>• Potential for the SWM alternative to maintain and improve 'habitat classification i.e. Cool Water and Dissolved Oxygen (LSPP);</li> <li>• Mitigate impacts to aquatic habitat (including flow, erosion, water quality); and</li> <li>• Preservation of the function of first order streams through the promotion of recharge and the maintenance of baseflow.</li> </ul>
<b>Source Water Protection</b>	<ul style="list-style-type: none"> <li>• Ability of the SWM alternative to protect drinking water sources and minimize the potential for groundwater contamination (including from de-icing salt), especially within identified Wellhead Protection Area (WHPA) where threats have been identified (Figure 4.9);</li> <li>• Maintain and where feasible enhance infiltrated water quantity and quality; and</li> <li>• Ability to recharge groundwater aquifers.</li> </ul>

**Table 7.2: Description of the Socio-Economic and Cultural Criteria.**

Criteria	Description of Criteria
<b>Impact on Existing Land Uses (including Agricultural, Commercial and Residential)</b>	<ul style="list-style-type: none"> <li>• Potential for the SWM alternative to be integrated with the existing agricultural, residential and commercial / industrial land uses within the study area.</li> </ul>
<b>Aesthetic Value</b>	<ul style="list-style-type: none"> <li>• Potential for the SWM alternative to provide an aesthetic benefit to the existing community and proposed development.</li> </ul>
<b>Potential Benefit to Community and Public Acceptance</b>	<ul style="list-style-type: none"> <li>• Potential benefit to the community with respect to integration into public areas (passive use areas, pedestrian and bike trails) as well as general public acceptance of the SWM alternatives.</li> </ul>

**Table 7.3: Description of the Technical / Engineering Criteria.**

Criteria	Description of Criteria
<b>LOS - Proven Effectiveness</b>	<ul style="list-style-type: none"> <li>• Degree to which the SWM alternative has been proven effective through scientific literature, implementation and/or monitoring.</li> </ul>
<b>Regulatory Agency Acceptance</b>	<ul style="list-style-type: none"> <li>• General level of acceptance of the SWM alternative by the various regulatory agencies (Municipal, Provincial, and CA) with respect to water quality, erosion, water balance preservation, flood control and the preservation of natural features.</li> </ul>
<b>Policy and By-Law Requirements</b>	<ul style="list-style-type: none"> <li>• Degree to which the SWM alternative will be impacted by or contradict to the existing Town's SWM policy including alteration to existing or development of new by-law requirements.</li> </ul>

Criteria	Description of Criteria
<b>Impact on Existing Infrastructure</b>	<ul style="list-style-type: none"> <li>• Potential impacts to existing stormwater infrastructure; and</li> <li>• Potential impacts to other forms of existing infrastructure (services, roads, etc).</li> </ul>
<b>Constructability</b>	<ul style="list-style-type: none"> <li>• Degree of difficulty in constructing the SWM alternative given the existing site conditions and constraints.</li> </ul>

**Table 7.4: Description of the Financial Criteria.**

Criteria	Description of Criteria
<b>Capital costs</b>	<ul style="list-style-type: none"> <li>• The relative cost of constructing the SWM alternative.</li> </ul>
<b>O&amp;M Costs</b>	<ul style="list-style-type: none"> <li>• The relative cost of operating and maintaining the SWM alternative.</li> </ul>
<b>Cost Avoidance</b>	<ul style="list-style-type: none"> <li>• Potential for the proposed SWM alternative to reduce the costs associated with the upgrade to existing SWM infrastructure and services including existing drainage networks and EOP facilities.</li> </ul>

## 7.2 Assessment of Alternatives

In light of the evaluation criteria tabulated above (Tables 7.1 through 7.4) and the long list of alternatives discussed in Chapter 6, the following discussion presents the assessment of alternative solutions. The process used for the assessment is based on the interdependence between evaluation criteria and feedback from the Town as shown in **Figure 7.1**

### 7.2.1 Pollution Prevention Measures and Municipal Management / Operational Practices

PPM and MMOP are methods which are not site specific and can generally be applied over a watershed or municipal boundary to prevent sources of pollution from entering the drainage system. These measures often include changing behavior, current practices and educational programs. Many of the PPM and MMOP listed in Chapter 6 are currently being undertaken by the Town. These measures and practices include:

- Catch Basin Cleaning (annually);
- Street Sweeping (annually);
- Roadside Leaf Pick-up and Removal (annual); and
- SMP – ongoing.

In addition to the list above, measures of particular interest to the Town may include:

- Safer Alternative Products;
- Materials Storage Controls;
- Pool Drainage;
- Erosion and Sediment Control;
- Cross Connection Control Program;
- Public Education;
- Business Education and Awareness; and
- Yellow Fish Road Program, in cooperation with the York Region.

The implementation of these measures would provide the following benefits:

**Table 7.5: Benefits of Pollution Prevention.**

<b>Criteria</b>	<b>Description of Criteria</b>
<b>Water Quality</b>	<ul style="list-style-type: none"> <li>• Reduce phosphorus loadings and other nutrients of concern;</li> <li>• Reduce pathogen loading to eliminate beach closures; and</li> <li>• Reduce contaminants to levels that achieve PWQO or better.</li> </ul>
<b>Impact on Aquatic Habitat</b>	<ul style="list-style-type: none"> <li>• Potential to restore a self-sustaining cold water community; and</li> <li>• Potential to maintain and improve 'habitat classification (i.e. Cool Water and Dissolved Oxygen).</li> </ul>
<b>Source Water Protection</b>	<ul style="list-style-type: none"> <li>• Ability to protect drinking water sources and minimize the potential for groundwater contamination (including from de-icing salt), especially within identified WHPA where threats have been identified; and</li> <li>• Maintain and where feasible enhance infiltrated water quantity and quality.</li> </ul>
<b>Social, Technical and Financial</b>	<ul style="list-style-type: none"> <li>• Providing an aesthetic benefit;</li> <li>• Regulatory agency acceptance;</li> <li>• Maintaining existing infrastructure; and</li> <li>• Avoiding cost resulting from any deterioration of SWM infrastructure due to lack of O&amp;M practices.</li> </ul>

### 7.2.2 Source Control Measures

SCM are small-scale stormwater treatment systems that are located at the beginning of a drainage system, that is they capture and treat stormwater on-site or close to where the rainfall lands. These measures, as detailed in Chapter 6 are generally installed on private property within residential, commercial, industrial and institutional land uses.

Successful SCM have been implemented in urban contexts in municipalities across Ontario. The following four (4) SCM are proposed as a result of local successes within the province:

- Rain gardens;
- Soakaway pits;
- Pervious pavements; and
- Rain barrels.

Implementing a social marketing strategy is key to implement such measures, where public input is surveyed and assessed in terms of acceptance of SCM, awareness of environmental benefits, and aesthetic preferences.

The implementation of these measures would provide the following benefits:

**Table 7.6: Benefits of Source Control Measures (SCM).**

<b>Criteria</b>	<b>Description of Criteria</b>
<b>Water Quality</b>	<ul style="list-style-type: none"> <li>• Reduce phosphorus loadings and other nutrients of concern;</li> <li>• Reduce pathogen loading to eliminate beach closures; and</li> <li>• Reduce contaminants to levels that achieve PWQO or better.</li> </ul>

Criteria	Description of Criteria
<b>Impact on Aquatic Habitat</b>	<ul style="list-style-type: none"> <li>• Potential to restore a self-sustaining cold water community; and</li> <li>• Potential to maintain and improve 'habitat classification i.e. Cool Water and Dissolved Oxygen.</li> </ul>
<b>Water Budget Targets</b>	<ul style="list-style-type: none"> <li>• Maintain in-stream flow regime: through augmenting baseflow contribution during the dry season and decreasing peak flows during frequent freshets;</li> <li>• Effective water conservation: through measures such as rain gardening and rain barrels directs towards conserving water consumption; and</li> <li>• Address climate change issues and incorporate adaptations (LSPP): research has shown that with climate change, rainfall intensities within Ontario are expected to increase, especially for shorter storm durations. SCM would be of great value since they are generally designed to infiltrate frequent storms leading to minimizing surface runoff volume and rate.</li> </ul>
<b>Source Water Protection</b>	<ul style="list-style-type: none"> <li>• Maintain and where feasible enhance infiltrated water quantity and quality; and</li> <li>• Ability to recharge groundwater aquifers.</li> </ul>
<b>Social, Technical and Financial</b>	<ul style="list-style-type: none"> <li>• Providing an aesthetic benefit;</li> <li>• Regulatory agency acceptance;</li> <li>• Proven effectiveness; and</li> <li>• Cost avoidance: reducing the costs associated with the upgrade to existing SWM infrastructure and services including existing drainage networks and EOP facilities.</li> </ul>

### 7.2.3 Conveyance Control Measures

CCM are measures that are designed to treat stormwater as it travels overland or through pipes on route to the downstream outlet. Traditional conveyance systems comprise curbs, gutters and buried concrete (or other) piping systems that move water away from a development area generally via the road network.

In consultation with the Town, a short list of CCM was developed and includes:

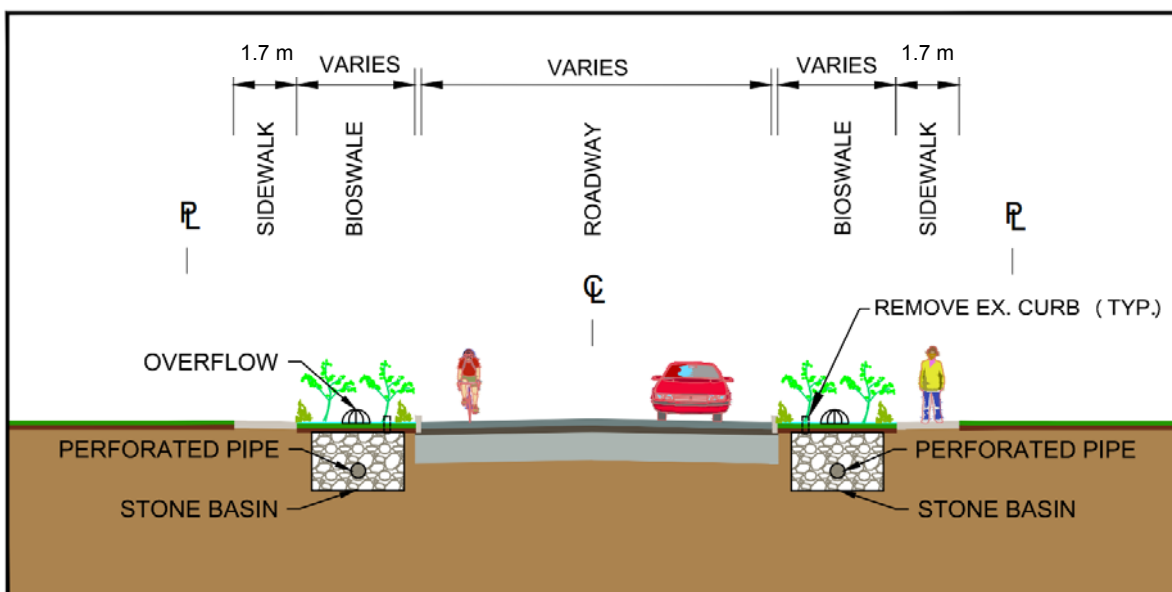
- Perforated pipes; and
- Bioswales/Bioretenion units.

Initial discussions with the Town staff were carried out in order to solicit feedback (**Figure 7.1**) as to existing drainage systems, constraints and opportunities, LID preferences (if any), and potential areas for implementation within the Town. Based on the evaluation criteria and consultations with the Town, a process that indicates opportunities at different road types (i.e. ditched and urban cross sections) will be followed. Such a process would be hierarchical in order to provide multiple solutions for multiple objectives and scales.

**Bioretention systems** are vegetated, shallow depressions below which is an engineered soil mix (media) which supports plant and microbial growth and provides a mechanism for achieving stormwater quality objectives. Bioretention facilities temporarily store and treat stormwater runoff by passing it through the engineered media and taking advantage of the chemical, biological and physical properties of plants, microbes and soils to remove pollutants from stormwater runoff.

**Bioswales** are bioretention facilities that have been designed with a slope for stormwater conveyance. They are designed to infiltrate water and only convey water during significant rainfall events. Due to their linear design they are well suited for use along existing ditches or boulevard areas.

Bioretention systems and bioswales are part of the suite of (BMPs), known as LID, that promote infiltration/groundwater recharge, and evapotranspiration. The many benefits of these systems include preservation of baseflow, enhanced water quality, thermal mitigation, and improved street aesthetics. The most recent studies indicate that bioretention provides effective pollutant removal for many pollutants as a result of sedimentation, filtering, plant uptake, soil adsorption, and microbial processes and can do so with and without an underdrain. A typical cross-section of a bioretention facility which is accepting flow from an impervious surface (roadway/parking lot) is presented in Figure 7.2.



**Figure 7.2: Typical Cross-Section of Bioretention Practice.**

The implementation of conveyance control systems as indicated above would provide the following benefits:

**Table 7.7: Benefits of Conveyance Control Measures**

Criteria	Description of Criteria
<b>Water Quality</b>	<ul style="list-style-type: none"> <li>• Reduce phosphorus loadings and other nutrients of concern;</li> <li>• Reduce pathogen loading to eliminate beach closures; and</li> <li>• Reduce contaminants to levels that achieve PWQO or better.</li> </ul>
<b>Impact on Aquatic Habitat</b>	<ul style="list-style-type: none"> <li>• Potential to restore a self-sustaining cold water community; and</li> <li>• Potential to maintain and improve 'habitat classification (i.e. Cool Water and Dissolved Oxygen).</li> </ul>
<b>Ability to meet targets for Erosion</b>	<p>Through the conveyance of runoff through a perforated system that is capable of infiltrating to the ground when it is applicable, runoff rate and volume are decreased through the system leading to:</p> <ul style="list-style-type: none"> <li>• Preventing down cutting of streambeds; and</li> <li>• Potential to reduce sediment sources.</li> </ul>

Criteria	Description of Criteria
Source Water Protection	<ul style="list-style-type: none"> <li>• Maintain and where feasible enhance infiltrated water quantity and quality; and</li> <li>• Ability to recharge groundwater aquifers.</li> </ul>
Social, Technical and Financial	<ul style="list-style-type: none"> <li>• Providing an aesthetic benefit;</li> <li>• Regulatory agency acceptance; and</li> <li>• Proven effectiveness.</li> </ul>

## 7.2.4 End-of-Pipe Control Measures

EOP measures are the most commonly used SWM measure in most municipalities. These measures as detailed in Chapter 6 provide treatment for the collected drainage at the end of conveyance system prior to discharge of stormwater to a watercourse. EOP measures are typically implemented in urbanizing areas as a requirement of development. Typical EOP measures which are used to treat stormwater include stormwater ponds (dry or wet), wetlands, hybrid facilities and/or infiltration basins.

EOP controls fall within the Municipal Class EA process in general because they are retained in the ownership of the municipality and designated as SWM infrastructure. Projects undertaken by municipalities vary in their environmental impacts. Consequently, projects are classified according to Class EA Schedules ranging from A and A+ to B and C project schedules in accordance with Part C -Municipal Water and Wastewater Projects. Proposed SWM facilities can generally be classified under two (2) Class EA Schedules according to the project nature i.e. either Retrofit or New Construction. The construction of new EOP controls are generally classified as Schedule B, whereas EOP control retrofits can be classified as either Schedule A+ or Schedule B according to the following criteria:

### Schedule A+

- Introduced in 2007 by the MEA, these projects are pre-approved; however the public is to be advised prior to the project implementation. Per Appendix I –Project Schedules of the Municipal Class EA (2000, as amended in 2007), wastewater management projects that are intended to **“modify, retrofit, or improve a retention/detention facility including outfall or infiltration systems for the purposes of stormwater quality control” including “biological treatment through the establishment of constructed wetlands”** are pre-approved under Schedule A+ of the MEA.
- Schedule A+ does not allow for the expansion of the existing facility, therefore the alteration/upgrade or retrofit must be confined to the existing facility footprint or SWM block limits.

### Schedule B

- Generally includes improvements and minor expansion to existing facilities beyond the existing facility footprint or SWM block limits. With these types of activities there is potential for some adverse environmental impacts and therefore the proponent is required to proceed through a screening process including consultation with those who may be affected.

The vision for implementing EOP measures within the Town is focused on the following tasks:

1. Maintenance of ponds identified for dredging and cleaning out;
2. Retrofit of ponds identified by LSRCA for increasing the removal efficiency of phosphorus;
3. Enforcing the MOE’s Certificate of Approval (CoA) for private properties; and
4. Town-wide detailed assessment of new opportunities for EOP control measures.

The implementation of these activities would provide the following benefits:

**Table 7.8: Benefits of End-of-Pipe Control Measures.**

Criteria	Description of Criteria
<b>Water Quality</b>	<ul style="list-style-type: none"> <li>• Reduce phosphorus loadings and other nutrients of concern (improve removal efficiency of retrofitted ponds to 21% from 16% per MOECC’s guidelines (MOE, 2003));</li> <li>• Reduce pathogen loading to eliminate beach closures; and</li> <li>• Reduce contaminants to levels that achieve PWQO or better.</li> </ul>
<b>Ability to meet targets for Flooding</b>	<ul style="list-style-type: none"> <li>• Ability to meet flood control criteria. Alternative must control peak post development runoff to pre-development from the 2-year through 100-year event (per the relevant stormwater polices of the Town and as identified in the hydrologic model, Chapter 5); and</li> <li>• Does not increase flooding risks to infrastructure and private property.</li> </ul>
<b>Ability to meet targets for Erosion</b>	<p>Through providing storage and regulation for runoff entering an EOP measure, the following environmental benefits would be achieved:</p> <ul style="list-style-type: none"> <li>• Preventing down cutting of streambeds; and</li> <li>• Potential to reduce sediment sources.</li> </ul>
<b>Social, Technical and Financial</b>	<ul style="list-style-type: none"> <li>• Public acceptance and aesthetic benefit: Potential benefit to the community with respect to integration into public areas (passive use areas, pedestrian and bike trails) as well as general public acceptance of the SWM alternatives;</li> <li>• Regulatory agency acceptance; and</li> <li>• Proven effectiveness.</li> </ul>

### 7.2.5 Stream Restoration

Stream restoration measures enhance the ability of the natural environment to improve water quality and prevent watercourse erosion from further degrading infrastructure, public and private property. Existing natural areas provide valuable ecological services, such as quality and quantity treatment of stormwater at no cost. If an existing natural area is degraded, it may be possible to restore the area and regain lost ecological services. Section 4.8 of this study presented a geomorphic overview of watercourses within the Town. The representative study segments were chosen based on the review of background studies, desktop analysis and confirmed with field assessment. This document tackles stream restoration issues as diagnostic exercise. The stream erosion or problem sites should be monitored with results used to update the Town’s database of erosion and stream rehabilitation issues, and provide insight into the overall geomorphic stability of the watercourses within the Town limits.

## **8. The Recommended Approach**

A key component of a Master Plan is to define and describe the Recommended Approach and the proposed alternative solutions (**Figure 7.1**), and provide physical context for the implementation of these measures. This chapter will explain this process in detail. Comprehensive implementation considerations are discussed in Chapter 9.

### **8.1 Stormwater Management Overview and Context**

Several recent studies and associated monitoring programs have shown that uncontrolled stormwater runoff from existing urban areas where SWM planning has not been implemented have led to negative impacts on rivers and streams. Among these impacts are bank erosion, decreased baseflow, increased peak flows, water quality degradation and loss of fisheries. These impacts, in turn, have significant social, economic and environmental implications.

The approach to SWM has changed significantly over the last four decades (Accompanying Figure). Prior to the late 1970's stormwater runoff from urban areas was discharged to a storm sewer or ditches directly to the receiving stream or river. Developments which occurred from the late 1970's to the mid 1990's generally involved the construction of a storm sewer system which discharged to a stormwater facility (typically a dry pond). This stormwater approach was intended to reduce the impacts of urbanization on flooding and erosion in the downstream receiving bodies of water. In the 1990's, issues with respect to water quality and fisheries, in addition to flooding and erosion became prevalent. This typically resulted in wet ponds replacing dry ponds, where the permanent body of water in a wet pond captures a significant percentage of pollutants that are present in stormwater runoff, thereby improving the quality of water in the receiving streams and rivers.

In the last decade, the traditional paradigm of applying urban drainage infrastructure (e.g. storm sewers) to quickly and efficiently remove stormwater to streams and rivers has shifted towards SWM planning with broader scope that embraces ecosystem-based solutions in conjunction with evolving treatment technology and enlightened management practices. Issues with respect to climate change, LID, and water budget considerations have driven watershed managers, engineers, and municipal planners to adopt alternative stormwater approaches that treat rain water as a resource rather than as waste. A variety of measures (or BMPs) including source control (measures on private property), conveyance control (measures within road ROW) together with traditional EOP measures (dry ponds, wet ponds, wetland and subsurface facilities) applied sequentially and termed 'the treatment train approach' to stormwater' has largely replaced traditional techniques.

### **8.2 LSRCA Guidelines and LSP Context**

The Recommended Approach (Strategy) for the Town is based on the following key components (Implementation considerations such as policy framework, funding, cost, and O&M are part of the Implementation Plan (Chapter 10):

- The Municipal EA planning process: Phases 1 and 2;
- Broad management approaches for management units;
- Identification of specific SWM measures;
- Identification and recommendation of LID measures;
- Following the recommendations of the LSPP, especially concerning phosphorus reduction targets and techniques; and
- Following the recommendations of the *West Holland River Subwatershed Plan* (LSRCA, 2010*d*) in terms of water quantity and quality findings and management strategies.

### 8.3 Management Units within the Town of Georgina

This study follows a landscape-based approach where landscape patterns, features, and functions are examined within an integrated framework while understanding that areas with shared characteristics can be grouped into discrete management units. Management Units are identified in **Figure 4.2**. Assessments and recommendations are tailored accordingly, and they follow the breakdown:

1. **Secondary Plan Areas (SPAs)**
  - Keswick SPA;
  - Sutton SPA;
  - Pefferlaw SPA; and
  - Keswick Business Park SPA.
2. **Hamlet Areas**
3. **Rural, Agricultural and Natural Land**

### 8.4 Stormwater Control Targets

The following (Table 8.1) shows specific water quality, water balance, and water quantity targets for the recommended measures that are discussed in the following sections. It is assumed that combinations of source control, conveyance control, and EOP control measures will meet the overall objectives of the LSPP (MOE, 2009).

**Table 8.1: Stormwater Management (SWM) Control Targets within the Three (3) Management Units within the Town.**

Management Unit	Water Quality	Water Balance	Water Quantity – Flooding	Water Quantity – Erosion
<b>Secondary Plan Areas (MU1)</b>	Water quality, water balance, and water quantity targets shall meet the targets and recommendations specified for each SPA. Development specific infiltration targets in section 9.5 should be applied to new development areas. The infiltration targets can contribute to the 25-mm capture volume per LSRCA Technical Guidelines for Stormwater Management Submissions (2016). New development will be required to meet MOECC and LSRCA stormwater policy as updated.			
<b>Hamlet Areas (MU2)</b>	<p>Level 1 Enhanced Removal following MOECC (2003) guidelines.</p> <p>Techniques and procedures that have high removal efficiency shall be implemented to conform with LSPP.</p> <p>Source-based LID solutions should be applied where feasible to mitigate the hydrologic impact of development and reduce pollutant loading.</p>	<p>For redevelopment sites, site specific studies and/or targets in the LSRCA Technical Guidelines for Stormwater Management Submissions (2016) will be used to define infiltration targets.</p>	<p>Post to pre design criteria.</p> <p>Infill development must meet the pre-development conditions.</p> <p>No flood risk downstream.</p> <p>Site specific studies at known flooding areas</p>	<p><u>For Source and Conveyance Controls</u>, minimum infiltration targets (Water Balance) shall be specified as erosion targets.</p> <p><u>For SWM Ponds</u>, extended detention shall follow the LSRCA (2016) guidelines which is retention from a 4-hour 25 mm event for 24-hours.</p>
<b>Rural, Agricultural and Natural Land (MU3)</b>	<p>Level 1 Enhanced Removal following MOECC (2003) guidelines.</p> <p>Techniques and procedures that have high removal efficiency shall be implemented to conform with LSPP.</p>	<p>For redevelopment sites, site specific studies and/or targets in the LSRCA Technical Guidelines for Stormwater Management Submissions (2016) will be used to define infiltration targets.</p>	<p>Post to pre design criteria.</p> <p>Infill development must meet the pre-development conditions.</p> <p>No flood risk downstream.</p> <p>Site specific studies at known flooding areas</p>	<p><u>For SWM Ponds</u>, extended detention shall follow the LSRCA (2016) guidelines which is retention from a 4-hour 25 mm event for 24-hours</p>

The targets in **Table 8.1** generally agree with the Stormwater Standards of the LSRCA’s SWM Policy. According to the most recent version of this draft policy, the general criteria are articulated as follows:

1. *The following general criteria shall be incorporated in site design for stormwater runoff to protect surface and ground water and other natural resources:*
  - i. *Reduce impacts on water;*

- ii. Decrease runoff volume;*
- iii. Decrease flow frequency, duration, and peak runoff rates;*
- iv. Increase infiltration (groundwater recharge);*
- v. Reduce time to peak flows by increasing the time of concentration to and through storm sewers;*
- vi. Store stormwater runoff on-site;*
- vii. Maintain existing flow patterns;*
- viii. Avoid natural channel and steep slope erosion as well as protect in stream habitats and channels;*
- ix. Preserve vegetation;*
- x. Decrease erosion and sedimentation; and*
- xi. Preserve and replace existing topsoil in an uncompacted manner.*

In the following Sections, five (5) categories of traditional and innovative SWM measures are described in the context of management units and other considerations.

## **8.5 Proposed Pollution Control Measures**

Initial discussions with the Town have revealed that various practices could be undertaken and added to the existing list of PPM. The addition of more measures and practices would enhance effective water quality management within the study area. These measures may include:

- Safer Alternative Products;
- Materials Storage Controls;
- Pool Drainage: Outdoor swimming pools and spa water containing chlorine can be toxic to aquatic life. Pool backwash water containing sediment can cause sediment pollution of surface waters. Advice should be given to landowners on environmentally acceptable ways to discharge pool backwash water and drawdown water for winterizing;
- Erosion and Sediment Control;
- Public Education; and
- Business Education and Awareness.

In addition to current pollution prevention control measures practiced within the Town, measures of particular interest to water quality management are:

- Salt Management measures; and
- Snow Disposal practices.

***Proposed PPM should be followed within the study area, and for each of the three (3) management units.***

Historically, SWM measures have been concerned principally with heavy metals, nutrients, hydrocarbons, pathogens, and sediment that run over impervious surfaces (e.g. road surfaces) into stormwater runoff and eventually contaminate groundwater and surface-water supplies. Recently, the application of road salt (NaCl) and its environmental consequences have come under scrutiny due to growing concern over habitat degradation, and water quality issues.

EC has conducted a comprehensive assessment of road-salt application to determine whether conventional deicers should be considered toxic substances under the Canadian Environmental Protection Act. Code of Practice for the Environmental Management of Road Salt helps municipalities better manage salt use to reduce negative environmental impacts of chloride. In that regard, cities within watersheds in Southern Ontario have been investigating management tools to alleviate the use of road salt and/or turn to alternative road deicers to prevent sodium contamination of residential drinking wells. The case studies from these watersheds would provide some guidance into salt management and monitoring within the Town.

The SMP indicates that effective communication with EC concerning salt management activities will be pursued annually, and based on a Communication Policy. Moreover, the SMP emphasizes the need to work with other agencies to identify and map salt vulnerable areas, in addition to pursuing the identification of strategies to reduce salt impacts to salt vulnerable areas.

### **Salt Management Case Studies from Ontario**

- The City of Mississauga Salt Study - developed between 2008 and 2010 examined the difference between using salt-sand mixtures and salt treated with magnesium chloride. The study found that there is a reduction of TSS and TP with the use of the salt treated with magnesium chloride. The study also found that chloride reduction is attainable using both compounds. One of the key recommendations of the study is that the City of Mississauga needs to optimize salt use and reduce salt loadings especially in primary roads where the impact of road salt loadings is more pronounced than in secondary roads.
- Research done by the University of Waterloo and the National Water Research Institute within the Region of Waterloo (UW and NWRI, 2010) showed that the reduction in total road salt application of 25% in urban road network resulted in approximately 50% reduction in chloride levels in the vadose zone (i.e. unsaturated zone). The research also showed that hybrid SWM ponds were more effective at reducing chloride discharge at the outflow. In addition, this report highlights the impacts of parking lot surfaces on chloride transfers into the environment, particularly within vulnerable groundwater zones and presents management options.

