

Black River Subwatershed Plan

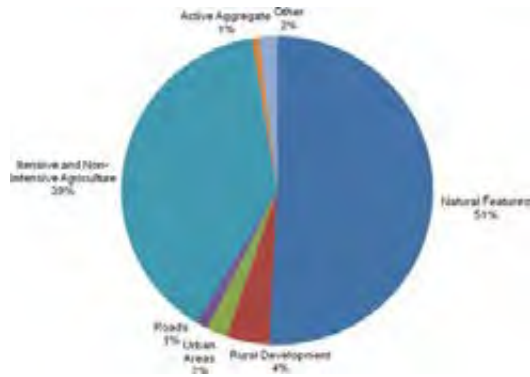


Lake Simcoe
Region
Conservation
Authority

2010

Executive Summary

The Black River subwatershed occupies 375 km² of lands south of the eastern portion of Lake Simcoe. With the headwaters originating on the Oak Ridges Moraine, the Black's watercourses flow mainly through natural features and agricultural areas throughout much of the system before reaching the community of Sutton and the outlet into Lake Simcoe. The subwatershed supports a high level of natural features, as well as a good deal of agriculture. The subwatershed jurisdiction is mainly within York Region, with a small portion falling within Durham Region. The municipalities that fall within its boundaries are Georgina, East Gwillimbury, Whitchurch-Stouffville, and Uxbridge.



Land use distribution in the Black River subwatershed

The land within the Black River subwatershed provides a number of benefits to the river, to Lake Simcoe, and to its residents and visitors. The 50% of subwatershed area that is occupied by natural areas, including a high percentage of wetland, absorb rain and snow melt, maintaining groundwater levels and baseflow, helping to prevent flooding and erosion, and improving water quality. These areas also provide habitat for a wide variety of species, as well as numerous nature-based recreation opportunities. In addition, the Black's agricultural areas, which occupy close to 40% of the subwatershed, provide a close-to-market supply of fresh vegetables, as well as opportunities for infiltration. The Black's natural

features and greenspaces provide its urban residents with the connection with nature that so many of them value. In a study undertaken to estimate the value of the services provided by the subwatershed's ecosystem, it was found that it would cost close to \$180 million to replace these natural services with man-made solutions. Given the immense intrinsic and monetary value of the subwatershed's features, the development of this subwatershed plan is an important step in ensuring that these services continue to be performed economically, while balancing the other demands on the subwatershed such as urban growth, agriculture, industrial, and recreational uses in a truly integrated fashion.

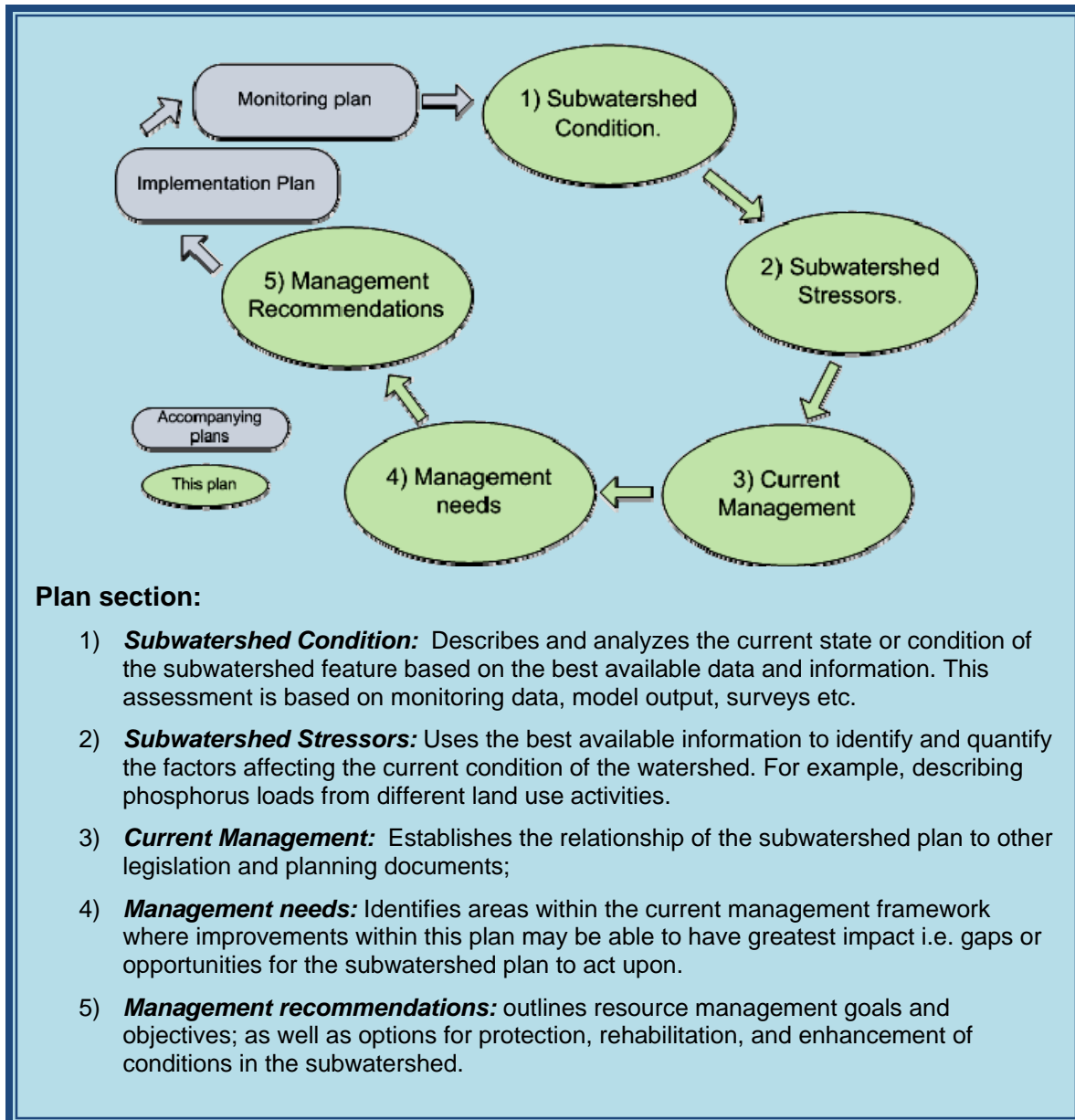
In spite of the benefits provided by its natural areas, the Black River is showing some signs of stress from anthropogenic land uses. For example, in the 2008 Watershed Report Card, the Black River received low grades for the amount of urban area with stormwater controls, and the fish community received a 'C' grade. In addition, phosphorus concentrations in the subwatershed regularly exceed the provincial water quality objective. Much of the stress in the subwatershed can be attributed to the very large extent of agricultural land use in the subwatershed, as well as several urban areas located throughout the system, such as Mount Albert and Sutton. Impacts from the agricultural areas include the removal of riparian vegetation, the input of sediment-laden sediment which impacts both water quality and the habitat of fish and benthic invertebrates, the use of large volumes of water for irrigation, channelization, and the rapid conveyance of stormwater directly to area watercourses by tile drainage. In the Black's urban areas, impacts from the high level of impervious surfaces include decreased infiltration of rain and melt water, which can result in low groundwater levels and reduced baseflow in area watercourses; impacts to water quality as contaminants are carried with stormwater runoff; instability and erosion of streambanks and other geomorphological impacts; effects on stream habitat such as sediment deposition or disruption of natural riffle-pool sequences, resulting in changes to the composition of aquatic communities; and impacts on biodiversity. These impacts

can be particularly detrimental in those areas of the subwatershed that lack stormwater controls, which are prevalent in this subwatershed. In addition, there are issues associated with other activities in the subwatershed such as recreation and industrial uses, including water consumption, the introduction of invasive species, and the input of nutrients and other contaminants into area watercourses. Another source of stress in the subwatershed is the removal of wetlands for peat extraction. The cumulative effects of these activities have caused some impacts in this fairly healthy subwatershed.

There have been some successes in addressing some of the concerns in the Black River subwatershed. Initiatives such as the completion of streambank erosion control projects, tree plantings, establishment of riparian vegetation, and other BMPs will help to improve conditions with respect to bank stability, water quality and quantity, and aquatic and terrestrial natural heritage in the subwatershed.

The Black River subwatershed is scheduled to experience some growth in the coming years; the Provincial Places to Grow Plan identifies that population and employment growth will occur in the Lake Simcoe watershed. Provincial growth forecasts have been allocated to all municipalities in the Region. In the Black River subwatershed, both the communities of Sutton and Mount Albert are expected to grow, though the population is not expected to increase as dramatically as in other subwatersheds in York Region. However, along with the housing that will have to be built to accommodate these new subwatershed residents, new employment lands, shopping centres, and schools will also be required to meet their needs. In addition to the above, in order to service these increases in population and employment, critical municipal infrastructure projects, including roads, municipal sewers and treatment facilities and water supply systems will also need to be built, maintained and expanded in the subwatershed. This will result in increased levels of impervious surfaces and its associated impacts, combined with a reduction in the natural features that help to mitigate these impacts. These changes, as well as the unknown impacts that climate change may bring to the subwatershed, will have a significant effect on the health of the subwatershed if measures are not taken to mitigate them.

To build on the successes of the projects initiated so far, and to mitigate impacts of the changes that are to come, a comprehensive, integrated subwatershed plan is needed for the Black River subwatershed. The plan that follows is intended to provide the blueprint for the conservation authority, the municipalities, and subwatershed stakeholders to move forward and continue the important work that has been completed in order to mitigate the impacts of land use changes and improve conditions in the subwatershed. It includes chapters dedicated to each of five subwatershed parameters, these being water quality, water quantity, aquatic habitat, fluvial geomorphology and terrestrial natural heritage, although it is acknowledged that all of these parameters are related and certainly interact with each other. Each chapter is loosely structured around a state-pressure-response framework, in that each chapter firstly describes the current condition (state), secondly describes the stressors likely leading to the current condition (pressure), and finally recommends management responses in the context of the current management framework (response) (See text box below).



The management responses (high level recommendations) fall into eight broad categories, these being:

- A. Planning and Policy
- B. Use of Better Management Practices
- C. Changing the Way Things Are Done 'On the Ground'
- D. Applied Research and Science
- E. Monitoring (Surveillance, Compliance, and Reporting)
- F. Management, Rehabilitation, and Restoration
- G. Adaptive Response (Climate, Social, Political)
- H. Communications

From these recommendations fall a number of detailed recommendations, the implementation of which will help to meet the plan's goals and objectives. These detailed recommendations will form the implementation plan, a document which will assign responsibilities, develop timelines, estimate costs, and set priorities for undertaking the actions that will need to be taken in the Black River subwatershed. Input from the subwatershed municipalities, conservation authority staff, stakeholders and members of the public will be incorporated through the process of developing the implementation plan. Implementing the recommended actions of this plan is a huge undertaking with respect to both the funding and human resources that will be needed, and will require assistance from all of these subwatershed partners.

Undertaking the actions outlined in the implementation plan will help to protect the existing natural resources, facilitate informed planning decisions, and improve the efficiency of the development review process. An over-arching concept to keep in mind throughout the subwatershed planning process is that it is far more beneficial, both financially and ecologically, to protect resources from degradation than to rehabilitate them once they have been damaged. These plans support this concept, and provide alternatives for instances where it may not be possible to maintain the Black's resources in their natural state.

The implementation plan will identify actions to be undertaken in both the short and the long term. However, the subwatershed plan will be reviewed on a regular basis as part of the adaptive management framework to ensure the effectiveness of the actions being undertaken. Depending on the state of the subwatershed the subwatershed and implementation plan may be updated at that point in order to incorporate the most up to date information on the subwatershed state and to incorporate any new tools and practices that may be used. By undertaking these regular evaluations and updates, the partners can ensure that all of the necessary steps are being taken in order to achieve the goal of a maintaining a healthy Black River subwatershed.

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1 Approach and Management Setting

1.1 Introduction

The Black River subwatershed is located south of Lake Simcoe in approximately the centre of the watershed. The subwatershed occupies an area of approximately 37,536 ha. The main tributaries of the subwatershed include Harrison Creek, Mount Albert Creek, Vivian Creek and Zephyr Creek. As with many of the subwatersheds south of Lake Simcoe, the headwaters of the Black River originate in the Oak Ridges Moraine.

The Black River is one of the healthiest systems in the Lake Simcoe watershed. It has a high level of natural cover, just over 50%. Thirty-eight percent of this natural cover is occupied by forested lands. Of the lands that have been subject to alteration by humans, agriculture is the main land use, and there is a small amount of urban development. Areas of both York and Durham Regions lie within the subwatershed, which contains portions of the Towns of Whitchurch-Stouffville, East Gwillimbury, Georgina, and Uxbridge. The communities that can be found within the subwatershed include Sharon, Holt, Mount Albert, Zephyr, Brown Hill, Baldwin, and Sutton. While a relatively large percentage of natural cover remains in the subwatershed, the ecosystem has felt the impact of human activities associated with changes in land use and development.

Some of the issues identified in the Black River subwatershed include impacts to water quality from both agricultural and urban land uses, issues with stream stability associated with land use changes, several dams and other barriers, the extraction of peat from wetlands, and some losses of coldwater habitat. This plan will discuss these issues and offer potential solutions for protecting and improving conditions in this subwatershed.

The land uses in the subwatershed have had impacts on the health of its ecosystem. Water quality and quantity have deteriorated due to the inputs of harmful substances from both urban and rural areas and because of the increasing amount of impervious area in this subwatershed. The stability of the subwatershed's watercourses has also been impacted due to these changing land uses.

In order to mitigate the impacts of land use changes in a subwatershed, and to prevent future impacts, subwatershed plans are developed. These plans provide a framework for the implementation of remedial activities and a focus for community action. More importantly, they prevent further serious degradation to the existing environment and can reduce the need for expensive rehabilitation efforts. Subwatershed plans provide a framework within which sustainable development can occur.

As part of the requirements through the Oak Ridges Moraine Conservation Act and Conservation Plan Regulation (ORMCP, O.Reg. 140/02, S. 24), all municipalities with subwatersheds originating on the Oak Ridges Moraine (ORM) are required to develop a subwatershed plan for each. York Region has commissioned the Lake Simcoe Region Conservation Authority to complete these plans for their subwatersheds. The four York Region subwatersheds that originate on the ORM are the West and East Holland Rivers, Maskinonge River, and the Black River. The watershed planning requirements of the Act and Conservation Plan Regulation represent an opportunity to strengthen a long established watershed management partnership between the Regional Municipality of York and its two conservation authorities. York Region has gone beyond their requirements under the ORMCP with the development of these subwatershed plans for the entire subwatershed area, not just the portion that lies on the Oak Ridges Moraine.

1.2 Black River Subwatershed Planning Process

1.2.1 Oak Ridges Moraine Conservation Plan

The Oak Ridges Moraine Conservation Plan (ORMCP) was developed in 2001, and is an ecologically based plan that provides land use and resource management direction for the 190,000 hectares of land and water that fall on the Oak Ridges Moraine (ORM), 8,056 ha of which falls within the Black River subwatershed. The ORM is one of Ontario's most significant landforms. It stretches from the Trent River in the east to the Niagara Escarpment in the west and divides the subwatersheds draining south into Lake Ontario from the subwatersheds draining north to Lake Simcoe. It has a unique concentration of environmental, geological, and hydrological features that make its ecosystem vital to south-central Ontario, including:

- Clean and abundant water sources
- Healthy and diverse plant and animal habitat
- An attractive and distinct landscape
- Prime agricultural areas
- Sand and gravel resources close to market.

Because of its location across the Greater Toronto Area, the ORM is under increasing pressure for new residential, commercial, industrial, and recreational uses which compete with the present natural environment. The Oak Ridges Moraine Conservation Plan provides land use and resource management planning direction to provincial ministers, ministries, and agencies, municipalities, municipal planning authorities, landowners and other stakeholders on how to protect the Moraine's ecological and hydrological features and functions.

1.2.2 Subwatershed Planning Context

This subwatershed plan has been written firstly to comply with the requirements under the ORMCP. However there are other documents that have influenced and fed into the development of this plan and its recommendations. The LSRCA's Integrated Watershed Management Plan (2008) and the Province's Lake Simcoe Protection Plan (2009) are the two main documents aside from the ORMCP that have guided this plan's development.

