

MMM Group Limited



Keswick Stormwater Management Study

Class Environmental Assessment Project
File Report

14-09606-001-WR1

COMMUNITIES
TRANSPORTATION
BUILDINGS
INFRASTRUCTURE



September 2010

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1.0 INTRODUCTION

1.1 BACKGROUND

The Town of Georgina proposes to increase employment opportunities in the community of Keswick by creating the Keswick Business Park. To permit this to occur, the Town has proposed Official Plan Amendment (OPA) 97. During the development and approval of this OPA, a number of concerns were raised as to the potential impact of storm runoff from the area in question upon Lake Simcoe, a recognized provincially significant resource. In an Agreement between the Town, the Region of York and the Ministry of Municipal Affairs and Housing (Minutes of Settlement, April 2008), the Town agreed to a number of actions designed to address those concerns. One of those actions was to carry out a comprehensive Stormwater Management Study for the entire community of Keswick by June 2010. The Terms of Reference for that study were to be developed in consultation with Lake Simcoe Region Conservation Authority (LSRCA) and the Province of Ontario and those parties were to be consulted during its completion. The study was to, at a minimum:

1. Use the Assimilative Capacity Study (ACS)¹ water quality targets to determine the appropriateness of potential approaches to improve and/or enhance water quality associated with storm water runoff from Keswick.
2. Identify and assess the stormwater management system (e.g. collection, retention, treatment and conveyance) in Keswick to identify remediation, retrofit and related opportunities to optimize the performance of the system with respect to water quality.
3. Quantify the approximate costs associated with each specific remediation, retrofit or other opportunity identified through the foregoing analysis.
4. Identify potential strategies to implement remediation, retrofit and related opportunities for existing development in association with the planned development and intensification of Keswick. Identify possible funding sources and public sector partners to assist with these potential strategies for remediation, retrofit and related opportunities.

¹ “2006 Final Pollutant Target Load Study – Lake Simcoe and Nottawasaga River Watersheds,” Louis Berger Group. See discussion in Section 2.

5. Consider applicable legislative, regulatory, and policy requirements, as well as financial impacts on the municipality, incorporate appropriate storm water strategies into the review of the Keswick secondary plan.

Terms of Reference were prepared for the study and these are contained in Appendix A. An important point of note is that the study addresses “the urban or built up Keswick Community” and that it “shall exclude those Greenfield and other areas currently in the development process.” It is taken as a given that all lands in the development process shall be subject to current and/or future stormwater management controls.

A consultant selection process undertaken by the Town resulted in the retention of the MMM Group to complete the Keswick Stormwater Management Study. This report describes the results of that study. Subsequent to the development of the original Terms of Reference, the Town decided that it would be advantageous to complete the Keswick SMS as a Class Environmental Assessment since this potentially reduces the future EA requirements for any projects identified in the study.

1.2 CLASS ENVIRONMENTAL ASSESSMENT PROCESS

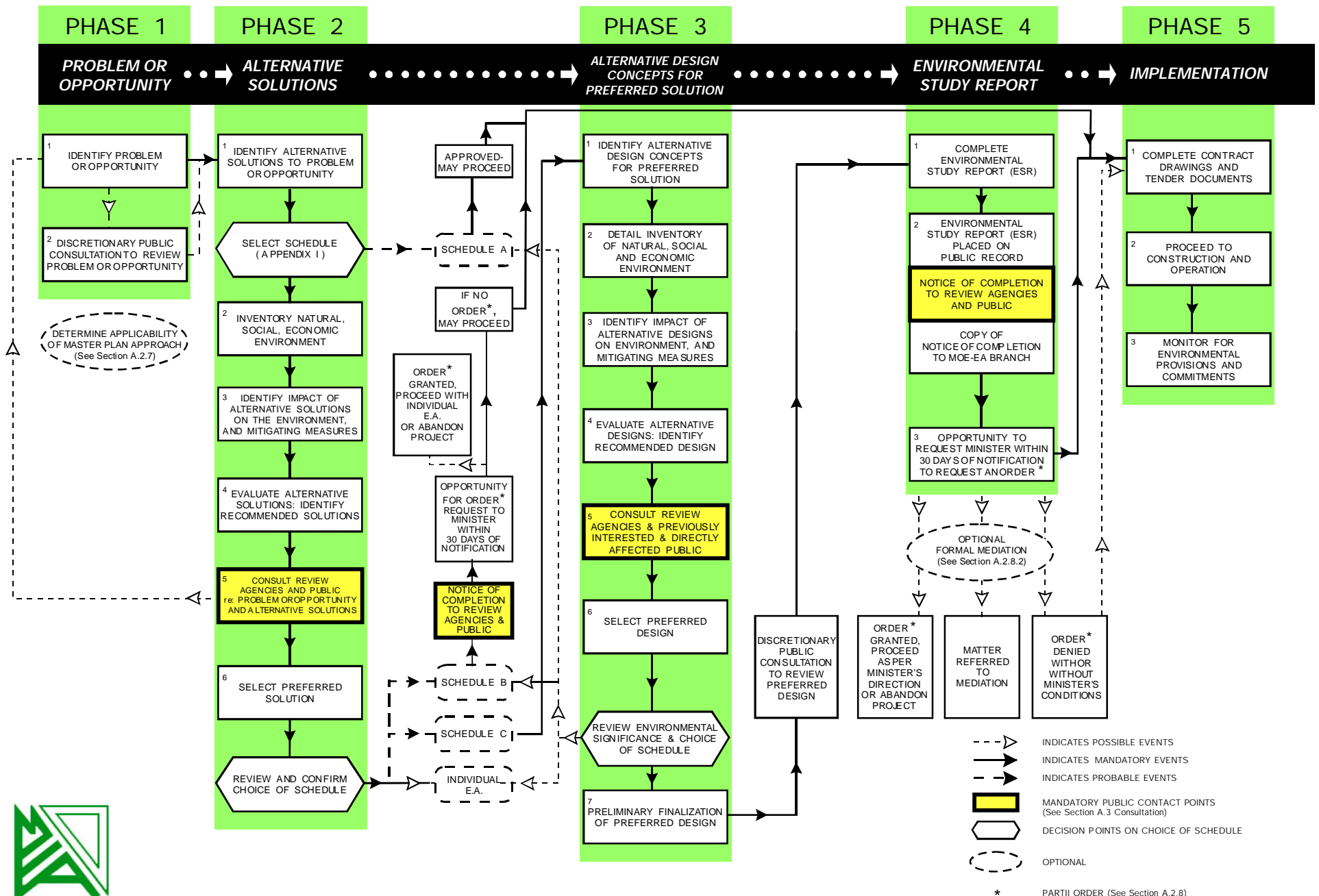
This report has been prepared within the framework of the Class Environmental Assessment according to the Municipal Engineers Association (MEA) Municipal Class Environmental Assessment (June 2000, updated 2007). The Class EA document has been accepted and approved under the Environmental Assessment Act. The Municipal Class EA process is generally undertaken in five phases (see Figure 1.2) as follows:

- Phase 1 – identification of the problem or opportunity
- Phase 2 – identification of alternative solutions
- Phase 3 – preparation of alternative design concepts for preferred solution
- Phase 4 – preparation of the Environmental Study Report or Master Plan Report
- Phase 5 – implementation.

Since this study was intended to develop a stormwater management master plan, it has been carried out in compliance with the Master Plan component of the Class EA as described in Sections A2.7 and Appendix 4 of the Class EA document. As required by that document, it fulfils Phases 1 and 2 of the Class EA process. For individual

FIGURE 1.2 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



projects within the Plan which are identified as Schedule B projects, this document will generally fulfil Phase 1 and 2 EA documentation requirements for them. For larger, more complex projects which are identified as Schedule C projects, additional documentation will be required to fulfil Phases 3 through 5.

The Master Plan process involves a minimum of two mandatory points of contact with the directly involved public and relevant review agencies to ensure they are aware of the project and that their concerns are addressed. The process requires that a project file be prepared and submitted for review by the public at the end of Phase 2. If outstanding concerns do not emerge from this review, the municipality may proceed to implementation (subject to any additional requirements). If however the review process raises a concern that cannot be resolved, it would normally be possible to request a Part II order to “bump up” the Class EA to an Individual EA. However, for the Master Plan process, it is not possible to request a Part II order for the Plan itself but only at a later stage for individual projects identified within the Plan.

As part of the current study, the following EA activities were completed:

Issuance of Notice of Commencement

A Notice of Commencement was issued in the local media and by direct mailing to appropriate agencies, NGOs and other potential stakeholders. Documentation of these actions and comments received is provided in Appendix B.

Public Information Centre No. 1

Depending on the nature of the project, review agencies and the public may be consulted as part of Phase 1. As part of this Class EA, a Public Information Centre/Meeting was held at the beginning of the process (February 24, 2010) to introduce the public to the study and to provide them with an opportunity to provide relevant information and raise any watershed issues or concerns. Documentation is included in Appendix B.

Public Information Centre No. 2

Phase 2 of the Class EA process involves a number of steps including identifying all reasonable alternative solutions to the problem, documenting the existing environment, evaluating the alternative solutions and consulting with appropriate review agencies and the public in order to identify the preferred solution. As part of the identification of the preferred solution, i.e. the projects, programs and policies that will be included in the Stormwater Management Master Plan, a second Public

Information Centre was held to obtain comments from the public on the alternatives considered and the draft plan. This occurred on May 27, 2010. The information presented at that meeting and the participant list are all documented in Appendix B. There were no formal written comments received.

Issuance of Notice of Completion

A formal Notice of Study Completion was published in the media on October 7, 14th, 2010. It was also sent directly to relevant agencies and all members of the public who had requested to be included on the project mailing list. The notice advised of the availability of the draft Stormwater Management Study. The document was made available to the public for the statutory 30 day review period. Documentation of these actions, comments received by the expiry date of that period and the means by which they were addressed is also provided in Appendix B.

In compliance with the Class EA requirements, this report includes a description of the project and its purpose, identification of alternatives, inventory of natural, social and economic environments, evaluation of potential environmental effects and appropriate mitigation measures, selection of the preferred alternative and documentation of consultation with review agencies and the public.

1.3 SCOPE OF WORK

Stage 1 of the project involved the following tasks:

- Project Initiation Meeting with Town staff
- Background Information – Assembly, Review and Evaluation
- Physical Inspections & Surveys of All SWM Facilities (Ponds, OGS & Bio-Filter)
- Sediment Sampling and Testing of All Wet SWM Facilities
- Preparation of Stage 1 Summary Report

Stage 2 of the project involved the following tasks:

- Identifying various opportunities for new SWM facilities and to retrofit existing SWM facilities
- Classifying the various opportunities into a number of SWM plan alternatives

- Calculating estimated costs and total phosphorus loading reduction for each alternative
- Reviewing social and environmental impacts of each alternative along with cost and total phosphorus load reduction
- Preparation of Stage 2 Report

In addition, the scope of work included the activities discussed in Section 1.2 to complete the Class EA process.

