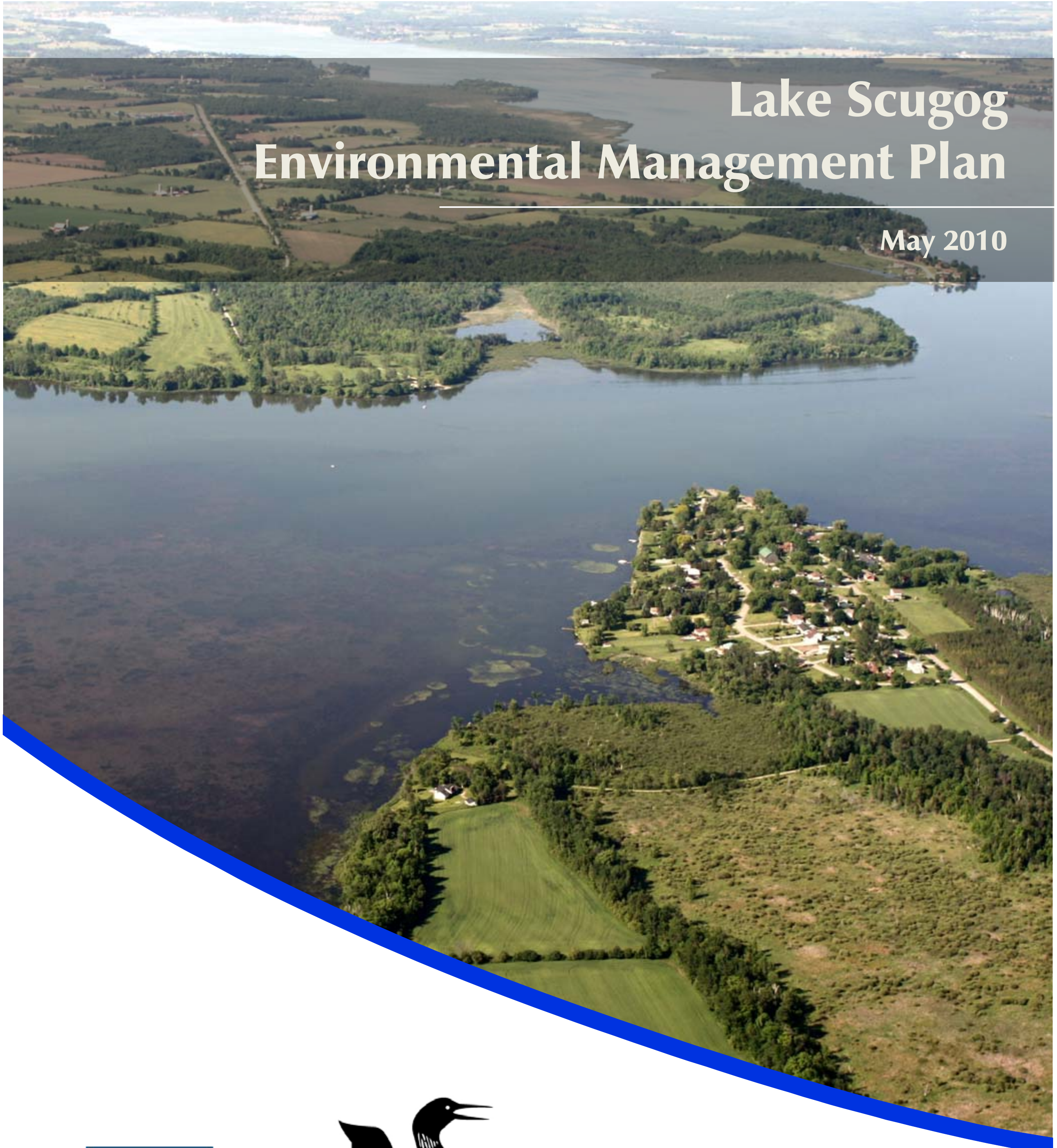
Lake Scugog Environmental Management Plan

May 2010



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About Kawartha Conservation

Kawartha Conservation is a non-profit, environmental agency that helps ensure the conservation, restoration and responsible management of water, land and natural habitats through programs and services that balance human, environmental and economic needs.

Established in 1979 under the Ontario *Conservation Authorities Act* (1946), we are governed by the municipalities that overlap the natural boundaries of our watershed. These municipalities include the City of Kawartha Lakes, the Township of Scugog (Region of Durham), the Township of Brock (Region of Durham), the Municipality of Clarington (Region of Durham), the Township of Cavan Monaghan, and the Township of Galway-Cavendish & Harvey.

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Acknowledgements

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Executive Summary

The Story of Lake Scugog

As one becomes familiar with Lake Scugog and the surrounding area, the lake's importance and connection to the local community become obvious — historical, social, recreational, economic, emotional — a place to live. Lake Scugog is "their lake".

This lake is an important natural resource for the Region of Durham, the City of Kawartha Lakes and the province as a whole. Situated within 90 minutes of Canada's largest population centre, Lake Scugog is a major driver of the local economy. As a demonstration, the comparison of two lakes provides meaningful background. Lake Simcoe, the largest lake partially within the Greater Toronto Area (GTA), has a surface area of 722 square kilometres (km^2), provided over 560,000 fishing hours in 2000 (Ministry of Natural Resources statistics), and is estimated to contribute over $200 million annually to the region's economy. Although less than one-tenth the size, Lake Scugog provided a little over 200,000 fishing hours that same year, although fishing intensity has decreased since then. Lake Scugog, together with the other major lakes in the Kawartha Conservation watershed, provides over 500,000 hours of fishing opportunities in most years.

Our estimates indicate that municipalities in the watershed receive approximately $10-15 million annually from tourism and recreational activities centred around the lake. In addition, the multiple shoreline residences and small lakeside communities support many local businesses, for example, landscaping, home renovation, and property management as well as commercial enterprises in the Port Perry and Lindsay areas.

In addition, the lake and its contributing watershed are significant on a landscape basis. Lake Scugog is situated primarily in the Township of Scugog (Region of Durham) and the City of Kawartha Lakes, with portions of the Township of Brock and the Municipality of Clarington within its watershed. It is an important headwater lake for Sturgeon Lake, the entire Kawartha Lakes system, and the Trent-Severn Waterway that eventually empties into Lake Ontario. Water flowing from Lake Scugog, via the Scugog River, is a primary source of drinking water for the residents of the Town of Lindsay.

All lakes age naturally over time. ***Eutrophication*** is a process whereby water bodies, such as lakes, estuaries, or slow-moving streams, receive sediments and excess nutrients from surrounding lands that stimulate increasing amounts of plant growth. Lake Scugog illustrates the cumulative impacts of a century or more of human settlement and development. The construction of a downstream dam in Lindsay in the 1830s caused a four-foot rise in water levels, creating a shallow, man-made impoundment and making Lake Scugog a navigable waterway. The lake is primarily comprised of flooded low-lying areas adjacent to two main watercourse channels on both sides of Scugog Island, with several deeper areas. These physical characteristics, combined with the highly productive lands around the lake, make Lake Scugog very susceptible to the cumulative effect of ongoing human influences. The process of eutrophication, accelerated by an increasing level of human activities in a watershed, has the ability to create large stretches of marsh in the shallower areas of such lakes in two or three human generations.

Although historical documentation exists that indicates abundant aquatic vegetation has been a concern from its earliest years, long-time lake users perceive greater problems and significant changes in their lifetimes. The symptoms of accelerating eutrophication and other human-caused factors include sedimentation and excessive aquatic vegetation growth, certain types of habitat loss and degradation, a wave of invasive species (aquatic plants, fish and invertebrates), and the unknown effects of climate change, still to be determined. In addition to the increasing aquatic vegetation growth in the lake, toxic algae (cyanobacteria) blooms, with the potential to pose a substantial health risk, may appear. Others are concerned about the decline of certain fish populations, such as walleye, while other species seem to be taking their place.

The Lake Scugog Environmental Management Plan

To address the eutrophication concerns, the Region of Durham funded Kawartha Conservation to initiate the Lake Scugog Environmental Management Plan (LSEMP) in 2004, with the City of Kawartha Lakes providing additional support in 2008. The mandate of the LSEMP is to identify phosphorus and nitrogen sources, determine the amounts entering Lake Scugog, and recommend specific measures to effectively address the accelerated aging process of the lake. Kawartha Conservation implemented the water quality monitoring, devised a management plan and recommended strategies for remedial actions. These actions are guided by a steering committee comprised of provincial and federal governmental agencies, municipalities and representatives from local volunteer organizations.

The LSEMP is not a fisheries management plan, nor does it deal in any significant way with aquatic habitats. However, Lake Scugog has always been and still is a significant fishing destination. The shorelines and many wetlands abutting the lake provide significant habitat for a wide variety of birds and wildlife; it is a very special place to observe migratory waterfowl and shorebirds. In fact, the naturally abundant aquatic vegetation and productive nature of the lake and landscape are the primary reasons for this rich resource. A primary goal of this plan is to encourage a greater understanding of the true nature of this lake, its watershed and an appreciation of its assets. The LSEMP must provide a balance between maintaining the integrity of these natural features and addressing the human-caused factors that are accelerating the lake's aging process.

The primary goal of the LSEMP is:

To ensure the long-term environmental and social sustainability of Lake Scugog and its resources by achieving the following objectives:

1. Protect and improve water quality in the lake and its tributaries.
2. Maintain healthy aquatic and terrestrial ecosystems within the watershed.
3. Improve the aesthetic values of the lake and enhance opportunities for public enjoyment within the lake's natural surroundings.
4. Foster community understanding of the lake and an appreciation of the lake's natural and historic heritage.
5. Promote environmentally sustainable use of the lake.
6. Maintain ongoing monitoring and research.

Key Findings

Following the analysis of the water quality research data, it is obvious that everyone contributes to nutrient input in one way or another and bears responsibility for the current state of the lake. Every year, 9,100 to 9,600 kilograms (kg) of phosphorus and 340 to 390 tonnes of nitrogen enter Lake Scugog. More than two-thirds of that phosphorus amount, as well as 30% of the nitrogen remain in the lake. Phosphorus and nitrogen calculations for the input from separate subwatersheds help to determine "hot" spots and provide the basis for recommendations as to where future stewardship activities would be most effective. Average phosphorus concentrations in most rivers and streams are typically two times higher than the Provincial Water Quality Objective (PWQO) of 30 micrograms per litre (μg/L). The PWQO represents a desirable level of water quality that is protective for all forms of aquatic life and prevents an excessive plant growth in rivers and streams.

While the largest source of phosphorus in the lake is runoff from agricultural fields and other agriculture-related activities, this needs to be placed in the proper context. Approximately 23.5% of phosphorus comes from the agricultural lands that comprise over 53% of the entire land area of the watershed. The second most significant human-caused source of phosphorus is urban runoff (approximately 18.2%); this amount comes from a mere 3.56% of the watershed. Other categories of phosphorus sources include rural road runoff (6.4%), the Port Perry Sewage Treatment Plant (1.8%), and private septic systems along the shoreline (9.7%). Phosphorus from septic systems around the lake is of special concern as it is leaching into the lake in dissolved form, readily available for consumption by algae and aquatic plants. A considerable amount of phosphorus comes from natural sources (21.4%) and with all precipitation types (19.0%).

Urgent actions are required to drastically reduce the input of nutrients and the rate of eutrophication in order to maintain the lake's ecosystem and watershed health for future generations. The western basin in particular, immediately offshore from the Port Perry urban area and north to the Nonquon River mouth, reveals the greatest problems and requires the most remedial action. The tributaries in general require intensified stewardship activities.

Estimates show that, in order to improve water quality and maintain the lake's ecosystem, a reduction of the total phosphorus load into the lake from the current 9,400 kg to approximately 6,000 to 6,200 kg per year is required.

Key Recommendations

Based on the data obtained during the research phase of the program, this document, the Lake Scugog Environmental Management Plan, has been prepared and includes a comprehensive set of recommendations and a detailed Implementation Plan. This plan provides an overall stewardship strategy for the lake for the next 10 years, with estimated costs for its implementation. After five years the LSEMP will be reviewed and updated if necessary. The Implementation Plan actions are designed to cover all aspects of human activities and are grouped under six strategies:

- Watershed Planning, Regulation and Enforcement Strategy
- Communications and Education Strategy
- Stewardship Strategy
- Agricultural Land Use Strategy
- Urban Land Use Strategy
- Monitoring and Scientific Studies Strategy.

The earliest activities must achieve an immediate social awareness of impacts and responsibility of personal actions; illustrate progress with the completion of site-specific, on the ground projects; and meet targets for nutrient reduction. The following are recommendations for priority activities.

Watershed Planning, Regulation and Enforcement Strategy

The first priority must be the protection of existing natural resource features, which is always less expensive than rehabilitation. This will require the following actions:

- Ongoing collaboration between municipal planning staff and Kawartha Conservation planning, regulatory and technical advisory staff.
- Effective implementation and enforcement of regional and municipal official plans and zoning bylaws.
- Effective implementation and enforcement of all applicable federal and provincial legislation (e.g., the *Clean Water Act*, *Fisheries Act* and *Historic Canals Regulations*).
- Enforcement of the Section 28 Regulations of the *Conservation Authorities Act* to prevent and mitigate the impact of development in natural hazard areas and environmentally sensitive sites.
- Updated Planning and Regulations Technical and Administrative Guidelines by 2010 to ensure clear, consistent, relevant processes and criteria for effective environmental protection and restoration.

Communications and Education Strategy

Initiate immediately a comprehensive social marketing program involving communications, public education and demonstration projects that will create awareness of best management practices for both urban and rural landowners. The “Scugog Connections” storefront project, funded by the Ontario Trillium Foundation, is the primary facilitator of this objective and commenced operation in October of 2009. This 3-year project initiative will rely heavily on youth and adult volunteer activities, creating a minimum of 3,000 hours of opportunities, while developing partnerships to sustain long-term activities.

Stewardship Strategy

Develop partnerships to implement a coordinated program of stewardship activities in the watershed. Currently, the total forest cover in the Lake Scugog watershed is approximately 112 km^2, representing 24.8% of the watershed area. This is below the 30% recommendation of Environment Canada and the Region of Durham Official Plan, and indicates a specific landscape target for the LSEMP. In the Lake Scugog watershed, there is a 57% average of natural, vegetated cover within a 30-metre riparian buffer zone, well below the 75% recommended by Environment Canada. A range of stewardship actions should include the identification of priority sites, the encouragement of natural regeneration where progress is feasible, and the planting of trees and vegetated buffers. These should aim to meet the following targets:

- Identify sites where additional forest cover will achieve other objectives, including connectivity of natural habitats, increasing forest interior habitat, ground water recharge, etc.
- Work toward a target of 30% total forest cover across the watershed as a long-term objective, utilizing both natural regeneration and strategic tree planting.
- Increase the percentage of natural cover in riparian zones to 75%.
- Utilize Conservation Areas in the Oak Ridges Moraine as a model for effective stewardship practices that are applicable to private lands.

Septic systems at shoreline residences account for an estimated 9.7% of the nutrient input to the lake, or 920 kg of phosphorus annually. Nutrient rich runoff from fertilized shoreline lawns accounts for an additional, undetermined volume. Kawartha Conservation’s Blue Canoe program was initiated specifically to implement a one-on-one dock visitation program, by trained staff, to address the high nutrient input from this relatively small area surrounding the lake, identified by the LSEMP research. This program ran for three summer seasons and will cease in March of 2010. Activities recommended to achieve a target of reducing phosphorus input by 25% over the next five to ten years include the following:

- Based on the evaluation of the Blue Canoe program, design a continued extension services program — implemented by trained staff — to effectively engage property owners living closest to the lake in reducing their nutrient footprint.
- Kawartha Conservation's Shoreline Naturalization program, involving partners such as the Durham and Victoria Stewardship Councils, was initiated and has evolved over the last six to seven years. Evaluate this program to determine its effectiveness.
- Develop septic system inspection programs and financial assistance opportunities for septic system upgrades.
- Consider regulatory means for legislating septic upgrades, e.g., a municipal bylaw requiring a certificate of approval prior to a property sale.

Agricultural Land Use Strategy

Blackstock Creek has a particularly high concentration of phosphorus that is twice the Provincial Water Quality Objective, and it contributes an average of 740 kg of phosphorus annually into the lake. The recommendation is to undertake a concentrated stewardship program in the Blackstock Creek subwatershed. This will require a coordinated effort involving the agricultural community, the Ontario Soil and Crop Improvement Association (who administer the Canada-Ontario Environmental Farm Plan), and the Ontario Ministry of Agriculture, Food and Rural Affairs. The final goal is to decrease the phosphorus load from the Blackstock Creek subwatershed by 400 kg over the next five to ten years, by undertaking a number of nutrient and soil management activities:

- Encourage increased nutrient management planning on individual farms and more widespread use of modern methods for nutrient application.
- Minimize erosion through activities such as conservation tillage, grassy waterways on erodable lands and other soil management techniques.
- Minimize the input of manure nutrients into the stream by managing runoff from livestock yards, improved land application techniques, restricting livestock access to waterways and installing pasture pumps for alternative watering systems.

Although the Nonquon River does not have the highest concentration of phosphorus, this tributary contributes the largest amount of phosphorus to the lake with its higher volume of flow. A strategy similar to the Blackstock Creek in the short term has been developed for implementation in the medium to longer term, in conjunction with the Nonquon River Fisheries Management Plan.

Urban Land Use Strategy

Greater than 18% of phosphorus input comes from urban areas comprising only 3.56% of the land area of the watershed. Using Scugog Connections as the primary vehicle for information and advocacy, focus immediately on stimulating urban and shoreline landowners to take personal and individual responsibility for reducing nutrient production on their own properties. An objective for urban areas is the reduction of phosphorus input by 850 to 900 kg over the next five to ten years.

Undertake a concentrated program of rehabilitation projects and implementation of best management practices in areas adjacent to urban shorelines and tributaries in the Cawker's Creek, William's Creek and other urban subwatersheds. Led by Kawartha Conservation, and involving Scugog Connections, volunteers, youths and urban landowners, a comprehensive education and restoration program will be implemented to create a model of urban watershed stewardship for southern Ontario.

Work with varied partners such as the municipal road department, small businesses and urban golf courses in the area toward further reductions of nutrients and sediments.

Complete the Port Perry Stormwater Management Plan for the effective treatment of stormwater runoff. Implement the Port Perry Stormwater Management Plan as capital project funding becomes available. Prepare and implement effective stormwater management plans for the Hamlet of Blackstock and other small urban areas on Lake Scugog.

Monitoring and Scientific Studies Strategy

The water quality monitoring implemented in 2004 according to a single protocol effectively established a reliable baseline for nutrient levels over the period of study. Successful implementation requires basic, ongoing water quality monitoring to maintain this knowledge of nutrient concentrations and loadings, detect trends and emerging threats, and also to determine the effectiveness of remediation efforts. In addition, research must be ongoing to identify and determine the long-term effectiveness of new methods of nutrient reduction and aquatic vegetation controls. Water quality and quantity information is also being researched under the Drinking Water Source Protection Program that will aid in furthering our overall understanding of hydrological and hydrochemical processes.

The LSEMP recommendations, when effectively implemented, will result in a more sustainable lake and watershed, and a healthier environment for humans and aquatic life. The LSEMP implementation will ultimately maintain tourism and recreation industries, a healthy aquatic ecosystem and viable fishery resources for future generations. All residents must become informed of the significance of Lake Scugog to their everyday lives, the lake's potentially fragile character and the harmful nature of certain activities. Residents must be motivated to take personal action.

A complete analysis of collected water quality and quantity data is presented in the *State of the Lake Scugog Watershed Report*, a comprehensive document that also describes geological, physiographical, biological, socio-cultural and economic aspects of the Lake Scugog watershed.

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1.0 Introduction

Since the middle of the 19th century, Lake Scugog has been central to the growing economy of the region and played a vital role in the development of local communities. Later, the lake became a major attraction for tourists, vacationers and anglers. Residents and visitors of the Township of Scugog and the southern portion of the City of Kawartha Lakes have always appreciated their “blue jewel”, resting among scenic green hills and providing an opportunity for everyone to enjoy Mother Nature at any time of year.

However, there have been growing concerns about the lake. Over many decades, the processes of eutrophication, siltation and overabundant development of aquatic vegetation have caused navigational, recreational and aesthetic difficulties for permanent and seasonal residents around the lake. The main cause of these processes is excessive input of phosphorus and nitrogen, two primary nutrients, into the lake as a result of modern human activities.

In 2004, Kawartha Conservation, the Township of Scugog and the Region of Durham recognized the importance of the environmental health of the Lake Scugog aquatic system for residents, stakeholders and the region’s economy. Accordingly, they initiated the research phase of the Lake Scugog Environmental Management Plan (LSEMP). The City of Kawartha Lakes joined the project in 2008.

1.1 Project History

For over 30 years, residents around Lake Scugog have had concerns about proliferating aquatic plants throughout the lake. As a result, the Ministry of the Environment (MOE) and the Ministry of Natural Resources (MNR) initiated a lake study in the early 1970s, but eventually that study was discontinued due to lack of funding.

In the 1980s, a Lake Scugog Task Force was created to examine water levels in the lake as well as aquatic plant problems. They concluded that the operations of the Trent-Severn Waterway (TSW) were not the cause of problems in the lake, but rather evaporation, high nutrient input from surrounding lands and invasive aquatic plant species, notably Eurasian water milfoil, were responsible.

In 1999, the MNR and Scugog Lake Stewards Inc. tried to initiate the Lake Scugog Fishery Management Plan, but this project was curtailed after the first draft due to funding constraints. It was agreed by all parties involved in the MNR plan that this project should go forward, but the lead organization would be Kawartha Conservation. It was also agreed that the mandate should be considerably expanded to become a comprehensive water quality oriented lake management plan, rather than a fisheries management plan.

In 2004, Kawartha Conservation resumed the scientific research with the purpose of developing a lake management plan that would prescribe the necessary remedial actions.

The initial background report was prepared in 2004. It compiled readily available information on water quality, and physical and biological resources, as well as identifying some issues affecting the lake. To improve our understanding of the lake, water quality and quantity monitoring has been conducted by Kawartha Conservation since the summer of 2004. The data collected through the 2004-2008 period are used for the calculation of the Lake Scugog water, phosphorus and nitrogen budgets. The monitoring network across the watershed provides informational data to determine “hot” areas that are sources of high phosphorus and nitrogen loads. These areas can then be targeted and remedial actions implemented in the nearest future. During the summer of 2007, sediment sampling was conducted within the lake area adjacent to Port Perry. The data collected allows Kawartha Conservation to characterize sediment quality and its current and future influences on the aquatic ecosystem of the lake.

1.2 Purpose of the Study

The LSEMP has established a viable action plan to implement rehabilitation measures that will improve water quality in Lake Scugog. To that end, it was necessary to identify sources and measure amounts of phosphorus and nitrogen entering the lake. Kawartha Conservation is the lead organization in the development of the LSEMP, working in partnership with the Township of Scugog, the Region of Durham, the City of Kawartha Lakes, Scugog Lake Stewards Inc., MNR, Fisheries and Oceans Canada (DFO), and Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA).

Lake Scugog is a man-made shallow impoundment. Furthermore, it is bordered by agricultural lands on fertile soils. Silt and nutrient runoff from surrounding lands promote the sedimentation and eutrophication process in the lake. In recent decades, this process has been apparently accelerated by human activities on and around the lake. As a result, social and economic costs for viable solutions are increasing, as is the complexity of diminishing the lake problems. The restoration process for this ecosystem requires close co-operation and synchronized actions from all partners participating in the project.

The collection of sound scientific data and evaluation of the current condition of the Lake Scugog ecosystem and its watershed have formed the base for designing remedial measures. Reducing inputs of phosphorus and nitrogen, and other contaminants to the lake and its tributaries through a wide range of actions, both physical and educational, will help to restore the environmental health of the lake and its watershed. Continuing research will enable finer tuning of yearly action plans.

1.3 Project Goal and Objectives

The primary project goal is **to ensure the long-term environmental and social sustainability of Lake Scugog and its resources** by achieving the following objectives as determined by the LSEMP Steering Committee:

1. ***Protect and improve water quality in the lake and its tributaries.***
2. ***Maintain healthy aquatic and terrestrial ecosystems within the watershed.***
3. ***Improve the aesthetic values of the lake and enhance opportunities for public enjoyment within the lake's natural surroundings.***
4. ***Foster community understanding of the lake and an appreciation of the lake's natural and historic heritage.***
5. ***Promote sustainable use of the lake.***
6. ***Maintain ongoing monitoring and research.***

Water from Lake Scugog, while moving through the Scugog River, also serves as a drinking water source for the majority of the population living in the Town of Lindsay. The protection and improvement of water quality in Lake Scugog and the Scugog River have great consequence from this perspective as well.

1.4 Steering Committee, Partners and Stakeholders

Environmental management of a watershed, lake or river encompasses a wide range of users, values and areas of expertise. This necessitates an interdisciplinary and coordinated approach to managing and protecting environmental values and resources. Implementation of the plan can be strengthened by this approach.

Several stakeholders and partners are highly interested in the Lake Scugog aquatic resources and are actively involved in projects relating to the lake management plan. Some stakeholders are responsible for management of aspects of the Lake Scugog ecosystem, for instance, the MNR, DFO, TSW and Kawartha Conservation. The Trent-Severn Waterway, for example, is responsible for managing water levels in Lake Scugog as well as in other lakes downstream. The water level regime is a very important component in maintaining the ecological health of the lake. Other partners are highly interested in the Lake Scugog aquatic resources from an economic point of view, namely, the Region of Durham, the City of Kawartha Lakes and the Township of Scugog.

Major partners and stakeholders with representation on the LSEMP Steering Committee, formed in 2004, include the following municipalities, provincial and federal agencies, and non-governmental groups:

- Region of Durham – Planning and Health Departments
- Township of Scugog
- City of Kawartha Lakes
- Ministry of Natural Resources
- Ontario Ministry of Agriculture, Food and Rural Affairs
- Ministry of the Environment
- Ontario Federation of Agriculture
- Fisheries and Oceans Canada
- Trent-Severn Waterway
- Durham Land Stewardship Council
- Victoria Land and Water Stewardship Council
- Haliburton, Kawartha, Pine Ridge District Health Unit
- Scugog Lake Stewards Inc.
- Kawartha Conservation.

The LSEMP Steering Committee members actively participated in the development of general strategy, the goal and primary objectives of the plan, and the major guidelines of the plan. Residents of the watershed from both the City of Kawartha Lakes and the Township of Scugog, as local stakeholders, also played an important role in the plan development and provided local knowledge of the lake and its issues. Kawartha Conservation has held several open houses during the past five years, where local residents were informed on the progress of the plan and had opportunities to make proposals, comments and recommendations about the plan.

2.0 Socio-Economic Characterization

2.1 History of the Watershed

The European history of the area surrounding Lake Scugog dates back to 1809, when Major Wilmot surveyed Reach Township to the west of the lake. The township was the first to be formed in the area, beginning in 1821. Wilmot was also responsible for surveying Cartwright Township, to the east of Lake Scugog, which he completed in 1816. The last of the townships to the north of Lake Scugog was surveyed in 1821 and named Mariposa. Prior to this time, Mississauga First Nations, who made use of the wild rice growing in Lake Scugog, inhabited the area around the lake.

Where towns developed was often a function of proximity to water and the milling power it provided. Gristmills and sawmills played an important role in the development of communities throughout the Lake Scugog watershed. Sawmills were the first industrial enterprises in the area. In Reach Township the first sawmills were constructed in 1831, in Mariposa in 1837, and in Cartwright Township in 1851.

The most consequential mill construction was the Lindsay gristmill. Constructed in approximately 1837 by William Purdy, the dam significantly changed the landscape around Lake Scugog. Prior to the mill's construction, Lake Scugog was described as merely a "mass of marsh and grass" (Weir, 1927). The dam caused a four-foot rise in water levels and made Lake Scugog a navigable waterway. This rise in water levels benefited the more isolated townships of Cartwright and Mariposa, making transportation to the "front" (Oshawa and Whitby) much easier. Similarly, the improved accessibility provided by the lake allowed Caesarea to become a major transportation hub and inportant shipping port for grain and timber, but the town declined when it was bypassed by the railway (Letooze, 1996). The water level also made transportation between Scugog Island and the mainland much more difficult. To provide a connection to the mainland, a rowed barge was used until a floating bridge was constructed in 1856, later replaced by a land bridge in 1884.

The creation of Lake Scugog had controversial results. Many people enjoyed the recreational opportunities created by the lake, such as fishing, boating, and even horse racing on ice, while others tended to ignore the lake because of its shallowness, muddy condition, and "rank summer weed growth" (Irwin, 1984). Reach Township sought to address this problem and in 1910 retained a Lindsay based contracting company to drag timber and boom chains along the bottom of the lake to remove the weeds (Hvidsten, 1999).

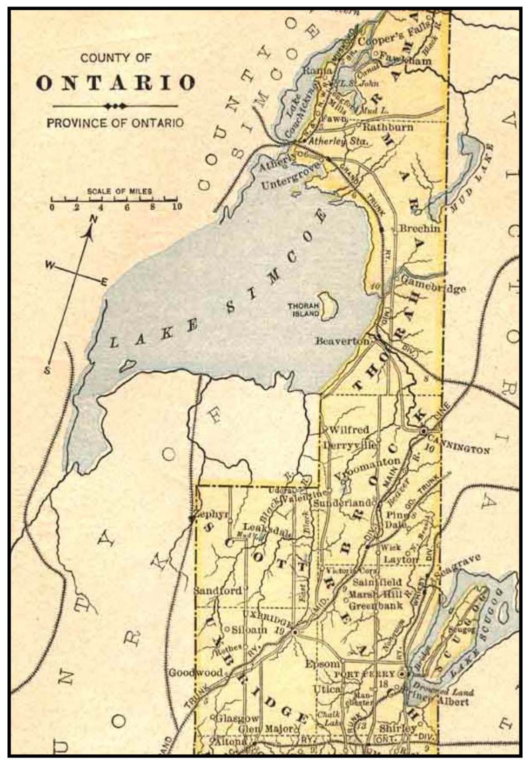

Figure 2.1. Ontario County, 1885

Aesthetics and recreation aside, many landowners were outraged by the thousands of acres of farmland lost under the rising waters; some even marched to Lindsay demanding that the water level be lowered.
In the mid-1800s, the towns of Manchester, Port Perry and Prince Albert, all within a 5-kilometre (km) distance of each other, were competing to become major trade centres in Reach Township. The Town of Manchester was positioned further away from Simcoe Street (present-day Old Simcoe), the main corridor to

Whitby, and did not thrive to the same extent as Port Perry or Prince Albert. Still, the mid-1800s was a time of extensive population growth. The 11 years between 1840 and 1851 saw the population of Reach Township grow by over 400%, from 771 to 3,897 residents (Johnson, 1973). After 1851, the growth rate slowed, but continued rising again until 1861, when there was a decade of decline in the rural population.

At the turn of the 20th century, as towns throughout the Lake Scugog basin continued to develop, the route of the railway became a determining factor in whether a town would flourish or fade. In 1867, the towns of Manchester, Port Perry and Prince Albert remained in competition as trade routes with significant volumes of grain and resources shipped through all three towns. The rail line from Whitby to Reach Township built stations south of Manchester and east of Prince Albert, with the terminus of the line at Port Perry. As a result, Port Perry became a much more important trade centre than the other two towns. Grain that was once shipped out of Manchester or Prince Albert was instead shipped through Port Perry. From the time the railway was built, Port Perry has flourished and continued to develop, with a present-day population of over 9,000, whereas both Manchester and Prince Albert have become small hamlets along the road to Port Perry.

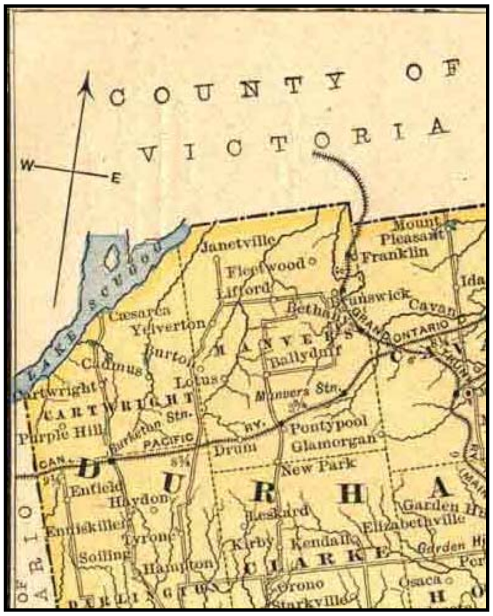

Figure 2.2. Durham County, 1885

To the north of Lake Scugog, the railway route through Mariposa did little to benefit existing towns. The established route bypassed the major towns that had already developed, explaining partly why no settlements developed in the southern part of Mariposa Township.

2.2 Natural Heritage

Natural heritage provides important context to the current state of Lake Scugog. First and foremost, Lake Scugog was created by human intervention: flooding what was once a marsh. As a result, the lake is shallow with a thick layer of sediment on the bottom. The area to the south of Lake Scugog continues in this natural state as the Osler Marsh.

In 1870, the Government of Ontario passed the *Drainage Act*. This Act promoted the draining of wetland areas by providing government grants to do so. A private company that attempted to reclaim the land in Osler Marsh never made it beyond a few pilings driven into the ground. Instead, the lands of the Osler Marsh were bought by a syndicate from Toronto that developed the area as a game preserve and hunting destination, still used today. The marsh is now the largest wetland in the Lake Scugog watershed, composed of over 2,700 hectares of Provincially Significant Wetland (PSW). The marsh provides important breeding and migratory habitat for waterfowl (Natural Heritage Information Centre, 2008) as well as habitat for fish, supporting the vibrant sport fishing industry of Lake Scugog. Throughout the Lake Scugog watershed, there are other smaller PSWs including the Nonquon River mouth wetland, the Scugog Island West wetland and the Seven Mile Island Marsh. All of these wetlands contribute to the unique ecosystem of the Lake Scugog watershed and should be protected and enhanced.

From the beginning, the fish community in Lake Scugog reflects its nature and is characterized by warm water fish species supported by natural reproduction (Kawartha Region Conservation Authority, 2004). The native sport fish community includes muskellunge and smallmouth bass, which were present in the area even before Lake Scugog was created. Largemouth bass were introduced in the early 1900s, and walleye were introduced to provide additional fishing opportunities from the 1920s through the 1940s. Other species that are non-native to the lake include common carp (since the late 1800s), bluegill (since the 1970s) and black crappie (since the 1990s). The present-day sport fish community is composed of muskellunge, smallmouth and largemouth bass, walleye, yellow perch, bluegill, pumpkinseed and black crappie (MNR, 2008).

When reviewing the history of this area of southern Ontario it is impossible to ignore the natural heritage significance of the Oak Ridges Moraine (ORM). The moraine is a major geological feature in southern Ontario that defines the southern boundary of the Lake Scugog watershed and stretches from the Niagara Escarpment in the west to Rice Lake in the east. The moraine's composition of a complex mix of glacially deposited sands, gravel and till with outcrops of boulder clay, kettle lakes and knobby hills results in an area of high aquifer recharge. This provides base flow for many of the streams and rivers that feed into Lake Scugog. These tributaries include the Nonquon River, Blackstock Creek, and some small tributaries to the south that flow into the Osler Marsh.

Following European settlement, large areas on the ORM were discovered to be unsuitable for long-term farming due to topography or poor soil types. With faster snowmelt, downstream flooding, erosion and dust storms, thousands of acres of cleared land were subsequently abandoned. Large areas of wasteland on the ORM became common with deep, eroded gullies and sand dunes. Once-productive forest soils were depleted of nutrient rich soils that had blown or washed away.

Forests were once abundant throughout the Lake Scugog watershed, blanketing most of the area. However, other than scattered remnants of the original forest, contemporary woodlands are the result of human settlement activities since the first quarter of the 1800s. The original forest was viewed mostly as an impediment to settlement and travel, something to be conquered or exploited for any kind of value, rather than managed. In fact, the volume of product was so enormous that there was no market for much of it during the intensive period of land clearing. The dominant land use throughout the Lake Scugog watershed has since become agriculture, with only small areas of forest remaining.

The natural features of the Lake Scugog watershed have been in constant transition since European settlement in the early 1800s. The unique ecosystem is primarily maintained in its current state by humans, but also stressed by human activities. As such, the lake requires responsible management including measures for the restoration and protection of diverse watershed ecosystems, while maintaining a balance between the natural environment and sustainable economic development.

2.3 Demographics

The Lake Scugog watershed is not densely populated. Most residents live either in small hamlets or scattered across the rural portions of the watershed. The Port Perry urban area, with a population of more than 9,600 residents (Durham Region, 2008), is the only large urban centre situated on the southwestern shores of the lake. As well, 16 smaller hamlets and subdivisions are situated in the lake's watershed. Many of these are located adjacent to the lakeshore. The largest among them are Caesarea, Seagrave, Blackstock, Greenbank, Viewlake and King's Bay.

The *Durham Regional Official Plan Amendment No. 128* (2009) estimates a population growth for the Township of Scugog of approximately 3,950 persons between 2006 and 2031, comprising a total population of 25,390 in 2031. Currently the Township of Scugog has a total population of 21,439 persons (Statistics

Canada, 2006), with 45% of them living in the urban area of Port Perry (Township of Scugog, 2009). The *Township of Scugog Official Plan* estimates that in the future, population growth will occur mainly in urban areas (60% of the total population increase), while the surrounding rural and shoreline areas will accommodate 40% of the total increase. Currently, further developments in Port Perry are limited by the treatment capacity of the Nonquon River Water Pollution Control Plant (or Port Perry lagoons).

The City of Kawartha Lakes has an even less dense population than the Township of Scugog. With only 24 persons per square kilometre, it is a more rural municipality. It is estimated that approximately 65% of its residents live in rural areas (*City of Kawartha Lakes Draft Official* Plan, 2009). Currently, the City of Kawartha Lakes has a population of 74,561 persons (Statistics Canada, 2006). The City *Draft Official Plan* predicts a population of approximately 100,000 by the year 2031: a population growth of more than 25,000 persons in 25 years. Major population growth is anticipated in existing urban areas and hamlets.

As the population in the City of Kawartha Lakes and the Township of Scugog continues to increase, more lands will be converted into urban and semi-urban areas with a higher percentage of impervious surfaces. This land conversion will have adverse effects on Lake Scugog if not managed according to the newest environmental standards for emerging urban developments. This will require a range of advanced Best Management Practices (BMPs) to be applied to urban land uses.

2.4 Industry

Industrial and commercial developments in the Lake Scugog watershed are mainly limited to the Port Perry urban area. The major designated area for the industrial sector is located to the west of Port Perry in the Nonquon River subwatershed. As well, the Township of Scugog will encourage and promote the economic development of home-based businesses, agricultural value added products, overnight accommodations and a variety of tourism related businesses, while maintaining and enhancing other employment opportunities in the commercial and service sectors (Township of Scugog, 2009). Commercial and resort developments along the Lake Scugog shoreline will incur an additional burden on the Lake Scugog aquatic system despite the current intention to improve development conditions and introduce new policies to protect the natural environment.

Development and employment opportunities are expected in other settlement areas (e.g., Caesarea and Blackstock) and have been identified in the regional and township official plans. These developments are believed to be compatible with the character and environment of the watershed (Township of Scugog, 2009).

In the City of Kawartha Lakes portion of the Lake Scugog watershed, no significant industrial and urban developments are anticipated. The City's *Draft Official Plan* (2009) identifies agriculture as the largest economic contributor to this part of the municipality. Some new rural residential areas or subdivisions can be created, often as retirement communities or golf clubs with housing. It is specifically recommended that further rural residential growth be limited to areas where the soil and groundwater conditions can support increased development while assuming minimal impacts to the surrounding water bodies (*City of Kawartha Lakes Draft Official Plan*, 2009).

It can be concluded that in the foreseeable future this part of the watershed will stay rural and agriculture-based in its nature. As the City of Kawartha Lakes is actively promoting tourism in the area, it is evident that recreational activities will also play a significant role in the economy of this part of the Lake Scugog watershed.

3.0 Watershed Characteristics

Lake Scugog is one of the largest water bodies among the Kawartha Lakes. Its watershed occupies the southwestern portion of the Kawartha Conservation watershed and is located within the Greater Toronto Area, at a one-hour driving distance from downtown Toronto. Lake Scugog is very attractive for anglers, boaters and other recreational users. The Lake Scugog watershed covers 529.7 km^2, with 78.5% of the drainage area situated within the Region of Durham and the remaining 21.5% within the City of Kawartha Lakes. At the township level, the majority of the watershed (~70%) is situated within the Township of Scugog (Region of Durham).

On the southern fringes of the watershed, the Oak Ridges Moraine forms headwater areas in the subwatersheds of several tributaries of the lake (Figure 3.1). Oshawa and Bowmanville Creeks to the south, the Mariposa Brook watershed to the north, the East Cross Creek basin to the east and the Beaver River catchment area to the west, all border the lake's drainage basin.

3.1 Geology and Landforms

The geology of the Lake Scugog watershed is dominated by a relatively thick sequence of Quaternary glacial sediments that overlie the Paleozoic bedrock formations. The surficial geology represents elements of the Wisconsin Glacial period, which was the last glacial period to affect the study area, with ice cover having retreated approximately 11,800 years ago (Barnett, 1992). Undercutting the Newmarket Till in the study area and regionally are several flat-floored, subglacial, glaciofluvial channels. Notably, Lake Scugog is situated in one of these channels. The channels are commonly one to four km wide, steep sided, up to 50 metres (m) deep, and they may contain eskers on their floors (Barnett, 1997).

