2012 Report to the Minister of the Environment
from the Lake Simcoe Science Committee

Recommendations for the Ecological Health and Sustainable Future of Lake Simcoe and its Watershed

June, 2012

Healthy Lake Simcoe ...protection based on science

Acknowledgements

We are grateful for the contribution and support received from the managers and staff of the Ontario Ministry of The Environment, Ontario Ministry of Natural Resources, Ontario Ministry of Agriculture, Food and Rural Affairs, and the Lake Simcoe Region Conservation Authority in assisting us with our deliberations over the past 2 years and French Planning Services Inc. in the preparation of this report.

A special word of thanks is extended to the Honourable Jim Bradley, Minister of the Environment and to past Ministers, for recognizing the importance of science-based decisions and supporting this endeavour to protect Lake Simcoe, its watershed and community.

Lake Simcoe Science Committee Chair

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Lake Simcoe Science Committee Members

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*These people were members of the Lake Simcoe Science Advisory Committee (2007-2008)

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Opening Letter from the Chair

June 19, 2012

The Honourable Jim Bradley
Minister of the Environment
77 Wellesley Street West
11th Floor, Ferguson Block
Toronto ON
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SUBJECT: 2012 Report of the Lake Simcoe Science Committee

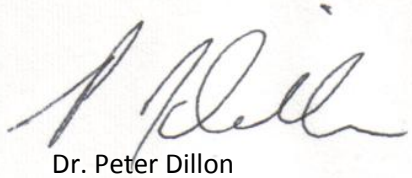
The Lake Simcoe Science Committee is pleased to provide you with our first report containing observations and recommendations on the implementation of the Lake Simcoe Protection Plan and the *Lake Simcoe Protection Act, 2008*.

While we can celebrate in the work accomplished to date, there is still much work to be done to ensure the ecological health and sustainable future of Lake Simcoe and its watershed. Over the next year, the Committee will discuss a range of topics dealing with outstanding questions on the science of the Lake Simcoe Protection Plan and focussing on operational issues related to implementation.

The Executive Summary highlights three key messages directly related to implementation of the Lake Simcoe Protection Plan. Our report contains forty-one recommendations resulting from our deliberations over the past two years that address key aspects of implementation of the Plan. Also, in Chapter 8 we outline the directions and issues that we propose to address during the coming year.

The Committee appreciates this opportunity and is very pleased to assist in the implementation of the Lake Simcoe Protection Plan, which we view as a leading edge initiative in environmental management that will have ongoing and lasting benefit to the citizens of our province.

Sincerely,



Dr. Peter Dillon
Chairperson
Lake Simcoe Science Committee

Executive Summary

In this document the Lake Simcoe Science Committee is reporting to the Minister of the Environment on its work to date. The report provides science-based observations and recommendations on implementation of key elements of the *Lake Simcoe Protection Act* and Lake Simcoe Protection Plan.

This advice to the Minister is offered from the perspective of a multi-disciplinary team of experts, who have examined current plan implementation within the context of new knowledge emerging from recent monitoring and research.

While there is still much to discuss in future deliberations of the Committee, there is also much to celebrate. At this time we can collectively celebrate the important advancements that have been made towards implementation of the Plan as well as recent advancements in applied science that will help to ensure ongoing successes. The Lake Simcoe Science Committee recognizes that the success of this comprehensive initiative is dependent on strong partnerships within the science community, between science, management, and community stewardship groups and among government and non-government organizations at all levels.

The Lake Simcoe Science Committee was established in March, 2010, following the passing of the Lake Simcoe Protection Act.

The Committee's mandate is to review the environmental conditions of Lake Simcoe and its watershed and to provide science-based advice to the Minister of the Environment with respect to both the ecological health of the Lake Simcoe watershed and implementation of the Lake Simcoe Protection Plan.

The Committee now looks to the future and provides three key messages for the successful implementation of the Lake Simcoe Protection Plan and the protection of Lake Simcoe and its watershed:

1. Continue to focus on reducing phosphorus loads through applied and innovative practices while increasing the protection of shoreline and natural heritage areas throughout the watershed. These elements are directly connected and must be addressed collectively.
2. Continue leading-edge research and monitoring activities so that future management decisions and actions are both effective and efficient, and based on the best available science.
3. Transfer scientific information to policy makers, stakeholders and the public in plain language to enhance understanding and support for progressive environmental management. This is essential for building informed and motivated communities with the common goal of restoring the health of Lake Simcoe and ensuring a healthy and sustainable future for the watershed.

This report provides new recommendations of the Lake Simcoe Science Committee. The organization and structure of this report corresponds to the chapter structure of the Lake Simcoe Protection Plan.

Aquatic Life - Chapter 3

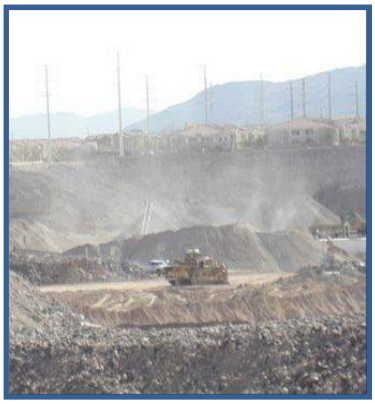
In 2008, the Lake Simcoe Science Advisory Committee, in its initial compendium of reports, specifically identified the poor state of the aquatic life of the lake as a major cause for concern. The primary focus of management has been on a) reduction of phosphorus loads for improvement of water quality and b) protection of habitats to benefit diversity, productivity and stability of native communities of aquatic species in the lake. Direct evidence of the benefits of water quality management can be seen in the recovery of some native cold water species, including lake trout, spoonhead sculpin, and mysid shrimp, in response to improved dissolved oxygen conditions. These changes also provide tantalizing evidence of the potential for full recovery of key native species.

The Committee has concern that the ongoing pressures of continued human population growth and changes related to climate warming will challenge this recovery in the future. Further advances in science and management will be essential to maintaining progress towards restoration. The Committee also identifies invasive species and infectious diseases to be of special concern. Recommendations provided throughout this report address known or potential effects of other stressors, such as climate change, that also directly or indirectly affect the health of aquatic life in Lake Simcoe. We emphasize the importance of monitoring and research to advance knowledge and understanding about the ecosystem impacts of multiple, interacting stressors.

Water Quality - Chapter 4

Degraded water quality, attributable to excessive loading of plant nutrients, primarily phosphorus, from urban runoff, waste water, atmospheric, and agriculture sources, has historically placed significant stress on Lake Simcoe, its tributaries and the life they support. Two important implementation actions were included in the Lake Simcoe Protection Plan to reduce phosphorus loading to the lake: the Phosphorus Reduction Strategy; and evaluation of the feasibility of developing a system of Water Quality Trading across the watershed.

The Committee recommends continued efforts to reduce phosphorus loading and applied research to advance understanding of phosphorus (P) loading in the watershed. The latter includes research to better understand the sources and dynamics of phosphorus loading; research to improve technologies for on-site sewage systems and P reductions for stormwater, polders, and septic systems; and, improved control of atmospheric deposition. The Committee believes that Water Quality Trading may offer some benefits, but requires additional consideration, in particular: cost-benefit analysis of the proposals; overall design and management of a trading program; supply and demand for credits; tracking and monitoring of projects; and the viable lifetime of the proposed program.



Water Quantity - Chapter 5

Maintaining adequate water quantity and water levels for both surface and ground water is critical for the protection of key ecological functions and biodiversity across the watershed. This is also a prerequisite for sustaining human activities and associated water requirements and managing for population growth.

The Committee has concern that targets for in-stream water flow, recommended in the Lake Simcoe Protection Plan, are not yet established. These need to be addressed for both low-flow and high-flow conditions. The current permitting regime of water withdrawal may be leading to site-specific low water conditions, and a recommendation is provided to review the current "water taking" regulations to consider whether changes are warranted.

Shorelines and Natural Heritage - Chapter 6

Natural shorelines are a critical element of the landscape and contribute to the functional integrity of the Lake Simcoe watershed. While a shoreline regulation was proposed in the Lake Simcoe Protection Plan, one has not yet been put into place. The approach taken by the Province has been to implement a shoreline Voluntary Action Program to promote best practices and stewardship along the shorelines of the lake and its tributaries. It is recommended that the proposed shoreline regulation be reviewed and its implementation be reconsidered in light of the progress of the Voluntary Action Program. Should the voluntary program continue, the Lake Simcoe Science Committee offers advice on its development, implementation and performance monitoring.