The Integrated Watershed Management Plan, released by the Lake Simcoe Region Conservation Authority in 2008, was intended to be a roadmap to provide future direction for the protection and rehabilitation of the Lake Simcoe watershed ecosystem. Its broad-scale recommendations for the Lake Simcoe watershed provided the basis for a number of this plan's recommended actions for the smaller scale Black River subwatershed; these two reports are meant to complement each other.

The Lake Simcoe Protection Plan, released by the Province in 2009, aims to be a comprehensive plan to protect and restore the ecological health of the lake and its subwatershed. Its priorities include restoring the health of aquatic life, improving water quality, maintaining water quantity, improving ecosystem health by protecting and rehabilitating important areas, and addressing the impacts of invasive species, climate change, and recreational activities. This subwatershed plan aims to be consistent with the themes and policies of the Lake Simcoe Protection Plan to ensure a consistent approach is being taken by all of the partners toward improving watershed health.

This subwatershed plan also aims to complement and be supportive of the policies of the applicable upper tier municipal official plans and the related municipal programs that strive to achieve similar outcomes related to subwatershed health.

Figure 1-1 depicts the relationship between this subwatershed plan and the documents that have guided and contributed to its development. It also depicts the implementation plan, which will provide details of a plan to undertake the recommended actions.

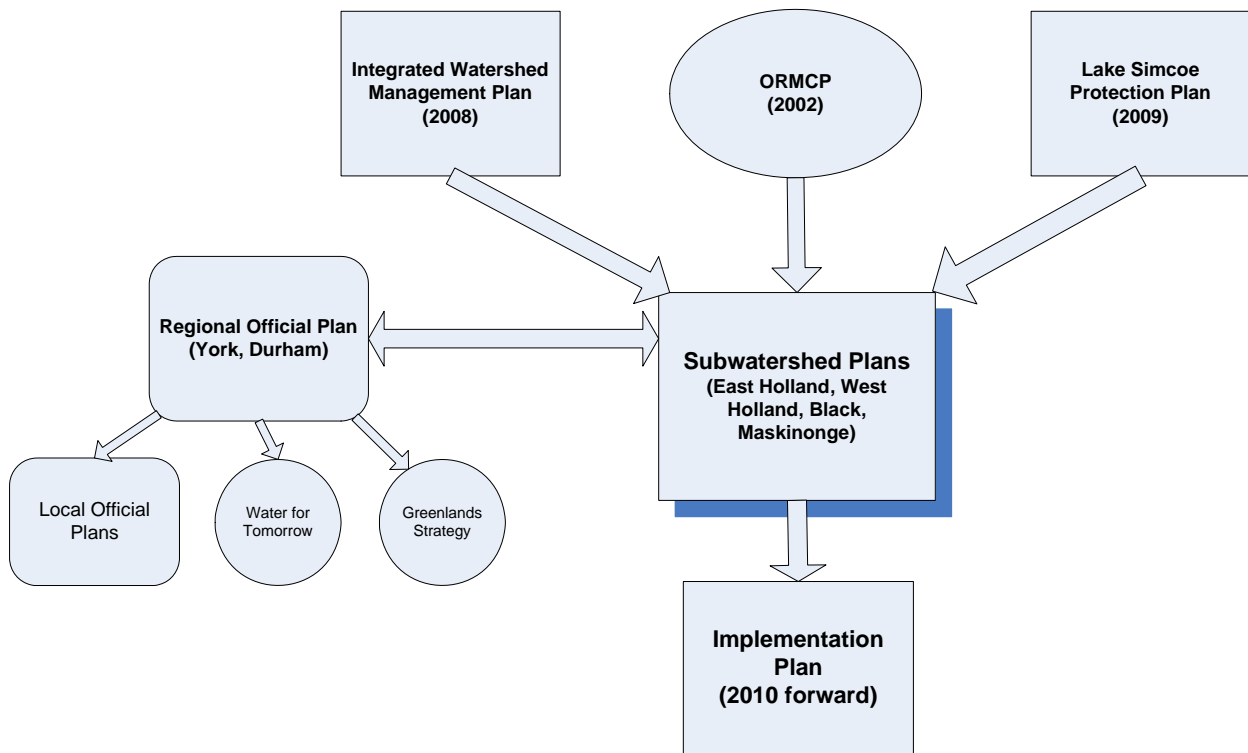


Figure 1-1 Subwatershed planning context

1.2.3 Subwatershed Planning Process

The Lake Simcoe Region Conservation Authority (LSRCA) has adopted a holistic approach to completing subwatershed plans to ensure compliance with ORMCP instead of managing one subwatershed at a time. This method ensures the completion of a comprehensive and consistent ORMCP subwatershed plan while maximizing efficiencies and funding. It also provides a one window approach for broader public consultation and the future development of policies and land use designations.

The initial focus of the subwatershed planning exercise has involved the completion and summarization of subwatershed characterization work. It also involved the development of water quality, quantity, aquatic, and terrestrial habitat models to assess the environmental impacts associated with potential changes in the landscape. This important information is then incorporated into the process of formulating management options and recommendations for the subwatershed plans.

The ecosystem approach to environmental management takes into consideration all of the components of the environment. These components include the movement of water through the system, the land use, climate, geology, and all of the species that comprise the community living in the system. These ecosystem components are all intricately related, and changes in any can have significant effects on the others.

To manage natural resources using an ecosystem approach it is essential to establish biophysical boundaries. In the Lake Simcoe watershed, the subwatersheds or river systems that drain into the lake have been identified as the best “fit” for the implementation of an ecosystem study because they are virtually self-contained water-based ecosystems (OMOE and OMNR, 1993). Watersheds are defined as the area of land drained by a watercourse and, subsequently, the land draining to a tributary of the main watercourse (Lake Simcoe is the “main watercourse” in this case) is called a subwatershed. Watershed processes are controlled by the hydrologic cycle (Figure 1-1). The movement of water influences topography, climate, and life cycles. It is due to this connectivity that any change within the watershed will impact other parts of the subwatershed.

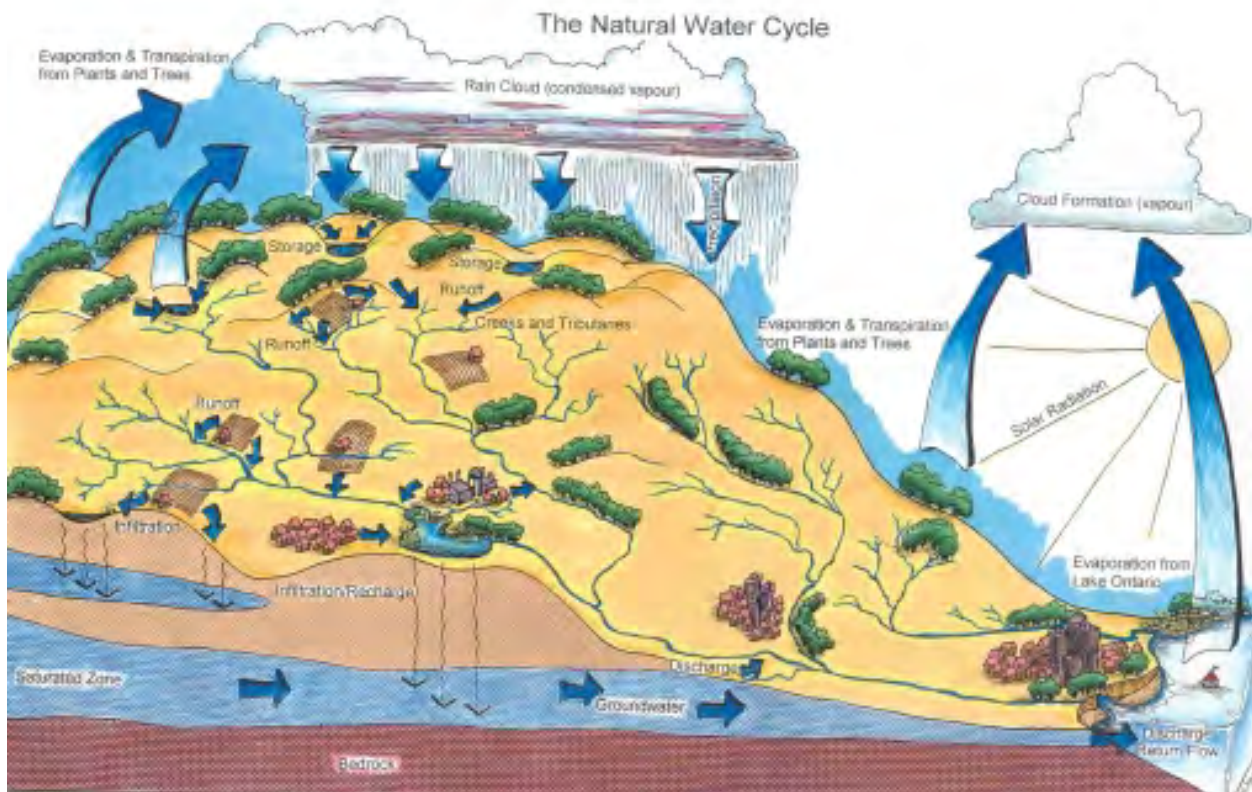


Figure 1-1 The hydrological cycle (image courtesy of Conservation Ontario)

1.3 Current Management Framework

In addition to meeting the requirements of the ORMCP, the goals and management recommendations offered in this plan have been developed in context of the other existing legislation and their associated plans and policies. There are many regulations related to the protection and restoration of Lake Simcoe and its subwatersheds, and obviously each of these acts and associated plans differ, although in some cases policies do overlap. The manner in which regulations differ include: (1) the number and types of watershed activity they have authority over. For example some regulations have a very broad mandate, regulating many activities (e.g. the Greenbelt Plan) while others are very specific (e.g. The Endangered Species Act); (2) the legal effect of policies they contain—policies fall into two broad categories, those legally requiring conformity, and those with no legal requirement but stating the need to “have regard for”; (3) the geographic area they represent—most cover the entire Lake Simcoe basin, however the Greenbelt Act and the ORMCP have defined geographic boundaries which do not

follow subwatershed boundaries; and (4) the degree of implementation—many aspects of more recent legislation such as the Lake Simcoe Protection Plan still need to be acted upon. Each chapter of this subwatershed plan provides a more detailed assessment of the legislation and associated policies related to that particular subwatershed feature (e.g. water quantity or aquatic habitat).

The key pieces of legislation, regulations and plans that form the planning framework in the subwatershed are described below. This is not a comprehensive list of all of the pieces that apply in the subwatershed, but rather those that are most influential of environmental conditions in the area.

1.3.1 Oak Ridges Moraine Conservation Plan

The province of Ontario developed the Oak Ridges Moraine Conservation Plan (ORMCP), after recognizing the vital importance of this feature to southern Ontario and the intense pressure that was being placed on it. The authority to establish the ORMCP comes from the Oak Ridges Moraine Conservation Act (2001), which established objectives for the plan.

The ORMCP is an ecologically-based plan that was established to provide land use and resource management direction for the land and water within the Moraine. The government's vision for the Oak Ridges Moraine is that of "a continuous band of green, rolling hills that provides form and structure to south-central Ontario, while protecting the ecological and hydrological features and functions that support the health and well-being of the region's residents and ecosystems". To achieve this vision, the ORMCP sets out a number of objectives:

- a) protecting the ecological and hydrological integrity of the Oak Ridges Moraine Area;
- b) ensuring that only land and resource uses that maintain, improve or restore the ecological and hydrological functions of the Oak Ridges Moraine Area are permitted;
- c) maintaining, improving or restoring all the elements that contribute to the ecological and hydrological functions of the Oak Ridges Moraine Area, including the quality and quantity of its water and its other resources;
- d) ensuring that the Oak Ridges Moraine Area is maintained as a continuous natural landform and environment for the benefit of present and future generations;
- e) providing for land and resource uses and development that are compatible with the other objectives of the plan;
- f) providing for continued development within existing urban settlement areas and recognizing existing rural settlements;
- g) providing for a continuous recreational trail through the Oak Ridges Moraine Area that is accessible to all including persons with disabilities;
- h) providing for other public recreational access to the Oak Ridges Moraine Area; and
- i) any other prescribed objectives.

The ORMCP contains four land use designations: Natural Core Areas, Natural Linkage Areas, Countryside Areas, and Settlement Areas.

Natural Core Areas – the protection of these lands, which contain the greatest concentrations of key natural heritage features, is vital to maintaining the integrity of the Moraine. Aside from existing uses, the only uses that will be permitted in these areas are resource management, agriculture, low intensity recreation, home businesses, transportation and utilities.

Natural Linkage Areas – these protect natural and open space linkages between the Natural Core Areas and along rivers and streams. The uses permitted in the Natural Core Areas are also permitted in Natural Linkage Areas, as are some aggregate resource operations.

Countryside Areas – these areas are intended to provide an agricultural and rural transition and buffer between the Natural Core and Linkage Areas and Settlement Areas. Prime agricultural areas and natural features are protected.

Settlement Areas – these include existing communities; urban uses and development as set out in municipal official plans are allowed.

The policies of the ORMCP provide protection for key natural heritage features and hydrologically sensitive features throughout the plan area

The *Oak Ridges Moraine Conservation Act, 2001* directs municipalities to bring their Official Plans into conformity with the ORMCP and to ensure that the planning decisions they make conform to the Plan. The policies include:

- Strict limitations on the activities that can be undertaken in Natural Core and Natural Linkage Areas
- Protecting key natural heritage features and hydrologically sensitive features by setting out minimum vegetation protection zones and minimum areas of influence around the features. Most activities are not permitted in minimum vegetation protection zones, and applicants are required to demonstrate that activities within the minimum area of influence will have no negative impact on the feature
- Requiring planning, design and construction practices that will maintain, improve, or restore the health, diversity, size, and connectivity of features on the moraine for developments adjacent to these features
- Municipalities are required to develop subwatershed plans (i.e. this plan) for river systems originating on the Moraine, including a water budget and conservation plan, land and water use and management strategies
- The protection of water quality and quantity
- Protection for landform conservation areas (such as steep slopes, kames, kettles, ravines, and ridges)

This subwatershed plan will satisfy the requirements of the ORMCP for both watershed planning (Section 24) and water budgets and conservation plans (Section 25).

1.3.2 Greenbelt Plan

Faced with intense growth pressures on the Greater Golden Horseshoe and its potential impacts to this area's rural and environmental resources, the Province created the Greenbelt Act in 2005. This Act authorizes the Lieutenant Governor in Council, by Regulation, to designate an area of land as the Greenbelt Area, and to establish a Greenbelt Plan for all or part of the Greenbelt Area. The Plan describes the Greenbelt as a broad band of permanently protected land which:

- Protects against the loss and fragmentation of the agricultural land base and supports agriculture as the predominant land use
- Gives permanent protection to the natural heritage and water resource systems that sustain ecological and human health and that form the environmental framework around which major urbanization in south-central Ontario will be organized; and

- Provides for a diverse range of economic and social activities associated with rural communities, agriculture, tourism, recreation and resource uses.

The Greenbelt includes lands within, and builds upon the ecological protection provided by, the Oak Ridges Moraine Conservation Plan.

The Plan identifies goals for the Protected Countryside area of the Greenbelt around Agricultural Protection; Environmental Protection; Culture, Recreation and Tourism; Settlement Areas; and Infrastructure and Natural Resources. The Environmental Protection goals are the most applicable to this subwatershed plan, and include:

- Protection, maintenance and enhancement of natural heritage, hydrologic and landform features and functions, including protection of habitat for flora and fauna and particularly species at risk;
- Protection and restoration of natural and open space connections between the Oak Ridges Moraine, the Niagara Escarpment, Lake Ontario, Lake Simcoe and the major river valley lands, while also maintaining connections to the broader natural systems of southern Ontario beyond the Greater Golden Horseshoe;
- Protection, improvement or restoration of the quality and quantity of groundwater and surface water and the hydrological integrity of watersheds; and
- Provision of long-term guidance for the management of natural heritage and water resources when contemplating matters including development and private or public stewardship programs

The Greenbelt Plan delineates a number of policy areas within the Protected Countryside, these are an agricultural system, which is comprised of specialty crop areas, prime agricultural areas, and rural areas; the Natural System, which contains the Natural Heritage System, Water Resource System, and key natural heritage features and key hydrologic features; and Settlement Areas, which are comprised of Towns/Villages and Hamlets.