2.0 PHASE 1 – PROBLEM OR OPPORTUNITY

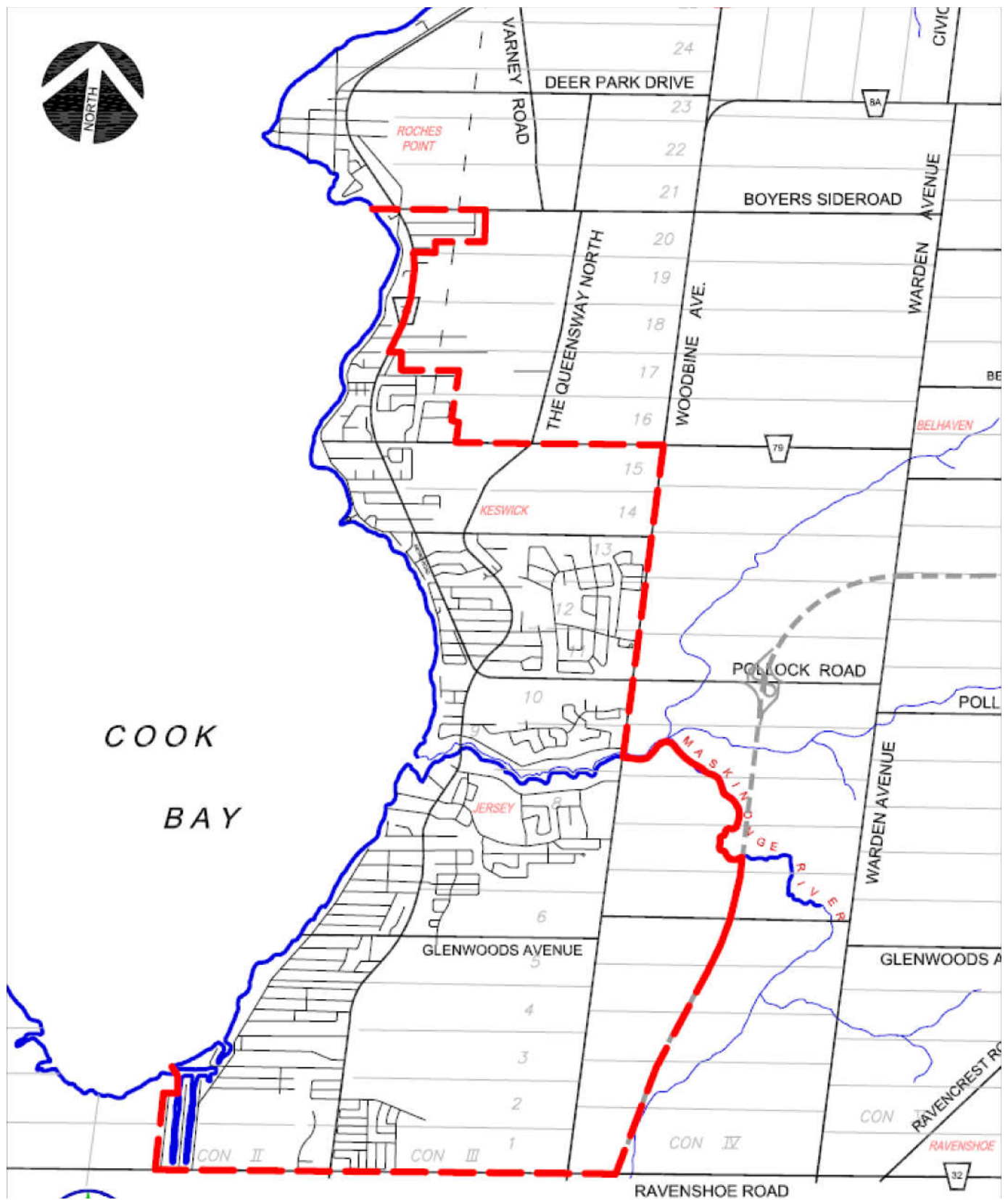
2.1 DEFINITION OF STUDY AREA

As noted previously, the study area encompasses the entire Keswick Community but focuses on the currently built up areas and excludes lands involved in the development process. The extent of the study area is shown on Figure 2.1.

2.2 IDENTIFICATION OF THE PROBLEM

For more than twenty years concerns have been raised by many groups over the health of Lake Simcoe. These have intensified over the years as more development of the shoreline has taken place. Increasingly, as well, development within the watersheds which drain into Lake Simcoe has intensified as communities such as Keswick, Barrie, Uxbridge, etc. have grown. The major focus of the concerns has been eutrophication of the lake as increased levels of nutrients have entered the water body. A key indicator of the potential for eutrophication has been the level of phosphorus in the lake and the loadings of phosphorus from the many sources reaching the lake. Many studies have been completed on the entire watershed of Lake Simcoe and its tributaries (e.g. the Uxbridge Brook subwatershed plan). These resulted, some years ago, in the development of the “Lake Simcoe Environmental Management Strategies” which took the first step in defining possible limits on phosphorus loadings to the lake.

As a result of provincial initiatives such as “Places to Grow,” further expansion of many communities such as Keswick, Barrie and Lefroy which lie within the Lake Simcoe watershed is proposed. This led to a further series of studies designed to determine how such growth might be environmentally sustainable in relation to the limitations created by maintaining and enhancing the health of Lake Simcoe. Two key studies defined a) current and potential phosphorus loadings (through modelling with a tool called CANWET) and b) water quality loading targets consistent with the assimilative capacity of the Lake. The latter (known as the Assimilative Capacity Study or ACS) identified three areas on the east side of Lake Simcoe which are potentially relevant to the Stormwater Management Study of the community of Keswick. These are the “Keswick Creeks” watersheds, the “Maskinonge River” watershed and the “Georgina Creeks” watersheds. In each case, total annual phosphorus loading targets were established which must be considered in relation to future development. For the Keswick and Georgina Creeks, these were based upon “Strategy C” which uses the Provincial Water Quality Objectives (PWQO) or the



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TITLE
STORMWATER MANAGEMENT
STUDY AREA



MMM GROUP

100 Commerce Valley Dr. W.
Thornhill, ON L3T 0A1
t. 905.882.1100
f. 905.882.1857
mmm@mmm.ca

Checked R.B.	Drawn AutoCAD/A.T.T.
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lowest possible load available from a comprehensive BMP strategy as a basis for target setting. For the Maskinonge, “Strategy B” was adopted which essentially results in the same level of control as Strategy C.

This Keswick Stormwater Management Study is designed to evaluate the current drainage and stormwater management system and identify opportunities to improve and optimize that system through remediation and retrofitting to move towards meeting the Accumulative Capacity Study (ACS) targets. This will be a significant step in implementing the ACS strategy as it will carry the process forward to the next level of detail from the subwatershed scale used in that study.

The draft “Lake Simcoe Protection Plan” (January 2009) was developed under the general authority of the Lake Simcoe Protection Act, 2008. It outlines a wide variety of strategies, policies and programs whose objectives are to:

- protect, improve or restore the elements that contribute to the ecological health of the Lake Simcoe watershed, including, water quality, hydrology, key natural heritage features and their functions, and key hydrologic features and their functions;
- restore a self-sustaining coldwater fish community in Lake Simcoe;
- reduce loadings of phosphorus and other nutrients of concern to Lake Simcoe and its tributaries;
- reduce the discharge of pollutants to Lake Simcoe and its tributaries;
- respond to adverse effects related to invasive species and, where possible, to prevent Climate Change.

The Plan includes specific sections dealing with stormwater management. It requires that within five 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 stormwater management master plans will be prepared in accordance with the Municipal Class Environmental Assessment and will include:

- a. a characterization of existing environmental conditions on a subwatershed basis, consistent with any relevant subwatershed evaluations, if available;

- b. an evaluation of the cumulative impact of stormwater from existing and planned development;
- c. a determination of the effectiveness of existing stormwater management works, including consideration of the potential impacts of climate change on the effectiveness of the works;
- d. an examination of any stormwater retrofit opportunities that have already been identified by the municipality or the LSRCA for areas where stormwater is uncontrolled or inadequately controlled;
- e. the identification of additional stormwater management retrofit opportunities or improvements to existing stormwater management works that could improve the level of treatment within a particular settlement area;
- f. a description of existing or planned programs for regular maintenance of stormwater management works;
- g. an identification of the recommended approaches for stormwater management in each settlement area; and
- h. an implementation plan for the recommended approaches.

The Terms of Reference for the current study respond to those requirements and the study report will eventually fulfil the municipality's obligation for the Keswick Community. In addition, the scope of the study was expanded from the original Terms of Reference to include a provision to follow the Municipal Class EA process as a Master Plan under that Class EA as described in Section 1.2.

2.3 PROBLEM DEFINITION

As previously discussed there is an opportunity to improve the health of Lake Simcoe. This study focuses on the currently developed areas of the community of Keswick and looks to contribute to achieving the goals of the Lake Simcoe Protection Plan. The problem definition can be stated as:

“What are the preferred methods of controlling storm runoff and reducing the total phosphorus loading to Lake Simcoe from the developed areas of the community of Keswick in order to improve water quality while protecting and enhancing aquatic and terrestrial habitats in Lake Ontario?”

This problem definition identifies the specific goal that must be met by an alternative in order to be considered a valid solution to the problem. Alternatives were identified

once the existing conditions within the study area had been characterized. The main criteria used to judge success was reduction on phosphorus loading. Other criteria were also defined related to environmental, social and economic conditions.

3 PHASE 2 - EXISTING CONDITIONS

3.1 GENERAL

The first step in Phase 2 of the Class EA process was to inventory the existing conditions which may affect or conversely may be impacted by alternative solutions to the problem. The following sections describe the natural and man-made features of Keswick relevant to stormwater management planning and information that was available on the current status of those features. Information is presented which contributed to the environmental, social and economic assessment of alternatives.

3.2 SUMMARY OF AVAILABLE INFORMATION

3.2.1 *Available Data*

The Town provided a wide range of data upon which to base the study. This included:

1. Geospatial data regarding the area including digital orthophotography as listed in Table 3.2.1.
2. Preliminary databases indicating the location and type of storm drainage features relevant to this study. This included: existing stormwater management facilities, existing oil-grit separators and existing storm outfalls to Lake Simcoe. Expanded versions of these databases created as result of the Stage 1 work are included in Appendices B, D and E respectively.
3. Reports, MOE Certificates of Approval (C of A), site plans and design drawings related to the existing stormwater management facilities and OGS. These were provided digitally on CD with a hierarchical directory structure. These were used in Stage 1 to develop an understanding of the facilities and to compare with field survey information to determine levels of sediment accumulation.