The Committee has concern that the "Loss of Natural Areas and Habitats" policies in the Lake Simcoe Protection Plan will not adequately protect natural areas and habitats. Also, there are no policies or strategies to move towards increased natural area, which is one of the targets articulated in the Plan. Recommendations are provided that address the development of more effective definitions of terms, improved data collection, the importance of comprehensive monitoring and the specific protection of Lake Simcoe's wetlands.

Other Threats and Activities - Chapter 7

Existing and new invasive species, and the impacts and effects of climate change are important additional threats to the health of Lake Simcoe and its watershed. The degradation of recreational opportunities is also a cause for concern.

The Committee supports developing a "rapid response plan" for invasive species and continued development and implementation of the Climate Change Adaptation Plan. The Lake Simcoe Science Committee recommends that increased attention be directed to the occurrence and vectors of pathogens including waterborne diseases that have a potential impact on human health, and diseases of aquatic and terrestrial species that in some cases, also affect humans (e.g. West Nile virus and Lyme disease). Other diseases of aquatic and wildlife species, such as Viral Hemorrhagic Septicemia (VHS) in fish and white nose syndrome in bats, have the potential to cause extensive die-off within wild populations. The Lake Simcoe Science Committee recommends, where there is a potential risk to native fauna, greater surveillance and protective measures be established to eliminate inter-watershed transport of wild species.

Future Considerations and Implementation - Chapter 8

In the final chapter of this report, the Committee lists those matters it intends to address over the next year. A specific recommendation is included for more effective public engagement, to communicate the important role of science in maintaining healthy and sustainable watersheds. To emphasize the importance of science-based management the Lake Simcoe Science Committee recommends that the next Lake Simcoe Science Forum focus on applying science to inform management actions for the protection of Lake Simcoe. The Lake Simcoe Science Committee also emphasizes the remarkable benefits to date of partnerships among science, management and community sectors at all levels and calls for continued and increased focus on development of partnerships of these kinds in the future.

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Acronyms

P	Phosphorus
PRS	Phosphorus Reduction Strategy
VHS	Viral Hemorrhagic Septicemia
WQT	Water Quality Trading

Chapter ONE Introduction

The work of the Lake Simcoe Science Committee can be characterized as: providing science-based advice contributing to implementation of the Lake Simcoe Protection Plan; monitoring changes in the state of the lake and the watershed as the plan is implemented; and tracking scientific advances that can contribute to successful implementation. The Committee also provides advice and recommendations on specific questions, topics, and issues to assist the Minister of the Environment and the Province in refining and enhancing policies and strategies of the Plan.

Prior to the creation of the Lake Simcoe Science Committee, the Lake Simcoe Science Advisory Committee had been appointed by the Minister of the Environment. This Committee addressed four objectives in its initial series of reports to the Minister: *Lake Simcoe and its Watershed - A Compendium of Reports Prepared by the Lake Simcoe Science Advisory Committee* (October, 2008). The work summarized in the Science Advisory Committee report of 2008 was the starting point for the deliberations of the Lake Simcoe Science Committee when it was established in March, 2010.

The Committee is not auditing the Plan's performance, but is providing to the Minister of the Environment observations and recommendations to help ensure that plan implementation and outcomes are heading in the right direction. This advice is offered from the perspective of a multi-disciplinary team of experts in various relevant disciplines, with reference to current plan implementation, new knowledge emerging from recent monitoring and research, and adjustments required for achievement of short and long-term goals. However, to date, there has not been sufficient data collected to allow for an assessment of the effectiveness of implementation of the Plan.

Not all topics have been fully addressed in this report. Additional topics to be considered by the Committee over the next year are listed in Chapter Eight, Future Considerations and Implementation.

This Report provides recommendations developed to date, and presents them within the framework of the Lake Simcoe Protection Plan. Chapters 3 through 8 in this report correspond directly to the chapters in the Plan.

Lake Simcoe Protection Act

Lake Simcoe Science Committee:

18. (1) A committee known in English as the Lake Simcoe Science Committee and in French as Comité scientifique du lac Simcoe is established.

Functions

(2) The Lake Simcoe Science Committee shall perform the following functions:

1. Review the environmental conditions of the Lake Simcoe watershed and provide advice to the Minister with respect to,
   - i. the ecological health of the Lake Simcoe watershed,
   - ii. current significant threats and potential significant threats to the ecological health of the Lake Simcoe watershed,
   - iii. potential strategies to deal with the threats identified under subparagraph ii, and
   - iv. the scientific research that needs to be pursued to support the implementation of the Lake Simcoe Protection Plan.
2. When requested by the Minister, provide advice to the Minister with respect to,
   - i. the design and implementation of monitoring programs to monitor whether the Lake Simcoe Protection Plan is meeting its objectives,
   - ii. whether a proposed amendment to the Lake Simcoe Protection Plan is consistent with the precautionary principle and, if not, whether the proposed amendment should be modified to achieve consistency,
   - iii. proposed amendments to the Lake Simcoe Protection Plan,
   - iv. proposed regulations under this Act,
   - v. proposed regulations under subsection 75 (1.7) of the Ontario Water Resources Act.
3. Such other functions as may be specified by the Minister.

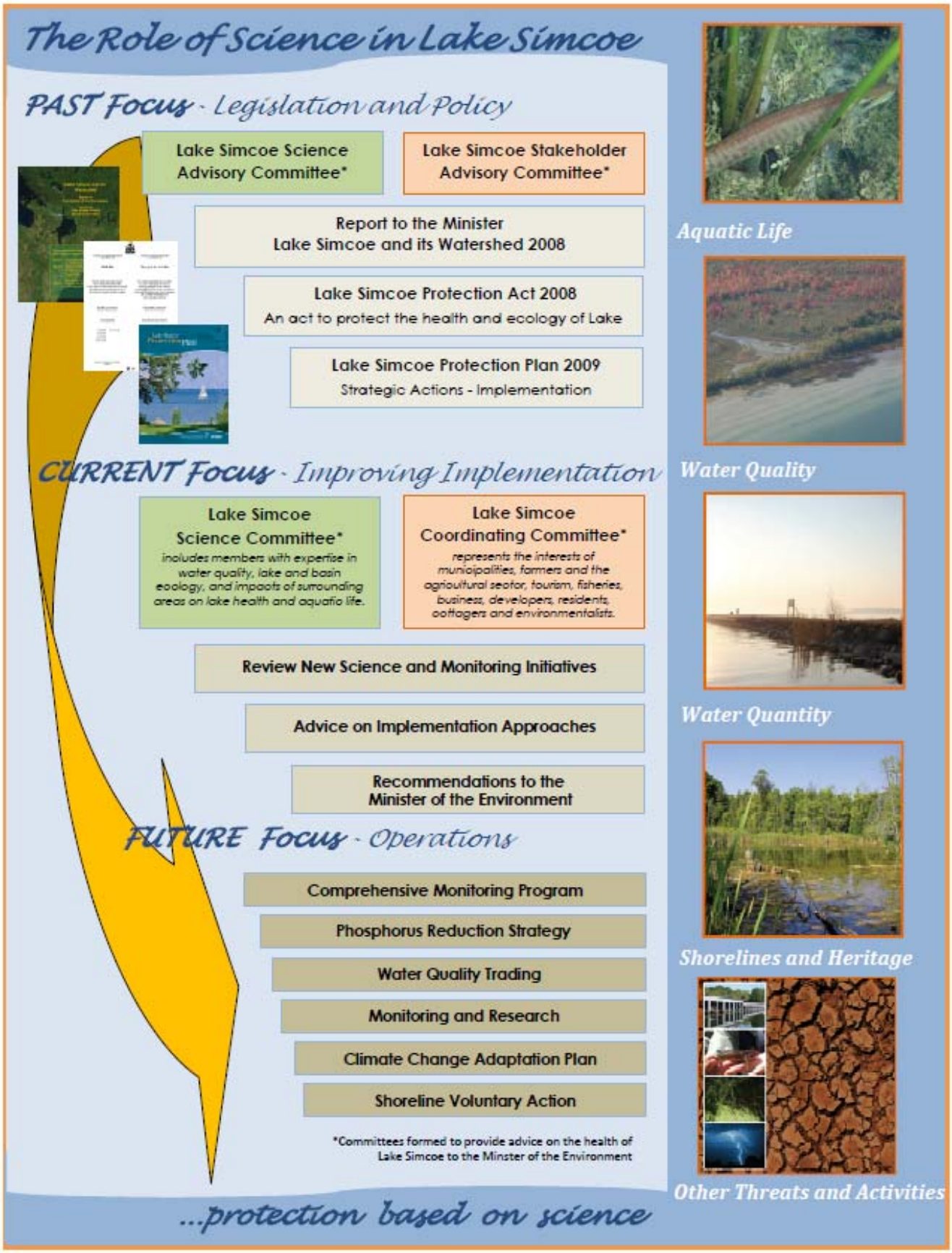
Chapter TWO Building the Future Through Science