Policies for the Natural System protect areas of natural heritage, hydrologic and/or landform features, which are often functionally inter-related and which collectively support biodiversity and overall ecological integrity of the system. These policies:

- Restrict the land uses that can be undertaken within key natural heritage and hydrologic features
- Protect important features from the impacts of development and site alteration and encourage improvement or restoration of features wherever possible
- Promote connectivity between features
- Protect, improve or restore the quality and quantity of water

Ninety-eight percent (just under 37,000 ha) of the Black River subwatershed lies within the Greenbelt Act area; this area is therefore subject to the policies of the plan.

1.3.3 Lake Simcoe Protection Plan

As part of the Ontario government's overall strategy to protect and restore the ecological health of the Lake Simcoe watershed, the Lake Simcoe Protection Act was introduced and passed by the legislature in 2008, receiving Royal Assent in December of that year. This Act provides authority for the establishment of and amendments to a Lake Simcoe Protection Plan. The Lake Simcoe Protection Plan (LSPP), which was released in June 2009, contains a wide variety of

objectives to achieve their vision of a healthy lake with healthy communities and people as well as a healthy economy. These objectives, as set out in the Lake Simcoe Protection Act, include:

- protecting, improving or restore the elements that contribute to the ecological health of the watershed, including water quality, hydrology, key natural heritage features and their functions, and key hydrologic features and their functions;
- restoring a self-sustaining coldwater community in the lake;
- reducing loads of phosphorus and other nutrients of concern and reducing the discharge of pollutants;
- responding to the effects of invasive species and, wherever possible, preventing their introduction into the watershed;
- providing for ongoing research and monitoring in the watershed;
- improving conditions for environmentally sustainable recreation activities, and promoting these activities; and
- building on the protections offered by existing legislation in the watershed.

The LSPP contains policies related to a number of critical issues: restoring the health of aquatic life in the watershed; improving water quality, maintaining water quantity; improving the health of the ecosystem by protecting and rehabilitating important areas such as shorelines and natural heritage; and addressing the impacts of invasive species, climate change, and recreational activities. The Plan takes a subwatershed approach to the activities that will need to be undertaken to improve conditions in the watershed. This approach will help to determine priorities in different areas of the watershed, depending on the conditions and issues in each subwatershed.

In addition to prescribing the development of the Lake Simcoe Protection Plan, the Lake Simcoe Protection Act established two advisory committees, the Lake Simcoe Science Committee and the Lake Simcoe Coordinating Committee, to facilitate the development and implementation of the Lake Simcoe Protection Plan.

The Lake Simcoe Science Committee, which is composed of scientific experts in watershed protection issues, is responsible for reviewing the environmental conditions of the watershed and to advise on the ecological health of the Lake Simcoe watershed and the current and potential threats to the ecological health, as well as to identify the scientific research that should be undertaken to support the implementation of the Plan. This committee may also be asked to advise on the design and implementation of monitoring programs to track whether the Plan is meeting its objects; proposed amendments to the Plan; and proposed regulations made under the Lake Simcoe Protection Act.

The functions of the Lake Simcoe Coordinating Committee will include:

- Providing advice to the Minister on Plan implementation and any issues or problems related to Plan implementation
- Providing advice to the Minister on the types of measures that could be taken to deal with threats to the ecological health of the watershed
- Assisting in monitoring progress on Plan implementation.

This committee will be comprised of representatives from across the watershed, including representatives from municipalities, Aboriginal communities, the LSRCA, the Province, the

agricultural, commercial and industrial sectors, interest groups, environmental organizations, and the public.

1.3.4 Provincial Policy Statement

The Provincial Policy Statement (PPS), issued under the authority of Section 3 of the Planning Act (1990), provides direction on matters of provincial interest related to land use planning and development, and promotes the provincial “policy-led” planning system. The PPS recognizes the complex inter-relationships among economic, environmental and social factors in planning and embodies good planning principles. It includes policies on key issues including the efficient use and management of land and infrastructure; protection of the environment and resources; and ensuring appropriate opportunities for employment and residential development, including support for a mix of uses.

The PPS was updated in 2005, with the intent of providing strong, clear policy direction on land-use planning to promote strong communities, a clean and healthy environment, and a strong economy.

1.3.5 Nutrient Management Act

The Nutrient Management Act, approved by the Ontario legislature in 2002, was developed by the Ministries of the Environment and Agriculture and Food and Rural Affairs as part of the provincial government's Clean Water Program. Its intent is to provide for the management of materials containing nutrients in ways that will enhance the protection of the natural environment and provide a sustainable future for agricultural operations and rural development. The NMA specifies requirements for the development of Nutrient Management Plans or Strategies for farms that generate and/or store over 300 ‘nutrient units’ of manure. These plans include information on how and where the manure is stored, how it is applied, as well as contingency plans for issues that may arise, such as inclement weather preventing the spreading of manure on fields. The implementation of these plans will help to protect water quality from contamination from nutrients, particularly phosphorus, as well as bacteria such as *E. coli*.

1.3.6 Environmental Protection Act

The purpose of the Environmental Protection Act (EPA), approved by the Ontario legislature in 1990, is to provide for the protection and conservation of the natural environment. The EPA contains policies and restrictions around the discharge of contaminants and pollution, and the management of waste and litter. It gives the Ministry of the Environment a number of powers, such as requiring an operation to have in place equipment and/or controls in order to prevent the release of contaminants or minimize the impacts from such a release, and issuing control orders in the case of a release of a contaminant in levels above that specified by the regulations.

1.3.7 Ontario Water Resources Act

The purpose of this Act is to provide for the conservation, protection and management of Ontario's waters and for their efficient and sustainable use, in order to promote Ontario's long-term environmental, social and economic well-being. This is accomplished through policies around activities including the construction of wells, stormwater and sewage works, preventing the impairment of water quality, water takings, and water transfers. It is through this Act that the Ministry of the Environment issues Permits to Take Water for non-domestic water takings over 50,000 L/day and Certificates of Approval for stormwater management facilities and sewage treatment plants.

1.3.8 Growth Plan for the Greater Golden Horseshoe

The Growth Plan for the Greater Golden Horseshoe was prepared under the Places to Grow Act (2005). The Growth Plan provides a framework for implementing the government of Ontario's vision for building stronger, prosperous communities by better managing growth in the Greater Golden Horseshoe to 2031. The Growth Plan is aimed at avoiding the negative aspects of growth, such as deteriorating air and water quality and the disappearance of agricultural lands and natural resources. The plan provides improvements in the ways in which our urban areas will grow over the long term, and guides decisions on a wide range of issues such as transportation and infrastructure planning, land-use planning, urban form, and natural heritage and resource protection, all in the interest of promoting economic prosperity.

The Growth Plan builds on the Greenbelt Plan, Planning Act reform and the PPS. It works within the existing planning framework to provide growth management policy direction for the area.

This plan seeks to address the challenges of urban sprawl through policy directions that:

- direct growth to built-up areas;
- promote transit supportive densities and community infrastructure to support growth;
- ensuring sustainable water and wastewater services are available to support future growth;
- identify natural systems and prime agricultural areas, and enhance the conservation of these resources; and
- supports the protection and conservation of water, energy, air, and cultural heritage, as well as integrated approaches to waste management.

The Guiding Principles of the Growth Plan are to:

- Build compact, vibrant and complete communities
- Plan and manage growth to support a strong and competitive economy
- Protect, conserve, enhance and wisely use the valuable natural resources of land, air and water for current and future generations
- Optimize the use of existing and new infrastructure to support growth in a compact, efficient form
- Provide for different approaches to managing growth that recognize the diversity of communities in the GGH
- Promote collaboration among all sectors – government, private and non-profit –and residents to achieve the vision.

1.3.9 Clean Water Act

The Clean Water Act (CWA), approved by the Ontario legislature in 2006, was developed to protect drinking water at its source, as part of the Province's overall commitment to safeguard human health and the environment. It was established to implement the recommendations of the Walkerton Inquiry, in which Justice Dennis O'Connor set out the concept of a multi-barrier approach to safe drinking water. The protection of sources of drinking water in the lakes, rivers and underground aquifers of Ontario comprises the first barrier. Source protection complements the other components of the multi-barrier approach, which include effective water treatment, secure distribution systems, monitoring programs, and responses to adverse test results, by reducing the risk that water is contaminated in the first place.

This Act is being implemented on a watershed scale, with most areas using existing conservation authority boundaries. The LSRCA is leading the initiative for the South Georgian Bay Lake Simcoe Source Protection planning region. The Source Protection process involves four stages:

- Stage 1: establishing source protection authorities and committees, and negotiating a terms of reference
- Stage 2: conducting an identification and assessment of the threats to drinking water in the source protection region and preparing an assessment report
- Stage 3: the preparation of a source protection plan, which will include policies to address significant threats to drinking water
- Stage 4: implementation of the source protection plans, including inspection and enforcement of the plan's policies, monitoring and reporting on progress, and reviewing the plan

It is expected that the process will be completed in 2012.

1.3.10 Endangered Species Act

The Endangered Species Act was approved by the Ontario legislature in 2007 and came into effect in 2008. This Act provides protection to Ontario's species at risk – those identified on the Species at Risk in Ontario list as extirpated, endangered, threatened or special concern. The Act recognizes the ecological, social, economic, cultural and intrinsic value of biodiversity, and that it is often human activities that put these species at risk. The Act provides protection to the species and their habitats, and also requires the development of recovery strategies once a species has been identified as being at risk. The implementation of these recovery strategies will help to protect the important habitats of these species, and enhance biodiversity in the subwatershed.

1.3.11 Fisheries Act

The *Fisheries Act* is a piece of federal legislation that dates back to confederation; it was established to manage and protect Canada's fisheries resources. The Act applies to all inland waters, and supersedes any provincial legislation.

The *Fisheries Act* contains a number of policies related to the protection and preservation of fish habitat, the most important of these being Section 35, a general prohibition of the harmful alteration, disruption or destruction of fish habitat, unless an authorization is issued. Under a Level III agreement between the LSRCA and Fisheries and Oceans Canada, LSRCA is responsible for reviewing applications and administering authorizations within the Lake Simcoe basin.

Under the Act, fish habitat includes "spawning grounds and nursery, rearing, food supply, and migration areas on which fish depend directly or indirectly to carry out their life processes." In order to protect fish habitat there is a hierarchy of management options including (in order of preference) relocation of the project, redesign, mitigation of the impact, and finally habitat compensation. Applicants must pursue location and design options which will avoid impacts to fish habitat before authorizations will be considered.

1.3.12 Conservation Authorities Act and the Role of the LSRCA

Delegated Responsibility to Represent Provincial Interest in Natural Hazards

Conservation Authorities (CAs) have delegated responsibilities to represent provincial interests regarding natural hazards encompassed by Section 3.1 of the Provincial Policy Statement, 2005 (PPS, 2005). These delegated responsibilities require CAs to review and provide comments on policy documents (Official Plans and comprehensive zoning by-laws) and applications submitted pursuant to the Planning Act as part of the Provincial One-Window Plan Review Service. In 2001, Conservation Ontario, the organization representing Ontario's 36 Conservation Authorities, signed a Memorandum of Understanding with the Ministry of Natural Resources and the Ministry of Municipal Affairs and Housing that defined the roles of and responsibilities of each agency with respect to delegated responsibilities for natural hazards.

Watershed Based Resource Management Agency

Conservation Authorities, as 'public bodies' pursuant to the Planning Act, are to be notified of policy documents and planning and development applications as prescribed under the Act. CAs may comment as per their mandate to the municipality/planning approval authority on these documents and applications. In this role, the CA is responsible to represent its program and policy interests as a watershed based resource management agency. In this regard, CAs operating under the authority of the CA Act, and in conjunction with municipalities, develop business plans, watershed plans and natural resource management plans within their jurisdictions (watersheds). These plans may recommend specific approaches to land use and resource planning and management that should be incorporated into municipal planning documents and related development applications in order to be implemented.

Planning Advisory Service to Municipalities

CAs may perform a technical advisory role to municipalities, as determined under the terms of a service agreement with participating municipalities which may include, but is not limited to, matters related to the assessment or analysis of environmental impacts associated with activities near or in the vicinity of sensitive natural features such as wetlands, river and stream valleys, fish habitat or significant woodlands; hydrogeology and storm water studies; and, in some cases, septic system reviews. By providing planning advisory services for the review of Planning Act applications, Conservation Authorities and municipalities can ensure the implementation of a comprehensive resource management program on a watershed basis.

The planning advisory service agreements allow the Conservation Authority the opportunity to provide advice to the municipality on the interpretation of the Provincial Policy Statement (PPS). With the exception of natural hazards for which Conservation Authorities have delegated responsibility to represent the provincial interest, this advice is not represented as a "provincial position".

Regulatory Responsibilities

CA Act Regulations: In participating in the review of development applications under the Planning Act, Conservation Authorities will (i) ensure that the applicant and municipal planning authority are aware of the Section 28 regulations and requirements under the CA Act, and, (ii) assist in the coordination of applications under the Planning Act and the CA Act to eliminate unnecessary delay or duplication in the process.

LSRCA Watershed Development Policies

In order to protect the environmental integrity of the Lake Simcoe watershed to the extent of its jurisdictional capabilities, which are granted through the provincial Conservation Authorities Act, the LSRCA applies a number of Watershed Development Policies in reviewing applications for development and site alteration. These policies include directing development away from areas

such as floodplains, wetlands, significant forests and valleylands, fish habitat, and a number of other sensitive or hazardous features; requirements for reports/studies including environmental impact studies, servicing plans, erosion and sediment control plans; buffer requirements for fish habitat; requiring Enhanced “Level 1” stormwater treatment for all new developments; as well as a number of others. The consistent application of these policies will ensure that important environmental features are protected, and enable the conservation authority to strive for minimal disturbance to the environment from development.

Watershed Regulations

In May of 2006, the Province of Ontario approved Ontario Regulation 179/06 which was entitled “Lake Simcoe Region Conservation Authority: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses”. The format of this regulation was established by the Province in the Generic Regulation which was approved in May of 2004. All Conservation Authorities in Ontario were given two years (May 2004 to May 2006) to produce regulations and associated mapping which would conform to the Generic Regulation. This process involved extensive remapping of the entire Lake Simcoe watershed using 2002 air photos and digital elevation models, development of a Draft Regulation and a series of five public open houses throughout the watershed. The regulated areas for the Black River subwatershed can be seen in Figure 1-2.

The intent of this regulation is twofold. Firstly, it is to protect features in the natural environment such as wetlands (and associated buffer areas), watercourses and valley systems. Secondly, to steer development away from hazard lands such as unstable slopes, flood plain, dynamic beaches, meander belts and erosion prone areas.

The preservation or enhancement of natural features such as wetlands and watercourses is important for the overall health of the watershed and significantly affects the quantity and quality of storm water runoff. Wetlands act as giant sponges, absorbing precipitation and releasing it over long periods of time, which helps to preserve base flow in creeks during periods of drought. The natural water storage in wetlands also serves to reduce peak creek flows in downstream areas. Natural watercourses with their vegetated flood plains and meandering channels help to slow the rate of water flow and provide storage and thus dampening water flows and velocities in the creek.

Hazardous lands such as unstable slopes, flood plain, dynamic beaches, meander belts, and erosion prone areas are not suitable areas for new development. Many slopes in the watershed are relatively unstable and triggers such as vegetation removal, concentrated surface drainage or the construction of a house near the top of the slope is enough to cause slope failure. Flood plains can be dangerous areas. A number of significant flood events occur in our watershed on a yearly basis and the Regulation serves to tightly control the location and type of development in or around flood plains. Dynamic beaches are currently not a large issue in the Lake Simcoe watershed but if any are discovered in the future the Regulation serves to restrict development in these areas. Meander belts and erosion prone areas are naturally hazardous areas adjacent to watercourses and lakes that can also impact on land and structures. The Regulation controls development within these areas and the Authority, through its Development Policies, ensures that the necessary studies are completed to ensure that the development occurs in a safe location.