TABLE 3.2.1
GEOSPATIAL INFORMATION PROVIDED BY TOWN OF GEORGINA IN ARC GIS FORMAT

ANSI MNR
Areas of Natural and Scientific Interest
Contours and Topographic Data
Digital Orthophotography
Forested Areas
Municipal Parcel Fabric
Municipal Parks
Oblique Photography 1999/2000
Railways
Regional and Municipal Boundaries
Regional Forest Boundary
Regional Forests
Single Line Road Network
Soils
Solid Waste Facilities
Waterbodies
Watercourses
Watersheds
Watershed LSRCA
Wetlands
Wetlands MNR
Environmental Data (i.e. ESAs, etc.)
Metadata
Natural Feature Data
Fire Hydrants
Aquifers
Wastewater Force Main
Wastewater Flow Meter
Wastewater Service Area
Wastewater Siphon Main
WW Underground Enclosure
Wstorage
Well head Pro Area
Watermains

3.3 EXISTING DRAINAGE/STORMWATER MANAGEMENT SYSTEM

A clear understanding of the existing drainage and stormwater management system is essential for the development of a Master Stormwater Management Plan. The following sections describe the main elements and present mapping showing the extent of the existing system.

3.3.1 Inspection and Sediment Survey of Existing Ponds

Ten wet ponds within the study area were inspected during the Fall of 2009. The locations and details of each facility were provided by the Town of Georgina. See Figure 3.3.1 for locations. Visual inspection of each pond was undertaken and photos of key elements are included in Appendix C.

Additionally, depth of sediment was measured on a grid of points in each pond. Half of the ponds were traversed on foot wearing chest waders as depth allowed and the other half required the use of a canoe to obtain measurements. The depth from the water surface to the top of sediment was measured, as well as the depth from the water surface to the bottom of sediment. These points were then entered into AutoCAD, where surfaces representing the top and bottom of sediment were created. Routines in AutoCAD were used to calculate the approximate volume of sediment in each pond based on the data collected. Output from the AutoCAD volume calculations are included in Appendix C.

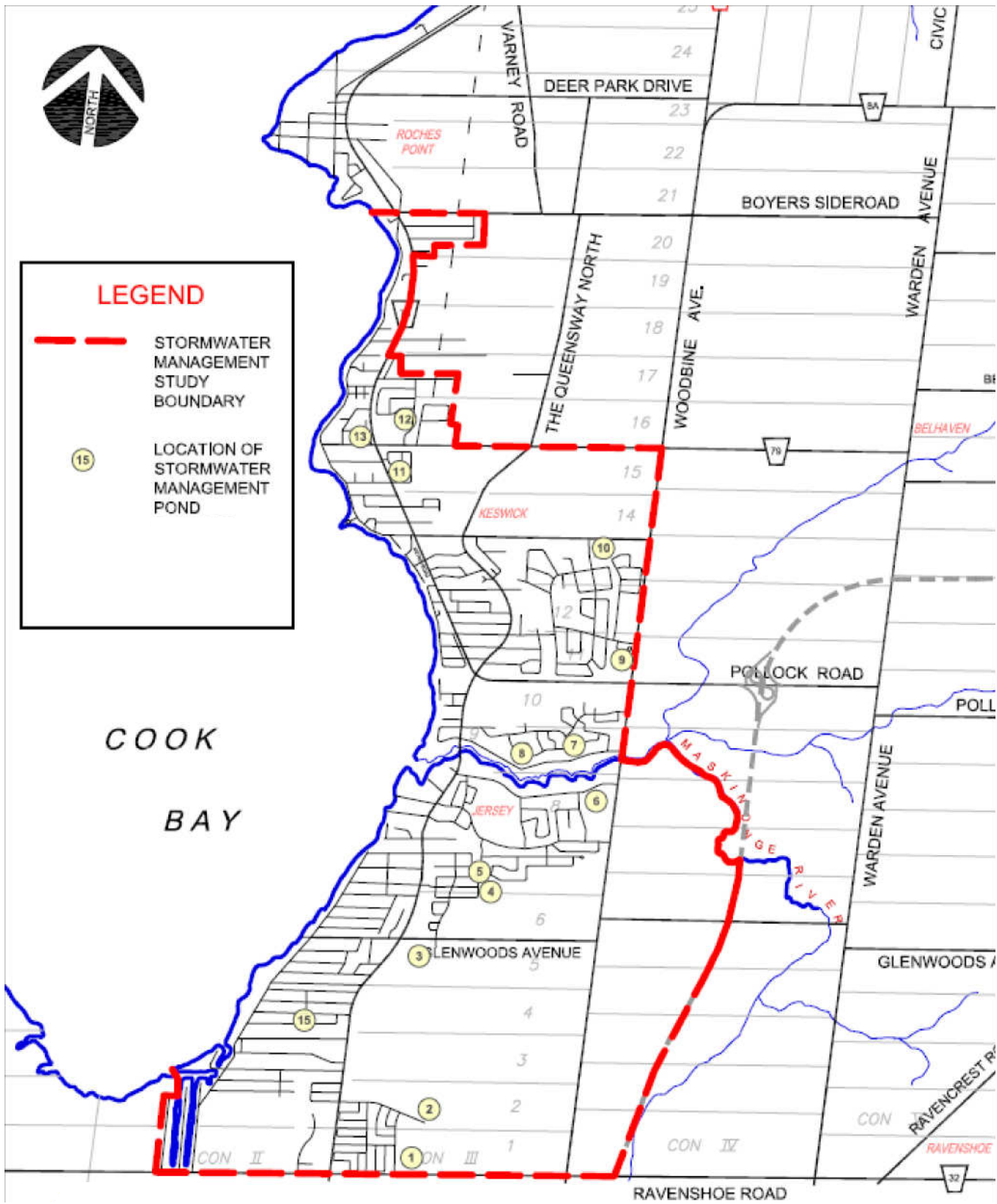
The current MOE Stormwater Management guidelines recommend sediment cleanout when the TSS removal efficiency of the pond is reduced by 5%. A report by the Lake Simcoe Region Conservation Authority for the Town of Newmarket stated that in general a storage loss of between 12% (wetland) and 30% (wet pond) is required to reduce a pond's TSS removal efficiency by 5%.

Table 3.3.1 summarizes the sediment volumes for each pond and lists the volumes as a percentage of the total design permanent pool volume where available. The percentages of sediment to total water volume may be high as the permanent pool volumes used are minimum volumes necessary to meet requirements, however the actual provided permanent pool volumes may be larger.



LEGEND

- STORMWATER MANAGEMENT STUDY BOUNDARY
- 15 LOCATION OF STORMWATER MANAGEMENT POND



CLIENT
TOWN OF GEORGINA

TITLE
STORMWATER MANAGEMENT POND LOCATIONS



100 Commerce Valley Dr. W.
Thornhill, ON L3T 0A1
t. 905.882.1100
f. 905.882.1857
mmm@mmm.ca

MMM GROUP

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TABLE 3.3.1
SEDIMENT VOLUMES VERSUS PERMANENT POOL VOLUME BY POND

Pond Number	Sediment Volume (m³)	Permanent Pool Volume (m³)	Percent Storage Loss (%)
1a	295	6362	4.6
1b	274	3878	7.1
2	624	4493	13.9
3	544	5500	9.9
4	248	900	27.6
5	323	1024	31.5
6	15	Unknown	N/A
7	288	3047	9.5
8	38	1160	3.3
9	395	1800	21.9
11	168	1060	15.8

3.3.1.1 Pond 1

Pond 1 consists of two SWM ponds located at the northeast corner of Thornlodge Drive and Ravenshoe Road, which outlet to a constructed channel that runs south under Ravenshoe Road to the Nelson Drain. These ponds were constructed as part of the Simcoe Landing development whose design was approved in June 1999. The west pond has two inlets, one into the forebay from the southwest and one into the main pond from the north. The east pond has a future inlet from the east that is still not constructed.

Water in both the east and west ponds appeared fairly clean. Pond 1 west had a total of 295 m³ of sediment in both the forebay and main pond and Pond 1 east had a total of 274 m³.

3.3.1.2 Pond 2

Pond 2 consists of a north and south forebay with a wet cell in between the two. It is located north of the pumping station at the east end of Joe Dales Drive. Like Pond 1 east and west, this pond is also part of the Simcoe Landing development. It outlets to the north end of the same channel that Pond 1 East and West outlets to. Both forebays have two headwall inlets.

During the inspection, crews were working on laying the gravel for the access roads. At this time the pond has not yet been taken over by the town and there is significant amount (up to 85 cm deep) of sandy sediment at the inlets. See photos in Appendix C.

The volume of sediment in the north and south forebays is approximately 229 m³ and 43 m³ respectively. The main pond has 352 m³ of sediment.

3.3.1.3 Pond 3

Pond 3 is located behind S & M Motors at the southeast corner of The Queensway South and Glenwoods Avenue. It was constructed as part of the development of the Our Lady of The Lake Highschool to the east. The pond was free of extraneous vegetation and the water seemed fairly clean. The forebay and main pond had 157 m³ and 387 m³ of sediment respectively.

3.3.1.4 Pond 4

Pond 4 is located at the east end of Dovedale Avenue and provides water quality control for runoff from the Lakeside Village development along Bayview and Lowndes Avenues and Rainbow Court as well as the Simcoe Shores development along Bambi and Wrendale Crescents, and Dovedale Avenue. There are diversion structures at each inlet that direct excess flows directly to Glenwoods Creek.

The pond contained several clusters of cattails in the centre as well as debris such as large pieces of wood and hockey nets. The sediment volume was found to be 248 m³.

3.3.1.5 Pond 5

Pond 5 is behind the southwest corner of Fairwood Drive, adjacent to Glenwoods Creek and was constructed to provide water quality and quantity control for the Amberview subdivision. There is a significant area of cattail growth at the east inlet which prevents access to take sediment depth readings. There are cattails along the north side of the pond and at the west inlet as well. However, the growth was not as significant as around the east inlet. The volume of sediment is estimated to be 323 m³, however it may be larger, as the area around the west inlet was not able to be measured due to cattail growth.

3.3.1.6 Pond 6

Pond 6 is at the southeast corner of Riverglen Drive and Windover Drive, behind the Zehrs plaza that fronts on Woodbine Avenue. It outlets to the north, through three CSP culverts under Riverglen Drive to the Maskinonge River. It was originally designed as a storm outfall channel to convey the runoff from the Patrician Homes development to the west. Information provided by Town employees stated that at some point after construction the area was dug out to provide more storage, however no design records could be found.

The pond is largely dry and covered with cattails and other dense vegetation except for a narrow and shallow wetted area through the centre of the pond. A single line of sediment depths were recorded along the length of this wetted area that varied in width from approximately 0.5 m to 1.5 m. The estimated volume of sediment along this corridor is 15 m³ with sediment depths ranging from 3 cm to 42 cm.

3.3.1.7 Pond 7

Pond 7 is at the southeast corner of Arlington Drive and Richmond Park Drive/Glendower Circle in behind a small playground. It is comprised of a north pond and a south pond water quality. The north pond was constructed as a water quality pond as part of the second phase of the Cedarwood subdivision. The south quality pond was constructed as part of the Forsite Homes development along Margaret Place and the south section of Iveagh Drive northwest of Woodbine Avenue and Riveredge Drive.

The surfaces of both ponds were covered with duckweed and appeared to have significant algal growth. The north pond contained some debris (running shoe, tennis racket, water bottles etc.) at its south end and also released a sulphuric smell when disturbed.