The Lake Simcoe Protection Plan explicitly recognizes the critical role of science and community in effective management to attain a healthy and sustainable future for the Lake Simcoe watershed ecosystem. The *Lake Simcoe Act* and Protection Plan were founded on nearly 40 years of ecological monitoring and scientific research that established the solid knowledge-base upon which an adaptive and defensible management approach could be built. Collaborative partnership between science and management was a key factor in translating the complexity of the Lake Simcoe ecosystem into a creative, leading-edge plan for restoration and sustainable management of the watershed. The Lake Simcoe Science Committee recognizes and emphasizes the critical role of science, management and community partnerships in the decision-making process to achieve the goals of the Plan.

The Lake Simcoe Science Committee has been meeting on a regular basis (approximately every three months) since its inaugural meeting in March, 2010. Since many of the members of this Committee had formerly served on the Lake Simcoe Science Advisory Committee, there was a seamless transition from the work of the earlier Committee. The Committee continues to rely on technical input from staff of the Lake Simcoe Region Conservation Authority and several provincial ministries (Ministry of the Environment, Ministry of Natural Resources, and Ministry of Agriculture, Food and Rural Affairs). When requested, the technical staff offered presentations, clarified queries of the Committee, and ensured that there was always up-to-date information on the progress of implementation of the Plan. As topics were discussed over the past two years, the Committee formed their recommendations that are now finalized and presented herein.

Figure 1 on the following page illustrates the role of science throughout this initiative. The focus of the Lake Simcoe Science Advisory Committee was on preparing a report to the Minister of the Environment (2008) that provided advice on 12 key questions to describe the ecological health and stressors of the lake, the state of the lake management approaches, as well as monitoring approaches to support the Lake Simcoe Protection Plan. The report provided the science foundation for the *Lake Simcoe Protection Act* and the subsequent Lake Simcoe Protection Plan. The focus of the current Lake Simcoe Science Committee has been reviewing new science and monitoring initiatives and providing advice and recommendations in support of the implementation of the *Act* and the Plan. Our future focus will be to continue to review new scientific information and provide advice on the implementation of the Plan and to improve the transfer of this knowledge to stakeholders and citizens.

Figure 1 - Role of Science in Lake Simcoe



Chapter THREE

Aquatic Life

TARGET:

- Mean Volume Weighted Hypolimnetic Dissolved Oxygen Concentration of 7 mg/L on September 15th

INDICATORS:

- ✓ Natural reproduction and survival of native aquatic communities
- ✓ Presence and abundance of key sensitive species (i.e. lake trout and brook trout)
- ✓ Shifts in cold, warm and tributary fish community composition

... Chapter 3 - Lake Simcoe *Protection Plan*

Healthy aquatic communities provide important social and economic benefits for people living in the Lake Simcoe watershed. These benefits are in effect the ecological services that a healthy ecosystem provides, such as clean water, and harvestable, contaminant-free stocks of self-sustaining wild species, including high profile species like lake trout, lake whitefish, smallmouth bass and yellow perch.

These species and many others, including microscopic plankton, invertebrates, and aquatic plants, are intimately connected via the flow of materials and energy through the food web. Together they comprise the diverse and abundant aquatic life of the Lake Simcoe watershed that are addressed in this chapter.

The Lake Simcoe Science Advisory Committee (2008), specifically identified the degraded state of aquatic life of the lake as a major cause for concern and cited poor water quality, reproductive failure of coldwater fish populations, excessive growth of aquatic plants and invasions of non-native aquatic species such as spiny water flea, zebra mussel, round goby and rusty crayfish as key indicators of the altered state of the lake. The Lake Simcoe Science Committee re-emphasizes the need to address the causes of impairment of aquatic life and to apply science-based solutions to achieve recovery.

A primary objective for aquatic life identified in the Lake Simcoe Protection Plan is restoration of a self-sustaining coldwater fish community in Lake Simcoe, the coldwater fish community being a sentinel of environmental quality and the overall health of the aquatic ecosystem. Recent observations of increased abundance of cold water species, including recruitment of wild lake trout after an absence of nearly two decades coincident with improved dissolved oxygen conditions, provides direct evidence of the benefits of effective water quality management. The Plan also identifies other aquatic communities, e.g. warm water and tributary fishes, and macro- and micro-invertebrates, aquatic plants and wetland species that contribute to aquatic biodiversity and ecological health of the watershed. While objectives for these communities were not specified it is implicitly understood that the entire web of aquatic life that is connected by habitat and food web interdependencies must be protected to achieve the objectives of the Plan.

Given the critical importance of dissolved oxygen for the well-being of the coldwater fish community and the keystone role of lake trout as the top coldwater predator, the dissolved oxygen target for that species (see text box on page 4 and 6) was set as the target for restoration of the coldwater fish community in the lake. Key indicators of the state of aquatic life in the lake and its tributaries include natural production and survival of native aquatic communities, presence and abundance of key native species such as lake trout and brook trout and the composition of warm and cold water fish communities.

Brook trout were specifically identified in the Plan as a key sensitive species but a specific target was not identified for their protection. Brook trout inhabit the headwaters of coldwater tributaries in the Lake

Simcoe watershed and are a key indicator of the health of these systems. Targets should be developed for protection of these sensitive and critical habitats to protect not only brook trout and the diversity of aquatic life in these tributaries, but importantly the quality and quantity of the waters that ultimately contribute to the health of the lake. These tributaries are particularly vulnerable to the effects of climate change. Accordingly we alert the Minister of their sensitivity and the requirement for special protection.

Recommendation 1 - A Target for Brook Trout

Develop specific temperature and habitat targets for headwater streams to protect native brook trout populations.

Several recommendations are provided throughout this report that address known or potential interactions of various stressors, including water quality, water quantity, shorelines and natural heritage features, climate change, invasive species and recreational activities that directly or indirectly affect the health of aquatic life in Lake Simcoe. Support of monitoring and research prior to and since inception of the Lake Simcoe Protection Plan has led to significant advances in knowledge and understanding about the complexity of these types of interactions. The Lake Simcoe Science Committee emphasizes the critical importance of these activities and the accruing science knowledge that provides the key foundation for important advances towards restoration and sustainable management of aquatic life in Lake Simcoe.

Key recommendations that apply directly to aquatic life appear in other Chapters of this report, however we focus attention on one item of special concern, invasive species and their effects on native fauna. The Lake Simcoe Science Committee emphasizes that invasive species are not only highly disruptive to native communities and whole ecosystems, but can also be directly linked to the introduction and spread of infectious diseases of aquatic species, e.g. Viral Hepatic Septicaemia (VHS). A key factor in the introduction of non-native species and diseases is inter-watershed transport of aquatic species by humans. Policy 7.4 SA of the Plan requires development of a watch list of aquatic and terrestrial species (including fish and wildlife diseases and insect pests) likely to be introduced to the Lake Simcoe watershed. Ensuring that species on the watch-list do not become established in the Lake Simcoe basin should be a high priority. This concern for aquatic life requires additional, immediate attention and is linked directly to our Recommendation 33 in Chapter 7.

Chapter FOUR

Water Quality

Degraded water quality has historically placed significant stress on Lake Simcoe, its tributaries and the life they support. Stresses from urban, industrial, rural, recreational and agricultural activities have changed the landscape, vegetation, and ecological functions of the watershed and contributed to increases in the inputs of pollutants. Human activities in the watershed have also affected water quantity which can, in turn, significantly affect water quality.