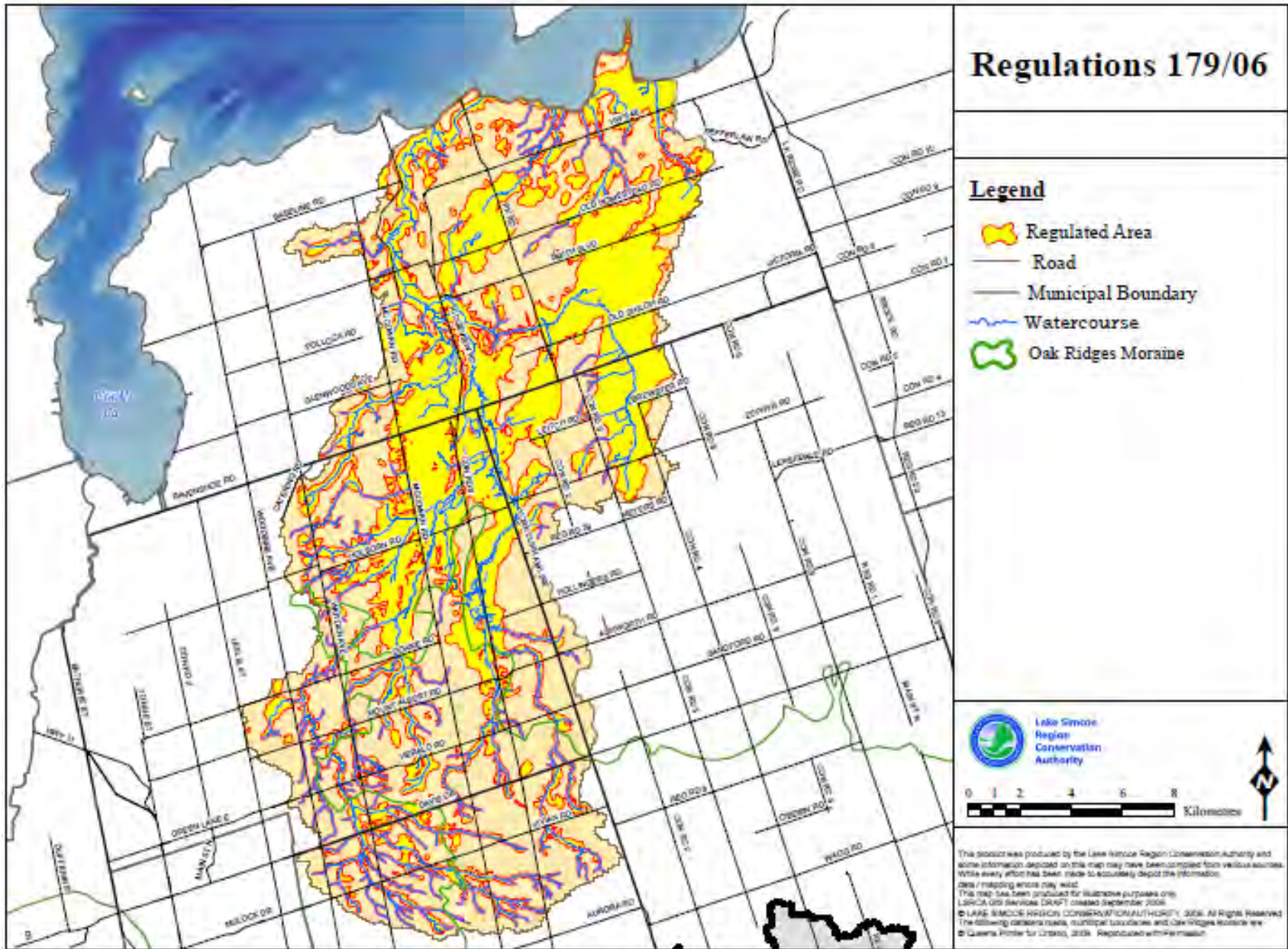


Figure 1-2 Areas regulated under O. Reg. 179/06

Flood Forecasting and Warning

The Flood Warning and Forecasting Program is a key component of the Authority's Watershed Management program. It works in concert with the Authority's regulations/planning program to achieve the Provincial goal of reducing the loss of life and property damage caused through flooding. The program is made up of two components; forecasting and warning.

Conservation authority staff utilize a number of parameters, including weather forecasts, stream flow gauges, weather stations, surveys of snow conditions, and computer models to predict whether a flood is likely to occur.

The warning component of the program follows the forecasting of stream flows and denotes the procedures required to ensure that a forecast of potential flooding or expected flooding is properly passed on to our flood clients to allow for appropriate response. The flood client base for the Authority consists of the Municipalities and School Boards within our jurisdiction as well as the media and police. There are three types of bulletins that a conservation authority will issue:

Flood Safety Bulletin/Advisory - Informs the public and municipalities that the conservation authority is assessing the flood potential.

Flood Advisory/Alert - Indicates the potential for flooding within specific watercourses or municipalities.

Flood Warning - Warns that flooding is imminent or is occurring in specific watercourses or municipalities.

LSRCA staff have developed a 'Vulnerable Feature in Floodplain' database to aid the flood warning component of the Authority's program. With a pilot project now completed for the municipalities within York Region, including the Town of Georgina within the Black River subwatershed, the database has increased the Authority's ability to:

- Provide increased detail of location and type of flood vulnerable structures,
- Provide increased detail of flood vulnerable road/rail segments,
- Provide a more accurate prediction of the scale of impact on vulnerable features,
- Increase the speed and clarity of communication to our flood clients

The database's purpose is twofold; Emergency Management Service (EMS) planning and operation. Map and tabular output from the database are excellent tools in alerting flood clients to potential infrastructure and EMS issues at a planning stage. The data provide answers to where the most vulnerable features are located, the type of vulnerable features impacted, the velocities and water depths affecting those features at various storm levels. Clients then have a clearer understanding of the risks inherent in a flood situation and are in a better position to mitigate the risk or plan for a flood prior to an event. Figure 1-3 displays an example of one of the map products that can be produced to depict the flooding risk in an urban area.

Once a flood event is imminent, communication of accurate information to clients is critical. The database houses a flood warning communication tool which enables the Authority to communicate the flood bulletin. Concurrently, the database is able to produce an address list of affected structures specific to a municipality or a subwatershed. The database's relation to GIS ensures maps and tabular data are produced quickly; an asset in any Emergency Operations Centre.

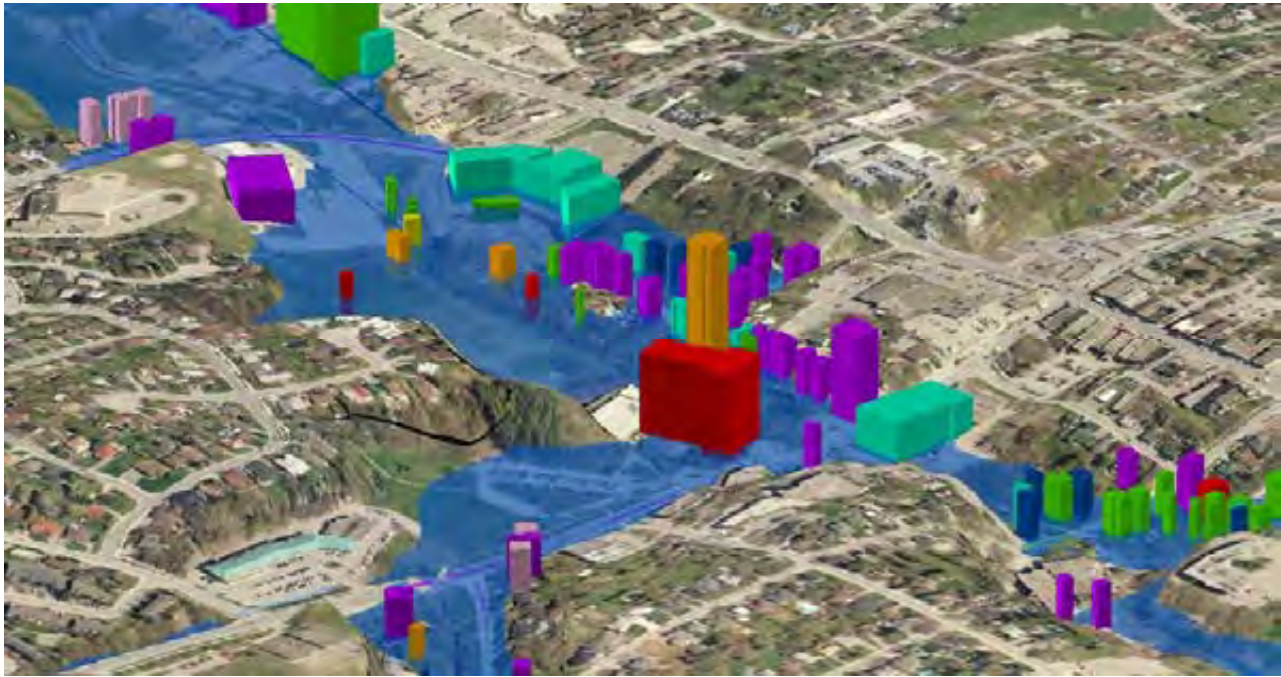


Figure 1-3 Sample product depicting vulnerable features

1.3.13 York Region Official Plan

The York Region Official Plan is a document intended to provide guidance on growth and development for the region as a whole, with high level policies pertaining to building a sustainable region, under the broad headings of ‘*A Sustainable Natural Environment*’, ‘*Healthy Communities*’, and ‘*Economic Vitality*,’ and also around growth management, with policies pertaining to ‘*Building Cities and Complete Communities*’, ‘*Agriculture and Rural Areas*,’ and ‘*Servicing [York Region’s] Population*.’ The plan’s policies are meant to guide decisions related to these areas and manage growth within the region. They help to co-ordinate and set the stage for more detailed planning by local municipalities.

With respect to the policies around a sustainable natural environment, the plan provides direction on enhancing a linked Regional Greenlands System and the treatment of the components that comprise the system, including key natural heritage features and key hydrologic features, Oak Ridges Moraine and Greenbelt features, habitat of endangered, threatened and special concern species, wetlands, significant woodlands, and landform conservation features. The plan also provides policy direction on maintaining and enhancing water system health in order to ensure water quality and quantity, and to maintain the natural hydrologic function of water systems.

1.3.14 Durham Region Official Plan

Similar to York Region’s Official Plan, Durham Region’s Official Plan provides guidance, in the form of text and maps, on growth and development within the Region, as per the intent of Regional Council. The Plan’s stated purposes include:

- Providing policies to ensure an improved quality of life and secure the health, safety, convenience and well-being of the present and future residents of the Region;

- Establishing the Region’s future development pattern and articulates goals, policies, and implementation mechanisms to achieve such a pattern; and
- Providing guidelines for Regional Council and Councils of the area municipalities in the preparation of future amendments to this Plan, area municipal official plans, zoning bylaws and other municipal actions and programs.

Guiding growth and development in this fashion will help to protect the region’s environmental resources, which will benefit the region’s residents as well as its natural environment now and into the future.

1.4 Recommended Actions for the Black River Subwatershed Plan

The following recommended actions were developed through the subwatershed planning process, and are based on the analysis of subwatershed conditions, stressors, and management gaps that were identified through the process. These recommendations are supported by a number of other, more detailed, recommended actions, which can be found in Chapter 10 of this document. These detailed recommendations will form the basis of the implementation plan, which will be developed following the completion of this plan.

The recommendations have been grouped into a number of categories in order to facilitate clarity and consistency. These categories are:

- A. Planning and Policy
- B. Use of Better Management Practices
- C. Changing the Way Things Are Done ‘On the Ground’
- D. Applied Research and Science
- E. Monitoring (Surveillance, Compliance, and Reporting)
- F. Management, Rehabilitation, and Restoration
- G. Adaptive Response (Climate, Social, Political)
- H. Communications

Planning & Policy

- 1) That the municipal partners and the LSRCA strive to reduce the impacts of stormwater through a number of methods including the implementation of policies and guidelines and enabling the use of new and innovative technologies, retrofitting of existing developments.
- 2) That the partner municipalities act to improve water quality by implementing measures to prevent and/or mitigate impacts from septic systems, development, and other activities that may cause impairment.
- 3) That the Province develop binding criteria for specific contaminants within the Lake Simcoe watershed, as well as criteria for addressing emerging substances of concern
- 4) That the municipal partners and the LSRCA strive to maintain natural hydrologic conditions on development sites
- 5) That the federal, provincial, and municipal governments, as well as the LSRCA, continue to evaluate and implement planning initiatives and practices aimed at reducing the impact of development on the condition of the Black subwatershed
- 6) That the value of the ecological goods and services (EGS) provided by ecological features be considered decision making around growth and development

- 7) That the rural/agricultural community be engaged in developing solutions for minimizing the impacts of practices on their lands
- 8) That the municipal partners, the LSRCA, and the Province support a common framework and develop and endorse policies and programs for the protection and enhancement of the Black subwatershed's natural heritage system and its functions
- 9) That the partners, including the municipalities, LSRCA, and the Province, seek to gain an improved understanding of the natural heritage features of the Black subwatershed
- 10) That LSRCA and its partners strive to maintain cover of peat wetlands in the subwatershed
- 11) That the Province, the municipal partners, and the LSRCA seek to gain an improved understanding of the impacts of climate change in the Black River subwatershed, incorporating this information into decision making scenarios and developing strategies to mitigate and adapt to its impacts.

Use of Better Management Practices

- 12) That the LSRCA and its municipal partners continue working to mitigate the impacts of stormwater to water quality and quantity through tracking its sources, completing stormwater retrofits, promoting methods of minimizing stormwater volume, and continuing to research new and innovative solutions to stormwater control and implementing these solutions where appropriate.
- 13) That support for programs offered to assist rural landowners in implementing BMPs on their properties, such as LSRCA's LEAP program, be continued and/or expanded as resources permit
- 14) That sectors that have the potential to have significant impacts on conditions in the Black River subwatershed be expected to undertake BMPs and other activities to mitigate their impacts, as required under the LSPP
- 15) That the LSRCA and the partner municipalities encourage the use of natural channel designs and 'soft solutions' wherever possible for preventing or mitigating streambank erosion and accommodating channel realignments; and that technical and financial resources be made available for retrofitting where appropriate to undertake these activities.
- 16) That the LSRCA assist partner municipalities in reducing the risk of flooding in the Black subwatershed
- 17) That the LSRCA work with large users of water (e.g. sod farms, market gardens) to develop solutions for decreasing water consumption, such as the installation of retention ponds.

Changing the way things are done 'on the ground'

- 18) That the LSRCA and its partner municipalities strive to maximize the infiltration of stormwater where appropriate through development approvals and the use of practices and technologies
- 19) That the partner municipalities, the LSRCA, and the related stakeholders work to reduce the impacts of construction practices on the Black subwatershed's water quality
- 20) That the partner municipalities continue to work to minimize the environmental impacts of road maintenance activities (e.g. chloride levels, sediment, phosphorus) on local watercourses

Applied Research and Science

- 21) That the Province, LSRCA and the municipal partners continue to work to identify sources of phosphorus within the subwatershed in order to set targets and develop strategies and solutions for reducing loads within the Black subwatershed
- 22) That all partners study the requirements for environmental flows within the Black subwatershed, explore innovative solutions, and undertake works and practices where possible in order to ensure adequate baseflow to support ecological function
- 23) That all partners continue to research techniques that may be undertaken in the subwatershed for improving water quality
- 24) That the partners explore the subwatershed to determine where reductions in groundwater discharge, excessive water takings and other impacts to aquatic habitat have occurred and undertake activities to mitigate these impacts
- 25) That measures be taken at site level to reduce demands on water resources
- 26) That the partners (LSRCA, MNR, NRCAN, etc) undertake studies to enhance understanding of natural heritage resources within the Black subwatershed in support of management strategies related to unique and/or significant features
- 27) That LSRCA and its partner municipalities assess the feasibility of increasing and/or enhancing natural cover, and develop strategies to prioritize these undertakings in order to achieve the greatest benefit to the subwatershed
- 28) That all partners cooperate to determine the presence and extent of invasive species in the subwatershed, and work to prevent their establishment and spread

Monitoring

- 29) That the water quality monitoring program undertaken by the LSRCA be continued into the future, with regular reviews to ensure that program goals are being met, and expanded as resources permit to undertake special projects or enhance the understanding of conditions in the subwatershed; with results to be reported on annually.
- 30) That the LSRCA continue to undertake the aquatic monitoring program, with expansions to the program in order to further understand conditions in the subwatershed; and cooperate with partner agencies on additional initiatives as required
- 31) That the LSRCA, partner municipalities, and developers undertake efforts to minimize the impacts of construction through the use of on-site practices aimed at protecting water quality; and by conducting monitoring to ensure the effectiveness of these practices.
- 32) That the LSRCA assess the impacts of land use change on fluvial geomorphology in the subwatershed.
- 33) That the amount of impervious area in the subwatershed be assessed on a regular basis by the LSRCA and its partner municipalities.
- 34) That the LSRCA undertake regular updates to its Natural Heritage and Land Use mapping to ensure the most up-to-date information is being used.