The sediment volume for the north pond is estimated to be 106 m³ and the south pond 182 m³.

3.3.1.8 Pond 8

Pond 8 is behind the houses at the southwest end of Glendower Circle and provides water quality treatment for runoff from the west portion of the Cedarwood subdivision. Its outlet crosses under Riveredge Drive and discharges into the Maskinonge River. The surface at the east end of the pond, at the inlet, was covered with duckweed. The volume of sediment in this pond is estimated to be 38m³.

3.3.1.9 Pond 9

Pond 9 is south of Wexford Drive and Fenimore Place and west of Woodbine Avenue. It was constructed as part of the Keswick North subdivision. It is quite vegetated and dry, with only two areas of open water; a small one at the north inlet and a larger one (about 1/3 the size of the entire pond area) at the east end by the pond outlet. The area by the north inlet was twice as deep (approx 1.8 m) as the area near the outlet (approx. 1.0 m). The estimated volume of sediment is 47 m³ for the north area and 325 m³ for the east area.

3.3.1.10 Pond 11

Pond 11 is on the east side of Metro Road North just south of Tulip Street and is a water quality pond for the Homestead development. There was a deposit of sand around the outlet, an Oaks mini slab erosion control system according to the engineering drawings. The total sediment volume estimate for the pond is 168 m³.

3.3.2 Sediment Sampling and Existing Ponds

A sediment sampling program was completed at eleven “wet” storm water management facilities. This included all facilities discussed in Section 3.3.1 and shown on Figure 3.3.1 except for Ponds 12, 13 and 15 which are “dry” SWM facilities.

The following tasks were completed as part of the sediment sampling program:

- Arranging for clearance of public and private utility locations in the vicinity of the proposed sediment sampling locations. Sampling locations were selected prior to field activities to provide spatial distribution of the facility and to ensure adequate representation of the fore-bay and main pond areas. GPS coordinates were used to guide field personnel during the sampling program;
- Collecting three sediment samples from each “wet” pond using core sampling techniques in accordance with the Ontario Ministry of the Environment (MOE), Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario. The samples were obtained from a canoe by hand driving a core sampler through the sediment until refusal on native material. Basket retainers or “core catchers” were used at the bottom of the core sampling tube to aid in retaining non-cohesive sediments within the core tube while it was being raised to the surface. A small portion of native material beneath the sediment was extracted to ensure the full depth of sediment core was removed. Between sample locations the sampler and field equipment was cleaned of adhering debris and rinsed;
- Characterizing the recovered sediment samples in the field noting the particle size, colour, presence of distinct layering and any odours or staining. The samples were placed in a laboratory-supplied jar suitable for BTEX/PHC analysis. The remainder of the sample were placed in a labelled polyethylene bag.

- Submitting sediment samples from each facility to an independent laboratory accredited with the Canadian Association for Laboratory Accreditation (CALA) for the following analyses:
 - One composite sample from each pond for bulk analysis of metals, petroleum hydrocarbons (CCME F1 to F4 fractions) and polycyclic aromatic hydrocarbons. The Triple Silica Gel Cleanup laboratory procedure was utilized to remove organic material that may cause interference when analyzing for heavy oils.
 - Two composite sediment samples were be submitted for bulk PCB analysis and O. Reg. 558 Toxicity Characteristic Leachate Procedure (TCLP) for Metals and Inorganic parameters to determine whether the sediment is considered non-hazardous or leachate toxic. TCLP and bulk PCB analysis are required by most waste receiver sites prior to accepting waste.
 - Two samples for grain size analysis.
- The sediment samples were kept in a cooler on ice until delivered to the laboratory. A chain of custody accompanied the samples to document the sample identification and the requested analysis.
- Comparing results of analysis to sediment standards documented in Soil, Ground Water and Sediment Standards for Use under Part XV.1 of the Environmental Protection Act. We assumed that MOE Table 2 site condition standards in a potable ground water condition applied;
- Providing sediment management options based on the findings of the sediment sampling program, including recommendations regarding disposal as appropriate.

The sediment sampling program was completed under the supervision of MMM field staff from September 22 to September 24, 2009. Sediment samples were collected using a core sampling method. A hand held corer was advanced into the sediment and twisted or pulled to remove the sample core. This action creates a partial vacuum that holds the sample in place and prevents washout. In addition, a core catcher was placed on the end of the corer to prevent washout of the sediment sample.

Three sediment samples were collected at each storm water management pond. Generally, two sediment samples were collected from the fore-bay and one sample

from the main pond area. One composite sample was submitted from each facility and chemically analyzed for potential contaminants to confirm the environmental quality of the material and to determine sediment management options. Typical sampling locations are shown on Figure 3.3.2. Locations for all facilities sampled are shown in Appendix D.

Sampling locations were referenced in the field using a GPS and by measuring the distance from the shoreline and other site features. At each sampling location the sample description, depth of water and thickness of sediment was recorded. The data is presented in Table 3.3.2.

3.3.2.1 Assessment Standards

To evaluate sediment quality at the site, data were compared to standards established in the Ministry of the Environment (MOE) Soil, Groundwater and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act (March 9, 2004) (the “Standard”).

Sediment was analyzed to determine the degree of contamination (if any) and potential disposal options. Therefore, the sediment analytical results have been compared to MOE Table 2 Standards for residential/parkland/institutional (RPI) land use in a potable groundwater situation. Depending on the specific sampling location, fine to medium or coarse textured soils were considered applicable to the Subject Property under O. Reg. 153/04 based on results of grain size analysis conducted on two samples collected during the sediment investigation (see Appendix D).

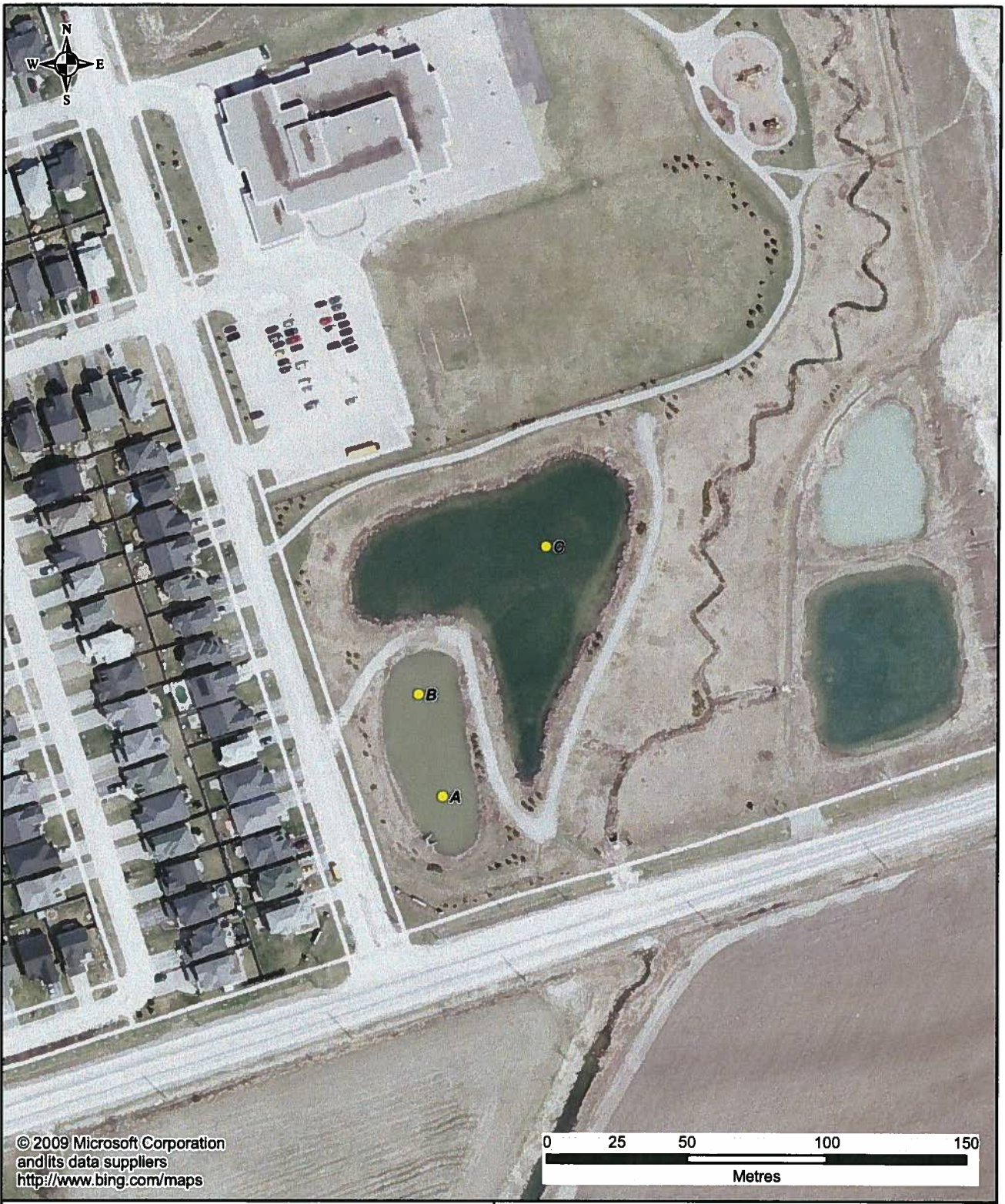
3.3.2.2 Sampling Results

The results of chemical analysis for Petroleum Hydrocarbons (PHCs), polycyclic aromatic hydrocarbons (PAHs) and Metals are included in Table 3.3.2.2. As noted previously, sampling locations are indicated on Figures 2 thru 11 of Appendix D.

The stratigraphy of the stormwater management ponds is relatively consistent with silt and fine to medium textured sand and trace gravel, organic material and clay. The measured water depth and sediment thickness varied at each pond location.

The concentration of metals, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) were less than the applied MOE site condition standard at each of the pond locations. The analytical results identified exceedances of MOE Table 2 standards for Petroleum Hydrocarbons (PHCs), F3 and F4 fractions (heavy oils) at only stormwater management ponds 6 and 10.


J:\1442 Projects by Job Number\2009\14-09606-001-BM1 Keswick Stormwater Ponds\50 Mapping\MXD\Figure3.3.2



© 2009 Microsoft Corporation and its data suppliers
<http://www.bing.com/maps>

Legend

● Sample Points

Client:	Town of Georgina	
Title:	Keswick Stormwater Pond 1	
Prepared by:	 MMM GROUP	
14-09606-001-BM1	Scale as Shown	Review: AFJ
Date: July 2010	Figure: 3.3.2	
© Queen's Printer for Ontario		

Based on these results, chemically impacted sediment identified at stormwater management ponds 6 and 10 is classified as waste and should be disposed off-site at a licensed waste disposal facility.

Sediment removed from all other sampled stormwater management ponds could be disposed of at acceptable receiving sites as determined by the Town of Georgina. Active or closed gravel pits would be considered acceptable to receive non-impacted sediment.