Glaciolacustrine deposits form the sand and clay till plains found in the Lake Scugog watershed. Alluvial, peat and muck deposits of recent age are found in river valleys and swamps. The uppermost regionally significant surficial geologic unit consists of a sequence of drumlins and glaciolacustrine deposits that vary from nearshore sands and gravel beach deposits of the Lake Iroquois shoreline located in the southern part of the study area, to the fine sands, silts and clays of glaciolacustrine pondings (Kawartha Region Conservation Authority, 1983). These sediments generally form thin layers over the underlying deposits, although they can be several metres thick.

Intensive glacial activities during the Pleistocene age produced a variable landscape, resulting in a number of different physiographic regions. There are three distinct regions within the Lake Scugog watershed boundaries (*LSEMP Background Report, 2005*). From south to north, these regions are: the Oak Ridges Moraine, the Peterborough Drumlin Field and the Schomberg Lowland Clay Plain. Physiographic features of these regions are presented in Figure 3.2. More detailed information on bedrock and surficial geology, physiography and landforms is presented in the *State of the Watershed Report* (Kawartha Conservation, in progress).

The Oak Ridges Moraine is an extensive, stratified deposit (about 160 km long and 5 to 20 km wide) extending from the Niagara Escarpment to the Trent River. It is one of the most distinctive physiographic regions of southern Ontario (Chapman and Putnam, 1984) and represents approximately 10% of the Lake Scugog watershed area. The ORM is oriented in an east-west direction, north of Lake Ontario, reaching an elevation of approximately 400 metres above sea level (masl). The ORM consists mainly of permeable glaciofluvial sands and gravels, and impermeable deposits of till, silt and clay. These components are interconnected to form a network of aquifers providing one of southern Ontario's main groundwater recharge zones. It is a region that is abundant with rolling hills in a knob-and-basin relief (Singer et al., 2003).

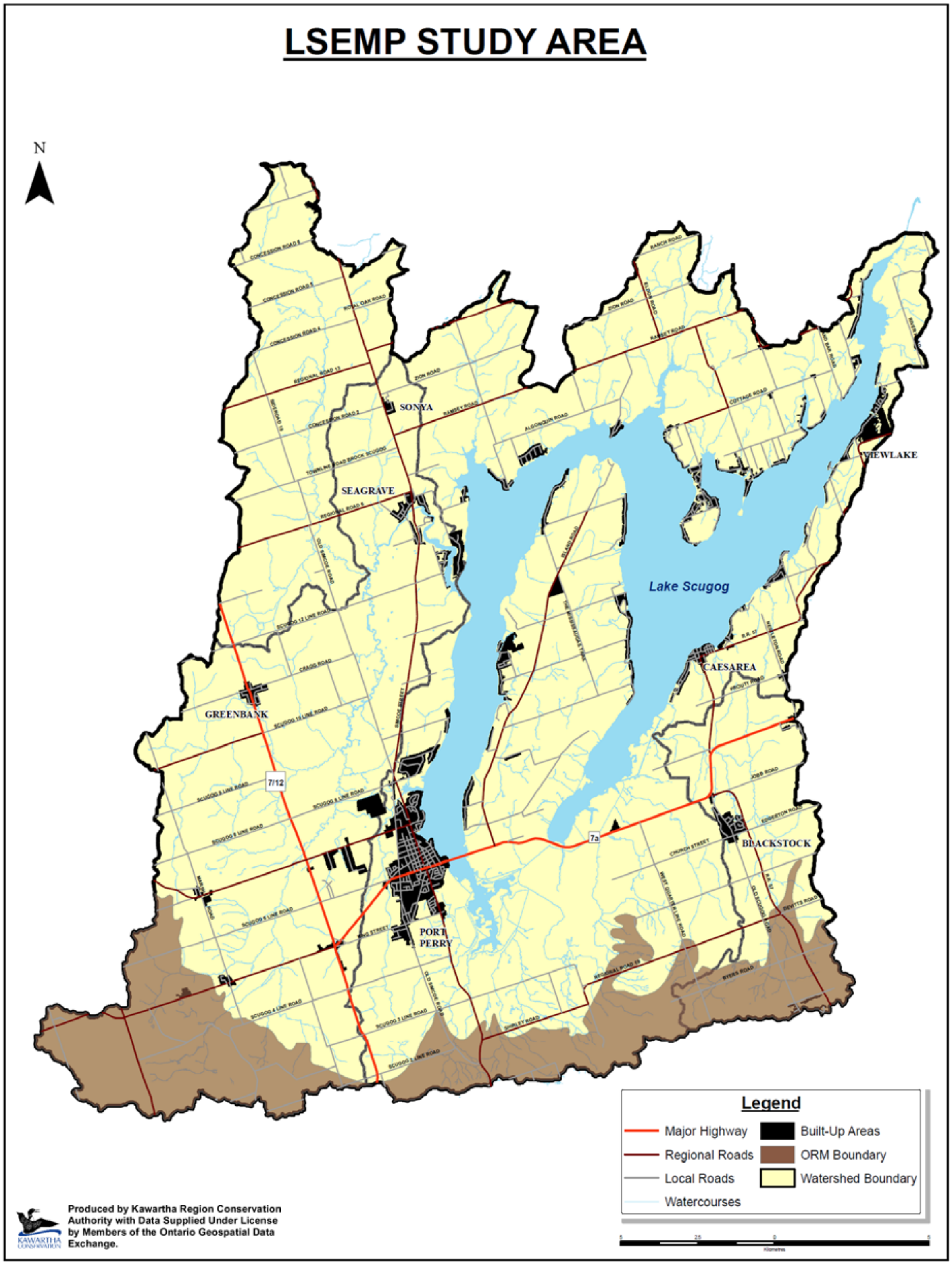

Figure 3.1. Lake Scugog Environmental Management Plan Study Area

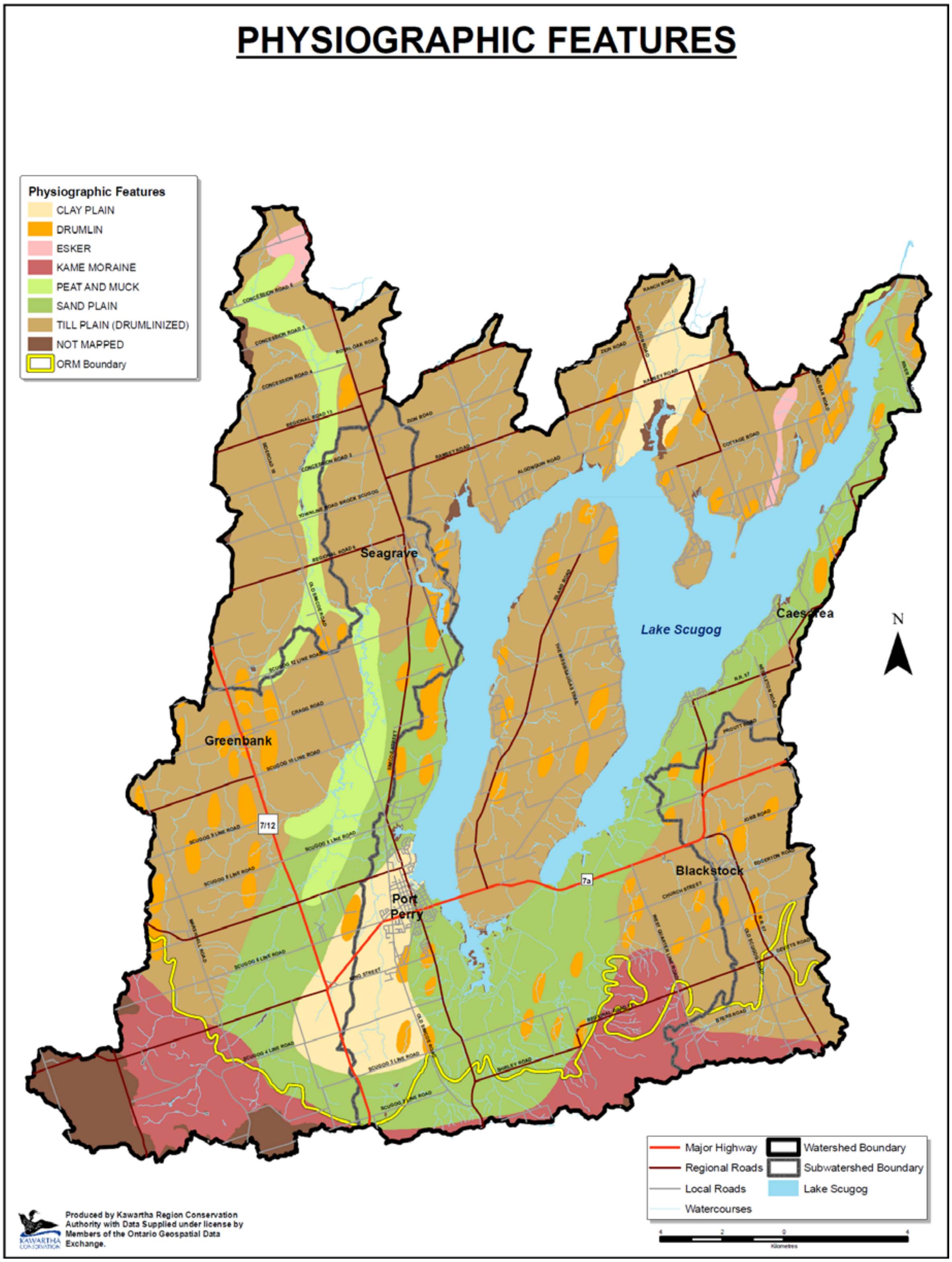

Figure 3.2. Lake Scugog Watershed Physiographic Features

All major Lake Scugog tributaries originate from the ORM and have well defined channels and a higher gradient than small streams in the northern part of the watershed. For example, the highest elevation in the headwaters of the Nonquon River is 304.78 m, while the mouth of the river is located at an elevation of 250 m. The highest point in the Blackstock Creek subwatershed is 314.63 m, while the lowest point (Lake Scugog water surface) is also 250 m. Therefore, the difference between the headwaters and mouth of the creek is more than 64 m.

The Peterborough Drumlin Field occupies the area immediately to the north of the ORM, stretching from Lake Simcoe to Trenton, and covers approximately 50% of the Lake Scugog watershed. Eighty-six drumlins exist in the area (See Figure 3.2). Drumlins typical of this area are elongated, low-lying hills, less than 1.5 km in length, 400 m or less in width, and 25 m in height. They are composed of highly calcareous glacial till consisting of sands and gravels. The general orientation is from northeast to southwest. The drumlin field is also notable for the presence of eskers (Crozier, 1974; Gillespie and Acton, 1981).

In the southern portion of the Drumlin Field near the ORM, materials are sandy. In the northern part of this region, clay tills are common. Many of the river valleys in this area are very flat and many of the wetlands occur at similar elevations, as lakes into which their rivers drain (Kawartha Region Conservation Authority, 1987). Major portions of the Nonquon and Layton Rivers, and Fingerboard Creek subwatersheds are located within the Peterborough Drumlin Field.

The Schomberg Clay Plain is a relatively flat, dish-shaped area bound by the Dummer Moraine to the north and the Peterborough Drumlin Field to the south. It occupies part of the central portion and the extreme northern portion of the Lake Scugog watershed and covers approximately 40% of the watershed. The majority of the area is covered by glacial till ranging between 1.5 and 3 metres in thickness and occasionally up to 8 metres.

The Schomberg Clay Plain is well suited for agriculture and this has been the dominant land use pattern in the area. The drumlinized areas are used for mixed agriculture, and grains are the predominant crops. The Scugog River area is more suited for pasture, therefore beef cattle and dairy farming practices are dominant here (Chapman and Putman, 1984).

3.2 Soils

Soils in the Lake Scugog watershed vary from loose, granular sands and sandy loams to dense, poorly drained clay loams. Their profiles are generally shallow with a pH near neutral to alkaline. In general, the watershed is covered by medium-textured soils consisting of clay loams and sandy loams. Most of the soils have good to moderate infiltration capacity as indicated through the hydrologic soil grouping (Figure 3.3). Soils overlying clay-rich glaciolacustrine deposits on the Schomberg Clay Plain area generally fall in the poor to moderately poor infiltration capacity with a high runoff potential. Although erosion potential in this area exists, soils may not erode as much as expected here due to the low relief. Soils in the Peterborough Drumlin Field are favourable to agricultural activities, and many agricultural operations are located in this physiographic region. Table 3.1 provides a short description of soil characteristics and agricultural capabilities of the watershed. More detailed information on soils is provided in the *State of the Watershed Report* (Kawartha Conservation, in progress).

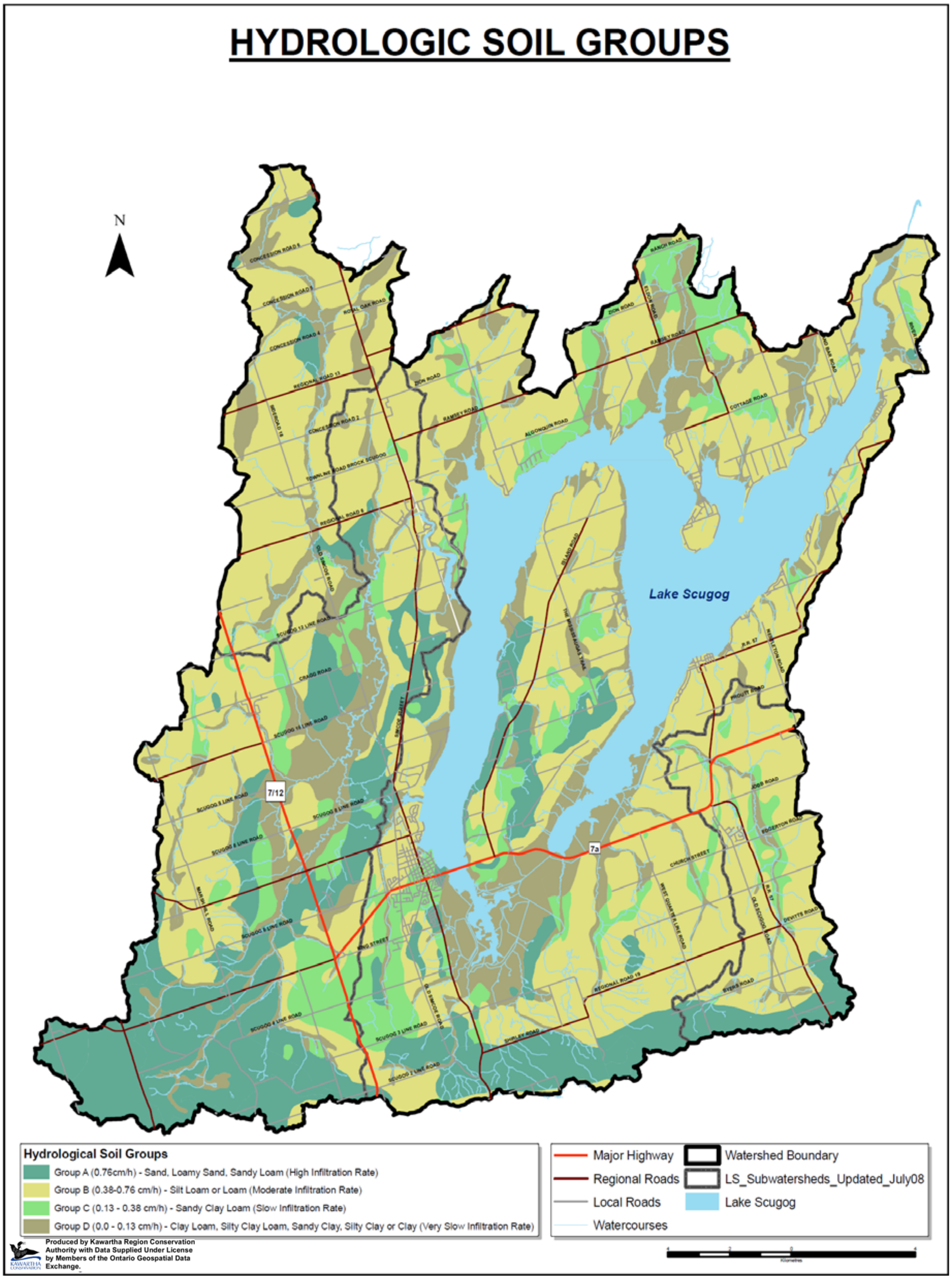

Figure 3.3. Lake Scugog Watershed Soil Permeability

Table 3.1. Soils within the Lake Scugog Watershed

Physiographic Region	Major Soil Types	Drainage Characteristics	Erosion Potential	Agricultural Capability
Oak Ridges Moraine	Deep sands, sandy loams and gravels	Excellent to excessive drainage	Severe to moderate	Severe limitations due to slopes and low fertility
Peterborough Drumlin Field	Sandy loams, loams and muck	Good to imperfect drainage with large areas of wetland	Low to moderate	Moderate limitations due to low permeability and slopes
Schomberg Clay Plain	Clay, clay loams and muck	Imperfect to poor drainage	Low	Minor limitations, some drainage restrictions

Source: *Water Resources Report*, Kawartha Region Conservation Authority 1987

3.3 Climate

Climate characterization of the Lake Scugog watershed is based mainly on data from the Environment Canada climate stations in and around the watershed. The Lake Scugog watershed is located in a humid continental climate zone. This zone represents the majority of east-central Ontario. This area typically receives approximately 909 millimetres (mm) of precipitation annually, of which 135 to 150 millimetres are in the form of snow (Environment Canada, 2009). There is little regional variability in the climate of the region.

The annual average temperature is 6.4˚C according to data from the Burketon McLaughlin climate station for the period of 1971-2000 (Environment Canada, 2009). According to the same data, July is the warmest month of the year and January represents the coldest month with average daily temperatures of 19.9˚C and minus 8.0˚C respectively. The wettest month is June with an average of 95.7 mm of precipitation. The driest month is February with an average of 48.3 mm. From current observations it is apparent that the southern part of the watershed receives more precipitation due to higher altitude in the ORM area. For instance, an annual total precipitation recorded during the last two years at the Blackstock climate station was 717 mm in 2007 and 1237.5 mm in 2008. At the same time, the Kawartha Conservation's precipitation monitoring station at King's Bay, representing the northern portion of the watershed, recorded 678.1 mm in 2007 and 1104.2 mm in 2008.

3.4 Hydrology

Lake Scugog has a surface area of 68 km^2 and an average depth of 1.4 m. The shoreline length of the lake is 172 km in total, whereas the Scugog Island shoreline length is 30.6 km. The deepest area of the lake, with a depth of 7.6 m, is located in the eastern part of the lake near the community of Caesarea. The lake volume is approximately 95.7 million cubic metres. The flushing rate is approximately two times per year and accordingly, retention time is six months. Considering the complex shape of the lake, it is likely that in some parts of the lake, water mass remains longer than six months. In particular, this may apply to the southwestern part of the lake.

The depth, area and volume of the lake are artificially maintained through the Lindsay Dam on the Scugog River, built more than 160 years ago. Consequently this old, man-made lake has a thick layer of bottom sediments and is probably shallower than it was just after its transformation. Due to the consistent shallowness of the lake, it does not exhibit characteristics of seasonal thermal stratification. Seasonal water level fluctuations on the lake are usually between 20 and 50 centimetres (cm) and depend on the operating regime of the Lindsay Dam by the Trent-Severn Waterway. In turn, the TSW operational decisions are subject to the current and forecasted weather and amount of precipitation. The TSW is the principal authority responsible for the management of water levels in Lake Scugog as well as in other Kawartha Lakes. A hydrological regime (i.e., water level fluctuations) can have a significant effect on water quality and the state of the aquatic ecosystem in the lake.

The watershed can be divided into several subwatersheds. The Nonquon River and Blackstock Creek are the largest tributaries of the lake. The Nonquon River has one large tributary, the Layton River, which occupies the northwestern part of the watershed (see Figure 3.1). As well, smaller watercourses such as Cawker's Creek, Fingerboard Creek and many tiny unnamed tributaries empty into the lake. The Scugog River is the only outflow from the lake in the northeastern corner of the watershed, carrying its waters through Lindsay into Sturgeon Lake.

The Nonquon River is the largest tributary of Lake Scugog and takes up approximately 35% of the total watershed area. It originates from a small wetland on the ORM at an elevation of 304.8 masl in the Township of Scugog and flows north to Lake Scugog. Approximately 5% of this subwatershed lies within the ORM, about 15% within the Schomberg Clay Plains, and the majority within the Peterborough Drumlin Field. In this area, the Nonquon River has a wide floodplain and a low gradient. The Layton River, its largest tributary, flows into the Nonquon River southwest of the Hamlet of Seagrave. After crossing Simcoe Street (Highway 2) in Seagrave, the Nonquon River dramatically changes direction and for the last few kilometres flows in a southeasterly direction.

Blackstock Creek is another tributary of Lake Scugog that originates on the ORM and flows in a northerly direction. While it is a small watercourse, significant groundwater inflow makes this stream important for the eastern portion of Lake Scugog.

There are a number of small tributaries that drain into Lake Scugog. These are primarily small, unnamed watercourses that drain the area to the south, west and north of Lake Scugog and flow directly into the lake. Some are named, including Cawker's Creek and William's (Jesters) Creek that empty into Lake Scugog in the Port Perry area, and Fingerboard Creek that empties into the northeast portion of Lake Scugog.

Water from Lake Scugog flows in a northerly direction through the Scugog River and after passing Lindsay, it empties into Sturgeon Lake. Mariposa Brook and East Cross Creek are medium-sized watercourses that drain areas between Lake Scugog and the Town of Lindsay. Mariposa Brook empties into the Scugog River approximately one kilometre north of the lake and four kilometres south (or upstream) of Lindsay. On the east bank of the Scugog River, opposite the mouth of Mariposa Brook, East Cross Creek enters the river.

3.5 Hydrogeology

Groundwater flow in the watershed generally moves toward the major drainage features, such as Lake Scugog, the Nonquon River or Blackstock Creek. On a regional scale, the groundwater flow in the bedrock aquifer is recharged by precipitation on the upland areas. The regional flow discharges into the main rivers and lakes of the Trent-Severn Waterway. On a local scale, the shallow supply wells recharge from precipitation in the immediate space surrounding the wellhead. Across the watershed area, the aquifer is recharged primarily from precipitation during the wet seasons (spring and fall), thus precipitation in the local vicinity of the wells is an important source of recharge to the local groundwater supplies.

Significant recharge and discharge areas are present in the ORM region. An abundance of recharge areas are identified in the Nonquon River, East Cross Creek and Blackstock Creek drainage basins. The ORM is considered a provincially significant feature and is the primary water source in the Lake Scugog area.

The Peterborough Drumlin Field area is characterized by a relatively thin overburden covering a limestone bedrock aquifer. Water wells in the area are usually overburden wells in the south, where greater overburden exists, and they become shallower and terminate at the bedrock in the northern part of this region. The vulnerability of the aquifer water quality is moderately susceptible near the ORM. Septic systems are a concern where overburden is shallow and sources of water are nearby.

Groundwater monitoring in the Lake Scugog watershed is being conducted in the framework of the Provincial Groundwater Monitoring Network (PGMN) at two monitoring wells. The monitoring wells are situated in the southern portion of the watershed, at the headwaters of the Nonquon River and in the Osler Marsh subwatershed.

3.6 Water Budget of the Lake

A water budget for any given water body or watershed is a sum of all water inputs, outputs and changes in storage. It is reasonable that all water inputs into the lake, such as precipitation, surface and groundwater inflows, and discharges from sewage treatment plants and septic systems, should be equal to the sum of all water outputs from the lake, such as evaporation and evapotranspiration, surface and groundwater outflows, and water extraction for water supply purposes. A water budget is an essential component of any hydrological and water quality study.

In the framework of the LSEMP, a water budget can be used for multiple purposes. For example, the water budget and its components are necessary to evaluate the cumulative effects of various land uses on water quality in the lake and its tributaries, and to determine priority areas for environmental monitoring. Moreover, an accurate water budget of Lake Scugog is crucial for further calculations of phosphorus and nitrogen loadings and balances for the lake.

The values of the Lake Scugog water budget components for the 2005-2006, 2006-2007 and 2007-2008 hydrologic years are shown below in Table 3.2. The hydrologic year begins on June 1st and ends on May 31st of the next year, and reflects the natural hydrological cycle.

During all three hydrologic years the water budget had a negative imbalance (-4.1% or 14,493,814 cubic metres (m^3)) in 2005-2006, (-8.9% or 35,266,143 m^3) in 2006-2007, and (-4.8% or 17,424,914 m^3) in 2007-2008 (see Table 3.2). All numbers are within the acceptable limits (10%) for water balance calculations (Scott et al., 2001), thus providing a high level of confidence in phosphorus and nitrogen load calculations. However, considering constant negative imbalances, when more water is leaving than entering the lake system, it can be assumed that Lake Scugog has considerable, undiscovered groundwater inflow from shallow aquifers.

Table 3.2. Lake Scugog Water Budget for 2005-2006, 2006-2007 and 2007-2008 Hydrologic Years

	2005 – 2006		2006 – 2007		2007 – 2008	
	Discharge, m^3/s	Volume, mln. m^3	Discharge, m^3/s	Volume, mln. m^3	Discharge, m^3/s	Volume, mln. m^3
Total Water Inflow:	**11.474**	**361.84**	**11.452**	**362.44**	**11.245**	**355.61**
Precipitation (P)	1.943	61.27	1.912	60.28	1.847	58.41
Surface inflow (Q_{in}) including:	9.531	300.58	9.540	302.16	9.398	297.20
Nonquon River	2.697	85.06	2.401	76.32	1.904	60.22
Cawker's Creek	0.117	3.70	0.137	4.35	0.100	3.16
Fingerboard Creek	0.119	3.74	0.103	3.27	0.120	3.78
Blackstock Creek	0.354	11.17	0.296	9.40	0.352	11.11
Mariposa Brook	2.075	65.43	2.618	82.92	2.622	82.68
East Cross Creek	2.077	65.50	1.951	61.77	2.441	76.99
Ungauged part of the watershed	1.950	61.50	1.915	60.39	1.705	51.25
Urban areas of the watershed	0.121	3.83	0.098	3.09	0.133	4.21
Anthropogenic inputs (A_{in})	0.021	0.65	0.021	0.65	0.021	0.65
Total Water Outflow:	**11.934**	**376.34**	**12.611**	**397.71**	**11.800**	**373.04**
Evapotranspiration (E)	1.251	39.44	1.251	39.44	1.251	39.44
Surface outflow (Q_{out})	10.528	332.01	11.279	355.69	10.382	328.31
Anthropogenic extraction (A_{out})	0.077	2.44	0.077	2.44	0.077	2.44
Change in lake storage (ΔS)	0.078	2.45	0.004	0.14	0.090	2.86
Imbalance ($\pm\Delta$), mln. m^3		**14.49**		**35.27**		**17.42**
Imbalance ($\pm\Delta$), %		**- 4.1**		**- 8.9**		**-4.8**

3.7 Aquatic Ecology

In Lake Scugog, as in most freshwater ecosystems, aquatic processes are complex and unique in nature. From microscopic plankton to trophy muskellunge, the lives of all aquatic species in the lake are linked in some way through the concept called a food web. A simple food web may start with small pieces of green algae being eaten by mayfly larvae. These larvae continue to feed and develop until they are large enough to serve as a meal for small minnows (baitfish). In turn, these minnows are an important food source for larger-bodied fishes such as bass and walleye, which might ultimately become a meal for an osprey, great blue heron or human. This portrays a simplified interaction among organisms living in or near a lake environment. Defining the actual food web structure in Lake Scugog is extremely complex and beyond the scope of this management plan. The purpose of this section is to highlight aquatic features (mainly aquatic plants and fish habitat) in the lake that are often regarded as high management priorities and to touch on some emerging issues that may affect them.

Aquatic Plants

In Lake Scugog, aquatic plants, or macrophytes, play an integral role in supporting aquatic life. Macrophytes provide important habitat (e.g., food, reproductive and cover habitat) for fish, invertebrates and wildlife. They also produce oxygen, consume nutrients and absorb contaminates, stabilize the lake bottom and reduce shoreline erosion. A significant aquatic plant community exists in the numerous wetlands around the margins of the lake. The largest wetland complex, known as Osler Marsh, is located south of the lake and occupies 13.77 km^2. This extensive wetland is especially important for migratory and breeding waterfowl, but also provides excellent spawning and nursery habitat for fish in the lake. Other smaller wetlands also provide beneficial ecosystem functions.

In Lake Scugog, aquatic plant growth is commonly perceived to be excessive. The lake can be classified as nutrient rich and conducive to increased aquatic plant and algal growth. This is due to a number of regional and local factors such as geology, physiography, climate and land use. In certain instances, excessive plant and algal growth in a lake can significantly reduce the amount of dissolved oxygen available for fish. This process can develop when large amounts of plant material decompose and oxygen-consuming microorganisms begin feeding on the decaying matter. This phenomenon can be accelerated by the formation of a thick layer of ice, preventing air to water oxygen exchange, as well as during periods of high water temperatures.

In many areas of the lake, increased macrophyte coverage results from the dispersal of Eurasian water milfoil, a non-native species. Eurasian water milfoil is an aggressive, submerged aquatic plant native to Europe, Asia and North Africa that has become one of the most widely distributed non-native aquatic plant species throughout North America. Although not positively identified until 1942, it is believed that milfoil was introduced to North America sometime in the late 1800s. Eurasian water milfoil emerges in early spring ahead of native species. This head start allows it to shade out other species and inhibit their growth. Milfoil tends to become the dominant species in any lake where it is present and has formed dense mats throughout Lake Scugog. Evidence from other Kawartha Lakes indicates that milfoil may eventually become self-limiting, with the trend in these lakes possibly indicating a reduction in growth after six to eight years. In Lake Scugog, the first indications of Eurasian water milfoil appeared around 1975 and peaked in 1989. Coverage has subsequently declined since that time (Kawartha Region Conservation Authority, 2004).

Areas of extensive milfoil growth consist of thick, dense beds of aquatic vegetation that can seriously impair the recreational uses of the lake, including swimming, boating and aesthetics. As a result, landowners and outdoor event operators often feel it necessary to actively reduce these aquatic plants in certain locations. Several site-specific plant control strategies exist including chemical (e.g., herbicide application), physical (e.g., harvesting equipment) and biological (e.g., milfoil weevil introduction). Some plant removal techniques have the potential to severely impact aquatic communities as most of the fishes in Lake Scugog rely, either directly or indirectly, on macrophytes to realize their life processes. Depending on the location, type and scale of control desired, work approval would likely be required from one or more approval agencies (i.e., DFO, TSW, MOE and/or Kawartha Conservation).

Fisheries

Fish habitat is defined as "spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly to carry out their life processes." The Lake Scugog watershed provides all of these habitat features, each of which are necessary for supporting and maintaining healthy, naturally reproducing fish populations.

Fish species are an important ecological link in the food web and are also important indicators of water quality and ecosystem health. They serve as food for other fish, birds, reptiles and mammals, including humans. Fish, as do all aquatic life forms, serve as "sentinel" species, providing a signal to humans that water quality may be changing.

One of the most central organizing features of aquatic communities is water temperature. In streams and lakes, thermal habitat is influenced by a number of factors, including air temperature, precipitation, topography, latitude, land use, vegetation coverage, water depth, geology and soils. In the Lake Scugog watershed, two main types of fish communities exist; warm water and coldwater. Warm water species (e.g., largemouth bass, muskellunge, walleye and common carp) occupy the entire lake as well as lower sections of its tributaries. No coldwater species are native to Lake Scugog. The distribution of coldwater fish species (e.g., brook trout and mottled sculpin) is limited to the upper sections of streams originating in the ORM and localized groundwater discharge areas.

The fish community in Lake Scugog is similar to others in the connected Kawartha Lakes and is characterized by warm water fish species supported entirely by natural reproduction. There is no active fish stocking program in the lake. The native sport fish community includes muskellunge and smallmouth bass. Largemouth bass were introduced in the early 1900s, and walleye were introduced to provide additional fishing opportunities from the 1920s through the 1940s. Other species that are non-native to the lake include common carp (late 1800s), bluegill (1970s) and black crappie (1990s). The present-day sport fish community is composed of muskellunge, smallmouth and largemouth bass, walleye, yellow perch, bluegill, pumpkinseed and black crappie (MNR, 2008a). The fishery in Lake Scugog is guided by the management directives outlined in the Fisheries Management Plan for Zone 17 (MNR, 2009).

To assess the extent of the open water and winter recreational fishery on Lake Scugog, the Kawartha Lakes Fisheries Assessment Unit (KLFAU) of the Ontario Ministry of Natural Resources has been periodically conducting angler surveys since 1977. In any given year, the effort spent fishing on Lake Scugog is quite substantial, amounting to approximately 200,000 angler-hours (Table 3.3). This level of effort is comparable to some of the larger lakes in Ontario including the Canadian side of Lake Superior and Lake St. Clair.

Table 3.3. Estimated Angler-hours by Survey Year for the Lake Scugog Open Water and Winter Recreational Fishery

Year	Total Winter Hours	Total Open Water Hours	Walleye Open Water Hours
1977	-	152,955	102,777
1980	-	97,893	57,895
1982	68,584	-	-
1984	60,599	121,170	87,874
1988	81,398	142,259	118,237
1992	147,503	-	-
1993	-	133,469	71,891
1994	51,724	-	-
1997	79,960	-	-
1998	-	120,911	94,165
2003	86,177	95,452	46,452
2007	40,560	62,167	29,628
Average	**77,063**	**115,785**	**76,115**

Data: MNR, 2008a, 2008b

Angler effort in the most recent survey in 2007 was considerably lower than in previous years. Since the late 1980s, angler effort in the open water fishery has been steadily declining. Walleye is the primary targeted species in the lake, therefore the decline in angler effort is likely due to the significant decrease in the relative abundance of walleye since the 1980s. The reduction in walleye does not indicate that the health of the fishery is declining, but that it may be a product of some regional shift in the physio-chemical characteristics of the lakes in the Kawartha Region. These conditions have made fish habitat more favourable for sport fishes such as bass and muskellunge, and less favourable for walleye (Robillard and Fox, 2006). Although species composition has shifted, recent field surveys indicate that total fish biomass actually meets or exceeds historical netting data (MNR, 2008c).

Emerging Issues

Most of the emerging threats and stresses identified as harmful to freshwater lakes in Ontario also apply to Lake Scugog. It is important to identify and minimize emerging threats in order to maintain healthy aquatic ecosystems.

What takes place on land is often mirrored in the water. For example, a river or stream flowing through an agricultural area can pick up fertilizer, manure and pesticides. Runoff passing through urban areas might gather fertilizers from lawns, wastewater discharges from industrial facilities, sediments from construction sites, and runoff from impervious surfaces such as transportation corridors and parking lots. A lake's biological communities live in the receiving waters. The health of these communities depends on the cumulative effect of chemical, physical and biological influences of upstream and adjacent land use.

Much of the natural shoreline around Lake Scugog has been altered by single dwelling developments and for waterfront access. Healthy riparian zones provide multiple benefits for watershed health and ecological diversity, in addition to improving water quality. The lack of natural riparian areas often results in increased shoreline erosion, loss of suitable aquatic habitat, and a reduced capacity for natural nutrient and contaminant filtration.

Exotic invasive species can present a serious threat to the aquatic habitat. For instance, natural controls such as predators, parasites, pathogens and competition are not present in their new habitats. The absence of such controls allows these exotic species to spread unchecked throughout a new environment. Once established, they are difficult to eliminate, often flourishing in their new habitat, challenging and crowding out the native species, and changing the physio-chemical properties of the water body. Introduced species, whether aquatic or terrestrial, are a major cause of biodiversity loss throughout North America. The Eurasian water milfoil, as well as zebra mussels, rusty crayfish and purple loosestrife, is perhaps the most well-known invasive species to recently colonize Lake Scugog. Other potential invaders, already present in Ontario, have the ability to influence the aquatic ecology of the watershed should they become established. Some examples include the round goby (fish), spiny water flea (invertebrate) and water soldier (plant).

There is an opinion within the scientific community that climate change can cause higher air and water temperatures, changes in rain and snowfall patterns, and changes to atmosphere circulation patterns (MNR, 2008). The potential impacts of climate change on the Lake Scugog aquatic ecosystem and all of southern Ontario are not yet understood. Research suggests that some possible changes to the fishes in southern Ontario can include shifts in species distributions, reduced growth in some species and enhanced in others, increased competition from invasive species, greater susceptibility to disease and parasites, and altered ecosystem function (Kennedy et al., 2002; Jackson and Mandrak, 2002).

3.8 Terrestrial Ecology

Terrestrial natural heritage features in the Lake Scugog watershed include forest, wetland, sand barren, rock barren, beach, bluff, and grasslands such as prairie and savanna. These naturally vegetated areas form part of a feedback loop, as groundwater and surface water cycle through the atmosphere and the landscape. Healthy watersheds have a good mix of naturally vegetated areas well distributed across the landscape. Watersheds with a higher percentage of natural cover are generally better able to keep soil, nutrients, pathogens and contaminants out of groundwater and surface waters.

Wetlands, forests and vegetated buffers protect watercourses and lakes because of higher infiltration rates in these areas and subsequently slow water release from shallow aquifers or wetland storage areas. As well, dense vegetation traps suspended sediments with associated nutrients and contaminants in surface runoff, preventing them from entering into water bodies.

Wetlands in the Lake Scugog watershed include swamps, marshes, fens and bogs. Although some wetlands have been drained to facilitate agricultural practices in parts of the watershed, a number of wetlands remain throughout the area. Large wetlands are present south from Lake Scugog (i.e., Osler Marsh) and in the western portion of the watershed due to the sluggish nature of the Nonquon River and low gradients in that area. Smaller wetlands are usually located in headwaters of streams or around the lake. There is approximately 70.3 km^2 of wetland habitat in the watershed. This represents about 15.5% of the watershed. Most of the wetland cover is in the form of forest and thicket swamps in lowland areas, although some relatively large cattail marshes exist on Lake Scugog (and Osler Marsh).

The total forest cover in the Lake Scugog watershed is 112.3 km^2, representing 24.8% of the watershed area. Forested swamps can be considered both wetlands and forest, and are included in the calculation of total cover and per cent cover for both (Table 3.4). This is still below the 30% recommendation that is being widely applied to planning areas in southern Ontario for the Great Lakes Areas of Concern (Environment Canada, 2004). The *Durham Region Official Plan* also establishes an overall forest cover target of a minimum 30% of total land area (Region of Durham, 2008). These numbers indicate a specific landscape target for the *LSEMP Implementation Plan*.

Table 3.4. Naturally Vegetated Area Characteristics for Various Subwatersheds

Major Watershed	Watercourse	Drainage Area, km^2	Wetland, %	Forest, %
Lake Scugog	Blackstock Creek	37.9	5.73	23.4
	Cawker's Creek	10.4	0.78	6.49
	Fingerboard Creek	12.7	5.08	19.22
Nonquon River	Nonquon River at Line 6	29.3	5.42	35.61
	Layton River	52.3	10.54	27.81
	Nonquon River, total	184.7	15.44	26.4

* Forested swamps are included in both forest and wetland cover

Forests have an effect on the hydrological regime by retaining snowmelt and storm runoff and increasing infiltration and groundwater recharge. Tree cover creates and maintains a mat of leaf and twig litter, which slows runoff and reduces soil erosion. The older, decomposed materials near the bottom of this layer enrich the soils with nutrients and improve soil structure and fertility. Infiltration may also be improved by the development of root channels as trees grow. Deforestation or significant disturbance of forests increases surface water runoff and soil erosion, and reduces the water retention capacity of a watershed.

In the southern portion of the watershed (with the exception of the ORM), much of the forest cover is fragmented into isolated patches of varying sizes and shapes. Forest fragmentation is detrimental to overall forest health and habitat, and reduces groundwater recharge and biodiversity. Working toward a goal of the recommended 30% of forest cover is desirable for improving water quality and quantity, as well as overall ecological function. Reforestation of riparian buffer strips also contributes to ecological function and improved water quality.

Riparian zones are highly variable, reflecting the physical heterogeneity of the drainage basin. The spatial extent and plant community type occupying the riparian zone will change longitudinally and laterally as a function of valley morphology, climate, hydrology and soils. As such, riparian zones should encompass a range of natural vegetation types, including woody vegetation, riparian meadows and other natural community types that contribute to water quality. A minimum setback distance from the shoreline or watercourse edge in which riparian vegetation is protected should be determined to delineate the extent of this feature. Many studies have examined optimal widths or lengths of vegetative cover along watercourses, according to how they buffer water quality, with distances varying from 3 to 200 metres. Healthy riparian zones provide multiple benefits in terms of watershed health, ecological diversity and improved water quality.