The primary stressors that degrade water quality include:

- *excessive nutrients, primarily phosphorus, and nitrogen;*
- *pollutants and contaminants, such as heavy metals, organic chemicals, sediments, and chlorides; and*
- *pathogens.*

TARGETS:

- Reduce phosphorus loadings to achieve a target for dissolved oxygen of 7 mg/L in the lake. This corresponds to a long-term phosphorus loading goal of 44 tonnes per year.
- Reduce pathogen loading to eliminate beach closures
- Reduce contaminants to levels that achieve Provincial Water Quality Objectives or better

INDICATORS:

- ✓ Dissolved oxygen in Lake Simcoe
- ✓ Total phosphorus (concentrations and loading)
- ✓ Pathogens (beach closures)
- ✓ Other water quality parameters (chlorides, other nutrients (e.g. nitrogen), total suspended solids, heavy metals, organic chemicals)

... from Chapter 4 - Lake Simcoe Protection Plan

Two important implementation actions were included in the Lake Simcoe Protection Plan to deal with the target to reduce phosphorus loading in the watershed. These were the development of a Phosphorus Reduction Strategy and an evaluation of the feasibility of developing a system of Water Quality Trading across the watershed. In June 2010, a *Phosphorus Reduction Strategy* was completed and released by the Ministry of the Environment. A study was also completed dealing with the concept of Water Quality Trading. While the conclusion drawn was that trading was feasible, concern was expressed that not all stakeholders may be in favour of Water Quality Trading. Although Water Quality Trading may have benefits, reductions in loads from each of the key sources of phosphorus in the watershed must be the paramount objective.

Phosphorus Reduction Strategy

The biggest challenge in implementing the Lake Simcoe Protection Plan is to reduce the amount of phosphorus that is entering the Lake Simcoe tributaries to a level where the dissolved oxygen levels of the lake will be able to support a self-sustaining coldwater fish community. The long-term goal to accomplish this is to reduce the phosphorus (P) loading level from the current estimated 72 tonnes per year to 44 tonnes per year. This 44 tonne per year target is 12 tonnes per year above pre-settlement loads and aggressive action must be taken or it will not be reached. The Lake Simcoe Phosphorus Reduction Strategy sets the high

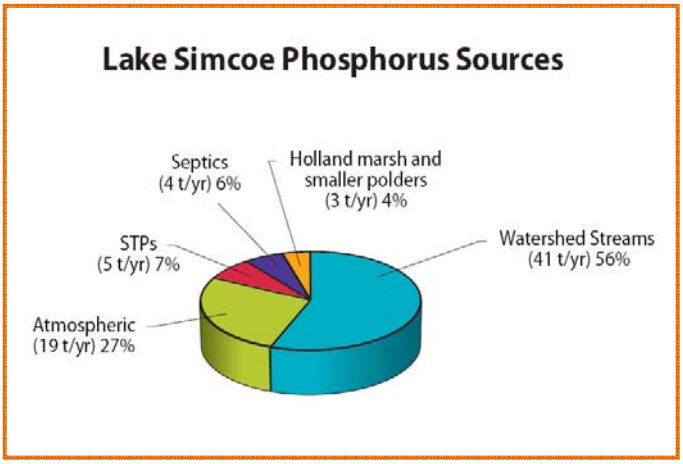


Figure 2 - Lake Simcoe Phosphorus Sources (2002 to 2007)

level, strategic direction to get this done and the recommendations that follow are intended to build on the strategy and provide additional level of detail to the recommended actions.

The current Phosphorus Reduction Strategy (PRS) provides strategies to proportionally reduce loading from 4 major sources of phosphorus entering the lake: 1) urban sources (sewage treatment plants and stormwater runoff); 2) rural (including agricultural inputs); 3) on-site sewage treatment (septic systems); and 4) atmospheric deposition. The Committee met and provided comments on the PRS prior to and following its release in 2010. The following are the key recommendations that arose from those discussions, beginning with general recommendations followed by a series of recommendations that relate to the four major phosphorus source categories.

General

The phosphorus load delivered by urban stormwater runoff is currently estimated at 23 tonnes per year. Because a relatively small proportion (approximately 6 %) of the watershed is urban, this load is 22 tonnes above the approximately 1 tonne natural background load from an equivalent, undeveloped watershed area. This illustrates the need to reduce phosphorus loading from urban areas. By comparison, with agriculture occupying slightly less than 50% of the land base in the watershed, the estimated 20 tonne per year load from agricultural runoff is only 9 tonnes over the natural background level. Although it is unlikely that this increase is uniformly distributed across all agricultural lands, it illustrates the limited extent by which the load from agricultural sources can be reduced and highlights the need to clearly identify major agricultural source areas ("hotspots") and to target effective best management practices in those areas. It should be noted that this agricultural source excludes the polders in the watershed, such as the Holland Marsh, which are addressed separately in the Phosphorus Reduction Strategy.

Both urban and agricultural land uses have significant spatial variability in phosphorus load contribution to stormwater runoff. The first step in implementation of a successful and cost-effective Phosphorus Reduction Strategy is to clearly identify major urban and agricultural sources, quantify the loads and focus implementation of effective best management practices in each area and land use.

Recommendation 2 - Feasible Solutions to Achieve Phosphorus Reductions

The Phosphorus Reduction Strategy must focus on reductions in phosphorus load that are the most feasible to achieve, including reducing loads from urban stormwater. Future iterations of the Phosphorus Reduction Strategy should use a reference condition approach by comparing loads from various sources to background levels on an areal basis.

Meeting the targets for phosphorus and the protection of natural areas while accommodating projected human population growth for the watershed will require implementation of innovative approaches for phosphorus management throughout the watershed.

Recommendation 3 - Evaluate and Adopt Innovative Approaches

Implementation of the Phosphorus Reduction Strategy must include actions to continually evaluate and adopt technological developments and innovative approaches to achieve reductions in phosphorus loads. Major sources ("hot spots") should be identified and effective best management practices targeted in those areas.

Improving estimates of phosphorus loading from non-point sources will help inform phosphorus reduction targets and promote appropriate management actions to reduce loads from those sources. Such management actions can then be evaluated in terms of cost associated with implementing them and the requirements for additional monitoring. Recommendation 17 also addresses this issue, specifically in terms of the future updating of the Phosphorus Reduction Strategy.

Recommendation 4 - Improve Knowledge of Non-Point Phosphorus Sources

Non-point sources of phosphorus should be monitored more precisely to reduce the uncertainty around the apportionment of the sources of the tributary load (e.g. more event-based monitoring, targeted monitoring of particular land use categories).

Urban Sources

Phosphorus loading from existing urban areas is high, and major urban growth and development is projected by the Growth Plan for the Greater Golden Horseshoe Region. It is critical to ensure that there will be a net-reduction in phosphorus loading from existing urban areas and no net increase of new sources of phosphorus from urban expansion and development.

Recommendation 5 - No Net Increase in Phosphorus Loading from Urban Development

There should be a no net increase in phosphorus loading over background from lands undergoing development and a net-reduction in phosphorus loading from currently developed lands.

There is a need to move away from just requiring percent total suspended solids removal from stormwater facilities to requirements for end-of-pipe concentrations of multiple parameters, similar to sewage treatment plants. A major implication is that monitoring requirements and operating costs will increase to maintain ponds in compliance.

Recommendation 6 - Expand Urban Stormwater Criteria

Develop urban stormwater criteria that include phosphorus, sediments, heavy metals, petroleum hydrocarbons, chlorides, and other harmful contaminants of concern typically found in urban runoff; and apply as end-of-pipe effluent concentration design guidelines at the point of discharge of major stormwater management systems to receiving waters, similar to sewage treatment plants.

There is no current solution proposed to accommodate increased P loading with population growth and with current growth projections of 150,000 in the watershed by 2031, the increased bio-solids and associated phosphorus generated will become an increasingly important issue. A “no net increase in P” discharge for sewage treatment plants and other sites of discharge may be the preferred approach to resolve this issue, over the longer term. A major implication is that new methodology for recovery and utilization of P needs to be developed. We suggest that Ontario should be at the forefront of these developments.

Recommendation 7 - No Net Increase Phosphorus Discharge from Sewage Treatment Plants

No net increase in phosphorus discharge limits from sewage treatment plants should continue to be a priority action in the Phosphorus Reduction Strategy, despite projected population growth.