3.3.3 Inspection and Sediment Survey of Existing Oil Grit Separators

A list of oil grit separators (OGS) was provided by the Town and each one was inspected in November 2009. Town staff sent letters to the private landowners where necessary to notify of upcoming OGS inspections and also took part in inspections to minimize issues with landowners.

A total of 40 OGS units were inspected. Appropriate safety equipment was worn during the inspections. However, the inspection procedure did not require entry by personnel into the units which are built within storm sewer access holes. See Figure 3.3.3 for locations of the units. Some locations shown on the map are not yet built or were found to not exist but are included in the figure to ensure that numbering matches Town documents.

Equipment similar to that used to determine depth of sediment in the SWM ponds was used to measure sediment depth in the OGS units. A measurement was taken from the ground surface to the top of sediment and from the ground surface to the bottom of sediment or to the point of refusal of the measuring instrument.

Most were Stormceptor units of varying sizes but there were a few CDS units and one Vortech unit. Table 3.3.3 summarizes the information collected during the inspections. Appendix E contains the full inspection results table.

The need for a clean out is based on sediment depth and the volume of the OGS rather than absolute sediment depth. There were no units that appeared to require immediate clean out, however all units should be monitored and put on a regular maintenance program to ensure optimal performance. Most OGS units inspected had an oily sheen visible on the water surface, although OGS 10 located at Our Lady of The Lake High School contained at least 43 cm of viscous amber liquid in the oil port, perhaps due to a spill or malfunction of the system.

**TABLE 3.3.3
 SUMMARY OF OIL GRIT SEPARATOR INSPECTIONS**

OGS No.	Latitude	Longitude	OGS Model	Sediment Depth (m)	Oil Observations
1	N44.19945	W079.44017	STC 750	0.11	Port access blocked
2	N44.19673	W079.45627	STC 100	0.27	none visible
3	N44.19380	W079.46279	STC 1500	0.49	yes
5	N44.20588	W079.46696	CDS PMSU20_2 0_5	0.50	could not access oil port
7	N44.20934	W079.46682	STC 750	0.15	visible on water surface
8	N44.20233	W079.47814		0.40	visible on water surface
9	N44.21204	W079.46622	STC 3000	0.39*	none visible
10	N44.21294	W079.46131	STC 5000	0.88	43 cm of viscous amber coloured liquid in oil port
11	N44.21458	W079.45887	STC 3000	little to none	visible on surface
12	N44.21336	W079.46366	STC 750	0.34	visible on surface
14	N44.22042	W079.45998	STC 3000	1.66	visible on surface
17	N44.22159	W079.45168	STC 1000	0.02	visible on surface
18	N44.22153	W079.45044	STC 750	0.39	visible on surface
19	N44.22148	W079.44859	STC 1500	0.37	visible on surface
20	N44.22079	W079.44743	STC 6000	little to none	visible on surface
21	N44.22128	W079.44764	STC 2000	little to none	visible on surface
22	N44.22698	W079.44921	STC 2000	0.35	visible on surface
23	N44.22761	W079.44939	STC 2000	1.38	visible on surface
25	N44.22524	W079.46454	Vortechnics 300i	0.15	visible on surface
26	N44.22737	W079.46331	CDS PMSU20_1 5_5	little to none	visible on surface
27	N44.22974	W079.46142	STC 1000	0.15	none visible
28	N44.23427	W079.44973	CDS PMSU20- 25-5	0.30	visible on surface
29	N44.23508	W079.44843	STC 3000	0.50	visible on surface
30	N44.23537	W079.44946	STC 5000	0.23	visible on surface
31	N44.23726	W079.44991	STC 2000	0.61	visible on surface
32	N44.24044	W079.45187	STC 2000	0.45	little to none visible on surface
33	N44.24236	W079.46644	750	0.10	visible on surface
34	N44.24482	W079.46607	1000	0.15	little to none visible on surface
35	N44.24835	W079.48481	750	0.15	visible on surface
36	N44.24897	W079.48522	3000	1.00	visible on surface
37	N44.24956	W079.48425	1500	little to none	little to none visible on surface

OGS No.	Latitude	Longitude	OGS Model	Sediment Depth (m)	Oil Observations
38	N44.24914	W079.48305	300	0.59	oil port capped
39	N44.24928	W079.48217	300	0.30	little to none visible on surface
40	N44.24962	W079.48172	300	0.70	little to none visible
41	N44.25095	W079.48488	3000	1.54	little to none visible on surface
42	N44.25407	W079.48826	1000	0.79	visible on surface
43	N44.24424	W079.47443	2000	0.70	visible on surface
44	N44.22837	W079.46615	1000	0.10	visible on surface
45	N44.22607	W079.45619	750	0.40	little to none visible on surface
46	N44.22781	W079.45070	750	0.07	little to none visible on surface

3.3.5 Reconnaissance of Existing Storm Outfalls

One of the key components of the study is to identify opportunities to capture and treat the storm runoff from currently developed areas which discharge into Lake Simcoe without any water quality control. In preparation, a field reconnaissance was completed to examine and photograph the existing storm outfalls to Lake Simcoe and to identify potential opportunities to retrofit stormwater treatment facilities at or close to those outfalls. Additional opportunities for retrofitting further upstream in each drainage area were also considered and are discussed in later sections.

Town staff had identified the locations of the outfalls and prepared an initial database indicating their type, size and location. Figures 3.3.5 and 3.3.6 show the locations and numbering system used for the 65 discharges identified. The database was expanded by adding photographs and comments related to each outfall regarding its retrofit potential. A print out of the information and the photographs is included in Appendix F.

During the field reconnaissance it became clear that the outfalls could be classified into a limited number of groups in regard to the opportunities for water quality retrofits. These are:

Type 1 – Piped Outfall with Limited Drainage Area and Limited Space at Outfall.

These consist of a catch basin connected to a culvert (typically 450 mm in diameter) which traverses the road and discharges directly into Lake Simcoe. The only type of retrofit which would be applicable would be an oil-grit separator (OGS). In some

cases, it may be feasible to intercept two or more outfalls with a short length of storm sewer and provide a single OGS to treat several outfalls. Photographs 1 and 2 show examples. Many of these cases are located along Lake Drive North.



Photograph 1:
Typical Catch
Basin Inlet Lake
Drive North



Photograph 2:
Typical Outfall
Location Lake
North Drive

Type 2 – Open Ditch/Swale with Limited Space at Outfall

A large proportion of the existing outfalls consist of open ditches with either standing water or running water in them or swales with grass or bulrushes growing in them. In some cases, it may be feasible to improve these outlets by creating “Enhanced Swales.” This would involve widening them, modifying their slope and planting appropriate vegetation to promote settling of sediments. Issues that would have to be addressed would include: potentially negative effects on upstream drainage, compatibility with adjacent land uses, availability of space and private property rights. Photograph 3 shows a typical outfall of this type.



Photograph 3:

Typical Open Ditch Outfall

Type 3 - Piped or Ditch Outlet with Potential Location for Retrofit SWM Facility

In a limited number of locations, there appear to be opportunities for a significant retrofit SWM facility to be constructed. These outfalls are generally located on or adjacent to property owned by the Town or other public agency. For example, a parking lot for a municipal park might afford the opportunity to construct some type of underground device such as a tank or filter to treat the parking lot runoff. Photographs 4 and 5 show an example of an outfall with a potential site nearby.



Photograph 4:
Major Storm Outfall



Photograph 5:
**Potential Site for
SWM Retrofit
Facility Adjacent to
Major Outfall**

Type 4 - No Potential Retrofit Opportunity

In a small proportion of the cases, there appears to be no potential to retrofit stormwater quality treatment at the outfall. This is generally because of a total lack of space, e.g. a narrow ditch running along the property boundary between two houses. In some of these cases, other opportunities may exist further upstream. These were also investigated and are discussed later in this report.

As noted, the Town's preliminary database of information related to the existing outfalls has been updated to include the additional information gathered through the field reconnaissance. This includes the type designation described above.

After this initial field reconnaissance was completed, further investigation was done to determine the feasibility and benefit of implementing the potential SWM quality retrofits. This information was used to classify the various opportunities and was used to group them into alternative scenarios to be investigated. This is discussed in detail in Section 4.

3.4 NATURAL ENVIRONMENTAL RESOURCES

The existing natural environmental resources which may affect the development of a stormwater management master plan or conversely be affected by the implementation of such a plan are described in the following sections.

3.4.1 Fish Community

Lake Simcoe is considered a highly important water body from a fisheries viewpoint. It has a long history as both a recreational and commercial fishery. It has both warm and coldwater fisheries. The latter has declined over the past decades and is one of the most significant reasons for the formulation of the Lake Simcoe Protection Plan and for the preparation of SWM Master Plans such as the present document. The following information regarding Lake Simcoe has primarily been obtained from the document "Natural Heritage System for the Lake Simcoe Watershed," LSRCA, 2007.

Coldwater Fishery

Lake Simcoe has historically been known for populations of lake trout (*Salvelinus namaycush*) and lake whitefish (*Coregonus clupeaformis*). At present, these are sustained by annual stocking programs as indicated by angler catch surveys and fall trap-netting results. Other coldwater species in the lake include: lake herring (*Coregonus artedii*), rainbow smelt (*Osmerus mordax*), brook trout (*Salvelinus fontinalis*), mottled sculpin (*Cottus bairdi*) and burbot (*Lota lota*) (LSEMS 2003). Lake Simcoe whitefish is listed as "Threatened" by the MNR and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Warmwater Fishery

Today, Lake Simcoe supports a relatively stable population of warm water fish such as largemouth bass (*Micropterus salmoides*), brown bullhead (*Ameiurus nebulosus*),

pumpkinseed (*Lepomis gibbosus*) and rock bass (*Ambloplites rupestris*). The effects of some rather well known introduced exotic species such as the zebra mussel (*Dreissena polymorpha*), black crappie (*Pomoxis nigromaculatus*), and round goby (*Neogobius melanostomus*) have not necessarily been realized to date (LSEMS 2003).

Fish community studies have been conducted in the Maskinonge River and at points within its tributaries since 1990. Most studies have been done by the Ministry of Natural Resources although some data has come from sampling done by the LSRCA. The twenty-five species have fish that have been found in the Maskinonge River since 1990 and are listed in Table 3.4.1. None of the reported species are rare or endangered. The Maskinonge is primarily warmwater habitat. There are some coldwater habitat areas, however they are primarily in the southern headwaters and are far removed from the Keswick area investigated in this study. Furthermore, no coldwater fish species have been found in these areas.