Management, Rehabilitation and Restoration

- 35) That the MNR, with the support of LSRCA and the partner municipalities, undertake initiatives aimed at maintaining the health of the subwatershed's fish community. These may include the development of fish community goals and objectives, fisheries management

plans, or other plans aimed at protecting the habitat of species at risk in applicable catchments.

- 36) That the LSRCA and its partners continue monitoring the aquatic community and habitat in the Black subwatershed, assessing the monitoring program on a regular basis and undertaking targeted monitoring where appropriate to fill data gaps.
- 37) That that LSRCA, in cooperation with its partner municipalities, prioritize and undertake activities to improve and restore aquatic ecological functions within the subwatershed, including barrier removal, natural channel design, restoring floodplain functions, and wetland creation. This could include undertaking pilot/demonstration projects to assess the feasibility of such works.
- 38) That the LSRCA continue to utilize buffer requirements and timing guidelines as tools to protect aquatic resources, and that other activities such as stormwater retrofits, tree planting, and habitat enhancement be undertaken to enhance aquatic habitat
- 39) That the LSRCA and the partner municipalities assess the feasibility of increasing natural cover (e.g. woodland, streambank vegetation, interior forest, grassland) in the subwatershed and set priorities and develop plans to undertake this enhancement, based on overall benefit to the subwatershed.
- 40) That the LSRCA identify opportunities for land securement of priority sites.
- 41) That the partner municipalities, in cooperation with the LSRCA, look to enhance existing woodland areas through replacing plantation species with appropriate native species through succession in order to provide higher quality habitat while maintaining the functions that plantation areas perform. These include maintaining water quality, providing shelter, encouraging infiltration and stabilizing soils.
- 42) That the LSRCA support the work of MNR and OFAH with respect to invasive species and encourage the distribution of promotional materials.
- 43) That the partner municipalities adopt policies to encourage the use of native species, particularly those drought tolerant species, through development approvals and property management programs.
- 44) That the LSRCA continue to undertake stewardship initiatives, priority areas for which may be identified through Phase II of LSRCA's Natural Heritage System.
- 45) That the LSRCA request the Ministry of Natural Resources to undertake the development of watershed rare lists and protection policies for species at risk in the subwatershed.
- 46) That LSRCA and its municipal partners investigate initiatives to improve the long term benefit and environmental sustainability of public properties and facilities.
- 47) That the LSRCA, the partner municipalities, and developers work to identify opportunities for undertaking restoration works on development sites, and incorporate these into proposals, where appropriate

Adaptive Response

- 48) That the LSRCA and partner municipalities work to reduce their carbon footprint and to increase ecological resilience in the watershed
- 49) That the LSRCA and the partner municipalities promote and support water conservation initiatives such as York Region 's 'Water for Tomorrow' program.

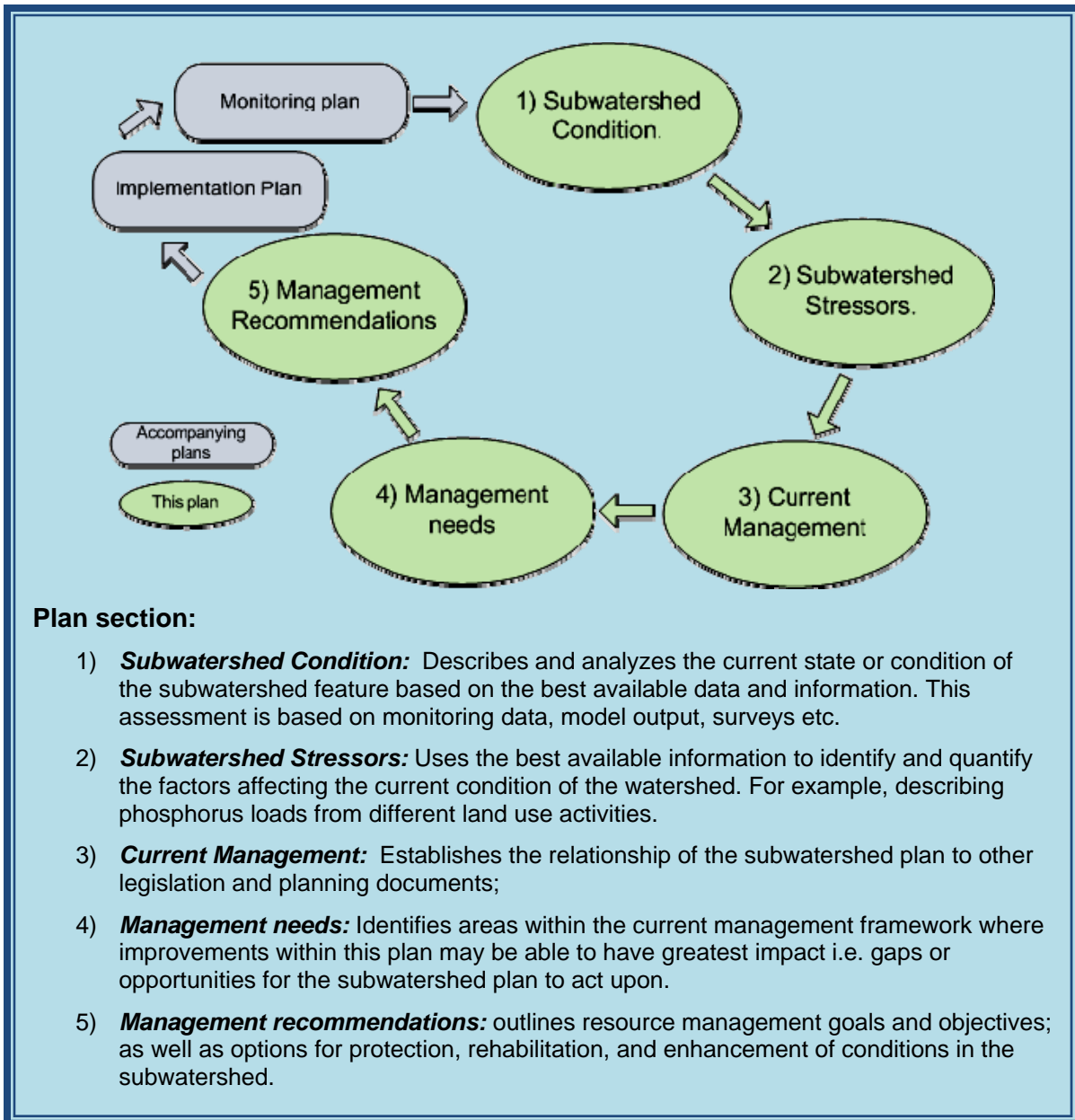
- 50) That the LSRCA in conjunction with the MNR and MOE undertake initiatives to understand the environmental flow needs within the Black subwatershed, and undertake studies and develop programs and policies to ensure that these needs are met, including the continuation of the Low Water Response Program, setting environmental flow targets, water reuse, and ensuring that water taking activities do not exceed the available supply.
- 51) That the LSRCA and its partners work to ensure that flood mapping is up to date; that the data needed for assessing flood risk is sufficient and that new monitoring equipment is added to the monitoring network as required; and that there be available programs to assist landowners in flood proofing their homes.

Communications

- 52) That the LSRCA use its website and other internet tools (e.g. Facebook groups) to communicate information about the subwatershed and the implementation of subwatershed plan recommendations
- 53) That outreach activities be conducted that: provide information to stakeholders about subwatershed plans and issues, encourage participation in the development of implementation plans and other subwatershed activities, and facilitate the undertaking of BMPs to improve subwatershed health
- 54) That the LSRCA promote enhanced relationships between sectors to work towards the goal of more sustainable development
- 55) That the LSRCA promote its programs (such as the LEAP), workshops, and seminars by a variety of methods in order to reach a broader audience and inform and educate subwatershed stakeholders about key issues and how they can be resolved

1.5 How this plan is organized

This plan includes a chapter dedicated to each of the five subwatershed features identified above, these being water quality, water quantity, aquatic habitat, fluvial geomorphology and terrestrial natural heritage. Each of these chapters follows an identical format, loosely structured around a pressure-state-response framework, in that each chapter firstly describes the current condition (state), secondly describes the stressors likely leading to the current condition (pressure), and finally recommends management responses in the context of the current management framework (response) (See text box below).



The resulting plan will protect the existing natural resources, facilitate informed planning decisions, and improve the efficiency of the development review process. An over-arching concept to keep in mind throughout the subwatershed planning process is that it is far more beneficial, both financially and ecologically, to protect resources from degradation than to rehabilitate them once they have been damaged.

2 Study Area and Physical Setting

2.1 Location

The Black River subwatershed is one of the largest subwatersheds in the Lake Simcoe basin. The subwatershed covers an area of 375km² to the south of Lake Simcoe. Municipally, the subwatershed is shared by York Region (89%) and Durham Region (11%), meandering through the Townships of Uxbridge, Whitchurch-Stouffville, and East Gwillimbury, and the Town of Georgina. Neighbouring subwatersheds include the Maskinonge River and Georgina Creeks to the east, and the Pefferlaw River to the northeast.

The Black River subwatershed is one of the healthiest subwatersheds in the Lake Simcoe basin in terms of wetland and woodland cover. This can be partly attributed to the fact that a large valley spans the central portion of the subwatershed. It can also partly be attributed to this area being one of the first regions to have its wetland cover evaluated and classified as provincially significant, in the early 1980s. As well, 20% of this subwatershed is part of the Oak Ridges Moraine and is therefore protected through the Oak Ridges Moraine Conservation Plan (ORMCP).

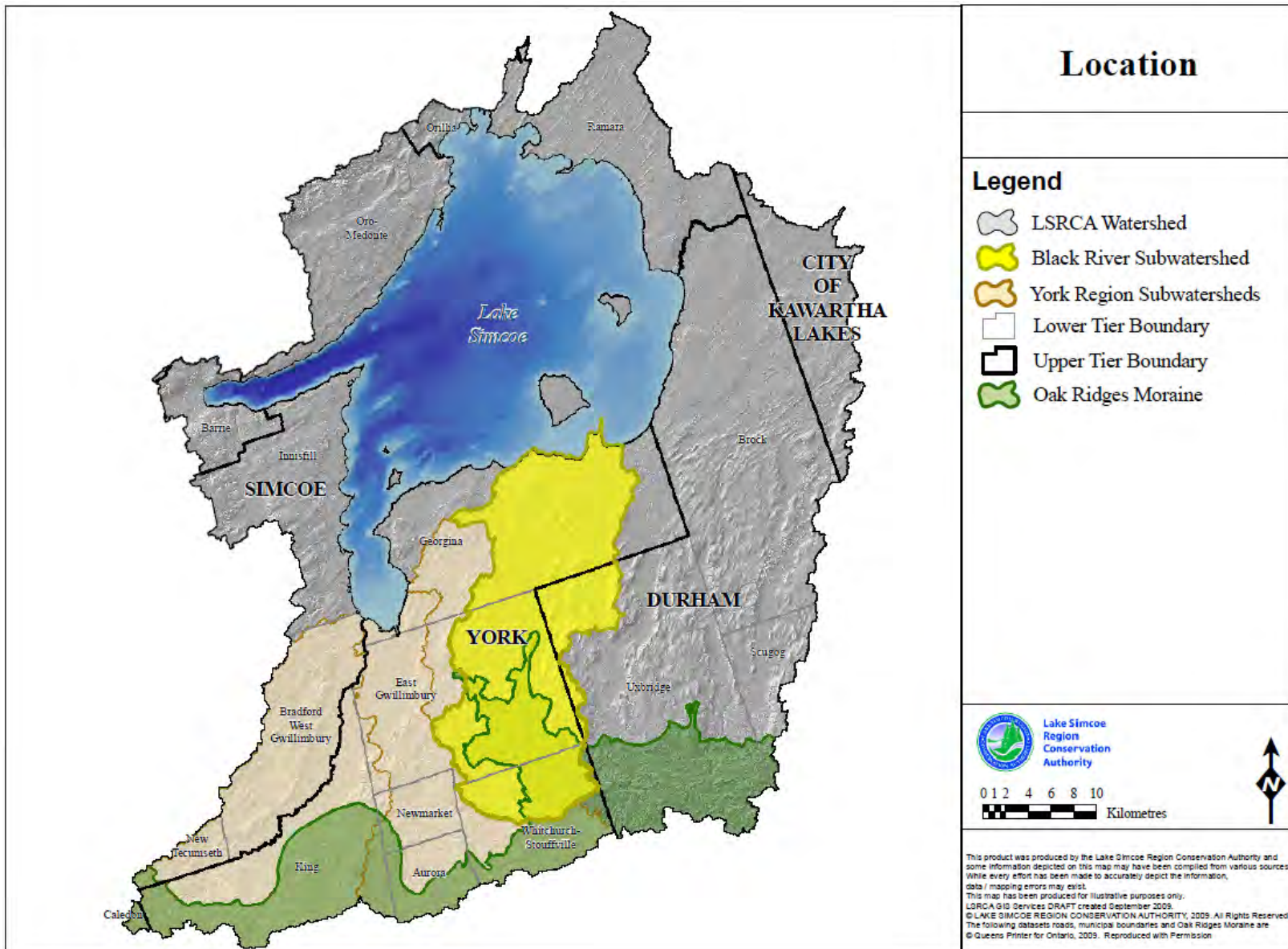


Figure 2-1 Location of the Black River subwatershed within the Lake Simcoe basin

2.1.1 Black River Subwatershed Land Use

The Black River subwatershed is one of the healthiest subwatersheds in the Lake Simcoe basin, particularly in terms of natural cover. This can be partly attributed to the fact that a large valley spans the central portion of the subwatershed. It can also partly be attributed to this area being one of the first regions to have its wetland cover evaluated and classified as provincially significant, in the early 1980s. As well, 20% of this subwatershed is part of the Oak Ridges Moraine and is therefore protected through the Oak Ridges Moraine Conservation Plan (ORMCP).

The largest component of land cover in the Black River subwatershed is natural heritage features at approximately 51%. Intensive and non-intensive agriculture comprise approximately 39% of the land base. The remainder of the breakdown of the land use of the subwatershed is shown in Figure 2-2, and its distribution is shown in Figure 2-3.

The main developed areas in the subwatershed include the community of Sutton, near the mouth of the river, Mount Albert, Holt, Zephyr, Brown Hill, Baldwin, and a portion of Sharon. While the communities in the subwatershed are not slated for the high level growth as some of the others, the communities of Sutton, Mount Albert, and Sharon will all experience growth in the coming years. The Sharon/Queensville/Holland Landing urban area, part of which lies within the subwatershed, is expected to have a population of over 76,000 people by 2031; Mount Albert is expected to grow to close to 6,000 people by 2031; and the population of the Town of Georgina, which contains the community of Sutton will grow to over 70,000, the majority of which will be in the community of Keswick outside of the subwatershed, but a large portion of this population will be located in Sutton.

Major industries within the subwatershed include recreation, retail, and hospitality, as well as a high level of employment in agriculture and construction. The recreation industry benefits from a large influx of tourists in all seasons, due to the lake's close proximity to the large GTA population, and also to its popularity as a fishing destination. Popular recreational activities include fishing (both ice and open water), snowmobiling, golf, hiking, and camping.