### **Salt Management Priorities within the Town**

Potential salt management priorities for the Town may include the following:

1. Management of winter road salt storage and application on private lands that include parking lots and public access;
2. Management of winter road salt storage and application on residential parcels; and
3. Management of potential salt loadings in private sewage disposal systems, including use of water softeners.

### **Salt Monitoring**

Generally speaking, Salt Monitoring Programs are essential to evaluate the storage, transport, and fate of salt released from salt storage sites, road salt application, and snow disposal sites. Estimating the total salt budget of the Town would facilitate management scenarios and provide public education. In order to quantitatively assess the impact of salt loading, implemented monitoring program should incorporate

measurements of salt loading in addition to measurements of the resulting concentrations in receiving waters.

## 8.6 Proposed Source Control Retrofits

Proposed SCM are designated as retrofit measures within residential land use and public land use areas. Source control retrofits can be implemented on land uses such as single-family houses and multiple family dwellings, and public land uses such as libraries and public open space. Proposed SCM include the following:

- Rain gardens;
- Soakaway pits;
- Pervious pavements; and
- Rain barrels.

The proposed source control retrofits are discussed below. The locations of these proposed measures are described in terms of their allocation within the three (3) management units. Within the context of this strategy, physical opportunities for SCM would be investigated in residential neighborhoods within the Town. The investigation may include several types of residential land use designations including:

- Old residential neighborhoods - have much potential and few constraints preventing implementation of LID source controls;
- New residential neighborhoods – have varying degrees of available space for implementing LID source controls, site specific assessments may be necessary in these areas. However, large estate homes were found to present a good opportunity for source control implementation;
- Mid-Rise Residential – have limited potential due to internal roof drainage, small proportion of pervious surfaces and high proportions of pavements/parking surfaces; and
- Town Houses and Row Houses – are currently utilizing shared overland drainage features (i.e. grass swales etc) which provide for improved water quality. Opportunities to encourage use of such features should be considered.

In addition to the social marketing effort, meetings and discussion among municipal staff from various departments would be necessary to determine municipal support/barriers to the implementation of SCM within the Town.

### 8.6.1 Existing Urban Areas - Residential Land Use Retrofits

Field reconnaissance surveys showed several source control opportunities within residential areas in the Town. **Figures 8.1 and 8.2** show private residential properties where opportunities exist for source control retrofits naturalized landscaping (**Figure 8.1**), and permeable pavement (**Figure 8.2**).

Since these measures are generally implemented within private properties, the Town has limited role in leading the implementation of these measures. However, the Town could provide a supportive role through the following:

1. Social marketing strategy and raising awareness within community; and
2. Refine, update or change by-laws related to implementing these measures.

### **Naturalized Landscaping and Tree Planting**



**Figure 8.1:** Existing Condition (Left) and Potential Opportunity (Right) for Naturalized Landscaping and Tree Planting.

### **Permeable Pavement**



**Figure 8.2:** Existing Condition (Left) and Potential Opportunity (Right) for Permeable Pavement.

#### ***8.6.1.1 Social Marketing Strategy for the Town of Georgina***

Municipalities within Ontario are carrying out Social Marketing programs to improve the uptake rate of source control retrofits on residential properties. There are many strategies that are being used. Four (4) types of social marketing programs are identified below.

### **LSRCA RainScaping and Landowners Environmental Assistance Program**

LSRCA's RainScaping program encourages LID practices such as source controls on residential properties to be implemented on new and existing development. Through the program, LSRCA offers guidance documents, training and workshop. These are geared towards landscape contractors, developers, consultant engineers, and municipal planners. Municipal staff from municipalities within the LSRCA jurisdiction are encouraged to attend events and review guidance documents to facilitate knowledge transfer within the Lake Simcoe watershed.



**Figure 8.3: LSRCA RainScaping Program.**

LSRCA's Landowners Environmental Assistance Program (LEAP) provides landowners with technical assistance and funding opportunities. LEAP is administered by the LSRCA and covers BMPs on both rural and urban properties. Rain gardens can be funded up to \$5,000 at a cost-share rate of 60% (60% of capital funds through LEAP, 40% by the Landowner). Properties eligible for rain garden LEAP funding must be within an urban area.

LEAP strives to use successes on residential lots as demonstration sites. These sites provide in-ground, aesthetically beautiful examples of rain gardens that can be duplicated by homeowners. Demonstrate sites must show source control at its very best; eye catching dynamic designs that are well maintained and sited in high traffic locations.

### **TRCA's Greening Your Grounds (A Homeowners Guide to Stormwater Landscaping Projects)**

TRCA's Greening Your Grounds is 55 page step-by-step guide to help homeowners with implementing source controls on their properties. The guide covers the following source controls:

- Naturalization;
- Downspout Disconnection;
- Rain Barrels;
- Rain Gardens;
- Soakaways; and
- Permeable Pavement.



**Figure 8.4: TRCA's Greening Your Grounds Guide for Homeowners.**

The guide takes homeowners from site assessment to selecting, installing and maintaining a source control that is appropriate for their property. To promote the implementation of source controls across the province, the TRCA offers the guide for \$12CAD a copy. For quantities of 100 or more, the Town's logo can be added to the cover.

### **Special Events**

Directly engaging property owners through special events is an effective means of building interest in source controls within a community. In the Alton Village (within the Town of Caledon), an “Ask a Designer Night” was held by Credit Valley Conservation (CVC) to allow home owners to connect with landscape designers. Done well, special events can successfully launch the residential LID program, showcase the beauty of LID landscapes, secure the participation of homeowners, and provide a promotional opportunity for program partners. These events should avoid technical presentation atmospheres and allow for more interaction between landscape designers and the public.



**Figure 8.5: “Ask a Designer Night” in Alton Village.**

### **Intensive Social Marketing**

Social marketing program can be rolled out on a large level or can be tailored to specific neighborhoods within a municipality. The Region of Peel conducted an intensive social marketing campaign for the source level controls. Key aspects of this program were:

- Determining priority areas and approaches;
- Establishing a community advisory group with resident and stakeholder representatives;
- Securing a representative sample of homeowners in the priority areas and conducting primary market research with those homeowners;
- Identifying and securing interviews with service and product suppliers and other key stakeholders;
- Developing a marketing strategy and implementation plan and executing the strategy; and
- Monitoring uptake and market transformation.

Market research conducted for the Region of Peel and other similar studies has shown that it is important to determine what will motivate residents to implement stormwater source controls on their properties. The most effective way to homeowner motivation is to conduct market research with a demographically representative sample. Market research allows a municipality to better understand residents' perspectives, intrinsic motivations and understanding, and identifies barriers to their uptake of LID measures. Through market research for the Region of Peel and other municipalities, the following have been found to be key components of a successful marketing strategy:



**Figure 8.6: Visually Based Signage for the Region of Peel's Fusion Landscape Marketing Campaign.**

**Visually Based Campaign** – Home owners respond best to simple messages and images. Words and phrases that reflect the emotional connection residents have with their home and its landscape should be used.

**Demonstration Sites** – Successful strategies often include a demonstration initiative in a high profile, leading residential community. Signage in these areas should promote the program and provide contact information to interested homeowners.

**Landscape Advisory Service** – A municipal or municipally supported service can be established to assist homeowners in their transition from more traditional landscapes to the marketed landscape. This service provides design ideas and answers to frequently asked questions about promoted source controls.

Additional to the marketing strategy components noted above, the following two (2) tasks were completed for the Region of Peel study:

**Strategic Partnerships** – Partnerships with key stakeholders in the Region of Peel were important as they are in the best position to communicate directly, face-to-face with homeowners. Partnerships can be formed with neighbourhood associations, gardening clubs, environmental organizations, landscape suppliers and landscape contractors.

**Products and “How-to” resources** – Information packages, guides and web resources should be developed in parallel with the roll-out of the marketing program to support the increased uptake.

## **8.6.2 Existing Urban Areas - Public Land Use Retrofits**

Proposed SCM within public lands may include retrofits in public open spaces, public schools, and libraries. Pilot projects are suggested within these areas to define variables such as landowners' awareness of the impacts from stormwater, their willingness to implement, the importance of public funding, and the adoption

rates for each of the proposed measures. Areas which are frequented by the broader community are ideal sites for innovative pilot projects as they provide a visible ‘high profile’ location to showcase the project, allow for a greater opportunity for education, community involvement and support. When implementing novel SWM techniques, providing a forum for community interaction and involvement is critical if broader, community wide adoption is desired.

### **8.6.2.1 Georgina Ice Park**

Through discussions with the Town, an opportunity for a parking lot retrofit was identified at the Georgina Ice Palace. The Town Ice Palace is located at 90 Wexford Drive, west of Woodbine Avenue. Soakaway trenches currently accept drainage from the majority of the facility’s parking lot. Above the trenches are grassed lined swales. Runoff is conveyed into the ditches by curb cuts. A bioretention system retrofit to the original design has been identified as a feasible design LID retrofit opportunity.



**Figure 8.7: Location of Parking Lot Retrofit Opportunity at the Georgina Ice Place.**



**Figure 8.8: Examples of Parking Lot Source Controls**

Figure 8.8 shows some examples of parking lot source controls that could be implemented in municipal parking lots such as the one in at the Georgina Ice Palace. The photo to the left depicts an inlet to a Jellyfish proprietary water quality device that is used to reduce the loading of phosphorus and other pollutants and a bioretention unit within the curb. The photo to the right illustrates the permeable pavement that can be used to reduce runoff and pollutant loading to receiving waterbodies.

The most effective source controls that can be implemented to provide both quality and quantity control at municipal parking lots are permeable pavement, bioretention, and proprietary treatment systems. Municipal and private parking lots in Ontario have been successfully retrofitted with one or a combination of these source controls.

### **8.6.2.2 Outlet Retrofits at the Shoreline**

As a result of the shallow grade along the shoreline of Lake Simcoe, many of the stormwater drainage systems servicing developed areas outlet to the Lake via surface features including ditches, swales and channelization. These drainage features offer an opportunity for water quality enhancements via simple retrofits. In many shoreline areas seasonally high water levels will preclude infiltration practices from functioning throughout the year. Instead of infiltration, filtration and settlement of pollutants should be the mechanisms of retrofits near Lake Simcoe.

The unique development pattern along the shoreline of the Town has resulted in the majority of the shoreline being privately owned. Much of the waterfront within the community of Keswick is managed by beach associations. Among other expenses including land taxes and insurance, beach associations use membership fees to maintain and improve their area of the waterfront. Project partnerships between beach associations, the LSRCA, the Town and environmental organizations may be able to accomplish significant water quality improvements along the Lake Simcoe shoreline.

An example of a stormwater outlet retrofit undertaken by a beach association recently is Pine Beach located between Woodycrest Ave and Parkway Ave. In 2012 the Pine Beach Landowners association in partnership with Rewilding Lake Simcoe undertook a pilot project at this beach. There is a stormwater outfall on the north side of the beach that drains 16 ha of residential development. Prior to the retrofit, stormwater from this outfall flowed into Lake Simcoe untreated. Swimming at the beach was severely compromised due to weeds and poor water quality. Among the many objectives of the beach improvement project were improved aesthetics, filtration of contaminants, infiltration and cooling of stormwater, shoreline

naturalization, erosion mitigation, and the creation of community meeting area. The beach site now includes a meandering stone-based channel, a shoreline of boulders and natural vegetation, and a large infiltration gallery under the parkland. The retrofits are estimated to reduce SS loadings from the catchment by 83% to 92% and phosphorus by up to 80% (Rewilding).



**Figure 8.9: A Shoreline Restoration Project that was Undertaken by the Pine Beach Landowners Association in 2012.**

Figure 8.9 shows a shoreline restoration project that was undertaken by the Pine Beach Landowners Association in 2012. This project was partially funded as a pilot project by Rewilding Lake Simcoe and was involved with the channel realignment of a stormwater outlet.

A potential retrofit area identified through discussion with Town staff is Claredon Beach Park at the intersection of Ways Bay Drive and Windy Shore Drive. There is a drainage swale that flows through the park and discharges to Lake Simcoe. The catchment area of this stormwater outfall is 18.5 ha of residential development. There is a public beach located immediately south of the stormwater outfall. This beach is prone to high levels of bacteria following heavy rainfall events as a result of stormwater contamination.



**Figure 8.10: York Region signage at Claredon Beach Park indicating waters may contain high levels of bacteria for 48 hours following heavy rainfall (left). The stormwater outlet at Claredon Beach Park during low flow conditions (right).**

In 2014 Claredon Beach Park underwent a refurbishment which included extensive landscaping of the upland areas. As part of the project, plantings were established along the banks of the outlet channel. The park improvements have created a significant draw for members of the community. There is an opportunity at this outfall to further enhance water quality and improve water quality at the public beach by implementing an EOP retrofit. Retrofit options include conveying stormwater from the roadway into a water quality pond or biofilter before discharging it into the lake. High groundwater levels in the area are likely to cause constraints for the implementation of an infiltration system in close proximity to the lake.



**Figure 8.11: Stormwater Outlet at Claredon Beach Park and Adjacent Parkland.**

Figure 8.11 depicts the stormwater outlet at Claredon Beach Park and adjacent parkland. There may be sufficient area for a biofilter or SWM pond to the north (photo right). A pipe conveying wastewater effluent

from the Morton Avenue Facility to the lake runs under this area and may pose construction phase constraints.

Through discussion with the Town's operations staff, another public lands opportunity was identified at Young's Harbour Park at the intersection of Walter Drive and Lake Drive South. A stormwater outfall in this park drains approximately 27.6 ha of residential development. Immediately upstream of this outfall grassed swales adjacent to the roads convey stormwater to two (2) Corrugated Steel Pipe (CSP) culverts under Lake Drive South. Downstream of the culverts another grass lined swale conveys stormwater to two (2) CSP outlet pipes. The four (4) CSPs in this drainage sequence are in need of replacement and there have been complaints of standing water in the area. The most feasible water quality retrofit for this outlet area involves the implementation of bioswales in the existing swales. Using a portion of the existing parkland for the development of a larger bioretention facility is another retrofit option.



**Figure 8.12: Stormwater Drainage Features around Young's Harbour Park from Upstream to Downstream: Grass swale along Lake Drive South (top left), Culverts under Lake Drive South (top right), swale between Lake Drive South and outlet (bottom left), and outlet CSPs to the Lake (bottom right).**

### **8.6.3 New Development Areas**

SCM should be applied to new developments as part of a treatment train approach to SWM, whereby stormwater BMPs are applied in succession along the stormwater flow path. In general, the application of innovative LID source and conveyance controls and EOP facilities within new developments should be done in accordance with the Recommended Approach and relevant guidelines that include the SWMPDM (MOE, 2003) and LID Manuals proposed by CAs within Ontario including TRCA and CVC LID Manuals.

Locally, the LSRCA has released a draft document titled **Lake Simcoe Watershed LID SWM Guidelines for Municipalities** (Draft April 2015). This document specifies that:

*“For new, nonlinear developments that create more than 0.5 hectares of new impervious surface on sites without restrictions, stormwater runoff volumes will be controlled and the post-construction runoff volume shall be retained on site from runoff of the first 25 mm of rainfall from all impervious surfaces on the site.”*

To achieve this target, the proponent of new development must design infiltration or filtration systems that provide a water quality volume (calculated as an instantaneous volume) of 25 mm of runoff (or 25 mm minus the volume of stormwater treated by another system on the site) from the new impervious surfaces created by the project.

## 8.7 Proposed Conveyance Control Retrofits

Conveyance control retrofit options differ with streetscape (ROW) type. Different streetscapes in the Town were discussed with municipal staff, and the way to manage stormwater conveyance along these streetscapes was examined through:

1. Review of the general types of treatment measures;
2. Field work in representative areas within the Town; and
3. Desktop analysis for aspects of implementation.

The proposed conveyance control retrofits are discussed below. The locations of these proposed measures are described in terms of their allocation within the road ROW within existing urban areas. CCM should be applied to new developments as part of a treatment train approach to SWM, whereby stormwater BMPs are applied in succession along the stormwater flow path.

Several CCM were assessed and discussed with the Town. Evaluation criteria and the discussions with municipal staff have resulted in proposing the following three (3) categories for implementing CCM:

### CCM for Existing Development Areas (Retrofits)

**Roads with ditches:** These roads are divided into two (2) categories:

- LID opportunity – Bioswales, perforated pipe systems; and
- No LID opportunity - To remain as is.

**Roads with Curb and Gutter:** These roads will be treated hierarchically

- ✓ LID opportunity – Perforated pipes, bioswales, bioretention units and permeable pavement;
  - ✓ No LID opportunity – when LID measures are not feasible, consider OGS devices with enhanced removal capacities; and
    - ✓ Convey to downstream water quality facility without conveyance control – this option is last option when the above two options are rendered not feasible/possible.

### 8.7.1 Roads with Ditches - Retrofits

The majority of the roads within the Town are built to a rural standard with ditches conveying runoff adjacent to shoulder areas. Discussion with the Town focused primarily on roads with ditches due to the fact that many of these required drainage improvements as a result of grading and conveyance issues within several residential neighborhoods. **Figure 8.13** shows examples of roads with ditches in the Town.



**Figure 8.13: Rural Road Cross-Sections at Sunset Beach Road (left) and Waterbend Drive (right).**

As shown in **Figure 8.14**, conveyance control potential opportunities for CCM could be implemented along streetscapes with ditch drainage (Left: during construction, Right: after construction). This opportunity would constitute an exfiltration trench / perforated pipe system that can be constructed adjacent to a road in the grassed area between the curb and the sidewalk. These systems promote infiltration of road drainage as it is conveyed along road ROW. Road drainage is first directed to the grassed surface where pollutants such as sediment, oil, grease, or grit, are filtered prior to entering the trench. After water has percolated through the gravels and pollutants have been removed, the water can then either infiltrate into the native soils or if the volume and rate of incoming water exceeds the infiltrative capacity it is conveyed to a local stormwater drain system.



**Figure 8.14: An Exfiltration Trench / Perforated Pipe System (Left: during construction, Right: after construction).**

## 8.7.2 Roads with Curb and Gutter

### 8.7.2.1 Road Re-Construction and Re-Surfacing

Within the Town, roads with urban cross-section are primarily located in the newer areas of the community of Keswick. Roads projects in these areas are likely to be resurfacing projects of existing urban cross-sections. Such projects can generally be classified under General O&M of Linear Paved Facilities and Related Facilities of Appendix 1 of the MEA document and will generally be considered as Schedule A or A+ and are pre-approved projects. All resurfacing projects, both urban and rural cross-sections, are considered as Schedule A or A+ projects.

Road reconstruction projects represent a smaller percentage of road projects in urban areas. These projects can generally be classified under Construction or Reconstruction of Linear Paved Facilities and Related Facilities Appendix 1 of the MEA document. Such road projects, by their nature, may be relatively large in terms of their total costs, and are subject to the predetermined cost ranges which determine whether the projects are A, A+, B or C.

The LSRCA's **Lake Simcoe Watershed LID SWM Guidelines for Municipalities** (Draft April 2015) classifies road reconstruction as "Linear Development". In Section 1.2.3 of the LSRCA Draft Guidelines the following volume control requirements are stated for linear development:

*"Linear projects on sites without restrictions that create 0.5 or greater hectares of new and/or fully reconstructed impervious surfaces, shall capture and retain the larger of the following:*

- i. The first 12.5 mm of runoff from the new and fully reconstructed impervious surfaces on the site*
- ii. The first 25 mm of runoff from the net increase in impervious area on the site"*

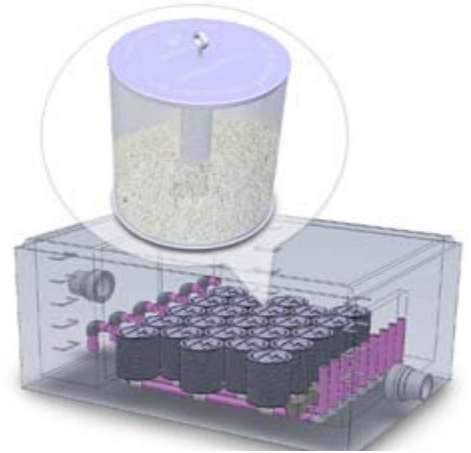
The LSRCA Draft Guidelines state that mill and overlay and other resurfacing activities are not considered fully reconstructed.

As part of road resurfacing / reconstruction projects:

1. All roads serviced by ditches (roads with a rural drainage system) be upgraded using exfiltration trench / perforated pipe systems to achieve improved water quality treatment; and
2. For roads with urban drainage infrastructure, water quality treatment should be achieved using bioretention units either on the road surface or within the municipal ROW.

### **8.7.2.2 Oil and Grit Separators with Enhanced Phosphorus Removal**

When constraints prevent the implementation of LID measures within a ROW, it is recommended to install stormwater treatment devices. OGS devices are recommended for small sites or infill development (5 ha or less) and where resurfacing and/or reconstruction are not attainable. As noted by the *LSRCA Technical Guidelines for Stormwater Management Submissions* (LSRCA, 2016), these facilities should be placed within a treatment train mechanism, where they complement other stormwater measures in terms of removal efficiency for phosphorus or any other pollutant of concern.



**Figure 8.15: Typical Enhanced Phosphorus Removal Device.**

The LSPP recommends stormwater treatment measures that have optimal phosphorus removal. Recent advances in OGS technology have revealed that phosphorus removal could reach a high level by using a combination of filtration and sorption mechanisms within an OGS device. Figure 8.15 shows an enhanced phosphorus removal device that can be integrated with existing storm sewer networks where site constraints implementation of infiltration-based source controls. Enhanced OGS devices have been used by many municipalities to remove sediment-bound and dissolved phosphorus, TSS, and hydrocarbons, with a TP removal efficiency of around 77%, and sediment removal efficiency of around 89%

The installation of the OGS devices with the removal efficiency indicated above and as part of an overall conveyance system (i.e. perforated pipes and other ROW LID opportunities) in addition to source control and EOP measures would constitute a land-scape based stormwater quality and quantity management.

### **8.7.3 Conveyance Control Opportunity Identification**

Meetings with Town staff were conducted to determine retrofit opportunities within the municipal road ROW. Through discussion it was determined that five (5) roads had been identified as having drainage issues resulting in standing water and urban flooding on an annual basis. The town intends to resolve these drainage issues in the coming years. An opportunity to integrate water quality improvements with drainage improvements via LID was identified.

Through discussion with the Town, the following roads were identified as potential retrofit opportunities:

1. Walter Drive;
2. Montsell Avenue;
3. Dunkirk Avenue;
4. Sunset Beach Road; and
5. Waterbend Drive.

The five (5) roads investigated are constructed to a rural cross-section with grass-lined ditches adjacent to both shoulders. The roads are located in residential areas with culverts conveying drainage through the entranceways. Drainage from each of the roads is conveyed directly to Lake Simcoe without quality or quantity controls.

### Walter Drive



**Figure 8.16: Walter Drive is approximately 920 m in length between the Queensway and Georgette Street. This photo is looking east from Georgette Street.**

### Montsell Avenue



**Figure 8.17: Montsell Avenue is approximately 525 m in length between the Metro Road North and Lake Drive East. This photo is looking north towards Lake Drive East.**

### **Dunkirk Avenue**



**Figure 8.18: Dunkirk Avenue is a 450 m long dead-end road running south of Hedge Road approximately 200 m east of the Black River. This photo is looking north from the southern limit of the road.**

### **Sunset Beach Road**



**Figure 8.19: Sunset Beach Road is approximately 980 m in length between the Highway 48 and Burnie Road. This photo is looking north towards Lake Simcoe.**

## Waterbend Drive



**Figure 8.20: Waterbend Drive is a 200m long dead-end road off Pleasant Boulevard. This photo was taken looking down Waterbend from Pleasant.**

Of these sites, the Town has begun the process of planning the implementation of conveyance controls on Waterbend Drive. It is expected that this streets will be retrofit with a perforated pipe system conveying drainage to a local creek system. Field visits were conducted along these streets to identify opportunities and constraints. Examples of retrofit scenarios are presented in **Figures 8.21** through **8.24**.



**Figure 8.21: Opportunities for the Implementation of Bioretention Units were identified on Montsell Avenue.**



**Figure 8.22: Opportunities for the Implementation of Bioretention Units were identified on Sunset Beach Road.**



**Figure 8.23: An opportunity for the implementation of a bioretention unit was identified on Ways Bay Drive. This location is adjacent to Claredon Beach Park, a community focal point of Keswick. Bioswales and bioretention areas can be incorporated into the park planting plans.**



**Figure 8.24: Opportunities for the Implementation of Bioretention Units was Identified on Dunkirk Avenue.**

## 8.8 End-Of-Pipe Control Measures

The Recommended Approach for implementing EOP measures within the Town is focused on the following tasks:

1. Retrofit of dry ponds to increase the removal efficiency of phosphorus from existing developed areas; and
2. Develop an O&M program outline for existing SWM facilities.

### 8.8.1 Retrofit of Dry Ponds

Dry SWM facilities are typically designed to control peak flows and provide temporary stormwater detention during large storm events. These facilities do not have a permanent pool and as a result the removal of stormwater pollutants is primarily a function of detention time. Though substantial improvement with respect to removal efficiency can be achieved by prolonging detention time to 48 hours (MOE, 2003), the retrofit of these facilities to wet SWM facilities (with a permanent pool) is more effective and mitigates the risk of pollutant re-suspension. **Figure 8.25** shows a dry stormwater detention facility that has been converted to a wet SWM facility. The pond provides additional water quality and erosion control benefits as well as providing an aesthetic water feature near a residential neighbourhood.



**Figure 8.25: Retrofit of a Dry Stormwater Detention Facility (left) to a Wet SWM Facility (right).**

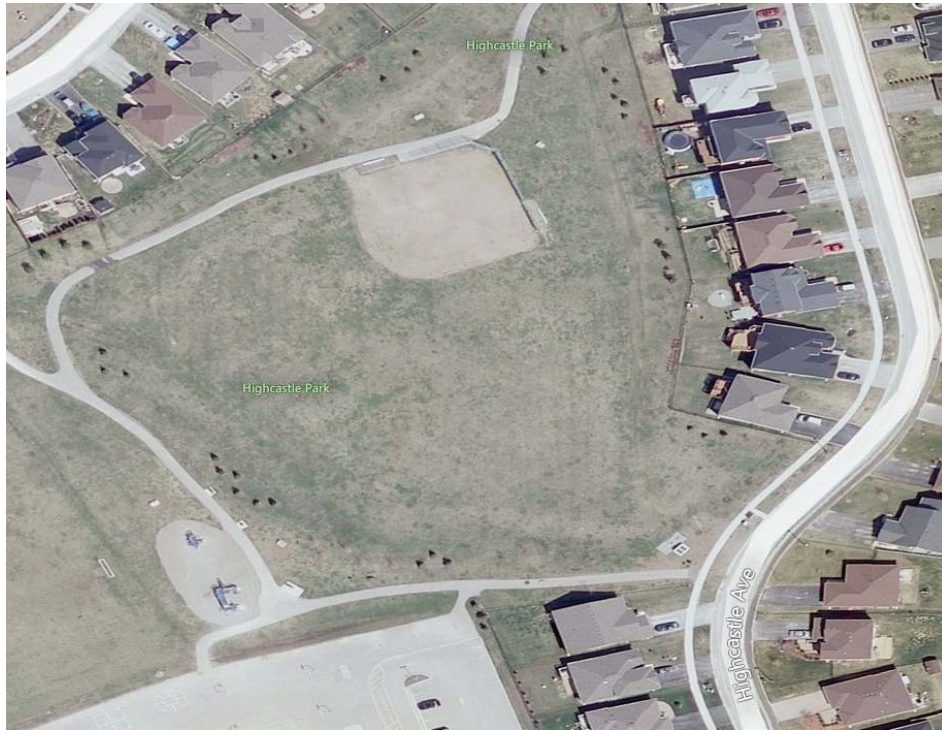
As part of this Master Plan, site investigations were conducted at the SWM facilities discussed in **Section 4.8** of this study. Five (5) of the facilities were identified as dry facilities. All five (5) facilities present retrofit opportunities. It is recommended that property ownership and easement information be thoroughly investigated before retrofit design is undertaken at any of these facilities. **Table 8.2** identifies the six (6) SWM facilities that are recommended to be retrofit.