Table 3.4.1
Fish Species in Maskinonge River

Common Name	Scientific Name
Bowfin	<i>Amia calva</i>
Rainbow Smelt [^]	<i>Osmerus mordax</i>
Northern Pike	<i>Esox lucius</i>
Central Mudminnow	<i>Umbra limi</i>
Common White Sucker	<i>Catostomus commersoni</i>
Common Carp [*]	<i>Cyprinus carpio</i>
Golden Shiner	<i>Notemigonus crysoleucas</i>
Emerald Shiner	<i>Notropis atherinoides</i>
Spottail Shiner	<i>Notropis hudsonius</i>
Spotfin Shiner	<i>Cyprinella spiloptera</i>
Bluntnose Minnow	<i>Pimephales notatus</i>
Fathead Minnow	<i>Pimephales promelas</i>
Blacknose Dace	<i>Rhinichthys atratulus</i>
Creek Chub	<i>Semotilus atromaculatus</i>
Brown Bullhead	<i>Ameiurus nebulosus</i>
Brook stickleback	<i>Culaea inconstans</i>
Trout-Perch	<i>Percopsis omiscomaycus</i>
Rock Bass	<i>Ambloplites rupestris</i>
Pumpkinseed	<i>Lepomis gibbosus</i>
Largemouth Bass	<i>Micropterus salmoides</i>
Black Crappie [^]	<i>Pomoxis nigromaculatus</i>
Yellow Perch	<i>Perca flavescens</i>
Walleye	<i>Sander vitreus</i>
Johnny darter	<i>Etheostoma nigrum</i>
Mottled Sculpin	<i>Cottus bairdi</i>

^{*} = non-native invasive species

[^] = non-native species

Note: This list is Table 6-2 in the 2010 LSRCA report entitled “Maskinonge Subwatershed Study”.

3.4.2 Terrestrial Features

The terrestrial features of the Maskinonge River subwatershed were of interest in preparing the Keswick stormwater management master plan. The terrestrial features of the watersheds are important as they provide habitat and they must be respected by any measures proposed in the plan and may also provide opportunities to redress some of the urban stormwater impacts by enhancing their form or function.

Wetlands

There are very few wetlands, provincially significant or otherwise, in the urbanized area of Keswick that is being investigated in this study however approximately 8.7% of the overall subwatershed is wetland with 6.7% being provincially significant. Approximately 70% of these wetlands are swamps (flooded seasonally or for long periods of time an primary vegetation of shrubs or trees) and 25% are marshes (periodically or permanently covered by standing water or slow moving water and primary vegetation that includes rushes, cattails and sedges).The other 5% are made up of wetlands that have been identified through aerial photography but have not been interpreted at the community level.

Woodlands

Again, because this study is focused on the urbanized area of the community of Keswick, there are very few woodlands within the study area, however over the entire Maskinonge River subwatershed approximately 13% is covered with woodlands. The majority of the woodland coverage is classified as deciduous forest followed by mixed forest and deciduous swamp. Table 3.4.2 shows the breakdown of woodland coverage by type.

**Table 3.4.2
Woodland Cover by Type**

Woodland Type	Woodland Cover			
	Area in sub'shed (ha)	Cover within subwatershed (%)	Cover by woodland type (%)	Percentage of woodland type of the Lake Simcoe watershed
Cultural Plantation (CUP)	28.2	0.4	3.4	0.5
Cultural Woodland (CUW)*	59.2	0.9	7.2	1.5
Conifer Forest (FOC)	40.9	0.6	5.0	0.9
Deciduous Forest (FOD)	241.5	3.8	29.5	1.4
Mixed Forest (FOM)	189.3	3.0	23.1	1.4
Conifer Swamp (SWC)	12.6	0.2	1.5	0.3
Deciduous Swamp (SWD)	179.2	2.8	21.9	1.4
Mixed Swamp (SWM)	67.6	1.1	8.3	0.6
Total	818.5	12.8		1.2

*This category includes substantial hedgerows which are continuous with other natural features (ca. 24 ha).

3.4.3 Fluvial Geomorphology

The fluvial geomorphology of the Maskinonge River has been studied by Parish Geomorphology and overall they noted that the subwatershed was fairly stable over their 43 year study period (1959-2002). However there have been some changes in the Keswick area between the confluence with Lake Simcoe and Woodbine Avenue mostly owing to increased development with new boat slips and channelization. Both desktop analysis and field reconnaissance were part of this study and the field reconnaissance included a Rapid Geomorphic Assessment (RGA) which evaluates the occurrence of aggradation, degradation, widening, and planform adjustment. The primary process in the four sites visited was aggradation and three of the four sites were noted as Transitional (showing signs of stress and may soon undergo an adjustment) while one was In Regime (in good condition; in a state of dynamic equilibrium). A Rapid Stream Assessment Technique (RSAT) was also conducted on the same four reaches, which assesses the overall stability of the reach by evaluating factors such as channel dimension, substrate composition of riffles and pools, and quality of available habitat. The reaches studies showed low to moderate stability ratings.

3.4.4 Water Quantity Characteristics

3.4.4.1 Hydrology

No studies could be found that assess the surface hydrology of the Maskinonge River subwatershed, although there are many existing studies that review the groundwater hydrology.

In 2006, the LSRCA placed a streamflow gauge in the Maskinonge subwatershed and recorded that the river dried up in the summers of 2006 and 2007. Historic data does not exist to determine whether this is part of a trend or a new phenomenon. However, long term residents have reported that this drying up is not something that has happened in the past. Additionally, there was evidence of daily water taking and downstream damming. Although these factors on their own can not account for the river drying up they can be considered as contributing factors. Changes in land use and increasing imperviousness are considered as further contributing factors to the change in streamflow. Climactic records for the last 40 years do not show any trends ruling out changes in precipitation patterns.

Measurements taken in the summers of 2004 and 2005 by the LSRCA indicate no baseflow to the system except in the headwater portion of the southern reach. Additionally, this flow was very low and this section of the river has been known to go dry in late summer. This indicates that groundwater contributions is low or water use is greater than the capacity of the river or wetland destruction has reduced the systems ability to store water or a combination of all of these factors. It is also likely that changes in land use such as increasing imperviousness has reduced the groundwater recharge capacity and consequently the baseflow.

3.4.5 Water Quality Characteristics

3.4.5.1 Surface Water

There are 12 provincial water quality monitoring stations in the Lake Simcoe watershed and one is located in the Maskinonge River subwatershed just upstream of the urban community of Keswick. Samples are collected 8 times a year during the ice-free period and are analysed for 32 different parameters and assessed using the Provincial Water Quality Objectives.

Table 3.4.5.1 shows the water quality monitoring data as presented in the 2010 Maskinonge River Subwatershed Plan by the Lake Simcoe Region Conservation Authority (LSRCA). Levels of phosphorus in most Lake Simcoe subcatchments have

been measure to be higher than the Provincial Water Quality Objectives (PWQO). Iron is also above PWQO levels in a few subwatersheds, including the Maskinonge.

However, there are no monitoring stations near the mouth of the Maskinonge and as a result this data does not account for any effects of the urbanized Keswick area on which this study is focused. These monitoring stations are largely reflective of the contributions of upstream agricultural lands.

Table 3.4.5.1
Surface Water Quality Data in Lake Simcoe Watershed (Source: LSRCA)

Monitoring Station	Current Conditions (2002 – 2008) Percentage of samples meet objectives Orange = median Concentration > objective Green = median Concentration < objective								Trends Analysis (1965-2008) Orange = Increasing/ Blank = no significant trend/ Green = Decreasing								
	Chloride	Phosphorus	Nitrate	TSS	Iron	Zinc	Cadmium	Copper	Chloride	Phosphorus	Nitrate	TSS	Iron	Zinc	Aluminium	Cadmium	Copper
West Holland River	100	0	94	89	69	98	65	98	Orange	Green	Orange						
Tannery Creek	94	10	100	77	51	94	69	92	*		Green						
Mt. Albert Creek	100	10	100	88	61	100	61	100	Orange		Orange		Historical data n/a		Historical data n/a		Historical data n/a
Beaver River	100	73	98	92	88	98	65	100	Orange		Orange		Historical data n/a		Historical data n/a		Historical data n/a
Pefferlaw	100	43	98	96	90	98	78	100	Orange		Orange		Historical data n/a		Historical data n/a		Historical data n/a
Lovers Creek	100	54	98	92	75	100	73	100	Orange		Orange		Historical data n/a		Historical data n/a		Historical data n/a
Schomberg	100	2	100	78	38	98	80	100	Orange		Green	n/a					
Maskinonge River	100	0	100	95	46	98	64	100		Orange	Orange	Orange					
East Holland	88	0	100	37	8	82	69	82	Historical data n/a								
Black River	100	20	100	96	76	98	65	98	Historical data n/a								
Hawkestone Creek	100	76	100	98	92	100	72	100	Historical data n/a								
Uxbridge Brook	100	29	98	98	78	98	67	98	Historical data n/a								
Objective	210 mg/L	0.03 mg/L	2.9 mg/L	30 mg/L	300 µg/L	20 µg/L	0.5 µg/L	5 µg/L									

Note: This is Table 4-2 of report, “Maskinonge Subwatershed Plan,” Lake Simcoe Region Conservation Authority, 2010.

3.4.5.2 Groundwater

There are no groundwater quality monitoring sites in the Maskinonge River subwatershed however there is one in the East Holland River subwatershed, which is close to the border of the two subwatersheds that should provide a good measure of groundwater quality for the Maskinonge River subwatershed. The only reported issue is that some samples exceed the standards for sodium for restricted diets however the areas where these exceedances are noted would not be used for drinking water.

3.4.6 Surficial Soils/Geology/Hydrogeology

The surficial soils and geology of a watershed play an important role in determining its hydrologic response. Where soils are impermeable, direct surface runoff rates tend to be higher and low flows tend to be lower. Where soils are permeable (e.g. sand and gravels) the watershed response tends to be less “flashy” and baseflows tend to be higher and more sustained. These trends will, of course, be modified by land uses which change the watershed’s imperviousness. The underlying geology and the associated hydrogeological system also influence the watershed response depending upon how local and regional aquifers interact with the surface water courses. For example, deep regional aquifers which are recharged many kilometres from a local stream may be intersected in its watershed and provide sustained baseflows which would not be present from only local recharge.