Kawartha Conservation undertook an analysis of riparian cover by length of stream in each subwatershed. Ecological communities were grouped into major habitat categories of forest, wetland and meadow. The per cent cover of each category was calculated for three buffer widths in each stream order. Combining these three habitats allowed the calculation of total natural cover in the riparian zone of each subwatershed (Table 3.5). For the Lake Scugog watershed combined, there is an average of 57.8% of vegetated cover within a 5-metre riparian buffer, 58.6% within 10 metres, and 56.8% within a 30-metre buffer. This is below the 75% riparian cover recommended for the watersheds in the Great Lakes Areas of Concern (Environment Canada, 2004), a figure that is frequently targeted. Approximately 40% of the riparian zones currently do not contain natural cover, suggesting there is ample room for improvement.

Table 3.5. Total Natural Cover in the Riparian Zone of Various Subwatersheds

Subwatershed	Natural Cover per Riparian Zone, %		
	5 m	10 m	30 m
Blackstock Creek	63	61	58
Cawker's Creek	68	67	61
Fingerboard Creek	58	58	54
Layton River	73	74	73
Nonquon River at Scugog Line 6	68	68	67
Nonquon River, total	71	75	71
Lake Scugog	36	39	42
Scugog River	46	44	41

A natural heritage strategy should be implemented in the Lake Scugog watershed, similar to one that the Toronto and Region Conservation Authority (TRCA) used. In the late 1990s, the TRCA initiated the Terrestrial Natural Heritage (TNH) Program to address terrestrial biodiversity loss in its watershed by applying principles of conservation biology and landscape ecology. A basic premise of the TNH Program is that, in the heavily fragmented landscape of the GTA, more natural cover is required to improve ecological function and integrity. Based on historical conditions and the tendency of natural succession, most of that cover should be forest. Thus, the identification of forest restoration opportunities is a key component in defining a target for an expanded terrestrial natural system. This is not to suggest that forest should be advocated everywhere. Where suitable conditions exist, wetlands and native meadows (e.g., prairies and savannas) should become a restoration focus. Once the terrestrial component is completed it will be integrated with aquatic and social elements to define a more comprehensive natural heritage system (TRCA, 2005). It is anticipated that this natural heritage strategy will address objectives of the *Endangered Species Act* and *Species at Risk Act* .

3.9 Land Use

Land use in the Lake Scugog watershed can be subdivided into agriculture (cultivated lands and pasture), forest, wetland, urban areas, scrubland and rural developments (Figure 3.4). Agriculture represents close to 53% of total land use while forest and wetland represent almost 34% of land use. The remaining 13% is composed of the other land uses. All data presented above were obtained from Ecological Land Classification done in 2002 by air photo interpretation in the GIS (Geographic Information System) Department of Kawartha Conservation.

As noted, 53% of the watershed land is used in some form of agriculture. Watershed-specific data have been extrapolated based on the percentage of the area within the watershed relative to total area. Total land use for farming is slightly over 240 km^2. Major crop production based on area, in descending order; includes alfalfa and alfalfa mixtures (64 km^2), corn for grain (48 km^2), soybeans (32 km^2), and total wheat (12 km^2) (Statistics Canada, 2006). Livestock is dominated by cattle, with over 16,250 head of cattle present in the region. In addition, a large number of poultry, over 450,000 in total, are produced within the watershed municipalities, particularly in the Township of Scugog where an estimated 85% of the total poultry population is present. In addition, a large number of farms within the watershed municipalities practice various forms of soil conservation practices including, but not limited to, crop rotation, permanent grass cover, and grassed waterways. Furthermore, over 40 km^2 are fertilized using manure (*LSEMP Background Report, 2005*).

Urban land use comprises slightly over 3.5% of the total area of the watershed. The Port Perry urban area is the major population centre in the watershed. From the *Durham Region Official Plan* combined with the population forecasts for Port Perry, land concentrated around Cawker's Creek is designated as area that may be developed on municipal water systems and private waste disposal systems (Region of Durham, 2008). In addition, the lands northeast of Port Perry and east of Highway 7/12 are designated as "areas developable on private wells and private waste disposal systems" (Region of Durham, 2003, 2008). All areas are within the defined urban area of Port Perry.

The shoreline of Lake Scugog has been highly manipulated. As of 2008, over 2,100 shoreline residential properties surround Lake Scugog. Many of these houses were initially built as summer cottages but were later converted to permanent residences. Furthermore, the majority of the waterfront residences have a manipulated shoreline that tends to lack the buffering capacity and habitat-producing aspects of a natural shoreline. These residences have private sewage systems and private wells for water uses.

Under provincial guidelines, municipalities, both upper-tier and lower-tier, have developed land use policies in the framework of their official plans to ensure efficient and appropriate use of land resources, and to protect unique natural features and the environment. A short description of land use designations in the Lake

Scugog watershed is given below for the Region of Durham, the Township of Scugog and the City of Kawartha Lakes.

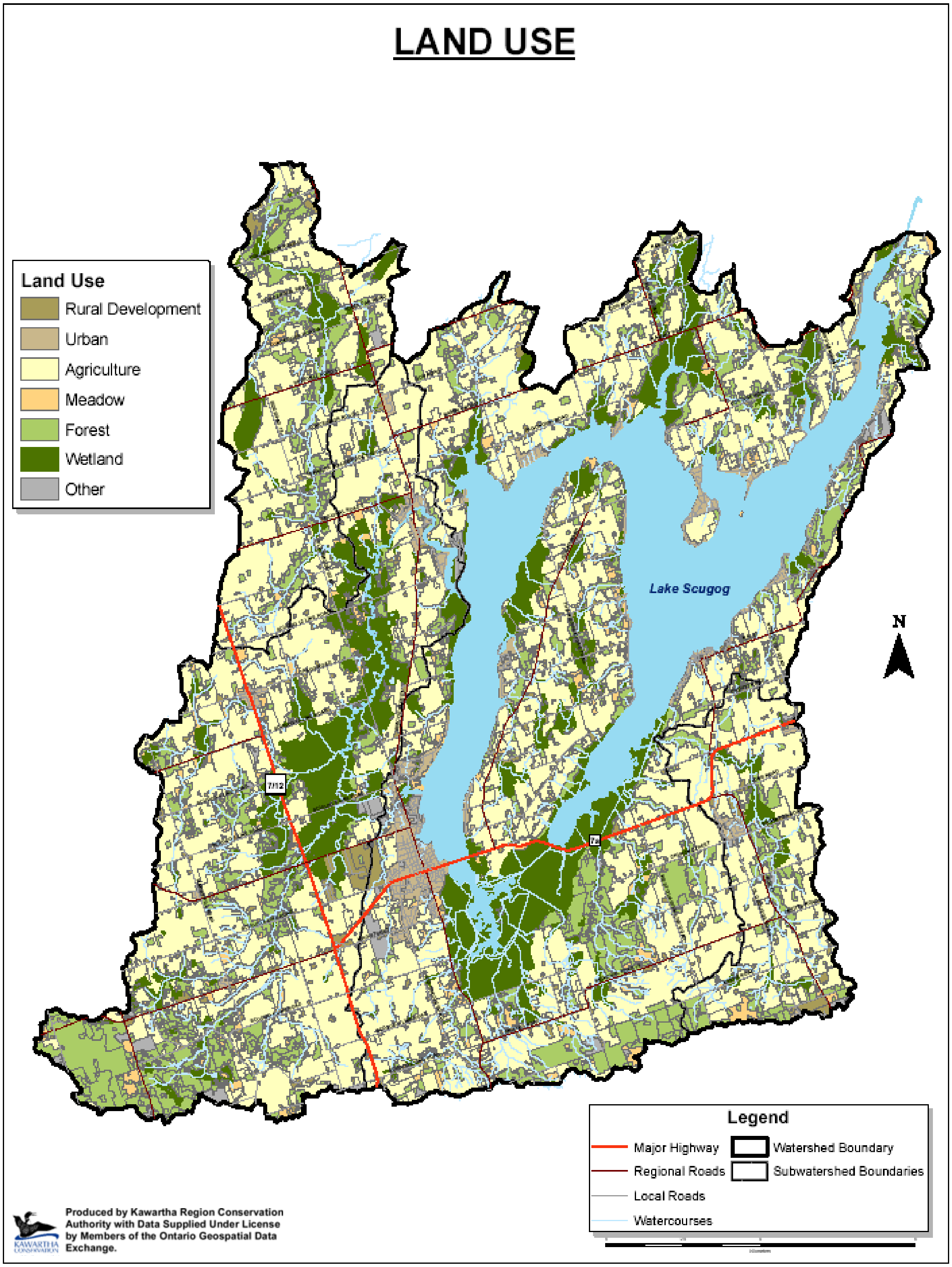

Figure 3.4. Land Uses in the Lake Scugog Watershed

3.9.1 Durham Region Official Plan Land Use Designation

Land use in the Region of Durham portion of the Lake Scugog watershed is regulated by the *Durham Region Official Plan*. Its newest version was approved in 2008 and amended in 2009 (Region of Durham, 2008, 2009). The official plan addresses Oak Ridges Moraine and Greenbelt legislation and is quite proactive in the protection of the environment. As well, this plan establishes a policy framework for guiding growth and development in the region.

The majority of the watershed, excluding the Port Perry urban area, is designated as Prime Agricultural Areas and Major Open Space Areas. Land designated as Permanent Agricultural Reserve is prime agricultural land and restricted from the establishment of non-agricultural activities except forest, fish and wildlife management. Major Open Space Areas include key natural heritage and hydrologic features, and prime agricultural lands as well as lands of lesser agricultural significance (Region of Durham, 2008). Lands in this category must be used for conservation and agriculture. The Lake Scugog shoreline is designated as either Shoreline Residential or Waterfront Areas (Figure 3.5). The waterfront of Lake Scugog shall be developed as "people places" with the exception of significant natural areas. Any development that occurs within the area must not negatively impact key natural heritage or hydrologic features (Region of Durham, 2008).

3.9.2 Township of Scugog Official Plan Land Use Designation

In February of 2009 a new, updated Township of Scugog Official Plan was prepared and posted for public comments. It was adopted by the Township Council in June of 2009 and is currently waiting for approval by the Region of Durham. The official plan ensures that future planning and development in the township meet the needs of the community. The official plan incorporates components from the *Oak Ridges Moraine Act* and the *Greenbelt Act*. In the official plan, a large portion of the Lake Scugog watershed is designated as Greenlands System (Figure 3.6). Accepted use of these lands includes agriculture, forestry, single detached dwellings, recreation that has no adverse effect on the environment and watershed management activities (Township of Scugog, 2009). Greenlands System includes fish habitat, areas of natural or scientific interest, environmentally sensitive areas, wetlands (e.g., Osler Marsh and Nonquon Marsh) and areas not suitable for development. Other areas are designated as Rural System that includes Agricultural Lands, Shoreline, Hamlets and Residential Clusters, and Mineral Aggregate Extraction. The other significant designated land is the Port Perry Urban Area that includes the Port Perry Employment Area, which occupies almost 358 hectares (Township of Scugog, 2009).

3.9.3 City of Kawartha Lakes Official Plan Land Use Designation

Currently, land use in the City of Kawartha Lakes (CKL), including that portion of the Lake Scugog watershed located within the CKL boundaries, is regulated by the *Victoria County Official Plan* that was initially approved in 1978. The most recent consolidated copy of the plan with all adopted amendments was released in May of 1999 (County of Victoria, 1999). The current official plan emphasizes the need to develop lake capacity studies for the Kawartha Lakes taking into consideration environmental, social and economic aspects.

The *City of Kawartha Lakes Draft Official Plan* is expected to be adopted by the City Council in 2010 and subsequently forwarded to the Ministry of Municipal Affairs and Housing for approval.

The majority of lands within the Lake Scugog watershed are designated as Prime Agricultural and should be used only for agricultural and agriculture-related purposes (*City of Kawartha Lakes Draft Official Plan*). The purpose of this designation is to protect and strengthen the agricultural community.

Another significant portion of the watershed falls into the Environmental Protection designation (Figure 3.7). The purpose of this designation is to identify land that is subject to flooding, where the water table is very close to the surface or is unsuitable for development due to physical hazards (*City of Kawartha Lakes Draft Official Plan*). Land uses permitted within this designation include agriculture, forestry, gardening, conservation and recreation. Any land uses should maintain the natural characteristics of designated lands and should not contribute to problems of erosion, flooding, pollution or the deterioration of the environment (*City of Kawartha Lakes Draft Official Plan*).

Designating land as Waterfront is important to Lake Scugog. It permits seasonal and permanent residential development adjacent to the lake as well as commercial uses with a tourism orientation, i.e., marinas, resorts or recreational vehicle parks. Within this designation, natural forms and functions shall dominate. Naturally vegetated shorelines should be retained and restored wherever possible (*City of Kawartha Lakes Draft Official Plan*). In its Draft Official Plan, the City of Kawartha Lakes recognizes the importance of lake environmental plans and lake stewardship programs and encourages their development in order to protect valuable natural resources.

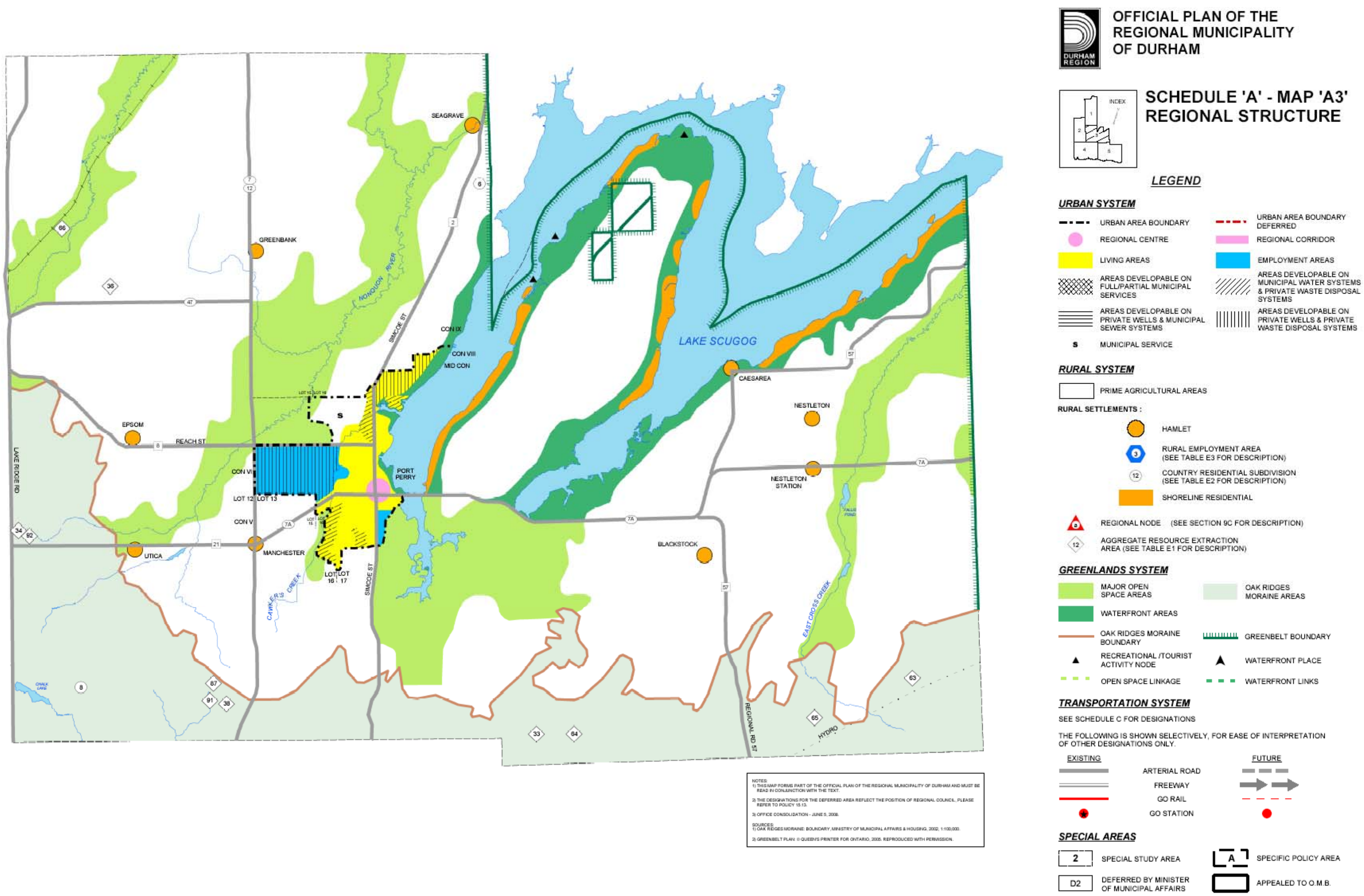

Figure 3.5. Lake Scugog Watershed Land Use Designation within the Region of Durham

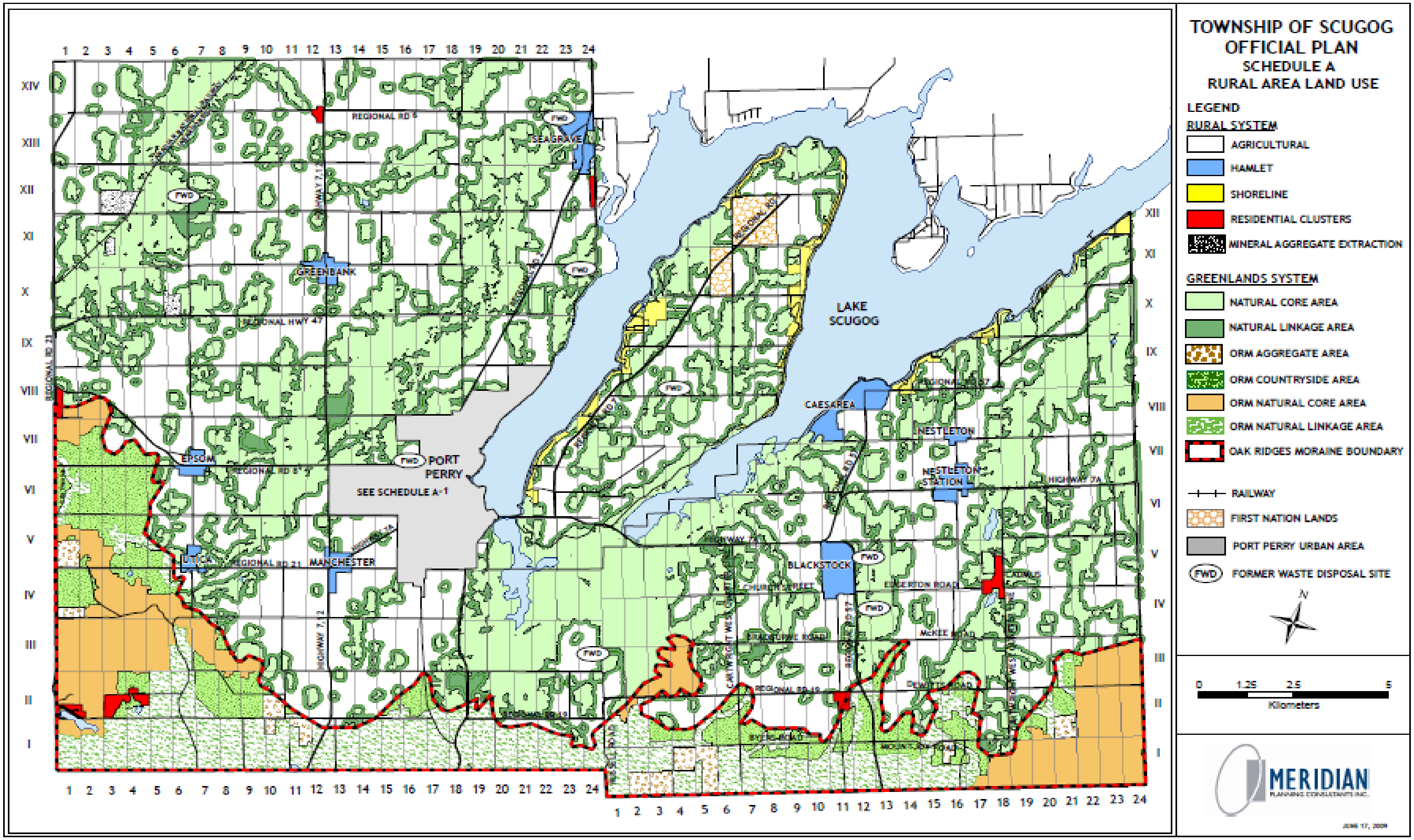

Figure 3.6. Lake Scugog Watershed Land Use Designation within the Township of Scugog*

*Pending approval by the Region of Durham

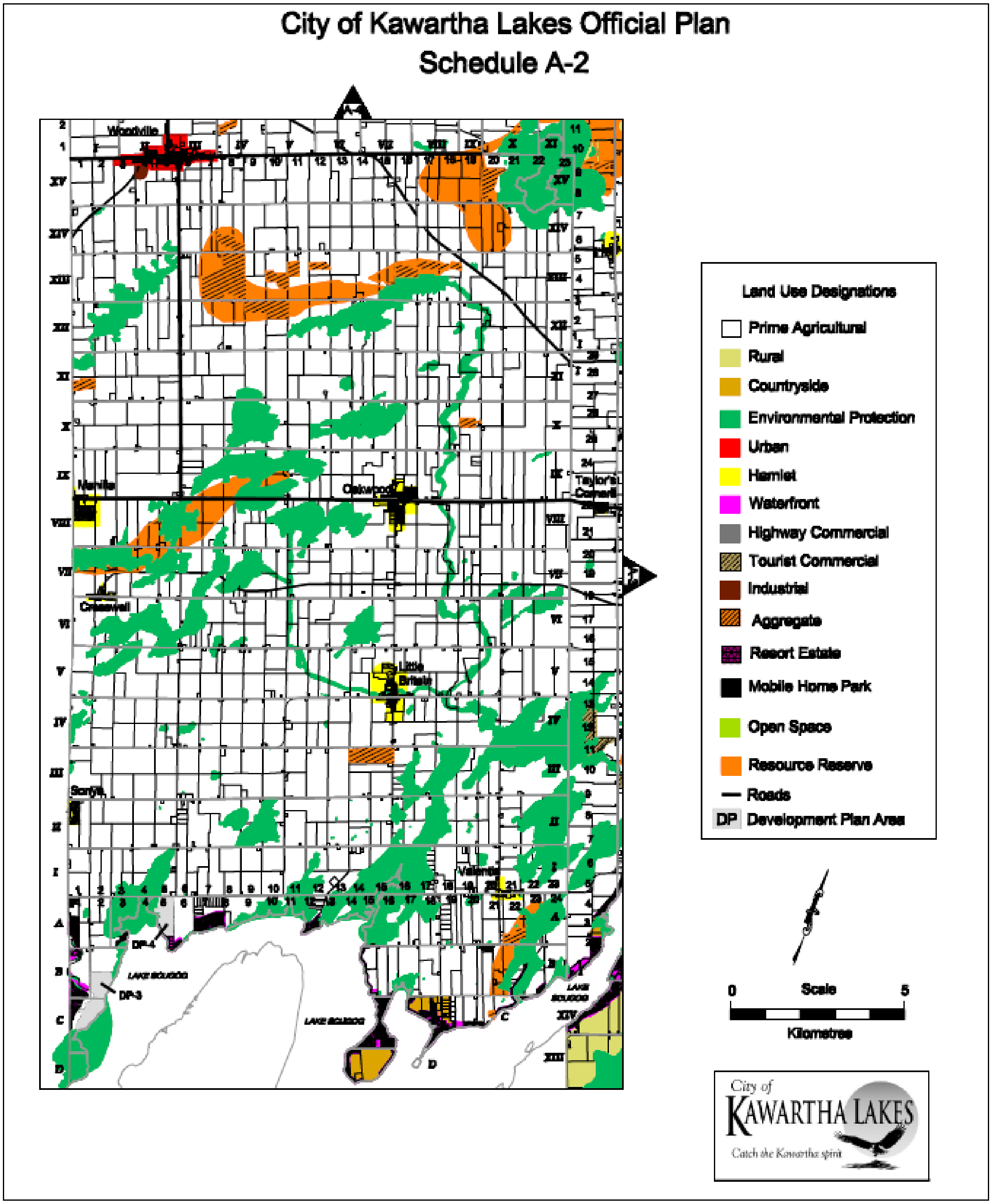

Figure 3.7. Lake Scugog Watershed Land Use Designation within the City of Kawartha Lakes

3.10 Water Use

Local residents, industry and agriculture use both surface and groundwater in the Lake Scugog watershed. A significant portion of the population around Lake Scugog relies on groundwater as a source of water supply. This includes residents of Port Perry, Blackstock, Greenbank, Mariposa Estates, Canadiana Shores, Sonya, Pleasant Point and King's Bay that receive their drinking water through the municipal groundwater systems as well as residents in rural areas that draw their water supply from private wells.

No communities in the Lake Scugog watershed rely on surface water for drinking purposes. However, the Town of Lindsay obtains drinking water for its residents from the Scugog River – the only outflow from Lake Scugog. The average water use for the Town of Lindsay is 6,697 cubic metres per day (m^3/day), with annual usage at about 2,439,370 m^3, collectively serving a population of approximately 19,000 (City of Kawartha Lakes, 2003). This includes water supply for residential, industrial, and institutional facilities in Lindsay as well as in Oakwood.

Due to high nutrient levels in lake water and, consequently, high organic matter levels, drinking water, after treatment at the Lindsay Water Treatment Plant with chlorine, very often has contained elevated concentrations of trihalomethanes that were above the Provincial Drinking Water Quality Standard (City of Kawartha Lakes, 2007; MOE, 2009a). According to the latest information from the City of Kawartha Lakes, trihalomethane levels have been mostly below the Drinking Water Quality Standard during 2009.

4.0 Water Quality

Water quality is the most crucial component of the LSEMP. The ultimate goal of the plan is to improve water quality in the lake and its tributaries to such a degree that it will ensure the long-term environmental and social sustainability of the lake.

Water quality can be defined as an integrated index of the chemical, physical and microbiological characteristics of natural water. Water quality is a function of natural processes and human impacts. Human influences on the quality of natural waters may severely damage the environmental health of aquatic systems and may originate from many sources. These include point sources of pollution such as municipal and industrial wastewater discharges, ruptured underground storage tanks, septic tanks and landfills. Non-point pollution may also heavily impact water quality, including diffuse sources such as agricultural drainage, urban runoff, land clearing and field application of waste.

The main objective of water quality data analysis is to convert water quality observations into educational programs and for use by the various levels of government to promote rehabilitation programs for disturbed environmental systems.

4.1 Water Quality in Tributaries

All major watercourses in the Lake Scugog watershed are under heavy pressure from human activities. As a result, streams very often have high concentrations of total phosphorus and total nitrogen and, in some cases, elevated levels of chloride and sodium. On several occasions, severe cases of dissolved oxygen deficit have been observed. From the analysis of collected water quality data, several areas of concern across the watershed have been revealed. Water quality is most affected in all three major tributaries, namely Blackstock Creek, Cawker's Creek and the Nonquon River (Figure 4.1). All of these watercourses exhibit extremely high phosphorus and nitrogen concentrations. As well, the Port Perry urban area and all other urban areas in the watershed generate significant amounts of phosphorus and other contaminants that eventually emerge in Lake Scugog. The northern portion of the watershed, including the Fingerboard Creek and Layton River subwatersheds, contains moderate levels of nutrients in its water.

As noted previously, the main water quality problem in Lake Scugog is a process of accelerated eutrophication caused by excessive input into the lake of two primary nutrients – phosphorus and nitrogen. The greater part of the nutrient load enters the lake with river flow. Therefore water quality and nutrient concentrations in tributaries may largely determine the water quality and ecological state of the lake.

Total Phosphorus

Average phosphorus concentrations in the water of most watercourses are typically above or steeply above the Provincial Water Quality Objective (PWQO) for rivers and streams that is set at 30 micrograms per litre (μg/L) (Figure 4.2).

The Blackstock Creek subwatershed occupies the southeastern corner of the watershed (see Figure 4.1). The total area of the subwatershed is 37.9 km^2. Agricultural lands occupy a considerable portion of the subwatershed. More than 62% of lands in the area are used for agricultural production. Blackstock Creek, despite its primarily rural land use and relatively high percentage of forests and wetlands in its subwatershed, is one of the main sources of phosphorus and nitrogen for Lake Scugog. It has very high phosphorus levels in its water in both the headwaters and the lower portion of the subwatershed.

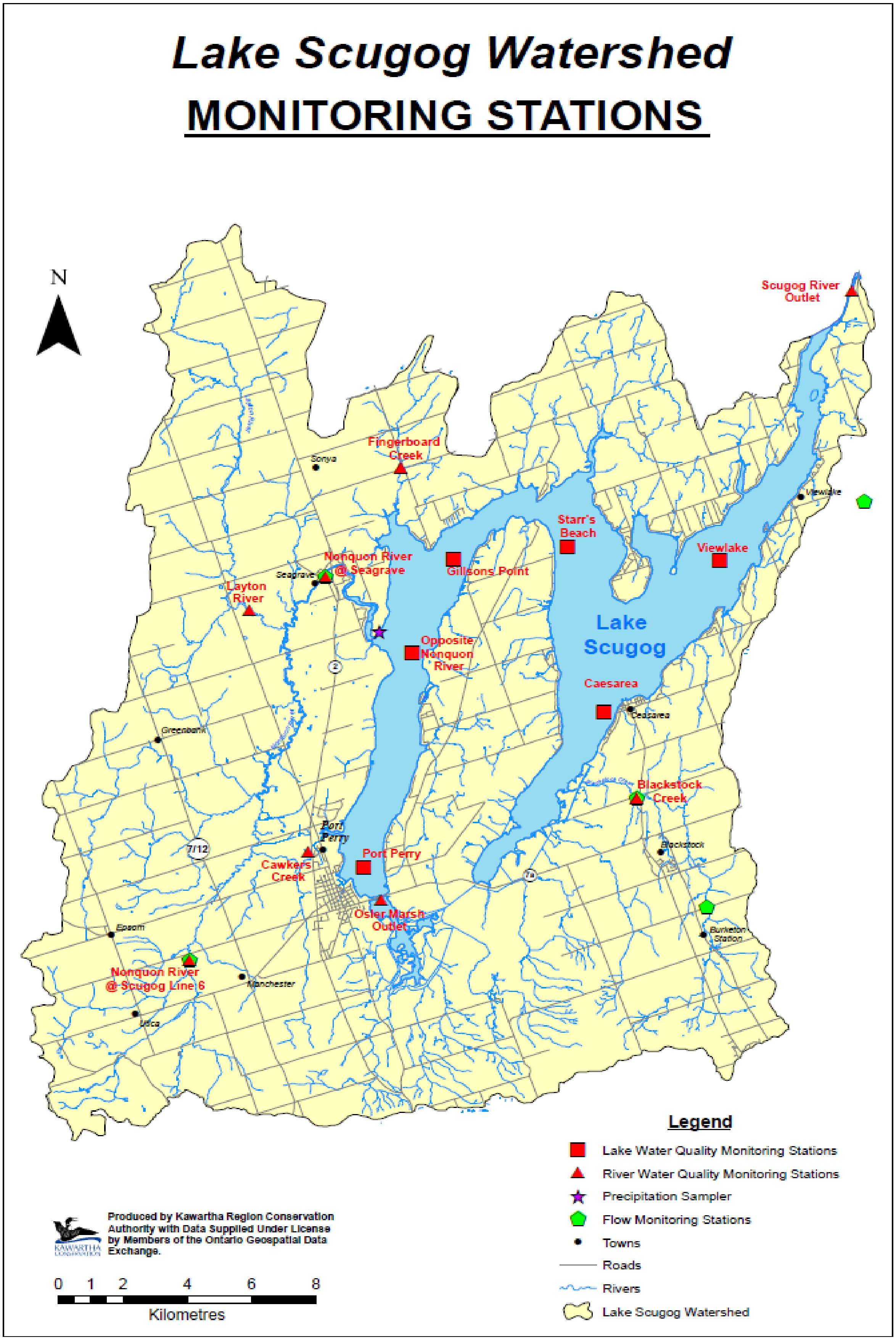

Figure 4.1. Lake Scugog Watershed Monitoring Network

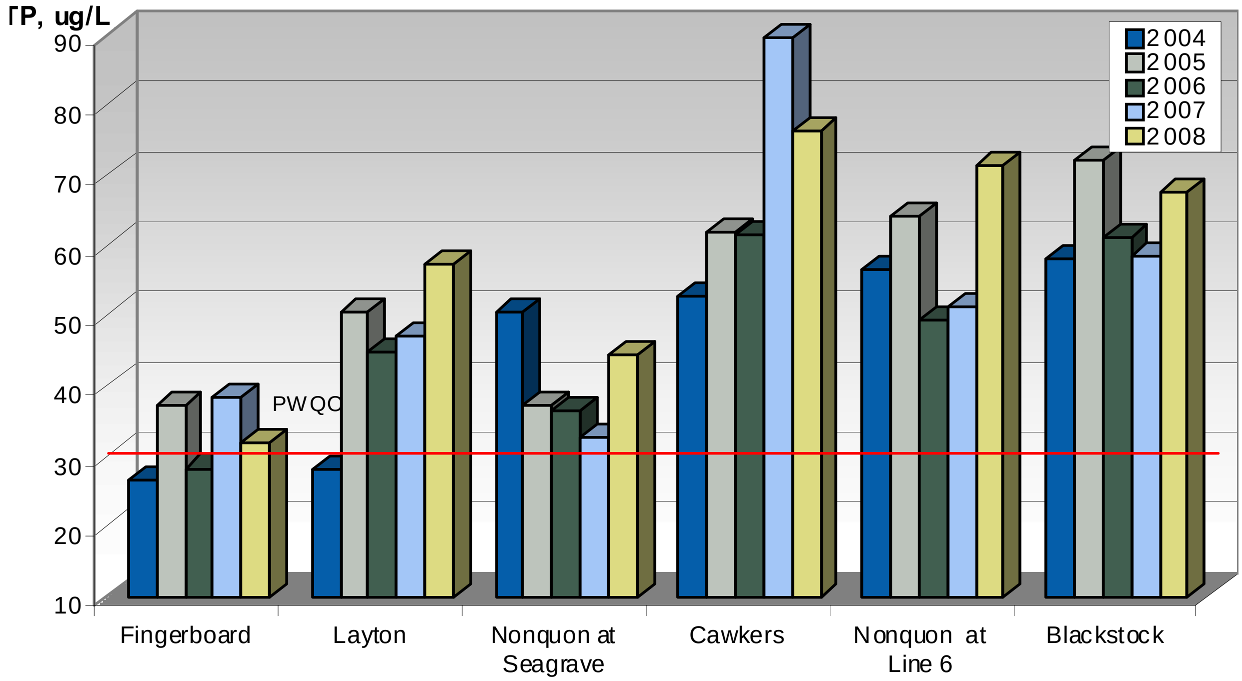

Figure 4.2. Average Phosphorus Concentrations in Water of Lake Scugog Tributaries in 2004-2008

Average annual phosphorus concentrations varied from 58 µg/L in 2004 to 72 µg/L in 2005 (see Figure 4.2). As viewed on the graph, an increasing trend in average phosphorus levels was observed from the beginning of the monitoring program. Throughout the study period, the total phosphorus (TP) concentrations ranged from as low as 10 µg/L in November 2007 and 2008 to as high as 540 µg/L in the beginning of April 2008. Seasonal distribution of phosphorus concentrations in the water of Blackstock Creek is characterized by the highest observed levels during the spring freshet and the lowest levels in the winter.

Cawker's Creek is the most urbanized stream among monitored major watercourses. The urbanized area occupies 1.5 km^2 or 14.4% of the creek's watershed. As a result, Cawker's Creek has very high total phosphorus concentrations (see Figure 4.2). Average annual phosphorus concentrations in the water of the creek are usually well above the PWQO. The highest annual average value was 89.6 µg/L in 2007, and the lowest value of 52.6 µg/L occurred in 2004. Maximum TP concentration was detected in August 2008, at 443 µg/L, and a minimum was detected at the end of March 2006, at 12 µg/L. During the study period, an apparent increasing trend in average and median phosphorus concentrations was observed. The highest TP levels were usually detected in springtime during the freshet. The lowest concentrations were frequently observed in February and October.

The Fingerboard Creek subwatershed is located in the northwestern corner of the Lake Scugog watershed (see Figure 4.1). It has a drainage area of 12.72 km^2. Almost 70% of the subwatershed lands are used in agriculture. It lacks any urban areas. Forests and wetlands occupy more than 21% of the subwatershed.

Despite a high percentage of agricultural lands in its watershed, Fingerboard Creek has the lowest concentrations of phosphorus compared to other streams. Average annual TP concentration was the lowest in 2004, at 26.7 µg/L, and the highest in 2007, at 38.3 µg/L. There are obvious cycles in average phosphorus levels on a yearly basis (see Figure 4.2). The long-term value for the period of 2004 to 2008 averaged 31.6 µg/L, which is reasonably good, especially in comparison to other monitored streams. The long-term median value is even lower, at 26.0 μg/L. Fingerboard Creek can be considered a typical subwatershed for the entire northern part of the Lake Scugog watershed, except for small urban pockets along the northern shoreline. Throughout the period of observation, individual phosphorus concentrations ranged from as low as 2 μg/L in the second half of April 2008 to as high as 125 μg/L during the spring freshet in March 2006. On average, the highest phosphorus levels are usually observed during summer, however all the highest individual results have been spotted during spring freshets. Average lowest TP concentrations typically prevail in the winter season, but can be interrupted by snowmelt during thaws that cause considerable increases in phosphorus levels.

The Layton River is the major tributary to the Nonquon River. Its subwatershed occupies the utmost northwestern corner of the Lake Scugog watershed and the Nonquon River subwatershed (see Figure 4.1). A considerable portion (more than 59%) of the Layton River drainage area is used for agricultural production. Combined area under forests and wetlands totals 33% of the subwatershed. Typically, the Layton River has fairly high total phosphorus levels. Average annual concentrations fluctuated from 28.2 μg/L in 2004 to 55 μg/L in 2008. The river has a noticeable increasing trend during the period of observation (see Figure 4.2). Maximum individual phosphorus results throughout this period increased as well. For example, the highest detected TP value was 39 μg/L in 2004, 148 μg/L in 2005, 175 μg/L in 2006, 184 μg/L in 2007 and 303 μg/L in 2008. Phosphorus levels are usually the highest in springtime during the freshet and the lowest throughout late autumn to early spring.

In the framework of the Nonquon River subwatershed study, the Layton River was sampled on several occasions in one location upstream from the main monitoring station. These data show that phosphorus levels are much lower in water from the upper part of the stream. It seems there is considerable deterioration of water quality in the area immediately upstream from the monitoring station at Old Scugog Road. On both sides of the river, intensive bank erosion is noticeable where livestock have free access to the river.

The Nonquon River subwatershed occupies almost the entire western part of the Lake Scugog watershed (see Figure 4.1). Similar to other areas in the watershed, the major land use in the Nonquon River subwatershed is agriculture. Almost 55% of the subwatershed area is engaged in agricultural production. At the same time, forests (26.4%) and wetlands (7.5%) cover more than one-third of the drainage area. The Nonquon Marsh area is situated in the middle of the subwatershed. This large marsh occupies 20.41 km^2 and provides substantial filtration capacity for the incoming river flow.

When comparing average and maximum phosphorus concentrations in the lower part of the Nonquon River (at the Seagrave monitoring station) and in the headwaters of the river (at the Scugog Line 6 station), it is increasingly obvious that the Seagrave location has lower TP levels overall. Average annual TP concentrations varied in water measured from the lower section of the river from 32.8 μg/L in 2007 to 50.4 μg/L in 2004. At the same time, the average annual phosphorus levels in the Nonquon headwaters fluctuated from 49.2 μg/L in 2006 to 64.3 μg/L in 2005 (see Figure 4.2). Throughout the entire study period, the average TP value at the Scugog Line 6 location was 56.4 μg/L, while much lower at the Seagrave location – only 39.6 μg/L – representing a 30% reduction in total phosphorus amount. Phosphorus levels ranged from 10 to 327 μg/L at the headwaters location, and from 7 to 112 μg/L at the downstream location. A considerable decrease in total phosphorus levels is evident along the river toward its mouth, despite an additional influx of phosphorus from the Nonquon River Water Pollution Control Plant and from the Layton River. This decrease may be an obvious indicator of self-purification processes that occur in the Nonquon Marsh area.

Similar to other streams, seasonal distribution of total phosphorus levels in the water of the Nonquon River is characterized by the highest readings in springtime, during intensive snowmelt and the resulting freshet. The lowest concentrations are usually observed in late winter. It is typical for both stations and applicable to the entire river system.

Concerning spatial distribution, TP concentrations diminish from the headwaters toward the mouth of the river. However, according to the data from additional monitoring sites in the headwaters of the river, water from the forested area in the southwestern corner of the subwatershed has very low phosphorus concentrations. A tributary that originates and flows through agricultural fields has much higher TP levels that probably affect water quality considerably in the main channel.

The Nonquon River is a key player in the water quality of Lake Scugog, especially in its western basin. The river is the largest watercourse in the Lake Scugog watershed and carries into the lake considerable amounts of phosphorus and nitrogen. LSEMP implementation activities should be specifically focused on the Nonquon River subwatershed, as the river's water quality is one of the key elements in improving the environmental health of the lake.