**Table 8.2: Stormwater Management (SWM) Facility Retrofit Recommendations.**

Facility ID	Facility # (Keswick SWM Study)	Location	Facility Type	Drainage Area (ha)	Design Basis
A	Pond 12	Dry flood detention in park, outlet at Highcastle Ave.	Offline Dry Pond (Water Quantity)	23.0	Convert to Wet Pond for Quantity and Quality Control
B	Pond 13	North of Old Homestead Rd. West of Hattie Court	Offline Dry Pond (Water Quantity)	2.89	Convert to Wet Pond or Constructed Wetland for Quantity and Quality Control
C	Pond 10	South of Church Street, North of Burnaby Drive	Offline Dry Pond (Water Quantity)	35.3	Convert to Wet Pond for Quantity and Quality Control
D	Pond 15	Dry flood detention in park, North of Tampa Drive, East of Camwood Drive	Offline Dry Pond (Water Quantity)	5.90	Convert to Wet Pond for Quantity and Quality Control
E	Pond 6	East of Windover Drive, South of Riverglen Drive	Offline Level 4 Water Quality Pond	25.2	Convert to Wet Pond for Quantity and Quality Control

**Note:** Recent data suggests that wet stormwater management facilities can discharge salt laden stormwater due to stratification of road salts and can under certain conditions re-release phosphorus into the receiver. As such, LID stormwater management practices that utilize the hydrologic pathways of infiltration and evapotranspiration are preferable to wet stormwater management facilities but are less feasible at the end of the pipe for large catchment areas. Over the long-term wet stormwater management facilities that allow for settlement of TSS show water quality benefits beyond conventional dry stormwater management facilities (MOECC, 2003).

## Pond A



**Figure 8.26: Pond A.**

Pond A is a dry SWM facility west of Highcastle Avenue and South of Kerfoot Crescent. The catchment area consists of 23.0 ha of high intensity residential development. The existing facility is dry and currently used as recreational space within Highcastle Park. The construction of a permanent pool within the park would enhance water quality but would reduce the usable area of the park.

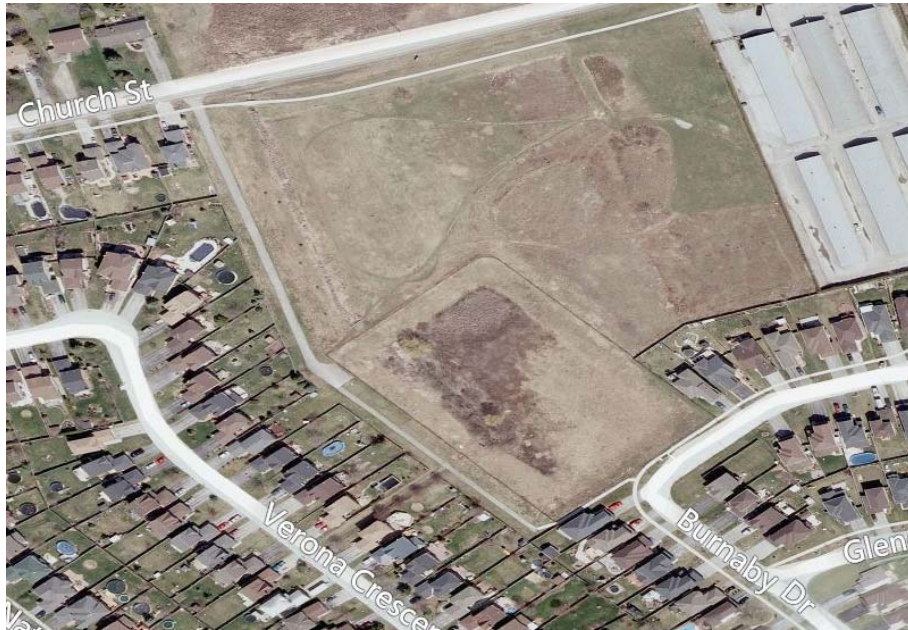
## Pond B



**Figure 8.27: Pond B.**

Pond B is a dry SWM facility north of Old Homestead Road. The catchment area consists of a 2.89 ha townhouse development on Hattie Court. With the small drainage area of the pond, it may be difficult to sustain permanent pool. The addition of phosphorus removal media to the facility is an option but it may be more economically feasible to retrofit facilities with larger drainage areas.

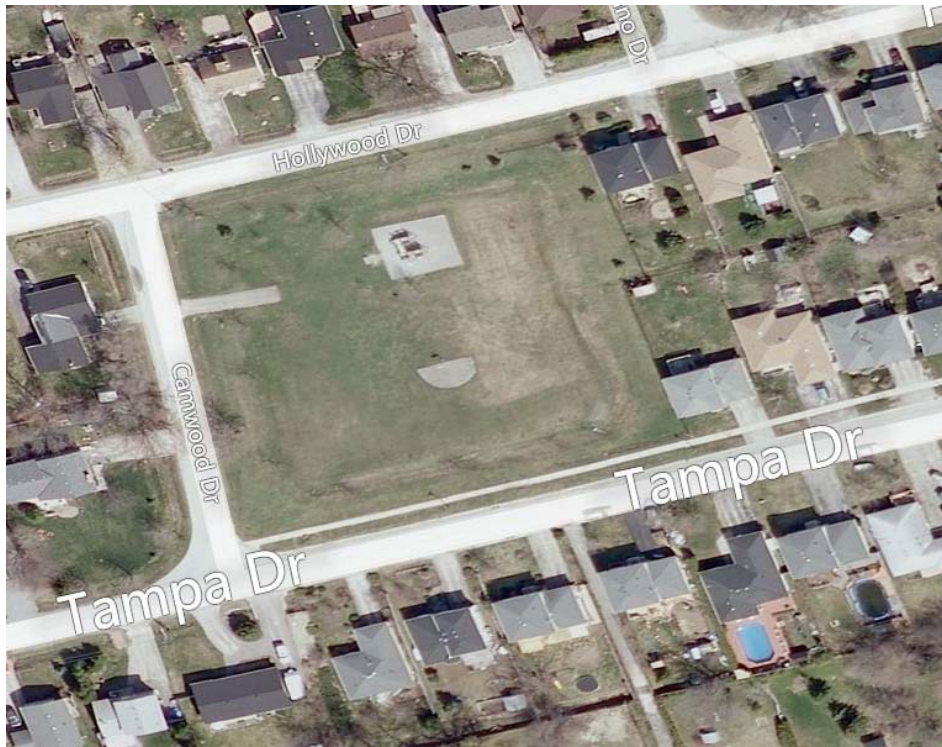
## Pond C



**Figure 8.28: Pond C.**

Pond C is a dry SWM facility north of Burnaby Drive and south of Church Street. The catchment has an area of 35.3 ha consisting primarily of intensity residential development. The most feasible retrofit scenario of this facility involves excavating a permanent pool to allow for pollutant loading reductions via settlement of SS. Some landscaping to the unused green space to the north combined with the excavation of a permanent pool can provide a highly aesthetic park feature for the surrounding community. Due to the large municipally owned area a constructed wetland is an option at this location.

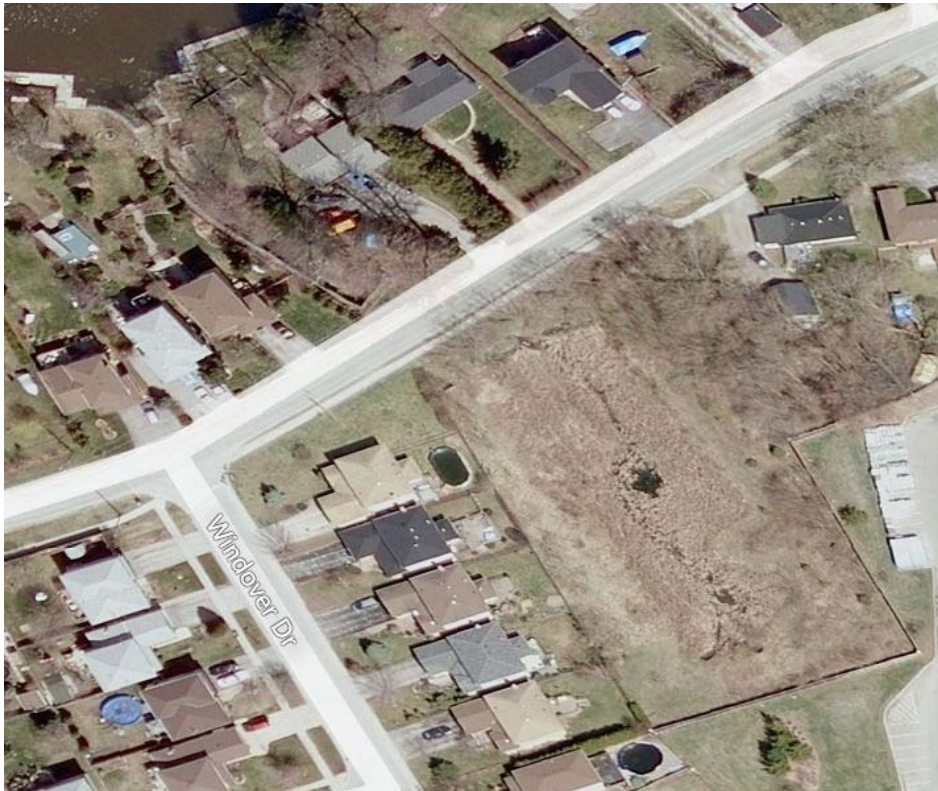
## Pond D



**Figure 8.29: Pond D.**

Pond D is a dry SWM facility located east of Camwood Drive between Hollywood Drive and Tampa Drive in Hollywood Park. The catchment area of this facility consists of 5.9 ha of residential development. The park is at a lower elevation than the surrounding roads and has swales along the south and east perimeter facility. Flood storage is provided on the surface of the park before discharging to the sanitary sewer along Tampa Drive. Several retrofit options exist for this facility including subsurface storage, addition of phosphorus removal media or the excavation of a permanent pool separating the SWM facility from the park.

## Pond E



**Figure 8.30: Pond E.**

Pond E is a dry SWM facility located south of Riverglen Drive and East of Windover Drive. The facility has a catchment area of 25.2 ha which includes both residential and commercial development. The Maskinonge River is approximately 100 m downstream of the facility. A feasible retrofit scenario includes the excavation of a permanent pool to encourage settlement of SS.

### **8.8.2 Operations and Maintenance Program**

SWM facilities need both routine operations and periodic maintenance to ensure the long-term achievement of SWM performance targets. In recognition of this, an O&M program which sets out maintenance and monitoring objectives and procedures for all of the functional components of SWM facilities is recommended for the Town.

The objective of this section is to provide an overview as to how an O&M program (or SWM Facilities Assessment Program) could be undertaken.

The Basic Steps involved in implementing a Town-wide O&M program are:

1. Undertake a physical inventory to define the existing condition of all SWM Ponds.
2. Develop an O&M program based on the following general:

- a. **Hydraulic operation of the facility** - The permanent pool provides functions including water quality enhancement, visual aesthetics and potential aquatic habitat. The permanent pool should normally be stable between storm events (the permanent pool will rise during and after rainfall events).

If the permanent pool is too high then storage for erosion and flood control will not be available. If the pool is too low, water quality is then threatened by algal blooms and anoxic conditions, which can lead to fish kills downstream of the facility.

Periodic monitoring, typically three (3) times per year, should be undertaken. If the water level is higher than normal then the outlet structure or downstream receiver should be checked. Too low of a water level may be attributed to leakage or due to evaporation during extended dry weather periods.

**Table 8.3: Hydraulic Operation and Maintenance Problems and Activities.**

<b>Problem</b>	<b>Activity</b>
<b>Damage / Leak in Outlet</b>	Seal leak and repair outlet
<b>Clogged Outlet or Downstream Channel</b>	Clean outlet or channel, consider installing trash rack
<b>Leak or Seepage in Berms</b>	Perform visual inspection, undertake dye test or drain permanent pool to inspect for deficient area
<b>Vortexing</b>	Drain pond and visually inspect outlet device for piping

- b. **Clogging** - The most frequent maintenance item common to stormwater facilities is the clogging of outfalls. Large storms transport significant amounts of debris. Some residents also discharge litter and trash into the facility. Furthermore, vandalism and nuisance problems such as beavers contribute to clogging as well.

A number of stormwater components should be inspected periodically (typically three (3) times per year). The monitoring inspection should include:

- Inlets/Outlets;
- Downstream and Upstream Channels;
- Low Flow Orifices;
- Underdrains;
- Trash Racks;
- Weirs; and
- Spillways/Emergency Spillways.

- c. **Pipe repairs** - Improper design, poor construction practice or inadequate maintenance may result in damage to pipes or riser structures. If the pipes or risers are damaged, then the functions of the facility will be impacted. The consequences may be particularly severe if pipes through embankments are jeopardized as this may lead to piping of water along the pipe or riser, which can lead to bank failure.

Physical inspections should be carried out three (3) times per year. The inspections may involve identification of obvious failures such as damaged inlet or outlet structures. Visual inspection for signs of piping along embankments should also be undertaken. Periodic inspections should also consider impacts associated with vandalism, corrosion, fatigue and U/V deterioration.

- d. **Grass cutting** - Grass cutting around stormwater facilities is generally limited to areas adjacent to walkways or maintenance access locations and is usually undertaken in order to provide a visual buffer between the adjacent urban landscape and the natural landscape within the stormwater facility, with limited grass cutting adjacent to the facility.

Generally, it is recommended that grass-cutting be limited or eliminated around SWM facilities since allowing grass to grow tends to enhance water quality and provide other benefits for wet facilities. Short grass around a wet stormwater facility provides an ideal habitat for nuisance species such as geese. Allowing the grass to grow is an effective means of discouraging geese.



**Figure 8.31: Grass Cutting along Walkways, Access and Inspection Areas. Grass has been left long adjacent to the permanent pool to deter geese.**

- e. **Weed control** - Weeds are generally defined as any kind of vegetation which is unwanted in a particular area. In terms of SWM facilities, weeds are generally invasive species which cannot provide the intended function of the planting strategy, or non-native species such as purple loosestrife, the spread of which is undesirable. Weed control by-laws should be consulted for local requirements. Weed control may be required annually.
- f. **Vegetation management** - Vegetation is an integral functional component of SWM facilities, contributing to bank stability, pollutant removal and the filtration of storm water. Consequently, it is important that the vegetation community within SWMPs be maintained appropriately in order to ensure that the facility performs as originally intended over the long-term. Maintenance activities will differ for Treed areas, seeded areas, and shrub beds.
- g. **Dredging and sediment removal** - To ensure long-term effectiveness, the sediment that accumulates in SWM facilities (e.g., wet ponds, wetlands and dry ponds) should be

periodically removed. The required frequency of sediment removal is dependent on many factors including:

- Type of SWM facility;
- Design storage volume (e.g., if active and permanent pool storage is oversized for sediment storage);
- Characteristics of the upstream catchment area (e.g., land use; level of imperviousness; upstream construction activities and effectiveness of sediment and erosion control activities; and
- Municipal practices (e.g., sanding).

Estimated annual SS loadings in runoff from catchments with different levels of percent imperviousness and estimated sediment density are provided in the SWMPDM (MOE, 2003) and are reproduced below in **Table 8.3**.

**Table 8.4: Annual Sediment Loading (MOE, 2003).**

Catchment Imperviousness	Annual Loading (kg/ha)	Wet Density (kg/m <sup>3</sup> )	Annual Loading (m <sup>3</sup> /ha)
35%	770	1,230	0.6
55%	2,300	1,230	1.9
70%	3,500	1,230	2.8
85%	4,680	1,230	3.8

Maintenance activities include sediment sampling and removal/disposal of accumulated sediment material. The goal of sediment sampling and testing is to obtain results that are representative and reproducible to determine appropriate disposal options. Prior to removal of the sediment the permanent pool should be drained by gravity or by using a pump. Pump hoses should be equipped with filter bags to avoid discharging sediment into the creek. Special care should also be taken when removing the sediment to avoid damaging the plantings on the flood and shoreline fringes of the pond. To allow the sediment to dry out, bypass system should be routinely employed.



**Figure 8.32: Sediment Dredging at a SWM Facility.**

- h. **Nuisance issues** - Nuisance issues generally relate to items such as the presence of waterfowl, mosquitoes, rodents, nutrient buildup, or poor water clarity. **Table 8.4** identifies maintenance activities associated with nuisance issues.

**Table 8.5: Maintenance Activities Associated with Nuisance Issues.**

<b>Problem</b>	<b>Maintenance Activity</b>
<b>Waterfowl</b>	<ul style="list-style-type: none"> <li>• Limit area which is mowed; and</li> <li>• Install cross lines within pond.</li> </ul>
<b>Animal Activity</b>	<ul style="list-style-type: none"> <li>• Inspect for animal burrows; and</li> <li>• Check inlet/outlets, flood fringe for evidence or animal activity.</li> </ul>
<b>Mosquitoes</b>	<ul style="list-style-type: none"> <li>• Check for isolated areas of shallow standing water. Regrade if necessary; and</li> <li>• Provide habitat for predators (bird houses) which consume larvae and mosquitoes.</li> </ul>
<b>Water Clarity / Excess Nutrients</b>	<ul style="list-style-type: none"> <li>• Remove sediments;</li> <li>• Install aerators; and</li> <li>• Use of Barley Straw Bales.</li> </ul>

3. Establish an Operations and Maintenance Program

The O&M program established by the Town should include an inspection component. Inspection sheets for each facility should be created. These should include maps, photos the facility and examples of issues to be watched for. These sheets should be created in collaboration with O&M staff who will be conducting the annual facility assessments. A database should be set up for tracking purposes. The O&M program should indicate expected maintenance frequency, contacts for supplies, equipment and professional services, and also be integrated with the stormwater facility funding schedule.

Prioritization will be defined upon completion of the O&M program. Prioritization and the overall tasks to be undertaken will be dependent upon funding and staffing. In general, prioritization will be based on ensuring facilities are functional and meet municipal or provincial standards including those as outlined in CoA / Environmental Compliance Approvals (ECA) for Sewage Works.

## 9. Environmental Benefits of the Recommended Approach

### 9.1 Introduction

This chapter presents key environmental benefits of the Recommended Approach (Chapter 8), and provides a decision making tool that can be utilized by the Town to select specific stormwater measures including source control, conveyance control, and EOP control measures. More specifically, Chapter 9 provides a framework to select the preferred SWM measure for specific objectives and at the defined scale per the recommended approach. The framework, which is presented through several Tables (Tables 9.1 to 9.7), include the following:

1. Type of stormwater control measure to be selected from the Recommended Approach;
2. Pollutant removal efficiency for each control measure (i.e. how much phosphorus or TSS can be removed using a certain SWM measure); and
3. Targets for each SWM measure (for example, uptake rates for SCM or pollutant removal needed per kilometer of a road where a conveyance control can be constructed).

Therefore, the Town could use the Tables from 9.1 to 9.7 to link any selected SWM measures to benefits and consequently obtain a target using removal efficiencies and effluent loads per facility, drainage area, or linear kilometer. Accordingly, the Town will have a systemized approach that is compliant with the LSPP and its guidelines and objectives.

Throughout this chapter, the discussion of the environmental benefits is holistic since it evaluates the effect of using SWM measures that provide water quality and quantity benefits. More specifically, using the three (3) SWM categories discussed here (i.e. source control, conveyance control, and EOP controls) would provide in addition to pollutant removal, a reduction in surface runoff volume and flow rate and a hydrological water balance.

These three categories which will provide a treatment train approach throughout the Town are discussed below with focus on water quality benefits, in particular phosphorus and TSS removal.

1. SCM, including:
  - a. Soakaways / Infiltration Trenches; and
  - b. Sand or Media Filters (i.e. Bioretention Units).
2. CCM, including:
  - a. Perforated Pipe Infiltration / Exfiltration Systems;
  - b. Sand or Media Filters (i.e. Bioretention Units); and
  - c. Sorbtive Media Interceptors (i.e. enhanced OGS).
3. EOP Retrofits, including:
  - a. Wet Detention Ponds; and
  - b. Constructed Wetlands.

For each category, drainage areas under SWM control are tabulated, with removal efficiencies that depend on the control measure selected. For SCM, uptake rates are another variable that could be part of the decision making process related to applying SCM within different land uses. For example, a ten percent (10%) uptake rate means that 10% of the drainage area or the neighborhood applies SCM and/or willing to implement these measures.

It should be emphasized that the environmental benefits of the three stormwater control categories should be considered holistically; where each of the three stormwater control measures complements the other. In that regard, and in order to understand the overall phosphorus or TSS removal, there should be no focus on the EOP wet ponds as stand-alone measures but as part of a treatment train approach.

## 9.2 Source Control Retrofits

The following analysis of source control benefits is based on estimating phosphorus and TSS removal from a drainage area of one (1) hectare within a typical residential neighborhood in the Town. Five (5) different control scenarios and two (2) control measures (soakaways and sand or media filters) were investigated:

1. Existing Conditions (i.e. no source control retrofit);
2. 10% Uptake Rate;
3. 20% Uptake Rate;
4. 30% Uptake Rate; and
5. 40% Uptake Rate.

For phosphorus removal, the Ptool was used for input on the removal efficiencies of the soakaways and sand or media filters. For TSS removal, we used literature-based values representing international and national experience. Tables 9.1 and 9.2 show the results of the analysis. Accordingly,

- **The phosphorus load reduction using Soakaway/Infiltration Trenches is expected to range from:**
  - **6.1% to 24.2%, for a 10% to 40% Uptake Rate respectively; and**
- **The phosphorus load reduction using Sand or Media Filters is expected to range from:**
  - **4.5% to 18.2% for a 10% to 40% Uptake Rate respectively.**

**Table 9.1: Phosphorus Removal per hectare using Source Control Retrofits.**

Source Control Measure	Source Control Removal Efficiency (%)	Phosphorus Treatment	Existing Conditions (No Retrofit) <sup>A</sup>	10% Uptake Rate	20% Uptake Rate	30% Uptake Rate	40% Uptake Rate
Soakaways / Infiltration Trenches	60	Phosphorus Loading (kg/yr)	1.32	1.24	1.17	1.08	1.00
		Phosphorus Removal (%)	-	6	11	18	24
Sand or Media Filters	45	Phosphorus Loading (kg/yr)	1.32	1.26	1.21	1.14	1.08
		Phosphorus Removal (%)	-	5	8	14	18

A) Assumed "High Intensity Residential" per Ptool.

**Table 9.2: Total Suspended Solids (TSS) Removal per hectare using Source Control Retrofits.**

Source Control Measure	Source Control Removal Efficiency (%)	TSS Treatment	Existing Conditions (No Retrofit) <sup>A</sup>	10% Uptake Rate	20% Uptake Rate	30% Uptake Rate	40% Uptake Rate
Soakaways-Infiltration Trenches	75	TSS Loading (kg/yr)	770	712	663	621	584
		TSS Removal (%)	-	58	107	149	186
Sand or Media Filters (i.e. Bioretention)	85	TSS Loading (kg/yr)	770	705	650	604	565
		TSS Removal (%)	-	65	120	166	205

A) SWMPDM (MOE, 2003) Table 6.3 assuming 35% impervious residential development.

### 9.3 Conveyance Control Retrofits

The following analysis of conveyance control benefits shows estimated phosphorus and TSS removal from five (5) road segments within residential neighborhoods in the Town. The roads were identified by town staff as having drainage issues resulting in standing water and urban flooding on an annual basis. The town intends to resolve these drainage issues in the coming years. An opportunity to integrate water quality improvements with drainage improvements via LID was identified. Field visits were conducted in September for all of the identified roads to assess retrofit opportunities.

**Appendix B** of this report is a Feasibility Assessment Memo: Bioretention & Bioswale Retrofits which includes an overview of the road retrofit locations, assesses the potential LID BMPs, provides considerations for design and construction, discusses opportunities and constraints, and provides recommendations for next steps and regulatory requirements. **Figure 1.3 of Appendix B** provides a map showing the location of all five (5) potential LID road retrofits.

For phosphorus removal, the Ptool was used for input on the removal efficiencies of the CCM. For TSS removal, we used literature-based values representing international and national experience in LID performance were utilized. Design and sizing considerations for the LIDs are discussed in Chapter 10.

**Table 9.3** shows the results of the analysis. The analysis consists of five (5) road segments. Each segment was assumed to have a 20 m wide ROW. The five (5) road segments combined have a total drainage area of 6.15 ha.

#### ***Phosphorus Removal under Retrofits:***

- Under the perforated pipe scenario, the phosphorus load would be reduced from 8.13 kg/yr (existing) to 1.06 kg/yr, representing a removal efficiency of 87%;
- Under the Sorbtive Media Interceptors scenario the phosphorus load would be reduced from 8.13 kg/yr (existing) to 1.71 kg/yr, representing a removal efficiency of 79%; and
- Under the Sand or Media Filters scenario the phosphorus load would be reduced from 8.13 kg/yr (existing) to 2.03 kg/yr, representing a removal efficiency of 75%.

#### ***TSS Removal under Retrofits:***

- Under the perforated pipe scenario, the TSS load would be reduced from 21,500 kg/yr (existing) to 4,300 kg/yr, representing a removal efficiency of 75%;
- Under the Sorbtive Media Interceptors scenario, the TSS load would be reduced from 21,500 kg/yr (existing) to 1320 kg/yr, representing a removal efficiency of 80%; and
- Under the Sand or Media Filters scenario, the TSS load would be reduced from 21,500 kg/yr (existing) to 3,220 kg/yr, representing a removal efficiency of 85%.

**Table 9.4** shows unitary loadings of phosphorus and TSS in kg/km. Accordingly, under existing conditions (no retrofit) each road segment in residential areas produces approximately 2.6 kg of phosphorus and 1724 kg of TSS per kilometer. Using any of the three (3) conveyance control options will result in removing:

- Phosphorous: 1.15 – 2.30 kg/km/yr
- TSS: 1290 – 1550 kg/km/yr

**Table 9.3 Phosphorus and Total Suspended Solids Removal for Proposed Road Reconstruction using Conveyance Control Retrofits.**

Road #	Road Reconstruction Project	Length (m)	Drainage Issue	Land Use	Mgmt. Unit	Drainage Area <sup>A</sup> (ha)	Phosphorus								Total Suspended Solids (TSS)							
							Option # 1 Existing Conditions (No Retrofit) <sup>B</sup>		Option # 2 Retrofit with Perforated pipe		Option # 3 Retrofit with Sorbtive Media (OGS)		Option # 4 Retrofit with Sand or Media Filters (Bioswale)		Option # 1 Existing Conditions (No Retrofit) <sup>C</sup>		Option # 2 Retrofit Perforated pipe		Option # 3 Retrofit with Sorbtive Media (OGS)		Option # 4 Retrofit with Sand or Media Filters (Bioswale)	
							Load (kg/yr)	% Removal	Load (kg/yr)	% Removal	Load (kg/yr)	% Removal	Load (kg/yr)	% Removal	Load (kg/yr)	% Removal	Load (kg/yr)	% Removal	Load (kg/yr)	% Removal	Load (kg/yr)	% Removal
1	Walter Drive	920	Standing Water	Residential	Keswick SPA	1.8	2.4	87	0.3	79	0.5	75	0.6	75	6,430	1,610	75	1,290	80	965	85	
2	Montsell Avenue	525	Standing Water	Residential	Rural Area	1.1	1.4	87	0.2	79	0.3	75	0.4	75	3,670	917	75	734	80	550	85	
3	Dunkirk Avenue	450	Standing Water	Residential	Sutton SPA	0.9	1.2	87	0.2	79	0.3	75	0.3	75	3,150	786	75	629	80	472	85	
4	Sunset Beach Road	980	Standing Water	Residential	Hamlet Area	2.0	2.6	87	0.3	79	0.5	75	0.7	75	6,850	1,710	75	1370	80	1,030	85	
5	Waterbend Drive	200	Standing Water	Residential	Keswick SPA	0.4	0.5	87	0.1	79	0.1	75	0.1	75	1,400	350	75	280	80	210	85	
<b>Totals</b>						<b>6.2</b>	<b>8.1</b>		<b>1.1</b>		<b>1.7</b>		<b>2.0</b>		<b>21,500</b>	<b>5,350</b>		<b>4,300</b>		<b>3,220</b>		

- A)   
 B) Drainage area was calculated based on a road width of 20 meters.   
 C) High-Intensity Residential Phosphorus Loading from Ptool.   
 D) SWMPDM (MOE, 2003) Table 6.3 assuming 70% impervious ROW width.