Recommendation 8 - Address Increased Phosphorus Loading from Population Growth

Increased P loading associated with population growth needs to be considered and factored into future P management. New aggressive approaches will be required to maintain existing P loads, let alone achieve further reductions.

Polder Agriculture

The estimated amount of phosphorus loading from the Holland Marsh and other smaller agricultural polders was 3 tonnes/year, or approximately 4% of the total phosphorus loading based on monitoring conducted between 2002 and 2007. With the exception of the requirements of the *Nutrient Management Act* which has relatively little impact on polder agriculture, action to reduce phosphorus loading from agricultural sources has relied to date on voluntary stewardship activities. These voluntary activities are important to the Phosphorus Reduction Strategy and should continue to be supported, but they may need to be augmented by other activities to effectively reduce P loading from all contributing agricultural sources (see Recommendation 4).

The polders of the Holland Marsh present a special set of circumstances (in some cases, these polders are "point sources" of P loading, similar to sewage treatment plants) and as such they may benefit from a different yet complementary approach than currently presented in the Phosphorus Reduction Strategy. If considered as point sources, increased load reduction requirements may be feasible, and if required, may stimulate required research and innovation. It's important to recognize that volunteer stewardship programs are in place and that they need continued support.

Recommendation 9 - Polders Considered as Point Sources of Phosphorus

Polder areas in the watershed should be addressed as "point sources" of phosphorus. Increase the required P load reduction from polders, which is currently set at only 1 tonne per year reduction between 2013 and 2032 and consider options to remove P prior to discharge.

On Site Sewage

Six percent of the total phosphorus loading to Lake Simcoe and its tributaries is estimated to originate from on-site sewage, or septic systems. As the roll-out of the mandatory maintenance/inspection program takes place a reduction in the overall contribution of phosphorus from septic systems can be expected. The next step in achieving additional phosphorus reduction will be to establish and implement advanced technologies for the treatment of on-site sewage.

Recommendation 10 - Advanced P removal from Septic Systems

The Phosphorus Reduction Strategy needs to place greater emphasis on promoting the development and implementation of advanced P removal and reuse technology for septic systems.

Recommendation 11 - Continued Research on P Migration

Continue to fund research and collaborate on projects to explore phosphorus migration in septic tank plumes through soils in the Lake Simcoe watershed. Review and synthesize the available literature and incorporate the knowledge into management actions.

Atmospheric

Phosphorus that comes to the watershed from atmospheric sources accounts for an estimated 27% of the total phosphorus entering the watershed, approximately 19 tonnes per year. Promoting and implementing effective and practical best management practices will reduce soil erosion and address some of the atmospheric deposition. While these best management practices are promoted throughout the Plan and the Phosphorus Reduction Strategy, research is needed to better understand this component of the phosphorus load to the lake. The research to date indicates that about 60% of the dust containing phosphorus is generated locally (i.e. within 20 km of the shoreline around the lake) and deposited on the lake from four key sources: agricultural areas, unpaved roads, aggregate extraction and construction sites. Research that is currently underway will help us to better understand the origin of airborne phosphorus, the amounts being deposited in the watershed, and what actions can be taken to reduce the levels.

Recommendation 12 - Atmospheric Phosphorus and Agricultural Sources

Identify priority areas for dust control based on soil susceptibility for dust emission and land use using results of ongoing research, and offer a range of solutions and programs to land owners in identified "high-priority areas" to reduce dust emission and atmospheric P export.

Recommendation 13 - Atmospheric Phosphorus and Unpaved Roads

Encourage municipalities to place a high priority on implementing dust suppression measures including tree planting to reduce wind erosion, and lower speed limits (and/or speed bumps) for the unpaved roads that are located in close proximity (< 20 km) to the Lake Simcoe shoreline.

Recommendation 14 - Atmospheric Phosphorus and Aggregate Extraction Sites

Implement random inspection of aggregate extraction sites near Lake Simcoe during the summer months, along with automated continuous air quality monitoring of particulate matter (particles with a diameter of 10 micrometers or less) during the spring/summer months down-wind of the major clusters of aggregate mining sites that are within 20 km of the shoreline of the lake to improve implementation of dust suppression measures and compliance with air quality guidelines. Also, encourage voluntary enforcement of lower speed limits on haul roads within the aggregate mining sites to reduce the amount of dust that is generated.

Recommendation 15 - Atmospheric Phosphorus and Construction Sites

a) *The next version of the Phosphorus Budget Tool should include dust emission calculations that aim at a no net increase in phosphorus-loading from lands undergoing development.*
b) *Erosion and Sediment Control Plans for major development projects must ensure that there is no net increase in phosphorus from lands under construction.*
c) *Phasing shall be required on all sites disturbing greater than 30 acres for earthworks and grading activity to limit the amount of exposed bare soil at a time as an effective and practical control measure.*

Considerations for the Phosphorus Reduction Strategy Update in 2015

To prepare for the update of the Phosphorus Reduction Strategy in 2015, there is a need to conduct further research and to better understand P loading and apportionment so that future changes are based on this new science and knowledge.

Recommendation 16 - Research Internal P Loading

Conduct investigations of return rates of soluble and particulate phosphorus stored in tributary and lake sediments to overlying waters (i.e. internal loading and re-suspension) because high return rates during periods of low oxygen or wind-induced mixing can delay the response of the lake to reductions in external loading.

Recommendation 17 - Understand P Load Apportionment

Improve our understanding of the apportionment of the phosphorus load to different sources in order to develop priority actions and to enhance development of cost-effective management strategies.

Recommendation 18 - Develop Long-term Vision for Stormwater

The Lake Simcoe Science Committee and Lake Simcoe protection partners should develop a long-term vision on how to address stormwater runoff, including consideration of:

a) Identifying stormwater from new development as point sources with effluent limitations identified in the Certificate of Approval and regulation of discharges similar to those at sewage treatment plants;

b) Imposing conditions for best management practices to limit effluents (e.g. phosphorus loads, total suspended solids);

c) Emphasizing monitoring and maintenance of stormwater works to ensure that design criteria are met;

d) Identifying and removing barriers to the uptake of low impact development solutions for urban areas; and

e) Promoting development of technologies for recovery of P from waste water streams and "traditional" nonpoint sources, such as polders and stormwater ponds.

Water Quality Trading

The Lake Simcoe Protection Plan Policy 4.25 requires that: "Within one year of the date the Plan comes into effect the MOE will conduct a feasibility study for Water Quality Trading pursuant to subsection 75, (1.8), of the *Ontario Water Resources Act*."

The feasibility study has been undertaken[1] and it concluded that, while a trading program may be feasible, it could not be implemented without acceptance by stakeholders. It was noted that so far, stakeholder reaction has been mixed, and some municipalities have expressed interest and/or pursued their own offsetting proposals.

Water quality trading addresses the financing needed to implement agricultural best management practices. However, it is not clear whether sufficient phosphorus reduction from agricultural supply is available for purchase even if sufficient demand can be created. If the demand and supply are deemed sufficient, an effective trading program might improve water quality in tributaries as well as Lake Simcoe. One of the best management practices, naturalization of riparian zones, would also improve wildlife habitat (i.e. natural heritage) and thus contribute to establishing natural corridors which are essential to protect small populations from extinction and maintain biodiversity. Water quality trading could also be used to restore large wetlands.

Recommendation 19 - Conduct a Science-Based Analysis of Water Quality Trading

In the event that a Water Quality Trading Program is considered further, a science-based as well as a cost-benefit analysis should be undertaken. The following technical and science issues need to be fully addressed prior to implementation:

a) Are there sufficient trading partners in the watershed, i.e. are there enough potential buyers and sellers of P credits for a viable program?

b) How much P is actually available for trading?

c) What kind of transition and exit strategies will there be based on achievement of P management targets?

d) Monitoring and tracking the actual effectiveness of the program to reduce loading and derive other ecological benefits are critical component requiring extensive advance planning and financial commitment.

e) How will trading ratios be established for various sectors given the uncertainties associated with measurement of non-point watershed P loading?

A decision on whether the Water Quality Trading Program will be implemented has not yet been made. In the event the Province moves in the direction of a water quality trading system, the Lake Simcoe Science Committee has a number of pre-implementation recommendations to validate its potential effectiveness. If a trading system is not implemented, other strategies will be required.