The Osler Marsh is connected with Lake Scugog through four culverts under Highway 7A. Most of the watershed, with many small creeks and streams south of the lake, is drained initially to the Osler Marsh and then to Lake Scugog through these culverts. The watershed area south of the Osler Marsh is occupied mainly by forests and wetlands (46.9%) and agriculture (42.6%). Despite the high percentage of land under forests and wetlands, all small southern tributaries flowing into Osler Marsh have relatively high phosphorus concentrations. At the same time, water samples collected at the Osler Marsh outlet location indicate fairly good water quality with low phosphorus concentrations at any time of the year. It proves the concept that wetlands act as natural biofilters for the incoming stream waters, as observed in the Osler Marsh area. By the time water from the southern tributaries reaches the lake, it is already filtered multiple times and purified in the dense vegetation of the marsh. As a result, phosphorus loading from the southern part of the lake watershed is decreased by approximately 75 to 80% due to sedimentation and assimilation of phosphorus in the marsh. At the same time, it is important to remember that any marsh or wetland, similar to a lake or river, has some upper limit of nutrient assimilation (or assimilative capacity). When that limit is exceeded, a marsh can begin, under some aquatic conditions, to release previously accumulated phosphorus and nitrogen.

William's Creek is a small watercourse with its watershed entirely situated within the urban area of Port Perry. Its catchment area occupies 1.39 km^2. William's Creek is one of several major routes for the transportation of stormwater from the downtown core of Port Perry into the lake. Currently there is only one stormwater treatment pond in the headwaters of the creek that treats two sewersheds with a total area of 0.41 km^2. Before entering the lake, William's Creek flows through the small natural wetland located immediately upstream from its mouth.

William's Creek, despite its small size, is interesting for the study and characterization of urban runoff in Port Perry. It was monitored in 2007 in the framework of the Port Perry Nutrient Study. Water samples were collected several times in 2008 as part of the LSEMP sampling program. The average total phosphorus concentration during the period of observation was 251 μg/L while the median was 142 μg/L. The maximum phosphorus concentration reached as high as 1,650 μg/L in November of 2007. The minimum concentration was 32 μg/L in June of 2007.

The Scugog River is the only outflow from Lake Scugog and it also receives inflow from its two major tributaries, East Cross Creek and Mariposa Brook. This river, as previously noted, is the main source of drinking water for the Town of Lindsay. Since 2004, average annual phosphorus concentrations in the

Scugog River, near its outlet from Lake Scugog, are decreasing and ranged from 16.7 μg/L in 2008 to 26.7 μg/L in 2005.

Nevertheless, the Scugog River remains a highly eutrophic water body with abundant macrophytes, weeds and algae populations, in addition to waste in the water and along the shores. It is highly recommended that remedial actions be undertaken to mitigate some of the identified problems and prevent potential problems. A safe and reliable drinking water supply for the growing population of Lindsay should be considered a priority.

Total Nitrogen

Total nitrogen includes inorganic forms of nitrogen: ammonia (NH_3), nitrites (NO_2), and nitrates (NO_3) and organic forms: total Kjeldahl nitrogen (TKN) less ammonia. The nitrite values are usually combined with the nitrate concentrations, as a nitrite-ion is the transitional form of nitrogen from ammonia to nitrate-ion. In a very short time, all nitrites in lake or river water transform into nitrates. As well, nitrites are usually present in surface water in very small concentrations, mainly in the range of 1 to 10 micrograms. The combined concentrations of nitrate and nitrite are usually called total nitrate and consist typically of 98 to 99.9% of nitrates and 0.1 to 2.0% of nitrites. Total Kjeldahl nitrogen is a measure of total organic nitrogen plus total ammonia and, in some cases, may indicate the presence of fresh organic pollution in a water object or it may demonstrate the level of phytoplankton development in the water.

The combined concentration of different forms of nitrogen (total nitrogen) reflects general land use and an anthropogenic pressure in the various parts of the watershed. In many cases, nitrates form most of the total nitrogen amount in the rivers and creeks of the watershed, ranging from 59% of total nitrogen on average in the water of Layton River and the upper Nonquon River, to 75% in Fingerboard Creek. The total nitrate levels tend to be high in winter, late autumn and early spring throughout the Lake Scugog watershed, with the exception of the lower reach of the Nonquon River. In general, the highest levels of total nitrate in all streams are detected during January and February when groundwater contributes most to the flow in rivers and creeks.

The TKN levels during the period of observation ranged from 0.2 milligrams per litre (mg/L) in Fingerboard Creek to as high as 3.24 mg/L in Cawker's Creek. Usually the average and median TKN concentrations are below 0.7 mg/L, except the Nonquon River at Seagrave and the Scugog River. Organic nitrogen comprises from 25% (in Fingerboard Creek) to 41% (in the Layton River) of the total nitrogen amount. Only in the water of the lower Nonquon River, organic nitrogen prevails above inorganic and, on average, makes up 65% of the total nitrogen amount.

In Blackstock Creek, concentrations of nitrates and total nitrogen are usually the highest in the upper portion of the subwatershed. Average and maximum nitrate concentrations decrease toward the mouth of the creek. Usually the highest nitrate levels are detected in small streams or in the main channel close to groundwater discharge points. The highest total nitrate levels observed in the water of Blackstock Creek varied from 2,588 to 6,206 μg/L, while the yearly mean stayed within 913 to 1,657 μg/L. Based on available monitoring data, it is possible to conclude that the main source of inorganic nitrogen in Blackstock Creek and other streams is groundwater discharge. In addition, high levels of nitrates in groundwater are caused by agricultural activities in the region. Average annual total nitrogen concentrations varied from 1.43 mg/L in 2005 to 2.25 mg/L in 2006 (Figure 4.3). Seasonal distribution of nitrogen due to changes in nitrate levels is characterized by high concentrations in winter, late autumn and early spring. Overall, the highest levels of nitrates in Blackstock Creek as well as in other streams have been detected in the middle of winter due to a high proportion of groundwater in the flow volume of rivers and creeks while natural processes of nitrate assimilation are very slow. Farming activities are probably the most significant source of nitrogen in the creek.

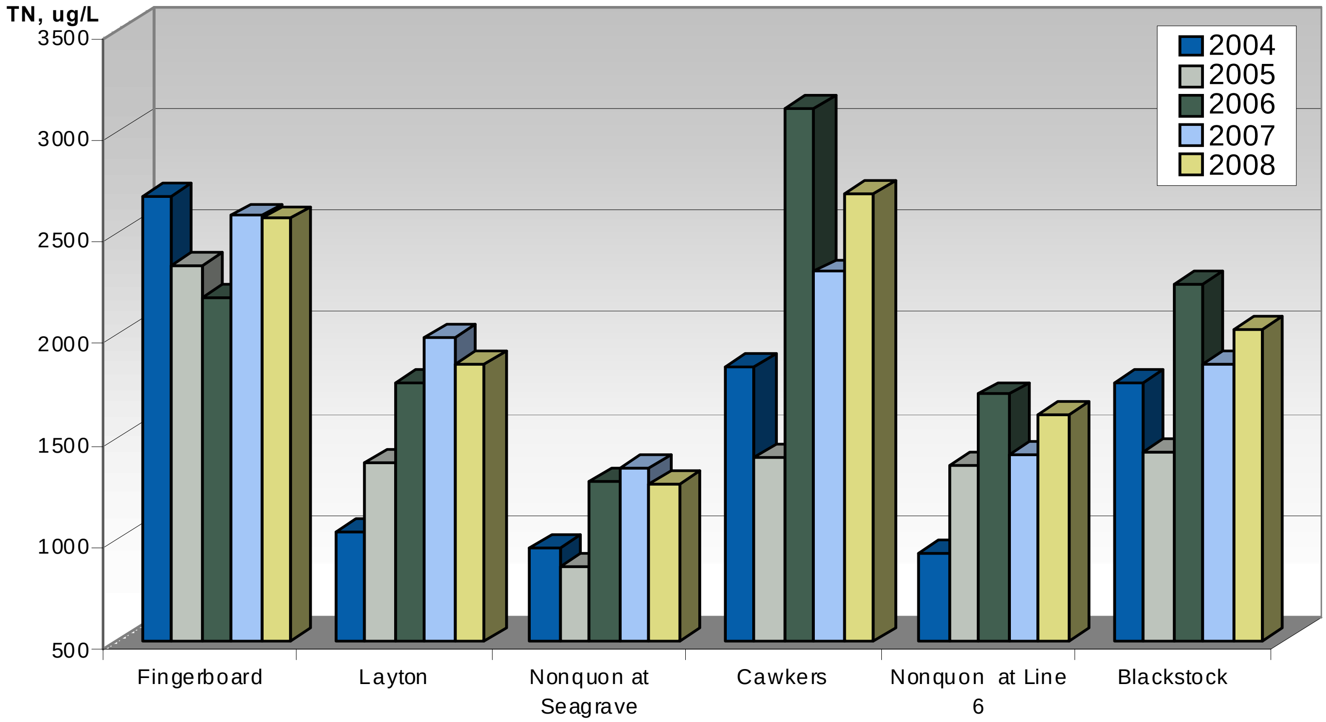

Figure 4.3. Average Nitrogen Concentrations in Water from Lake Scugog Tributaries in 2005-2008

Cawker's Creek has the highest total nitrogen (TN) concentrations in the watershed. A maximum TN concentration was observed in January 2006 in the amount of 7.84 mg/L. Minimal TN levels (0.5 to 0.6 mg/L) are usually present in summertime. Analysis of total nitrogen and nitrate levels on an annual basis shows a slight declining trend in recent years (2006 to 2008) (see Figure 4.3). The highest nitrate levels observed in the water of Cawker's Creek ranged from 3,015 to 6,764 µg/L, with a mean of 1,850 µg/L. In the creek water, nitrate concentrations have most often exceeded the guideline, set at 2.93 mg/L, of the Canadian Water Quality Guidelines for the Protection of Aquatic Life (Canadian Council of Ministers of the Environment, 2007). In Cawker's Creek, 26% of samples taken were above the guideline.

Fingerboard Creek had very high nitrate and total nitrogen concentrations throughout the entire period of observation. Average annual TN concentrations are fairly stable in the long-term perspective and varied from 2.18 mg/L in 2006 to 2.68 mg/L in 2004, with the long-term average being 2.45 mg/L (see Figure 4.3). The highest TN and NO_3 values were observed during winter and summer seasons when the groundwater component of stream flow prevails. Similar to other creeks in agricultural areas, the main source of nitrogen in Fingerboard Creek is farming activity, dispersing excess nitrogen from fields into the creek with the groundwater flow component.

Small southern creeks in the Osler Marsh subwatershed have high total nitrogen concentrations, mainly in nitrate form. At the same time, water samples collected at the Osler Marsh outlet into the lake indicate good water quality, with low total nitrogen concentrations and virtually absent nitrates, and only slightly elevated TKN levels in summertime.

Total nitrogen and nitrate concentrations in the water of the Layton River are generally in the moderate range. Average annual TN values fluctuated from 1.03 mg/L in 2004 to 1.98 mg/L in 2007. As TKN concentrations are fairly stable and vary in relatively narrow limits – from 0.4 to 1.0 mg/L – nitrates form a major portion of the TN amount. Any noticeable changes in total nitrogen levels are usually caused by variations in NO_3 values. For example, nitrate concentrations ranged from as low as 0.13 mg/L in September 2004 to as high as 4.13 mg/L in January 2008.

An increasing trend in nitrogen levels through the monitoring period was observed (see Figure 4.3). Seasonal distribution of different forms of nitrogen is quite dissimilar. The highest nitrate (and consequently TN) concentrations are observed in wintertime. However, the higher TKN levels are usually seen during the summer and, at the same time, NO_3 levels are very low as most of the nitrates are utilized by aquatic vegetation. Similar to other subwatersheds, it appears that the main source of nitrogen, and especially nitrates, in the Layton River is underground runoff from agricultural fields.

In the Nonquon River, concentrations of nitrates, and therefore total nitrogen levels, are usually the highest in the upper portion of the subwatershed. Average and maximum nitrate concentrations decrease toward the mouth of the creek. Based on available monitoring data, it is possible to conclude that the main source of inorganic nitrogen in the Nonquon River and other streams is groundwater discharge. High levels of nitrates in groundwater are caused by agricultural activities in the region, namely watershed-wide fertilizer applications.

Average annual total nitrogen concentrations varied from 0.93 mg/L in 2004 to 1.71 mg/L in 2006 in the headwaters of the river and from 0.86 mg/L in 2005 to 1.35 mg/L in 2007 in the lower section of the Nonquon River. Nitrate levels ranged from 3 μg/L near Seagrave to 3,969 μg/L at Scugog Line 6, the headwaters of the river.

The Nonquon River is the only watercourse that frequently has very low concentrations of dissolved oxygen, presumably due to high nutrient and organic matter concentrations, a low gradient downstream from Highway 7/12 and low flow velocities. As a result, there is excessive growth of filamentous algae and other aquatic vegetation. Furthermore, in summertime the Nonquon River has a higher proportion of swamp water, which is low in dissolved oxygen. During the monitoring period, an acute deficit of dissolved oxygen was often observed in the water of the Nonquon River downstream from Scugog Line 8. For example, during the summers of 2006 and 2008, dissolved oxygen levels fluctuated mainly between 0.44 and 4.71 mg/L, that is, only 5 to 47% of saturation. As a result, widespread fish kills were observed in the Nonquon River in June 2006, probably caused by an oxygen deficit in the water column and, relatedly, a release of toxic substances from bottom sediments. However, the regime of dissolved oxygen was quite favourable during the summers of 2005 and 2007. The issue of the dissolved oxygen deficit in the Nonquon River is of great importance, as it creates favourable conditions for an additional supply of nutrients and metals from the river sediments into its water and eventually into Lake Scugog.

4.2 Lake Scugog Water Quality

Water quality in Lake Scugog is determined by a number of abiotic and biotic factors. Among the abiotic factors are the hydrological regime, lake water level regime, shoreline developments and population density along shorelines. As well, meteorological conditions in any given year play a significant role in the formation of water quality. The amount of precipitation, solar radiation, number of sunny and cloudy days, average annual air temperature – all of these factors can have a very significant effect on water quality in any lake, and especially in one as shallow as Lake Scugog.

Biotic factors are also very important for water quality in the lake. These factors include bottom sediments and conditions at the water-sediment interface; the amount and consumption rates of dissolved oxygen in different layers of water; the amount of macrophytes, weeds and algae in the lake; and competition between them for nutrients, light and oxygen.

Overall, Lake Scugog, based on the intensity of the aquatic vegetation development and the Secchi disk depth readings, can be characterized as a eutrophic water body. However, according to phosphorus levels in recent years, the lake can be placed into a mesotrophic category (Figure 4.4). According to the Canadian Council of Ministers of the Environment (CCME) classification, a lake can be defined as a mesotrophic water body if it has total phosphorus concentrations less than 20 μg/L (CCME, 2007). During the 2007 and 2008 monitoring seasons, phosphorus concentrations in Lake Scugog were considerably below that limit.

Lake Scugog can be divided into two dissimilar portions: the western basin and the eastern basin. These two parts of the lake have very different hydrographic features and hydrological regimes. As a result, the hydrochemical regime is determined first by the hydrography and hydrology of the western and eastern portions of the lake and second, by the abiotic anthropogenic factors, including a large urban area (i.e. Port Perry), and the huge influx of nutrients with the Nonquon River flow into the western basin of the lake. Consequently, the western part of the lake is more eutrophic, always has higher phosphorus and nitrogen concentrations, and has remarkably more aquatic vegetation compared to the deep-water eastern basin. This condition is aggravated by the shallowness of the western portion and the considerable load of phosphorus from the Port Perry urban area.

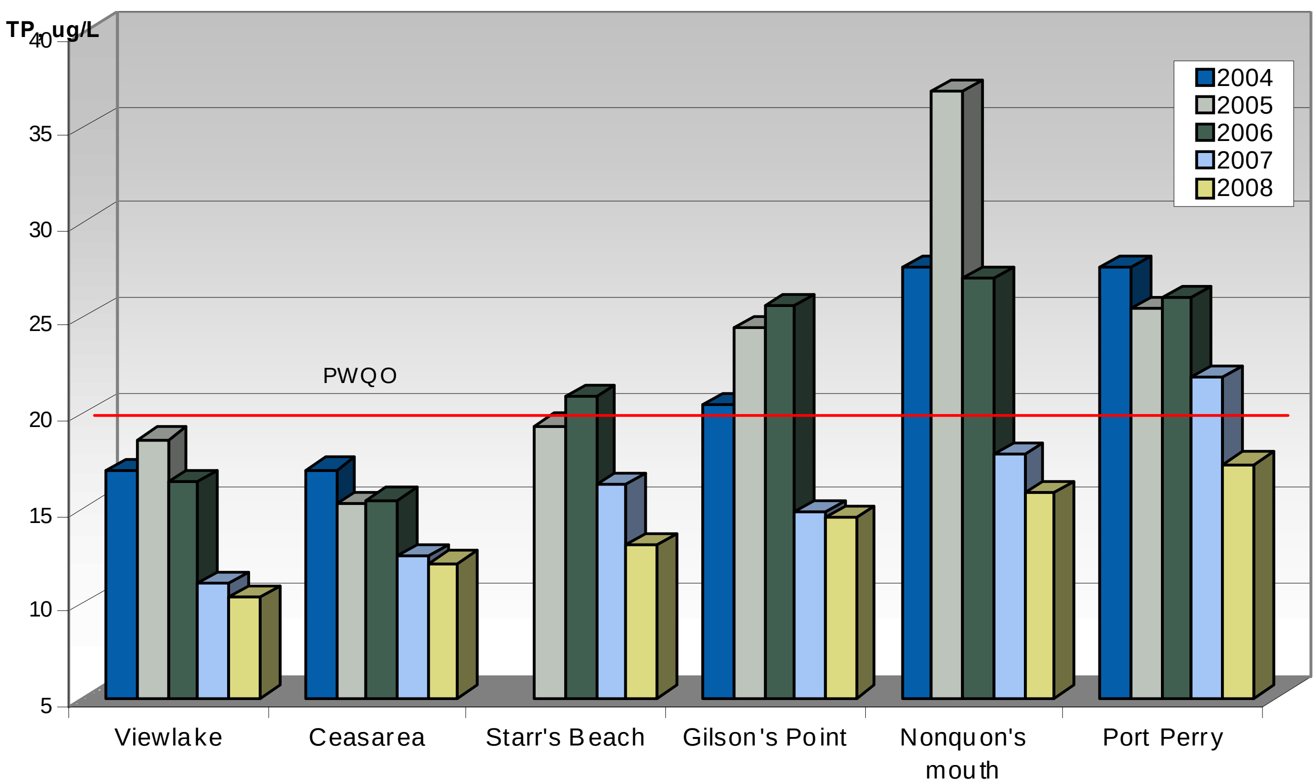

Figure 4.4. Average Phosphorus Concentrations in Lake Scugog in 2004-2008

The western basin occupies a portion of Lake Scugog west from the line of Newman's Beach to the northern tip of Scugog Island, all the way to Port Perry. The Nonquon River, Cawker's Creek, Fingerboard Creek and William's Creek empty into this portion of the lake. As well, the largest urban area in the watershed, Port Perry, is located along the shores of the western basin.

The three stations representing the Lake Scugog western basin are Port Perry, the Nonquon River mouth and Gillson's Point. Before 2007, the mean phosphorus concentrations at all three stations were typically above the Provincial Water Quality Objective (PWQO) for lakes, which is set at 20 μg/L. In 2007, phosphorus levels dropped below the PWQO at all monitoring locations except Port Perry (see Figure 4.4). This tendency continued in 2008, when average TP concentrations in the water of all monitoring stations in the western part of the lake reached their recorded minimum. Average phosphorus concentrations were 14.5 μg/L at Gillson's Point, 15.8 μg/L near the mouth of the Nonquon River, and 17.3 μg/L in the vicinity of Port Perry. Throughout the summer period of 2007, the total phosphorus levels fluctuated from as low as 10 μg/L in the beginning of June to as high as 34 μg/L in the beginning of September. In 2008, the highest detected TP level was 23 μg/L in the beginning of July at the Port Perry station. Total phosphorus levels are usually higher in the middle of summer (July and August).

Total nitrogen concentrations show the same decreasing trend in recent years (Figure 4.5). In 2007, total nitrogen levels in the western basin of the lake ranged from 0.6 mg/L in June to as high as 1 mg/L in September. In 2008, nitrogen concentrations were lower, ranging from 0.59 mg/L to 0.92 mg/L. In the majority of cases, organic nitrogen constitutes most of the total nitrogen amount in the lake water ranging from 78% of TN in May to 99% during summer and early autumn. Nitrate levels tend to be higher in winter and early spring.

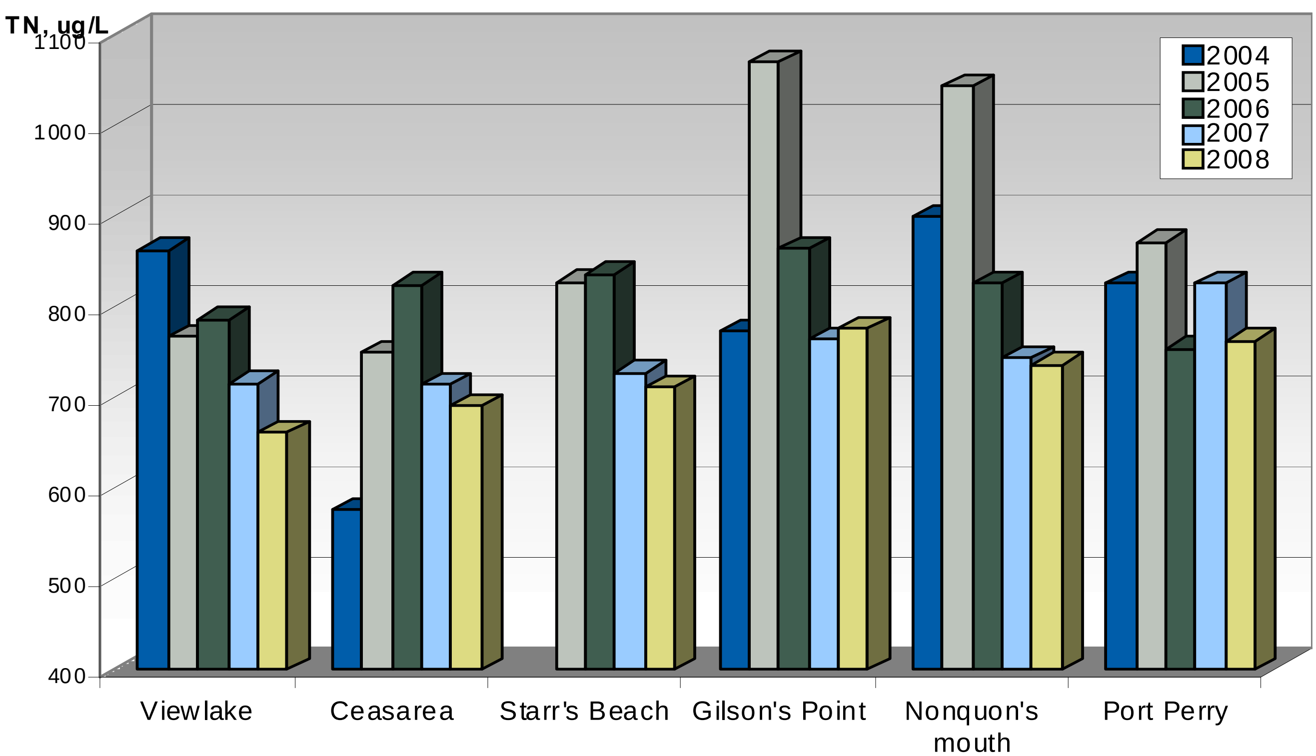

Figure 4.5. Average Nitrogen Concentrations in Lake Scugog in 2004-2008

The highest nitrate concentrations, in the range of 0.37 to 2.55 mg/L, were detected in February 2006 when winter sampling was accomplished at all lake monitoring stations. As well, slightly elevated nitrate levels (0.11 to 0.28 mg/L) are usually present in May – well below the Canadian Water Quality Guideline for the Protection of Aquatic Life (2.93 mg/L). For the remainder of summer and autumn, nitrate concentrations are typically under a laboratory detection limit (0.008 to 0.01 mg/L).

The eastern basin occupies a larger area of Lake Scugog to the east from the line of Newman's Beach to the northern tip of Scugog Island, all the way south to Highway 7A and north to East Cross Marina located just upstream from the mouths of Mariposa Brook and East Cross Creek. The eastern portion of the lake receives inflow only from one large tributary, which is Blackstock Creek. In summertime when the Lindsay dam is completely closed, some backwater inflow from Mariposa Brook and East Cross Creek can return into the lake. The semiurban communities of Caesarea, Viewlake and Washburn Island are located along shores of this part of the lake.

Three monitoring stations represent the eastern portion of the lake: Viewlake, Caesarea and Starr's Beach. From the beginning of the monitoring period, these stations have demonstrated lower total phosphorus levels in comparison with the western basin stations. Nevertheless, they have shown a significant decreasing trend in TP concentrations during the 2007 and 2008 monitoring seasons (see Figure 4.5). In the last two years, phosphorus concentrations and Secchi disk depth readings clearly indicate that the eastern basin of Lake Scugog shifted deeply into the mesotrophic category according to the lake trophic status classification (CCME, 2007). However, it still has considerable aquatic vegetation as well as several areas of concern. Of primary interest is an area near the Blackstock Creek mouth in the southern portion of the lake. This area is quite shallow with abundant aquatic vegetation, which has been and still is (according to local residents) slowly moving north to Caesarea. The considerable phosphorus and nitrogen load with the Blackstock Creek flow is likely the main contributing factor to this development. Another problematic area is Starr's Bay between Washburn Island and Ball Point peninsula. This bay is also very shallow (the depth is mainly less than 1.0 m), with intense residential development along the shores that creates favourable conditions for the input of considerable amounts of phosphorus and nitrogen into the nearshore waters from private septic systems, lawns, driveways and streets.

4.3 Lake Scugog Sediment Quality

Artificial organic and inorganic pollutants are substantial threats to the health of aquatic ecosystems. Most of them are extremely toxic and dangerous to aquatic life, as well as to human health if these contaminants reach drinking water sources. In many Canadian rivers and lakes, contaminated sediments are a widespread and serious problem. A number of compounds being investigated are very persistent, such as the organochlorinated pesticides (OCPs), polychlorinated biphenyls (PCBs) and heavy metals, which may have been released into the environment years ago but are still dangerous for biota and humans.

As human impacts on the Lake Scugog watershed increase, it is probable that heavy metals and other toxic pollutants can accumulate in lake sediments. Their concentrations can escalate to unacceptable levels and sediments may serve as a contaminant reservoir and source of pollution. Contaminated sediments can significantly impact the benthic environment and, as a result of bioaccumulation by benthics, some contaminants can work their way up the food chain.

Therefore, within the framework of the LSEMP, Kawartha Conservation initiated a sediment sampling program aimed at studying possible contamination of bottom sediments in Lake Scugog in the vicinity of Port Perry. This study evaluated the condition of sediments for the presence of selected organic and inorganic contaminants. Sediment samples were collected from 13 monitoring stations located throughout Port Perry Bay and Rowing Club Bay (Figure 4.6). Sampling was conducted over a two-day period in June 2007.

Regarding sediment quality in Lake Scugog, the positive finding is that no OCPs, PCBs or benzene, toluene, ethylbenzene and xylene (BTEX) have been detected in sediment samples from any monitoring station.

Polycyclic aromatic hydrocarbons (PAHs) have been detected in 13 of 15 samples. In eight samples, at least one parameter exceeded the corresponding guideline. The highest concentration of total PAHs was detected in the sediment sample collected from SD1 station (13,163 micrograms per kilogram (μg/kg)), located closest to the stormwater outlet (see Figure 4.6). Concentrations of total PAHs at SD1 were approximately 19 times higher than the next highest measured concentration found at SD4 (683 μg/kg), located in close proximity to another smaller culvert. Moreover, 10 individual PAH parameters have been detected in the sample collected from station SD1 and all of them exceeded the corresponding guideline. Of the pollutants sampled in this study, PAHs are the most prevalent in Lake Scugog sediments. PAHs are coming into the aquatic environment from non-point sources. Typical sources of PAHs include incomplete combustion (when airborne particulate matter settles or precipitates out), motor oil and gasoline, asphalt abrasion, leaching from creosote-treated wood (in railway ties and bridge pilings), and road and roof tarring. The main pathway for transportation of PAHs into the lake is through stormwater runoff.

Petroleum Hydrocarbons (PHCs) (F3 and F4 fractions) have been detected in all sediment samples, but only at station SD1 did the F3 fraction exceed the corresponding guideline.

Metals have been detected in the majority of samples, and in 13 sediment samples, one or more metals exceeded the related guideline. Lead (Pb) was the prevailing parameter among this group of contaminants. It has been detected above the Ontario Sediment Quality Guideline (OSeQGs) in collected samples from 12 stations. Particularly high lead concentrations were found in sediments from stations SD12, SD11 and SD7. The frequent recurrence of lead at such high concentrations, especially those detected at stations SD7 and SD12, indicates anthropogenic pollution. At station SD12, elevated concentrations of cadmium (Cd), copper (Cu), zinc (Zn) and PAHs also have been revealed. At station SD7, in addition to lead, cadmium, mercury, copper and phenanthrene also exceeded corresponding guidelines. This station is located in close proximity to the pier, frequently used by numerous private boats and the local cruise ship.

As well, sediment samples have been analyzed for TP, TKN and total organic carbon (TOC). Most sediments have shown very high concentrations of phosphorus. Average phosphorus concentration in sediments of the southwestern portion of Lake Scugog is 948 milligrams per kilogram (mg/kg)—a significant number. Fortunately, most of that phosphorus amount is bound to sediment particles and is not available for consumption by aquatic plants when water is saturated with dissolved oxygen.

However, when an oxygen deficit occurs and pH values decline, the process of phosphorus desorption and, consequently, internal loading from sediments can be initiated. As well, reducing conditions at the water-sediment interface can lead to the mineral dissolution of iron-phosphorus, manganese-phosphorus and aluminum-iron-phosphorus minerals present in sediments. This produces elevated concentrations of both phosphorus and the above-mentioned metals in the bottom layer of water. The issue of possible internal loading of phosphorus and metals requires additional studies in the future.

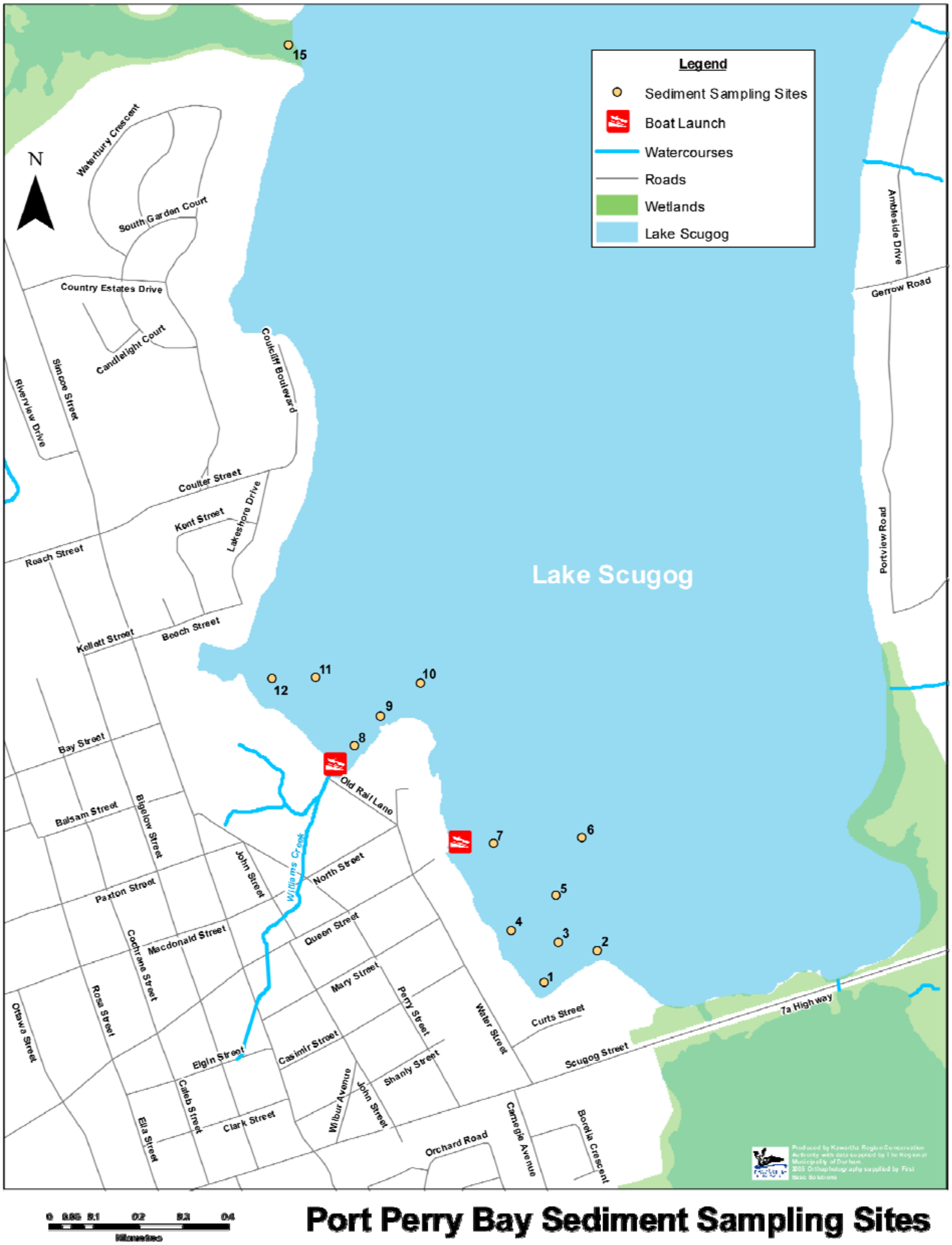

Figure 4.6. Sediment Sampling Sites Near Port Perry

5.0 Sources of Nutrients in Lake Scugog

Phosphorus and nitrogen are two chemical elements responsible for the process of eutrophication and overabundant development of water plants in the aquatic system of the lake. These are also the two primary nutrients in aquatic ecosystems. Other elements such as copper, iron, manganese, molybdenum, zinc and others, referred to as micronutrients, are also vital in the development of aquatic vegetation. Only phosphorus and nitrogen determine the rate of growth and consequently, the speed of eutrophication.

Phosphorus and nitrogen enter Lake Scugog from various sources. It is not possible to determine one single source of nutrients responsible for the entire process of eutrophication. This process is a combination of many factors, but most of them have human origin.

All nutrient sources can be separated into two large groups: point sources and non-point sources. Point sources of nutrients include industrial and municipal sewage outflows, individual septic tanks, single wastewater discharge pipes from farms and certain other operations, etc. Non-point sources include nutrients entering water bodies with urban runoff, agricultural runoff, and atmospheric deposition (wet and dry) as well as natural sources such as shoreline and riverbank erosion, groundwater discharges, wild waterfowl, local bedrocks and soils, and so forth.

Lake Scugog receives nutrient input from almost all of the above sources. In order to quantify nutrient load into the lake, all sources are separated into five major categories:

1. River flow
2. Atmospheric deposition
3. Direct urban runoff
4. Septic systems
5. Nonquon River Water Pollution Control Plant (NRWPCP).

Table 5.1 presents annual phosphorus loads into the lake, plus its yield from the lake with the Scugog River flow, during three hydrologic years. Table 5.2 presents annual nitrogen loads into the lake.

As shown in Table 5.1, the highest total input of phosphorus to Lake Scugog was in the 2005-2006 hydrologic year, measured at 9,611 kg. The least amount of phosphorus was present in the 2007-2008 hydrologic year, measured at 9,062 kg. However, the largest net phosphorus loading occurred in 2007-2008, when 6,992 kg of phosphorus remained in the lake. Conversely, the net nitrogen loading was minimal that year (see Table 5.2). Net loading is the amount of phosphorus, nitrogen or any other substance that is annually accumulated in the lake; it is the difference between total annual load into the lake and annual loss of substance from the lake with the Scugog River flow. Phosphorus in suspended form is accumulated in bottom sediments, while dissolved phosphorus is consumed by aquatic vegetation and algae. Dissolved phosphorus moves into sediments during the autumn-winter season when remnants of aquatic plants are decomposing.

Table 5.1. Lake Scugog Phosphorus Budget for 2005-2006, 2006-2007 and 2007-2008 Hydrologic Years

	2005 – 2006		2006 – 2007		2007 – 2008		Average
Total Phosphorus Input:	**TP, kg**	**TP, %**	**TP, kg**	**TP, %**	**TP, kg**	**TP, %**	**TP, kg**
River Flow	5433	56.5	5491	57	5067	56	5330
Atmospheric Deposition	1900	20	1743	18	1710	19	1784
Nonquon WPCP	150	1.5	200	2	160	2	170
Direct Urban Runoff	1228	13	1203	13	1209	13	1213
Septic Systems	900	9	916	10	916	10	911
Total Load	**9611**	**100**	**9553**	**100**	**9062**	**100**	**9408**
Scugog River TP Output	**3540**	**37**	**3653**	**38**	**2070**	**23**	**3088**
TP net loading*	**6071**	**63**	**5900**	**62**	**6992**	**77**	**6320**

*Net loading – amount of phosphorus that is annually accumulated in the lake. It is the difference between total annual load into the lake from all sources and annual loss of phosphorus from the lake with the Scugog River flow.

Table 5.2. Lake Scugog Nitrogen Budget for 2005-2006, 2006-2007 and 2007-2008 Hydrologic Years

	2005 – 2006		2006 – 2007		2007 – 2008		Average
Total Nitrogen Input:	**TN, t***	**TN, %**	**TN, t**	**TN, %**	**TN, t**	**TN, %**	**TN, t**
River Flow	310.7	72	218.1	64	247.8	64	258.9
Atmospheric Deposition	70.8	16	70.6	21	86.7	23	76
Nonquon WPCP	12	3	13.5	4	12.5	3	12.7
Direct Urban Runoff	12.4	3	12.1	4	12.2	3	12.2
Septic Systems	25	6	25	7	25	7	25
Total Load	**430.9**	**100**	**339.3**	**100**	**384.2**	**100**	**384.8**
Scugog River TN Output	**289**	**67**	**198**	**58**	**285**	**74**	**257**
TN net loading**	**141.9**	**33**	**141.3**	**42**	**99.2**	**26**	**127.8**

*t – tonne

**Net loading – amount of nitrogen that is annually accumulated in the lake. It is the difference between total annual load into the lake from all sources and annual loss of nitrogen from the lake with the Scugog River flow.

The phosphorus load with the river flow was further divided into four subcategories: natural component, urban component, agricultural component, and TP load with runoff from the extensive network of rural roads. Detailed descriptions and characteristics of the sources of phosphorus and nitrogen are given in the following sections. All sources of phosphorus, both of natural and human origins, and their TP load proportions are shown in Figure 5.1.

5.1 River Flow

Most of the inflow into Lake Scugog arrives as surface or river flow (see Table 3.2). The highest concentrations of total phosphorus and total nitrogen in river water are observed in periods of high water levels and discharges occurring in the spring freshet, in winter thaws and after intensive rain events in the spring, summer and autumn. During such periods, phosphorus concentrations have been recorded at 303 to 540 μg/L, a level that is 10 to 18 times above the PWQOs limit. The largest portion of nutrient load is delivered to the lake in spring, when streams have high volumes of flow and also high levels of phosphorus and nitrogen. Annually, rivers and streams transport into the lake 5 to 5.5 tonnes of phosphorus and 218 to 310 tonnes of nitrogen (see Tables 5.1 and 5.2; Figures 5.1 and 5.3).

The Nonquon River is the largest single contributor of phosphorus and nitrogen into Lake Scugog. Every year this river carries into the lake 2.2 to 3 tonnes of phosphorus and 105 to 140 tonnes of nitrogen including the load from the Nonquon River Water Pollution Control Plant (see Section 5.5 for additional information). Another large single source of phosphorus is Blackstock Creek that runs into the eastern portion of the lake, south of Caesarea. With the Blackstock Creek flow, usually 600 to 900 kg of phosphorus and 24 to 36 tonnes of nitrogen annually enter the lake. Fingerboard Creek carries the smallest amount of phosphorus into the lake, usually about 75 to 90 kg per year or 0.8% of the TP total load. As well, it is noteworthy that the Fingerboard Creek subwatershed has the lowest annual phosphorus export per unit area (8.48 to 9.05 kilograms per square kilometre per year (kg/km^2/yr)) in comparison with other subwatersheds (Table 5.3). Conversely, another small watercourse – Cawker's Creek – has one of the highest annual phosphorus exports per unit area among the tributaries of Lake Scugog. In its subwatershed, due to the high percentage of urbanized areas, TP export per unit area varied from 20.35 to 31.68 kg/km^2/yr. Despite its small size, Cawker's Creek transports into the lake 212 to 330 kg of phosphorus and 10 to 15 tonnes of nitrogen annually.

Table 5.3. Average Annual Phosphorus and Nitrogen Export per Unit Area from the Major Tributaries Within the Lake Scugog Watershed, 2005-2008

Subwatershed	TP export, kg/km^2/yr	TN export, kg/km^2/yr
Fingerboard Creek	8.8	656.4
Layton River	15.4	621.4
Nonquon R. at Scugog Line 6	23.2	779.3
Nonquon River at Seagrave	13.1	596.1
Cawker's Creek	24.6	1,303.2
Blackstock Creek	19.5	790.6

Implementation of the LSEMP can significantly reduce phosphorus loading with river flow. The overall target for an average phosphorus concentration in river water must be 30 μg/L according to the PWQO, which will prevent excessive weed growth. It will correspond to an average annual load of 3,265 kg of phosphorus or 61% of the current annual load.