**Table 9.4 Unitary Phosphorus and Total Suspended Solids (TSS) Loadings (kg/km/yr) in Residential and Industrial Roads.**

	Existing Conditions (No Retrofit)		Retrofit Perforated Pipe		Retrofit with Sorbtive Media (OGS)		Retrofit with Sand or Media Filters (Bioswale)	
	Residential	Industrial	Residential	Industrial	Residential	Industrial	Residential	Industrial
Phosphorus Loading (kg/km/yr)	2.6	2.6	0.3	0.3	0.5	0.5	1.5	1.5
TSS Loading (kg/km/yr)	1,720	1,150	431	286	345	229	259	172

## 9.4 End-of-Pipe Retrofits and Opportunities

The characterization of existing SWM within the Town (Section 4.10) showed that there are twenty four (24) SWM facilities. Of these facilities, five (5) were identified as retrofit opportunities in section 8.8.1 of this report. These ponds are identified in **Table 8.1**. The EOP retrofits are located in the Town's largest urban center of Keswick. The Keswick SPA is identified in **Figure 4.2a**.

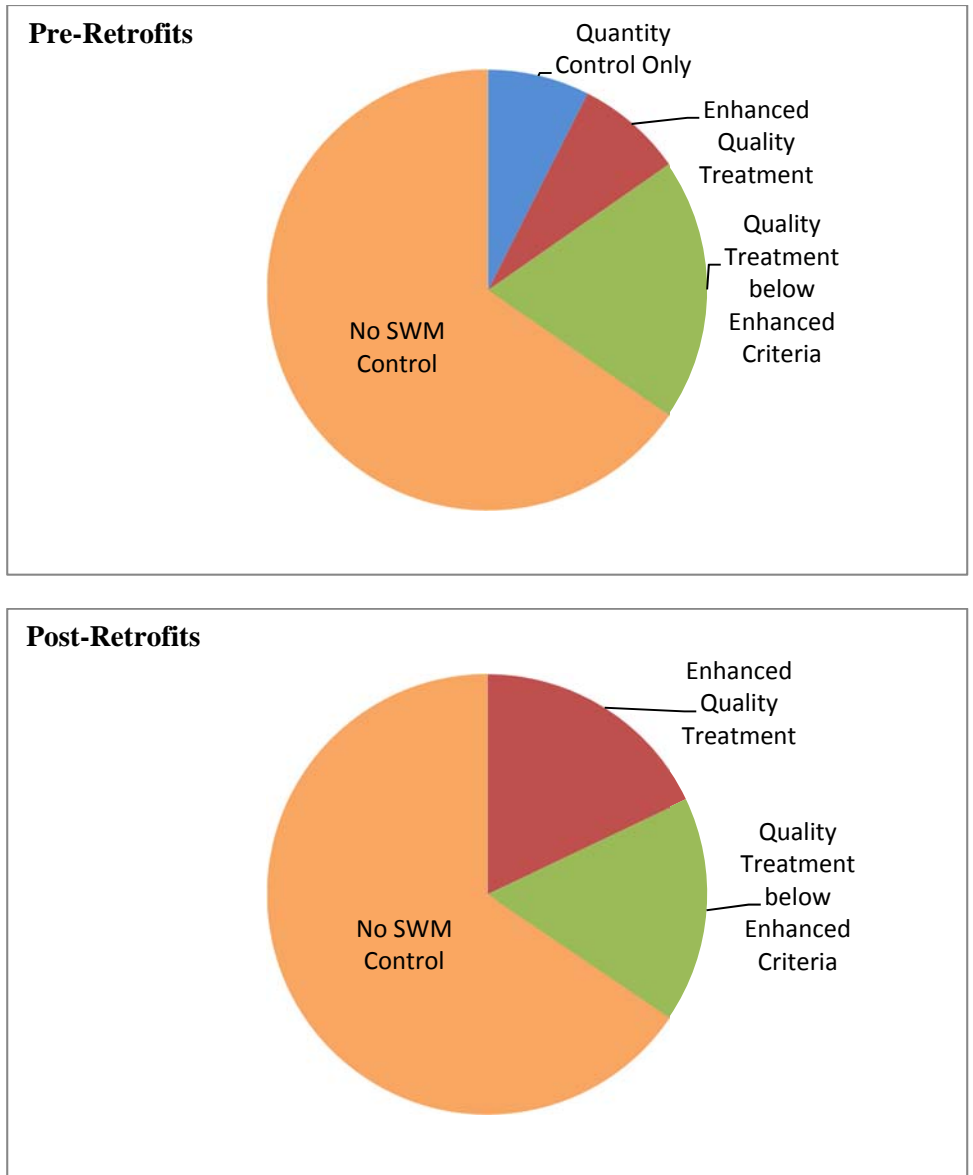
As part of the Recommended Approach, the five (5) dry ponds (quantity control) were selected for retrofit to quantity and quality control. **Table 9.5** shows the controlled drainage areas and percentages of stormwater controlled areas in relation to the total urban area of Keswick (900 ha). The purpose of **Table 9.5** is to show the breakdown of stormwater controlled areas in terms of quantity control (dry ponds) and quantity and quality control (wet ponds).

**Table 9.5 Breakdown of Controlled Areas within the Existing Land Uses of Keswick.**

Existing/Future	End-of-Pipe Treatment Type	Area (ha)	% of Total Urban Area - Keswick
Existing Conditions	Quantity Control Only (existing dry ponds)	67.2	7.5
	Enhanced - Level 1 Quality Treatment (existing wet ponds)	70.6	7.8
	Quality Ponds that do not meet Enhanced Criteria	174	19.3
	No Stormwater Control	588	65.4
Future Conditions	Quantity Control Only (existing dry ponds)	0	0
	Enhanced - Level 1 Quality Treatment (wet ponds)	161	17.9
	Quality Ponds that do not meet Enhanced Criteria	149	16.5
	No Stormwater Control	588	65.4

According to **Table 9.5**, the five (5) EOP retrofit opportunities would add 90.3 ha of enhanced level SWM controlled or 10.0% of Keswick's total urban catchment area. It should be noted that the potential retrofits at Claredon Beach Park and Young's Harbour Park would add an additional 18.5 and 27.6 ha of enhanced level quality control if they are found to be feasible after further analysis. These two (2) EOP projects represent another 46.0 ha or an additional 5% of the total Keswick urban area.

A simplified graphical representation of the previous tabulated information in Table 9.5 is depicted in **Figure 9.1**. In a nutshell, all dry SWM facilities (quantity control ponds) will be modified to provide enhanced treatment. In addition, the pond located at the East of Windover Drive will be upgraded to an enhanced level SWM facility.



**Figure 9.1: Graphical Representation of Percentage Coverage of Stormwater Control for the Community of Keswick.**

**Table 9.6** presents an assessment of water quality benefits from implementing these five (5) retrofit opportunities. The assessment is based on three (3) options that are compared to baseline conditions:

1. Existing Conditions;
2. Wet Ponds; and
3. Constructed Wetlands (as per the MOECC's guidelines (MOE, 2003)).

For phosphorus removal, the Ptool was used for input on the removal efficiencies of the CCM. For TSS removal, literature-based values representing international and national experience were utilized.

The results of the assessment of retrofits are as follows:

- **Phosphorus Removal with SWM Facility Retrofits:**
  - Under the wet pond scenario, the phosphorus load from the urban area (including uncontrolled areas) would be reduced from 1,032 kg/yr (existing) to 904 kg/yr, representing a reduction of 128 kg/yr or 12.4%.
  - Under the wet pond and wetland scenario, the phosphorus load from the urban area (including uncontrolled areas) would be reduced from 1,032 kg/yr (existing) to 826 kg/yr, representing a reduction of 206 kg/yr or 20%.
- **TSS Removal with SWM Facility Retrofits:**
  - Under the wet pond scenario, the TSS load from the urban area (including uncontrolled areas) would be reduced from 529,406 kg/yr (existing) to 483,735 kg/yr, representing a reduction of 45,671 kg/yr or 8.6%.
  - Under the wet pond and wetland scenario, the TSS load from the urban area (including uncontrolled areas) would be reduced from 529,406 kg/yr (existing) to 481,168 kg/yr, representing a reduction of 48,238 kg/yr or 9.1%.

Phosphorus and TSS loading for the existing SWM system vs. recommended SWM system is shown in **Table 9.7**. Accordingly, the following findings are noted:

1. Under existing conditions, municipal SWM facilities in Keswick reduce Phosphorus loading by 14% (1190 kg assuming no controls, 1030 kg with existing SWM). With proposed wet pond retrofits municipal SWM facilities would reduce Phosphorus loading by 24% (1190 kg assuming no controls, 904 kg with recommended SWM). With the proposed wetland retrofit at Pond C and the proposed wet pond retrofits SWM facilities would reduce Phosphorus loading by 31% (1190 kg assuming no controls, 826 kg with recommended SWM).
2. Under existing conditions, municipal SWM facilities reduce TSS loading by 13% (609,231 kg assuming no controls, 529,406 kg with existing SWM). With proposed wet pond retrofits municipal SWM facilities would reduce TSS loading by 21% (609,231 kg assuming no controls, 483,735 kg with recommended SWM). With the proposed wetland retrofit at Pond C and the proposed wet pond retrofits SWM facilities would reduce TSS loading by 21% (609,231 kg assuming no controls, 481,168 kg with recommended SWM).
3. Removal efficiencies vary depending on the type of SWM facility used. **Table 9.7** shows results for wet ponds and constructed wetlands scenarios.

**Table 9.6: Phosphorus and Total Suspended Solids (TSS) loading of Stormwater Management (SWM) Facility Retrofit Opportunities.**

Facility ID (Type)	Facility # (Keswick SWM Study)	Location	Drainage Area (ha)	Phosphorus							TSS						
				No SWM Facility Load (kg/yr)	Option # 1 Existing Conditions		Option # 2 Wet Pond		Option # 3 Constructed Wetland		No SWM Facility Load (kg/yr)	Option # 1 Existing Conditions		Option # 2 Wet Pond		Option # 3 Constructed Wetland	
					Load (kg/yr)	% Removal	Load (kg/yr)	% Removal	Load (kg/yr)	% Removal		Load (kg/yr)	% Removal	Load (kg/yr)	% Removal	Load (kg/yr)	% Removal
A (Quantity)	Pond 12	Dry flood detention in park, outlet at Highcastle Ave	23.0	30.4	27.4	10	12.5	59	Not Feasible	Not Feasible	15,600	14,000	10	6,400	59	Not Feasible	Not Feasible
B (Quantity)	Pond 13	North of Old Homestead Rd. West of Hattie Court	2.90	3.81	3.43	10	1.56	59	Not Feasible	Not Feasible	1,960	1,761	10	802	59	Not Feasible	Not Feasible
C (Quantity)	Pond 10	South of Church Street, North of Burnaby Drive	35.3	46.7	42.0	10	19.1	59	12.1	74	23,900	21,500	10	9,810	59	6,220	74
D (Quantity)	Pond 15	Dry flood detention in park, North of Tampa Drive, East of Camwood Drive	5.90	7.79	7.01	10	3.19	59	Not Feasible	Not Feasible	4,000	3,600	10	1,640	59	Not Feasible	Not Feasible
E (Level 4 Quality)	Pond 6	East of Windover Drive, South of Riverglen Drive	25.2	33.2	19.9	40	13.6	59	Not Feasible	Not Feasible	17,100	10,200	40	6,990	59	Not Feasible	Not Feasible

Note: All stormwater retrofits identified in table 9.6 are in the Keswick SPA

Table 9.7 Environmental Benefits Following the Implementation of End-of-Pipe Type Opportunities.

Existing/Future	End-Of-Pipe (EOP) Treatment Type	Area (ha)	% of total Town area	Total Phosphorus (TP) Loading (kg/yr)					Total Suspended Solids (TSS) Loading (kg/yr)					
				Loading without SWM Control	Dry Pond	Wet Pond	Constructed Wetland	TP Loading	Loading without SWM Quality Control	Dry Pond	Wet Pond	Constructed Wetland	Total TSS Loading	
Existing Conditions	Quantity Control Only (existing dry ponds)	67.2	7.5	-	80	-	-	-	-	40,900	-	-	-	
	Enhanced - Level 1 Quality Treatment (existing wet ponds)	70.6	7.8	-	-	38	-	-	-	-	19,600	-	-	
	Quality Ponds that do not meet Enhanced Criteria	174	19.3	-	138	-	-	-	-	70,600	-	-	-	
	No Stormwater Control	588	65.4	776	-	-	-	-	398,000	-	-	-	-	
	<b>Total (System)</b>	<b>900</b>	<b>100</b>						<b>1,030</b>					<b>529,000</b>
Future Conditions	Quantity Control Only (dry ponds)	0	-	-	-	-	-	-	-	-	-	-	-	
	Enhanced - Level 1 Quality Treatment (existing wet ponds)	70.6	7.8	-	-	38	-	-	-	-	19,600	-	-	
	Quality Ponds that do not meet Enhanced Criteria	149	16.5	-	78	-	-	-	-	40,200	-	-	-	
	No Stormwater Control	588	65.4	776	-	-	-	-	398,000	-	-	-	-	
	Retrofit Opportunities (dry ponds to be converted) using Wet Ponds	92.3	10.2	-	-	50.0	-	-	-	-	25,600	-	-	
	<b>OR</b>													
	Retrofit Opportunities (dry ponds to be converted) using Wet Pond & Constructed Wetland at Pond C	92.3	10.2	-	-	36.3	37.3	-	-	-	18,600	4,430	-	
	<b>Total (System) Following Retrofit with Wet Ponds</b>	<b>900</b>	<b>100</b>	<b>776</b>	<b>78</b>	<b>50</b>	<b>-</b>	<b>-</b>	<b>904</b>	<b>398,000</b>	<b>40,200</b>	<b>45,200</b>	<b>-</b>	<b>484,000</b>
<b>Total (System) Following Retrofit with Wet Pond &amp; Constructed Wetland at Pond C</b>	<b>900</b>	<b>100</b>	<b>776</b>	<b>-</b>	<b>36.3</b>	<b>13.6</b>	<b>-</b>	<b>826</b>	<b>398,000</b>	<b>40,200</b>	<b>38,300</b>	<b>4,430</b>	<b>481,000</b>	

Note: All stormwater retrofits identified in table 9.7 are in the Keswick SPA

## 9.5 Water Balance Targets and Benefits

The predominant soil types within the Town are clayey to silty loam in the central part of the study area (i.e. Glaciolacustrine Deposits) running in a northeast-southwest direction. The eastern portion of the watershed contains moraine deposits especially in the communities of Pefferlaw and Udora. In the areas where sandy soils are present, infiltration deficits because of development are higher. Infiltration deficits in New Development Areas as identified in **Tables 5.1** and **5.2** range from 79 mm/yr to 118 mm/yr. To maintain a healthy water balance in these areas the following minimum infiltration targets based on rainfall distribution and depth needed to make up for post-development infiltration deficits is recommended. These targets allow for full infiltration of the most frequent rainfall events. Site specific studies and/or applicable targets in the LSRCA Technical Guidelines for Stormwater Management Submissions (2016) will supersede these minimum infiltration targets. **Tables 9.8** through **9.10** identify minimum infiltration targets for New Development Areas.

**Table 9.8:** Minimum Infiltration Targets for New Development Areas in the Community of Keswick

Development	Infiltration Deficit (mm/yr)	Minimum Infiltration Target (mm)	Resulting Infiltration Depth (mm/yr)
Queensway West	91	2.6	93
Queensway East	91	2.6	93
Glenwoods	91	2.6	93
South Keswick	79	2.3	82

**Table 9.9:** Minimum Infiltration Targets for New Development Area in the Keswick Business Park

Development	Infiltration Deficit (mm/yr)	Minimum Infiltration Target (mm)	Resulting Infiltration Depth (mm/yr)
Keswick Business Park	118	3.3	118

**Table 9.10:** Minimum Infiltration Targets for New Development Areas in the Community of Sutton

Development	Infiltration Deficit (mm/yr)	Minimum Infiltration Target (mm)	Resulting Infiltration Depth (mm/yr)
Northwest	87	2.5	90
Southwest	87	2.5	90
Northeast	87	2.5	90
Southeast	87	2.5	90

It is however noted that volume-based MOECC SWM guidelines are expected to be released in 2017. In order to meet these volume-based water quality targets, additional infiltration beyond the minimum values identified in the above tables may be required. Using infiltration-based LIDs to achieve this water quality target will also allow for full infiltration of the most frequent rainfall events.

## 10. Implementation Plan

### 10.1 Overview

This Chapter provides recommendations on how to implement the Town's CSWM-MP.

In preparing the Implementation Plan, the following points were considered:

- The Implementation Plan must be consistent with the other Municipal programs, policies and standards; and recognize existing and proposed land uses;
- The success associated with implementing various steps will not only be dependent upon the development community, municipality and agencies, but will also be somewhat dependent upon the support of residents within the watershed; and
- The Implementation Plan, as presented, is a starting point. Several key studies will have to be undertaken in order to implement certain components. Furthermore, various policies and standards will have to be assessed and delegation of roles and responsibilities will have to be defined.

*The successful implementation of this strategy will:*

- Ensure that maximum benefit is achieved from existing and proposed SWM infrastructure over the short and long term;
- Establish a framework for retrofitting existing infrastructure and undertaking measures within existing urban areas which will improve water quality and quantity within the streams and rivers within the Town;
- Fulfill the requirements of the LSPP, local SWSs, and provincial requirements in terms of water **quality** and **quantity**, and provide water quality improvements of urban stormwater discharging to streams, rivers and Lake Simcoe;
- Provide water quantity benefits including :
  - Reduction of in-stream erosion problems;
  - Improvement of aquatic habitat and fisheries; and
  - Enhancement of groundwater resources and watershed hydrologic functions.

### 10.2 Implementation Considerations

**Table 10.1** presents implementation considerations for each component of the Recommended Approach described in Chapter 8. In general, the activities that will need to be considered for each component, in order to successfully implement the Plan include:

- **Key Next Steps:** The key steps that need to be undertaken in order to continue the existing measure or to kick start a new program;

- **Future Study Requirements:** required in order to implement each type of measure which constitutes the recommended strategy;
- **Policy/Standards:** Existing or proposed policies and/or standards that need to be reviewed or updated;
- **Facilitator & Contributors:** The agency or group that will coordinate efforts to implement the measure and or the agency(ies) or groups(s) that will assist in implementing the measure by providing support in any number of ways, e.g., funding, labour, materials, technical expertise;
- **Overall or Unit Cost:** Total cost over the proposed period of the program and or unit cost to implement recommend works;
- **Funding Considerations:** General funding alternatives that were considered;
- **O&M Considerations:** O&M activities and costs associated with the implementation of the proposed measures; and
- **Integration with Other Documents:** How the Recommended Approach integrates with existing and future documents and studies.

**Table: 10.1 Implementation Considerations - Summary.**

Recommended Approach	Description of Recommended Approach	Key Next Steps	Future Study Requirements	Policy/ Standards	Facilitator & Contributors	Overall or Unit Cost	Funding Considerations	Operations and Maintenance (O&M)	Integration with Other Documents
<b>Pollution Prevention Measures and Municipal Management/ Operational Practices</b>	<ul style="list-style-type: none"> <li>Continue ongoing practices; and</li> <li>Add more practices in relation to materials storage, drainage, and public education.</li> </ul>	n/a	Develop Salt Management Plan	n/a	Municipal departments, Town staff and LSRCA.	Integrated within existing programs	Allocation of funds to ensure current LOS is at a minimum maintained.	n/a	Municipal operational policies and standards including Town's 2013 Development Design Criteria.
<b>Source Control Measures (SCM)</b>	<p>Utilize multi-layered marketing strategy/program to drive uptake in residential land use, followed by commercial/ industrial land uses.</p> <p>Strategy may include:</p> <ol style="list-style-type: none"> <li>1. Visually based marketing campaign;</li> <li>2. Community demonstration sites; and</li> <li>3. Community Visioning Sessions.</li> </ol>	<ul style="list-style-type: none"> <li>Develop tailored the Town's resources;</li> <li>Develop strategic partnership with the York Region, LSRCA (RainScaping Program), and the RAIN SWM Program;</li> <li>Continuation of existing strategic partnerships with the LSRCA;</li> <li>Establish tracking system to document the implementation of SCM; and</li> <li>Undertake Public Lands Pilot project.</li> </ul>	<p>Undertake a public lands retrofit project. To include all necessary EA, site specific assessments, detailed design, construction and monitoring.</p> <p>Pilot project – need for feasibility assessment and in-situ soils test and geotechnical investigations.</p>	<p>Review of:</p> <ul style="list-style-type: none"> <li>Clean Yards By-law;</li> <li>Fill and Site Alteration By-law;</li> <li>Standing and Stagnant Water By-Law; and</li> <li>Property Standards By-Law.</li> </ul> <p>To ensure compliance with the recommended approach.</p> <p>Forthcoming MOECC Volume Control Policies</p>	<p>Lead – Town</p> <p>Support – York Region and LSRCA</p>	<p>Social Marketing Strategy</p> <p>\$ 10,000 – 100,000</p> <p>Use of existing materials can reduce implementation costs i.e. TRCA's Greening Your Grounds: A Homeowners Guide to Stormwater Landscaping Projects can be purchased for distribution in hardcopy for a cost of \$12/guide.</p>	<p>Grants (public and private)</p> <p>General Municipal Fund</p> <p>Development Charges</p> <p>Combined Approach</p>	<p>O&amp;M will be the responsibility of the homeowner.</p> <p>Municipal Requirement – develop and distribute maintenance program guidance, and establish tracking system.</p>	<p>Conforms with source control recommendations of LSPP and <i>West Holland River Subwatershed Plan</i> (LSRCA, 2010d).</p> <p>Low Impact Development (LID) Stormwater Planning and Design Guide (TRCA/CVC, 2011).</p> <p>Grey to Green Residential Retrofits: Engaging Residents to adopt LID on their Properties.</p> <p>Source Control recommendations should be evaluated within future financing studies.</p>
<b>Conveyance Controls Measures (CCM)</b>	<p>Retrofit of five (5) roads as identified in section 8.7 and in Appendix B – Feasibility Assessment Memo - Road Retrofits</p> <p>As part of road reconstruction projects - achieve improved water quality treatment for two (2) approaches:</p> <ol style="list-style-type: none"> <li>1. Road with Ditches</li> <li>2. Hierarchical approach for all other roads: <ol style="list-style-type: none"> <li>a. LID</li> <li>b. OGS w phosphorous removal</li> <li>c. Convey to EOP facility</li> </ol> </li> </ol>	<ul style="list-style-type: none"> <li>Incorporate conveyance control strategy into Capital Road program;</li> <li>Develop internal 'triggers' to stimulate internal project review to identify opportunities;</li> <li>Develop municipal standards; and</li> <li>Develop O&amp;M program.</li> </ul>	<p>Complete Class EA:</p> <p>Resurfacing – A or A+ (pre-approved).</p> <p>Reconstruction – consult MEA document for Schedule.</p> <p>Prior to design complete: all required site assessment per the Grey to Green Road Retrofit Guide, including all in-situ soils test and geotechnical investigations.</p>	<p>The Town's municipal road standard may conflict with recommended approach. Consider strategic review of standards and policy as part of 1<sup>st</sup> Road Retrofit Pilot Project</p>	<p>Lead – Town</p> <p>Support – LSRCA</p>	<p>See Tables 10.2 and 10.3 for unit costs.</p> <p>Assuming the Town's allocated LSPP implementation budget is maintained and utilized.</p> <p>See Tables 10.6, 10.7 and 10.8 for O&amp;M costs.</p>	<p>General Municipal Fund</p> <p>Development Charges</p> <p>Implementation of a Stormwater Utility</p>	<p>See Section 10.5.8 and Table 10.4 for O&amp;M considerations</p>	<p>Conveyance Control recommendations should be evaluated within the Capital Plan.</p> <p>LID Stormwater Planning and Design Guide (TRCA/CVC, 2010).</p> <p>Grey to Green Road Retrofits: Optimizing your Infrastructure Assets Through LID (CVC, 2013).</p>

Recommended Approach	Description of Recommended Approach	Key Next Steps	Future Study Requirements	Policy/ Standards	Facilitator & Contributors	Overall or Unit Cost	Funding Considerations	Operations and Maintenance (O&M)	Integration with Other Documents
<b>End-Of-Pipe (EOP) Control Measures</b>	<p>Construction of new water quality facilities in locations recommended in recent and past planning documents.</p> <p>Retrofit of the five (5) existing quantity control facilities to provide water quality control.</p> <p>Construct shoreline retrofits at Claredon Beach Park and Young's Harbour Park.</p>	<ul style="list-style-type: none"> <li>• Complete Class EAs for new facilities and retrofit sites;</li> <li>• Complete detailed design, tender development and construction of new facilities and retrofit per study prioritization; and</li> <li>• Undertake processes for land acquisition for new facilities.</li> </ul>	<p>Confirm Schedule and complete Class EA.</p> <p>Prior to design complete geotechnical investigations.</p> <p>New Development Area Specific Hydrologic, Hydraulic and Geomorphic analysis</p>	<p>Stormwater Management Planning and Design Manual (2003)</p> <p>LSRCA Guidelines for Stormwater Management Submissions (2016)</p>	<p>Lead – Town</p> <p>Support – LSRCA</p>	<ul style="list-style-type: none"> <li>• Top three (3) priorities cost a combined \$1.3 to \$2.1 million; and</li> <li>• Remaining four (4) retrofits range from \$100,000 to \$1.7 million.</li> </ul>	Development Charges	Integrate within existing EOP O&M programs.	<p>Conforms with the Town's Stormwater Ponds Vegetation Guidelines.</p> <p>Conforms with EOP recommendations outlined in SWSs.</p>
<b>Stream Restoration</b>	<p>Initiate Watercourse Baseline Inventory.</p> <p>Continued practice of Natural Channel Design.</p>	<ul style="list-style-type: none"> <li>• Prepare Watercourse Baseline Inventory refined specifically to Town's needs.</li> </ul>	Watercourse Baseline Inventory	n/a	<p>Lead - Town</p> <p>Support – LSRCA, DFO, MNR, Public.</p>	Watercourse Baseline Inventory - \$15,000 to \$30,000	General Municipal Fund	Study will streamline CA approvals for O&M.	SWSs and this CSWM-MP

## 10.3 Pollution Prevention and Municipal Management / Operational Practices

PPM and MMOP are methods which are not site specific and can generally be applied over a watershed or municipal boundary to prevent sources of pollution from entering the drainage system. The implementation of these measures will include:

1. Continuing current practices;
2. Incorporating new practices that would enhance pollution prevention, including:
  - a. Safer Alternative Products;
  - b. Materials Storage Controls;
  - c. Pool Drainage Controls;
  - d. Erosion and Sediment Control;
  - e. Cross Connection Control Program;
  - f. Public Education;
  - g. Business Education and Awareness;
  - h. Yellow Fish Road Program, in cooperation with the County of Simcoe Region;
  - i. Salt Management measures; and
  - j. Snow Disposal practices.

Generally speaking, Salt Monitoring Programs are essential to evaluate the storage, transport, and fate of salt released from salt storage sites, road salt application, and snow disposal sites. Estimating the total salt budget of the Town would facilitate management scenarios and provide public education. In order to quantitatively assess the impact of salt loading, implemented monitoring program should incorporate measurements for salt loading as well as concentrations.

Future steps may include requirements for those responsible for winter maintenance, snow clearing and de-icer application (including third-party providers) to be accredited through a salt management and control program. Examples to consider include the Region of Waterloo's smart about salt™ program and others.

## 10.4 Source Controls

### 10.4.1 Description of Recommended Approach for Source Controls

#### **Residential Land Use Retrofits**

Since these measures are generally implemented within private properties, the Town has limited role in leading the implementation of these measures. However, the Town could provide a supportive role through the following:

1. Social marketing strategy and raising awareness within community. The Town should refer to the **Grey to Green Residential Retrofits**: Engaging Residents to adopt LID on their Properties (CVC, pending) which describes the step-by-step process to developing a residential marketing strategy.
2. Refine, update or change by-laws related to implementing these measures;
3. Strategic partnerships with local agencies and public outreach programs, including the LSRCA's RainScaping Program, the Windfall Ecological Centre ([www.windfallcentre.ca](http://www.windfallcentre.ca)) and the RAIN SWM Program.