[1] *Water Quality Trading in the Lake Simcoe Watershed. Feasibility Study*. February 2010, A Report to the Ontario Ministry of the Environment by XCG Consultants Ltd., Kieser & Associates LLC, D.W Draper Associates, and Commexus Inc.

Recommendation 20 - Water Quality Trading Design

In the event that the Water Quality Trading Program (WQT) is considered further, the following design considerations should be addressed prior to implementation:

a) Advice and perspectives from independent experts and stakeholders should be available to the Water Quality Trading Panel;

b) Monitor and report on the effectiveness of P reduction; and

c) Address priority issues during further evaluation of WQT in addition to phosphorus reduction such as restoring natural heritage features including riparian zones and wetlands (e.g. short-term buffers).

Salt and Other Water Quality Contaminants

While phosphorus is a major water quality issue in Lake Simcoe, there are other contaminants that require monitoring and/or research. For example, winter salt use is a growing concern, as are effluents from sewage treatment plants that contain "contaminants of emerging concern" such as pharmaceuticals and personal care products.

Recommendation 21 - Pharmaceuticals and Other Contaminants

Additional research and monitoring is needed to better understand current and trending levels of persistent contaminants and pharmaceuticals from sewage effluents. Results of these studies need to be assessed to determine if reduction of these chemicals from the effluent is required.

Chloride concentrations in Lake Simcoe have increased significantly over a 36-year period, with concentrations increasing more than three-fold at the lake's outflow since 1971. Concentrations have increased significantly in eight tributaries of the lake from 1993 to 2007, and were highest in those rivers draining the greatest percentage of urban land and roads. Road salts containing inorganic chlorides have been designated as toxic under the *Canadian Environmental Protection Act*. A code of practice for the environmental management of road salts has been developed to manage risks posed to the environment[2]. In particular, the code recommends the development of salt management plans by municipalities to achieve reductions of the negative impacts of salt releases, and the implementation of best management practices in the areas of salt application, salt storage and snow disposal.

The issue of winter salt and increasing chloride concentrations in Lake Simcoe and its inflowing rivers will be the topic of future Lake Simcoe Science Committee meetings (see Chapter 8, Future Considerations and Implementation).

[2] Environment Canada 2004. Code of Practice for the Environmental Management of Road Salts. Environmental Protection Series Report EPS 1/CC/5

Chapter FIVE

Water Quantity

TARGET:

- No targets - Policy 5.1 of the Lake Simcoe Protection Plan indicates that in-stream flow targets are to be developed for Lake Simcoe subwatersheds, with stressed subwatersheds to be given priority.

INDICATORS:

- ✓ Maintenance of in-stream flow regimes that are protective of aquatic ecosystem needs (as identified in the in-stream flow studies and implemented through the water-taking strategy); and
- ✓ Effective water conservation and efficiency plans (e.g. as measured through reductions in peak water demand, reduced water use per capita, progress in achieving municipal targets).

... from Chapter 5 - Lake Simcoe Protection Plan

Maintaining adequate water quantity levels across the watershed is critical in the protection of the ecological integrity of the watershed, and to sustaining human use. The *State of the Lake Simcoe Watershed Report* (LSEMS, 2003) pointed to decreases in stream flows that have affected the availability of aquatic habitats and resulted in the loss of recreational opportunities and impacts to the local economy. Removal of water (surface and groundwater) has led to instances where the base flow in the watercourse has been exceeded by the amount of water taking (Maskinonge River).

The present regulations for water taking allow up to 50,000 litres/day to be taken without a Permit To Take Water, without reference to natural flow rates, flow rates required to sustain environmental conditions (environmental flows) that maintain habitat requirements of sensitive species such as brook trout, or the cumulative effects of multiple takings. With respect to issuing permits, the Lake Simcoe Protection Plan sets out a number of policies, including:

> Policy 5.1 a. Require the development of targets for all other subwatersheds, and set out how much water can be allocated among users in a subwatershed, including setting aside an allocation to support the natural functions of the ecosystem;

Current pressures on the water quantity levels of the watershed can be expected to increase with a combination of increased population and effects of climate change.

Recommendation 22 - Establish Specific Flow Targets for Tributaries and Sensitive Headwater Areas

In establishing in-stream flow targets it is critical that targets be established for low flow conditions and high flow events. Sudden high flow events can result from a large percentage of hardened, impervious surfaces, such as roads, car parks and roofs, in a catchment and lead to detrimental impacts to the environment such as stream bank erosion and damage to aquatic habitats.

Recommendation 23 - Revisit Permits to Take Water

The current minimum level of water taking that requires a permit, set at 50,000 l/day, should be revisited to determine whether the level should be set at a lower minimum and whether a maximum stream-specific cumulative withdrawal cap should be set. Revised minimum takings should be based on meeting established in-stream flow targets.

Chapter SIX

Shorelines and Natural Heritage

Shorelines

Under Section 26 of the *Lake Simcoe Protection Act*, a shoreline regulation was proposed in the Lake Simcoe Protection Plan (see Policies 6.16 SA to 6.19 SA), but has not been put into place. The approach taken by the Province to date has been to implement a Shoreline Voluntary Action Program to promote best practices and stewardship along the shorelines of the lake and its tributaries. The purpose of the proposed regulation was to protect the ecological functions of shorelines, wetlands, littoral zones and riparian areas and limit loss or damage due to exceptions under Lake Simcoe Protection Plan policy 6.23, particularly under 6.23 c and f (existing uses and aggregate operations).

Shorelines are a critically important element of the watershed:

- The physical structures and living communities of the land along a lake's edge are key features of lake ecosystems as are fish and other aquatic species in its waters. Both can contribute to important ecological processes including the flow and storage of nutrients and energy.
- As a transition zone where the land meets the water, shorelines are important in supporting biotic diversity as well as controlling the flow of materials between land and water (Lachavanne and Juge, 1997). Shorelines are not "a line", rather they are an ecotone with significant transitional dimensions (along its length, towards land and in the water).
- Shorelines are buffer zones that reduce nutrient transport from land to water.
- Human alteration of shoreline terrestrial and littoral zone habitat has an impact on the lake's ecosystem by affecting water quality through runoff of nutrients, sediments, organic material and contaminants, and by directly altering structural elements of the system like the composition and density of plants on land and in the water, the amount of biologically important woody debris, and the size and uniformity of substrate and soil particles (Jennings et al., 1999). These changes can negatively affect the fish and other organisms living in the water as well as the terrestrial animal and plant communities living on the shore.
- Naturalized shorelines are also important aesthetically and for recreational satisfaction. The Science Advisory Committee mentioned the importance of the view and smell of a healthy lake during their discussions. A study reviewed by Norris (1993) found that the geomorphological and ecological surroundings at recreational sites were more important than water quality in determining recreational satisfaction on lakes.
- Trees along the shoreline of the lake will also serve as a windbreak and intercept a portion of the airborne dust that would otherwise be deposited on the lake's surface.

TARGETS:

- No further loss of natural shorelines on Lake Simcoe
- Achieve a greater proportion of natural vegetative cover in large high quality patches
- Achieve a minimum 40 percent high quality natural vegetative cover in the watershed
- Achieve protection of wetlands
- Achieve naturalized riparian areas on Lake Simcoe and along streams
- Restore natural areas or features
- Achieve increased ecological health based on the status of indicator species and maintenance of natural biodiversity

INDICATORS:

- ✓ Change over time in the proportion of land in wetland, forested valleyland, natural riparian and upland forest taking into account habitat quality
- ✓ The degree of fragmentation of wetland, forested valleyland, riparian and upland forest
- ✓ The integrity of natural shoreline, i.e. the amount of shoreline that is either undeveloped or maintained in a naturalized state
- ✓ Change over time in the status of key biological indicators, including species of conservation concern
- ✓ Integrity of significant recharge areas

... from Chapter 6 - Lake Simcoe Protection Plan

Recommendation 24 - Shoreline Regulation

That the previously proposed shoreline regulation be reviewed with respect to the following matters, and passage of the regulation should be reconsidered in light of whether progress of the Voluntary Action Program is satisfactory:

a) Power of a conservation authority to issue a "stop work order";
b) Regulations to prohibit peat extraction;
c) Definition of "significant alteration" regarding shoreline works;
d) Ability to restrict removal of vegetation adjacent to wetlands; and

Recommendation 25 - Protect Shorelines

Ensure protection of the physical integrity and ecological functions of all natural and re-naturalized shorelines, littoral zones, riparian zones, their vegetation, and wetlands, including areas under existing uses or in relation to other actions outlined in 6.23 in the Lake Simcoe Protection Plan.