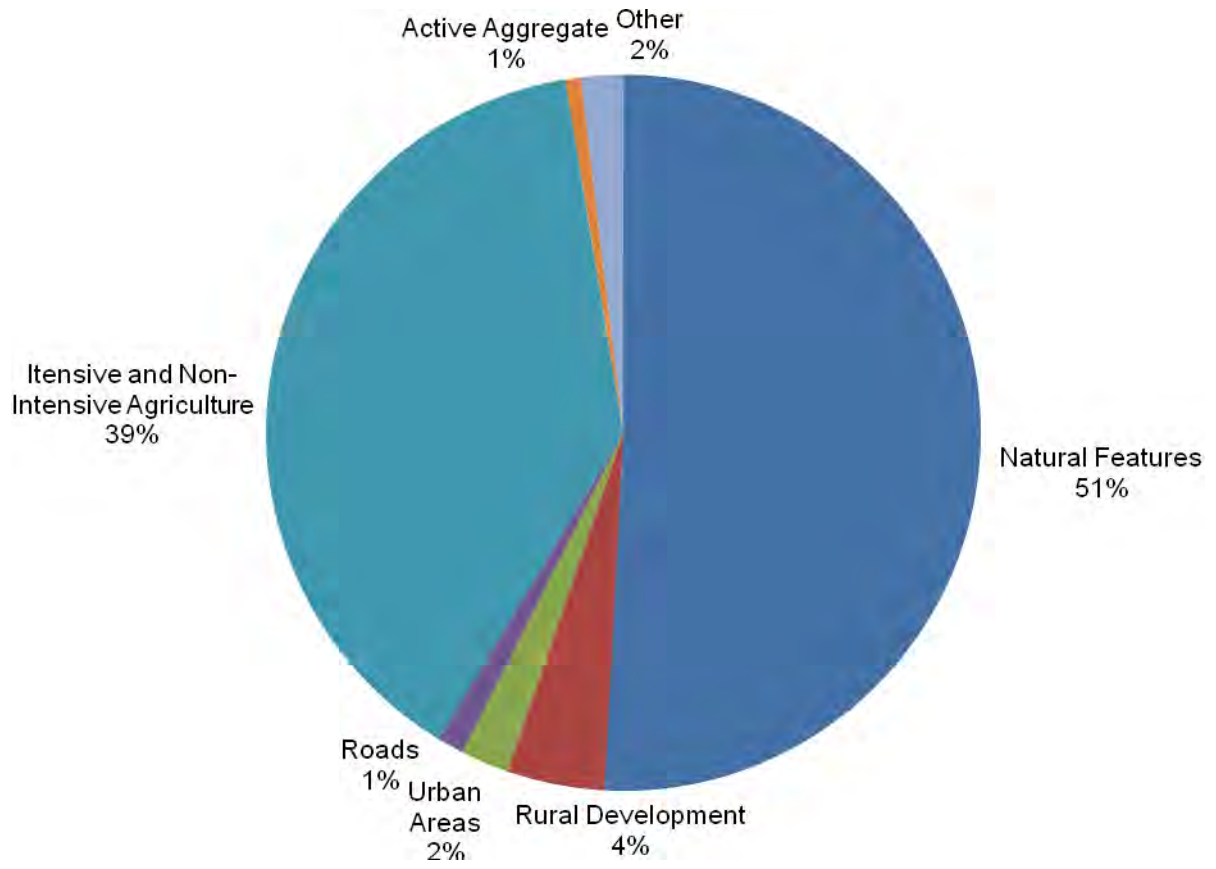


Figure 2-2 Land use distribution in the Black River subwatershed

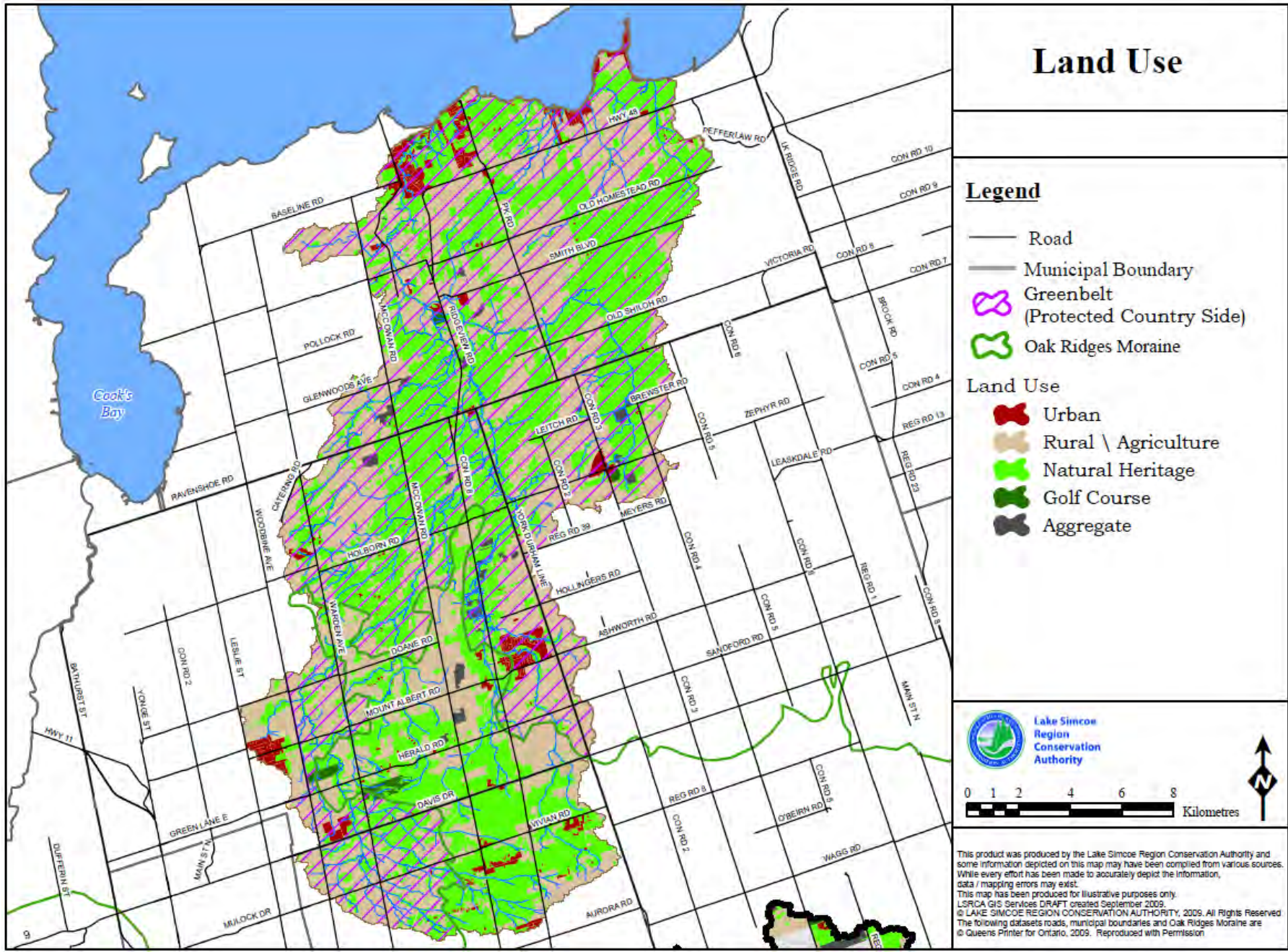


Figure 2-3 Land use within the Black River subwatershed

2.2 Drainage

All of the lands within the Lake Simcoe watershed ultimately drain into Lake Simcoe, via one the tributary rivers. The Black River subwatershed is one of 18 subwatersheds that drain into Lake Simcoe. It is also one of five major tributaries that account for 60 percent of the total drainage to Lake Simcoe.

The main tributaries of the Black River include Zephyr Creek, the Baldwin Branch, Harrison Creek, Mount Albert Creek, and Vivian Creek.

2.3 Topography and Physiography

2.3.1 Topography

The topographic features of the Black River subwatershed are related to its geological history, including significant glacial events. The ground surface topography within the Black River subwatershed ranges from 345 metres above mean sea level (mASL), at the Oak Ridges Moraine, to 219 mASL at Lake Simcoe (Figure 2-4).

There are three topographic areas that have been identified within the subwatershed the northern extent of the ORM, a rolling clay plain, and areas of peat and muck. The ORM is located along the southern portion of the subwatershed. It is characterized by hummocky terrain that ranges from approximately 275 to 390 mASL. The area that has elevations ranging between 275 to 225 mASL represent the rolling clay plain that is characterized by numerous valleys, which make its relief very uneven (Chapman and Putnam, 1984). The peat and muck is found in the lower elevations of the subwatershed leading to poor drainage and high water table conditions (Earthfx & Gerber, 2008).

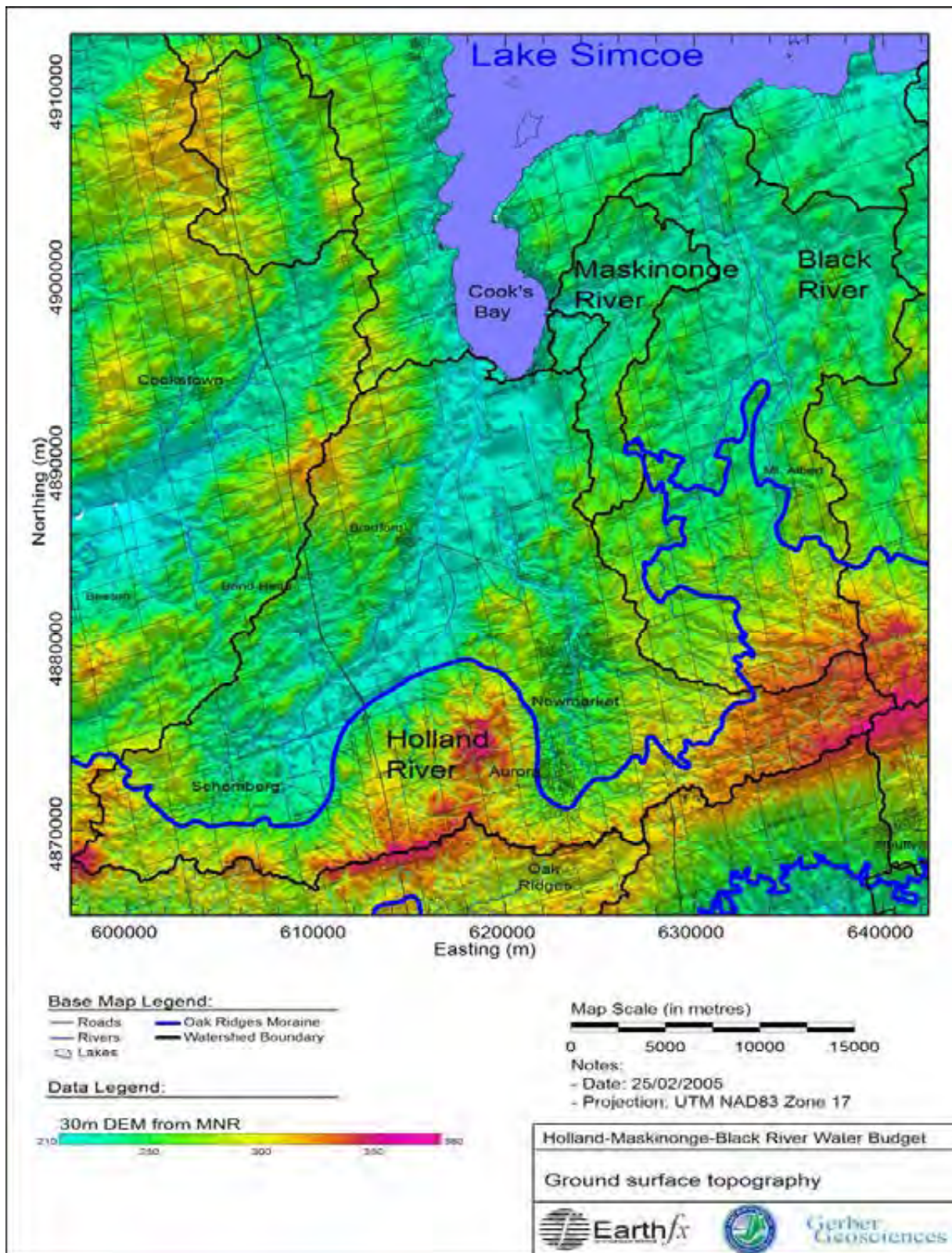


Figure 2-4 Ground surface topography (Earthfx and Gerber Geosciences, 2008)

2.3.2 Physiography

The physiographic regions within the Black River subwatershed is a direct result of the deposition and erosion during glacial and post-glacial events, and closely corresponds to the topography discussed above. According to Chapman and Putnam (1984), four physiographic regions are found within the subwatershed: the Oak Ridges Moraine (ORM), the Simcoe Lowlands, the Schomberg Clay Plain and the Peterborough Drumlin Field (Figure 2-5). The ORM generally makes up the topographic highs, while the Simcoe Lowlands and the Schomberg Clay Plain make-up the low areas within the subwatershed.

Oak Ridges Moraine

The headwaters of the streams flowing into Lake Simcoe from the south are located on the most widely recognized feature in the watershed, the Oak Ridges Moraine. The Oak Ridges Moraine is a significant physiographic feature that lies between the Trent River and the Niagara Escarpment. It is a total length of approximately 160 km, and has topographic elevations ranging from 305 to 395 mASL. The peak of the moraine forms the surface water divide separating flow towards Lake Simcoe from flow towards Lake Ontario.

The Oak Ridges Moraine is comprised of rolling sandy hills, hummocky topography and closed depressions that form the source of the headwaters to major streams that drain off the moraine. The moraine within the subwatershed consists primarily of surficial sand and gravel deposits, which can have a thickness of as much as 90 m. Along the topographic divide within the moraine these deposits are covered with silt to clay silt till (Halton Till). Also, a sand to sandy silt till (Newmarket Till) abuts the northern edge of the moraine in the Aurora area, and is believed to extend under the sand and gravel cap of the moraine.

A unique feature of the Oak Ridges moraine is the lack of surface drainage. Precipitation in this area either infiltrates to replenish the groundwater system or returns back to the atmosphere via evapotranspiration. It is at the northern and southern flanks of the moraine where the groundwater emerges as springs or seepages, creating the headwaters of the subwatersheds originating on the moraine, including the Black River. The high infiltration capacity of the moraine makes it one of the most important recharge zones in southern Ontario, and within the Black River subwatershed.

Schomberg Clay Plain

The Schomberg Clay Plain is not a continuous feature like the Oak Ridges Moraine outlined above. It occurs in several low lying regions around the Schomberg, Newmarket, and Lake Scugog areas. Within this subwatershed, the clay plain is found near the communities of Ravenshoe and Mount Albert and has an approximate elevation range of 225 to 275 mASL. The Schomberg Clay Plain is characterized as having rolling relief that reflects the underlying till plain. The Schomberg Clay Plain areas are characterised by thick deposits of fine-grained sediments that are draped over an irregular till plain and are typically 15 m in thickness (Chapman & Putnam, 1984).

Simcoe Lowlands

The Simcoe Lowlands is the physiographic region that comprises the majority of the Black River subwatershed. The region extends from the ORM northward to Lake Simcoe, and is described as having lower elevations, with flat-floored valley features that generally correspond to current river systems (Sharpe et al., 1999). The lowlands were flooded by glacial Lake Algonquin and as a result are floored by sand, silt and clay (Chapman and Putnam, 1984).

One valley occurs immediately south of Lake Simcoe. The floor of this valley is now a swampy sandy plain, covered by organic deposits. The continuity of this plain is disrupted by drumlinized till composed of glaciolacustrine deposits. The tributary creeks of the Black River including; Zephyr creek and Mount Albert Creek, have approximately 1.6km wide swampy valleys that drain into the main valley (Chapman and Putnam, 1984).

Peterborough Drumlin Field

The Peterborough Drumlin Field extends north of the ORM to east of Lake Simcoe into the Nottawasaga basin. A portion of the Peterborough drumlin field regime occurs south of Kempenfelt Bay (west of Cook's Bay), and within the south-central and eastern portions of the Lake Simcoe watershed. Within the Black River subwatershed this regime is very minor, found only in the eastern most reaches of the subwatershed. This physiographic region is typically characterized by numerous drumlins that are on average oriented 60° west of south or 240° azimuth. On average, drumlins are 20-75 m in width and 100-450 m in length. Internally, drumlins are composed of a stone-rich, slightly silty to silty fine to medium grained sand till. Texturally, the percentage of silt increases in a southerly direction, more specifically drumlins immediately north of the Oak Ridges Moraine are composed of a stone-rich, fine to medium grained sandy, silt till.