Distribution of existing guidance materials for residential property owners including the “Greening Your Grounds: A Homeowners Guide to Stormwater Landscaping Projects” created by the TRCA and others.

4. Residential Workshops to educate and inform the Town’s residents.



Most relevant to the recommended residential land use retrofits proposed as part of the CSWM-MP, is the RAIN program. The RAIN SWM Program motivates homeowners to take action in reducing NPS pollution entering local lakes and rivers via storm sewers. It promotes a collective strategy whereby small retrofits add up to a much larger net benefit. Residential strategies encouraged through RAIN include:

- Rain Barrels installation;
- Rain Garden construction;
- Use of permeable pavements; and
- Tree planting.

The Town should demonstrate their commitment to LID retrofits on private property, by undertaking pilot project(s) within a selected, high-visibility, public lands sites (municipally owned). The pilot project(s) should be combined with media releases, educational programs/ campaigns as well as high visibility education signage. By undertaking public land pilot projects, the Town is taking a ‘leading by example’ approach which has been shown to improve private land retrofit uptake rates. Additional detail is provided below.

**Public Land Use Retrofits**

Proposed SCM within public lands may include retrofits in public open spaces, public schools, and libraries. Pilot projects are suggested within these areas to define variables such as landowners’ awareness of the impacts from stormwater, their willingness to implement, the importance of public funding, and the adoption rates for each of the proposed measures.

Potential public land retrofit site(s) should have high community appeal and be a community ‘hub’ which experiences high volumes of visitors, this can include but is not limited to:

- Schools,
- Parks, and
- Community centers.

The Town's staff are currently investigating the possibility of using LID measures on public lands. The first site is proposed to be the Georgina Ice Palace. This site is currently being designed to incorporate bioswales.

#### 10.4.2 Key Next Steps

The Town is to initiate a marketing study and campaign for the promotion of alternative residential landscapes that address lot-level SWM issues related to water quality. This would generally involve:

##### 1. **Marketing Campaign**

- a. **Visually-Based Advertising Campaign** – May include outdoor signage, point-of-purchase displays, direct mail initiatives and supporting marketing resources that are to be determined, but likely a full-colour, photo-based brochure promoting alternative landscapes would be the primary print resource. This creates desire and a vision of what their landscape could look like;
  - b. **Web-based tools and Resources** - Modifications to the Town web site providing supporting tools and information for residents;
  - c. **Joint ventures with Key Stakeholders** - Garden centres, box stores, landscape design and landscape maintenance firms should be engaged through joint promotional initiatives. Garden centres and nurseries can play a key role, as they are a trusted source of advice on plants, trees and shrubs and the layout of the landscape;
  - d. **Landscape Consultation Service** - A landscape consultation service targeting residents in the study area and providing them with a how-to approach to implementing the alternative landscape will help residents make the transition. The consultation service will be linked to the retail stakeholders through promotional discounts at participating retailers and added support in design and plant selection provided by retail personnel; and
  - e. **Workshops** - In co-operation with participating retailers, workshops to motivate, promote and assist residents with design ideas and how-to information should be part of the overall alternative landscape program, but would be implemented in later years of the program. TRCA's Healthy Yards Resources or others should be considered (<http://www.trca.on.ca/yards/#sthash.U9LXyz4b.dpbs>).
2. **Coordinate with LSRCA** on establishing a technical framework from available LID information that would help the marketing strategy; and
  3. **Establish tracking system** to document the implementation of SCM (location, type, size, drainage area etc.) for use in future asset management scenarios.

#### 10.4.3 Future Study Requirements

In general, future study requirements for source controls are minimal. SCM fall outside of the Municipal Class EA process, since they are to be constructed on private property, often by the individual land owner as a retrofit or during development/ redevelopment.

Should residents wish to implement less common - more aggressive LID source control techniques such as:

1. Full infiltration designs without secondary flow paths (i.e. overflows or underdrains); and
2. Source control techniques which include a structural component:
  - a. Permeable pavements; and
  - b. Green Roofs.

The Town could require the homeowner to undertake additional studies. Additional studies may include:

- In-Situ Hydraulic Conductivity Testing (per Appendix C of the LID Stormwater Planning and Design Guide, TRCA/CVC, 2010); and/or
- Geotechnical investigations and recommendations from geotechnical engineer. For permeable pavements, manufacturer specifications and testing requirements should be followed.

It is suggested that the Town encourage homeowners to undertake the above (as necessary) based on advice of design professionals.

#### **10.4.4 Policy / Standards Considerations**

Understanding the policy framework would help materialize the implementation of source control opportunities. At present, the Town has the following by-laws that may potentially impact the source control implementation and general naturalization efforts:

1. Building By-Law: Regulates the construction, reconstruction, grading and backfilling of private properties;
2. Property Standards By-Law: Regulates the maintenance of private properties including front yard areas; and
3. Site Alteration By-Law: Prohibits or regulates the removal of topsoil, the placing or dumping of fill material and the alteration of the grade of land in all areas within the Town.

**At issue** – source controls (such as those presented in Chapter 8) which utilize a more naturalized landscape approach (commonly referred to as a “Cottage Garden”) maybe in violation of one or both of these by-laws, contrary to the goals and objectives of the Recommended Approach for source controls.

**Moving Forward** – It is recommended that the Town, with the support of an Georgina Environmental Advisory Committee (GEAC), review the aforementioned by-laws to ensure barriers do not exist on the implementation of SCM including limitations on the naturalized landscape approach, temporarily ponded water (up to 48 hours), uniform grading requirements etc.

#### **10.4.5 Facilitators and Contributors**

To aid in the successful implementation of the Recommended Approach for source controls, key facilitators and contributors would include:

- York Region – including rain barrel program;
- LSRCA - RainScaping Program; and
- TRCA - Greening Your Grounds: A Homeowners Guide to Stormwater Landscaping Projects and the Healthy Yards Resources.

Additional facilitators and contributors would include:

- Naturalists clubs and local environmental organizations

#### 10.4.6 Funding Considerations

The identification of funding sources for the implementation of the marketing program/strategy for source controls is critical to the long term success of the implementation plan. Stormwater program managers have a wide range of funding sources to finance implementation of these programs, from general funds to dedicated sources like stormwater utilities. The program manager must assess each funding source to ensure it meets the stormwater program needs.

In this regard, the following funding sources have been identified:

- **Grants** – a variety of environmentally based grants and granting agencies (both private and public) are available and may be a potential source of funds for community based pilot projects, education programs and training expenses. Examples include RBC Blue-Water, TD Green Funds etc. Municipalities are not eligible for such grants, and as such, private land-owners must lead the application. This does not limit the involvement, financial and or technical support by the Town.
- **Municipal General fund** – tax based funds are reallocated from the general fund;
- **Development Charges** - a portion of charges paid by developers (generally used to pay the cost of new capital projects required as a result of growth) reallocated towards source control marketing in opportunity neighborhoods;
- **Combination Approach** – the above approach are combined or used selectively to provide long-term, sustainable funding in support of residential retrofit program.

Additionally the LSRCA administers and/or has the ability to coordinate with land owners regarding several programs that offer financial and/or technical assistance for landowners hoping to implement source controls. These include:

- **The Landowner Environmental Assistance Program (LEAP)** – This program provides landowners with funding and technical assistance for environmental projects on their land. LEAP is administered by the LSRCA and made possible by funding from municipal partners.
- **The lake Simcoe / South-eastern Georgian Bay Clean-Up Fund** – This program was created to fund collaborative projects with the goal of reducing phosphorous inputs into Lake Simcoe and South-eastern Georgian Bay, improve water quality, and conserve critical aquatic habitat and associated species in these waters.
- **LSRCA's Industrial Commercial Institutional (ICI) Grant Program** – This program which is to be rolled out in 2016 is to fund innovative source control and pollution prevention on ICI properties.

#### 10.4.7 Costs

Provided below are costs estimates for the implementation of the Recommended Approach for Source Controls including the development of the Town's Social Marketing Strategy and the implementation of Public Lands Pilot Projects.

### Social Marketing Strategy

The approximate cost to implement the Social Marketing Strategy is estimated to cost up to \$100,000, this includes costs for marketing campaign, and production of materials. Through the use of strategic partnerships with group listed previously, and distribution of existing resources, the costs have the potential to be significantly reduced. For example, TRCA's Greening Your Grounds: A Homeowners Guide to Stormwater Landscaping Projects can be purchased for distribution in hardcopy for a cost of \$12/guide.

### Public Lands Pilot Project(s)

It is suggested that 1 to 2 public lands pilot projects be undertaken by the Town. The Georgina Ice Park LID plan has the potential to be a highly visible pilot project. Pilot projects can also be implemented in parks such as Claredon Beach Park or Young's harbor Park. Alternatively projects at beach association properties could be further supported. The costs to implement a pilot project(s) within a selected, high-visibility, public lands site (municipally owned) including media releases, educational programs/ campaigns as well as high visibility education signage can start at \$70,000 and increase with size and complexity.

### **10.4.8 Operation and Maintenance Considerations**

O&M activities and costs associated with the voluntarily implementation of SCM on private property will be the responsibility of the private property owner. Generally, maintenance requirements for most source control technologies have little difference from most turf, landscaped, or natural areas and do not typically require new or specialized equipment. Typical homeowner activities will include:

- General inspection;
- Litter removal;
- Weed control;
- Grass Cutting; and
- General landscape upkeep i.e. pruning, mulching and seasonal clean-up activities.

Municipal guidance could be provided to property owners through the development of O&M guides/ resources that incorporates SCM. Typical municipal requirements/ steps include:

1. Develop/ adopt O&M program documents;
2. Distribute materials through homeowner outreach; and
3. Establish tracking system to document SCM location, type, size etc for use in future management scenarios.

### **10.4.9 Integration with Other Document and Studies**

The implementation of SCM within the Town would have an opportunity to benefit from relevant documents that may shed light on important features and functions of concern to proposed SCM. These documents include:

1. LSPP (MOE, 2009), which indicates the need to prescribe SCM for existing development areas where stormwater controls are lacking or insufficient;
2. SWSS, including *Maskinonge River Subwatershed Plan* (LSRCA, 2010c) especially material related to soil cover, water quality analysis, and groundwater-surface water interactions;

3. Evaluation of LID Stormwater Technologies and Water Reuse Options for the Lake Simcoe Region (Ryerson University, 2010);
4. LID Stormwater Planning and Design Guide (TRCA/CVC, 2010);
5. Greening Your Grounds: A Homeowners Guide to Stormwater Landscaping Projects (TRCA, 2012)  
<http://www.trca.on.ca/get-involved/stewardship/healthy-yards-program/greening-your-grounds.dot>; and
6. Grey to Green Residential Retrofits: Engaging Residents to adopt LID on their Properties  
<http://www.creditvalleyca.ca/low-impact-development/low-impact-development-support/stormwater-management-lid-guidance-documents/>

## 10.5 Conveyance Controls

### 10.5.1 Description of Recommended Approach for Conveyance Controls

The recommended approach for conveyance controls includes two key components:

**Roads with ditches:** These roads are divided into two (2) categories:

- To be retrofitted; and
- To remain as is: Special Policy Areas.

**All other roads:** These roads will be treated hierarchically

1. LID opportunity – preferred perforated pipes. Other opportunities may include bioswales and bioretention units;
  - ✓ No LID opportunity – when LID measures are not feasible, consider OGS devices with enhanced removal capacities; and
  - ✓ Convey to downstream water quality facility – this option is last option when the above two options are rendered not

As part of this study, the implementation of CCM for different streetscapes was considered in the light of specific opportunities including five (5) CCM within residential and industrial areas within the Town (Table 9.3).

The following section details the key next steps, future study requirements, policy and standards considerations, potential facilitators and contributors, estimated costs, funding and O&M considerations, and integration of the recommended approach for conveyance control with existing and future documents and studies.

### 10.5.2 Key Next Steps

Key next steps related to the implementation of CCM include:

1. Undertaking pilot projects: road reconstruction projects within Table 9.3 represent an opportunity to implement CCM since it would be feasible and cost effective to undertake the installation of perforated pipe systems (as an example for CCM) during road reconstruction. Existing guidance on road retrofits using LIDs, including the Grey to Green Road Retrofits: Optimizing your Infrastructure Assets through LID (CVC, 2013);
2. Incorporating the Recommended Approach for conveyance controls into the Capital Program for road resurfacing and reconstruction, including the required funding allocation;
3. Developing Municipal standards for design, construction and O&M based on collected data from the pilot projects; and
4. Developing O&M tracking protocols for staff, effort, equipment etc. to better forecast O&M requirements and costs.

### 10.5.3 Future Project Requirements

In general, CCM fall within the Municipal Class EA process, specifically Part B- Municipal Road Projects. The specific Class EA Schedule of individual projects must be determined in relation to the specifics of the road reconstruction process per Part B of the MEA Class EA document (MEA 2000, as amended 2001), and should be reviewed in conjunction with the project schedules in Appendix I of the aforementioned document.

Project requirements for the implementation of CCM include but are not limited to the following:

**Geotechnical Investigation:** To determine soil and groundwater conditions it is recommended that boreholes and/or hand driven piezometers be used to determine groundwater conditions onsite. In both cases soil samples should be collected as part of geotechnical investigations in order to characterize the soil properties including natural moisture content, plasticity characteristics, particle size distribution, groundwater elevation and analytical results for contaminants. Utility locates will be undertaken as part of the geotechnical assessment. For the geotechnical assessment it is recommended that minimum of two (2) boreholes be drilled to a depth of three (3) meters or to bit refusal. For roads longer than 300 m an additional borehole should be drilled every 300 m to properly characterize subsurface conditions.

**In-situ Infiltration Testing:** In-situ infiltration testing characterizes the hydraulic properties of the existing native material on-site. On-site infiltration testing using the Guelph Permeameter test is recommended to determine the in-situ field saturated hydraulic conductivity and the design infiltration rate per the LID Stormwater Planning and Design Guide (CVC/TRCA, 2011). Testing should be performed within the approximate footprint of the LID at the proposed invert of the LID practice. Results of the testing will determine the dimensions and functionality of the bioretention facilities or bioswales. The approach for In-situ Infiltration testing will largely depend on the results of the Geotechnical Investigation. Should the Geotechnical Investigation determine a homogeneous soil profile along the length of a street, fewer tests will be required.

**Topographic Survey:** To produce base mapping for the detailed design phase, it is necessary to complete a topographic survey of the sites using total station survey or GPS equipment. Surveys should include the following site features:

- Topography of the proposed site;
- Identification of above ground and below ground services;
- Utility locate markings (from geotechnical locates);
- Inverts and sizes for existing sewers, catch basins, manholes, etc.;
- Location and description of on-site structures;
- Available legal monuments;
- Borehole locations;
- Infiltration testing locations;
- Significant vegetation (coordinated with tree inventory assessment);
- Existing parkland features;
- Fence lines and existing landscaping; and
- Local benchmarks.

**Preliminary Design (30% Designs):** Preliminary design (30% designs) will be completed for each road. The deliverable will be a memo including a detailed screening of implementation locations as well as plans

identifying the proposed locations. The memo will include results of the hydrologic analysis outlining the catchment area and design flows.

**Conceptual Design (60% Designs):** A conceptual design (60% designs) complete with all aspects of the proposed LID design for each road including cross-sections, hydraulic connections, bioretention features, overland flow routes, and the proposed outlet to the existing storm sewer will be prepared for the Town to review and comment. The conceptual designs will include:

- Cover Sheet, including key plan and drawing index;
- General/Construction Notes and Legend & Abbreviations Plan;
- Removal plans;
- Plan and profile;
- Tree Protection, Erosion and Sediment Control Plan;
- Planting Plan(s) / schemes;
- Utility and Restoration Plan;
- Detailed Cross Section Plans;
- Typical cross section for LID facilities; and
- Testing and monitoring well locations and details (as required).

**Detailed Design (90% Design):** The specifications of various design elements incorporating comments from the Town and its stakeholders and prepare a functional design in accordance with all applicable specifications and standards is to be prepared for each retrofit. The detail design package will include alignment and chainage stations, control layout points, invert elevations for plan and profile of each LID feature. The design drawings will be submitted to the Town for review and finalized.

**Public Information:** A Public Event for the neighbourhood should be included as part of the retrofit project. A basic event including information boards attended by Aquafor Beech staff is included in the costing.

An enhanced approach similar to that used at our Lakeview Project in Mississauga or Forest Glen in Newmarket is recommended for the residential ROW retrofits in the Town. For this project a community barbecue was hosted by the design team prior to construction to provide an educational experience and opportunity for residents to select the type of restoration measures (i.e. sod or perennial planting) to be implemented in front of their property. Topics such as maintenance programs, construction issues, and overall concerns were discussed during this process. In the cases of Lakeview and Forest Glen, additional funding for these events was provided by CVC and LSRCA respectively.

**Tendering Documents:** A concise draft and final versions of the contract documents, including specifications, special provisions, estimated quantities, schedule of items, cost estimates utilizing the Town's template tender document are to be prepared for each ROW retrofit. Sufficient copies of the documents will be provided to the Town for review. Aquafor will assist with answering any questions asked during the tendering period and review the tenders received and make a recommendation to the Town regarding the award and tender.

#### **10.5.4 Policy / Standards Considerations**

Consultations and discussions amongst municipal staff and departments may be required in regards to fire safety and access, winter O&M requirements, public entity requirements (school boards etc.).

### 10.5.5 Facilitators and Contributors

To aid in the successful implementation of the Recommended Approach for conveyance controls, key facilitators and contributors would include:

- York Region; and
- LSRCA.

### 10.5.6 Funding Considerations

The costs associated with the physical implementation (i.e. construction) of the recommended approach for conveyance controls will require the allocation of funds. The funding is proposed as an incremental funding model in two (2) parts:

1. The funds for the road reconstruction and resurfacing would be allocated from capital works budget as part of road resurfacing and reconstruction budgets; and
2. The funds for the implementation of Recommended SWM Approach for Conveyance Controls should be allocated from the general municipal fund and any additional funding requirements shall be allocated from the LSPP Implementation Budget. These budgets would be used to fund the SWM portion of the reconstruction or resurfacing projects.

In this manner, cost efficiency is achieved, such that stormwater works are implemented incrementally as part of planned road works, thereby eliminating the need for unnecessary repairs or replacements of municipal roadways and reducing the costs associated with design and construction. The identification of funding sources into the 2020s and beyond is critical to the long term success of the implementation plan. Stormwater program managers have a wide range of funding sources to finance implementation of these programs, from general funds to dedicated sources like stormwater utilities. The program manager must assess each funding source to ensure it meets the stormwater program needs.

In this regard, the following funding sources have been identified:

- **Municipal General fund** – tax based funds are reallocated from the general fund; and
- **Development Charges** - a portion of charges paid by developers (generally used to pay the cost of new capital projects required as a result of growth) reallocated towards source control marketing in opportunity neighborhoods.

### 10.5.7 Costs

The most cost effective means of implementing Bioretention/ Bio-swales and Exfiltration trenches (perforated pipe systems) in the municipal ROW is to complete the construction concurrent with municipal road works projects. The opportunity to incorporate CCM will likely come as a result of redevelopment pressures (which require replacement of the infrastructure) or replacement due to deteriorating condition of the infrastructure. In the latter case, replacement of the drainage infrastructure may well occur as part of the overall reconstruction of the roadway.

For the purpose of this cost comparison, Road Reconstruction is defined replacement of the existing roadway surface including replacement/installation of storm sewers, complete aggregate base replacement, concrete curb replacement, sub drains under curbs, catch basin replacement and the replacement off all subsurface infrastructure associated with the segment of road. Road Reconstruction

shall also be defined as the conversion of an existing rural cross section roadway (ditched street) into an urban cross section (subsurface sewers). The typical cost of road reconstructions is estimated to be approximately \$325 / m<sup>2</sup> and includes a 20% contingency.

It should be noted that prior to undertaking a Road Reconstruction that the Town assesses the existing SWM infrastructure and replaces only the infrastructure which is deemed to be unfit for continued use or in poor condition. In such cases, a full storm sewer replacement is not cost effective or warranted and the Recommended SWM Approach for Conveyance Controls shall not be implemented.

Alternatively, Roadway Resurfacing is defined and shall include the grinding of the base and top asphaltic compound to nominal depth of 80-90mm from the existing road surface and allowing for 30% spot base repair where required, repairing or replacing concrete curb (if more than 45% of curbing is deficient it is cheaper to replace all with machines rather than hand repair), install sub-drains, repair concrete sidewalk if required, adjust and replace driveway aprons, and sod. The typical cost of road resurfacing is estimated to be approximately \$65 m<sup>2</sup> and includes a 20% contingency.

The implementation of the preferred stormwater quality treatment measure (perforated pipe) as part of municipal road works projects has been estimated to represent costs that is lower or neutral to the cost of “upgrading” a traditional storm sewer system design. In general, where added costs are to be incurred in the implementation conveyance controls (i.e. bioretention, bioswales etc.) these costs can generally be attributed to a greater level of water quality control treatment provided. Additional costs associated with the preferred stormwater quality treatment measure are generally offset by savings in:

- Traditional storm sewer (\$100-120/m<sup>2</sup>) required as part of the road works; and
- EOP infrastructure required to provide equivalent water quality control for the collected drainage area (wet ponds, wetland and or underground EOP facilities) at the end of the drainage system.

**Table 10.2** illustrates the cost to construct recommended CCM as part of both road resurfacing and reconstruction projects in comparison to conventional storm sewer infrastructure. Costs are provided in both \$/m<sup>2</sup> and \$/m of roadway.

**Table 10.2: Approximate Construction Costs for Conveyance Control Measures.**

Treatment Measure	Unit Construction Cost	Unit Cost as part of Road Resurfacing		Unit Cost as part of Road Reconstruction (*)	
	(\$/m <sup>2</sup> of facility)	\$/m <sup>2</sup>	\$/m <sup>(2)</sup>	\$/m <sup>2</sup>	\$/m <sup>(2)</sup>
Road Surface	n/a	\$65	\$546	\$325 <sup>(4)</sup>	\$2,730
Conventional Storm Sewer System	n/a	n/a <sup>(1)</sup>	n/a <sup>(1)</sup>	\$100-120	\$840-1,010
Perforated Pipe	\$150-200	n/a	n/a	\$ 95 -120	\$798-1,010
Bioretention	\$600 - \$750	\$9	\$75 <sup>(2)</sup>	\$135	\$1,130
Bioswales	\$300 - \$375	n/a	n/a	\$140-175	\$1,180-1,470
OGS with enhanced removal capacities	\$ 45,000/ha treated <sup>(3)</sup>				
<p><b>Note:</b>  <sup>1</sup> Would be considered a reconstruction.  <sup>2</sup> Assumes 8.4 m road width.  <sup>3</sup> Prices adjusted from 2007 to 2016 CAN \$.  <sup>4</sup> Unit cost for road resurfacing and reconstruction – reconstruction unit costs (\$325/m<sup>2</sup>) include cost of installation or replacement of traditional storm sewers (\$100-120/m<sup>2</sup>).  * Stormwater unit costs are interchangeable within the road reconstruction estimate of \$325/m<sup>2</sup>.  i.e. Reconstruction using perforated pipe system : \$325/m<sup>2</sup> – conventional storm sewer system cost (avg)  + perforated pipe system cost (avg) = \$323/m<sup>2</sup>  All costs averaged from tendered southern Ontario construction projects.</p>					

Although, individual site constraints to be determined via in-situ testing and monitoring at each of the five (5) ROW retrofit sites (high groundwater table, utilities, available area etc.) may prohibit the implementation of perforated pipes, the full budgetary implications were determined assuming the following:

- Retrofit projects will be undertaken during a road reconstruction project;
- All existing stormwater allocations to each road project will remain committed to stormwater infrastructure;
- An average roadway width of 8.4 m; and
- A perforated pipe unit cost of \$798/m of roadway reconstruction (assumes perforated pipes are constructed along two (2) ROW edges).

Following the completion of the analysis, the following was identified in regards to the implementation of the preferred conveyance control strategy:

- In general, the cost of implementing the preferred stormwater quality treatment measure (perforated pipe) as part of the Town's road reconstruction projects has been shown to represent costs that are in general lower or neutral to the cost of a traditional storm sewer system replacement.

Prior to completing the reconstruction of the aforementioned roads, it is recommended that the stormwater infrastructure be re-assessed by the Town to determine if infrastructure replacements are required. If replacements are warranted, **Table 10.3** can be used to determine the associated construction costs.

**Table 10.3: Road Reconstruction Cost Estimates with Conveyance Controls.**

Street	Reconstruction Length (m)	Conventional Reconstruction Cost (\$)	Road Reconstruction with Perforated Pipe System Cost (\$)	Road Reconstruction with Bioretention (\$)	Road Reconstruction with Bioswales (\$)
Walter Drive	920	2,510,000	1,040,000 to 2,510,000	3,550,000	3,560,000 to 3,860,000
Montsell Avenue	525	1,430,000	594,000 to 1,430,000	2,030,00	2,030,000 to 2,210,000
Dunkirk Avenue	450	1,230,000	509,000 to 1,230,000	1,740,000	1,740,000 to 1,890,000
Sunset Beach Road	110	300,000	125,000 to 300,000	425,000	425,000 to 462,000
Waterbend Drive	160	437,000	436,000 to 437,000	618,000	618,000 to 672,000

The costs indicated in **Table 10.3** include complete road reconstruction as part of the ROW retrofit project. A more simple retrofit approach involves the construction of bioswales along the existing roadside ditches while the road and associated infrastructure remains in place. This approach to retrofits is common for rural cross-section roads that are not in need of replacement. Costs associated with this retrofit approach are estimated below.

**Walter Drive (920 m)**

Tasks:

- 1) Geotechnical Investigation: \$6,800
- 2) In-situ Infiltration Testing: \$5,400
- 3) Topographic Survey: \$1,800
- 4) Public Information Event: \$3,000
- 5) Design and Tendering: \$30,000

**TOTAL: \$47,000**

**Montsell Avenue (525 m)**

Tasks:

- 1) Geotechnical Investigation: \$5,800
- 2) In-situ Infiltration Testing: \$3,600
- 3) Topographic Survey: \$1,200
- 4) Public Information Event: \$3,000
- 5) Design and Tendering: \$25,000

**TOTAL: \$38,600**

**Dunkirk Avenue (450 m)**

Tasks:

- 1) Geotechnical Investigation: \$5,800
- 2) In-situ Infiltration Testing: \$3,600
- 3) Topographic Survey: \$1,200
- 4) Public Information Event: \$3,000
- 5) Design and Tendering: \$25,000

**TOTAL: \$38,600**

**Sunset Beach Road (980 m)**

Pre-Design Tasks:

- 1) Geotechnical Investigation: \$6,800
- 2) In-situ Infiltration Testing: \$5,400
- 3) Topographic Survey: 1,800
- 4) Public Information Event: \$3,000
- 5) Design and Tendering: \$30,000

**TOTAL: \$47,000**

**Waterbend Drive (200 m)**

Pre-Design Tasks:

- 1) Geotechnical Investigation: \$4,800
- 2) In-situ Infiltration Testing: \$1,800
- 3) Topographic Survey: \$1,200
- 4) Public Information Event: \$3,000
- 5) Design and Tendering: \$20,000

**TOTAL: \$30,800**

**10.5.8 Operation and Maintenance Considerations**

The purpose of this section is to outline the maintenance requirements for each conveyance control practice proposed for the Town municipal road ROW (i.e. exfiltration trench/perforated pipe systems and bioretention).

Maintenance requirements for most LID technologies including source and conveyance control practices have little difference from most turf, landscaped, or natural areas and do not typically require new or specialized equipment (EPA, 2007). However, LID techniques are green ‘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 facilities is vital to their long continued operation. **Table 10.4** provides a summary of the maintenance requirements for perforated pipe systems and bioretention/bioswale practices. Additional information is provided in subsequent sections.