Recommendation 26 - Comprehensive Shoreline Inventory

Place a high priority on completing a comprehensive inventory of shorelines and riparian areas and their characteristics so that the effectiveness of shoreline protection, either by the Shoreline Voluntary Action Program or by regulation, can be credibly assessed.

Recommendation 27 - Shoreline Voluntary Action Program

In the case that a Regulation does not replace the Shoreline Voluntary Action Program (see Recommendation 24), consider the following for revision of the Shoreline Voluntary Action Program:

a) Seek input from the Lake Simcoe Science Committee on:
    i. Identified targets (desired behavioural outcomes and phosphorus loading and shoreline vegetation changes) to be achieved through program;
    ii. Review of the design of the monitoring program; and
    iii. Monitoring and assessing how well the program is working.
b) Conduct scientifically-defensible surveys to develop and assess the voluntary action program.
c) Review the voluntary program in five years, with the option of pursuing regulatory measures if established targets are not met.
d) Ensure that the Shoreline Voluntary Action Program is widely and frequently advertised to inform new residents of shoreline objectives and targets and to respond to the changing demographics and increasing population in the watershed.
e) Recognize that the target audience for fertilizer use is larger than for shoreline protection, and that related survey(s) and marketing campaigns should address attitudes and behaviours of shoreline residents regarding fertilizer use.
e) Inform contractors, landscapers and realtors about the watershed benefits of the Shoreline Voluntary Action Program as a means to inform new property owners about the value of shoreline restoration and protection.

Terrestrial Natural Heritage

Protecting and enhancing the terrestrial ecosystems of the watershed will provide benefits not only to the terrestrial-based flora and fauna, but also to the watershed's water quality and quantity. Enhancements to the size and quality of natural areas and to the connectivity of forests and wetlands offer multiple benefits, not least of which is improved ability of the watershed to retain water that falls on, and flows across it, leading to both quality and quantity improvements to the surface and ground water of the area.

The Lake Simcoe Science Committee has concern that the recommendations of the former Lake Simcoe Science Advisory Committee about "Loss of Natural Areas and Habitats" (Recommendations 35-39) as realized in the Lake Simcoe Protection Plan, and as subsequently implemented, will not meet the original intent of the Science Advisory Committee. In particular, the Lake Simcoe Science Committee recognizes that the current area of all "natural vegetative cover" in the watershed is below the target of 40% high quality "natural vegetative cover" advocated in the Plan. Emphasis in the plan is on protection of existing cover. There are currently no policies in the Plan which directly promote increased natural vegetative cover. The amount of natural vegetative cover will largely be determined by the balance between land use economics and land use planning guidelines under other current legislation, for example the Provincial Policy Statement under the *Planning Act*, the *Greenbelt Act*, and the *Oak Ridges Moraine Conservation Act*.

Recommendation 28 - Protect Terrestrial Natural Heritage

Protect terrestrial natural heritage by developing:

a) An ecologically-based definition (beyond minimum size), and appropriate data collection protocols encompassing both site and landscape characteristics, for the identification and mapping of "high-quality natural vegetative cover"; and

b) A Natural Heritage System Plan that would identify, map and protect wildlife corridors, forest linkages and natural core areas to reduce the effects of fragmentation of natural areas on wildlife and biodiversity.

Recommendation 29 - Emphasize Benefits of Natural Heritage Areas

Give greater weight to the benefits of restoring natural heritage areas (phosphorus-related, and non-phosphorus related), across the watershed, and notably in the Phosphorus Reduction Strategy and the Water Quality Trading Program. Provide adequate funding to stewardship programs to assist in restoring natural heritage areas.

Recommendation 30 - Terrestrial Shoreline and Natural Heritage Monitoring

In developing and implementing the monitoring program for shorelines and natural heritage, consider the following:

a) Develop an implementation plan (including cost estimates). This should be considered a high priority and be done immediately;

b) Give priority to monitoring wetland change within 5 years of the plan proclamation, so that the intent of no loss of wetlands that was strongly expressed in the Science Advisory Committee Report (Recommendation 37: "Protect all wetlands…") can be accurately assessed;

c) Determine sample size for terrestrial monitoring based on meeting the commitments in the Lake Simcoe Protection Plan, and monitoring budgets established based on this identified need;

d) Sample annually, and at random, stratified sites based on geographic and ecologically distinct strata, including a number of reference plots within strata that are consistently sampled to assess natural seasonal and inter-annual variability, and sampling with sufficient effort to provide statistical power to separate natural ecological variation from change due to human impacts on the ecosystem; and

e) Begin terrestrial monitoring as soon as possible.

Wetlands

The Science Advisory Committee, in its 2008 report, included as a key objective: "to prevent further loss of……all wetlands….." (Objective 12). Many wetlands in the watershed have not been evaluated, which may not be a critical issue if this objective, to protect all wetlands, is pursued. However, if regulatory approaches are not used, it may be difficult to achieve this objective.

Recommendation 31 - Define Shoreline and Connected Wetland

Establish a clear definition of the terms "Lake Simcoe shoreline" and "connected wetlands" and include in the Lake Simcoe Protection Plan.

Recommendation 32 - Protect All Wetlands

Delete the term "significant" from the Lake Simcoe Protection Plan Policy #6.42a, such that the policy would protect all wetlands.

Chapter SEVEN

Other Threats and Activities

TARGET:

- Prevent new invasive species

INDICATORS:

- ✓ Presence of newly introduced species

... from Chapter 7 - Lake Simcoe Protection Plan

Invasive species, climate change, and recreational activities were identified by the Lake Simcoe Protection Plan as significant ecological stressors within the Lake Simcoe watershed, each having specific science, monitoring and management requirements. All three of these stressors have unique ecosystem impacts but also interact with several other primary stressors including phosphorus loading. These threats are potentially very disruptive as they affect physical and biological processes including thermal regime, nutrient dynamics, water quality and species composition and production.

Invasive Species

The effects of existing invasive species on the aquatic and terrestrial ecosystems of the Lake Simcoe watershed are only beginning to be understood, and as such, monitoring and research will be important to improve our knowledge. It will be important to understand the impacts of invasive species in general, and in particular, on phosphorus mineralization, distribution and storage. Once established, invasive species generally become naturalized components within the ecosystem. Eradication of new aquatic species such as zebra and quagga mussels, spiny water flea, and rusty crayfish becomes essentially impossible requiring management strategies that adapt to their presence. In those cases where there is some possibility of stopping or limiting further spread as is the case for some terrestrial plant species, active management strategies to control abundance will potentially be effective.

New invasive species will bring with them new threats, and their impacts cannot easily be predicted. The Lake Simcoe Protection Plan places a strong emphasis on understanding the pathways that invasive species may follow to enter the watershed, and the need for developing tactics to prevent new species from arriving and becoming established.

Monitoring and research is essential to gain scientific understanding of the impacts of invasive species on physical and biological processes and the population responses of native species. For example, displacement of native species from their preferred habitats would be expected to affect their production and in some cases their potential for harvesting. In the case of invasive dreissenid mussels system wide shifts in energy dynamics, water quality and production of aquatic plants and benthic invertebrates has been observed.

Recommendation 33 - Rapid Response to Invasive Species

In association with the proposed monitoring plan (policy 7.10 in Lake Simcoe Protection Plan), a "rapid response plan" should be immediately prepared and subsequently implemented if and when a new invasive species is observed or suspected to exist.

Some diseases transmitted by aquatic and terrestrial species, such as West Nile virus and Lyme disease, can impact human health. Other diseases of aquatic and wildlife species, for example Viral Hemorrhagic Septicemia (VHS) in fish and white nose syndrome in bats, have the potential to cause massive die-off within populations of wild species. The recent identification of VHS in round gobies, bullhead and sunfish in Lake Simcoe in June 2011 reinforces the Lake Simcoe Science Committee concern about human mediated movement of species between watersheds. While a new bait fish licensing regulation established January 1, 2012 prohibits the movement of baitfish into or out of the new Lake Simcoe Management Zone by commercial baitfish dealers, the Committee remains concerned about importation of invasive species and new diseases via other human activities. The Committee recommends measures be implemented as soon as possible to eliminate inter-watershed transport of wild, native and non-native species by all persons, where there is a potential risk to the recipient and donor native faunas both within and outside the Lake Simcoe watershed.