Throughout the implementation process, when addressing phosphorus load with the river flow, it will be beneficial to separate different sources of phosphorus in this category to determine the specific, targeted areas.

Natural surface water always contains some amount of phosphorus, even in the most pristine conditions, unaffected by human activities. Natural sources of phosphorus include bedrocks supplying this element to water through the weathering process, soils resulting from natural erosion of riverbanks and lake shorelines, fallen leaves and branches, feces of wild animals and waterfowl, and other decomposing organic materials. As well, river flow accumulates phosphorus from various human land uses across the watershed including major ones such as urban areas, agricultural lands, and rural roads and others such as golf courses, soccer and baseball fields, quarries, small rural developments, cemeteries, etc.

5.1.1 Natural Sources of Phosphorus in River Flow

The first challenge is to determine what portion of the phosphorus load has a natural origin. According to Evans et al., 1996, the pre-settlement phosphorus loading rate in neighbouring Lake Simcoe was approximately 30 to 32 tonnes per year, constituting 35 to 40% of the current TP load into the lake. It is reasonable to assume that Lake Scugog has the same proportion. Accordingly, about 3,300 to 3,700 kg of phosphorus represents the natural component of loading. When excluding from this amount an atmospheric portion (~1,500 kg), this will compute to 1,800 to 2,200 kg of phosphorus load per year as a natural component in river flow. In order to confirm these numbers, another method of computation was used. This method is based on total phosphorus concentrations in the relatively undisturbed headwater sections of the Nonquon River.

Average phosphorus concentrations in the headwaters of the Nonquon River are usually about 15 μg/L, and they increase considerably further downstream. A comparison among some monitoring sites in the headwaters of several streams allows for the acceptance of 15 μg/L as a natural background level of phosphorus in watercourses across the watershed. As a result of further calculations, the natural portion of phosphorus load into Lake Scugog was determined for the 2005-2006, 2006-2007 and 2007-2008 hydrologic years. It makes up 2,200, 2,050 and 1,800 kg respectively, which is 35 to 40% of the total phosphorus loading with river flow. The average from three years is approximately 2,000 kg or 37% of TP loading. These numbers correspond well with data from studies in the Lake Simcoe basin (Johnson and Nicholls, 1989; Nicholls, 1995; Evans et al., 1996).

As a result, it can be estimated that the natural component of phosphorus loading into Lake Scugog is, on average, about 2,000 kg per year or 35 to 40% of the total phosphorus loading with river flow. This amount comprises approximately 20% of the total TP load into the lake.

5.1.2 Urban Sources of Phosphorus in River Flow

Urban areas are a significant source of nutrients in rivers and lakes. Due to the high percentage of impervious surfaces in urban areas, they generate much larger volumes of runoff into adjacent streams and lakes and at a much faster speed, thus transporting all of the pollutants from the urban environment. According to numerous studies, urban areas generate nutrients and other pollutants at a much higher rate per unit area than agricultural lands.

The urban portion of the phosphorus load with river flow was calculated using the same methodology and data used for calculations of the direct TP load into the lake from urban areas bordering the lakeshore (see Section 5.3). Direct and indirect urban runoff contributions to the phosphorus load are combined in Figure 5.1 under the single urban runoff portion.

There are 15.93 km^2 in the Lake Scugog watershed occupied by urban areas including hamlets, subdivisions, villages and towns. Approximately 11.2 km^2 of urban areas are adjacent to the lakeshore and are drained, in one way or another, directly into the lake. The remaining urban areas (4.73 km^2) are dispersed across the watershed in various subwatersheds. For example, the Hamlet of Blackstock is situated in the Blackstock Creek subwatershed upstream from the LSEMP and PWQMN monitoring stations. It contributes some

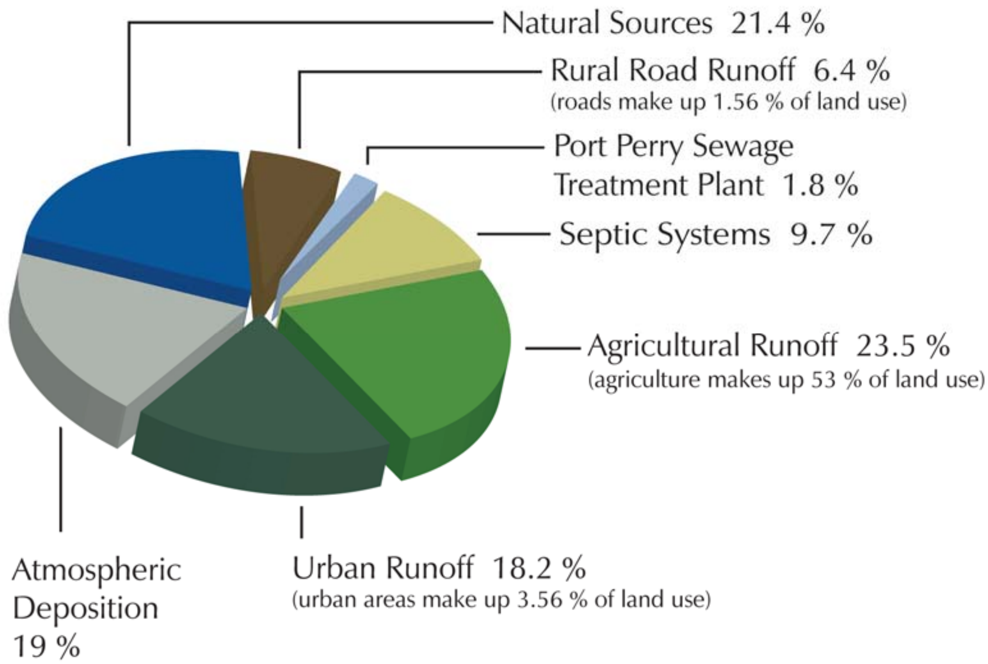

Figure 5.1. Major Sources of Phosphorus Loading into Lake Scugog

amounts of phosphorus and nitrogen into the creek that are ultimately included in TP and TN loads calculated for the entire Blackstock Creek subwatershed.

In order to calculate the volume of flow from urban areas, several runoff coefficients were used depending on urban land use and the percentage of impervious surfaces. Data from the *Port Perry Urban Area Nutrient Study* completed by Kawartha Conservation in 2007 and monitoring data for the *Port Perry Stormwater Management Plan* were used to establish phosphorus and nitrogen concentrations in surface runoff from urban areas. It was calculated that approximately 500 kg of phosphorus is generated annually from urban areas located across the watershed. This amount constitutes about 5.3% of the total TP load into the lake.

Through the implementation of the LSEMP and specifically the stormwater management plans, the phosphorus load from urban areas across the watershed can be decreased by 50 to 60%, reducing the amount to 200 to 250 kilograms per year. These estimates are based on performance numbers for stormwater management ponds in the *Stormwater Management Planning and Design Manual* (MOE, 2003).

5.1.3 Rural Road Sources of Phosphorus in River Flow

Runoff from roads is another significant human-induced source of phosphorus. In the Lake Scugog watershed, there is an extensive network of roads with a total length of 573 km, excluding roads and streets in urban areas. All of these roads, which occupy almost 6.8 km^2 of the land area, are almost 100% impervious. As a result, surface runoff from roads can represent up to 95% of preceding rain or snowfall. They are the most intensively used parts of the watershed, resulting in a high contaminant load onto their surfaces. During a rain event, all contaminants are instantly washed off of road surfaces into ditches and later into local streams and the lake.

The road network generates approximately 600 kg of phosphorus annually and constitutes 6.4% of the total TP load into the lake.

5.1.4 Agricultural Sources of Phosphorus in River Flow

Agriculture is a substantial source of phosphorus and nitrogen in the Lake Scugog watershed. Nutrients can enter watercourses and the lake from various agricultural activities, including field applications of manure, biosolids and chemical fertilizers, milkhouse wastewater discharge, cropland erosion and livestock operations.

Manure and chemical fertilizer usage on fields, along with soil erosion, are probably the most significant sources of phosphorus and nitrogen among the agricultural activities noted. It is very important to promote and use advanced techniques in modern management of agricultural lands. At the same time, it is necessary to recognize that intensive nutrient losses from agricultural fields usually coincide with significant storm events or the spring freshet, and it is unreasonable to expect that nutrient loading from agricultural lands can be completely eliminated even with BMPs applied to all farm lands.

Another considerable local source of nutrients stems from unrestricted access of livestock to watercourses, which can also increase bacteriological contamination of surface water (*E. coli*, total coliform, fecal coliform, etc.) and initiate or accelerate erosion along riverbanks and shorelines.

Phosphorus loading in agricultural runoff is the most difficult component to quantify because there are multiple sources of phosphorus with diverse characteristics. Therefore, the amount of phosphorus was calculated as a difference between total phosphorus load with river flow, and the sum of the three sources (natural, urban and rural roads) described above.

Total agricultural runoff generates approximately 2,200 kg of phosphorus or 23.5% of the total TP load into Lake Scugog (Figures 5.1 and 5.2). Preliminary numbers from the CANWET model show that implementing watershed-wide agricultural BMPs can help decrease this amount by approximately 40 to 50% or 1,000 kg.

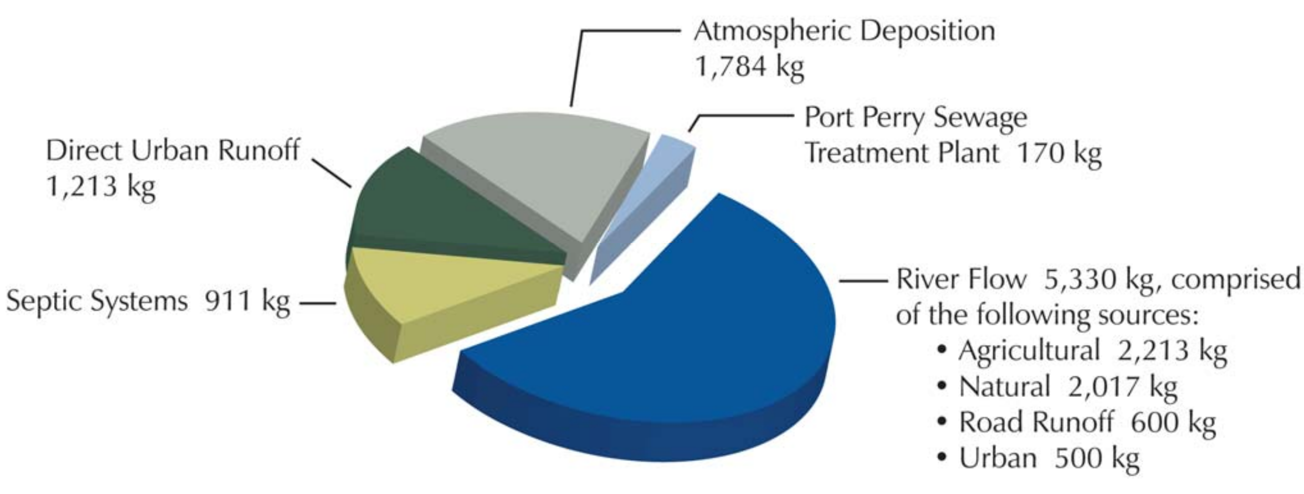

Figure 5.2. Average Annual Phosphorus Loading into Lake Scugog, kg

5.2 Atmospheric Deposition

Atmospheric deposition of phosphorus and nitrogen includes wet deposition (rain, snow and dew) and dry deposition (dust, etc.). Air masses and precipitation can bring nutrients into the lake from local sources such as wind erosion of bare ground, construction sites and local industrial emissions, as well as from locations thousands of kilometres away, for example, from Ohio in the U.S. where hundreds of coal power plants are situated.

Concentrations of phosphorus and nitrogen in precipitation samples vary significantly during the year. Usually the highest concentrations are observed in the spring season and the lowest during late autumn-winter. Atmospheric depositions of phosphorus and nitrogen were calculated as the sum of a number of precipitation amounts collected biweekly and multiplied by the surface area of the lake, and then multiplied by phosphorus and nitrogen concentrations in the corresponding rain and snow samples.

Atmospheric deposition annually contributes 1,700 to 1,900 kg of phosphorus, which is 18 to 20% of the total TP load, as well as 70 to 87 tonnes of nitrogen, which is 16 to 23% of the total TN load (see tables 5.1 and 5.2). Considering that atmospheric deposition is the third largest source of phosphorus loading into the lake, a number of recommendations within the Stewardship, Agricultural Lands and Watershed Planning Strategies as well as some implementation actions are intended to reduce phosphorus and nitrogen concentrations in the air and precipitation.

5.3 Direct Urban Runoff

Urban runoff is one of the main sources of nutrients and other contaminants in Lake Scugog. Urban and semi-urban centres have large impervious areas paved with asphalt and concrete as well as many impermeable roofs on buildings. Urban areas also have plenty of manicured open spaces such as golf courses, soccer and baseball fields and parks that are rich in nutrients due to regular fertilization. All of this creates favourable conditions for the rapid rainwater or snowmelt runoff that carries large quantities of phosphorus and nitrogen and can easily contaminate water in nearby streams and lakes.

Many urban areas around Lake Scugog do not have any stormwater treatment facilities, making them a significant source of pollutants. The *Port Perry Urban Area Nutrient Study* and *Draft Port Perry Stormwater Management Plan* results have confirmed this information (Kawartha Conservation, 2009b). Data from these studies were used to calculate phosphorus and nitrogen loadings into Lake Scugog from adjacent build-up areas. Between 1,203 and 1,228 kg of phosphorus and between 12.1 and 12.4 tonnes of nitrogen are transported annually into the lake with direct urban runoff; that constitutes approximately 13% of the total TP load and 3% of the total TN load.

As a result of the LSEMP implementation, including comprehensive stormwater management plans and urban BMPs implementation, phosphorus load from the nearshore urban areas can be decreased by 50 to 60% to approximately 500 to 600 kg per year, based on performance results for stormwater management ponds in the *Stormwater Management Planning and Design Manual* (MOE, 2003).

5.4 Private Septic Systems

Septic systems on private properties, even if properly maintained, can still be a significant source of phosphorus and nitrogen in inland lakes, especially shallow lakes with a small water volume such as Lake Scugog. This situation can be further aggravated when a septic system is malfunctioning, in which case practically all of the phosphorus and nitrogen from the tank can eventually reach a nearby water body.

There are approximately 2,100 private septic systems surrounding Lake Scugog in close proximity to the lakeshore. A phosphate plume from a septic system with a concentration of 0.6 to 1.5 mg/L can extend in a shallow aquifer for 70 to 75 m (Harman et al., 1996). The phosphate concentration in groundwater with an average of about 1 mg/L generally remains unchanged for a distance of 50 to 60 m.

Average nitrogen concentration in regular septic tank effluent is 45 mg/L (MOE, 1982). Approximately 25 to 30% of nitrogen can be attenuated, while effluent is passing through a shallow aquifer on its way to the closest water body. The remaining nitrogen (in nitrate form), taking into consideration the extension of the plume from conventional septics (Harman et al., 1996; MPCA, 1999), will reach the lake.

As a result, properties with well-functioning septic systems, assuming the average household has 2.6 persons per house, can generate about 0.365 kg of phosphorus and about 12 kg of nitrogen per year per septic system. Malfunctioning or old, poorly designed systems can produce up to 2.5 to 2.9 kg of phosphorus and up to 16 kg of nitrogen annually.

Every year, there is a total of approximately 920 kg of phosphorus and 25 tonnes of nitrogen loading into Lake Scugog from private septic systems located within a 50 m band around the lake (see Tables 5.1 and 5.2; Figures 5.1 and 5.3).

In the short-term, phosphorus loading can by reduced by 25% (to 700 kg per year) by implementing a wide range of stewardship and regulation activities for septic systems in lakeshore communities. This can be achieved with an active stewardship program designed to remedy malfunctioning septic systems and illegal grey water outlets into the lake. In the long-term, small, municipal wastewater treatment plants should be developed for the majority of lakeshore households. This is also an effective means of resolving health issues related to contamination from septic systems.

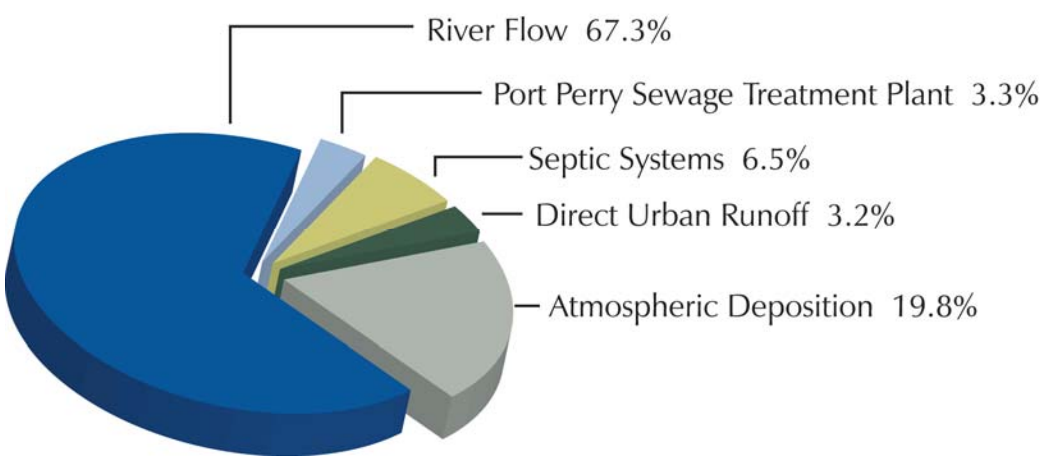

Figure 5.3. Major Sources of Nitrogen Loading into Lake Scugog

5.5 Nonquon River Water Pollution Control Plant

The Nonquon River Water Pollution Control Plant (NRWPCP) serves the communities of Port Perry and Prince Albert with a total serviced population of approximately 9,511 people (Region of Durham, 2009). The plant is situated on the south side of Scugog Line 8, east from the Nonquon River and releases its final effluent into the river. The approved discharge period is from October 16 to May 31, with the time period May 15 to May 31 allowable for the discharge only if the water temperature in the Nonquon River is less than 10˚C. The NRWPCP was designed and approved to treat wastewater at an annual average daily flow rate of 3,870 m^3/day (Region of Durham, 2008). In recent years the plant operated at 90.8% of capacity in 2006, at 67.5% of capacity in 2007, and at 88.7% in 2008 (Region of Durham, 2007, 2008, 2009).

Annually, the plant releases 150 to 200 kg of phosphorus and 12 to 14 tonnes of nitrogen into the Nonquon River (see Tables 5.1 and 5.2). The MOE Certificate of Approval objective for phosphorus loading is 0.9 kg/day or approximately 192 kg/year and the Certificate of Approval limit is 1.2 kg/day or about 213 kg/year. Monthly Certificate of Approval limits for total ammonia loading vary from 11.7 kg/day to 38.7 kg/day, but the total annual limit is approximately 5,600 kg.

The perception that the NRWPCP is the main source of pollution for the Nonquon River and Lake Scugog is not correct. The NRWPCP is responsible only for approximately 2% of the phosphorus load and 3 to 4% of the nitrogen load into the lake (see Figures 5.1 and 5.3).

Currently, the major concern about the NRWPCP operation is that the plant's effluent has continuously elevated ammonia concentrations during winter and spring months, which considerably exceed the compliance limits set by the MOE. As a result of this issue, the Region of Durham plans to undertake a Municipal Class Environmental Assessment (EA) to examine alternatives to address the elevated ammonia concentrations in the effluent and consider an additional water pollution control plant capacity for Port Perry. An assimilative capacity study of the Nonquon River will probably be part of this process. Furthermore, the Region of Durham continues consultations with the MOE on improvements at the NRWPCP that are necessary to resolve this issue.

6.0 Study Summary

The results of the LSEMP research and monitoring program undertaken through the period 2004 to 2008 revealed that Lake Scugog requires an active stewardship program to address a wide range of factors that cumulatively affect water quality and the ecological state of the lake. Implementation of an integrated watershed management approach is required to solve current problems, improve water quality and maintain the ecological sustainability of aquatic and terrestrial ecosystems.

As a result of this study, the first ever water budget for Lake Scugog was calculated for the 2005-2006 hydrologic year, and for the succeeding 2006-2007 and 2007-2008 hydrologic years. The water budget was balanced against the standard calculation error of 10%. The imbalance in the Lake Scugog water budget varied from 4.1% to 8.9%, imparting a high level of confidence in collected and calculated hydrological data.

The total phosphorus and total nitrogen balances and loads into the lake were calculated for three consecutive hydrologic years (2005-2006, 2006-2007 and 2007-2008). The sources of phosphorus and nitrogen were separated into five major categories: river flow, precipitation, direct urban runoff into the lake, municipal point sources (the Nonquon River WPCP), and private septic systems along the lake's shoreline. The river flow category was further partitioned into four additional subcategories: natural sources of phosphorus in river water, urban sources, agricultural sources and road runoff outside of urban areas. As a result, the most significant sources of nutrients were determined, and specific remedial strategies to decrease phosphorus and nitrogen loads into the lake were developed. It is important to remember that the more recommended strategies are employed, the greater the certainty that all phosphorus loading targets can be achieved.

On average every year, Lake Scugog receives more than 9.4 tonnes of phosphorus (9,062 to 9,611 kg) and 340 to 430 tonnes of nitrogen. Approximately 60% of that phosphorus amount remains annually in the lake, as well as 30% of the nitrogen. The remaining phosphorus and nitrogen exit the lake aquatic system with the Scugog River flow. It is estimated that, in order to improve water quality, reduce aquatic vegetation growth and maintain a healthy lake ecosystem, the total phosphorus load into the lake must be reduced to approximately 6.1 to 6.2 tonnes per year, which is 65% of the current amount. This amount is still almost double the pre-settlement phosphorus loading rate, which was estimated at 3.3 to 3.5 tonnes annually.

The average annual phosphorus load with the river flow is 5,330 kg. In order to improve water quality in the lake, the phosphorus load from watercourses should be significantly reduced. The overall target for an average total phosphorus concentration in the river water must be 30 μg/L, in accordance with the PWQO to prevent excessive aquatic vegetation growth. That will correspond to 3,265 kg of phosphorus load per year or 61% of the current amount. It will help to decrease excessive aquatic vegetation growth and improve the dissolved oxygen regime in the lake. As a result, instances of fish kills will be considerably reduced, benefiting the Lake Scugog fishery industry.

The average annual phosphorus load with atmospheric precipitation is 1,784 kg. The recent monitoring data show some stabilization of this portion of phosphorus load at approximately 1,650 kg per year that can be considered as a targeted number.

The effluent from the Nonquon River Water Pollution Control Plant contributes about 150 to 200 kg of phosphorus annually. It is recommended that the phosphorus load from the NRWPCP not exceed 150 kg per year to prevent further eutrophication of the Nonquon River.

The average annual phosphorus load with direct urban runoff from areas adjacent to Lake Scugog is 1,213 kg. The overall target for urban runoff can be established at 500 kg of phosphorus per year based on the MOE stormwater management ponds performance criteria (MOE, 2003). The above number is approximately 40% of the current level.

Private septic systems around the lake contribute approximately 920 kg of phosphorus annually. The short-term target is identified as 700 kg per year. A long-term target will depend on the number of lakeshore properties designated for municipal wastewater services in the future.

As well, phosphorus loads from the major subwatersheds were calculated in the river flow category. As a result, it was determined that the Nonquon River is the largest single source of phosphorus for Lake Scugog. It contributes annually between 23 and 32% of the total TP load into the lake. Furthermore, it was determined that the Port Perry urban area, as well as other urban areas across the watershed, had the highest export of total phosphorus per unit area ($kg/km^2/year$). Among regularly monitored tributaries, Cawker's Creek had the highest export of phosphorus and nitrogen per unit area. The upper Nonquon River and Blackstock Creek subwatersheds are also among areas of special concern.

The western basin of the lake is in a more aggravated ecological state than the eastern portion of the lake. High phosphorus concentrations, along with an overabundant development of weeds and macrophytes, and a considerable inflow of nutrients from the surrounding lands position this part of Lake Scugog in the eutrophic category of water bodies. Complex remedial actions are required for the western basin of Lake Scugog to prevent increasing degradation of the lake's ecosystem.

The monitoring results of the urban nutrient study done in 2007 revealed that the Port Perry urban area has a significant impact on water quality in the adjacent part of the lake. Water quality is most affected by stormwater runoff from William's Creek, Cawker's Creek and several stormwater culverts that discharge urban runoff directly into the lake. Presumably, this is one of the main reasons the western basin of the lake is in an impaired ecological condition.

The results of the sediment study in the vicinity of Port Perry revealed substantial contamination of bottom sediments in Lake Scugog by heavy metals and polycyclic aromatic hydrocarbons.

Among analyzed metals, lead was detected above the applicable guideline in 12 out of 15 samples. Such frequent recurrence of lead at high concentrations, exemplified at SD7 and SD12 stations, indicates anthropogenic pollution.

Polycyclic aromatic hydrocarbons exceeded corresponding guidelines in sediment samples from eight stations. The highest concentration of total PAHs was detected in the sediment sample from SD1 station (13,163 $\mu g/kg$) and was 19 times higher than the next highest concentration found in sediments at SD4 station (683 $\mu g/kg$). Moreover, all 10 individual PAH compounds detected in the SD1 sample exceeded the corresponding guidelines. However, organochlorinated pesticides, polychlorinated biphenyls, and benzene, toluene, ethylbenzene and xylene have not been detected in any sediment sample.

7.0 Principles of Future Watershed Management

The Lake Scugog watershed is comprised of multiple aquatic and terrestrial ecosystems, in conjunction with intensive human activities in the area of interest. Its sustainable future depends on the ability of the watershed community to understand human impacts and to properly manage this complex natural system.

Careful and balanced environmental management of such a unique natural system is not possible without a comprehensive understanding of the principles and functions of such management.

First, it is important to understand that watershed management is a continuous process and requires a multi-disciplinary approach, ongoing commitment and partnership among numerous stakeholders and partner organizations. As well, watershed management is a process that requires active participation of those affected by the decisions and activities of the plan. These could include farmers, cottagers, boaters, urban residents, local politicians and others.

The whole process requires profound knowledge of the subject, supported by sound scientific results, with a target-oriented plan of action. Such environmental philosophical principles as sustainable development, the precautionary approach and integrated ecosystem management should be widely used. To ascertain whether the plan is on the right path, it is necessary to evaluate actions through continuous monitoring and research, and amendments to the plans as required. Thus, an adaptive approach is another guiding principle of environmental management.

The management plan establishes a clear goal with objectives that will help to achieve it. The primary goal will serve as a beacon for the entire process and for all partners involved in the course of action. A vigorous lake and its watershed management is a continual engagement that never ends, especially in today's constantly changing environment, when every month and every day can bring new challenges and problems.

In initiating any watershed or lake management program, it is necessary to understand that the watershed is a balanced natural system. Today, many of these systems have been disturbed by human activities and it is virtually impossible to return them to their original state. Therefore, the primary mission of watershed management is to mitigate current human-induced disturbances and restore elements of the natural system where possible. There is also a need to maintain the balance between socio-economic and environmental aspects of the watershed management. We cannot sacrifice the environment for the economy, but we also cannot abandon the socio-economic interests of people in the name of the environment. A carefully designed and implemented watershed management plan can provide mutual benefits for both the environment and the economy.

Management efforts can be directed at three main watershed elements: the water body itself (in this case, Lake Scugog), floodplains and riparian zones around the main water body and its tributaries, and the remainder of the watershed. In each particular case, management efforts can be focused on one or two elements, or preferably on all of them, creating an integrated watershed management approach.

Finally, the environmental management plan should identify existing problems, recommend specific restoration actions, assign each action to the partner responsible for its implementation, and determine when actions should be initiated.

For the successful implementation of the environmental management plan, all stakeholders and partners involved in the process should have clearly defined roles and responsibilities. This is especially important in a case where stakeholders have regulatory power and can heavily impact the recommendations and directions of the plan.

The intent of this plan is to focus on priority areas. Maintaining the short-term achievable targets while sustaining the long-term strategies is a key to success.

There is not a strict, step-by-step guideline for watershed management since all watersheds, lakes and watercourses are different and face their own separate pressures. The need for flexibility in planning and managing is a key requirement. For instance, Lake Scugog is completely different from Lake Simcoe. They have similar problems, but approaches, methods and solutions can be, in some respects, unique and innovative.

The next chapter will present and exemplify recommendations that will pave the way for implementation activities. A detailed Implementation Plan with a description of particular actions is presented in Appendix A.

8.0 Recommendations

The Lake Scugog Environmental Management Plan provides comprehensive planning, educational, stewardship and research strategies for Lake Scugog for the next 10 years. As well, it provides an estimated cost for its implementation. After five years the LSEMP should be reviewed and updated if necessary. Similar to any other lake management or watershed management plan, it is essential to establish directions or strategies for future activities in managing Lake Scugog and its watershed. Each strategy defines actions for achieving objectives in each area of human activity.

Integrated efforts are fundamental to improving the environment in and around the lake. Everyone in the watershed shares a responsibility for the current state of the lake and is needed to participate in the stewardship and protection of Lake Scugog. A broad spectrum of partners, businesses and residents is required in the implementation process in the watershed. Simultaneously, they can accomplish tasks in different areas. The more recommendations and strategies that are implemented, the more likely that targets for phosphorus reduction will be achieved.

Using a co-operative process, the following strategies should be established:

- Communications and Education Strategy
- Stewardship Strategy
- Agricultural Land Use Strategy
- Urban Land Use Strategy
- Watershed Planning, Regulation and Enforcement Strategy
- Monitoring and Scientific Studies Strategy.

These strategies, each comprised of a number of recommendations, will address a full range of current concerns regarding water quality and other issues in the lake and its watershed. Activities and actions of the *LSEMP Implementation Plan*, presented in Appendix A, are also grouped under these strategies and related to individual recommendations. Effective implementation of the LSEMP can only be realized through a collaborative effort to establish funding partnerships and strategic alignments with existing programming.

8.1 Communications and Education Strategy

This strategy is linked with Objectives 4 and 5, defined in Section 1.3:

– *Foster community understanding of the lake and an appreciation of the lake's natural and historical heritage.*
– *Promote sustainable use of the lake.*

An effective education strategy is one of the key elements in achieving the main goal and primary objectives of the LSEMP. Public education, together with fostering community understanding of the lake, aquatic processes in the lake and appreciation of the lake's natural heritage, are all critical in helping to change people's habits and behaviours in everyday life around the lake.

The majority of recommendations for the education and communication strategy include the development of programs directed to local citizens and people using Lake Scugog for recreational purposes. By widely involving the general public in stewardship and restorative actions, we can promote environmental thinking and encourage changes in behaviour.

A framework for the Communications and Education Strategy includes the following:

- Implement fully a “Scugog Connections” storefront in downtown Port Perry. This location will become the local educational office for the LSEMP, with a complete supply of information materials on water quality, aquatic habitat, and stewardship opportunities as well as other environmental issues. The storefront will become the program hub for the development of local alliances involving old and new partners, volunteers and students to assist in the planning and implementation of outreach activities, water quality enhancement projects and emerging issues of water conservation and waste management.
- Establish a partnership with Parks Canada for the supply of educational and promotional materials on the Trent-Severn Waterway to the storefront (including shoreline naturalization, species at risk program and shoreline permitting).
- Engage municipal councils and staff in the implementation process.
- Develop and continuously update educational materials including thematic brochures, regular publications in local newspapers and magazines (the co-operation of Scugog Lake Stewards with FOCUS magazine is a notable example), and specifically oriented flyers.
- Establish the LSEMP racks in public libraries, Chambers of Commerce and local marinas.
- Install waterfront signage on environmental and sustainable living topics.
- Continue and enhance the Blue Canoe program or a similar program.
- Conduct information sessions in local schools and during agricultural meetings.
- Update regularly and maintain the LSEMP web page.
- Continue educational efforts to reach every member of lakeshore communities about the effects of individual activities on Lake Scugog water quality.
- Promote educational initiatives addressing the use of fertilizers and pesticides and their adverse effects on water quality in the lake.
- Initiate an annual Lake Scugog Festival oriented to environmental education through fun activities for families.
- Promote shoreline naturalization activities around the lake. Emphasize the importance of naturalized shorelines for water quality and the ecological health of the lake.
- Incorporate into the LSEMP process local professional and interest groups by introducing collaborative projects.
- Encourage more cooperation among jurisdictions in establishing a simple permitting protocol for landowners concerning shoreline works.
- Establish programs to support cleanup efforts on public and private lands.
- Provide information for the general public on low-impact development practices.
- Increase awareness of ecological problems associated with established and emerging invasive species in the lake.

The earliest activities must achieve immediate social awareness of the impact of personal actions. In the framework of this strategy it is crucial to initiate a comprehensive social marketing program involving communications, public education and demonstration projects. The “Scugog Connections” storefront project, funded by the Ontario Trillium Foundation, commenced operations in November 2009 as the primary facilitator of this objective.

It is essential to understand and promote public opinion about the lake's problems. Creating a Local Citizens Advisory Committee will be an excellent step forward. It is also necessary to establish relationships and engage in continuous dialogue on the lake health issues of the Mississaugas of Scugog Island First Nation.

The ultimate goal of the Communications and Education Strategy is to facilitate actions which contribute to lake sustainability by increasing awareness about the LSEMP not only among local municipalities and local residents, but also at the provincial and even federal levels.

8.2 Stewardship Strategy

This strategy is linked with Objectives 1, 2, 3 and 4, defined in Section 1.3:

- *Protect and improve water quality in the lake and its tributaries.*
- *Maintain healthy aquatic and terrestrial ecosystems within the watershed.*
- *Improve the aesthetic values of the lake and enhance opportunities for public enjoyment within the lake's natural surroundings.*
- *Foster community understanding of the lake and an appreciation of the lake's natural and historical heritage.*

The implementation of a Stewardship Strategy will deal with such problems and issues as shoreline manipulation and erosion, streambank erosion, and will also include tree planting and natural cover restorative activities, rehabilitation and restoration of degraded river and lake ecosystems as, for example, damaged littoral zone fish habitat.

Stewardship activities should move to a higher, more proactive and energetic level. A stewardship strategy is intended to cover the entire watershed by incorporating actions and programs directed to both urban and rural areas as well as to lakeshore zones. At the same time, the main focus should be on areas that contribute high amounts of phosphorous.

A framework for the Stewardship Strategy includes the following:

- Stabilize and naturalize eroding stream banks and lake shorelines using various design techniques and natural materials.
- Plant vegetative buffer zones along rivers and streams using native tree, shrub and plant species that will also help to improve the groundwater regime, increase vegetative diversity along shorelines and enhance terrestrial habitats.
- Promote soil nutrients testing in order to advise lakeshore property owners on how much fertilizer they need to apply to their lawns.
- Provide or arrange funds to repair or replace faulty septic systems that may leach wastewater into the lake and rivers.
- Protect and restore woodlots, wetlands and other types of natural cover, e.g., savannas or prairies.
- Restore damaged littoral zones using natural materials and advanced techniques.
- Improve aquatic habitats in rivers by applying natural channel design principles.
- Increase considerably the percentage of natural cover within a 30-m buffer zone along streams and around the lake.
- Provide or arrange funds for agricultural stewardship activities.

The subwatersheds with a low percentage of riparian natural cover have been identified as priority areas for the implementation of stewardship activities (e.g., shoreline naturalization and vegetative buffer zone restoration). These are the Lake Scugog shoreline areas (42% of natural cover in the 30-metre buffer zone) and the Blackstock Creek subwatershed (58% of natural cover in the 30-metre buffer zone). This is considerably below the 75% of natural cover within the riparian zones recommended for southern Ontario that could serve as the LSEMP target.

Within this strategy, a comprehensive reforestation program shall be developed and implemented.

A Reforestation Program includes the following:

- Undertake windbreak and shelterbelt planting, especially along roads and highways.
- Undertake reforestation of marginal and unworkable lands.
- Identify areas where natural regeneration is progressing satisfactorily.
- Encourage sustainable woodlot management according to forest conservation bylaws (the current Durham Region Tree By-law is a solid model).

Priorities in the reforestation activities should be directed to the most important areas of the watershed, focusing on water quality protection and other natural heritage values. All of these activities will decrease water and wind erosion across the watershed as well as phosphorus and nitrogen concentrations in the river water and atmospheric precipitation.

Priority areas with a low percentage of forest cover include the Cawker's Creek subwatershed (6.49%), Blackstock Creek subwatershed (23.4%), the part of Nonquon River subwatershed upstream from Scugog Line 10 (17.6%), and Fingerboard Creek subwatershed (19.2%). In the Lake Scugog watershed, overall forests occupy 112.3 km^2 or 24.8% of the area. This is still below the 30% guide that is being widely applied to planning areas in southern Ontario according to Environment Canada recommendations.

A wide range of stewardship tree-planting activities should seek to increase the total forest cover across the watershed to 30%. This includes an increase to at least 15% in the Cawker's Creek subwatershed, 30% in the Blackstock Creek subwatershed, and 25% in the Fingerboard Creek subwatershed.

It is useful to consider the creation of a Lake Scugog Stewardship Coalition (LSSC) that would include all organizations — governmental, non-profit, business and public — currently involved in stewardship activities across the watershed. It would help to coordinate activities among the large group of organizations working toward the same goal. As well, it would help to promote environmental values to the general public and professional groups in the watershed. Annual shoreline stewardship awards could be established to honour the most active members of the watershed community. This coalition could be similar to the Stewardship Alliance planned for the Lake Simcoe watershed.

The Lake Scugog Stewardship Coalition would accomplish the following tasks:

- Enhance collaboration and increase efficiencies in cost-sharing and communications.
- Facilitate information sharing, technology transfer and accountability.
- Support and enhance funding and other resources.
- Identify stewardship priorities in different areas of the watershed.
- Enhance influence in other sectors of the watershed community.
- Promote new initiatives, technologies and best management practices.
- Assist with watershed-wide planning (*Lake Simcoe Protection Plan*, 2009).

8.3 Agricultural Land Use Strategy

This strategy is linked with Objectives 1, 2 and 3, defined in Section 1.3:

– *Protect and improve water quality in the lake and its tributaries.*
– *Maintain healthy aquatic and terrestrial ecosystems within the watershed.*
– *Foster community understanding of the lake and an appreciation of the lake's natural and historic heritage.*

Agricultural activities utilize over 53% of the Lake Scugog watershed area. Approximately 23% of phosphorus loading into the lake comes from agricultural sources. The agricultural community, in close co-operation with provincial and federal ministries and agencies, has already achieved a substantial decrease in soil erosion and nutrient runoff from agricultural fields. Many farmers have already adopted agricultural BMPs. For example, 31.2% of farmlands in Ontario have been prepared for seeding using no-till practice and another 24.9% by means of conservation tillage (Statistics Canada, 2006). Amounts of fertilizers used in Ontario also decreased over the last 20 years. The purpose of the LSEMP is to help farmers to further reduce phosphorus and nitrogen loads from fields, feedlots and barnyards.

The proper management of farmlands is essential in maintaining the environmental health of the watershed and in decreasing phosphorus and nitrogen loads into the lake. Implementation of best management practices in agriculture across the entire watershed could have a large positive impact on water quality in the lake and its tributaries.

BMPs for the Agricultural Sector are grouped as follows:

1. Source BMPs decrease the amount of phosphorus from initial sources.
2. Transport BMPs affect the transportation of phosphorus on its way from sources to water bodies.
3. Combination BMPs have an impact on both the source and transportation of phosphorus.

The full list of currently known BMPs within these three groups is presented in 32 fact sheets, published by the group of research scientists working toward minimizing phosphorus losses from agricultural fields and known as the SERA-17 organization (SERA-17, 2005). All fact sheets are short, two-page publications that identify and clearly describe agricultural BMPs. These fact sheets, grouped into the three above categories, are presented below in Table 8.1. As well, the Ontario Ministry of Agriculture, Food and Rural Affairs, in the last 10 years, published a series of books describing some BMPs for decreasing erosion processes, soil loss, and phosphorus and nitrogen loading into watercourses. These books are between 40 and 150 pages and are free of charge. The series has 21 books, and 11 of these present BMPs that help to protect aquatic ecosystems and improve water quality. Some of the current book titles include: *Buffer Strips*; *Manure Management*; *No-Till*: *Making It Work*; *Nutrient Management* and others.

Considering current conditions and recent scientific research, the priority should be on the use of source and combination BMPs as more cost-effective ways of managing agricultural phosphorus. Since the protection of drinking water begins at its source, so should the protection of water bodies from phosphorus pollution.