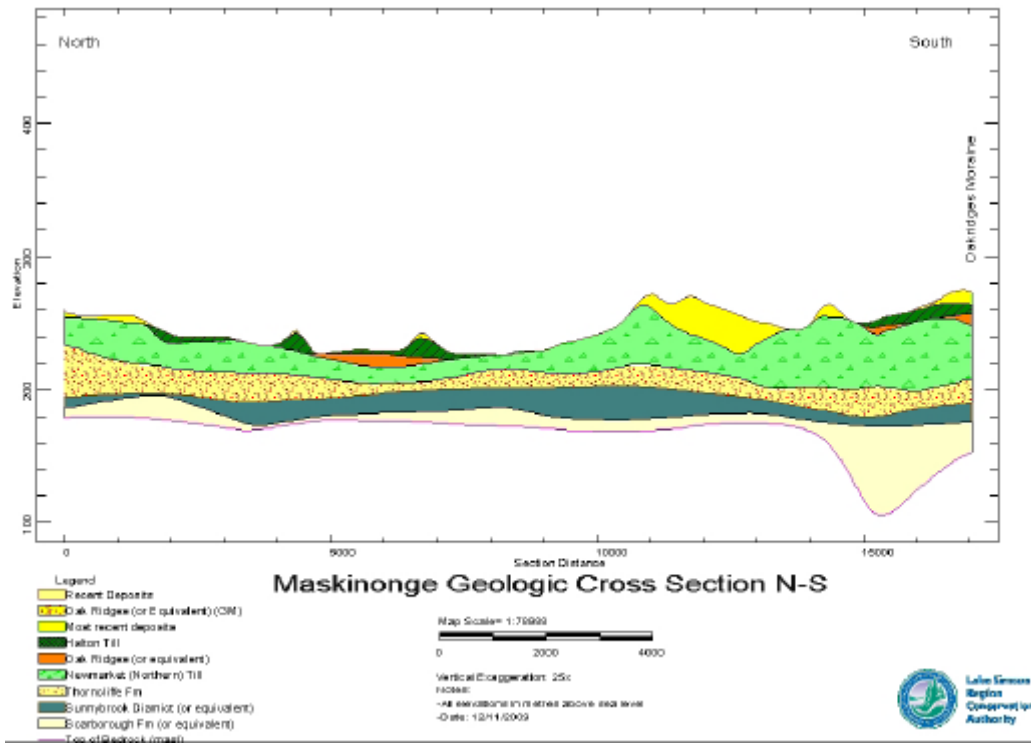
The Maskinonge River subwatershed is underlain by various geologic layers and has three major aquifer systems. Flow is typically from the higher areas to the south in the Oak Ridges Moraine to the lowlands of the river and other watercourses. Figure 3.4.6 is a geologic cross section from north to south showing the various components of the hydrogeologic system.

The conceptual model layers from youngest to oldest are:

- Surficial deposits and/or weathered Halton Till
- Halton Till or Kettleby Till
- OakRidges Aquifer complex and/or Mackinaw Interstadial deposits
- Newmarket Till
- Thorncliffe Formation deposits
- Sunnybrook Drift
- Scarborough Formation deposits
- Weathered bedrock

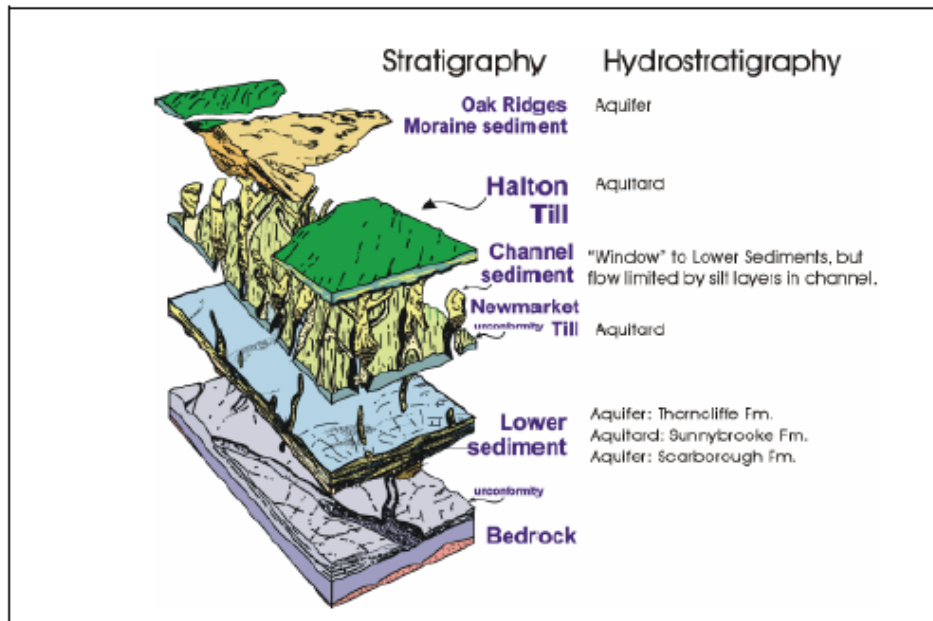
Figure 3.4.7 shows the stratigraphy of the layers and illustrates the aquifer and aquitard layers.

Figure 3.4.6
Maskinonge Geologic Cross Section N-S



SOURCE: Earthfx & Gerber, 2008

Figure 3.4.7
Geologic Survey of Canada Stratigraphic Framework in Oak Ridges Moraine Region



SOURCE: (Sharpe et al., 1999)

3.5 SOCIO-ECONOMIC ENVIRONMENT

3.5.1 Existing Land Use

Land use within the study area varies, but is dominated by urban land uses. Figure 3.5.1 indicates the distribution of land uses from agricultural/open space through various types of residential land use to roadway, commercial and industrial uses. Appendix G provides further detail in a table listing the land use breakdown for each catchment within the study area. The importance of mapping and quantifying this information is that each land use has a different potential to generate storm runoff and associated pollutants. Stormwater management measures must account for these differences in order to provide the degree of control and treatment desired.

3.5.2 Recreational Uses

Recreation and the use of Lake Simcoe is a very important for many residents of Keswick. In fact this is a key aspect of the community, especially for the residents who live on the shores of Lake Simcoe. Most of the lakefront is dotted with beach association owned property that provides beach access and recreational space for local residents. There are also some public marinas and parks, all of which are important to the overall well-being of the community of Keswick and which rely to a great extent on the health of Lake Simcoe.

4 PHASE 2 - EVALUATION OF ALTERNATIVES

4.1 GENERAL

As part of the Class Environmental Assessment process, it is necessary to consider alternative solutions to the identified problem, to evaluate them and ultimately select a preferred alternative. This method was originally developed to provide transparency in the design process for specific municipal projects such as sewage treatment plants, roads or sanitary landfill sites. In terms of a master planning project such as the current one, the process is still applicable but the identification of “alternatives” is somewhat more abstract. Since a Master Plan can contain dozens or even hundreds of individual components for which there may be multiple solutions, an approach is needed which groups them as classes of solutions designed to achieve the plan’s goals. The method used in this study is described in Section 4.4.

In order to provide consistency and transparency in the evaluation process, each alternative must be evaluated using a set of predetermined criteria. These criteria cover the areas of environmental, economic and social impacts and the effectiveness of the plan in achieving the goals and objectives of the project. The following section describes the evaluation framework used in this study. The evaluation process involved the identification of a long list of potential alternatives, screening of the list to determine which might be technically feasible in the Municipality of Keswick, formulation of alternative scenarios from the screened list and evaluation of those alternatives. Section 4.3 discusses the long list alternatives while Section 4.4 describes the evaluation process in detail.

4.2 EVALUATION FRAMEWORK

The evaluation framework used consists of identifying how successful an alternative solution would be in meeting the plan’s targets including a set of parameters which identified whether the alternative would have any potential impacts which might occur as a result of the implementation of that alternative. By ranking the alternatives in terms of their achievement of the targets and their potential impacts, an overall evaluation of the potential solutions was completed. This provided a basis for selection of a preferred alternative and development of the recommended SWM Master Plan for the community of Keswick.

The plan’s target was to minimize the total phosphorus loading to Lake Simcoe from the existing developed areas from the community of Keswick.

The factors used to evaluate the potential impacts of alternatives included the following:

1. ***Economic*** – the estimated capital costs of alternatives were compared. The long term operation and maintenance costs were also qualitatively compared.
2. ***Environmental*** – the potential impacts of the alternatives on the aquatic and terrestrial environmental systems were qualitatively compared.
3. ***Social*** – the potential impacts of the alternatives on social factors such as recreation, disturbance during construction and aesthetics were compared.

4.3 LONG LIST OF ALTERNATIVES

A long list of stormwater management alternatives was developed which included possible locations for new SWM facilities as well as potential upgrades to existing facilities in order to minimize the total phosphorus loading to Lake Simcoe.

Opportunities for new facilities were identified through analysis of aerial photographs as well as field visits to confirm suitability. Many locations were identified during the Phase 1 investigations of the outfalls to Lake Simcoe. Additionally, retrofit opportunities identified in the 2007 LSRCA Lake Simcoe Basin SWM and Retrofit Opportunities report were further investigated and included in the long list of alternatives. See Table 4.3 for the long list of opportunities. See Appendix K for examples of phosphorus removal facilities. These facilities could be applied to existing as well as green field developments.

Benefits provided by a proposed facility were evaluated on a catchment basis. In some cases identified opportunities overlapped others already present or proposed in the same catchment. In this situation the effects of the most effective measure was accounted for and the other ignored to ensure there was no “double counting” of phosphorus removal. The catchment areas are based on the catchments presented in the 2007 LSRCA report mentioned above as well as the catchments in the 1980 stormwater management study completed by Project Planning Associates Limited provided by the Town of Georgina. This data was combined and input into a GIS database. The catchments used can be seen in Figures 4.4.1.1 through 4.4.1.5.

4.4 EVALUATION OF POSSIBLE CONTROLS

The applicability of any or all of proposed facilities or upgrades requires a technical screening evaluation to determine what opportunities are actually feasible to implement. For example, certain conveyance measures such as bioswales require suitable soils that have medium to high levels of infiltration capacity. End-of-pipe measures such as extended detention wet ponds require open space where required levels of storage can be constructed.

Once the screening evaluation was completed, a technical evaluation of the effectiveness of the measures to achieve the desired objectives was required, e.g. the ability to reduce total phosphorus loading to Lake Simcoe. The penultimate step was to estimate the costs of implementing the technically feasible options. The final aspect to be considered was the potential socio-environmental impacts of the alternatives.

One difficulty with such an approach at a Master Plan level is that there are many, possibly hundreds of, different types of stormwater management that can potentially be implemented in numerous geographical locations. This produces an almost infinite number of “alternatives” which could be feasible. This leads to a practically intractable evaluation process. Hence some form of simplification was required. The approach used was to group potential control measures into classes based upon their type and to evaluate a series of “scenarios” based upon the progressive implementation of those classes. The specifics of the scenarios will be described below.

4.4.1 Step 1: Screening of Opportunities

Once the long list of opportunities was developed it became necessary to classify them. A number were removed from further consideration for various reasons including private property, no contributing drainage area, built over since air photo or initial consideration. Others were classed as retrofits to existing facilities.

The two final classifications were readily available new opportunities and maximized new opportunities. Readily available meant that these opportunities would result in limited permanent and/or temporary disruption of the existing land use and were highly recommended. These opportunities were seen as able to be implemented with fewer roadblocks than the opportunities classed as maximized new opportunities. The maximized new opportunities are opportunities that are technically feasible but will likely result in significant, permanent and/or temporary disruption of existing land

use. For example, some of these are in swampy and/or treed areas close to the Maskinonge River and construction may disturb natural areas that would better serve the purpose of reducing phosphorus removal to Lake Simcoe remaining as is. Other concerns are the opportunities identified in private park lands on the shores of Lake Simcoe belonging to the various beach associations. These were not considered readily available as it was thought that even to improve the condition of Lake Simcoe these organizations would not be willing to give up their lands to a wet pond. However, there is the possibility that they may be temporarily willing to give up the enjoyment of land temporarily to facilitate construction of an underground facility.