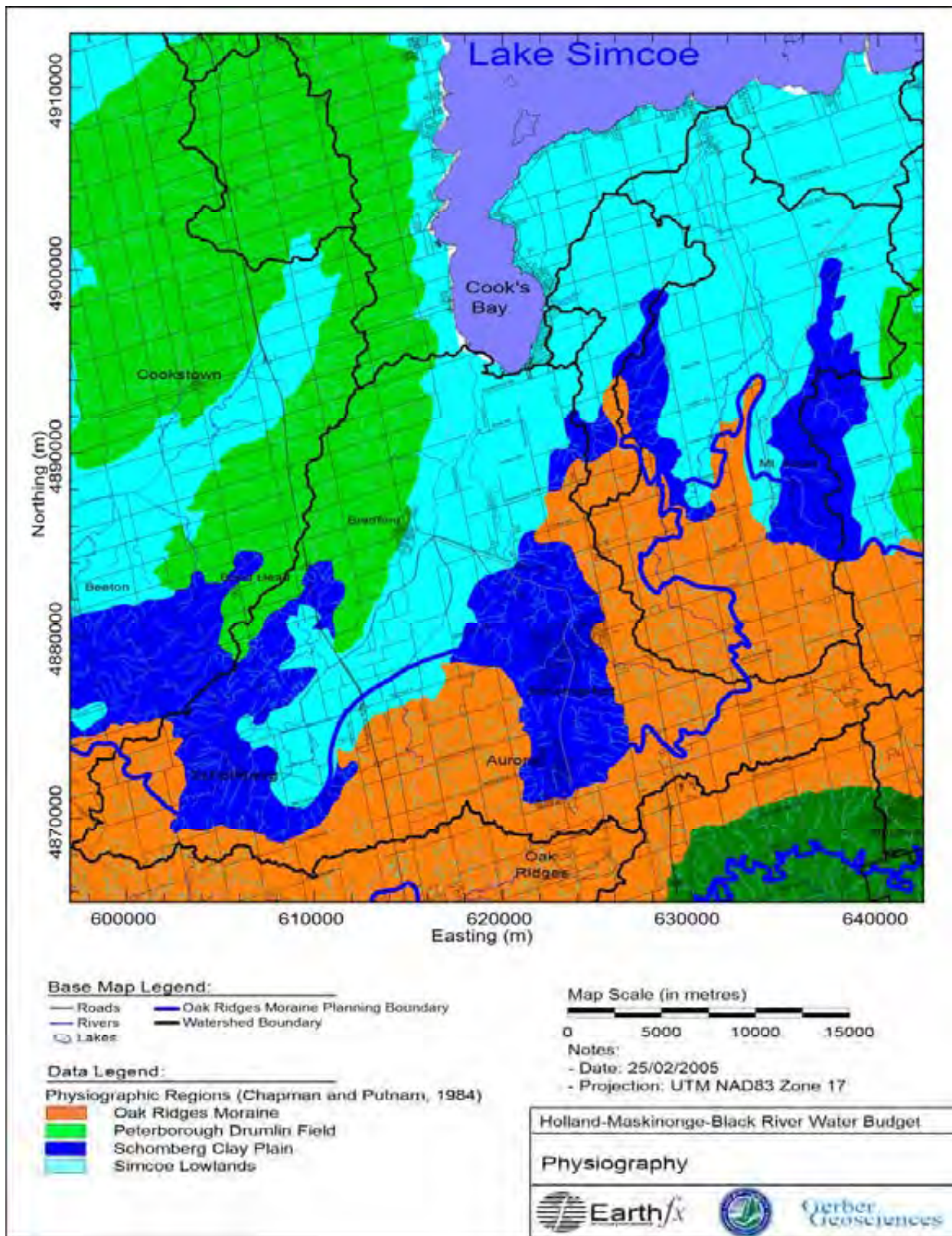


Figure 2-5 Physiographic regions within the Black River subwatershed

2.4 Geology

There have been a number of studies that have led to the geologic understanding in the area. A generalized description of the bedrock geology, Quaternary geology, and conceptual stratigraphic units within the Black River subwatershed is provided below. For more detailed information the reader is referred to Liberty (1969), Karrow (1989), Johnson *et al.* (1992) and Barnett (1992).

The geology of the Black River subwatershed is complex and has been influenced by a number of glacial events. Bedrock topography, which has a significant influence on the nature and extent of deeper aquifer units, has been mapped using data obtained from the MOE's digital water well records. Overburden thickness has also been estimated as the difference between bedrock and ground surface elevation. Areas of thicker overburden generally correspond to moraine or 'hummocky topography' features

2.4.1 Bedrock Geology

The bedrock can be characterized as being from the Paleozoic Era, consisting primarily of limestone of the Middle Ordovician Simcoe Group in the north, and shale of the Upper Ordovician Blue Mountain in the south (Johnson *et al.*, 1992). The bedrock has been overlain by a sequence of sediments that have been deposited over the last 135,000 years by glacial, fluvial and lacustrine environments (Figure 2-6).

The Middle Ordovician deposits make up the Simcoe Group, which consists of five formations. However, only the Lindsay Formation is found within the subwatershed. The younger, Upper Ordovician deposits found within the subwatershed consist of the Georgian Bay-Blue Mountain Formation.

Lindsay Formation

The Lindsay Formation overlays the Verulam Formation and extends from the northeastern boundaries of the subwatershed toward its southern and southwestern boundaries. The formation is also of Middle Ordovician age and is a member of the Simcoe Group (which is represented as 5 on Figure 2-6). Within the subwatershed the Lindsay Formation has a thickness of 67 m and is richly fossiliferous, which indicates that the depositional environment was a shallow to deep marine environment (Thurston *et al.*, 1992).

Blue Mountain Formation

The Blue Mountain Formation (formerly the Whitby Formation) overlies the Lindsay Formation. This formation is represented as part of the Georgian Bay formation (6) on Figure 2-6. The formation is Upper Ordovician in age (approximately 420 million years ago) and is present as a band running southeast to northwest in the southern portion of the subwatershed. The formation consists of blue-grey, poorly fossiliferous, non-calcareous shale up to 60 m thick (Thurston *et al.*, 1992).

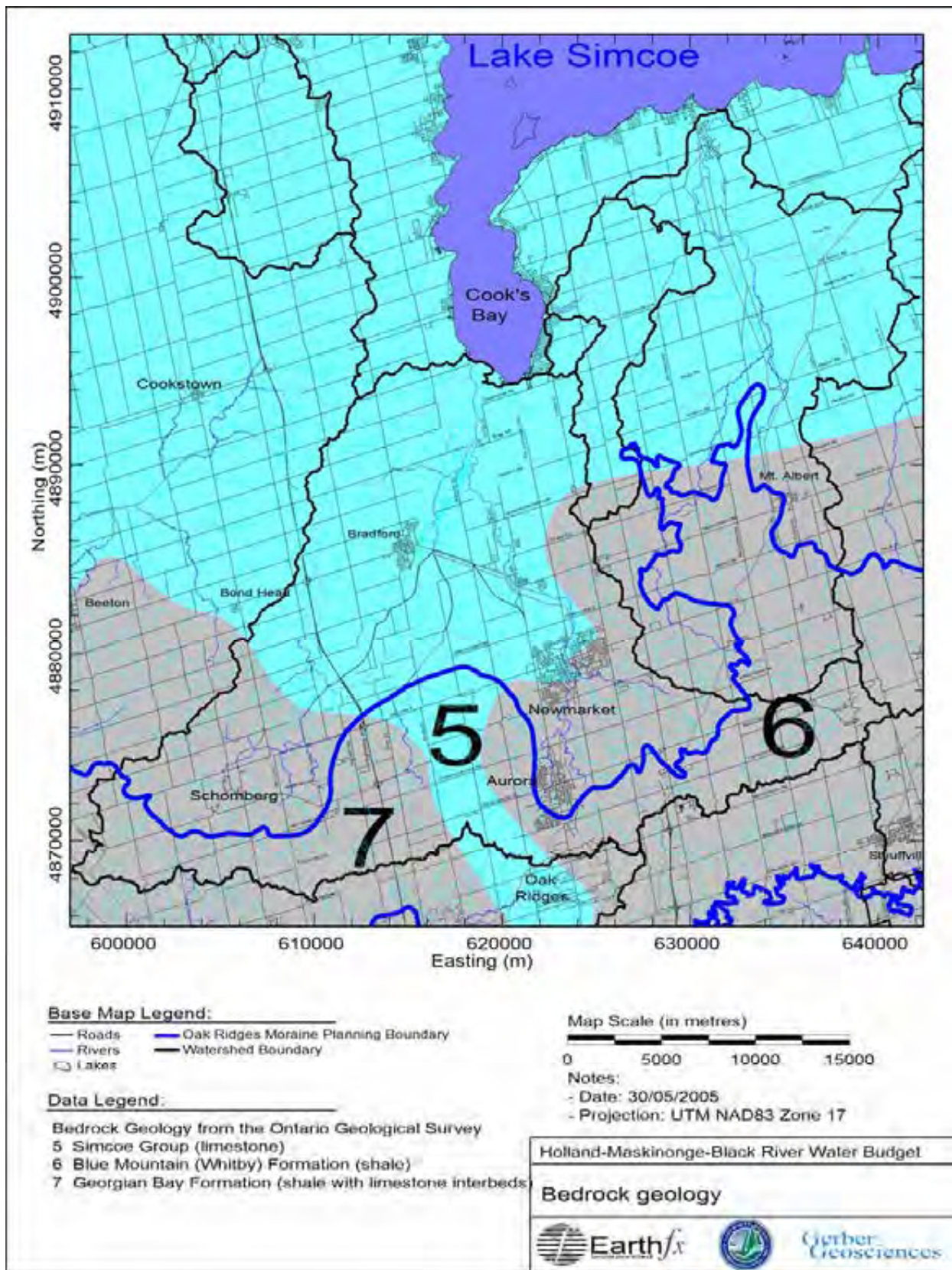


Figure 2-6 Bedrock geology within the study area (Gerber & Earthfx, 2008).

2.4.2 Bedrock Topography

The bedrock surface of the Black River subwatershed has a general elevation range of 218 to 200 m ASL, Figure 2-7. The bedrock surface is thought to have been the result of a long period of non-deposition and/or erosion activity that occurred between the deposition of the sedimentary bedrock and the overlying sediments.

The topographic lows are associated with significant valleys that have been eroded into the bedrock surface. These valleys are believed to be a result of fluvial activity prior to glaciation, approximately 440 to 2 million years ago with additional modification by glacial processes over the last 2 million years (Earthfx & Gerber Geosciences, 2008).

A major bedrock valley known as the Laurentian bedrock channel traverses through the southwestern portion of the Lake Simcoe watershed. Recent interest has been generated over the Laurentian Channel (also referred to as the Laurentian Valley), a proposed Tertiary-aged river network that extended from Georgian Bay to Lake Ontario (Brennand *et al.*, 1998; Sharpe *et al.*, 2004). This interest has been driven primarily through the attempt to locate additional sources of potable water as increasing population continues to place additional stress on existing groundwater supplies. This valley identifies an ancient drainage system that extended from Georgian Bay to Toronto. Tributary valleys to the main Laurentian valley are interpreted to occur beneath the subwatershed extending from Mount Albert through Newmarket and Aurora to join the main valley south of the study area (Earthfx & Gerber Geosciences, 2008).

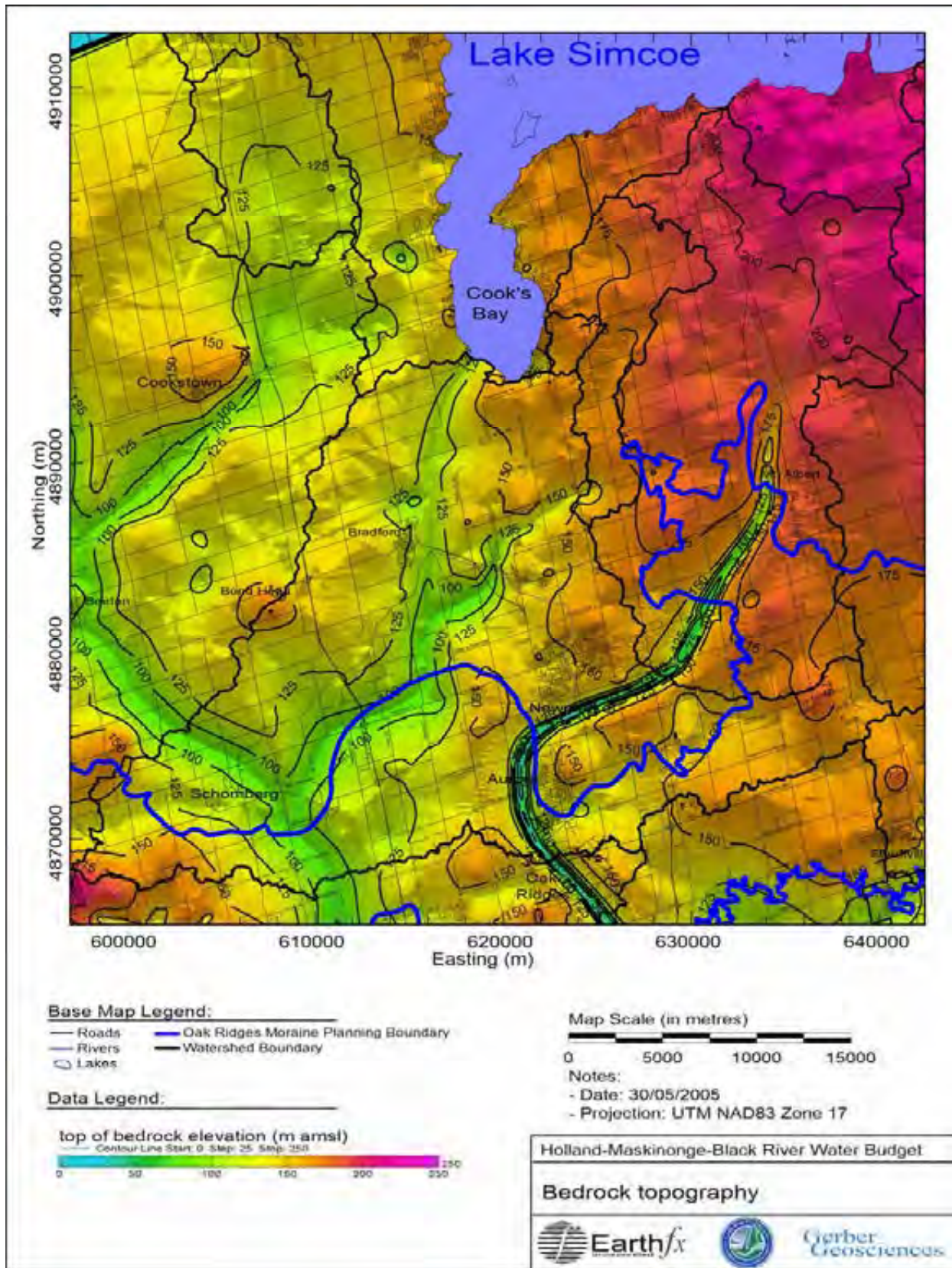


Figure 2-7 Interpreted bedrock surface topography (Earthfx and Gerber Geosciences, 2008)

2.4.3 Quaternary Geology

Glacial History

The bedrock within the Black River subwatershed is overlain by unconsolidated sediments, known as the overburden, which was deposited during the Quaternary Period. The Quaternary Period can be further divided into the Pleistocene (Great Ice Age) and the Holocene (Recent) Epochs. During the Pleistocene, at least four major continental-scale glaciations occurred, which include, from youngest to oldest, the Wisconsinan, Illinoian, Kansan and Nebraskan Stages (Dreimanis and Karrow, 1972). All of the surficial deposits within the subwatershed, and within most of southern Ontario are interpreted to have been deposited by the Laurentide Ice Sheet during the Wisconsinan glaciation. The Laurentide Ice Sheet is the glacier that occupied most of Canada during the Late Wisconsinan period, approximately 20,000 years ago (Barnett, 1992).