Table 8.1. Published SERA-17 Agricultural Phosphorus BMPs Fact Sheets

Source BMPs	Transport BMPs	Combination BMPs
• Phosphorus balance • Soil testing • Dietary phytase to reduce phosphorus content in manure • Dietary phosphorus levels for dairy cows • Manure phosphorus testing • Physical manure treatment • Treating poultry litter with aluminum sulphate • Treating swine manure with aluminum chloride • Manure spreader calibration • Phosphorus application timing and methods • Management of spray fields • Composting effects on phosphorus availability in animal manures • Vegetative mining • Reducing urban phosphorus runoff from lawns	• Erosion control systems • Cover crops • Terraces • Strip cropping • Phosphorus loss with surface irrigation • Filter strips • Riparian zones protection • Grassed waterways • Constructed wetlands • Drainage ditch management • Septic drain field design and maintenance • Streambank and shoreline protection	• Lake and pond treatment by nutrient inactivation • Conservation tillage and crop residue management • Grazing management • Barnyard and feedlot runoff management • Milkhouse filters • Tail water recovery

Great Lakes Phosphorus Forum Proceedings, 2009

BMPs for use in early or later stages of the Implementation Plan are as follows:

1. **Conservation tillage**. This BMP includes several methods that leave crop residue, such as plant materials from past harvest, on the soil surface. Techniques used include no-till, mulch till and ridge till. All of these reduce surface runoff and soil erosion from the fields, conserve soil moisture, help to keep nutrients and pesticides on the field, and improve soil, water and air quality. No-till has the greatest value in reducing runoff and sheet erosion as well as decreasing the amount of soil particles in the air.

2. **Nutrient management.** This BMP helps to ensure that all mineral and organic nutrients applied to the field remain available for crop consumption and do not travel with surface runoff to the nearest watercourse. It requires soil testing to determine the volume of fertilizers to be applied. In addition, the utilization of a Global Positioning System (GPS) and other advanced technologies can ensure that nutrients are applied directly to the crops. That reduces the movement of nutrients off the fields and prevents their excessive build-up in soils. The implementation of this BMP requires the development of a nutrient management plan based on soil testing and specific crop requirements.

3. **Conservation buffers**. This BMP creates vegetative barriers for the protection of streams, lakes and wetlands. Conservation buffers are areas or strips of land with permanent vegetation that prevent pollutants from reaching surface water bodies and thus improve water quality. As well, vegetative buffers improve soil stability, protect crops, enhance wildlife habitat and eventually create sustainable healthy landscapes. Conservation buffers include the following practices: alley cropping, contour

buffer strips, cross wind trap strips, field borders, filter strips, grassed waterways with filters, riparian forest barriers, vegetative barriers, herbaceous wind barriers and wind breaks /shelterbelts. The last two practices are directed at wind erosion control.

4. **Grazing land management**. This BMP involves a rotational grazing of pastures. This maximizes pasture utilization, while preventing soil and bank erosion by restricting livestock from watercourses and riparian areas. Usually livestock move between two or more pastures. Grazing land management also includes stream fencing, animal walkways through or around sensitive areas, and stabilized stream crossings.

5. **Animal feeding operations management**. This BMP is intended to reduce the discharge of wastewater from farms, decrease surface runoff from feedlots and barnyards, and prevent seepage into groundwater. Some techniques include clean water diversion, proper waste storage, and other management methods such as wastewater treatment by vegetated filter strips.

6. **Streambank and shoreline protection.** This BMP refers to several techniques that mitigate the effects of grazing livestock on adjacent streams or lakes. The most frequently used form of protection is streambank fencing. Another technique is streambank stabilization that includes the installation of rock or wood stick walls along the sharp edges of a stream to protect banks during periods of high flow. In this case, stream banks or shorelines are often covered with rocks or vegetated with trees, shrubs and tall grass that reduce bank erosion.

7. **Riparian zone and wetland protection and restoration.** This BMP's main purpose is to protect riparian zones and wetlands, which are vital components for maintaining a healthy watershed and lake. When it is possible, wetlands can be restored to enhance the watershed hydrological function. The Canada-Ontario Environmental Farm Plan (EFP) and Ducks Unlimited can provide funds for such projects.

8. **Cover crops and crop rotation.** These two BMPs are mainly directed toward soil protection from water and wind erosion. Cover crops are used to cover soil on agricultural fields in periods between harvesting and planting of the primary crop (usually autumn to spring). Crop rotation improves quality of soil, helps to balance nutrient supply to crops and reduces nutrient losses with surface runoff from farmlands.

Within each BMP it is possible to use additional techniques. As well, it is important to encourage and promote advanced techniques for handling, application and storage of manure, fertilizers and pesticides. Good stewardship of agricultural lands can make a significant impact on improving water quality in Lake Scugog and its tributaries across the watershed.

The Ontario Soil and Crop Improvement Association, with the delivery of the Canada-Ontario Environmental Farm Plan, will take a lead role in agricultural stewardship with farm workshops and funding assistance. The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) will also play a leading role in the promotion of BMPs in the Lake Scugog watershed.

The recently created Scugog WATER Fund is recommended to encourage more agricultural projects. Such projects can also be financially supported by the Environmental Farm Plan (EFP) and/or the Greenbelt Foundation. The most appropriate locations for such projects will be determined by taking into consideration scientific information about water quality in nearby streams.

Blackstock Creek, as a mainly agricultural watercourse, is contributing into the lake an average of 740 kg of phosphorus annually. In the very near future, a full range of stewardship activities will be initiated in the Blackstock Creek subwatershed as part of a comprehensive stewardship program. This will require a coordinated effort involving the agricultural community, the Ontario Ministry of Agriculture, Food and Rural Affairs, and existing programs such as the EFP, as well as preparation and implementation of a stormwater management plan for the Hamlet of Blackstock. The final goal is to reduce the phosphorus load from the Blackstock Creek subwatershed by 400 kg over the next 5 to 10 years by undertaking a number of nutrient and soil management activities.

Other priority areas for the implementation of the agricultural BMPs have been identified during the LSEMP development. These areas include the lower portion of the Layton River subwatershed (for erosion control and streambank fencing), the upper part of the Cawker's Creek subwatershed (for riparian zone protection and restoration, and a set of multi-source BMPs), and the headwaters of the Nonquon River upstream from Scugog Line 6 (for several BMPs).

8.4 Urban Land Use Strategy

This strategy is linked with Objectives 1 and 2, defined in Section 1.3:

- *Protect and improve water quality in the lake and its tributaries.*
- *Maintain healthy aquatic and terrestrial ecosystems within the watershed.*

The recommended urban stormwater management strategy will provide an integrated basis for comprehensive stormwater management planning in all urban catchment areas. Implementation of this strategy can help reduce contaminants associated with urban runoff by using water quality and quantity treatment and by reducing or eliminating the sources of pollutants.

As an urgent initial step, stormwater management plans for all urban areas across the watershed should be developed, starting with the Port Perry urban area. The next step will be the implementation of those plans as funding for capital projects becomes accessible. If space is available and construction is feasible, it is necessary to retrofit and maintain wet stormwater ponds and/or constructed wetlands, at the enhanced protection level, in all older urban areas to remove nutrients and other contaminants from urban runoff. Where opportunities exist, constructed wetlands are a preferable solution. Artificial (constructed) wetlands are more natural and require less maintenance than conventional stormwater ponds. In areas with insufficient land for the construction of stormwater management facilities (SWMFs), other controls should be considered based on the size of the catchment area and the amount of contaminants it contributes.

An intensive series of rehabilitation projects and implementation of best management practices adjacent to urban shorelines and tributaries is recommended in the Cawker's Creek, William's Creek and other urban subwatersheds. Involving volunteers, youths, urban landowners, the municipal roads department and area golf courses in the projects is advised.

Plans to retrofit or construct stormwater management facilities in existing urban areas should also be augmented by the following:

- Create an inventory, inspection and maintenance schedule for the existing urban storm drainage system.

- Adopt stormwater controls ranging from lot level to end-of-pipe practices such as reduced lot grading, grassed swales, small dry ponds, permeable paving and oil/grit separators.
- Implement urban BMPs such as rain barrels, rain gardens, reduced fertilizer and pesticide use, advanced road sanding and salting, etc. that will help to minimize water quantity and reduce the amount of contaminants entering the stormwater system.

Inventory, Inspection and Maintenance Schedule of Existing SWMFs

Sediment accumulation in a stormwater management facility can degrade the level of treatment, and can decrease the storage capacity of a pond. When creating a maintenance schedule, the size of the facility and the rate of sediment and debris accumulation must be taken into consideration. Regular inspections by the municipality can also help in developing a maintenance schedule. An inspection of a facility will determine what needs to be done in and around the SWMF to ensure safe, efficient operations. A regular inspection schedule will also show the frequency of the development of maintenance issues such as sediment accumulation, flooding, erosion and dying of vegetation. For new facilities, it is recommended that inspections take place after every major storm event. For other facilities, conducting inspections in the spring and fall would most likely be adequate if the facility is functioning normally. If a facility is known to have a recurring issue, more frequent inspections may be necessary.

Oil/grit separators, swales and other stormwater management controls require a routine maintenance schedule to ensure efficient operation. This is based on the amount of water flowing through the system and the rate of sediment and debris accumulation.

The proper maintenance of stormwater system features such as sewers and culverts will improve the quality of stormwater runoff. Cleaning storm sewer pipes, culverts and catch basins can help to reduce the amount of sediments, debris and contaminants that enter SWMFs, controls and surrounding water bodies. Cleaning activities can also prevent clogging that may lead to flooding during intense storms. Identifying and repairing or replacing damaged or corroding pipes and catch basins is also important. Damaged and corroded sewer pipes allow water that has infiltrated into the ground to enter the storm sewer system. This can cause the storm sewer and any controls or facilities to deal with more water volume than they were designed for, which can result in flooding or a poor level of treatment. Leaks in the system can also create erosion or damage to overlying roads, parking lots and neighbouring pipes or conduits. Furthermore, leaking storm sewer pipes in close proximity to leaking sanitary pipes can result in untreated sanitary sewage entering the stormwater system.

A yearly inspection of catch basins, and storm sewer inlets and outfalls to identify areas where cleaning or maintenance is required is a common practice in many Ontario municipalities. The need for maintenance of the actual sewers is often determined through manual inspections or sewer photography reports. In terms of cleaning, some municipalities flush one section of the storm sewer network each year as part of a several year rotation. This approach is both efficient and cost-effective.

As many controls and facilities are located on private property, it is necessary to ensure that property owners are aware of the need to provide proper maintenance. This can be achieved through education on the benefits of stormwater management and its impacts on the community and the lake, as well as by providing information to property owners regarding the operation and maintenance of their specific facilities or controls.

Stormwater Management Controls

While stormwater management facilities service subdivisions and multiple sewersheds, stormwater management controls are primarily used at lot level or other small areas. Many different stormwater management controls exist for quality and quantity, ranging from inline technologies such as oil/grit separators and underground storage to end-of-pipe controls such as filter beds. Individual controls are geared toward either quantity or quality, but rarely account for both. As such, they are most effective when used with other quality or quantity controls, or in conjunction with SWMFs.

Oil/grit separators
Oil/grit separators are inline treatment devices that temporarily detain stormwater, thus allowing for the settling of sediment and the rising of oil and debris. They are most effective when used just upstream of the outlet to ensure that all runoff from the sewershed passes through the system. Oil/grit separators are commonly used in parking lots, gas stations and garage drainage areas, as these are where oil is most likely to be flushed into the sewer system. When servicing larger areas, two or more separators should be used in series in order to provide a good quality of treatment.

Peat/sand filters
Peat/sand filters work by allowing stormwater to infiltrate through a series of peat/sand mixtures before being discharged. Some filters also incorporate a layer of vegetation above the filter media to provide a higher level of treatment. Peat/sand filters can be installed either above-ground or underground. Above-ground filters are generally less expensive and easier to maintain, but require more space than underground filters and may be considered an eyesore. Because filters are designed to remove suspended sediment and associated contaminants, they are less effective at removing more soluble pollutants.

Soakaway pits
Soakaway pits are lot level controls used to promote the infiltration of runoff from roofs. They operate by receiving roof runoff from a roof leader that discharges directly into a stone filled excavation. The discharge then infiltrates the surrounding soil. Soakaway pits are installed below grade and thus do not take up any space on the lot. However, they can only be used in areas where the surrounding soils allow water to infiltrate quickly.

Grassed and vegetated swales
Grassed swales are lot level controls that consist of a shallow grass lined depression designed to convey stormwater. As stormwater flows through the swales, it infiltrates the soil and is filtered by the grass. Some swales may incorporate check dams or hay bales to temporarily detain the water and thus increase the opportunity for infiltration.

Vegetated swales are similar to grassed swales in their design and operation. However, vegetation is allowed to grow instead of being manicured, as is often the case with grassed swales. Furthermore, a variety of terrestrial and emergent vegetation can be grown in these swales, increasing infiltration rates and providing a higher degree of filtration.

Flow spreaders
Flow spreaders are end-of-pipe features that focus primarily on quantity control. Discharging large quantities of water at a single source, such as a storm sewer outfall, can create problems with erosion and temperature changes in the receiving water body. Using flow spreaders at outfalls spreads the stormwater out over a larger area before releasing it back into surrounding watersheds, thus lowering discharge velocity and preventing erosion. Rock lined or vegetated spreaders also provide a final opportunity for infiltration and filtration. Some stormwater management facilities also incorporate flow spreaders at their inputs to help prevent erosion in the facility.

Best Management Practices

Aside from the installation of stormwater management facilities and controls, stormwater quality and quantity can be improved through the implementation of best management practices for urban areas. BMPs are relatively inexpensive features or practices that can be undertaken by the municipality and the general public to reduce and improve stormwater runoff.

Prevention at the Source

Dealing with pollutants before they enter the stormwater system is the most efficient method of stormwater management. Ensuring that contaminants do not enter the stormwater system to begin with eliminates the need to filter them out later. This can be done by a change in the practices contributing to a build-up of pollutants on the surface. Examples of preferred practices include creating a used oil recycling program, providing household hazardous waste collection, implementing material storage control and promoting alternatives to discharging pool drainage into the stormwater system. These will help reduce the amount of pollutants that enter the system directly through illegal dumping, pool drainage and spills of improperly stored chemicals and waste.

Implementation of (and amendments to) the *Pesticides Act* that restricts the cosmetic use of pesticides, as well as the control of litter and pet waste through municipal bylaws, will reduce the amount of pollutant build-up on lawns, parks and other surfaces. This will minimize the amount of contaminants being flushed into the stormwater system during precipitation and melt events. Where feasible, municipalities will introduce street sweeping programs, which should be evaluated for effectiveness.

Ensuring the proper use of erosion and sediment controls at construction sites will reduce the amount of suspended sediments entering the stormwater systems and watercourses nearby.

Finally, general education and awareness through programs such as the Yellow Fish Road will help inform the general public about the consequences of stormwater pollution. These programs also give members of the public an opportunity to take part in an activity that benefits their community, the township and the lake.

Lot Level Control

Lot level controls focus on water quantity. Less volume flowing through the stormwater system permits the development of less intensive and more efficient stormwater controls and facilities. This mitigates the effects of large influxes of stormwater into receiving water bodies, for instance, erosion and increases in water temperature.

Examples of these controls include rain barrel programs, downspout disconnection, storm garden development, green roofs and the creation of lot level infiltration features. The creation and promotion of urban forests and vegetated buffer strips also help to reduce the amount of water being directed into the stormwater system by increasing infiltration and evapotranspiration. Tree canopies also detain rainwater and release it slowly to the surface, again providing quantity control.

The development of features such as these helps to maintain the natural hydrologic cycle by the local detention of rainwater. Moreover, choices such as rain barrels can provide an alternative source for the watering of lawns and gardens thus reducing the load on the municipal water supply system.

Municipal Operations

Changes to municipal operating procedures can improve the quality of stormwater runoff. Implementing or increasing the frequency of leaf collection and street sweeping activities will help reduce the amount of sediment and debris being flushed into the stormwater system. Catch basin and stormwater control maintenance can ensure efficient operations and prevent potential blockages and flooding of the system. Proper inspection and maintenance of sanitary sewers will help prevent possible leaks to, or cross-connections with, the stormwater sewer system. Replanting or promoting vegetation growth in recently dug or cleaned ditches will help promote infiltration, prevent erosion, allow for settling of sediments and provide filtering. Finally, improvements to road de-icing and salting operations will enhance stormwater quality. For example, ensuring that only the minimum amount of de-icer is used to accomplish the job will prevent unnecessary sediments and salts from entering the stormwater system and surrounding water bodies.

Because urban areas consist mainly of impermeable surfaces in high traffic commercial areas, selected BMPs should focus on promoting infiltration. Features such as green roofs and storm gardens will account for runoff from structure roofs. The creation of infiltration and filter controls such as infiltration trenches, permeable asphalt and concrete or vegetated swales in parking lot areas will provide a degree of filtering and help reduce the quantity of water directed into the storm sewer system. Controls such as filter systems and oil/grit separators in parking lot areas or upstream of outfalls can provide a higher level of treatment for stormwater runoff. Stormwater management facilities provide a high degree of water quality treatment, and constructing enhanced protection level facilities will greatly benefit the lake. To be successful, a stormwater management strategy must combine BMPs, controls and facilities to provide efficient and cost-effective treatment of urban stormwater runoff.

The ultimate goal of the Urban Land Use Strategy is to ensure that the Stormwater Management Facilities provide stormwater quality and quantity control and treatment for all urban areas in the watershed. As a result, phosphorus export from these areas will be reduced by 50 to 60% or 850 to 1,030 kg annually.

8.5 Watershed Planning, Regulation and Enforcement Strategy

This strategy is linked with Objectives 1 and 2, defined in Section 1.3:

- *Protect and improve water quality in the lake and its tributaries.*
- *Maintain healthy aquatic and terrestrial ecosystems within the watershed.*

Planning, regulation and enforcement activities are vital for the success of the Lake Scugog Environmental Management Plan. Any remedial implementation plans and further actions must be supported by the official policies, plans and associated legislation. If necessary, these should be updated, improved, or newly developed.

Implementation of the LSEMP, in terms of the fundamental planning policies, shall be based on relevant federal and provincial legislation, including the following:

- *Planning Act* (primary legislation related to land use planning in Ontario)
- *Clean Water Act*
- *Conservation Authorities Act*
- *Endangered Species Act*
- *Environmental Assessment Act* (Ontario) and *Canadian Environmental Assessment Act*
- *Environmental Protection Act* (federal legislation)
- *Fisheries Act* (federal legislation)
- *Fish and Wildlife Conservation Act*

- *Greenbelt Act*
- *Green Energy Act*
- *Historic Canals Regulations*
- *Lakes and Rivers Improvement Act*
- *Oak Ridges Moraine Conservation Act*
- *Provincial Policy Statement*
- *Public Lands Act*
- *Species at Risk Act*s (federal and provincial)
- *Water Resources Act*.

As well, regional and municipal official plans should contain sections relating to the LSEMP implementation process. More specific planning documents, such as the Port Perry Downtown Development Strategy and stormwater master plans, should reflect the recommendations of this plan.

It is important to maintain and improve collaboration among municipal planning staff, federal and provincial regulating authorities, and Kawartha Conservation planning, regulatory and technical advisory staff related to shoreline regulations and permitting procedures. This will streamline processes and improve transparency for the general public. In particular, the Trent-Severn Waterway is the primary authority in the permitting process for in-water and shoreline alterations *up to the high water mark*. Coordination with the authorities responsible for shoreline areas *above the high water mark* is therefore crucial.

In order to successfully implement the LSEMP, a great deal of work should be done in the framework of the Watershed Planning, Regulation and Enforcement Strategy. As the Drinking Water Source Protection planning proceeds, more legislation will be available for use in the LSEMP implementation. Considering the results of the monitoring study and the analysis of current environmental problems in the Lake Scugog watershed, the following measures are recommended:

A framework for the Watershed Planning, Regulation and Enforcement Strategy includes the following**:**

- Adopt the GTA *Erosion and Sediment Control Guideline for Urban Construction* for the Township of Scugog and the City of Kawartha Lakes to decrease sediment and nutrient loads from construction sites.
- Adopt for further use in stormwater management activities, the Low Impact Development Stormwater Management Manual prepared by Credit Valley Conservation and Toronto and Region Conservation Authority. This manual describes the most advanced techniques in modern stormwater management.
- Update existing stormwater management plans, considering the most effective state-of-the-art techniques (see previous recommendation).
- Complete stormwater management plans for the Port Perry urban area as well as for Caesarea, Blackstock, Greenbank, Seagrave, Sonya, Utica, Viewlake and some larger shoreline communities around the lake.
- Develop comprehensive, sustainable urban design guidelines for the Region of Durham and the City of Kawartha Lakes.
- Integrate into municipal planning policies the LSEMP goal and objectives in order to enhance environmental protection and restoration in the watershed.
- Develop regional policies and/or municipal bylaws for stricter regulations on fertilizer use for aesthetic purposes, especially in proximity to water bodies.

- Update regional planning policies, if needed, to ensure and enhance the protection and rehabilitation of headwater areas, wetlands, environmentally sensitive areas, stream 30-metre buffer zones and lake shoreline zones.
- Enact or review municipal site alteration bylaws within the 50-metre lake shoreline zone. Such bylaws (if existing) will capture shoreline modifications that fall outside the purview of the *Planning Act*.
- Recommend to municipalities that they incorporate into their official plans policies encouraging the implementation of integrated stormwater management infrastructure, starting from source and lot level and finishing with end-of-pipe controls such as constructed wetlands.
- Recommend that all future major developments in the Lake Scugog watershed be served by municipal sewage and water services as per policy 1.6.4.2 of the *Provincial Policy Statement* (PPS). Investigate the possibility of communal sewage and water services where municipal services are not feasible, as per policy 1.6.4.3 of the PPS; particularly where it is required to address a serious health concern.
- Investigate opportunities to convert septic systems in lakeshore communities to secondary or tertiary small municipal wastewater treatment plants. A good example is King's Bay subdivision in the City of Kawartha Lakes, where more than 100 houses are served by one small municipal wastewater treatment plant. The Town of Georgina in the Lake Simcoe watershed decommissioned 2,200 residential septic systems along the shoreline and placed those houses on municipal service. That resulted in a net phosphorus loading reduction estimated at 1.2 tonnes (LSEMS Phase III Progress Report, 2007). It can be costly and therefore a cost-benefit analysis needs to be undertaken. This project cost the Town of Georgina and the Region of York $54 million.
- Consider, in the meantime, regulatory actions for legislating septic upgrades, e.g., a municipal bylaw requiring a certificate of approval prior to a property sale.
- Recommend that municipalities increase enforcement activities to prevent sediment losses from construction sites as a result of water and wind erosion.
- Recommend that municipalities increase enforcement activities to control contamination from pets on streets, in parks and other public places. Promote poop-and-scoop practices.
- Protect, enhance and restore lands with significant natural features that perform important ecological functions and play a vital role in the ecosystem. These areas should not be used for any kind of development.
- Recommend that current biosolids spreading policies be examined to ensure the protection of groundwater and surface water quality.
- Review and strengthen municipal bylaws regulating land disturbance, e.g., forbid topsoil stripping until construction site plan approval is in place.
- Ensure that all new septic systems are located at least 50 m from the nearest point of a water body.

Septic systems at shoreline residences within a 50 m band from the shoreline account for an estimated 10% of the nutrient input to the lake or 920 kg of phosphorus annually. It is important to promote an extension services program for shoreline residences and develop financial assistance opportunities for septic system upgrades, with a target of reducing phosphorus input by 20 to 25% over the next 5 to 10 years. Opportunities to build small municipal wastewater treatment plants in lakeshore communities should be seriously considered in the very near future.

As for the Nonquon River Water Pollution Control Plant, the Region of Durham should accelerate the process of a Municipal Class Environmental Assessment and find a solution for the existing issue with elevated ammonia concentrations in the effluent as soon as possible. As well, it is recommended that annual phosphorus loading with the NRWPCP effluent should not exceed 150 kg. Consider the option to increase effluent volume during the months of November, December and January, and decrease it in February and April. It would be preferable not to release any effluent in May.

Kawartha Conservation, with support from municipalities and other funding sources, will continue efforts to promote the values of the LSEMP. Kawartha Conservation will work in close co-operation with municipalities and other interested partners, and will carry out any necessary actions according to its mandate, as described in the *Conservation Authorities Act*.

8.6 Monitoring and Scientific Studies Strategy

This strategy is linked with Objectives 1 and 6, defined in Section 1.3:

- *Protect and improve water quality in the lake and its tributaries.*
- *Maintain ongoing monitoring and research.*

All management decisions and recommendations as well as remedial and restorative actions depend on sound scientific data and knowledge. It is essential to continue regular water quality monitoring on the lake and its major tributaries for phosphorus and nitrogen concentrations to determine the long-term trends, calculate phosphorus and nitrogen loads, and to detect changes in water quality in the trophic state of the lake, and in the amounts of phosphorus and nitrogen entering the lake.

A framework for the Monitoring and Scientific Studies Strategy includes the following**:**

- Continue water quantity monitoring. Maintain and enhance the river flow monitoring network across the watershed.
- Install an additional precipitation sampler on the eastern shore of the lake.
- Undertake annual calculations of the Lake Scugog water budget.
- Deploy automatic samplers to sample stormwater runoff after rain events at several locations across the watershed.
- Continue regular water quality monitoring on the main tributaries of the lake.
- Continue regular water quality monitoring at the lake stations to examine the long-term trends in phosphorus concentrations and in the trophic state of the lake.
- Initiate and run the water and nutrient management model (CANWET) and the prediction model (PREDICT) for the entire Lake Scugog watershed and for its separate subwatersheds (the Nonquon River, Blackstock Creek and Cawker's Creek).
- Initiate water quality monitoring for a wide range of pollutants at each stormwater outlet for at least two wet weather events and one dry weather event (if feasible) per year to identify pollutant concentrations in local urban runoff.
- Continue scientific studies that will provide a better understanding and forecast of phosphorus and nitrogen movement and loading into the lake and watercourses, from septic beds through soils and shallow aquifers.
- Initiate experimental scientific projects to test new materials that may discourage aquatic plant regrowth in economically and aesthetically important areas or within the heavily affected areas of the lake.
- Undertake a paleolimnological study of sediments in the lake to better understand historical sedimentation rates, and phosphorus and metals loading rates.

- Conduct a comprehensive scientific study of phosphorus (and associated metals) adsorption and desorption processes from sediments.
- Conduct a study of hydrodynamic processes in the lake, which can be an important factor in eutrophication processes.
- Analyze the assimilative capacity of the watershed or its parts in anticipation of future developments. A Lakeshore Capacity Assessment Model may be run. As noted previously, 71.3 km or 41% of the Lake Scugog shoreline is currently developed. There is a need to know if any further shoreline developments are feasible and acceptable.
- Integrate into the LSEMP database and widely use information and data collected for the Drinking Water Source Protection planning.

The Lake Scugog water level operational regime is another important aspect of comprehensive lake management from both scientific and practical points of view. Therefore, it is recommended that the Trent-Severn Waterway should maintain water levels in Lake Scugog that do not disturb natural habitat in and around the lake. Considerably fluctuating water levels in the lake during summer create navigational hazards, have a negative impact on the natural environment, cause problems for lakeshore properties and require the construction of extensive docks that, in turn, leads to more disturbances to natural habitat. A better understanding of the hydrological regime of the lake, achieved through improved forecasting and monitoring, will help to decrease fluctuations of lake water levels and maintain them within the upper amplitude.

To achieve this, the TSW must maintain ongoing collaboration and develop a close partnership with Kawartha Conservation. The recently established Water Management Advisory Council for the Trent-Severn Waterway can provide such an opportunity. Currently Kawartha Conservation represents five conservation authorities on this Council. The possibility of establishing an additional gauge station (in any form) on Lake Scugog in the vicinity of Port Perry should also be considered.

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Glossary

Agricultural area: A portion of the watershed where the predominant land use is agriculture or agriculture related.

Agricultural activities: Refers to any actions related to farm operations. This includes, but is not limited to, growing crops, raising livestock, spreading manure, irrigation and clearing fields.

Anthropogenic: Effects, processes or materials that are derived from or as a result of human activities.

Aquatic system: An ecosystem located within a water body. (Also see: Ecosystem)

Aquatic vegetation: Refers to plants and algae that grow within an aquatic environment.

Aquifer: Layer of permeable rocks or loose materials (gravel, sand) that is saturated with water and through which groundwater moves and can be extracted using a water well.

Baseflow: The portion of stream flow that is entirely attributed to groundwater inputs.

Benthics: Organisms that live in the benthic zone at the bottom of a water body.

Best management practice (BMP): A term used to describe the preferred method of management that has proven to reliably lead to a desired result. Usually associated with stormwater management or agricultural practices.

Bioaccumulation: The build-up of substances such as pesticides or heavy metals within an organism. This occurs when the organism obtains a substance at a greater rate than it can dissipate it.

Biodiversity: The variability among living organisms and the ecological complexes of which they are part. A healthy ecosystem is traditionally one with a high level of biodiversity.

Biosolids: A term used in wastewater management referring to treated sludge from commercial and domestic sewage and wastewater treatment.

Biota: The total collection of organisms of a geographic region.

Coldwater fish: Fish species such as brook trout that prefer colder water temperatures (usually below 15°C).

Conductivity: In regards to water, conductivity measures the ability of a water sample to conduct electricity. This is dependent on the concentration of dissolved salts and other ionizing chemicals.

Dissolved oxygen (DO): An amount of oxygen that is being dissolved in the water column.

Drumlin: A geographic feature created through glaciation in the form of a "tear drop" shaped hill. Usually occurs in clusters or "fields".

Dry deposition: Materials such as dust that fall out of the atmosphere onto the earth's surface.

Ecological functions: The natural processes, products or services that living and non-living environments provide or perform within or between species, ecosystems and landscapes.

Ecosystem: A recognizable ecological unit such as a group of plant and animal species living together in a particular area.

End-of-pipe practices: Stormwater management controls or facilities located at a storm sewer outlet. (Also see: stormwater management controls, stormwater management facilities)

Erosion: The removal of soil sediment and rock in the natural environment. This may be as a result of natural processes such as weathering or through anthropogenic processes such as deforestation and poor farm management practices.

Eutrophication: A natural or human-caused process whereby water bodies receive excess nutrients (phosphorus and nitrogen specifically) that stimulate excessive aquatic plant and/or algae growth. Nutrients can come from natural sources such as erosion of soils or stream banks, or human sources (fertilizers, urban runoff, sewage treatment plant discharges, etc.).

Eutrophic water body: A lake, stream or any other natural or man-made water body that has high levels of nutrients in its water, is highly productive and supports high growth rates of aquatic vegetation and/or algae.

Evaporation: The transfer of water from the earth's surface into the atmosphere under influence of solar radiation and heat, and wind.

Evapotranspiration: The transfer of water from vegetation into the atmosphere.

Farming activities: (See agricultural activities)

Freshet: High water levels resulting from heavy rains or snowmelt. Usually associated with a spring thaw event.

Groundwater: Water located beneath the surface, usually in aquifers or other porous spaces.

Groundwater discharge: The flow rate of groundwater through an aquifer usually expressed in cubic metres per second.

Habitat: An ecological or environmental area that is inhabited by a particular organism and that influences or is utilized by that organism.

Hardness: In regards to water, hardness measures the concentration of dissolved minerals such as calcium and magnesium. Hard water has a high mineral concentration.

Infiltration: Water entering the ground via pores in the earth's surface.

Invasive species: A non-indigenous plant or animal, e.g., Eurasian milfoil (Also see: native species)

Lot level practices: In regards to stormwater, these are changes that can be made on a lot or property to reduce the quantity or improve the quality of stormwater runoff, e.g., installation of rain barrels.

Macrophytes: Aquatic plants that grow in or near the water.

Mesotrophic water body: A lake, stream or any other natural or man-made water body that has moderate levels of nutrients in its water and consequently moderate plant growth.

Heavy metals: In regards to water quality, this refers to metals located within the water column as a result of natural or anthropogenic processes. Heavy metals are usually toxic for aquatic organisms and humans, e.g., lead, cadmium, and mercury.

Moraine: A geographic feature consisting of a mound of earth and rock pushed up in front of an advancing glacier.

Naturalization: (See restoration)

Native species: A species that is indigenous to an ecosystem in that it occurs there naturally without any human intervention.

Nutrients: In terms of water quality, this refers to the chemicals that aquatic vegetation requires for vital functions. Nutrients include phosphorus, nitrogen, potassium and some other chemical elements.

Oligotrophic water body: A lake, stream or any other natural or man-made water body that has very low levels of nutrients, such as phosphorus and nitrogen, in its water and, as a result, low productivity with few aquatic plants.

Petroleum hydrocarbons (PHCs): Group of several hundred chemicals that originally come from crude oil. These chemicals are present in many petroleum products made from crude oil. PHCs are a mixture of chemicals, but all of them are made mainly from hydrogen and carbon and therefore called hydrocarbons.

Polycyclic aromatic hydrocarbons (PAHs): Group of over one hundred different chemicals made up of only hydrogen and carbon. They are the standard product of the incomplete burning of carbon-containing materials like oil, wood, garbage or coal. Automobile exhaust, industrial emissions and smoke from burning wood, charcoal and tobacco contain high levels of PAHs. Several PAHs, such as anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene and some others are carcinogenic.

Precipitation: The transfer of water from the atmosphere to the earth's surface in the form of rain, snow, hail, dew, etc.

Provincially significant wetland (PSW): Based on the guidelines for wetland management (MNR, 1984), these are wetlands classed as 1 through 3 in the wetlands policy (Section 3 of the *Planning Act*).

Recharge: In regards to groundwater, recharge refers to water being added to a groundwater system such as an aquifer.

Restoration: Returning an altered landscape back to its original form through physical restructuring and the reintroduction of native species. For example, shoreline restoration or naturalization refers to the removal of non-natural features such as lawns and break walls and the addition of native plant species.

Riparian (zone/area): The interface between land and a stream or lake.

Secchi disk: White and black disk 20 centimetres in diameter used to measure water transparency in lakes. The disc is lowered into the water on the line. The depth at which the pattern on the disk is no longer visible is taken as a measure of the transparency of the water. This measure is known as the Secchi depth and is related to water turbidity in the lake.

Sediments: Any particulate matter that can be transported by fluid flow and which is eventually deposited on the bottom of a water body.

Sewershed: The total area of land that drains to a sewer system.

Stormwater: A term used to describe water that originates during a precipitation event. Usually used to define water that flows through storm sewer systems in urban areas.

Stormwater management control: A device or system used to treat stormwater quality or quantity. Examples are oil grit separators, infiltration trenches, etc.

Stormwater management facility: A constructed wet pond, dry pond or wetland used to detain stormwater in order to treat for quality or quantity. Water quality treatments primarily rely on the settling of sediments.

Subwatershed: A subsection of a watershed. (Also see: watershed)

Surface water: Precipitation that does not soak into the ground or return to the atmosphere but instead flows through streams, rivers, lakes and wetlands.

Suspended sediments: Sediments that have not yet settled and are still situated within the water column. (Also see: sediments)

Sustainable development: A pattern of resource use that aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for future generations.

Transpiration: Evaporation from aerial parts of a plant such as the leaves. (Also see: Evaporation, Evapotranspiration)

Urban area: An area with an increased density of human-created structures and population when compared to surrounding areas. In Canada, an urban area is defined as having more than 400 people per square kilometre and has more than 1,000 people in total.

Warm water fish: Fish species that prefer warmer water temperatures such as muskellunge and smallmouth bass.

Water balance: The concept of maintaining the various water budget components after urban development.

Water budget: A summary of the quantity of water in the atmosphere, ground and surface water systems within a watershed.

Water quality: An integrated index of chemical, physical and microbiological characteristics of natural water that determines suitability of water for the aquatic life and various human uses.

Watershed: The total area of land that drains to a river or other large body of water.

Wet deposition: Materials deposited on the surface by precipitation.

Wetland: Lands that are seasonally or permanently covered by shallow water as well as lands where the water table is close to or at the surface. The four major types of wetlands are swamps, marshes, bogs and fens.

Woodland: Treed areas that provide environmental and economic benefits such as erosion prevention, water retention, provision of habitat, recreation and the sustainable harvest of woodland products.

Appendix A: LSEMP Implementation Plan

The following Implementation Plan provides a list of actions that are required for the comprehensive management of Lake Scugog and its contributing watershed. It is based on the scientific research regarding sources of nutrients, recommending priorities, and how to address priorities with limited funding. The Port Perry Urban Drainage Study provides recommendations for higher cost projects in conjunction with the LSEMP. Some activities were initiated during the early years of the planning process, others will be implemented gradually in the short term (one to five years), and more costly recommendations will be implemented as funding becomes available in the longer term.

The primary goal of the LSEMP is:

To ensure the long-term environmental and social sustainability of Lake Scugog and its resources by achieving the following objectives:

1. Protect and improve water quality in the lake and its tributaries.
2. Maintain healthy aquatic and terrestrial ecosystems within the watershed.
3. Improve the aesthetic values of the lake and enhance opportunities for public enjoyment within the lake's natural surroundings.
4. Foster community understanding of the lake and an appreciation of the lake's natural and historic heritage.
5. Promote environmentally sustainable use of the lake.
6. Maintain ongoing monitoring and research.

The Implementation Plan is divided into six primary strategies, each comprised of the following activities:

1. Communications and Education:

Action	Priority	Timetable
1.1 Public Advisory Committee	Highest	2010-2012
1.2 Scugog Connections (storefront)	Highest	2009-2012
1.3 Communication plan	Medium-High	2009-2010
1.4 Blue Canoe program	Low-Medium	2012+
1.5 Lake Scugog festival	Low-Medium	2009-2011

2. Stewardship – Rural, Urban and Shoreline:

Action	Priority	Timetable
2.1 Shoreline Naturalization Program	Medium-High	2010+
2.2 Scugog WATER Fund	High	2010+
2.3 Reforestation program	Medium	2010-2020
2.4 Rural Landowner Stewardship Guide	Medium	2010-2012

3. *Agricultural Land Use:*

Action	Priority	Timetable
3.1 Cost estimation for accomplishment of Best Management Practices	N/A	2009-2010
3.2 Develop partnership with the Environmental Farm Plan program	Medium-High	2010-2012+
3.3 Implementation of Best Management Practices	High	2010-2020
3.4 Source BMPs for phosphorus reduction	High	2010-2012+

4. *Urban Land Use:*

Action	Priority	Timetable
4.1 Port Perry Stormwater Management Plan	Highest	2009-2010
4.2 Stormwater Management Retrofit Program	High	2011+
4.3 Blackstock Stormwater Management Plan	High	2010-2011
4.4 Lot level stormwater controls and low-impact developments	Medium	2011+
4.5 Stormwater Best Management Practices	High	2010-2011+
4.6 Lake Dredging	Low-Medium	TBD

5. *Watershed Planning, Regulation and Enforcement:*

Action	Priority	Timetable
5.1 Watershed planning	High	2010+
5.2 Regulation	Medium	2011+
5.3 Sustainable municipal operations	High	2010-2012+
5.4 Septic Inspection and Decommission Program	High	TBD
5.5 Nonquon River Water Pollution Control Plant upgrade	Medium-High	2011+

6. *Monitoring and Scientific Studies:*

Action	Priority	Timetable
6.1 Long-term water quality monitoring	High	2011+
6.2 Pilot project - Phoslock	Low-Medium	2011-2015
6.3 Pilot project - Milfoil Weevil	Ongoing-Medium	2009-2011
6.4 CANWET and PREDICT models	High	2009-2010

Key **Recommendations** and **Early Actions** priorities identified in the **Executive Summary** are encompassed in several of the individual activities described in the **Implementation Plan**.

Strategy: Communications and Education

The effective implementation of this strategy will address two primary LSEMP objectives:

- Foster community understanding of the lake and an appreciation of the lake's natural and historical heritage.
- Promote sustainable use of the lake.

Addressing the above two objectives is a prerequisite for public contribution to the objectives below, more appropriately addressed as a result of other strategies:

- Protect and improve water quality in the lake and its tributaries.
- Maintain healthy aquatic and terrestrial ecosystems within the watershed.
- Improve the aesthetic values of the lake and enhance public enjoyment opportunities of the lake's natural surroundings.