**Table 10.4: Summary of Maintenance Requirements for Conveyance Controls.**

LID Technique	Maintenance Requirements	Notes
Perforated pipe	Regular Maintenance <ul style="list-style-type: none"> <li>• Clean debris and litter;</li> <li>• Inspect perforated pipe for clogging; and</li> <li>• Lawn maintenance.</li> </ul> Annual <ul style="list-style-type: none"> <li>• Vacuum debris from inlets/catch basins; and</li> <li>• Inspection of stone drainage area.</li> </ul> Long-term (as required) <ul style="list-style-type: none"> <li>• Perforated pipe clean.</li> </ul>	Ensure that perforated piping, grating, catch basins are not clogged with sediment or debris.  Clean debris from grating, catch basins, and perforated pipe using high pressure sprayers or vacuum.

LID Technique	Maintenance Requirements	Notes
<b>Bioretention/ Bioswales</b>	Post Installation (1 <sup>st</sup> 6 months) <ul style="list-style-type: none"> <li>• Inspection after each storm &gt; 10 mm or minimum of twice.</li> <li>• Irrigate until established (weekly for 1<sup>st</sup> year and bi-weekly for 2<sup>nd</sup> year; as needed based on rainfall).</li> </ul> Annual <ul style="list-style-type: none"> <li>• Inspect each spring and events &gt; 60 mm;</li> <li>• Replace mulch as required; and</li> <li>• Reinforce planting as required.</li> </ul> Regular <ul style="list-style-type: none"> <li>• Integration into existing landscape; and maintenance program (additional training required).</li> </ul>	Lost plants should be re-planted to maintain desired plant density.  Core aerating or deep tilling may be required to alleviate clogging due to fines accumulation.

### **Perforated Pipe Maintenance**

With appropriate pre-treatment, perforated pipe systems do not require additional maintenance beyond that of a conventional storm sewer. These routine maintenance items include:

- Vacuum debris and litter from catch basins;
- Replace damaged or missing grates; and
- Lawn maintenance (if planted under turf).

Perforated pipes have been installed in several Ontario communities with high levels of success. Conveyance systems consisting of grassed swales and underlying perforated pipes were installed in Ottawa during the 1980s and 1990s. After more than twenty (20) years of performance, these systems were found to function without issue.

### **Inspections**

Inspection and maintenance efforts occur following public complaints. Subsequent inspection efforts generally involve scoping pipes to located obstructions and debris. Observation ports extending from the surface to perforated pipes or stone galleries should be included in the design to allow for easy subsurface inspections.

### **Maintenance**

If an issue has been identified through inspections obstructions can be removed or dislodged using vacuums or high pressure water sprayers. If inspections identify problems such as broken pipes, defects or other pipe structure problems full repairs may be necessary.

### **Bioretention / Bioswales Maintenance**

Maintenance of bioretention, and bioswales, generally involves maintenance of the vegetative cover. Two or three growing seasons may be required to establish vegetation to the desired level. As such, contract documents often specify that the contractor be responsible for undertaking a minimum of two (2) years

maintenance. This ensures that the contractor is responsible for the health of the plant material before, during and after installation.

### **Inspections**

Inspections are important to confirm that the LID practice is functioning and to identify maintenance or rehabilitation issues. Regular inspections should be conducted in order to schedule routine maintenance operations such as sediment removal, spot re-vegetation, and inlet stabilization. For the first six (6) months following construction, the site should be inspected after each storm event greater than 10 mm, or a minimum of two (2) visits. If staffing and budget allow, consider scheduling two (2) inspections per year, one of which should occur after snow is melted and ground is thawed. At the minimum schedule annual inspections conducted in the spring of each year. Inspections should also occur after all major rainfall events in excess of 60 mm.

Ponded Water - If during inspections ponded water is identified as an issue, (ponding for more than 48 hours after a storm) adjustments to the grading may be needed or underdrain repairs may be needed. The surface of the filter bed should also be checked for accumulated sediment.

### **Irrigation**

The irrigation of plants is necessary for the first two (2) years or until plants are established. Watering requirements may differ with selected plants but is typically required on a weekly basis during this period. The season between May and August is a critical period for the survival of your plants. During this hot dry season watering should be increased to occur twice a week. When planning watering operations, consider how much precipitation has fallen. During overly wet periods, watering schedules can be modified.

### **Removal of Litter and Debris**

Trash and large debris tends to collect around pretreatment devices and at the inlets of LID practices. Trash may also become stuck in outlet areas affecting the hydraulic function of the facility. The removal of trash and debris should occur at least twice a year but will be heavily dependent on accumulation rates.

### **Sediment Removal**

Pretreatment devices are designed to provide a buffer area where sedimentation occurs before it can reach the bioretention, or bioswale. These should be cleaned out before they lose their functionality. Sediment removal techniques will differ by pretreatment practices but may involve hand tools, or high-pressure washer and vacuum trucks. The frequency of sediment removal will also vary depending on pre-treatment practice and catchment conditions.

Surface Cover/Filter Bed - The surface of filter beds may become clogged with fine sediment over time. Core aeration or deep tilling of non-vegetated areas may relieve the problem. The surface cover layer (e.g., mulch) will need to be removed and replaced every 3 to 5 years in areas where vegetation has not yet colonized. The inlets and pretreatment measures may also need frequent inspections to ensure they are working properly and to remove deposited sediments

## Weeding and Pruning

Bioretention or bioswales which have perennial vegetation will require weeding and pruning. Pruning is typically required only once per year, while weeding may be more frequent dependent on local conditions.

## Additional First Year Maintenance

Bioretention and bioswale, are most prone to failure during the first year of establishment. During the first year additional maintenance practices will be required, these typically include:

- Adding reinforcement planting to maintain desired vegetation density;
- Checking inflow and overflow points for clogging and remove any sediment;
- Inspecting grass filter strips for erosion or gullies and reseeding as necessary;
- Examining the drainage area for bare soil. These areas should be stabilized immediately. Silt fence or other measures may be needed until the area is reseeded;
- Identifying plant material stressed due to salt contamination following the spring melt period and replacing dead vegetation as necessary. (Note: reduce salt loadings from de-icing practices if possible); and
- Inspecting overflows to ensure that snow blockages are prevented.

## Typical O&M Costs for LID Source and Conveyance Controls

Tables 10.5 and 10.6 provides typical maintenance costs by individual maintenance activities and generalized life cycle costs for perforated pipe and bioretention/ bioswales LID practices, respectively. Table 10.7 provides typical service and inspection costs, annualized costs and unit costs per drainage area for OGS unit with enhanced phosphorous removal capabilities.

**Table 10.5: Typical Maintenance Costs by Activity for Low Impact Development (LID) Measures.**

Activity	Applicable to:		Maintenance Interval (years)	Unit	Cost per unit
	Perforated Pipe	Bioretention/ Bioswales			
Litter Removal	√	√	½	ha	\$ 1,000 to \$2,000
LID Litter Removal	√	√	½	m <sup>2</sup>	\$ 0.20
Weed Control		√	1	ha	\$ 1,000
LID Weed Control		√	1	m <sup>2</sup>	\$ 0.20
Grass Cutting	√	√	*	ha	\$ 250
Landscape Restoration (Terrestrial Vegetation)		√	10	ha	\$ 1,000
LID Landscape Restoration		√	½	m <sup>2</sup>	\$ 0.20
Sediment Removal and Disposal (Heavy machinery)		√	10	m <sup>3</sup>	\$ 300-350
Sediment Removal and Disposal (Vacuum Truck)	√	√	½	m <sup>3</sup>	\$120-250
LID Sediment Removal (manual)	√	√	½	m <sup>3</sup>	\$ 50-100
Soil Sampling and Infiltration Testing		√	10	L.S.	\$ 1,000-1,200

Activity	Applicable to:		Maintenance Interval (years)	Unit	Cost per unit
	Perforated Pipe	Bioretention/ Bioswales			
Inspection of Inlet/Outlet	√	√	1	L.S	\$ 150
Pervious Pipe / Underdrain Cleanout (8 to 10 m/hr)	√	√	**	hr	\$ 850
Infiltration Media Restoration (Tilling and Re-Vegetation)		√	**	m <sup>2</sup>	\$ 150
Shrub Replacement		√	**	each	\$ 20-40

\* Routine maintenance.  
\*\*when necessary (repair item) (Source: MOE, 2003; Halton Hills, 2009).

**Generalized Life Cycle Costs**

The following life cycle costs were developed as Life Cycle Assessment of LID Practices through the Sustainable Technologies Evaluation Program (STEP) developed by TRCA (TRCA, 2016). The project evaluated the capital and life cycle costs of LID practices over a 50-year time horizon based on a detailed assessment of local input costs, maintenance requirements, rehabilitation costs and design scenarios relevant to Canadian climates. The following life cycle costs for average annual maintenance costs and rehabilitation costs to a 50-year present value have been summarized in **Table 10.6** below:

**Table 10.6: Annual Maintenance Costs and Rehabilitation.**

	Average Annual Maintenance Cost (CAD \$/m <sup>2</sup> )	Rehabilitation Cost at 25 years (CAD \$/m <sup>2</sup> )
Perforated Pipes (road drainage) – per m <sup>2</sup> of facility	12.8	n/a
Bioretention/ Bioswales (full infiltration) – per m <sup>2</sup> of facility	7.26	57
Bioretention/ Bioswales (partial infiltration) – per m <sup>2</sup> of facility	7.33	57

**Table 10.7: Typical Maintenance Costs for Oil and Grit Separators with Enhanced Phosphorous Removal.**

Drainage Area (ha)	Service Interval (yr)	Service Cost (CAD \$)	Inspection Cost (CAD \$)	Annualized Cost (CAD \$/yr)	Annualized Cost (CAD \$/ha/yr)
0.6	5	2,200	1,750	790	1,320
1	5	3,750	1,750	1,120	1,120
1.5	5	5,200	1,750	1,390	927

OGS with enhanced phosphorus removal include Jellyfish® and other proprietary devices using membrane or media filtration

**10.5.9 Integration with Other Documents / Studies**

The implementation of CCM within the Town would have an opportunity to benefit from relevant documents that may shed light on important features and functions of concern to proposed CCM including technical and policy contexts. These documents include:

1. LSPP (MOE, 2009), the recommended approach for conveyance controls aligns with the recommendations of the LSPP which indicates the need to prescribe CCM for existing development areas where stormwater controls are lacking or insufficient;
2. SWSs especially material related to soil cover, WHPA, water quality analysis, and groundwater-surface water interactions;
3. Evaluation of LID Stormwater Technologies for the Uncontrolled Urban Areas in the Lake Simcoe Region (Ryerson University, 2010);
4. Impact Development Stormwater Management Planning and Design Guide, Version 1.0 (TRCA/CVC - 2010); and
5. Grey to Green Road Retrofits: Optimizing your Infrastructure Assets Through LID (2013- Draft). <http://www.creditvalleyca.ca/wp-content/uploads/2013/09/SWI-ROWDraft-Complete1.pdf>

## 10.6 End-Of-Pipe Controls

### 10.6.1 Description of the Recommended Approach for End-Of-Pipe Controls

At present, only 7.8% of the community of Keswick receives stormwater quality treatment to an enhanced level of protection. In urban centers outside of Keswick, 12% of the Community of Sutton receives enhanced level quality control while Pefferlaw does not have facilities with the ability to meet the enhanced level water quality criteria. In order to provide water quality treatment to areas that do not have EOP treatment facilities, two (2) types of SWM opportunities were evaluated and prioritized as part of this study:

1. Retrofit of five (5) quantity control facilities to provide enhanced level water quality control.
2. Construction of EOP water quality treatment facilities in Claredon Beach Park and Young's Harbour Park.

With the implementation of the recommended EOP controls (retrofits at the five SWM facilities) the percentage of the Town which will receive water quality control will increase from 7.8% to 17.9%. If retrofits are implemented at the two (2) municipal parks along the waterfront, and additional 5% of the urban area will be provided with enhanced level quality control for a total of 22.9%.

#### **Key Next Steps**

Key next steps in regard to the implementation of the EOP ponds indicated above include:

- Complete Class EAs for new facilities and retrofit sites per the required Class EA schedule in accordance with the implementation prioritization developed as part of this study (**Table 10.8**);
- Following the completion of Class EA studies, detailed design, tender development and construction of new facilities and retrofit sites should be completed in accordance with the implementation prioritization developed as part of this study. Approvals are required from respective CA and MOECC prior to construction;
- Undertake processes for land acquisition (as required) for proposed EOP facilities within privately owned lands or lands held by other the Town's departments (i.e. Parks); and
- Undertaken discussions with LSRCA in regard to obtaining approvals for any EOP facilities proposed within the regulatory floodplain.

## 10.6.2 Future Study Requirements

The proposed EOP new facilities and retrofits will be subject to the Class EA Process. Projects undertaken by municipalities vary in their environmental impacts. Consequently, projects are classified according to Class EA Schedules ranging from A and A+ to B and C project schedules.

Proposed SWM facility can generally be classified under the following two (2) Class EA Schedules according to the project nature i.e. either Retrofit or New Construction. The construction of new EOP controls are generally classified as Schedule B, whereas EOP control retrofits can be classified as either Schedule A+ or Schedule B according to the following criteria:

### Schedule A+

- Introduced in 2007 by the MEA, these projects are pre-approved; however the public is to be advised prior to the project implementation. Per Appendix I –Project Schedules of the Municipal Class EA (2000, as amended in 2007), wastewater management projects that are intended to **“modify, retrofit, or improve a retention/detention facility including outfall or infiltration systems for the purposes of stormwater quality control”** including **“biological treatment through the establishment of constructed wetlands”** are pre-approved under Schedule A+ of the MEA.
- Schedule A+ does not allow for the expansion of the existing facility, therefore the alteration/upgrade or retrofit must be confined to the existing facility footprint or SWM block limits.

### Schedule B

- Creation of a new stormwater facility or the improvements and/or minor expansion to existing facilities beyond the existing facility footprint or SWM block limits. With these types of activities there is potential for some adverse environmental impacts and therefore the proponent is required to proceed through a screening process including consultation with those who may be affected.

The five (5) recommended SWM facility retrofits (dry pond to water quality facilities with permanent pools) are expected to fall under Schedule A+, while the construction of new facilities in the municipal parks is expected to be completed under schedule B.

General project tasks associated construction of new EOP facilities and or the upgrade or retrofit of existing SWM facilities would include, but not limited to:

- Examination of background material included as part of this document;
- Completion of site inventory and topographic surveys;
- Subsurface Investigations - Geotechnical Investigation (physical and chemical);
- Completion of Class EA, per the associated Schedule as detailed above;
- Preparation of preliminary designs;
- Public Information Center (Schedule B – required; optional under Schedule A+, but recommended);
- Development of detailed designs;
- Approvals – MOECC ECA and necessary construction permits as required (LSRCA);
- Preparation of detailed design drawing packages, tender and specification; and
- Construction, construction administration and construction supervision services.

### 10.6.3 Policy / Standards Considerations

In general, the prioritized EOP controls recommended as part of this study shall be required to comply with the criteria of the SWMPDM (MOE, 2003). Additional policy requirements include the facilities within regulated floodplains and facilities discharging to Redside Dace watercourses. In regard to Redside dace watercourses, the study team found no evidence in previous studies and documents of the presence of Redside dace habitat.

### 10.6.4 Facilitators and Contributors

To aid in the successful implementation of the Recommended Approach for EOP controls, key facilitators and contributors may include LSRCA. The LSRCA and the Town have established a long history of collaboration on projects and should be involved early in the retrofit and new EOP construction process to identify:

- Approval requirements;
- Targets and objectives; and
- Opportunities to work collaboratively.

### 10.6.5 Funding Considerations

The costs associated with the physical implementation (i.e. construction) of the proposed EOP controls will require the additional allocation of funds beyond the current levels. In general, the full cost of implementation of all SWM facilities will be recovered through development charges or the general municipal fund. However, alternative funding mechanisms should be identified, reviewed and evaluated, including, but not limited to:

- Special fees and charges;
- Municipal Stormwater Utility; and/or
- A dedicated Stormwater Reserve.

### 10.6.6 Costs

**Table 10.8** presents cost estimates for EOP retrofit opportunities of the five (5) SWM facilities as well for the new water quality facilities recommended at the municipal parks. Pond locations are identified in **Figure 4.10**. Cost estimates are based on volumetric requirements for constructed wetlands, wet ponds and hybrid wetland-wet pond facilities as identified in the SWMPDM (MOE, 2003) as well as experience with similar retrofit projects within the LSRCA jurisdiction and across southern Ontario.

The prioritization as identified in **Table 10.8** intended to use the Town's allocated SWM dollars as efficiently as possible. Priority is identified based on cost and TP and TSS reductions achieved by implementation of retrofit or new SWM opportunity. Based on the prioritization, the following was identified:

- The large drainage area, land availability and cost associated with the Pond A retrofit result in a High Priority rating. Both municipal parks receive a High Priority due to the large drainage areas, relatively low costs and the fact that both are lacking any stormwater control;
- High priority projects have been identified to range from an estimated \$325,000 (low estimate for a wet pond at Claredon Beach Park) to \$900,000 (high estimate for a hybrid facility at Young's Harbour Park); and
- Other retrofit opportunities range from an estimated \$100,000 to \$1,700,000.

**Table 10.8: Cost Estimates and Implementation Priority for the Identified End-Of-Pipe Facilities.**

Facility ID	Facility Number (*)	Stormwater Management Type	Drainage Area (ha)	Land Use	Approximate Impervious Area (%)	Recommended Retrofit Type(s)	Volumetric Requirement (m <sup>3</sup> )	Approximate Project Cost (\$)	Priority
A	12	Quantity Control - Dry Pond	23.0	Residential	30	Wet Pond	3,030	450,000 to 600,000	High
B	13	Quantity Control - Dry Pond	2.89	Residential	45	Wet Pond	3,800	550,000 to 750,000	Low
C	10	Quantity Control - Dry Pond	35.3	Residential	45	Wet Pond or Wetland	<u>Wet Pond</u> 5,840 <u>Wetland</u> 3,250	<u>Wet Pond</u> 850,000 to 1,120,000 <u>Wetland</u> 1,500,000 to 1,700,000	Moderate
D	15	Quantity Control - Dry Pond	5.9	Residential	25	Wet Pond	710	100,000 to 140,000	Low
E	6	Level 3 Quality Control	25.2	Residential / Commercial	30	Wet Pond	3,320	400,000 to 650,000	Moderate
Claredon Beach Park	-	-	18.5	Residential	25	Wet Pond or Hybrid Facility	<u>Wet Pond</u> 2,230 <u>Hybrid</u> 1,770	<u>Wet Pond</u> 325,000 to 425,000 <u>Hybrid</u> 530,000 to 600,000	High
Young's Harbour Beach	-	-	27.6	Residential	25	Wet Pond or Hybrid Facility	<u>Wet Pond</u> 3,330 <u>Hybrid</u> 2,640	<u>Wetland</u> 500,000 to 650,000 <u>Hybrid</u> 750,000 to 900,000	High

Note: \* (MMM, 2011).

### 10.6.7 Operation and Maintenance Considerations

There are numerous activities that are required in order to properly operate and maintain the SWM EOP facility. These activities were identified in **Section 8.8.2** and typically include the following:

- Regular inspection of control structure, manholes and orifices (as applicable);
- Hydraulic operation of the facility monitoring;
- Unclogging of outlets and controls;
- Pipe repairs;
- Grass Cutting;
- Weed Control;
- Vegetation Management;
- Sediment Removal (vacuum truck);
- Maintenance of Access Routes; and
- Control of Nuisance Issues.

Typical maintenance requirements are presented in **Table 10.9**. Additional O&M guidance is provided in Chapter 6 of the SWMPDM (MOE, 2003).

**Table 10.9: Maintenance Requirements for Various Conventional Best Management Practices.**

Operation or Maintenance Activity	Wet Pond	Wetland	Hybrid	Dry Pond	Underground Storage
Inspection	■	■	■	■	■
Grass Cutting	□	□	□	■	■
Weed Control	■	■	■	■	
Upland Vegetation Replanting	□	□	□	□	
Shoreline Fringe & Flood Fringe Vegetation Re-planting	□	□	□		
Aquatic Vegetation Replanting	□	□	□		
Removal of Accumulated Sediments	■	■	■	■	■
Outlet Valve Adjustment	□	□	□	□	□
Trash Removal	■	■	■	■	■
■ Normally Required      □ May be Required					(Source: MOE, 2003)

### 10.6.8 Integration with Other Documents / Studies

In order to achieve an implementation plan that is effective and relevant to the context of the study area, the implementation of EOP control measures within the Town will need to cross-reference with relevant documents that may shed light on important features and functions of concern to proposed EOP control measures. These documents include:

1. LSPP (MOE, 2009);
2. Lake Simcoe Basin Stormwater Management and Retrofit Opportunities (LSRCA, 2007), which provides baseline information in regard to inventories of SWM ponds, controlled areas, and effectiveness in phosphorus removal; and

3. SWSs, including *Maskinonge Subwatershed Study* (LSRCA, 2010) especially material related to location in watershed, stormwater infrastructure, water quality analysis, and fish habitat.

## 10.7 Stream Restoration

Although watercourse within the Town are generally in good condition with respect to geomorphic condition, rapidly developing and changing land uses have the potential to cause significant changes to stream morphology. As such a town-wide Inventory of Watercourse Baseline Conditions is recommended. This study would focus on areas of significant interaction between local watercourses and municipal infrastructure, specifically:

- Bridge Crossings;
- Major Stormwater Outfalls;
- SWM Facility Outlets; and
- New Development in close proximity to watercourses.

The purpose of the study would be to:

- Identify priority sites along the Town's watercourses which may develop issues such as bank erosion, downcutting, sedimentation and irregular channel migration before they pose a risk to public health and safety and environment;
- Identify geomorphic issues and guide mitigation strategies before they deteriorate and require large-budget solutions via the Municipal Class EA process; and
- Guide capital budget program for stream restoration projects.

The recommended Inventory of Watercourse Baseline Conditions should include a detailed photographic record of focus areas and discuss the potential impact of local infrastructure as well as potential mitigation strategies. The inventory may include recommendations for ongoing monitoring at specific locations if deemed necessary. The cost to undertake an Inventory of Watercourse Baseline Conditions is estimated to cost \$15,000 to \$30,000.

## 10.8 Measures for New Development and Redevelopment

To achieve the greatest water quantity and quality benefits from source, conveyance and EOP controls, it is necessary to implement the Recommended Approach as part of new development/re-development within the Town.

### **New Development and Stormwater Management**

Source, conveyance and EOP controls should be applied to new developments as part of a treatment train approach to SWM, whereby stormwater BMPs are applied in succession along the stormwater flow path.

Only with greater adoption and implementation of LID techniques in new developments; that transcend SWM into areas such as energy efficiency, water conservation and re-use, green space maximization, tree conservation and better site design; will the additional water quality and broader environmental benefits be fully realized.

In general, the application of innovative LID source and conveyance controls and EOP facilities within new developments should be done in accordance with the Recommended Approach and relevant guidelines

that include the SWMPDM (MOE, 2003) and LID Manuals proposed by CAs within Ontario including the TRCA/CVC LID SWM Planning and Design Manual (CVC/TRCA, 2011).

### **Re-Development and Stormwater Management**

The urban intensification associated with the future re-development pressures have the potential to add additional demands to the existing stormwater conveyance and treatment systems. Redevelopment projects can range in size from a single lot to the complete redevelopment of significantly larger areas. Many forms of redevelopment can be more intensive than previous uses and have higher levels of imperviousness (e.g., more pavement), runoff rates, and contaminant loading per unit of area. These effects are exacerbated when the proposed redevelopment sites are located in older development areas built before the need for stormwater controls was recognized.

Re-development projects generally present the most complex challenges with respect to integrating solutions for SWM. This is because:

- sites are typically constrained with respect to the extent of potential open space available;
- land cost often limit SWM options;
- there is typically limited flexibility to manipulate topography since grades around the perimeter of the site are fixed;
- service infrastructure around the site, including stormwater conveyance systems are typically fixed in terms of location, depth and capacity; and
- the presence of other service infrastructure beneath and around the site may limit potential excavation depths and opportunities for infiltration.

As a result, the exploration of SWM solutions for redevelopment sites requires a high level of imagination, ingenuity and creativity and can generally benefit from the application of LID source and conveyance controls as noted in the LSPP (MOE, 2009) and the *West Holland River Subwatershed Plan* (LSRCA, 2010d).

## **10.9 Climate Change Considerations**

The term *climate change* refers to a statistical variation in the climate of a specific location, region, or of the planet persisting for an extended period of time. Climate change may be caused by a variety of factors including natural processes; however, the current period of climate change has been shown by an overwhelming majority of scientific evidence to be caused by human factors, as proclaimed by the International Panel on Climate Change (IPCC).

The following sections illustrate two (2) key relevant considerations related to climate change:

- 1. Key findings and potential climate change impacts to water resources; and**
- 2. Climate change adaptation strategies for stormwater infrastructure management.**

In preparing this summary on Climate Change issues relating to the Town's CSWM-MP, the following documents were reviewed and summaries or relevant information is provided in the subsequent sections:

- Guide for Assessment of Hydrologic Effects of Climate Change in Ontario (EBNFLO and AquaResource, 2010) ; and

- Technical Guide- Development, interpretation and use of rainfall Intensity-Duration-Frequency (IDF) information: Guidelines for Canadian water resources practitioners (CSA PLUS 4013-10, June 2010).

### **10.9.1 Key Findings and Potential Climate Changes Impacts to Water Resources**

Most recent studies on climate change observations and predictions indicate the following:

- Total annual precipitation increased 5-35% since 1900, with southern Canada increasing 12% from 1900-1998 or by 5% from 1950-1998;
- Heavier, more frequent and intense rainfall events have been detected in the Great Lakes Basin since the 1970s;
- The maximum intensity for one-day, 60-minute, and 30-minute duration rainfall events increased on average by 3-5% per decade from 1970 to 1998;
- Total annual precipitation could increase by 2 to 6% by the 2050s, 4.5-5.8% annually;
- Summer and fall precipitation amounts may decrease up to 10% in Southern Ontario;
- Increase in frequency / severity of extreme precipitation events; and
- Winter precipitation may increase as much as 10% in the south and 40% in the north.

These findings have many important implications and impacts on the stormwater quality and quantity within the Lake Simcoe Watershed in general and within the Town in specific. These may include:

- More extreme thermal impacts on the natural environment (i.e. water temperatures thresholds for aquatic species);
- Increased seasonal evapotranspiration rates from open water sources, potentially leading to reduced water quality as a result of lower water levels;
- Earlier spring runoff events;
- Increased flows to stormwater systems – need for retrofit and/or LID;
- Uncertainty in hydrologic predictions/ models;
- Possibility for more extreme high contaminant concentrations; and
- Increased demand on surface water causing increased stress on water supply and treatment, algae blooms affecting water quality.

### **10.9.2 Climate Change Adaptation Strategies for Stormwater Infrastructure Management**

As a result of climate change, it is possible that stormwater infrastructure may be subject to loadings which exceed original design capacity. While in some cases the effect of a changing climate may be offset by the effect of other conservative engineering assumptions used at the time of design (e.g., rounding up pipe sizes, etc.), in other instances this may not be the case. For example, an ongoing infrastructure deficit may result in assets being used much longer than originally intended, perhaps leading to unanticipated surcharging and increasingly uneconomic O&M costs (i.e., sewer rehabilitation).

#### **Existing Infrastructure and Climate Change Adaptation**

In the case of existing infrastructure which are expected to be adversely affected (i.e., with a risk of exceeding original design capacity) by climate change, it may be possible to extend their lives by:

- Removing or diverting loading from the sewer (e.g., LID or Green Infrastructure (GI) strategies, integrated resource management techniques, rehabilitating sewers to reduce inflow and infiltration, etc.);
- Expanding or rerouting major flow path (i.e., the solution may not always be in the piped system); and
- Re-evaluating appropriate levels of service under future climate scenarios (e.g., is the originally anticipated LOS still going to be practical and economic?).

### **New Infrastructure and Climate Change Adaptation**

Design of new infrastructure should consider the effects of anticipated climate change. Although there will normally be considerable uncertainty relating to the effects of projected climate change, especially at shorter storm durations, it may be possible in the particular location of interest to develop reasonable bounding estimates for consideration during design. Even if a defensible design estimate cannot be established, it will generally be possible at the early stages of infrastructure planning to design infrastructure that is resilient to a wide range of possible future climates.