Once the long list of opportunities was classified, they were grouped into various alternatives to allow the effects to be analyzed and compared. The alternatives are shown in Figures 4.4.1.1 through 4.4.1.5 and are as follows:

Alternative 1 – Do Nothing

This is the base case or “do nothing” scenario. This alternative takes into account the phosphorus removal effects of the existing stormwater management facilities (ponds, oil grit separators) and sets the baseline that the other alternatives are compared to.

Alternative 2 – Standard Retrofits

This considers the five existing ponds which were recommended as retrofit opportunities in the long list. It considers standard retrofits only, which means upgrading to current design standards.

Alternative 3 – Enhanced Retrofits

Enhanced retrofits builds on the standard retrofits in alternative 2 by including enhanced phosphorus removal for all existing stormwater management facilities. This enhanced retrofit would be achieved by filtering runoff through a phosphorus absorbing medium.

Alternative 4 – Readily Available New Opportunities

This scenario includes all upgrades and retrofits considered in the previous alternatives as well as the long list opportunities classed as readily available (items 1-12 in Table 4.4.1). Additionally it includes enhanced swales, sand filters and/or other similar facilities specially designed to remove phosphorus at or just upstream of the storm outlets to Lake Ontario, the locations of which are illustrated in Figures 3.4.5 and 3.4.6.

Alternative 5 – Maximized New Opportunities

Alternative 5 is alternative 4 with the addition of the maximized new opportunities (items 13-23 in Table 4.4.1) as described above.

4.4.2 Step 2: Technical Assessment of Alternatives

The five different alternatives were analyzed to determine the theoretical annual phosphorus loading to Lake Simcoe. The total phosphorus loading for each alternative was calculated in a spreadsheet on a subcatchment basis. Subcatchments that had a treatment facility also had an annual phosphorus reduction calculated. The spreadsheets for each alternative are in Appendix H. Table 4.4.2.1 summarizes the loading and reduction for each alternative.

**Table 4.4.2.1
Phosphorus Loading Factors**

Alternative	Total Phosphorus Loading (kg/yr)	Phosphorus Reduction (kg/yr)
1 – Do Nothing	1378	0
2 – Standard Retrofits	1327	51
3 – Enhanced Retrofits	1220	158
4 – Readily Available New Opportunities	834	544
5 – Maximized New Opportunities	737	641

The total phosphorus loading from each catchment was calculated based on the land use (determined using satellite photos and GIS) using average annual precipitation, runoff coefficient and an event mean concentration (EMC) to obtain a phosphorus loading factor. An average annual precipitation of 850 mm was used which was an average of the values from weather stations in the Keswick area available from Environment Canada Current Climate Normals. As part of the scope of work, the IDF curves in the Town of Georgina’s Development Design Criteria were reviewed and recommendations can be found in Appendix I.

The EMCs were obtained from an in depth literature review, the results of which were published in 2003 by the City of Toronto as part of the Toronto Wet Weather Flow Management Master Plan. Table 4.4.2 shows the land use categories, runoff coefficients, EMCs, and phosphorus loading factors used in the overall phosphorus loading calculations.

Table 4.4.2.2
Phosphorus Removal Percentages

Land Use Category	Runoff Coefficient	EMC (mg/L)	Loading (kg/ha/yr)
Residential	0.45	0.36	1.377
Commercial	0.80	0.25	1.700
Industrial	0.80	0.30	2.040
Educational/Institutional	0.60	0.36	1.836
Open Space (park)	0.25	0.36	0.765
Forest	0.15	0.12	0.153
Agricultural	0.25	0.40	0.850
Roads	0.90	0.25	1.913

Phosphorus removal percentages for various stormwater management facilities were obtained from a literature review as well which included data in the Toronto Wet Weather Flow Management Master Plan mentioned above. For facilities considered that specifically targeted phosphorus removal, information provided by Imbrium, distributors of phosphorus removal media and systems, was considered. Table 4.4.2.2 shows the phosphorus removal percentages used in the overall calculations.

Table 4.4.2.3
Phosphorus Loading Reduction Values

	% PHOSPHORUS REMOVAL	
	Current Facilities	Enhanced Phosphorus Removal
Wet Pond Level 1	65	80
Wet Pond Level 2	57	80
Dry Pond	20	80
Oil Grit Separator	30	50
Enhanced OGS	n/a	60
Enhanced Swale	n/a	40

The above values are somewhat conservative especially the enhanced OGS and the enhanced swale. There are presently filters and media that can remove upwards of 80% of total phosphorus. However, when it comes to the detailed design some sites may present certain physical limitations for the installation of these facilities. There is a strong possibility that when the detailed design begins, there will be other available facilities to target phosphorus that will work on the sites that presented difficulties using currently available technologies.

4.4.3 Step 3: Cost Estimates for Alternatives

An approximate estimate of the capital costs of implementing the various scenarios was completed to facilitate an order-of-magnitude cost comparison between them. These estimates were based upon unit costs for different types of stormwater management controls developed during the City of Toronto WWF study. They were increased slightly to allow for inflation since they were originally computed (2003). Approximate costs for facilities providing enhanced phosphorus removal used information provided by Imbrium². Appendix J includes a spreadsheet that shows the detailed cost estimate for each alternative.

Table 4.4.3 shows a summary of the estimated costs in millions, for each of the control scenarios discussed above.

**Table 4.4.3
Order of Magnitude Cost**

Alternative 1 - Do Nothing	\$0
Alternative 2 - Standard Retrofits	\$3M
Alternative 3 – Enhanced Retrofits	\$9M
Alternative 4 – Readily Available New Opportunities	\$19M
Alternative 5 – Maximized new Opportunities	\$34M

² Note: MMM gratefully acknowledges Imbrium’s assistance in providing the referenced information. However, use of information from Imbrium does not imply endorsement of their products or a recommendation that these specific products should be installed. Equivalent products from other manufacturers should be given equal consideration at the design/implementation stage.

5 PHASE 2 – SELECTION OF PREFERRED ALTERNATIVE

5.1 GENERAL

The preferred alternative will be the most cost-effective in achieving the objectives of the plan (reduction of phosphorus loading to Lake Simcoe) while minimizing any adverse environmental impacts.

5.2 CRITERIA FOR SELECTION OF PREFERRED ALTERNATIVE

Each of the five alternatives was ranked based on a number of factors. The level to which each alternative meets the objective of the plan was determined by the reduction of the total phosphorus loading achieved over and above that achieved in the “do nothing” or base case presented in Alternative 1. The goal is “to improve the quality of storm runoff that discharges to Lake Simcoe to contribute to achieving the goals of the Lake Simcoe Protection Plan.” In accordance with this project’s Terms of Reference, lands currently under development or slated for future development are not included in the analysis as it is assumed that these areas will contain phosphorus removal facilities that will meet the goals of this plan. The order of magnitude capital cost as discussed in the previous section was another main factor used to rank the various alternatives in order of suitability.

Additionally, a group of factors that captured concerns regarding social and environmental implications were considered in the evaluations. The difficulty of implementing each alternative was considered and evaluated based upon accessibility and the extent to which private lands are affected and therefore must include agreements with landowners prior to implementation. For example, existing publicly owned facilities can be readily modified as they do not need the agreement of external parties. In ranking the impact on community facilities the level of disruption (either temporary or permanent) to existing uses of affected lands was reviewed. For example, a public park would be highly affected if modified to a wet pond, whereas it would only be moderately affected if an underground facility was constructed and the original use re-established. The future maintenance requirements for each scenario were also considered and this was generally proportional to the number of facilities proposed which would eventually have to be maintained by the municipality.

5.3 RECOMMENDED STORMWATER MANAGEMENT MASTER PLAN

The recommended alternative is Alternative 4 – Readily Available Opportunities, as it provides the best balance between cost, effectiveness, and minimization of negative social and environmental impacts. Table 5.3 shows the ranking by category for each alternative.

Table 5.3
Ranking of Alternatives

Evaluation Factors Considered	Alternatives Evaluated ¹				
	1	2	3	4	5
	Do-Nothing	Standard Retrofits	Enhanced Retrofits	Readily Available New Opportunities	Maximized New Opportunities
Additional Phosphorus Load ² Reduction (kg/yr)	0	51	158	544	641
Estimated Capital Cost (\$)	\$0	\$3 million	\$9 million	\$19 million	\$34 million
Degree to Which Alternative Meets Study Goal ³	None (0% reduction)	Low (4% reduction)	Medium (11% reduction)	High (39% reduction)	High (47% reduction)
Difficulty of Implementing Alternative ⁴	None	Low	Medium	Medium	High
Impact on Community Facilities ⁵	None	Low	Medium	Medium	High
Impact of Construction on Natural Environment	None	Low	Low	Medium	Medium
Future Maintenance Requirements ⁶	None	Low	Medium	High	High
Construction Impacts (Noise, Dust, Traffic)	None	Low	Medium	High	High
Ranking of Benefit vs Cost/Impact	5th	4th	3rd	1st	2nd

5.4 FUNDING OF THE PLAN

The recommended alternative would require funds both for initial construction as well as continuing maintenance. It is anticipated that the recommended alternative will be constructed facility by facility as funds become available. Potential sources of funding to supplement funds from the municipal budget include:

- 1. *Lake Simcoe Protection Plan (LSPP) Funding*** – it is understood that up to \$30 million of funding has been allocated towards the implementation of the LSPP. This would be the most obvious source of funding for the works recommended as part of this Plan.
- 2. *In Lieu Payments*** – funds could be collected from parties involved in redevelopment or infill development which for technical reasons could not provide on-site stormwater management to the levels required by the City’s policies. These funds could be used to construct “compensating” SWM facilities from those recommended in this Plan.
- 3. *Green Infrastructure Fund*** – this federal fund announced in May 2009 will provide \$1-billion over five years. The fund focuses on large scale, strategic infrastructure projects and winning projects will be supported on a cost-shared basis. This fund description does not explicitly list stormwater management infrastructure, however it may be possible to include these projects under the eligible wastewater treatment category. As of summer 2010, there is no deadline for submissions.
- 4. *Stormwater Levy*** – a specific levy could be added to the municipal property taxes to fund stormwater management infrastructure. The rate could be based upon the contributing imperviousness of different types of properties. Similar programs are currently operational in other North American cities including Regina, Saskatchewan and Portland, Oregon.
- 5. *Stormwater Utility*** – the Town could form a separate Stormwater Utility to develop and manage all stormwater related infrastructure. This could be funded by a separate charge on the municipal tax bill and through charges to developments connecting to the stormwater infrastructure.

APPENDIX A

Study Terms of Reference

APPENDIX B

Documentation of Public Consultation

APPENDIX C
Documentation of Existing SWM Pond
Sediment Survey

APPENDIX D

Documentation of Existing SWM Pond Sediment Sampling

APPENDIX E

Documentation of Existing OGS Survey

APPENDIX F
Documentation of Field Reconnaissance of
Existing Storm Outlets

APPENDIX G

Land Use Data

APPENDIX H

Phosphorus Loading Calculations

APPENDIX I

IDF Curve Analysis

APPENDIX J

Cost Estimate Calculations

APPENDIX K

Phosphorus Removal Facilities