<table>
<tr><th colspan="2">Action</th><th>Lead Organization, Partners</th></tr>
<tr><td colspan="2">1.1. Public Advisory Committee

Establish a local Public Advisory Committee to function as a core aspect of (or to function as) the Implementation Committee. This committee will engage local communities by promoting sustainable living and gather community support for certain projects. As well, the Advisory Committee will represent local businesses and residents, will help to hear and understand public opinion about the lake’s problems, and will form a link to agencies such as the Trent- Severn Waterway and the Ministry of Natural Resources. This committee will also establish a relationship and constant dialogue about the lake’s problems with various other stakeholders, i.e., Chamber of Commerce, Mississaugas of Scugog Island First Nation, fishing clubs, marinas and resort businesses.</td><td>Kawartha Conservation, Township of Scugog, Chamber of Commerce, Scugog Connections, Durham and Victoria Stewardship Councils, Scugog Lake Stewards and other local organizations</td></tr>
<tr><td colspan="3">Priority: Highest</td></tr>
<tr><td colspan="3">Project Measurables:
Recruit 6-8 key individuals who wish to provide input and local leadership to the implementation of the LSEMP while volunteering their time on this committee. This committee will require representation from committed individuals combining a mix of representation of environmental agencies (providing scientific expertise) with community representation.
Develop a terms of reference and strategic plan to effectively engage the local community to promote awareness about the LSEMP goal, objectives and mission among local residents.
Work in close partnership with Scugog Connections to organize and implement an effective fundraising strategy.
Prepare and distribute an Annual Report on LSEMP implementation activities.</td></tr>
<tr><td>Short Term Timetable: Organization and initiation of priority activities, 2010 – 2011. This period coincides with the initial funding period for Scugog Connections.</td><td colspan="2">Medium / Long Term Timetable: Develop and implement long-term strategies, 2012 and beyond</td></tr>
<tr><td colspan="3">Estimated Cost: $7,500 - 10,000 annually, including staff time, travel, communications, project seed funding and administrative costs. This cost will vary depending on the nature and scope of projects, success of funding applications and commitment from the volunteer sector.</td></tr>
<tr><td colspan="3">Funding Sources:
Scugog Connections / Ontario Trillium Foundation
LSEMP implementation funding, the Region of Durham and the City of Kawartha Lakes
Relevant private and governmental foundations.</td></tr>
<tr><td colspan="3">Issues Requiring Attention:
The key instrument for success will be to effectively engage local residents and businesses with the plan’s implementation.
The need for an effective and influential body to access funding for the ongoing sustainability of the plan’s implementation.</td></tr>
</table>

<table>
<tr><th colspan="2">Action</th><th>Lead Organization, Partners</th></tr>
<tr><td colspan="2">1.2 Scugog Connections (storefront)
Implement a storefront in downtown Port Perry, which is running from mid-fall 2009 to mid-fall 2012 as a pilot project. The objective of this initiative is to develop an environmental hub that creates the synergy for local alliances involving traditional and new partners, volunteers, secondary school students and resource agencies. Working with partners, the Scugog Connections Program Coordinator will plan and implement outreach activities and water quality enhancement projects, also considering the emerging issues of water and energy conservation, waste management and climate change. This location will become the local office for the community marketing aspect of the LSEMP – with a complete supply of information materials on water quality, aquatic habitat and stewardship opportunities, as well as other environmental issues.
Depending on the project success and community support, the project can be extended beyond 2012.</td><td>Durham Sustain Ability, Kawartha Conservation, Scugog Lake Stewards Inc., Durham Land Stewardship Council</td></tr>
<tr><td colspan="3">Priority: Highest</td></tr>
<tr><td colspan="3">Project Measurables:
• A wide range of educational and stewardship activities over 3 years, according to the approved Action Plan attached to the funding proposal – note Appendix B. Through this program, well over 3,000 hours of youth and volunteer opportunities will be created.
• Educational materials, information sessions, outreach activities, on-site stewardship demonstration projects, etc., including activities such as the Yellow Fish Road.
• Development of a Lake Scugog Foundation, involving volunteers to actively pursue funding for associated environmental activities.</td></tr>
<tr><td>Short Term Timetable: Funding for 2009 – 2012 has been obtained. The official opening was in November 2009.</td><td colspan="2">Medium / Long Term Timetable: The program will be evaluated as it progresses, with the intent of being sustained as needs and effectiveness are determined over the first 3 years.</td></tr>
<tr><td colspan="3">Estimated Cost: The initial project budget is $85,000 / year, totaling $255,000 over the period of 2009 – 2012.</td></tr>
<tr><td colspan="3">Funding Sources:
• The Ontario Trillium Foundation provided a total of $225,000 that has been awarded for 3 years to cover the rental, salary and most other costs to Durham Sustain Ability, in collaboration with Kawartha Conservation, Scugog Lake Stewards and the Durham Land Stewardship Council.
• The Region of Durham provided $8,000 for 2009 and 2010.
• Additional funding partners will be approached to support additional program initiatives.</td></tr>
<tr><td colspan="3">Issues Requiring Attention:
• Require an increased public understanding of the collective impact of individual (all) landowners on the lake water quality, and the need for their involvement in watershed stewardship.
• This initiative should become the primary means of implementing the “community marketing” aspect of the LSEMP in conjunction with other environmental issues.
• The formation of an effective fundraising committee to access funds from local and other sources.</td></tr>
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<table>
<tr><th colspan="2">Action</th><th>Lead Organization, Partners</th></tr>
<tr><td colspan="2">1.3 Communication Plan
Effective communication will be an essential component of the LSEMP's implementation. A comprehensive communication plan will provide a blueprint that ensures all communication activities under the LSEMP work toward the goal and objectives of the LSEMP. The following communication objectives have been established and will be used to develop the communication plan:
• Foster community understanding of the lake and its value to the community, and an appreciation for the lake's natural and historical heritage.
• Promote sustainable use of the lake, based on LSEMP findings.
• Promote and inform as to sustainable land use practices within the Lake Scugog watershed, based on LSEMP findings.
• Increase awareness of and support for the LSEMP locally and provincially.</td><td>Kawartha Conservation, Scugog Connections and program partners</td></tr>
<tr><td colspan="3">Priority: Medium - High</td></tr>
<tr><td>Short Term Timetable: 2009 – 2010, promoting the LSEMP completion and early activities, including Scugog Connections</td><td colspan="2">Medium / Long Term Timetable: TBD as plan implementation is funded</td></tr>
<tr><td colspan="3">Project Measurables:
Development of a communication plan - specific communication activities will be identified in the plan, based on implementation measures receiving funding</td></tr>
<tr><td colspan="3">Estimated Cost: $3,000-5,000 over 2-3 years, based on funding support for plan implementation</td></tr>
<tr><td colspan="3">Funding Sources:
• Partner municipalities
• Relevant foundations.</td></tr>
<tr><td colspan="3">Issues Requiring Attention:
• The need to reach and influence the majority of residents who are generally not attracted to this type of issue.
• Identification of target audience outcomes, including awareness and understanding levels, and specific behavioural changes.
• Development of communication messaging that facilitates identified outcomes and is appropriate to target audiences.
• Development of communication activities for delivering messages and facilitating identified outcomes.
• Development of evaluation methods for determining effectiveness of communication activities, making adjustments and identifying new communication opportunities.</td></tr>
</table>

<table>
<tr><th>Action</th><th>Lead Organization, Partners</th></tr>
<tr><td>1.4 Blue Canoe Program – pilot program ending in March 2010
Implemented dockside visits with lakeshore residents. These visits included one-on-one discussions about shoreline stewardship issues and best management practices associated with lake living. These discussions promoted shoreline naturalization and water conservation techniques, including low-flow showerheads, toilets, and rational lawn watering.
Expand program to address offshore environmental problems.
Depending on Blue Canoe accomplishments and directions provided by the project partners, application can be made for the program or a similar program to be extended.</td><td>Kawartha Conservation,
Township of Scugog,
City of Kawartha Lakes</td></tr>
<tr><td colspan="2">Priority: Low - Medium. This program or its equivalent is considered to be the most effective way to discuss lake issues and best management practices with individual shoreline residents. As the pilot program has just ended, this is a lower priority.</td></tr>
<tr><td colspan="2">Project Measurables:
• Increased public awareness about the condition and environmental health of the watershed.
• Summers of 2007 – 09: Completed over 1,650 visitations; prepare annual report. Following the completion of this project in March 2010, the need for a similar program will be evaluated and designed with consideration to the success of the current initiative (i.e., number of shoreline landowners remaining to be contacted, further definition of most effective landowner contact mechanisms, etc.).
• Eventual reduction of as much as 220 kg of phosphorus loading into the lake from private septic systems.
• Anticipated reduction of phosphorus load from lawn run-off.
• Improved ability of agency staff to increase understanding and address public opinion about the problems of Lake Scugog.</td></tr>
<tr><td>Short Term Timetable: Initial Blue Canoe funding ends in March 2010</td><td>Medium / Long Term Timetable: 2012 and beyond – To be determined</td></tr>
<tr><td colspan="2">Estimated Cost: $75,000 - 80,000 in each of the full budget years this program operated</td></tr>
<tr><td colspan="2">Funding Sources:
• The pilot Blue Canoe program was co-funded by the Eco-Action Fund and the major municipal funding partners of Kawartha Conservation.
• Future initiatives, to be determined.</td></tr>
<tr><td colspan="2">Issues Requiring Attention:
• Need to engage shoreline owners that were not home when the crew visited the area.
• Need to provide workshop style demonstrations on the “how to” for certain aspects of implementation and maintenance.
• Provide ongoing support for landowners (i.e., the early innovators) who have made a commitment to change.
• The need to develop a catalyst for initiating, building and maintaining peer pressure among shoreline residents in terms of adopting widespread “green living” practices.</td></tr>
</table>

<table>
<tr><th colspan="2">Action</th><th>Lead Organization, Partners</th></tr>
<tr><td colspan="2">1.5 Lake Scugog Festival
Implement an annual Lake Scugog Festival to provide environmental education through recreation-based activities for the families and lake users who would make up the majority of individuals who would not typically attend information-type events. This will be a forum for the newest information exchange, sharing experience and enhancing partnerships.</td><td>Scugog Connections, Kawartha Conservation, Township of Scugog, City of Kawartha Lakes, Scugog Lake Stewards, Trent-Severn Waterway, Fisheries and Oceans Canada, Fleming College, Durham College</td></tr>
<tr><td colspan="3">Priority: Low - Medium - in short term</td></tr>
<tr><td colspan="3">Project Measurables:
• For 2011, combine with other events, e.g., Dragon Boat Races, fishing tournaments, other waterfront summer events.
• Reach 250 – 1000 individuals, depending on location and the event in collaboration.
• Use this event as a part of the continuing process for effectively engaging and informing the public, key stakeholders and partners.</td></tr>
<tr><td>Short Term Timetable: Evaluate success and formats as to how this event should continue in consultation with Community Advisory Committee.</td><td colspan="2">Medium / Long Term Timetable: TBD</td></tr>
<tr><td colspan="3">Estimated Cost: $5,000 + per event, including staff time, venue, supplies, and promotion. Not including volunteer time or other in-kind contributions</td></tr>
<tr><td colspan="3">Funding Sources:
• Partner municipalities
• Fisheries and Oceans Canada and other federal government agencies
• Private businesses and foundations and other funding sources, e.g., the Ontario Trillium Foundation.</td></tr>
<tr><td colspan="3">Issues Requiring Attention:
• Require broad representation of all community stakeholders and partners during the festival.
• Involve local community organizations effectively.
• Develop a program that will connect with the average rural and urban watershed resident/visitor, not only those who realize there is a problem, i.e., the ‘converted’ who regularly attend these types of events.
• Address the need for effective promotion to the specific target audience for each festival, and schedule it at the best time to attract that group of stakeholders, e.g., seasonal shoreline residents.</td></tr>
</table>

Strategy: Stewardship

The effective implementation of this strategy will address the following LSEMP objectives:

- Foster community understanding of the lake and an appreciation of the lake's natural and historic heritage.
- Maintain healthy aquatic and terrestrial ecosystems within the watershed.
- Improve the aesthetic values of the lake and enhance opportunities for public enjoyment within the lake's natural surroundings.
- Protect and improve water quality in the lake and its tributaries.

This strategy is comprised of a set of core actions that educate rural landowners, urban and shoreline residents, thereby encouraging a basic understanding of their responsibility to live environmentally friendly lifestyles and undertake best management practices on their properties — for the benefit of all and the future health of the lake— most practices involving considerable in-kind landowner contributions, with only minor or no financial incentive.

All other strategies, including the Communications & Education and Agricultural Land Use Strategies, involve one or more elements of the Stewardship Strategy, however the actions described in this section are considered to be core elements of a stewardship program.

Action	**Lead Organization,** Partners
2.1 Shoreline Naturalization Program Continue with this successful program. Over the last 4-5 years, a comprehensive program of workshops, demonstration sites and one-on-one visits to local shoreline property owners has been implemented and must continue. It is necessary to maintain funding for this program and expand its scope. A significant reality of such programs is the fact that small numbers of the landowner group (5-15%) typically lead the way. This group can be considered the innovators. Significant numbers of the remaining landowners will watch to see the results – what will this look like? Will the innovators remain with this change, or revert back to the old way? In the medium to long term, with ongoing information services pertaining to lake health concerns, and seeing positive results on other lake properties, many other landowners can be expected to undertake naturalization best management practices on their shorelines.	**Kawartha Conservation,** Scugog Lake Stewards, Durham and Victoria Stewardship Councils, Scugog Connections, Township of Scugog, City of Kawartha Lakes, Ministry of Natural Resources, Fleming College, local youth groups and other volunteers

Priority: Medium - High

Project Measurables:
- Conduct 15 or more landowner consultations annually around the lake to encourage additional private land naturalization projects and provide support to projects already implemented.
- Conduct 2 real estate education courses annually for area realtors on lake values, naturalized shorelines, and well and septic maintenance.
- Develop long-term maintenance processes for 4-5 large naturalized sites on public park land on the Lake Scugog shoreline.
- Implement the Great Canadian Shoreline Cleanup annually.
- Monitor and document water quality improvements associated with shoreline naturalization.
- Ensure compliance with tree planting and other natural shoreline provisions set out in subdivision agreements.

Short Term Timetable: 2010-11: work in progress. Work with Community Advisory Committee to determine most effective means of progressing on this initiative.	**Medium / Long Term Timetable:** 2012 and beyond: Require program evaluation and a means of developing long-term funding support.

Estimated Cost: Estimate $12,000-15,000 for 2010. Long term – TBD. Annual costs for this program are expected to decrease as individual landowners understand the rationale and social benefits for naturalized shorelines.

Funding Sources:
- Partner municipalities
- Stewardship councils
- Environmental foundations
- Federal and provincial governments
- In-kind from private landowners.

Issues Requiring Attention:
- Maintenance techniques and processes must be developed for municipal park lands to alleviate increased pressures for municipal parks employees.
- Demonstration sites are funded by grants that are not always sustainable in the long term.
- Address the problem of stream bank erosion resulting in accelerated sedimentation and degradation of aquatic habitat as well as hardened shorelines.

<table>
<tr><th colspan="2">Action</th><th>Lead Organization, Partners</th></tr>
<tr><td colspan="2">2.2 Scugog WATER Fund
The Scugog WATER Fund provides monetary incentives to landowners in the Lake Scugog watershed to implement water-related stewardship projects. Top priority should be given exclusively to projects that focus on surface water improvements, such as restrict livestock access from watercourses and provide alternative watering systems; construct erosion control structures; construct proper manure storage; divert clean water from manure storages, feedlots and livestock yards to reduce contaminated runoff; establish buffer strips along watercourses and lake shorelines.
A Review Committee comprised of the township staff, a member of the Durham Land Stewardship Council and an agricultural representative provides program direction and reviews project applications on a confidential basis.</td><td>Kawartha Conservation,
Township of Scugog,
Region of Durham, Durham Land Stewardship Council, local producers</td></tr>
<tr><td colspan="3">Priority: High</td></tr>
<tr><td colspan="3">Project Measurables:
Due to the nature of the current program, it is not possible to provide an accurate forecast. For example, 2 large manure storage projects and 10 well decommissioning projects would utilize all of the funds at the current funding level, according to project funding caps and eligibility.</td></tr>
<tr><td>Short Term Timetable: 2010 in the Region of Durham</td><td colspan="2">Medium / Long Term Timetable: 2011 and beyond – This program must be re-evaluated with respect to the overall implementation of the LSEMP. Increasing funding levels and focusing on rural water quality improvements throughout the entire watershed would facilitate a greater agricultural stewardship program.</td></tr>
<tr><td colspan="3">Estimated Cost: Currently, this program provides $40,000 annually, with $32,000 provided to landowners. The recommendation is to double or triple funds.</td></tr>
<tr><td colspan="3">Funding Sources:
• Region of Durham, currently
• City of Kawartha Lakes, potentially
• Provincial and federal government, potentially
• Eco-Action.</td></tr>
<tr><td colspan="3">Issues Requiring Attention:
• Currently, only 70% of the lake watershed is covered by this program, i.e., the Durham portion.
• Water well management is the major application of this program; it provides value to localized groundwater sources, but contributes little to the improvement of surface water quality in the watershed. Consider whether it would be most effective for this fund to be re-configured to focus exclusively on surface water improvements, and possibly on 2-3 large priority projects (annually) that could leverage additional funding and provide the greatest nutrient reduction effect.
• Insufficient funding to encourage agricultural producers to initiate large projects, without utilizing these funds to top up other sources of funding, such as the Environmental Farm Plan.</td></tr>
</table>

<table>
<tr><th colspan="2">Action</th><th>**Lead Organization,** Partners</th></tr>
<tr><td colspan="2">**2.3 Reforestation Program**
The total forest cover in the Lake Scugog watershed is 112.3 km^2, representing 24.8% of the entire watershed area. This is well below the 30% recommendation that is being widely applied to planning areas in southern Ontario. This indicates a specific landscape target for the LSEMP over the long term to increase the current forested area by up to 4% (450 hectares) by 2040. The reforestation plan should involve strategic tree planting in conjunction with natural regeneration processes.</td><td>**Trees Ontario, supported by Kawartha Conservation,** Durham Land Stewardship Council, Victoria Land and Water Stewardship Council, Scugog Connections, other partners</td></tr>
<tr><td colspan="3">**Priority: Medium** - with certain locations considered to be high due to a combination of objectives</td></tr>
<tr><td colspan="3">**Project Measurables:**

1. Develop a Natural Heritage Strategy for the Lake Scugog basin, with consideration to species at risk and the *Endangered Species Act*.
2. ELC mapping and computer modeling should be utilized to identify the highest priority sites to accomplish the greatest range of objectives.
3. Determine which of these sites will most effectively be reforested through natural regeneration processes at no cost, or by small scale, strategic tree planting at lower densities.
4. Develop an effective delivery system, in collaboration with the Trees Ontario reforestation program.
5. Increase the current forested area (112.3 square km) by up to 4% (i.e., 450 hectares) **by 2040**; working toward the following objectives:
• Focus on lands with marginal agricultural values.
• Enhance regionally significant woodlands.
• Enhance buffering capacity and aquatic habitat in riparian areas.
• Establish a higher degree of habitat connectivity, with a high level of concentration on riparian and wetland areas.
• Enhance large woodlands and interior habitat areas.
• Decrease land erosion with the objective of filtering nutrients from runoff more effectively.
• Identify aquifer recharge areas for municipal wells or clusters of wells, and enhance capacity for recharge.</td></tr>
<tr><td>**Short Term Timetable:** 2010 – 2012: Develop the natural heritage strategy plan, identify those sites that will regenerate naturally, identify priority sites for reforestation, and initiate an effective partnership with Trees Ontario and other partners.</td><td colspan="2">**Long Term Timetable:** 2012 – 2040: effective program delivery.</td></tr>
</table>

Continued: Reforestation Program

Estimate that 50 – 60% of this area will regenerate naturally, at no cost.
Estimated Tree Planting Cost: there are four separate costs:

1. Development of the program's strategic direction including the Natural Heritage Strategy and identification of priority sites.
2. Stock production costs involve the collection of seeds and production of reforestation costs at the nurseries. These costs are now covered partially by the Province of Ontario, as well as being somewhat self-supporting through the purchase price of seedling stock by the landowner and program partners.
3. Program organization costs involve site inventory leading to a tree planting prescription, preparation of landowner agreement for planting and with planting contractor, overseeing the planting project to ensure effective tree handling and planting techniques, follow-up monitoring, program promotions, and other aspects of program administration. Support for this aspect of the program required approximately ½ person / year per 50,000 trees during the large-scale tree planting program implemented by MNR from the late 1960s to the mid-1990s, with many of these duties requiring a professional forester.
4. Actual tree planting costs of tree planting involve nursery stock purchase, tree planting, site preparation or tending of planted trees, follow-up assessments and total $1,750 – 2,000 per thousand trees, or up to $1.6 million (2010 funds) to reforest 450 hectares over 30 years, in conjunction with estimated natural regeneration on 50 – 60% of the target area..

Funding Sources:

- Federal and provincial governments
- Trees Ontario Foundation
- Partner municipalities
- Landowner in-kind and financial contributions.

Issues Requiring Attention:

- Recommend that marginal lands only be planted, with other progressive land management techniques (e.g., no-till and other nutrient management techniques) implemented on high risk agricultural lands.
- A significant challenge will be the organization and co-ordination of all agencies with a role in the planning and implementation of large-scale tree planting.
- Although slightly more than 50% of this area is estimated to reforest naturally over the next 2-3 decades, much of this natural regeneration will be exotic species such as Scots pine and European buckthorn.
- The requirement for a natural heritage strategy that will identify priority sites for multiple forest objectives, facilitate natural regeneration with reforestation activities, and work in conjunction with municipal Official Plans objectives.

<table>
<tr><th>Action</th><th>Lead Organization, Partners</th></tr>
<tr><td>2.4 Rural Landowner Stewardship Guide
The Rural Landowner Stewardship Guide is a workbook designed for rural non-farm property owners. It provides a self assessment basis for evaluating features and concerns such as natural shoreline buffers, water runoff management, water and energy efficiencies, buying a rural property, working with ecosystems on their properties, environmental turf maintenance and landscaping, and management of natural areas. The Scugog Connections Program Coordinator will organize these events, with instructors being experienced staff from one of the following partners:
• Durham Sustain Ability, Well Aware Program
• Kawartha Conservation
• Durham Land Stewardship Council.</td><td>Durham Sustain Ability / Scugog Connections, supported by Kawartha Conservation and Durham and Victoria Stewardship Councils</td></tr>
<tr><td colspan="2">Priority: Medium</td></tr>
<tr><td colspan="2">Project Measurables:
As per the Scugog Connection Work Plan:
• 2010 – 3 workshops, estimate 15 to 20 landowners per workshop
• 2011 – 4 workshops
• 2012 – 4 workshops
• 2013 – # dependent on the success of previous workshops and involvement of landowners.</td></tr>
<tr><td>Short Term Timetable: 2010 – 2012, in conjunction with the Scugog Connections 3-year work program</td><td>Medium / Long Term Timetable: Develop a means of delivery, based on evaluation of program to date.</td></tr>
<tr><td colspan="2">Estimated Cost: ~ $900 per workshop, including the organizational / planning support provided by the storefront</td></tr>
<tr><td colspan="2">Funding Sources:
• Ontario Trillium Foundation
• Municipal support for the LSEMP implementation.</td></tr>
<tr><td colspan="2">Issues Requiring Attention:
• Small, rural, non-farm residences often house small numbers of livestock, store various amounts of contaminants (e,g, petroleum products) and apply fertilizers and pesticides with little or no knowledge of regulations or best management practices.
• Promote to the agricultural community our interest in working with all residents in the rural community, and that we are not targeting agriculture only.</td></tr>
</table>

Strategy: Agricultural Land Use

The effective implementation of this strategy will address the following LSEMP objectives:

- Protect and improve water quality in the lake and its tributaries.
- Maintain healthy aquatic and terrestrial ecosystems within the watershed.
- Foster community understanding of the lake and an appreciation of the lake's natural and historic heritage.

The activities proposed in the framework of this strategy will contribute to a total phosphorus reduction target of 500 – 600 kg annually from agricultural sources.

The following information is necessary background for the organizing and implementing of some of the Agricultural Strategy activities described in the following pages:

- The Canada-Ontario Environmental Farm Plan (EFP) has been the primary agricultural stewardship program in the province of Ontario since the early 1990s. This program was developed by Ontario farmers and farm organizations, in collaboration with the provincial government, universities and conservation authorities. It combines an educational program, leading to a prioritized Action Plan for each farm, with cost share opportunities for a wide range of farm stewardship activities, e.g., nutrient management, surface water quality improvement projects, soil management and erosion control, managing of manure and livestock yard runoff, water well improvements, storage of hazardous materials, and so on.
- The EFP program is a funded element of the Canada-Ontario Farm Stewardship Program (COFSP) and is administered in Ontario by the Ontario Soil and Crop Improvement Association (OSCIA) from a head office in Guelph. Individual Program Representatives are employed by OSCIA to implement EFP workshops and administer farm stewardship activities in each county and/or municipality.
- Although this amount has been considerably higher, approximately $7 to 10 million is available annually at this time to Ontario farmers for EFP project activities, on a first come-first served basis. Approximately 40 municipalities throughout the province access this total allocation.
- Participation by individual farmers is on a voluntary basis.
- Depending on the type of project, the cost share award to farm businesses is either 30% or 50% of the total cost of the project.
- Funding from other sources for specific purposes – e.g., Greenbelt, Oak Ridges Moraine, Species at Risk, Lake Simcoe Environmental Management Strategy – are most often utilized as top-up funds for EFP projects, i.e., to increase the cost share from the noted 30% or 50%. The Scugog WATER Fund, described previously, could be used as top-up funding for this program to increase participation for selected projects.

<table>
<tr><th colspan="2">Action</th><th>Lead Organization, Partners</th></tr>
<tr><td colspan="2">3.1 Cost estimation for accomplishment of Best Management Practices
Develop a working relationship with local agriculture industry to provide an estimation of relevant costs for appropriate farm stewardship actions contributing to reduction of nutrients and sediments into local watercourses and lakes.
Identification of priority areas where BMPs, noted below, can be implemented.
As well, there is a need to promote and encourage usage of modern approaches for storage, handling and application of manure, fertilizers and pesticides by farm operators.</td><td>Kawartha Conservation, Durham Federation of Agriculture, local farm industry representatives
OMAFRA, OSCIA</td></tr>
<tr><td colspan="3">Priority: N/A</td></tr>
<tr><td>Project Measurables as Best Management Practices</td><td>Estimated project totals</td><td>Cost estimation</td></tr>
<tr><td>• Grassy waterways with respect to erodable sites on crop land</td><td>295 km</td><td>$220,000</td></tr>
<tr><td>• Vegetated buffer strips adjacent to water courses</td><td>54 km</td><td>$575,000</td></tr>
<tr><td>• Water course/livestock grazing mgmt. – fencing, crossings, alternative watering</td><td>37 km</td><td>$825,000</td></tr>
<tr><td>• Improved manure storage, runoff reduction/management; livestock yards/feedlot operation runoff mgmt.; diversion of upslope water</td><td>85 properties in medium – high priority range</td><td>$10,250,000</td></tr>
<tr><td>• Conservation tillage, cover crops as BMPs that stabilize soils and reduce erosion</td><td>No estimate</td><td>No estimate</td></tr>
<tr><td>• Nutrient management planning: modern technologies such as GPS units, improved application techniques for more accurate application of nutrients and pesticides</td><td>No estimate</td><td>No estimate</td></tr>
<tr><td>TOTAL</td><td></td><td>$11,870,000 +</td></tr>
<tr><td>Short Term Timetable: Cost estimates and field verification were completed in 2009/2010.</td><td colspan="2">Medium / Long Term Timetable and Workplan: 2010 – 2020: Identify and approach priority areas for BMPs implementation.</td></tr>
<tr><td colspan="3">Funding Sources: N/A</td></tr>
<tr><td colspan="3">Issues Requiring Attention:
• There is concern by some individual members of the agricultural community over these programs and investigations into project locations. Landowners may be cautious of providing information/allowing access to property for fear of future repercussions and perceived potential use of information/records gathered.
• Build partnership with the agricultural community and ensure confidentiality as to priority project locations.
• Creation of priority areas. They may involve distrust/caution i.e., first and second point.
• Timing of landowner participation must be considered, i.e., spring and fall are busy times, and winter is the least busy.</td></tr>
</table>

<table>
<tr><th>Action</th><th>Lead Organization, Partners</th></tr>
<tr><td>3.2 Develop partnership with the Canada-Ontario Environmental Farm Plan Program: building momentum to address priority problem sites, and access greater level of federal/provincial funding for this program
Foster an effective partnership among Kawartha Conservation, the Canada-Ontario Environmental Farm Plan (EFP) and other stewardship groups to provide a greater focus for action on priority sites for remediation and BMP implementation in Lake Scugog and tributary watersheds. This will be achieved through the following:
• Work with the Agricultural Advisory Committee of the existing Scugog WATER Fund to increase participation by Lake Scugog watershed farm businesses in the EFP.
• Determine a non-threatening process for identifying the priority sites and contacting landowners to initiate projects.
• Promote and develop additional funding support from a number of sources to top-up the EFP program.</td><td>Kawartha Conservation, Ontario Soil and Crop Improvement Association, Ontario Ministry of Agriculture and Rural Affairs, local farm businesses, Durham and Victoria Stewardship Councils</td></tr>
<tr><td colspan="2">Priority: Medium - High</td></tr>
<tr><td colspan="2">Project Measurables:
• Formation and operation of the Agricultural Advisory Committee.
• Priority site identification.
• Number of landowners contacted.
• Number of additional farm businesses participating in the EFP.
• Number of successful funding proposals.</td></tr>
<tr><td>Short Term Timetable: 2010 – 2011: Work with the local OSCIA Program representative and other farm committees to increase level of formal involvement by local farm businesses.</td><td>Medium / Long Term Timetable: 2012 and beyond: Develop and implement process for addressing priority sites and refine process as required.</td></tr>
<tr><td colspan="2">Estimated Cost: Staff time and minor operating expenses for an estimated 2-3 months annually – ongoing for 5 years – to enable us to focus programs and effectively address priority areas.</td></tr>
<tr><td colspan="2">Funding Sources:
• Partner municipalities
• Private foundations
• Province
• Environmental Farm Plan, Ontario Soil and Crop Improvement Association.</td></tr>
</table>

<u>Continued</u>: Develop partnership with the Canada-Ontario Environmental Farm Plan Program

Issues Requiring Attention:

- There is currently no mechanism for coordinating the EFP with the implementation of projects on high priority sites for phosphorus reduction.
- There is distrust by some members of the agricultural community for such programs, e.g., the completion of the EFP workbook by the landowner does involve (although on a confidential basis) identification of certain occasions when provincial or federal regulations are being contravened.
- There is a need for effective planning and implementation of individual stewardship projects.
- Many environmental improvement projects are often low in priority for certain landowners because of personal time constraints and financial limitations.
- There is a lack of knowledge regarding how to access available funding from a variety of programs that are usually unknown to individual farm businesses. This is especially significant with small farm businesses where the farm operator also has an off-farm job and limited time.
- The EFP process is considered by many farmers to be overly bureaucratic, and for some, challenging in terms of necessary paperwork.
- There may be a requirement for hands-on assistance with the preparation of EFPs for certain properties.
- There is a perception that the EFP program is geared toward smaller producers rather than larger producers, i.e., caps, paperwork per property, FBRN-based funding.
- Priority areas may need more funds than non-priority areas, e.g., caps and percentages.
- EFP uses one-time payments when some activities require long-term support, e.g., cover crops.
- Opportunities can exist in some cases to use the farm community to approach priority areas instead of a regulatory organization.
- The EFP representatives are paid for their time from OSCIA. If this is an added work load or time for the reps, is OSCIA going to pay for this time?
- Where will top-up funds go within the EFP?
- How will special cases, such as priority projects over the cap, be dealt with?

Action	**Lead Organization,** Partners
3.3 Implementation of Best Management Practices, *with the EFP being the program delivery mechanism* With the delivery of educational work, watershed-wide implementation of BMPs in priority locations will have a significant effect on water quality in the lake, and in rivers and streams. Utilizing the close partnership with OSCIA, OMAFRA and stewardship councils for the accomplishment of BMPs, noted below. As well, there is a need to promote and encourage usage of modern approaches for storage, handling and application of manure, fertilizers and pesticides by farm operators.	**Ontario Soil and Crop Improvement Association, Kawartha Conservation,** Ontario Ministry of Agriculture and Rural Affairs, local farm businesses, Durham and Victoria Stewardship Councils

Priority: High

Project Measurables:	**Estimated Total Cost**	**Funds from EFP**		**Additional Funds**
Grassy waterways with respect to erodible sites on crop land	$220,000	50%	Up to $20,000 per farm business	TBD
Vegetated buffer strips adjacent to water courses	$575,000	50%	Up to $20,000 per farm business	TBD
Grazing land management: fencing, crossings, alternative watering systems	$825,000	50%	Up to $20,000 per farm business	TBD
Improved manure storage, runoff reduction/management; livestock yards/feedlot operation runoff mgmt.; diversion of upslope water	$10,250,000	30–50%	Variable, up to $30,000 per farm business	TBD
Conservation tillage, cover crops as BMPs that stabilize soils and reduce erosion	No estimate	30%	Up to $10,000 per farm business	TBD
Nutrient management planning: modern technologies such as GPS units, improved application techniques for more accurate application of nutrients	No estimate	50%	Up to $3,000 per farm business	TBD

Short Term Timetable: 2010 – 2014: Complete BMP projects on 20% of priority project sites.

Medium / Long Term Timetable: 2015 – 2020: Complete BMP projects on an additional 40% of identified project sites.

Ultimate Nutrient Reduction Target: Contribute to a total decrease in nutrient loading from agricultural sources by 25-30% (500-600 kg).

Estimated Cost: This is somewhat dependant on the number of applicants participating – the EFP is a voluntary process. As background, the total funding provided by the COFSP (EFP) for such work in the Township of Scugog for the time period of April 2005 to March 2009 totalled $100,989.51.

Funding Sources:

- Canada-Ontario Environmental Farm Plan (provincial/federal funding)
- Scugog WATER Fund (Region of Durham funding)
- Other funding opportunities that are occasionally available, e.g., Greenbelt, Oak Ridges Moraine, Eco-Action.
- ALUS – Alternative Land Use Services
- Nutrient trading.

Continued: Implementation of Best Management Practices

Issues Requiring Attention:
- The total allocation from federal and provincial governments – province wide – to the EFP is currently $7-10 million annually.
- There is a need to access other funding sources and coordinate their allocation with EFP projects.
- There is a need to recognize what is limiting voluntary involvement with the EFP, and to encourage a higher level of participation.
- How to identify priority sites and direct funds to where they will be most effective.

<table>
<tr><th colspan="2">Action</th><th>Lead Organization, Partners</th></tr>
<tr><td colspan="2">3.4 Source BMPs for phosphorus reduction
This is a set of relatively new BMP practices being developed for managing the production and escape of excess phosphorus and other nutrients into water bodies, involving activities such as soil testing, manure testing to determine phosphorus content, dietary means of reducing phosphorus content in manure, manure treatment with aluminum chloride, manure spreader calibration and manure composting effects on phosphorus.
This activity will require a number of early promotional and educational activities to bring a higher profile to this proactive approach to nutrient management, e.g., EFP Workshops, pasture tours and other local information events, led by the Ontario Ministry of Agriculture and Rural Affairs and local farm organizations.</td><td>Canada-Ontario Environmental Farm Plan, Ontario Ministry of Agriculture and Rural Affairs, farm organizations, supported by Kawartha Conservation and Stewardship Councils</td></tr>
<tr><td colspan="3">Priority: High</td></tr>
<tr><td colspan="3">Project Measurables:
• Develop materials and organize partners for implementation.
• Implement approved activities and distribute materials.
• Complete and activate nutrient management plans.
• Revise and develop preceding years’ agendas on an ongoing basis.
• Establish Kawartha Conservation as a reputable source for agriculture and environment enquiries.</td></tr>
<tr><td>Short Term Timetable: 2010 – 2011: promotion</td><td colspan="2">Medium / Long Term Timetable: 2012 and beyond: implementation</td></tr>
<tr><td colspan="3">Ultimate Nutrient Reduction Target: Contribute to a total decrease in nutrient loading from agricultural sources by 25-30% (500-600 kg).</td></tr>
<tr><td colspan="3">Estimated Cost:
Staff time and minor operating expenses for an estimated 1-2 months annually – for 2 years.</td></tr>
<tr><td colspan="3">Funding Sources:
• Canada-Ontario Environmental Farm Plan
• Provincial and federal governments
• Partner municipalities
• Environmental foundations.</td></tr>
<tr><td colspan="3">Issues Requiring Attention:
• New techniques and practices will require time to become accepted by many farm businesses.
• A real or perceived high cost in laboratory fees for soil, manure and other types of testing for phosphorus will block the participation of many farmers in this BMP activity.</td></tr>
</table>

Strategy: Urban Land Use

The effective implementation of this strategy will address the following LSEMP objectives:

- Protect and improve water quality in the lake and its tributaries.
- Maintain healthy aquatic and terrestrial ecosystems within the watershed.

Implementation of the Urban Land Use Strategy involves a mixture of public works projects, policy changes and public education.

The primary focus of this strategy involves the construction, retrofit and maintenance of stormwater sewers, facilities, controls and low-impact developments on both private and municipal properties. The strategy provides examples of the size and cost of implementing these measures and the expected benefits. These examples can be used as guidelines for similar projects throughout the watershed.

Policy changes also represent a critical part of the Urban Land Use Strategy. Amendments to existing maintenance practices and engineering design standards can ensure that future urban development in the watershed accounts for stormwater runoff and undertakes the necessary measures to mitigate its effects on the lake. Bylaw amendments can also be used to control substances entering storm sewers and help prevent pollutants from entering the lake.

Finally, public education can demonstrate the benefits of lot level low-impact developments and best management practices. Additionally, programs such as the Yellow Fish Road highlight the perspective that everyone living in the watershed is linked to the lake and has an impact on it for better or for worse.

Expected outcomes:

- Provision of stormwater quality and quantity control and treatment for all urban areas in the watershed
- Improved stormwater management practices, controls and facilities
- Reduced quantity of water entering urban stormwater systems
- Decreased sediment export in the lake from urban sources
- Decreased nutrient export in the lake from urban sources
- Reduction in intentional dumping or spills of pollutants into water systems.

Action	**Lead Organization,** Partners
4.1 Port Perry Stormwater Management Plan Develop a comprehensive stormwater management plan for urban areas of Port Perry. This plan will focus on improving stormwater quality in areas listed as medium and high priority in the Urban Drainage Project, with emphasis being placed on high priority areas. Specific recommendations will be made based on calculated flow and nutrient loadings including type of control, sizes, locations and cost estimates. As well, storm sewer data will be collected and a list of recommendations will be provided.	**Kawartha Conservation,** Township of Scugog, Region of Durham
Priority: Highest	
Project Measurables: • Completion of the stormwater management plan. • An estimated decrease of phosphorus load from the Port Perry area by 50-60% (400-470 kg), upon implementation of all recommendations. • An estimated decrease of sediment load from the Port Perry area by 70-80%, upon implementation of all recommendations.	
Short Term Timetable: 2009 – 2010: for site inventory and plan completion for the Port Perry area.	**Medium / Long Term Timetable:** 2010 and beyond: stormwater plan implementation
Estimated Cost: $65,000 has been allocated for site inventories and plan development for the Port Perry area.	
Funding Sources: • Region of Durham • Township of Scugog.	
Issues Requiring Attention: • Funding for construction and maintenance costs of retrofitting. • No hard data on success of low-impact development controls.	

Action	Lead Organization, Partners
4.2 Stormwater Management Retrofit Program (for the entire watershed) Initiate and implement an urban stormwater management strategy that provides an integrated approach to master drainage planning for all urban catchment areas in the watershed including construction and maintenance of stormwater treatment facilities starting from a source and lot level and finishing with end-of-pipe controls. Create an inventory of existing and newly constructed urban storm drainage systems, conduct regular inspections, and establish a maintenance schedule for them.	**Township of Scugog,** **City of Kawartha Lakes,** Region of Durham, Kawartha Conservation
Priority: High	
Project Measurables: • Completion of individual urban stormwater management plans. • Construction of lot level low-impact stormwater controls. • Construction of new stormwater management facilities. • Decrease in the phosphorus load into the lake from all urban sources by 50-60% (850-1,000 kg), upon implementation of all measures. • Decrease of sediment load from all urban areas by 70-80%, upon implementation of these measures.	
Short Term Timetable: N/A	**Medium / Long Term Timetable:** 2011 and beyond
Estimated Cost: The preliminary cost for stormwater management plans development can be estimated at $250,000. The cost of new stormwater management facilities and controls can reach $5-6 million or higher.	
Funding Sources: • Partner municipalities • Province • Federal funds.	
Issues Requiring Attention: • Funding for construction and maintenance costs of retrofitting. • Insufficient or absent stormwater infrastructure to implement retrofit program in some areas.	

Action	**Lead Organization,** Partners
4.2.1 Stormwater management pond construction (<u>as an example</u>) • Construction of a wet stormwater management pond at a location to be determined, with a total volume of 5,343 m^3 including 3,562 m^3 of storage and a 1,781 m^3 permanent pool. This pond will treat stormwater runoff coming from sewershed #45, which has a drainage area of 20.75 ha, as per Port Perry Urban Drainage Study. • This pond will work in conjunction with the small wet pond at Curts and Water Streets. • Based on an approximate runoff of 1.02 m3/second during a 2-year rain event, a wet pond with a storage volume of 3,562 m^3 will be required in order to provide an enhanced protection level, as outlined in the MOE *Stormwater Management Planning and Design Manual 2003*.	**Township of Scugog,** Region of Durham, Kawartha Conservation

Priority: N/A

Project Measurables:
- Construction of a wet pond.
- A phosphorus loading reduction of approximately 22-25 kg.
- Annual accumulation of 17,200 kg of sediments in the pond.

Short Term Timetable: TBD	**Medium / Long Term Timetable:** TBD

Estimated Cost:
- Approximately $124,000 based on the capital construction unit costs described in the *Stormwater Management Planning and Design Manual*, assuming the above pond and property dimensions. (Note: Does not include re-directing of existing storm sewer or other infrastructure in the area.)
- Annual maintenance costs will be approximately $1,000.
- Assuming sediment loading of 17 m3/year, sediment removal and disposal will cost $5,000 to $7,000 if done annually, although sediment removal will not be absolutely necessary for 30 years.

Funding Sources:
- Partner municipalities
- Province
- Federal funds.

Issues Requiring Attention:
- Property availability.
- Funding for construction and maintenance costs.