Some general considerations for designing new infrastructure in the face of uncertain climate change include:

- Capitalize on local knowledge and data;
- Carefully consider the anticipated service life of infrastructure;
- Do not count on beneficial aspects of climate change;
- Consider an adaptation design increment when investing in larger, long-lived infrastructure;
- Allow for flexible designs that can accommodate future infrastructure upgrades (increase) where possible;
- Arrange for possible expansion of major flow path; and
- Consider GI and LID.

## 11. Conclusions and Recommendations

Conclusions that can be drawn from the Town's CSWM-MP are:

- The development of this CSWM-MP is an important step to meet the objectives of the LSPP, specifically reducing loading of phosphorus and other nutrients of concern to Lake Simcoe and its tributaries;
- With the implementation of conventional SWM practices, new development within the Town is expected to increase phosphorus loading to Lake Simcoe by 227 kg/yr;
- The loading of pollutants including TSS and Phosphorus can be greatly reduced by applying a multi-level SWM approach incorporating PPM, SCM, CCM, EOP measures, and stream restoration;
- The retrofit of five (5) dry SWM facilities and two (2) public parks in the Keswick can increase the percentage of area within the urban boundary of Keswick provided with enhanced level water quality controls from 7.5% to 22.9%;
- Applying the five (5) pond retrofits is expected to reduce Phosphorus loading by between 128 kg/yr to 206 kg/yr for the wet pond and wet pond / wetland retrofit scenarios respectively. This represents a loading reduction range of 12.4% to 20% from the community of Keswick;
- Applying the five (5) pond retrofits is expected to reduce TSS loading by between 45,671 kg/yr to 48,238 kg/yr for the wet pond and wet pond / wetland retrofit scenarios respectively. This represents a loading reduction range of 8.6% to 9.1% from the community of Keswick; and
- Implementing conveyance controls within municipal ROW is feasible and can achieve TSS and Phosphorus removal efficiencies from local catchment of between 75% and 89%. Conveyance controls are estimated to achieve Phosphorus reductions of 0.85 to 2.3 kg/km annually on residential streets. Conveyance controls are estimated to achieve TSS reductions of 1293 to 1495 kg/km annually on residential streets.

Consistent with the recommended approach as outlined within this report, the fourteen (14) study recommendations for the consideration by the Town are as follows:

1. That the plan set forth in the CSWM-MP be adopted by the Town;
2. That the Town consider the implementation of the identified PPM to complement current practices;
3. That the Town develop an updated Salt-Management Plan that takes into consideration EC's Code of Practice for Environmental Management of Road Salts and incorporates a Salt Monitoring Program;
4. Consistent with the recommended approach, that the Town consider for the purposes of long term SWM planning, the development and implementation of a marketing strategy to encourage SCM on private property, including but not limited to:

- a) Social marketing strategy to raise awareness within community; and
  - b) Refine, update or alter existing by-laws related to implementing these measures.
5. That the Town undertake the implementation of a pilot LID retrofit project on public lands to increase public awareness of SCM, improve drainage and stormwater quality, and understand internal Town requirements relating to widespread Town implementation;
  6. That the Town undertake the retrofit of existing ROW using the recommended approach, specifically:
    - a) the construction of bioswales at thees five (5) identified ditched streets:
      - i. Walter Drive;
      - ii. Montsell Avenue;
      - iii. Dunkirk Avenue;
      - iv. Sunset Beach Road; and
      - v. Waterbend Drive.
    - b) As part of planned road reconstruction and re-surfacing activities, the Town shall implement the recommended CCM within the ROW. Road re-construction and re-surfacing present an opportunity for the integration of these measures in the ROW and may include bioretention, bioswales and perforated pipe systems;
    - c) As part of planned road reconstruction and re-surfacing activities where recommendations 6a) or 6b) are not implementable due to site specific constraints, that the Town consider the implementation of OGS with enhanced phosphorus removal capacities;
  7. That the Town undertake the retrofit of the identified five (5) EOP facilities per the recommend prioritization;
  8. That the Town further investigate the feasibility of EOP facilities and Claredon Beach Park and Young's Harbour Park;
  9. That the Town support the efforts of local beach associations in their effort to improve water quality along the shores of Lake Simcoe;
  10. That the Town implements an O&M Program to define existing conditions as well as the required measures for SWM facilities;
  11. That the Town conduct a Watercourse Baseline Inventory at major bridge crossing, major storm outfalls, SWM facility outlets and in the vicinity of new development;
  12. That the Town undertake a review and update of the Town's SWM Policy:
    - a) To include the above noted recommendations;
    - b) To ensure the policies are extended to include all stormwater treatment systems, both conventional and LID, for both water quality and quantity control; and
    - c) To ensure that the Town's SWM funding mechanisms and policies will allow the Town to obtain appropriate funds to deliver future SWM capital projects.

13. That future private developments and proposed changes to existing private developments within the Town shall be in compliance with a treatment train approach to SWM which utilizes source and conveyance controls in combination with EOP controls and the recommended approach of the CSWM-MP; and
14. That the Town continues to complete the recommendations in the previous reports that don't conflict with this report and its recommendations.

## 12. References

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**APPENDIX A**

**EXAMPLE OF STORMWATER MANAGEMENT FACILITIES  
INSPECTION FORM**

**SWM FACILITY MAINTENANCE INSPECTION FORM**

**SWM FACILITY MAINTENANCE INSPECTION FORM**

Facility Number: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_  
 Subdivision Name: \_\_\_\_\_ Watershed: \_\_\_\_\_  
 Weather: \_\_\_\_\_ Inspector(s): \_\_\_\_\_  
 Date of Last Rainfall: \_\_\_\_\_ Amount: \_\_\_\_\_ Inches Nearest Street(s): \_\_\_\_\_  
 GPS Coordinates: \_\_\_\_\_  
 Property Classification: \_\_\_\_\_ Other: \_\_\_\_\_

**Type of Practice:**

As-built Plan Available? \_\_\_\_\_ Signage Present? \_\_\_\_\_  
 Is Facility Inspectable? \_\_\_\_\_ Why? \_\_\_\_\_ Treatment Provided? \_\_\_\_\_ Other \_\_\_\_\_  
 SWM Facility Receiver: \_\_\_\_\_ Other \_\_\_\_\_ SWM Facility On-line: \_\_\_\_\_  
 Maintenance Access Available: \_\_\_\_\_ Facility Fenced: \_\_\_\_\_

<b>Evaluation Status</b>	<b>Scoring Breakdown</b>	<b>*Use Note section in each section to further explain scoring as needed and note maintenance issue on sketch</b>
N/A – Not Applicable	0 = Not a Problem	
NI – Not Investigated	1 = Monitor (Potential for future problems exist)	
E/I – Evaluated/Investigated	2 = Routine Maintenance Required 3 = Immediate Repair Necessary	

Example 1: Outfall Channel(s) from Pond	Evaluation Status	Score	Notes
Woody growth within 5' of outfall	E/I	2	Dense Vegetation around Outfall (See Sketch for Details)
Outfall channel functioning	E/I	3	Outfall Channel Clogged(No Flow) (See Sketch for Location)

1. Outfall Channel(s) from Pond	Evaluation Status	Score	Notes
Woody growth within 5' of outfall			
Displaced rip rap/round stone			
Degraded concrete liner			
Wildlife nuisances			
Sediment deposition			
Flow restriction (clogging/debris)			
Erosion			
Other:			

2. Earthen/Rock Berms	Evaluation Status	Score	Notes
Cracking, bulging, or sloughing of dam			
Erosion and/or loss of dam material			
Sediment deposition			
Wildlife nuisances (e.g. animal burrows)			
Soft spots or boggy areas			
Displaced rip rap/round stone			
Steep/unsafe side slope grading (>3:1)			
Other:			

**SWM FACILITY MAINTENANCE INSPECTION FORM**

**3. Spillway(s)**

# of Emergency Overflow Spillways:

Spillway Types:

# of Inlet Spillways:

Spillway Types:

Woody growth within spillway			
Soft or boggy areas			
Displacement/degrading spillway material			
Sediment deposition			
Wildlife nuisances			
Flow restriction (clogging/debris)			
Erosion			
Other:			

**4. Outlets/Barrels**

# of Outlets:

Size:

Types:

Damage/degradation of structure(s)/pipe(s)			
Loss of joint material/joint failure of pipe(s)			
Structure access available			
Leaking			
Corrosion			
Safety grate(s) damage			
Spillway/baffle damage			
Sediment deposition			
Flow restriction (clogging/debris)			
Erosion			
Other:			

**5. Riser Structures**

# of Risers:

Size:

Types:

Damage/degradation of structures			
Structure access available			
Lockable access			
Corrosion			
Anti-vortex device secure / acceptable			
Woody or vegetative growth within 25' of riser			
Safety grates damaged or corroded			
Flow restriction (clogging/debris)			
Sediment accumulation within riser			
Erosion in/around riser structure			
Displaced rip rap/round stone jacket			
Other:			

**6. Low Flow System (Pilot Channel)**

Low Flow Channel Through Facility Existing?

Low Flow Pipe?

Size:

Types:

# of Orifice(s)

Size:

Types:

Damage/degradation of pipe(s)			
-------------------------------	--	--	--

**SWM FACILITY MAINTENANCE INSPECTION FORM**

<b>6. Low Flow System (Pilot Channel) (cont'd)</b>	<b>Evaluation Status</b>	<b>Score</b>	<b>Notes</b>
Loss of joint material/joint failure of pipe(s)			
Trash grate(s) damaged or corroded			
Corrosion			
Displaced rip rap/round stone			
Leaking			
Sediment deposition			
Flow restriction (clogging/debris)			
Erosion			
Other:			

**7. Overflow**

# of Overflows:	Size:	Types:
Discharge pipe(s):	Size:	Types:
Damage/degradation of structure(s)/pipe(s)		
Loss of joint material/joint failure of pipe(s)		
Corrosion		
Flow restriction (clogging/debris)		
Erosion		
Other:		

**8. Control Valve(s)**

# of Valves:	Size:	Types:
Operation limited		
Exercised		
Leaks		
Chained & locked correctly		
Set to design opening		
Other:		

**9. Pond Drain Valve**

Operation limited		
Exercised		
Leaks		
Chained & locked correctly		
Other:		

**10. Permanent Pool**

Permanent Pool Existing?		
Visible pollution		
Shoreline and / or side slope erosion		
Aquatic bench inadequately vegetated		
Abnormally high or low water (pool) levels		
Sediment / debris accumulation		
Wildlife nuisances		
Other:		
Bathometric study recommended		

**SWM FACILITY MAINTENANCE INSPECTION FORM**

**11. Dry Storage**

Wetland vegetation growth			
Standing water or spots			
Surplus material within storage areas			
Sediment or debris accumulation			
Wildlife nuisances			
Other:			
Bathometric study recommended			

**12. Pretreatment**

Maintenance access			
Is pretreatment a practice other than a forebay		If so, _____	
Dredging required			
Fixed vertical sediment depth marker present			
Marker Reading _____			
Sediment accumulation			
Other:			

**13. Inflow Points**

# of Inflow Pipes:	Size:	Types:	Direction
Damage/degradation of structure(s)/pipe(s)			
Loss of joint material/joint failure of pipe(s)			
Structure access available			
Leaking			
Corrosion			
Safety grate(s) damage			
Spillway/baffle damage			
Sediment deposition			
Flow restriction (clogging/debris)			
Erosion			
Other:			

**14. Culverts**

# of Culverts:	Size:	Types:
Damage/degradation of structure(s)/pipe(s)		
Corrosion		
Leaking		
Sediment deposition		
Flow restriction (clogging/debris)		
Erosion		
Other:		

**15. Vegetation**

% cover _____			
Predominant vegetation types:			
Vegetation matches landscape design plan			
Coverage needs improvement			

**SWM FACILITY MAINTENANCE INSPECTION FORM**

<b>15. Vegetation (cont'd)</b>	<b>Evaluation Status</b>	<b>Score</b>	<b>Notes</b>
Nuisances causing damage			
Tree and shrub dieback/damage			
Aquatic vegetation dieback/damage			
Presents of noxious weeds/Invasive plants			
Adequate coverage			
Other:			

**16. Access**

<b># of Access Points:</b>	<b>Type:</b>	<b>Surface Treatment:</b>
Vehicular access		
Easements		
Pedestrian access		
Trail conditions		
Obstructions		
Bollars		
Gates/Locks		
Access to pretreatments and structures		
Other:		

**17. Miscellaneous**

Encroachment in pond area and/or easement area		
Fence condition		
Excessive garbage		
Encroachment by structures		
Safety/Educational signs		
Complaints from local residents		
Graffiti		
Public hazards		
Were any pad locks cut and replaced		
Other:		

**SWM FACILITY MAINTENANCE INSPECTION FORM**

18. Upstream Evaluation	Evaluation Status	Score	Notes
Upstream Source:	Extent of Upstream Evaluation:		
Sediment deposition/accumulation			
Bank undercutting/slumping			
Channel widening			
Channel incision			
Vegetation conditions			
Flow restriction (clogging/debris)			
Garbage/trash			
Other:			
Sketch:			

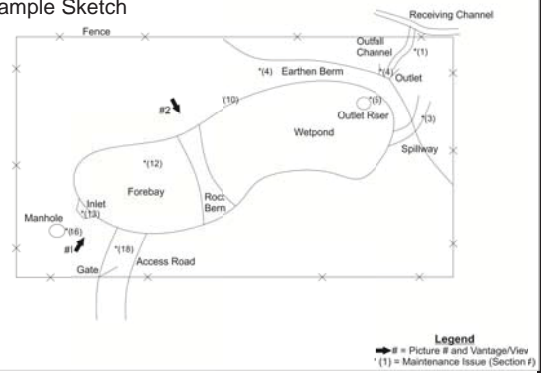
**SWM FACILITY MAINTENANCE INSPECTION FORM**

19. Downstream Evaluation	Evaluation Status	Score	Notes
Downstream Receiver:	Extent of Downstream Evaluation:		
Sediment deposition/accumulation			
Bank undercutting/slumping			
Channel widening			
Channel incision			
Vegetation conditions			
Flow restriction (clogging/debris)			
Garbage/trash			
Other:			
Sketch:			



Sketch:

Example Sketch



NIA = Not Applicable  
 Nil = Not Investigated  
 0 = Not a Problem

1 = Monitor for Future Repairs  
 2 = Routine Repairs Needed  
 3 = Immediate Repair Needed

**APPENDIX B**

**FEASIBILITY ASSESSMENT MEMO – ROAD RETROFITS**

*Prepared for:*  
The Town of Georgina

**FEASIBILITY ASSESSMENT MEMO:  
BIORETENTION & BIOSWALE RETROFITS  
GEORGINA, ON**



2600 Skymark Ave.

Mississauga ON

L4W 5B2

## Table of Contents

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4.0 Design Considerations for LID in the Municipal ROW	9
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## 1.0 Introduction

**A**quafor Beech Limited is currently undertaking the CSWM-MP (CSWM-MP) for the Town of Georgina (Town). As part of the study, municipal roads are being assessed for Low Impact Development (LID) retrofit opportunities. The objectives of the retrofits are to reduce the loading of phosphorus and other pollutants to Lake Simcoe per the LSPP and to mitigate drainage issues within municipal road right-of-ways (ROWs). Five (5) roads were identified by the Town's staff as seasonal issues of standing water relating to poor drainage.



**Figure 1.1: Standing water in roadside ditch.**

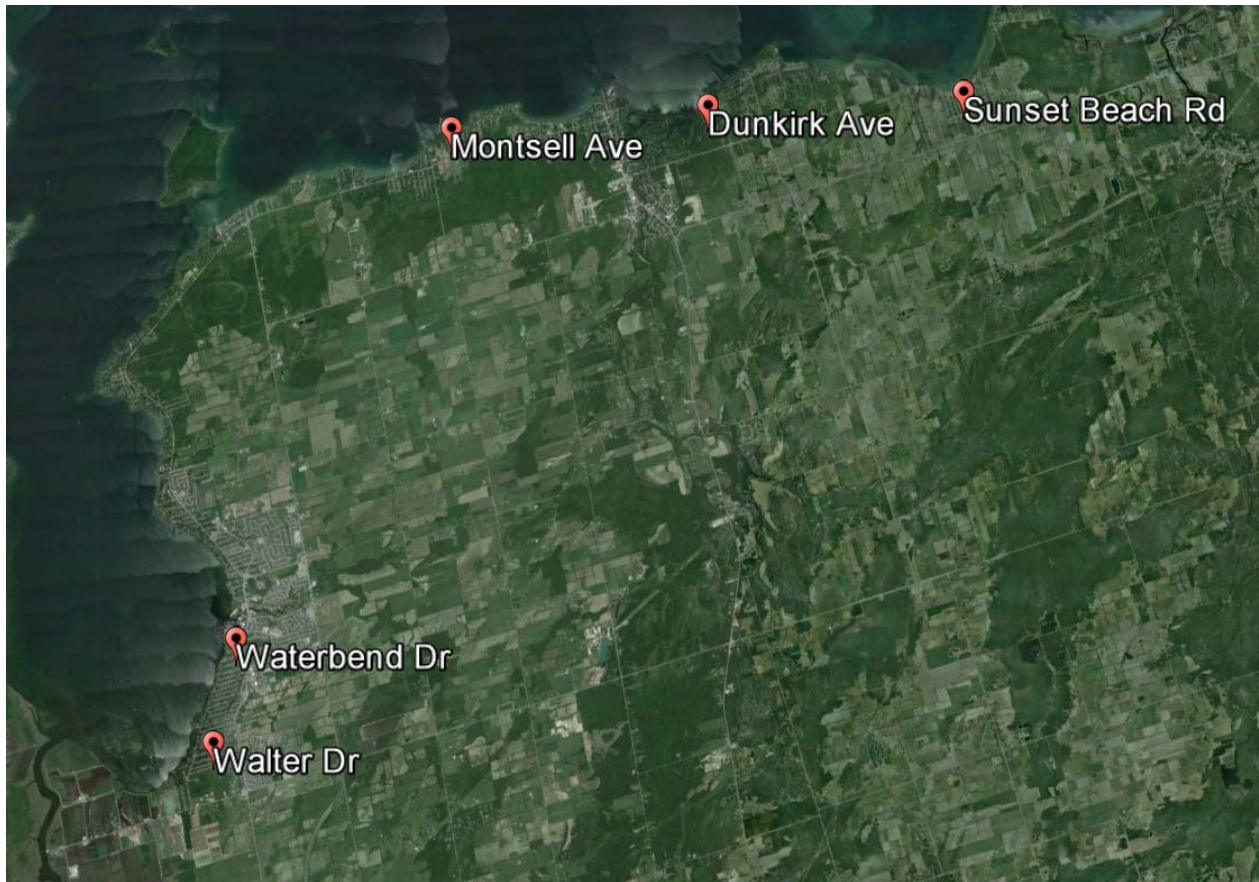
This feasibility study for incorporating bioretention or bioswale features into five (5) municipal road ROWs within the Town is based on preliminary field investigations conducted on August 28, 2015. The sites that were investigated are shown in Figure 1.3 - Location of Potential LID Sites.

The five (5) potential LID sites are:

1. Walter Drive (South Keswick)
2. Montsell Avenue (Willow Beach)
3. Dunkirk Avenue (Sutton)
4. Sunset Beach Road (Virginia)
5. Waterbend Drive (Keswick)



**Figure 1.2: Bioretention System designed and implemented by Aquafor Beech in Mississauga.**



**Figure 1.3: Location of Potential LID Sites (Imagery: Google)**

The memorandum is broken down into the following sections:

- Overview of Roads;
- Potential LID Practices;
- Design Considerations for LID in the Municipal ROW;
- Construction Considerations for LID in the Municipal ROW;
- Construction Phase;
- Summary of opportunities and constraints; and
- Next steps and potential regulatory requirements.

## **2.0 Overview of Roads**

All the roads investigated as part of the Friday August 28<sup>th</sup>, 2015 site visit were suggested as potential retrofit sites by Gagan Sandhu, P.Eng. , Infrastructure and Operations Manager for the Town to alleviate drainage issues within the municipal ROW.

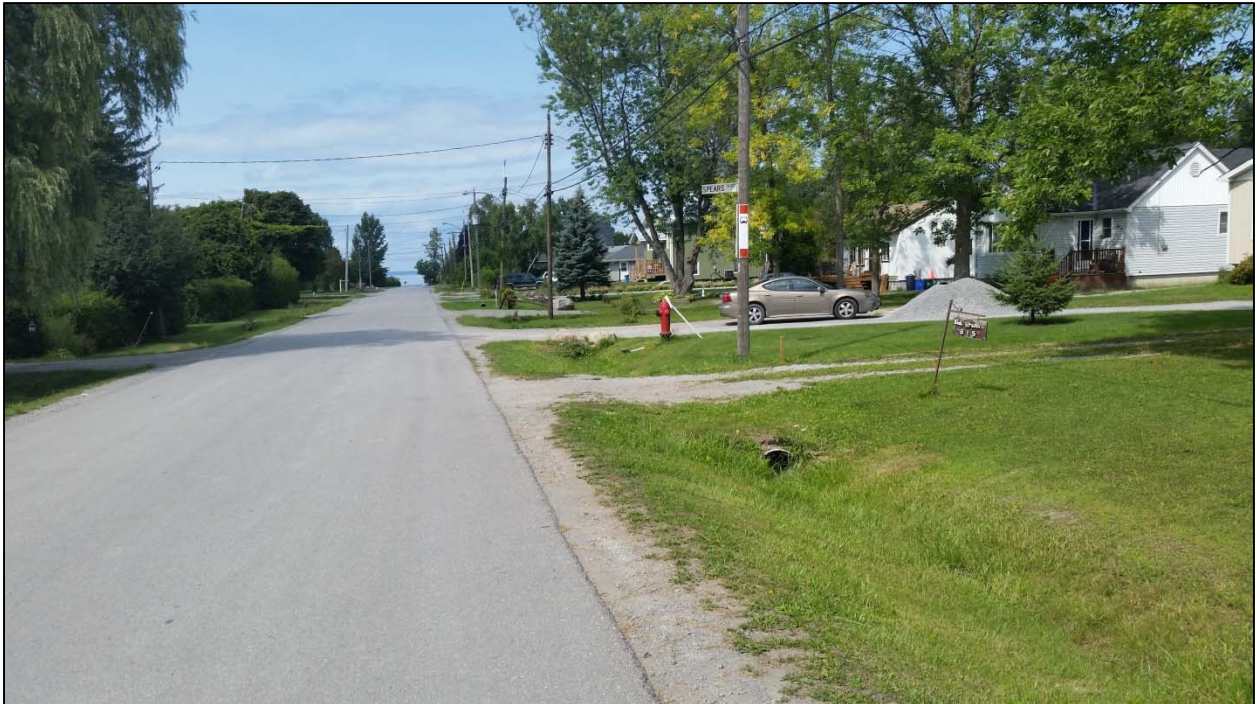
The five (5) roads investigated are constructed to a rural cross-section with grass-lined ditches adjacent to both shoulders. The roads are located in residential areas with culverts conveying drainage through the entranceways. Drainage from each of the roads is conveyed directly to Lake Simcoe without quality or quantity controls.

### Walter Drive



**Figure 2.1:** Walter Drive is approximately 920 m in length between the Queensway and Georgette Street. This photo is looking east from Georgette Street.

### Montsell Avenue



**Figure 2.2:** Montsell Avenue is approximately 525 m in length between the Metro Road North and Lake Drive East. This photo is looking north towards Lake Drive East.

### Dunkirk Avenue



**Figure 2.3:** Dunkirk Avenue is a 450 m long dead-end road running south of Hedge Road approximately 200 m east of the Black River. This photo is looking north from the southern limit of the road.

### Sunset Beach Road



**Figure 2.4:** Sunset Beach Road is approximately 980 m in length between the Highway 48 and Burnie Road. This photo is looking north towards Lake Simcoe.

## Waterbend Drive



**Figure 2.5:** Waterbend Drive is a 200 m long dead-end road off Pleasant Boulevard. This photo was taken looking down Waterbend from Pleasant.

## 3.0 Potential LID Practices

**Bioretention systems** are vegetated, shallow depressions below which is an engineered soil mix (media) which supports plant and microbial growth and provides a mechanism for achieving stormwater quality objectives. Bioretention facilities temporarily store and treat stormwater runoff by passing it through the engineered media and taking advantage of the chemical, biological and physical properties of plants, microbes and soils to remove pollutants from stormwater runoff.

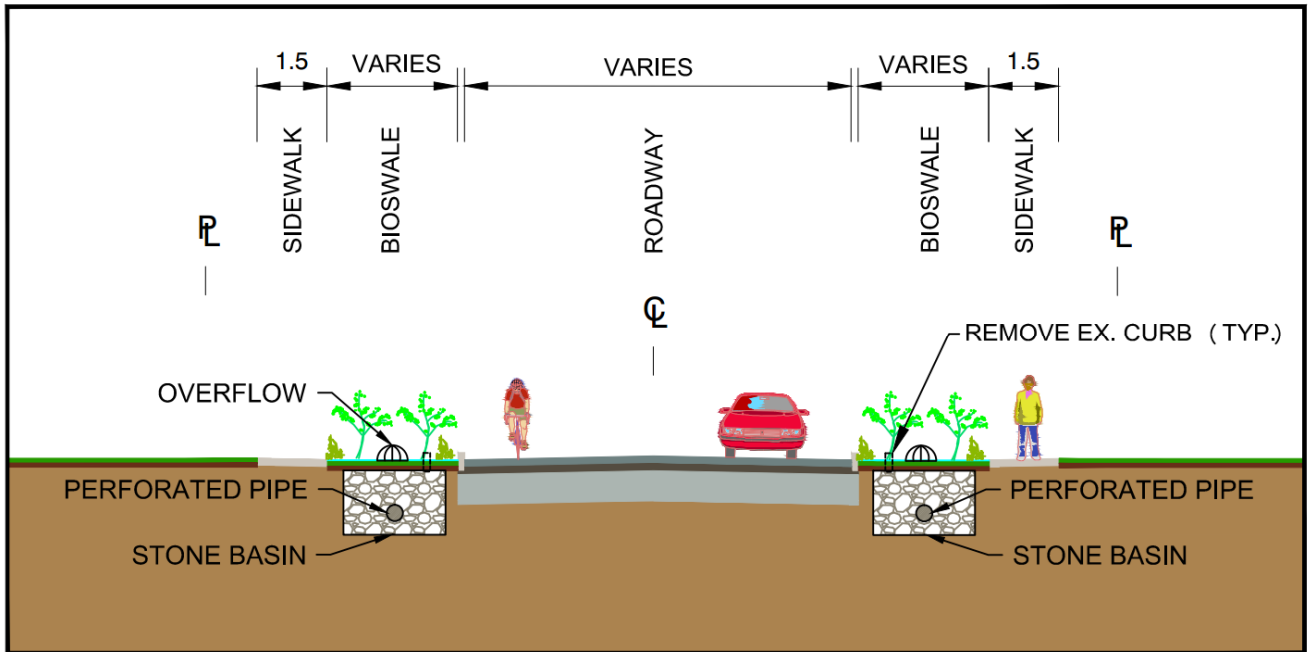
**Bioswales** are bioretention facilities that have been designed with a slope for stormwater conveyance. They are designed to infiltrate water and only convey water during significant rainfall events. Due to their linear design they are well suited for use along existing ditches or boulevard areas.



Bioretention systems and bioswales are part of the suite of best management practices (BMPs), known as LID, that promote infiltration/groundwater

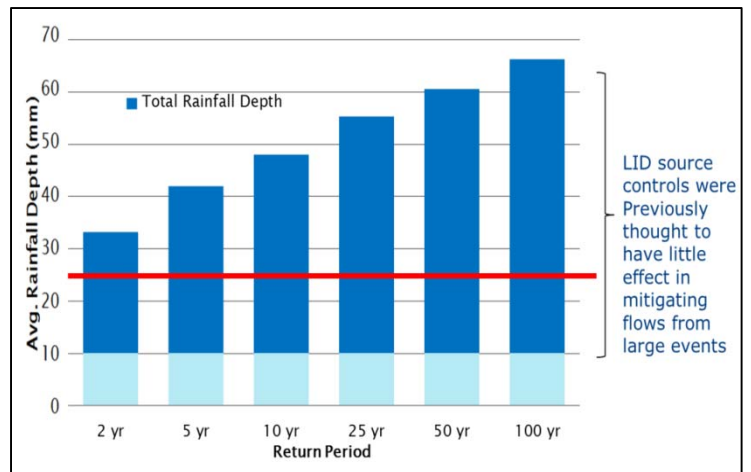
**Figure 3.1: Bioretention at Lakeview in Mississauga.**

recharge, and evapotranspiration. The many benefits of these systems include preservation of baseflow, enhanced water quality, thermal mitigation, and improved street aesthetics. The most recent studies indicate that bioretention provides effective pollutant removal for many pollutants as a result of sedimentation, filtering, plant uptake, soil adsorption, and microbial processes and can do so with and without an underdrain. A typical cross-section of a bioretention facility which is accepting flow from an impervious surface (roadway/parking lot) is presented in Figure 3.2.