Recommendation 34 - Species Control and Infectious Diseases

Monitoring and prevention activities should be immediately directed to understand the occurrence and vectors of pathogens including waterborne diseases and diseases of aquatic and terrestrial species.

Climate Change

The advance of climate change has already had measurable effects on the Lake Simcoe watershed, for example, the length of time the lake is covered with ice has been reduced and will have important ecological and socio-economic impacts. Watershed components and features that will be affected by changing climate include water quality, water quantity, water use, species composition, terrestrial habitat quality, the occurrence and abundance of native and invasive species, fish spawning times and production, fishing opportunities, stream flow, and plant and animal diseases. Climate change is an emerging contemporary issue with consequences that will accumulate well into the future in ways yet to be fully understood.

Climate change affects essentially all physical, chemical and biological aspects of aquatic and terrestrial ecosystems at all spatial and temporal scales, which means that there are inevitably major knowledge and science gaps with regard to aquatic life, water quality and quantity and natural heritage features of the watershed. Understanding how to adapt to the changes that are emerging at the present time and anticipating those that will occur in the future, is an important part of implementing the Lake Simcoe Protection Plan. Ongoing collection of ecological and socio-economic information is essential to developing adaptive tactics and strategies for coping with future change. However, given limited research and monitoring resources, potential future climate scenarios must be very carefully evaluated and best bet adaptive strategies designed accordingly. Major conflicts can be expected, for example, between water supply and demand for support of critical ecosystem functions versus municipal, industrial, agricultural and recreational requirements.

Recommendation 35 - Adapting to Climate Change

Adaptation preparation would be greatly assisted by including:

a) The results of regionally relevant climate models, models that have been specifically revised to include local features such as the Great Lakes and Lake Simcoe which are climate modifiers. There is a need to identify the work that has been completed, to expedite work that is underway and to initiate new projects to fill gaps that remain; and

b) An analysis of long-term precipitation and runoff data to evaluate water supply to the watershed and delivery to the lake. Land use changes, especially increases in impermeable surfaces should be taken into account when interpreting runoff changes. Changing pattern of precipitation is a major factor in mass balance modelling of loadings of phosphorus and other nutrient and chemicals constituents.

Recommendation 36 - Review/Revision of Climate Change Plan

Similar to the adaptive management process embedded in the Lake Simcoe Protection Plan, the Climate Change Adaptation process should commit to a review and possible modification of the strategy, where necessary, within 5 years anticipating rapid accumulation of new scientific information and understanding.

Recreational Activities

The Lake Simcoe Science Committee continues to be involved with the development of the recreational strategy for the watershed as identified in policy 7.12 of the Lake Simcoe Protection Plan. Matters of particular interest to the Committee include:

- Pathogen source tracking, information needed to improve beach quality;
- Impact of boat use on shoreline erosion;
- Impacts of gray water discharges on water quality;
- Declining public access and restricted use of public docks;
- Impact of golf courses and sod farms on water use and nutrient applications; and
- Effects of climate change and other factors on socio-economic benefits of the recreational fisheries of the lake.

The subject of recreational activity, its continued quality, and its impacts, is an important public concern, with only limited information available to make scientifically-sound decisions.

Recommendation 37 - Reducing Coliform Counts

Steps should be taken to identify sources of coliform contamination and to reduce coliform levels at beaches and thus decrease the frequency and duration of beach closings in Lake Simcoe.

Recommendation 38 - Socio-economic Benefits of the Fisheries

The Lake Simcoe Science Committee should review and have input on climate change impacts on the socio-economic analysis of the benefits of aquatic life and valuation of the recreational fisheries of Lake Simcoe required under Policy 3.3 of the Lake Simcoe Protection Plan.

Chapter EIGHT Future Considerations and Implementation

The Lake Simcoe Science Committee looks to the future with very specific ideas of what it needs to do to effectively advise the Minister. The work plan for the upcoming year will be based on the needs identified in the past two years' deliberations, and the feedback it will receive from the Minister, senior staff, and the Lake Simcoe Coordinating Committee. Although the Committee currently consists of a comprehensive and multi-disciplinary group of experienced and knowledgeable individuals, there may be a need for some additional expertise in the area of terrestrial ecology.

The Committee would like to be invited to review all major policy documents relevant to Lake Simcoe as they are being developed, and be given appropriate time to discuss the documents.

Over the next year, the Committee will discuss a range of topics dealing with outstanding questions on the science of the Lake Simcoe Protection Plan and focus on operational issues related to implementation. These include:

- Assessment of management approaches in place for achieving the targets of the Lake Simcoe Protection Plan under scenarios of population growth forecast for the watershed (i.e. can we currently expect to meet loading targets, or natural vegetative cover targets with the projected population growth and form of settlement);
- Review the matter of environmental costs to justify investment;
- Evaluation of recent phosphorus loading data to interpret emerging trends and causal relationships; and to further advise on phosphorus reduction approaches and to inform the update of the Phosphorus Reduction Strategy;
- Review technological options for recovery and alternate use options of phosphorus from municipal waste water;
- Review options for treating stormwater and polder runoff as point sources and options for phosphorus removal and/or recovery;
- Evaluate stormwater management and the need for enhanced stormwater management guidelines in the Lake Simcoe watershed;
- Examine the atmospheric inputs of phosphorus to better understand loading sources, vectors and mitigation strategies;
- Review and provide recommendations on the Comprehensive Monitoring Program underway in the Lake Simcoe watershed. For example, terrestrial monitoring remains a key information gap; and a faster, more effective means of communicating results might be desirable;
- Track key implementation elements, including best management practices, stewardship programs, and research;
- Examine ways to better link information on natural features to municipal planning in the watershed;
- Review the effectiveness of protecting shoreline and terrestrial components through voluntary approaches and/or regulations;
- Review chloride loading to the lake and its inflowing tributaries, and road salt management approaches in the watershed;
- Review climate change modeling results in the watershed and future scenarios; and
- Identify priority research needs.

The Lake Simcoe Protection Plan mandates an adaptive approach for the management and protection of Lake Simcoe. Monitoring and research, including the regular analysis and reporting of results through the biennial Lake Simcoe Science Forum (Policy 8.12 of the Plan), is the cornerstone of an effective, adaptive management approach. Adaptive management means making adjustments when new information becomes available and as scientific knowledge advances, or if targets for the lake and its watershed are not met. The focus of the next Lake Simcoe Science Forum in 2013 should be translating the extensive new scientific knowledge that is available into recommendations for management actions.

Recommendation 39 - Allocate Resources for Comprehensive Monitoring Program

Allocate sufficient resources to fill the gaps in the Comprehensive Monitoring Program to:

a) initiate monitoring and evaluation immediately;

b) continue monitoring to ensure relevant data are analyzed and available for policy recommendations; and

c) ensure the monitoring results are effectively communicated and reported to all stakeholders.

Recommendation 40 - Focus of Lake Simcoe Science Forum 2013

The 2013 Lake Simcoe Science Forum should focus on applying science to inform management actions for the protection of Lake Simcoe.

The Lake Simcoe Science Committee wishes to emphasize the outstanding achievements to date of partnerships among science, management and community sectors at all levels and calls for continued and increased emphasis on development of partnerships of these kinds in the future. Throughout this process there has been significant progress made in connecting with Lake Simcoe scientists and community stakeholders. Further efforts must be given to transferring monitoring results and new best management practices in a useable medium and understandable form. We must understand the audience and work to transfer this knowledge so that people can effectively understand and apply this information.

Recommendation 41- Engage and Inform the Public

Engage and inform the public more effectively by:

a) Providing more information on the website on the activities of the Lake Simcoe Science Committee, such as: recommendations; action items and response tables; detailed description of what is to be done; and, when and how the policies are being implemented;

b) Obtaining more public feedback on actions through a web-based discussion forum or through a "public comments option" on the website, or similar approach; and

c) Communicating the monitoring results to all stakeholders in a timely, understandable, and geographically appropriate manner by ensuring this is a high priority task within the comprehensive monitoring program and stewardship program.