Action	**Lead Organization,** Partners
4.2.2 Stormwater control and BMP implementation (as an example) • Implementation of stormwater controls in sewershed #40 with a drainage area of 1.57 ha, as per *Port Perry Urban Drainage Study* to treat for quality the approximate 0.30 m^3/second of runoff based on a 2-year storm event. • Installation of stormceptor model STC 2000 upstream of Williams Creek storm sewer outlet based on the approximate 0.30 m^3/s of flow. • Construction of vegetated swales around commercial and municipal parking lot areas in SS40 (roughly 262 m of swales). Vegetated swales will reduce water quantity by promoting infiltration and reducing velocity when compared to standard storm sewers. Water quality will also be improved through nutrient uptake by vegetation as well as allowing for the settling of suspended sediments when used in conjunction with rock check dams. • Installation of low-impact soakaway pits to temporarily store rooftop runoff from the roughly 1,950 m^2 of rooftops in SS40. These pits will reduce water quantity through infiltration.	**Township of Scugog,** Region of Durham, Kawartha Conservation

Priority: N/A

Project Measurables:
- Installation of stormceptor.
- Construction of vegetated swales.
- Installation of soakaway pits.
- Result: an 80% removal of suspended sediment in the runoff from the sewershed.

Short Term Timetable: TBD	**Medium / Long Term Timetable:** TBD

Estimated Cost:
- The Stormceptor STC 2000 costs approximately $20,600, with an annual maintenance of approximately $750 including sediment disposal.
- Vegetated swales cost $17,030 to construct with an annual maintenance of approximately $1,000.
- The cost of soakaway pits varies but they generally cost $500/$m^3$ of water treated. Based on the estimated 1,950 m^2 of rooftops and the IDF curves for the area, approximately 0.04 m^3/s of runoff can be attributed to rooftops. Assuming a storm of 1-hour duration, this accounts for 144 m^3 of runoff to be treated. Therefore, it will cost roughly $72,000 to install soakaway pits to treat all the runoff. However, this calculation does not account for draw down times and thus, the actual amount of required storage will be less.

Funding Sources:
- Partner municipalities
- Province.

Issues Requiring Attention:
- Persuading property owners to implement lot level controls.
- Funding for construction and maintenance costs.

<table>
<tr><th colspan="2">Action</th><th>Lead Organization, Partners</th></tr>
<tr><td colspan="2">4.3 Blackstock Stormwater Management Plan
Complete a stormwater management plan that includes aspects of an urban drainage study for the community of Blackstock in order to locate and determine the specifics of existing capital infrastructure related to stormwater, delineate sewersheds, and make recommendations on the implementation of new or retrofitting of existing stormwater facilities or controls. The plan will focus on improving stormwater quality in priority areas. Specific recommendations will be made based on calculated flow and nutrient loading, including type of stormwater control, size, location and cost estimate. Further, GIS format data layers for existing infrastructure (storm sewer locations, manhole locations, catch basin locations) and GIS format data layers of sewersheds, sewershed status, drainage locations and retrofit priorities will be provided. The final product will be a report highlighting all aspects of the project and a set of recommendations on how to mitigate the effects of urban runoff on water quality in Blackstock Creek. Interim reports may also be provided as needed.</td><td>Kawartha Conservation,
Township of Scugog,
Region of Durham</td></tr>
<tr><td colspan="3">Priority: High</td></tr>
<tr><td colspan="3">Project Measurables:
• Delivery of data layers
• Delivery of interim reports
• Delivery of final stormwater management plan.</td></tr>
<tr><td>Short Term Timetable: 2011 – 2012</td><td colspan="2">Medium / Long Term Timetable: Plan implementation</td></tr>
<tr><td colspan="3">Estimated Cost: Based on the cost of the Port Perry Urban Drainage Study and Stormwater Management Plan, a similar project in a community the size of Blackstock would cost approximately $20,000.</td></tr>
<tr><td colspan="3">Funding Sources:
• Partner municipalities.</td></tr>
<tr><td colspan="3">Issues Requiring Attention:
• Potential lack of background information for community of Blackstock, such as engineering drawings.</td></tr>
</table>

<table>
<tr><th>Action</th><th>Lead Organization, Partners</th></tr>
<tr><td>4.4 Lot level stormwater controls and low-impact development
Implement state-of-the-art BMPs in urban areas that will result in greater infiltration rates including:
Urban forests and vegetated buffer strips
Green roofs
Storm gardens
Infiltration trenches
Permeable asphalt and concrete or vegetated swales in parking lot areas.
Use filter systems and oil/grit separators in parking lot areas or upstream of outfalls to provide a higher level of treatment for stormwater runoff.
Identify and promote alternatives to discharging pool drainage into the stormwater system.</td><td>Township of Scugog,
City of Kawartha Lakes,
Kawartha Conservation,
Scugog Connections</td></tr>
<tr><td colspan="2">Priority: Medium</td></tr>
<tr><td colspan="2">Project Measurables:
Per cent area increase in natural cover in urban areas, especially adjacent to waterways.
Number of green roofs created.
Number of storm gardens created.
Length of infiltration trenches created.
Number of communities committing to use permeable asphalt or vegetated swales in parking lots.
Number of stormwater facilities using filter systems and/or separators to provide a higher level of treatment for stormwater runoff.</td></tr>
<tr><td>Short Term Timetable: 2011-2012</td><td>Medium / Long Term Timetable: 2013 and beyond</td></tr>
<tr><td colspan="2">Estimated Cost: $ TBD</td></tr>
<tr><td colspan="2">Funding Sources:
Partner municipalities (including support from development charges and other revenue sources)
Province
Federal funds
In-kind from private landowners.</td></tr>
<tr><td colspan="2">Issues Requiring Attention:
Lack of awareness.
Persuading businesses and urban residential property owners to implement lot level controls.
Construction and maintenance costs.</td></tr>
</table>

<table>
<tr><th colspan="2">Action</th><th>Lead Organization, Partners</th></tr>
<tr><td colspan="2">4.5 Stormwater Best Management Practices
• Ensure sanitary sewers are properly inspected and maintained to prevent leaks that may enter the stormwater sewer system.
• Initiate and support programs for public involvement and education aimed at responsible water use and decreasing both spills and the intentional dumping of contaminants into the water system. This may include rain barrel programs, downspout disconnection, Yellow Fish Road, ‘poop and scoop,’ oil recycling, household hazardous waste collection and material storage control. A rain barrel program will reduce dependence on the municipal water supply system for watering lawns and gardens.
• Ensure stormwater infrastructure is properly maintained.
• Initiate and support best road maintenance practices, bylaw changes and engineering design standards changes.</td><td>Township of Scugog,
City of Kawartha Lakes,
Kawartha Conservation,
Scugog Connections</td></tr>
<tr><td colspan="3">Priority: High</td></tr>
<tr><td colspan="3">Project Measurables:
• Number of public water conservation programs initiated.
• Number of education events.
• Number of downspouts disconnected from storm drains.
• Number of rain barrels distributed and installed.
• Number of residents who discontinue use of or greatly reduce lawn fertilizer applications.
• Programs implemented and maintained, e.g., Yellow Fish Road, ‘poop and scoop.’</td></tr>
<tr><td>Short Term Timetable: 2010-2011</td><td colspan="2">Medium / Long Term Timetable: 2012 and beyond</td></tr>
<tr><td colspan="3">Estimated Cost: TBD</td></tr>
<tr><td colspan="3">Funding Sources:
• Ontario Trillium Foundation, i.e., Scugog Connections
• Partner municipalities
• Province.</td></tr>
<tr><td colspan="3">Issues Requiring Attention:
• Funding for initiatives.</td></tr>
</table>

Action	**Lead Organization,** Partners
4.6 Lake Dredging Investigate and evaluate opportunities to conduct dredging of the lake bottom in some economically and aesthetically significant areas (e.g. high use areas such as public access or community docking; areas for specialized activities such as regattas, Dragon Boat races). Those specific areas would be dredged to increase depth, remove sediments and nutrients and reduce overabundant weed growth. In conjunction with dredging, artificial wetlands may be constructed for improved stormwater treatment in certain urban runoff outlet locations.	**Township of Scugog,** Region of Durham, Kawartha Conservation, Trent-Severn Waterway, Ministry of the Environment, Fisheries and Oceans Canada, rowing clubs, marinas

Priority: Low - Medium

Project Measurables:
Improved water quality, reduced aquatic plant growth, enhanced fish habitat, decreased nutrient and contaminant load with urban runoff. Provision of access and lake uses for certain specialized uses, e.g. rowing, improved boat access to Port Perry commercial facilities.

Short Term Timetable: N/A	**Medium / Long Term Timetable:** TBD

Estimated Cost: TBD

Funding Sources:
- Federal/provincial funds
- Regional and municipal funding
- Private business groups.

Issues Requiring Attention:
- Complexity and cost of dredging.
- Possible public concerns about dredging effects on water quality in the lake.
- Application and approval process may be lengthy and difficult.
- Disposal of sediments, especially should they contain heavy metals and other contaminants.

Strategy: Watershed Planning, Regulation and Enforcement

The effective implementation of this strategy will address the following LSEMP objectives:

- Protect and improve water quality in Lake Scugog and its tributaries.
- Maintain healthy aquatic and terrestrial ecosystems within the watershed.

Expected outcomes:

- Improved partnership among governments, Kawartha Conservation and the public to address the contamination of waters by urban activity.
- Improved regulation and permitting procedures with respect to the shoreline and in-water works.
- Reduction in intentional dumping or spills of pollutants and nutrients into water systems.
- Decreased use of fertilizers on lawns, urban parks and other manicured green spaces.
- Increased percentage of naturalized shorelines around the lake.
- Decreased nutrient and sediment load from urban sources.
- Improved road, ditch, culvert or bridge construction and maintenance practices by municipal road departments and construction companies.
- Improved municipal operations and legislation in relation to watershed health.

<table>
<tr><th colspan="2">Action</th><th>**Lead Organization,** Partners</th></tr>
<tr><td colspan="2">**5.1 Watershed Planning**
In conjunction with the ongoing Oak Ridges Moraine Subwatershed Planning initiative (and where applicable), incorporate LSEMP objectives and recommendations into regional and municipal policies.</td><td>**Region of Durham,**
Township of Scugog,
City of Kawartha Lakes, Kawartha Conservation</td></tr>
<tr><td colspan="3">**Priority: High**</td></tr>
<tr><td colspan="3">**Project Measurables:**
• Incorporate into planning policies recommendations provided by the LSEMP (Section 8.5) for enhanced protection of watercourses and improved water quality.
• A decrease of phosphorus loading into Lake Scugog from agricultural, urban and other land-based sources by 15-20%.</td></tr>
<tr><td>**Short Term Timetable:** 2010 – 2011: Plan completion</td><td colspan="2">**Medium / Long Term Timetable:** 2012 and beyond: Implementation</td></tr>
<tr><td colspan="3">**Estimated Cost:** Ongoing ORMCP watershed plans currently being developed by Kawartha Conservation, to be completed in 2011 in the Region of Durham</td></tr>
<tr><td colspan="3">**Funding Sources:**
• Funded within the Kawartha Conservation annual work plan, as a Special Benefiting Project for the Region of Durham.</td></tr>
<tr><td colspan="3">**Issues Requiring Attention:**
• Successful integration of plan recommendations into municipal planning documents.
• Regulation and enforcement.</td></tr>
</table>

<table>
<tr><th colspan="2">Action</th><th>Lead Organization, Partners</th></tr>
<tr><td colspan="2">5.2 Regulation
Develop or update, if needed, regional policies and municipal bylaws to ensure protection and rehabilitation of headwater areas, stream 30-m buffer zones and lake shoreline zones. Coordinate this process among municipalities, Kawartha Conservation and Parks Canada/Trent-Severn Waterway (TSW). The TSW can lead the lake shoreline regulation and permitting process.</td><td>Region of Durham,
Township of Scugog,
City of Kawartha Lakes, Kawartha Conservation, Trent-Severn Waterway</td></tr>
<tr><td colspan="3">Priority: Medium</td></tr>
<tr><td colspan="3">Project Measurables:
Protect lands with significant ecological functions. Ensure, by introducing appropriate legislation, that these areas will not be considered for future development.
Strengthen and enforce bylaws regulating land disturbances.
Develop and/or strengthen municipal site alteration bylaws within the lake shoreline zone. Such bylaws can include works that fall outside the purview of the Planning Act.
Ensure that all new septic systems are located at least 50 m from the nearest shoreline or riverbank.
Consider the possibility of specific legislation for private septic systems in close proximity to the lake and watercourses.
Develop regional policies and/or municipal bylaws for stricter regulation on fertilizer use for aesthetic purposes in close proximity to water bodies.
New or revised policies and bylaws
All these activities can contribute to an overall decrease of phosphorus loading into the lake from the watershed-based sources by 15-20%.</td></tr>
<tr><td>Short Term Timetable: N/A</td><td colspan="2">Medium / Long Term Timetable: 2012 and beyond, in conjunction with completion of the ORMCP Watershed Plans</td></tr>
<tr><td colspan="3">Estimated Cost: TBD</td></tr>
<tr><td colspan="3">Funding Sources:
Funded within the Kawartha Conservation annual work plan, in conjunction with municipal staff activities.</td></tr>
<tr><td colspan="3">Issues Requiring Attention:
Coordination of federal regulations, regional and provincial policies, and municipal bylaws.</td></tr>
</table>

<table>
<tr><th colspan="2">Action</th><th>Lead Organization, Partners</th></tr>
<tr><td colspan="2">5.3 Sustainable municipal operations
Road, ditch and water crossing construction and maintenance activities are high risk works in terms of erosion potential. Improve municipal operating procedures as they relate to minimizing impacts on water quality and watershed health.</td><td>Kawartha Conservation,
Township of Scugog,
City of Kawartha Lakes, Stewardship Councils, Community Stream Stewards (OFAH)</td></tr>
<tr><td colspan="3">Priority: High</td></tr>
<tr><td colspan="3">Project Measurables:
• Introduce or make amendments to bylaws concerning cosmetic fertilizer use, litter and pet control on municipal lawns and parks.
• Replant and promote grass growth in recently dug or cleaned ditches to improve infiltration, significantly reduce erosion, and provide an initial stormwater filtration.
• Training courses have been developed for municipal staff regarding legislative and best management practices for maintenance of travel corridors. Work with partners and adjacent municipalities to hold one such workshop every 3-5 years for municipal staff.
• Ensure the proper use of erosion and sediment control measures at construction sites.
• Improve road de-icing operations (ensuring that only the minimum amount of de-icer is used to accomplish the job).</td></tr>
<tr><td>Short Term Timetable: 2010 – 2011: host one workshop for road superintendents and foremen</td><td colspan="2">Medium / Long Term Timetable: 2012 and beyond: Develop a strategy for determining and/or enacting appropriate best management practices, legislation and ongoing staff training.</td></tr>
<tr><td colspan="3">Estimated Cost: The total cost of one workshop is estimated to range from $3,500 – 5,000. This would include planning and organizational costs, rental of event location, material costs, per-diems for keynote speakers, etc.</td></tr>
<tr><td colspan="3">Funding Sources:
• Ministry of Natural Resources, via local stewardship councils
• Partner municipalities.</td></tr>
<tr><td colspan="3">Issues requiring Attention:
• Lack of understanding regarding impact of road works on erosion potential.
• The need for increased understanding of federal and provincial legislation regarding such projects.</td></tr>
</table>

<table>
<tr><th colspan="2">Action</th><th>Lead Organization, Partners</th></tr>
<tr><td colspan="2">5.4 Septic Inspection and Decommission Program
Septic systems at shoreline residences on the narrow strip of land around the lake are estimated to contribute 9 - 10% (920 kg) of the total phosphorus load to the lake. In addition, with fecal coliform being ineffectively treated or contained by faulty septic systems in the vicinity of residential wells, human health should be a major consideration.</td><td>Township of Scugog,
City of Kawartha Lakes, Health Units, Region of Durham, Kawartha Conservation, Scugog Connections</td></tr>
<tr><td colspan="3">Priority: High</td></tr>
<tr><td colspan="3">Project Measurables / Options for Consideration:
Activities and options recommended to achieve a target of reducing phosphorus input by 25% over the next 5 - 10 years include the following:
• The top priority is to ensure that individual septic systems are properly installed and maintained.
• Promote ongoing replacement of outdated and faulty septic systems.
• Maintain periodic “dock talk” extension services and local workshops that focus on septic systems, wells and other shoreline issues.
• Create a comprehensive municipal or regional inventory of all septic systems in the Lake Scugog watershed.
• Explore the merits and feasibility of a Septic Re-Inspection Program.
• Consider regulatory means for legislating septic upgrades, e.g., a municipal bylaw requiring a certificate of approval prior to a property sale.
• Effectively investigate official complaints of malfunctioning systems to address potential health hazards and determine corrective actions as required.
• Long-term consideration: conversion of private septic systems around the lake to small secondary/tertiary municipal wastewater treatment plants.</td></tr>
<tr><td>Short Term Timetable: TBD</td><td colspan="2">Medium / Long Term Timetable: TBD</td></tr>
<tr><td colspan="3">Estimated Cost: TBD</td></tr>
<tr><td colspan="3">Funding Sources:
• Federal/provincial assistance
• Partner municipalities
• Individual landowners
• Scugog Connections – for specific workshops and information products.</td></tr>
<tr><td colspan="3">Issues Requiring Attention:
• The large number of old systems around the lake that are under capacity, poorly constructed, and may not be functioning as desired.
• Septic system upgrades normally are a financial burden for private landowners.
• First time buyers of shoreline properties with septic systems are not informed about septic systems, wells, and their impact on the lake environment.
• The gradual contamination of groundwater/wells by improperly functioning septic systems.
• Concern with cost and liability for small municipal wastewater treatment facilities.</td></tr>
</table>

Action	**Lead Organization,** Partners
5.5 Nonquon River Water Pollution Control Plant Upgrade Investigate opportunities to improve the functioning of the Nonquon River Water Pollution Control Plant (NRWPCP) with focus on more efficient removal of phosphorus and nitrogen from effluent. Explore alternatives in wastewater management. Undertake a Municipal Class Environmental Assessment to examine alternatives to address the elevated ammonia and nitrogen concentrations in the effluent.	**Region of Durham,** Township of Scugog, Kawartha Conservation
Priority: Medium - High	
Project Measurables: Decreased ammonia, nitrate and phosphorus loads into the Nonquon River with the NRWPCP effluent.	
Short Term Timetable: N/A	**Medium / Long Term Timetable:** 2011 and beyond
Estimated Cost: TBD	
Funding Sources: • Partner municipalities • Federal/provincial assistance.	
Issues Requiring Attention: • Elevated ammonia concentration in the NRWPCP effluent. • Public concerns about water quality in the Nonquon River related to the NRWPCP.	

Strategy: Monitoring and Scientific Studies

The effective implementation of this strategy will address the following LSEMP objectives:

- Maintain ongoing environmental monitoring and research.
- Protect and improve water quality in Lake Scugog and its tributaries.

Monitoring and scientific studies will be used to establish the effectiveness of plan implementation measures, allowing better decision making when allocating future lake management funding. It will build upon current base line data.

<table>
<tr><th colspan="2">Action</th><th>Lead Organization, Partners</th></tr>
<tr><td colspan="2">6.1 Long-term water quality monitoring
Staff representatives from collaborative agencies working on the LSEMP Steering Committee have expressed concern that the 5-6 years of water quality monitoring provides only a baseline for nutrient levels. This is insufficient to reliably determine trends or effectiveness of implementation measures. An ongoing monitoring program, while at reduced levels, will provide an additional means of evaluating the effectiveness of the plan implementation measures.</td><td>Kawartha Conservation,
Township of Scugog,
City of Kawartha Lakes,
Region of Durham, Trent University</td></tr>
<tr><td colspan="3">Priority: High</td></tr>
<tr><td colspan="3">Project Measurables:
• Continue regular water quality and quantity monitoring on the lake and major tributaries for higher accuracy levels on long-term trends.
• Target sampling with a means of assessing the effectiveness of remedial measures and actions.
• Calculate annual phosphorus and nitrogen loads and balances.
• Complete CANWET and PREDICT Models simulation for subwatersheds and the entire watershed to provide modeling for the plan scenarios for BMP implementation.
• Initiate water quality monitoring for a wide range of pollutants in stormwater runoff from the Port Perry urban area.</td></tr>
<tr><td>Short Term Timetable: N/A</td><td colspan="2">Medium / Long Term Timetable: 2011 and beyond, TBD</td></tr>
<tr><td colspan="3">Estimated Cost: $20,000 - 40,000 annually, depending on the geographic scope, number of contaminants determined for testing and requiring laboratory analysis.</td></tr>
<tr><td colspan="3">Funding Sources:
• Partner municipalities
• Provincial funding
• Private sources
• Foundations
• In-kind from various educational institution sources
• Organized and trained volunteer.</td></tr>
<tr><td colspan="3">Issues Requiring Attention:
• Our knowledge of the nutrient levels over a relatively short period provides a base level knowledge, but no knowledge of long-term trends.
• We require a means of evaluating program effectiveness, as well as identifying any need for refocusing the expenditure of implementation funding.</td></tr>
</table>

<table>
<tr><th colspan="2">Action</th><th>Lead Organization, Partners</th></tr>
<tr><td colspan="2">6.2 Pilot project – Phoslock
Initiate an experimental pilot project to test new material – Phoslock, which is reputed to bind phosphorus in water and sediments for an indefinite time and discourage aquatic plant growth. Develop a pilot project for an appropriate area, e.g., an area of dense vegetative growth in a very economically and aesthetically important area of the lake.</td><td>Kawartha Conservation,
Township of Scugog,
City of Kawartha Lakes, Ministry of the Environment, Trent-Severn Waterway, Fisheries and Oceans Canada, Ministry of Natural Resources, Trent University</td></tr>
<tr><td colspan="3">Priority: Low – Medium: to be determined in conjunction with municipal staff and local businesses</td></tr>
<tr><td colspan="3">Project Measurables:
• Identification of preferred area for application.
• Development of proposals and permit applications.
• Development of any environmental assessment information required by licensing agencies.
• Purchase and application of Phoslock.
• Monitoring and evaluation of effectiveness of Phoslock application.
• Report preparation.</td></tr>
<tr><td>Short Term Timetable: 2011 – 2012: Initiate process</td><td colspan="2">Medium / Long Term Timetable: 2013 – 2015: Monitor and report</td></tr>
<tr><td colspan="3">Estimated Cost: $30,000 for the purchase and application of sufficient material, plus an estimated cost of $8,000 - 10,000 for project management, monitoring and evaluation activities.</td></tr>
<tr><td colspan="3">Funding Sources:
• Partner municipalities
• Provincial funding.</td></tr>
<tr><td colspan="3">Issues Requiring Attention:
• Concern with a new and relatively untested material being placed in the lake.
• As this is a new substance, with only two previously known applications in Ontario (Lake Simcoe watershed), the application and approval process may be lengthy. This proposal would require a careful review by Parks Canada and other regulatory agencies for this work and would require permitting (e.g., Parks Canada Research and Collection Permit).
• Ability of Phoslock to block access for Eurasian water milfoil and other aquatic vegetation to phosphorus present in upper layer of lake sediments.
• Environmental assessment could be required.</td></tr>
</table>

Action	Lead Organization, Partners
6.3 Pilot project – Milfoil Weevil Initiate an experimental project to test the ability of small water bugs; weevils play a role in the biological control of Eurasian water milfoil, which may discourage this aquatic plant growth in the lake. Overabundance of a non-native invasive plant, Eurasian water milfoil (*Myriophyllum spicatum)*, now known to be a hybrid of this exotic Eurasian species and the native species in Lake Scugog, is causing: • Inconveniences to lakefront property owners. • Decreased suitability of the lake for recreation and tourism (e.g., navigational difficulties and hazards for boaters). • Detrimental effect on aquatic habitat.	**Scugog Lake Stewards,** Trent University
Priority: An ongoing program is TBD, based on the evaluation of the first phase of the project in 2009.	
Project Measurables: • Experimental stocking of the milfoil weevil – accomplished in summer of 2009. • Effectiveness of weevils in decreasing Eurasian milfoil and other milfoil populations in Lake Scugog to be evaluated by Trent University • Project report. • Evaluation and determination for future applicability.	
Short Term Timetable: 2009 – 2010: Initial application and evaluation	**Medium / Long Term Timetable:** TBD
Estimated Cost: $30,000 for weevils, plus in-kind contributions from Scugog Lake Steward volunteers and Trent University	
Funding Sources: • Baagwating Foundation contributed the funds for the 2009 introduction of the weevil.	
Issues Requiring Attention: • Other aquatic plant species can replace Eurasian milfoil in the lake. • This weevil is reputed to be a native species that is already present in the lake. There is concern as to why the existing weevil population has not developed to a level where it will control the milfoil without the introduction of additional numbers. • Questions regarding an insufficient habitat feature that limits the milfoil weevil population, e.g., overwintering habitat, and if changes in the lake dynamics of certain fish species - such as the recent influx of the black crappie - have created a new predator that limits weevil numbers and the effectiveness of milfoil control. • Research and Collection Permit as well as In-water Work Permit from Parks Canada (TSW) need to be obtained.	

Action	Lead Organization, Partners
6.4 CANWET and PREDICT Water and Nutrients Models CANWET is a GIS based software tool for estimating water balance and nutrient loading, and it has predictive modeling capabilities for evaluating the implementation of agricultural and urban pollution reduction strategies at the subwatershed level. The general approach used in this GIS application is to: 1. Derive watershed input data for the nutrient loading engine of the model. 2. Simulate nutrient and sediment loads in the watershed. 3. Identify and evaluate pollution mitigation strategies that could be applied in an impaired watershed to achieve pollutant loads that yield acceptable constituents concentrations. This unique tool allows the user to create multiple scenarios in which current landscape conditions and pollutant loads (point and non point) can be compared against future conditions using different pollution reduction strategies such as agricultural and urban BMPs, and stream upgrading of wastewater treatment works. It includes pollutant reduction coefficients for nitrogen, phosphorous and sediment, and also has built-in cost information for an assortment of pollution mitigation techniques.	**Kawartha Conservation**

Priority: High

Project Measurables:
- The water balance and nutrient loading component of CANWET was completed in 2009 for the Nonquon River subwatershed using calibrated data.
- Run the predictive modeling application using the results from the water balance and nutrient loading component of CANWET.
- Determine best management practices and their associated cost for input into the LSEMP implementation plan.

Short Term Timetable:	Long Term Timetable: 2011 and beyond:
2009 –2010: Complete Water Balance and Nutrient Loading Models for other parts of the watershed. 2010: Run and complete Predictive Modeling.	Continue water quantity and quality data collection for further input into water and nutrient models as an increased data set. This will increase the confidence for outputs of both the CANWET and PREDICT models.

Estimated Cost:
$4,000 – 5,000

Funding Sources:
- Partner municipalities.

Issues Requiring Attention:
- Time constraints may not allow us to run the model and obtain results for input into the plan for peer review. However, it will be completed for the final plan implementation.
- Training may be required for running the Predictive Model and ensuring proper analysis.

Appendix B: Scugog Connections Workplan

Year 1, mid autumn 2009 – mid autumn 2010

Expected Results	Activities	Performance Indicators
Hire a qualified Program Coordinator.	• Develop position description and transparent selection process. • Advertise for suitable applicants. • Interview with a panel representing collaborative partners. • Select appropriate candidate. • Mentor, guide program development with Steering Committee.	• Hire most suitable candidate for the position. • Develop performance indicators with which to evaluate Program Coordinator. • Develop a suitable schedule for meeting with employee and discussing program progress and performance indicators. • Meet OTF reporting obligations. • 6 Steering Committee meetings, year 1.
Establish a credible community presence.	• Locate / furnish office in a suitable location. • Create marketing materials. • Outfit office with a full range of suitable information materials. • Utilize high school student volunteer in office.	• # of contacts, i.e. walk-in clients, public appearances. • Significant distribution of information products. • Successful completion of items listed below.
Outreach • Initiate contact with local community organizations and youth to develop momentum. • Initiate community marketing of Best Management Practices (BMP's) regarding environmentally healthy living to develop momentum. • Website development.	• Utilize the expertise of collaborative partners. • Cross promotion of programs at partner events. • Practice community based social marketing. • Speaking engagements that inform the public about the Lake Scugog Environmental Plan and initiate the public's involvement in volunteer activities. Program Coordinator will organize these speaking engagements, with presenters involving staff from these various partners: 1. Durham Sustain Ability 2. Kawartha Conservation 3. Durham Land Stewardship Council 4. Scugog Lake Stewards 5. Inhouse, highschool volunteer 6. Others as required.	• Program materials displayed at all applicable collaborative partner events. • Presentations to 3 service clubs. • Presentations to 3 landowner and cottager organizations. • Presentations to 8 elementary classes. • Presentations to youth organizations, e.g. Scouts Canada, Militia, bible study groups. • 6 news releases in 3 local papers (2 in each paper). • Create an annual newsletter or collaborate on the local Life on the Lake publication.
Initiate private land stewardship education activities.	The *Rural Land Landowner Stewardship Guide* is a workbook for rural, non-farm property owners that provides a self assessment basis for evaluating issues such as natural shoreline buffers, water runoff	• 2 workshops in first year. • Target 15-20 properties in each workshop.

	management, water and energy efficiencies, buying a rural property, working with ecosystems on your property, environmental landscaping, and management of natural areas. The Program Coordinator will organize these events, with instructors being trained staff from one of the following partners: 1. Durham Sustain Ability 2. Kawartha Conservation 3. Durham Land Stewardship Council.	
Strategic planning development with an objective of program sustainability beyond 3 years.	• Initiate strategic planning exercise. • Involve committed community volunteers. • Indicate during presentations to local organizations the development of a fundraising initiative – establish target for end of year 3.	• Organize 2 open houses to determine community priorities. • Prepare 2 funding proposals.
Establish a variety of on-site stewardship projects that demonstrate appropriate 'best management practices" with a priority placed on water quality enhancement projects, i.e.: • Tree planting / buffer strip establishment along rural and urban water courses and lake shore. • Enhancing urban green spaces to create greater permeability, thereby reducing urban runoff. • Planting more urban trees to increase shade and clean and cool the air. Promote participation by elementary students in the stewardship projects.	The Program Coordinator will work with landowners and partner agencies to: • Facilitate enhanced delivery of their existing programs. • Organize additional project opportunities. • Develop funding proposals. • Identify appropriate / visible 'hot-spot' sites for stewardship demonstration projects. • Develop and organize additional volunteer base to participate in demonstration projects. • Contact secondary schools for participation in stewardship projects. Partners will include: 1. Trees Ontario 2. Kawartha Conservation 3. Durham Land Stewardship Council 4. Victoria Land and Water Stewardship Council 5. Ducks Unlimited 6. Township of Scugog 7. Scugog Lake Stewards 8. Ontario Environmental Farm Plan, a program of the Ontario Soil and Crop Improvement Association 9. Others, as determined.	Project types will include: • Initiating plan development for 1-2 agricultural projects in each spring-summer of 2010, 2011 and 2012. • 3-4 tree planting projects identified and planting prescriptions prepared for each spring (2010 – 2012), with at least 1 being an urban project each year, and 5,000 trees planted in Year 1. • Developed plans for 1 wetland project in year 2 and 3. • 15-20 people participating. • 2 elementary schools taking part. • Successful implementation of 4-6 projects in spring – summer of 2010.
Brochure for Real Estate Agencies on lakeside living.	• Volunteers with Scugog Lake Stewards create a	• Number of agencies taking part in distribution of

	brochure on lakeside living that promotes healthy and sustainable practices that improved water quality and environmental health.	brochure to new home owners, include a questionnaire.
Three workshops annually on wells, septics, and nutrient reduction to protect surface and ground water.	• Schedule workshops to deliver information promoting well awareness and the impacts of nutrients on water quality. • Work in conjunction with Durham Sustain Ability, the local delivery agent of Green Communities Canada's 'Well Aware' program, to enhance their program delivery. • Scugog Lake Stewards to speak regarding the LSEMP, septics and nutrient reduction. • Kawartha Conservation to speak on a variety of water issues.	• 3 workshops conducted in first year • Number of attendees at each workshop

Volunteer acknowledgement.	• Schedule a year-end event to acknowledge the very significant contribution of volunteers
	  ◦ Awards
	  ◦ Snacks and refreshments
	  ◦ Involve local politician, e.g. Mayor of Scugog
		• 1 volunteer acknowledgement event

Scugog Connections Workplan - Year 2

Expected Results	Activities	Performance Indicators
1. Maintain momentum from Year 1, ensure program credibility. 2. Program evaluation.	• Initiate community feedback for program evaluation and to identify gaps • Continue to provide program support to Program Coordinator, mentor as required • Guide program implementation with Steering Committee	• Review performance indicators with Program Coordinator • Address program concerns as required • 4 Steering Committee meetings • Meet Ontario Trillium Fund reporting obligations
Build on the strategic planning exercise of Year 1 to further develop the objective of program sustainability beyond 3 years.	• Establish the Lake Scugog and Region Environmental Sustainability Foundation and a local committee to guide this aspect of the program	• Determine if there is a local organization that can take on the lead role for this purpose, e.g. Durham Sustain Ability or the Scugog Lake Stewards • Organize 1 fundraising event, e.g. dinner with a high profile, key note speaker; boat tour and dinner • Prepare 2 funding proposals

Delivery of on-site urban and rural stewardship projects that demonstrate appropriate 'best management practices" with a priority placed on water quality enhancement projects, i.e.:
• Tree planting / buffer strip establishment along rural and urban water courses and lake shore
• Enhancing urban green spaces to create greater permeability, thereby reducing urban runoff
• Planting more urban trees to increase shade and clean and cool the air
Expand educational programs into secondary schools.
	The Program Coordinator will work with landowners and partner agencies to:
	• Facilitate enhanced delivery of their existing programs.
	• Organize additional project opportunities.
	• Develop funding proposals for additional work.
	• Identify appropriate / visible 'hot-spot' sites for stewardship demonstration projects.
	• Develop and organize additional volunteer base to participate in demonstration projects.
	• Contact secondary schools for participation in stewardship projects.
	Partners will include:
	1. Trees Ontario
	2. Kawartha Conservation
	3. Durham Land Stewardship Council
	4. Victoria Land and Water Stewardship Council
	5. Ducks Unlimited
	6. Township of Scugog
	7. Scugog Lake Stewards
	8. Ontario Environmental Farm Plan, a program of the Ontario Soil and Crop Improvement Association
		• Projects will include:
		  • Implement 1-2 agricultural projects in each spring-summer of 2011.
		  • Implement 1-2 shoreline naturalization project in yr 2.
		  • Implement 3-4 tree planting projects for 2011, with at least 1 being an urban project.
		  • Implement 1 wetland project in year 2.
		  • Plan similar projects for 2012.
		• 30 volunteers participating.
		• Secondary schools and 2 primary schools.
		• 2 youth groups.
		• 7,500 trees planted.

	9. Other funding partners to be determined	
Continue with private land stewardship education activities.	Organize workshops which involve the *Rural Land Landowner Stewardship Guide*. The Program Coordinator will organize these workshops, with instructors being trained staff from one of the following partners: 1. Durham Sustain Ability 2. Kawartha Conservation 3. Durham Land Stewardship Council.	• 2-3 workshops • Target 15-20 non-farm properties per workshop
Continued from Year 1 - community marketing of Urban BMP's regarding: • Cosmetic fertilizer and pesticide use. • Collection and disposal of pet droppings. • Increasing catchment and treatment of urban stormwater runoff at a lot level, e.g. rain barrels to capture / reuse water; utilizing / increasing permeable surfaces. • Expanding urban green areas. • Landscaping with drought-resistant plants. • Using cool / reflective materials on the roofs to reduce urban heat. • Providing current information re solar and wind energy opportunities. • Waste reduction. • Energy and water efficiency.	This will be accomplished by: • Media releases. • Educational materials. • Door to door promotion with summer program staff. • Speaking engagements with staff or volunteers from collaborative. • Demonstration projects.	• 6 news releases in 3 local papers (2 in each paper). • 25% of urban area coverage, door to door. • 6 speaking engagements conducted. • Phone and online surveys to determine level of community engagement.
Lake festival in a Scugog Lake community, to be determined.	• Organize a "Lake Festival" that is geared toward children and adults and promotes a healthy lake. • Utilize a Fleming College 3rd year Credit for Product team (3 students for 1 semester) to work for a small project committee.	• Successful event. • Number of Attendees at the festival.
Three workshops annually on wells, septics, and nutrient reduction to protect surface and ground water.	• Schedule workshops to deliver information promoting well awareness and the impacts of nutrients on water quality. • Work in conjunction with Durham Sustain Ability, the local delivery agent of Green Communities Canada's 'Well Aware' program, to enhance their program delivery. • Scugog Lake Stewards to speak regarding the LSEMP, septics and nutrient reduction.	• Number of workshops conducted annually • Number of attendees at each workshop

	• Kawartha Conservation to speak on a variety of water issues.	

Volunteer acknowledgement.	• Schedule a year end event to acknowledge the very significant contribution of volunteers
	  • Awards
	  • Snacks and refreshments
	  • Involve local politician, e.g. Mayor of Scugog
		• 1 volunteer acknowledgement event

Scugog Connections Workplan - Year 3

Expected Results	Activities	Performance Indicators
1. Maintain momentum from Year 2, ensure program credibility. 2. Program evaluation.	• Maintain community feedback for program evaluation and to identify gaps. • Provide ongoing program support to Program Coordinator; mentor as required. • Guide program implementation with Steering Committee.	• Review performance indicators with Program Coordinator. • Address program concerns as required. • 4 Steering Committee meetings, year 3. • Meet Ontario Trillium Foundation reporting obligations.
Build on the strategic planning exercise of Year's 1 and 2 to further develop the objective of program sustainability beyond 3 years.	• Building on the first two years, maintain the Lake Scugog and Region Environmental Sustainability Foundation.	• $75,000 raised for foundation • 2 funding proposals developed • Permanent fundraising committee in place
Continue with private land stewardship education activities	• Organize workshops which involve the *Rural Land Landowner Stewardship Guide*. The Program Coordinator will organize these workshops, with instructors being trained staff from one of the following partners: 1. Durham Sustain Ability 2. Kawartha Conservation 3. Durham Land Stewardship Council.	• 4-5 workshops in year 3. • 15-20 rural non-farm property owners in each workshop. • Total will be 8-10 workshops over 3 years, with approximately 150-175 rural non-farm properties being self evaluated.
Delivery of on-site urban and rural stewardship projects that demonstrate appropriate 'best management practices' with a priority placed on water quality enhancement projects, i.e.: • Tree planting / buffer strip establishment along rural and urban water courses and lake shore. • Enhancing urban green spaces to create greater permeability, thereby reducing urban runoff. • Planting more urban trees to increase shade and clean and cool the air.	The Program Coordinator will work with landowners and partner agencies to: • Facilitate enhanced delivery of their existing programs. • Organize additional project opportunities. • Develop funding proposals for additional work. • Identify appropriate / visible 'hot-spot' sites for stewardship demonstration projects. • Consolidate volunteer base to participate in demonstration projects. • Continue to engage students in process. **Partners will include**: 1. Trees Ontario 2. Kawartha Conservation 3. Durham Land Stewardship Council 4. Victoria Land and Water Stewardship Council	Projects will include the following: • Implement 1-2 agricultural projects in each spring-summer of 2012. • Implement 1-2 shoreline naturalization projects in yr 2. • Implement 3-4 tree planting projects for 2012, with at least 1 being an urban project. • Implement 1 wetland project in year 3. • Plan similar projects for 2013. We estimate that over 3 years, we will accomplish: • 4-5 farm projects that will feature environmental improvements adjacent to public watercourses. • 2-3 shoreline projects. • 9-10 tree planting projects, both urban and rural. • 2 wetland improvement projects.

	5. Ducks Unlimited 6. Township of Scugog 7. Scugog Lake Stewards 8. Ontario Environmental Farm Plan, a program of the Ontario Soil and Crop Improvement Association 9. Other funding partners to be determined.	
Continued from Year 2 - community marketing of Urban BMP's regarding: • Cosmetic fertilizer and pesticide use. • Collection and disposal of pet droppings. • Increasing catchment and treatment of urban stormwater runoff at a lot level, e.g. rain barrels to capture / reuse water; utilizing / increasing permeable surfaces. • Expanding urban green areas. • Landscaping with drought-resistant plants. • Using cool / reflective materials on the roofs to reduce urban heat. • Providing current information re solar and wind energy opportunities. • Waste reduction, composting. • Energy and water efficiency.	• This will be accomplished by: o Media releases o Educational materials o Door to door promotion with summer program staff o Speaking engagements with staff or volunteers from collaborative o Demonstration projects. • Utilize a Fleming College 3rd year Credit for Product team (3 students for 1 semester) to work for the Program Coordinator / collaborative to enhance this aspect of the overall project.	• 6 news releases in 3 local papers (2 in each paper). • 50% of urban area coverage door to door. • 6 speaking engagements conducted. • Phone and online surveys to determine level of community engagement.
Educational component focusing on promotion of clean water and prevention of invasive species.	• Provide information to the public through marinas about the importance of healthy practices around water and the prevention of invasive species. • Work with marinas and the Ontario Federation of Anglers and Hunters.	• 2 marinas participating. • 200 boaters contacted. • Survey boaters / fisherman to determine their level of participation in reducing the movement of invasive species.

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