**Figure 3.2: Typical Cross-section of Bioretention Practice.**

Bioretention systems and bioswales are best suited to meet water quality objectives but can also be used to meet water balance objectives by reducing runoff volume through evapotranspiration and infiltration of runoff. A conservative runoff reduction rate of 80% is assigned to designs that rely upon full infiltration (Note: Runoff reductions correspond to rain events up to a 25 mm rainfall). Bioretention may also be used in a treatment train with traditional detention practices that meet the geomorphic peak discharge requirements.



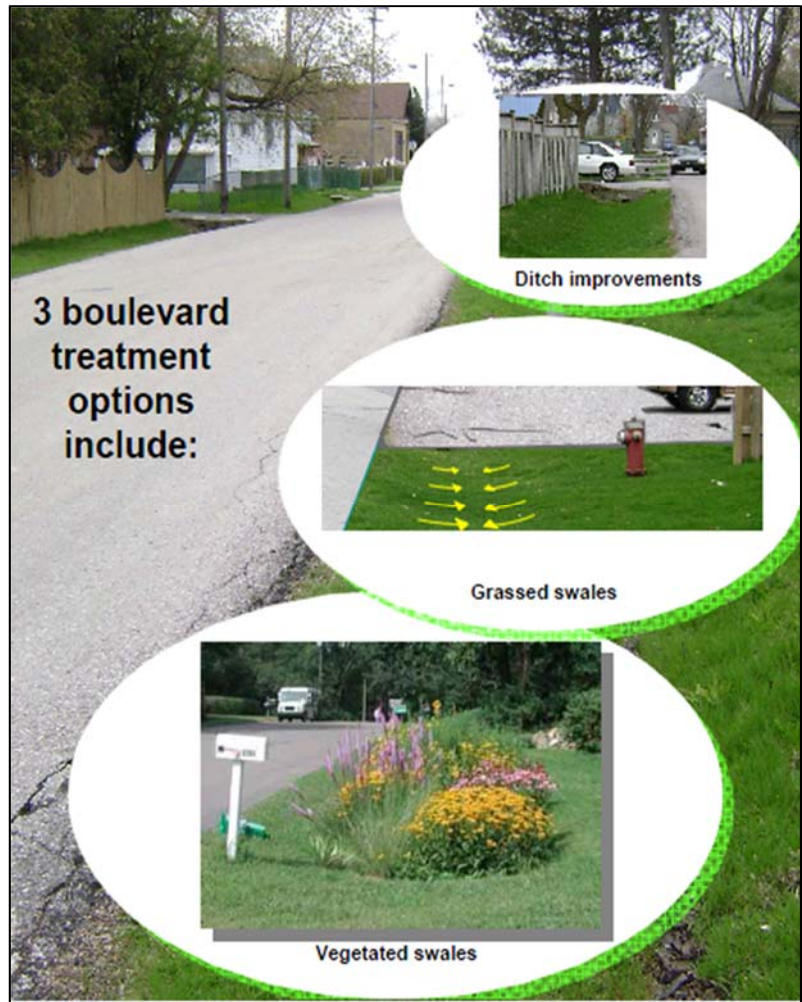
**Figure 3.3: Capturing 25mm of every precipitation event can be achieved with properly designed bioretention facility.**

## 4.0 Design Considerations for LID in the Municipal ROW

**Planting Scheme:** Town staff should allow residents to decide on the planting scheme implemented within the boulevard. Options available include an assortment of perennial plantings or a traditional sod. Perennials installed should be low maintenance and tolerant to both prolonged dry periods and seasonal inundations as well as moderate salt loading. Woody vegetation is not recommended as it is more prone to damage from snow loading.

For the Lakeview project City staff allowed residents to decide on the planting scheme using a “dot-mocracy” approach. The vast majority of home owners chose the perennials over the sod.

**Parking:** On street parking was observed at some locations during the field visit. Vegetation encroachment onto the street should be avoided to allow for access to parked vehicles. In some areas a sod buffer around the planted vegetation should be maintained.



**Figure 4.1: Lakeview before construction (top) as well as sod (middle) and perennial (bottom) planting options.**

## 5.0 Construction Phase

Based on experiences and lessons learned in the field, it is our recommendation that professionals with LID construction experience (preferably in a ROW setting) be involved from project design through construction supervision. A team with LID experience can train new staff members and provide educated answers about the project to the public. With the right supervision, administration, and training, teams can overcome and learn from project challenges including LID specific erosion and sediment control, contractor/designer mistakes, product quality assurance control, unforeseen utilities conflicts and public interaction.



**Figure 5.1: Construction photos taken during the Lakeview project in Mississauga. First and Third Streets had similar site constraints as the ROWs investigated in the Town of Georgina.**

## 6.0 Summary of Opportunities and Constraints

The feasibility screening is intended to be utilized for the purposes of evaluating the alternatives at a ‘high-level’ based primarily on engineering feasibility in order to identify the options to be carried forward to the detailed evaluation. LID options are evaluated as feasible, feasible with additional effort, cost or mitigation (more effort) or not feasible for each of the criteria listed in Table 6.0.

The screening criteria can be described as follows:

**Suitable Outlet/ Overflow:** Ability of the proposed LID option to discharge to a suitable outlet or overflow (storm sewer or watercourse) based on capacity, elevations and additional structure requirements.

**Elevation Constraints:** Ability of the proposed LID option to be integrated with the constructed/ proposed grades (design elevations) without the need for significant alteration. Includes all surface and sub-surface infrastructure.

**Source of Stormwater:** Ability of the proposed LID option to accept stormwater at surface or below grade given the constructed/ proposed roadway designs (top of pavement).

**Conflicts with Utilities:** Ability of the proposed LID option to integrate within the constructed/proposed roadway designs without conflicts to existing or proposed utilities. Note: at the feasibility screening stage, the criteria are limited to conflicts which cannot be mitigated in design and would require relocations or present an unacceptable risk. Includes impact existing or proposed sanitary sewers, watermains, electrical lines including signalization and surface walkways/pathways. Follow-up via a review of engineering drawings is recommended to assist with this “high-level” screening.

**Road Structure:** Ability of the proposed LID option to be integrated into the constructed/ proposed roadway designs without compromising the road structure including sub-base soils, aggregate base and roadway surface. Long-term design-life must also not be compromised.

**Sight-lines and Safety:** Ability of the proposed LID option to be integrated into the constructed/ proposed roadway designs without compromising vehicle sight-lines or user safety.

**Drainage Function:** Ability of the proposed LID option to be integrated into the constructed/proposed roadway designs without compromising the existing drainage system design or capacity. Criteria includes impacts related to transferring drainage from adjacent but previously separate drainage areas, reduced pipe/outlet capacity, risk of ponding on the roadway surface and storm sewer surcharging.

**Cost Effectiveness:** Relative cost of the proposed LID options. Criteria includes the screening of the options which present an unacceptably high construction costs based on the requirement for structural reinforcements, excessive infrastructure and or excavation or a high degree of disturbance to the built environment including the constructed roadway surface.

**Integration with Neighbourhood and Public Use:** Potential for the proposed LID option to be accepted by the community and general compatibility with existing public use features such as sidewalks, trails and community green spaces



**Figure 6.1: LIDs are flexible in both design and construction. Here a clear stone trench for the Lakeview Bioretention System is constructed around utilities.**

**Operation and Maintenance (O&M):** Ability of the proposed LID option to have a low life-cycle cost and associated low maintenance burden for landscape elements and stormwater infrastructure (includes staff time, equipment and energy/utility fees).

**Constructability:** Potential for the proposed LID option to require complex construction methodology and/or many non-standard type design features. Options which do not have complex are preferred construction methodology and/or many non-standard type design features are preferred.

**Table 6.0: High-Level Feasibility of Bioretention or Bioswales at each site.**

	Walter Drive	Montsell Avenue	Dunkirk Avenue	Sunset Beach Road	Waterbend Drive
<b>Suitable Outlet/ Overflow</b>	more effort	feasible	feasible	more effort	more effort
<b>Elevation Constraints</b>	feasible	feasible	feasible	feasible	feasible
<b>Source of Stormwater</b>	feasible	feasible	feasible	feasible	feasible
<b>Conflicts with Utilities</b>	feasible	feasible	feasible	feasible	feasible
<b>Road Structure</b>	feasible	feasible	feasible	feasible	feasible
<b>Sight-lines and Safety</b>	feasible	feasible	feasible	feasible	feasible
<b>Drainage Function</b>	feasible	feasible	feasible	feasible	feasible
<b>Cost Effectiveness</b>	feasible	feasible	feasible	feasible	feasible
<b>Integration with Neighbourhood and Public Use</b>	feasible	feasible	feasible	feasible	feasible
<b>Operations and Maintenance</b>	feasible	feasible	feasible	feasible	feasible
<b>Constructability</b>	feasible	feasible	feasible	feasible	feasible
<b>OVERALL</b>	<b>feasible</b>	<b>feasible</b>	<b>feasible</b>	<b>feasible</b>	<b>feasible</b>

Note on Suitable Outlet: Walter Drive, Sunset Beach Road and Waterbend Drive are feasible but elevation of the downstream end of the roads in relation to the Lake may cause seasonal inundation of the outlet. LID systems would still maintain water quality treatment throughout the year.

## 7.0 Next Steps and Potential Regulatory Requirements

Now that it has been determined that all locations are feasible based on the preliminary study, activities that will further quantify the physical characteristics at each site are required to proceed to detailed design. Upon completion of the below tasks, detailed design drawings, and tender packages should be

developed. Aquafor Beech is capable of conducting design activities as well as producing detailed design drawings and tender packages for the Town.

**Utility locates:** Utility locates are undertaken prior to geotechnical investigations and related drilling activities. The company selected to complete the geotechnical investigation is usually responsible for obtaining utility locates. Utility locates can be scheduled by contacting the Ontario One-Call service.

**Geotechnical Investigation:** To determine soil and groundwater conditions it is recommended that boreholes and/or hand driven piezometers be used to determine groundwater conditions onsite. In both cases soil samples should be collected as part of geotechnical investigations in order to characterize the soil properties including natural moisture content, plasticity characteristics, particle size distribution, and analytical results for contaminants.

**In-situ Infiltration Testing:** In-situ infiltration testing characterizes the hydraulic properties of the existing native material on-site. On-site infiltration testing using the Guelph Permeameter test to determine the in-situ saturated hydraulic conductivity and the design infiltration rate per the LID Stormwater Planning and Design Guide is recommended. Testing should be performed within the approximate location and invert of proposed LID practices.

**Topographic Survey:** To produce base mapping for the detailed design phase, it is necessary to complete a topographic survey of the sites using total station survey or GPS equipment. Surveys should include the following site features:

- Topography of the proposed site;
- Identification of above ground and below ground services
- Utility locate markings;
- Inverts and sizes for existing sewers, catch basins, manholes, etc.;
- Location and description of on-site structures;
- Available legal monuments;
- Borehole locations;
- Infiltration testing locations;
- Significant vegetation (coordinated with tree inventory assessment);
- Existing parkland features;
- Fence lines and existing landscaping; and
- Local benchmarks.



**Figure 7.1: In-situ infiltration testing via Guelph Permeameter.**

### **Hydrologic Assessment**

A hydrologic assessment must be completed to accurately delineate the catchment area. This information is used to determine flow rates and storage volumes used for sizing bioretention components.

### **Regulatory Requirements**

Based on recent experience with similar projects, it is expected that bioretention and bioswale facilities located within the municipal ROW will require an ECA from the Ministry of the Environment and Climate Change.

### **Gauge Neighbourhood Interest**

It is essential to have buy-in from the neighbourhood prior to implementing an LID feature within the ROW. A project launch BBQ was successfully held in a neighbourhood park on a weekend for the Lakeview Project in Mississauga.



**Figure 7.2: Project Launch BBQ at Lakeview in Mississauga.**

## **APPENDIX C**

### **PHOSPHORUS LOADING CALCULATIONS**

## Project DEVELOPMENT Summary

**DEVELOPMENT: Southeast Sutton**

**Subwatershed: Black River**

Total Pre-Development Area (ha):	<b>31</b>	Total Pre-Development Phosphorus Load (kg/yr):	<b>2.60</b>
----------------------------------	-----------	------------------------------------------------	-------------

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)		P Load (kg/yr)
Cropland	5	0.23		1.15
Forest	21	0.05		1.05
Hay-Pasture	5	0.08		0.40

### POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency	P Load (kg/yr)
High Intensity - Residential	31	1.32	Wet Detention Ponds 63%	15.14

Post-Development Area Altered:	<b>31.00</b>		<b>P Load (kg/yr)</b>
Total Pre-Development Area:	<b>31.00</b>		
Unaffected Area:	<b>0</b>		
		Pre-Development:	<b>2.60</b>
		Post-Development:	<b>40.92</b>
		Change (Pre - Post):	<b>-38.32</b>
		<b>1474% Net Increase in Load</b>	
		Post-Development (with BMPs):	<b>15.14</b>
		Change (Pre - Post):	<b>-12.54</b>
		<b>482.32% Net Increase in Load</b>	

**DEVELOPMENT: Southeast Sutton**  
**Subwatershed: Black River**

**CONSTRUCTION PHASE LOAD**

	<b>P Load (kg/yr)</b>
<b>SUMMARY WITH IMPLEMENTATION OF BMPs</b>	
Pre-Development:	<b>2.60</b>
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	<b>15.14</b>
Post-Development + Amortized Construction:	<b>to be determined</b>
<b>Pre-Development Load - Post-Development Load:</b>	<b>-12.54</b>
<b>Conclusion:</b>	<b>482% Increase in Load</b>
<b>Pre-Development Load - (Post-Development + Amortized Construction Load):</b>	<b>to be determined</b>
<b>Conclusion:</b>	<b>to be determined</b>
<b>Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:</b>	
<b>Not approve development as site specific appropriate</b>	

## Project DEVELOPMENT Summary

**DEVELOPMENT: Northeast**  
**Subwatershed: Black River**

Total Pre-Development Area (ha): **39**      Total Pre-Development Phosphorus Load (kg/yr): **3.45**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	5	0.23	1.15
Forest	14	0.05	0.70
Hay-Pasture	20	0.08	1.60

### POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency	P Load (kg/yr)
High Intensity - Residential	39	1.32	Wet Detention Ponds 63%	19.05

Post-Development Area Altered:	<b>39.00</b>			<b>P Load (kg/yr)</b>
Total Pre-Development Area:	<b>39.00</b>			
Unaffected Area:	<b>0</b>			
			Pre-Development:	<b>3.45</b>
			Post-Development:	<b>51.48</b>
			Change (Pre - Post):	<b>-48.03</b>
				<b>1392% Net Increase in Load</b>
			Post-Development (with BMPs):	<b>19.05</b>
			Change (Pre - Post):	<b>-15.60</b>
				<b>452.1% Net Increase in Load</b>

**DEVELOPMENT: Northeast**  
**Subwatershed: Black River**

**CONSTRUCTION PHASE LOAD**

	<b>P Load (kg/yr)</b>
<b>SUMMARY WITH IMPLEMENTATION OF BMPs</b>	
Pre-Development:	<b>3.45</b>
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	<b>19.05</b>
Post-Development + Amortized Construction:	<b>to be determined</b>
<b>Pre-Development Load - Post-Development Load:</b>	<b>-15.60</b>
<b>Conclusion:</b>	<b>452% Increase in Load</b>
<b>Pre-Development Load - (Post-Development + Amortized Construction Load):</b>	<b>to be determined</b>
<b>Conclusion:</b>	<b>to be determined</b>
<p><b>Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:</b></p> <p style="text-align: center;"><b>Not approve development as site specific appropriate</b></p>	

## Project DEVELOPMENT Summary

**DEVELOPMENT: Southwest Sutton**  
**Subwatershed: Georgina Creeks**

Total Pre-Development Area (ha): **47**      Total Pre-Development Phosphorus Load (kg/yr): **4.84**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Forest	40	0.10	4.00
Hay-Pasture	7	0.12	0.84

### POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency	P Load (kg/yr)
High Intensity - Residential	47	1.32	Wet Detention Ponds 63%	22.95

Post-Development Area Altered:	<b>47.00</b>			<b>P Load (kg/yr)</b>
Total Pre-Development Area:	<b>47.00</b>			
Unaffected Area:	<b>0</b>			
			Pre-Development:	<b>4.84</b>
			Post-Development:	<b>62.04</b>
			Change (Pre - Post):	<b>-57.20</b>
			<b>1182% Net Increase in Load</b>	
			Post-Development (with BMPs):	<b>22.95</b>
			Change (Pre - Post):	<b>-18.11</b>
			<b>374.27% Net Increase in Load</b>	

**DEVELOPMENT: Southwest Sutton**  
**Subwatershed: Georgina Creeks**

**CONSTRUCTION PHASE LOAD**

	<b>P Load (kg/yr)</b>
<b>SUMMARY WITH IMPLEMENTATION OF BMPs</b>	
Pre-Development:	<b>4.84</b>
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	<b>22.95</b>
Post-Development + Amortized Construction:	<b>to be determined</b>
<b>Pre-Development Load - Post-Development Load:</b>	<b>-18.11</b>
<b>Conclusion:</b>	<b>374% Increase in Load</b>
<b>Pre-Development Load - (Post-Development + Amortized Construction Load):</b>	<b>to be determined</b>
<b>Conclusion:</b>	<b>to be determined</b>
<b>Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:</b>	
<b>Not approve development as site specific appropriate</b>	

## Project DEVELOPMENT Summary

**DEVELOPMENT: Northwest Sutton**

**Subwatershed: Georgina Creeks**

Total Pre-Development Area (ha): **34** Total Pre-Development Phosphorus Load (kg/yr): **3.58**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Forest	25	0.10	2.50
Hay-Pasture	9	0.12	1.08

### POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency	P Load (kg/yr)
High Intensity - Residential	34	1.32	Wet Detention Ponds 63%	16.61

Post-Development Area Altered:	34.00	P Load (kg/yr)
Total Pre-Development Area:	34.00	
Unaffected Area:	0	
Pre-Development:		3.58
Post-Development:		44.88
Change (Pre - Post):		-41.30
<b>1154% Net Increase in Load</b>		
Post-Development (with BMPs):		16.61
Change (Pre - Post):		-13.03
<b>363.84% Net Increase in Load</b>		

**DEVELOPMENT: Northwest Sutton**  
**Subwatershed: Georgina Creeks**

**CONSTRUCTION PHASE LOAD**

	<b>P Load (kg/yr)</b>
<b>SUMMARY WITH IMPLEMENTATION OF BMPs</b>	
Pre-Development:	<b>3.58</b>
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	<b>16.61</b>
Post-Development + Amortized Construction:	<b>to be determined</b>
<b>Pre-Development Load - Post-Development Load:</b>	<b>-13.03</b>
<b>Conclusion:</b>	<b>364% Increase in Load</b>
<b>Pre-Development Load - (Post-Development + Amortized Construction Load):</b>	<b>to be determined</b>
<b>Conclusion:</b>	<b>to be determined</b>
<b>Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:</b>	
<b>Not approve development as site specific appropriate</b>	

## Project DEVELOPMENT Summary

**DEVELOPMENT: Keswick Business Park**

**Subwatershed: Maskinonge River**

Total Pre-Development Area (ha): **265.2** Total Pre-Development Phosphorus Load (kg/yr): **41.67**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	190.9	0.19	36.27
Forest	66.3	0.05	3.32
Open Water	8	0.26	2.08

### POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency	P Load (kg/yr)
Hay-Pasture	53.21	0.07	NONE	3.72

High Intensity - Comm/Industrial | 211.99 | 1.82 | Wet Detention Ponds | 63% | 142.75

Post-Development Area Altered:	265.20	P Load (kg/yr)
Total Pre-Development Area:	265.20	
Unaffected Area:	0	
Pre-Development:	41.67	
Post-Development:	389.55	
Change (Pre - Post):	-347.88	
<b>835% Net Increase in Load</b>		
Post-Development (with BMPs):	146.48	
Change (Pre - Post):	-104.81	
<b>251.55% Net Increase in Load</b>		

**DEVELOPMENT: Keswick Business Park**  
**Subwatershed: Maskinonge River**

**CONSTRUCTION PHASE LOAD**

	<b>P Load (kg/yr)</b>
<b>SUMMARY WITH IMPLEMENTATION OF BMPs</b>	
Pre-Development:	<b>41.67</b>
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	<b>146.48</b>
Post-Development + Amortized Construction:	<b>to be determined</b>
<b>Pre-Development Load - Post-Development Load:</b>	<b>-104.81</b>
<b>Conclusion:</b>	<b>252% Increase in Load</b>
<b>Pre-Development Load - (Post-Development + Amortized Construction Load):</b>	<b>to be determined</b>
<b>Conclusion:</b>	<b>to be determined</b>
<p><b>Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:</b></p> <p style="text-align: center;"><b>Not approve development as site specific appropriate</b></p>	

## Project DEVELOPMENT Summary

**DEVELOPMENT: South Keswick**  
**Subwatershed: East Holland**

Total Pre-Development Area (ha): **397.9**      Total Pre-Development Phosphorus Load (kg/yr): **201.89**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	252.4	0.36	90.86
Forest	63.25	0.10	6.32
High Intensity - Residential	79	1.32	104.28
Low Intensity Development	3.25	0.13	0.42

### POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency	P Load (kg/yr)
High Intensity - Comm/Industrial	69.8	1.82	Wet Detention Ponds	63% 47.00

High Intensity - Residential	328.1	1.32	Wet Detention Ponds	63% 160.24
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Post-Development Area Altered:	<b>397.90</b>			<b>P Load (kg/yr)</b>
Total Pre-Development Area:	<b>397.90</b>			
Unaffected Area:	<b>0</b>			
			Pre-Development:	<b>201.89</b>
			Post-Development:	<b>560.13</b>
			Change (Pre - Post):	<b>-358.24</b>
				<b>177% Net Increase in Load</b>
			Post-Development (with BMPs):	<b>207.25</b>
			Change (Pre - Post):	<b>-5.36</b>
				<b>2.65% Net Increase in Load</b>

**DEVELOPMENT: South Keswick**  
**Subwatershed: East Holland**

**CONSTRUCTION PHASE LOAD**

	<b>P Load (kg/yr)</b>
<b>SUMMARY WITH IMPLEMENTATION OF BMPs</b>	
Pre-Development:	<b>201.89</b>
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	<b>207.25</b>
Post-Development + Amortized Construction:	<b>to be determined</b>
<b>Pre-Development Load - Post-Development Load:</b>	<b>-5.36</b>
<b>Conclusion:</b>	<b>3% Increase in Load</b>
<b>Pre-Development Load - (Post-Development + Amortized Construction Load):</b>	<b>to be determined</b>
<b>Conclusion:</b>	<b>to be determined</b>
<b>Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:</b>	
<b>Not approve development as site specific appropriate</b>	

## Project DEVELOPMENT Summary

**DEVELOPMENT: Glenwoods**

**Subwatershed: East Holland**

Total Pre-Development Area (ha):	<b>47.5</b>	Total Pre-Development Phosphorus Load (kg/yr):	<b>4.97</b>
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Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Forest	36.3	0.10	3.63
Hay-Pasture	11.2	0.12	1.34

### POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency	P Load (kg/yr)
High Intensity - Residential	47.5	1.32	Wet Detention Ponds 63%	23.20

Post-Development Area Altered:	47.50	P Load (kg/yr)
Total Pre-Development Area:	47.50	
Unaffected Area:	0	
Pre-Development:		4.97
Post-Development:		62.70
Change (Pre - Post):		-57.73
<b>1161% Net Increase in Load</b>		
Post-Development (with BMPs):		23.20
Change (Pre - Post):		-18.22
<b>366.41% Net Increase in Load</b>		

**DEVELOPMENT: Glenwoods**  
**Subwatershed: East Holland**

**CONSTRUCTION PHASE LOAD**

	<b>P Load (kg/yr)</b>
<b>SUMMARY WITH IMPLEMENTATION OF BMPs</b>	
Pre-Development:	<b>4.97</b>
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	<b>23.20</b>
Post-Development + Amortized Construction:	<b>to be determined</b>
<b>Pre-Development Load - Post-Development Load:</b>	<b>-18.22</b>
<b>Conclusion:</b>	<b>366% Increase in Load</b>
<b>Pre-Development Load - (Post-Development + Amortized Construction Load):</b>	<b>to be determined</b>
<b>Conclusion:</b>	<b>to be determined</b>
<b>Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:</b>	
<b>Not approve development as site specific appropriate</b>	

## Project DEVELOPMENT Summary

**DEVELOPMENT:** Queensway East  
**Subwatershed:** Georgina Creeks

Total Pre-Development Area (ha): **86.7**      Total Pre-Development Phosphorus Load (kg/yr): **31.21**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	86.7	0.36	31.21

### POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency	P Load (kg/yr)
High Intensity - Residential	86.7	1.32	Wet Detention Ponds 63%	42.34

Post-Development Area Altered:	86.70	P Load (kg/yr)
Total Pre-Development Area:	86.70	
Unaffected Area:	0	
Pre-Development:		31.21
Post-Development:		114.44
Change (Pre - Post):		-83.23
		267% Net Increase in Load
Post-Development (with BMPs):		42.34
Change (Pre - Post):		-11.13
		35.67% Net Increase in Load

**DEVELOPMENT: Queensway East**  
**Subwatershed: Georgina Creeks**

**CONSTRUCTION PHASE LOAD**

	<b>P Load (kg/yr)</b>
<b>SUMMARY WITH IMPLEMENTATION OF BMPs</b>	
Pre-Development:	<b>31.21</b>
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	<b>42.34</b>
Post-Development + Amortized Construction:	<b>to be determined</b>
<b>Pre-Development Load - Post-Development Load:</b>	<b>-11.13</b>
<b>Conclusion:</b>	<b>36% Increase in Load</b>
<b>Pre-Development Load - (Post-Development + Amortized Construction Load):</b>	<b>to be determined</b>
<b>Conclusion:</b>	<b>to be determined</b>
<b>Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:</b>	
<b>Not approve development as site specific appropriate</b>	

## Project DEVELOPMENT Summary

**DEVELOPMENT:** Queensway West  
**Subwatershed:** Georgina Creeks

Total Pre-Development Area (ha): **28.5**      Total Pre-Development Phosphorus Load (kg/yr): **10.26**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Cropland	28.5	0.36	10.26

### POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency	P Load (kg/yr)
High Intensity - Residential	28.5	1.32	Wet Detention Ponds 63%	13.92

Post-Development Area Altered:	Area (ha)	P Load (kg/yr)
Total Pre-Development Area:	28.50	10.26
Unaffected Area:	0	0
Post-Development (with BMPs):		13.92
Change (Pre - Post):		-3.66
<b>35.67% Net Increase in Load</b>		

Area (ha)	P Load (kg/yr)
Pre-Development:	10.26
Post-Development:	37.62
Change (Pre - Post):	-27.36
<b>267% Net Increase in Load</b>	

**DEVELOPMENT: Queensway West**  
**Subwatershed: Georgina Creeks**

**CONSTRUCTION PHASE LOAD**

	<b>P Load (kg/yr)</b>
<b>SUMMARY WITH IMPLEMENTATION OF BMPs</b>	
Pre-Development:	<b>10.26</b>
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	<b>13.92</b>
Post-Development + Amortized Construction:	<b>to be determined</b>
<b>Pre-Development Load - Post-Development Load:</b>	<b>-3.66</b>
<b>Conclusion:</b>	<b>36% Increase in Load</b>
<b>Pre-Development Load - (Post-Development + Amortized Construction Load):</b>	<b>to be determined</b>
<b>Conclusion:</b>	<b>to be determined</b>
<b>Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:</b>	
<b>Not approve development as site specific appropriate</b>	