Sediments deposited during the Late Wisconsinan substage are extensive in southern Ontario, and are thought to represent all of the surficial deposits in the Black River subwatershed. All of the deposits which outcrop at surface within the subwatershed, were likely laid down within the last 15,000 years during and after the Port Bruce Stade. Deep boreholes indicated that older Wisconsinan deposits do occur at depth, however, it is not always possible to date them (Dreimanis and Karrow, 1972).

The stratigraphy of the surficial deposits within the subwatershed is extremely complex, particularly in the ORM area where the deposits are very thick and are a direct result of the complex glacial history over the last 115,000 years.

Quaternary Sediment Thickness

Within the subwatershed the Quaternary sediment thickness is the difference between the ground surface and the interpolated bedrock surface. The thickness of the Quaternary sediments has been determined from borehole and water well information within the subwatershed. Figure 2-8 shows the thickness ranges from approximately 0 m to 171 m. The Paleozoic bedrock topography appears to strongly influence the overlying Quaternary sediment thickness and distribution. The thicker Quaternary sediments occur in bedrock topographical lows (i.e. within bedrock valleys and beneath the ORM), while the thinnest areas of Quaternary deposits occur at the north end of the subwatershed, south of Cook's Bay. In addition, areas of thicker overburden can generally correspond to moraine and 'hummocky topography' features, as shown in Figure 2-8.

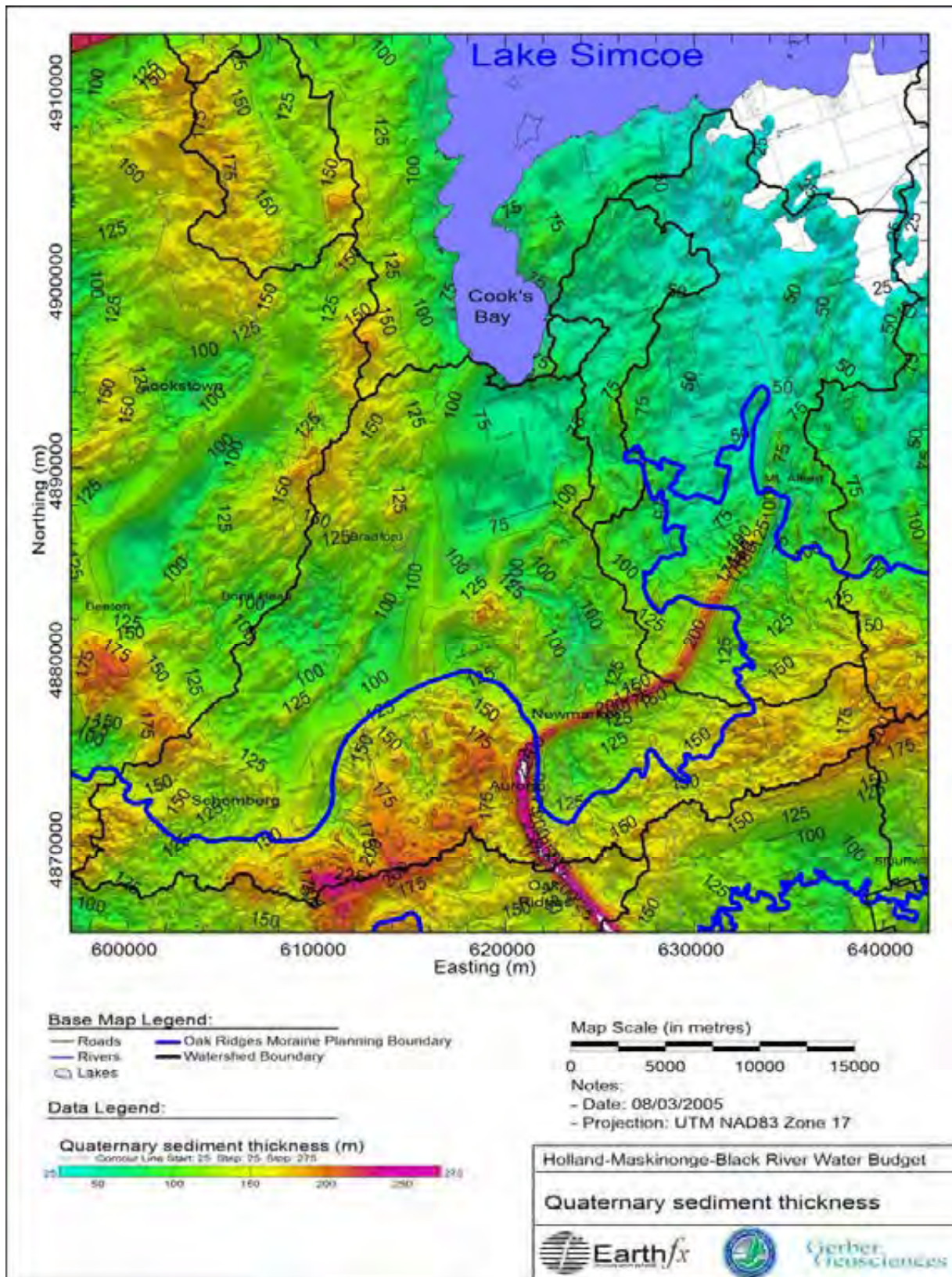


Figure 2-8 Quaternary sediment thickness (Earthfx and Gerber Geosciences, 2008)

2.4.4 Stratigraphy

The stratigraphy of the surficial deposits within the Black River subwatershed is complex as a result of the glacial history. There are a number of ongoing initiatives to understand the local stratigraphy. The following subsections provide a brief overview of relevant and previously completed stratigraphic studies.

The stratigraphic framework of Quaternary glacial and non-glacial sediments, as shown on Figure 2-9, was completed using exposed sediment along the Lake Ontario bluffs and in the Don Valley brickyard (Eyles, 2002). In addition, a conceptual understanding of the stratigraphic framework was completed for the ORM area by the Geological Survey of Canada (GSC) and later refined by the Conservation Authorities Moraine Coalition York-Peel-Durham-Toronto Groundwater Study (CAMC-YPDT). The GSC constructed a five-layer geologic model of the moraine based in part by the stratigraphy of the Scarborough Bluffs. The CAMC-YPDT group combined the two stratigraphic models presented above to produce an eight-layer geologic model, shown in Figure 2-10. Further information can be obtained from Earthfx *et al.* (2006).

The eight conceptual model layers (from youngest to oldest) are:

1. Surficial deposits and/or weathered Halton Till
2. Halton Till or Kettleby Till
3. Oak Ridges Aquifer complex and/or Mackinaw Interstadial deposits
4. Newmarket Till
5. Thorncliffe Formation deposits
6. Sunny Brook Drift
7. Scarborough Formation deposits
8. Weathered bedrock

Don Formation and York Till

The Don Formation and underlying York Till have not been mapped within the subwatershed due to lack of deep borehole information that would be necessary to delineate these deposits since they are only within lows on the bedrock surface.

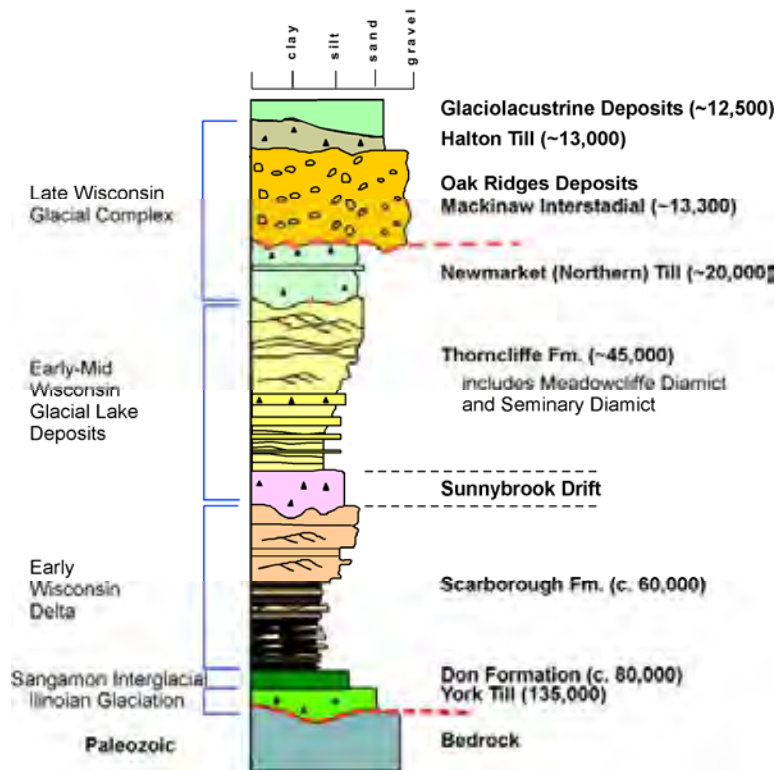


Figure 2-9 Quaternary deposits found within the study area (Figure from Eyles, 2002).

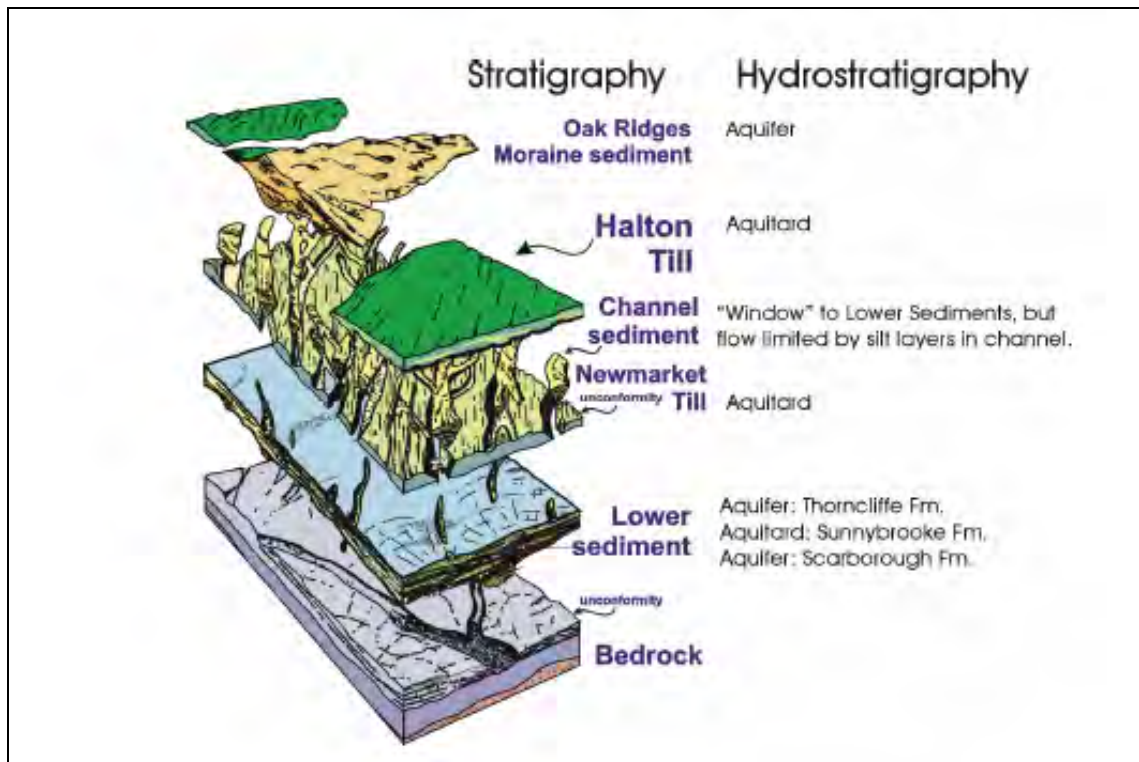


Figure 2-10 GSC Stratigraphic framework of the ORM region (Sharpe et al., 1999)

Scarborough Formation

The oldest Quaternary deposit of significant (mappable) thickness present within the subwatershed is the Scarborough Formation or equivalent to the Scarborough Formation as mapped in outcrop in areas to the south. The Scarborough Formation marks the start of the Wisconsin glacialiation, approximately 100,000 years ago.

The Scarborough Formation (or equivalent) was formed by fluvio-deltaic processes leading to deposition of a lower clay layer overlain by sands showing varieties of cross-beddings. However, within the Black River subwatershed these deposits are mostly sand. This unit is mainly found within bedrock valleys and thins laterally away from the valleys (Gerber and Earthfx, 2008).

Sunny Brook Drift

The Sunnybrook Drift (or equivalent) overlies the Scarborough Formation and consists of clast-poor silt and clay deposited by glacial and lacustrine processes. This formation was deposited in close proximity to an ice sheet as it finally reached the subwatershed about 45,000 years ago (Gerber and Earthfx, 2008).

Thornccliffe Formation

The Thornccliffe Formation (or equivalent) represents glaciofluvial deposition of sand and silty sand generally within lows in the underlying stratigraphy. South of the study area, this unit largely consists of glaciolacustrine deposits of sand, silt and clay. The Thornccliffe Formation was deposited approximately 45,000 years ago and consists of sedimentary deposits of silt-clay rhythmites and cross-laminated and cross-bedded sands (Gerber and Earthfx, 2008).

Newmarket Till

The Newmarket Till overlies the lower sedimentary sequences described above. The Newmarket Till is a dense diamict unit deposited when the Laurentide ice sheet was at its maximum extent, approximately 18-20,000 years ago. This unit can be up to 100 m thick but is generally 20-30 m thick. The Newmarket Till is an important formation as it hydraulically separates the upper and lower aquifers and serves as a protective barrier to the deeper groundwater resources in the area.

Channel Sediments

Following its deposition, the Newmarket Till was subject to erosional processes by glacial meltwater that modified the upper surface of the till. In some locations, the processes fully or partially eroded entirely through the till (Figure 2-11). These features have been termed tunnel channels by the GSC, who believe these erosional events occurred beneath glacial ice (Sharpe *et al.*, 2004). The location of the major Newmarket Till tunnel channel erosion features as interpreted in the CAMC-YPDT study are shown on Figure 2-12. These channels cover much of the study area, as major erosional channels occur beneath the Holland Marsh extending from Lake Simcoe through Schomberg, and within the Aurora and Newmarket area. These erosional channels were largely infilled with sand and silt deposits as meltwater energy waned. Extensive work was carried out to identify these channels and map the upper silt layer that frequently occurs within them. The nature of the infill material is important for understanding the groundwater flow system as it determines the degree of hydraulic communication between the shallow and deeper aquifer systems.

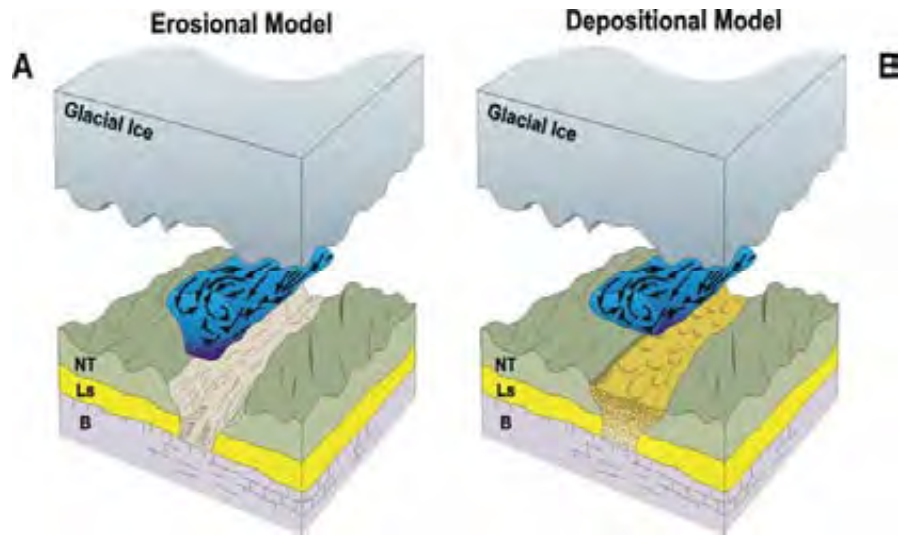


Figure 2-11 Interpreted erosional and depositional process in the tunnel channels (GSC)

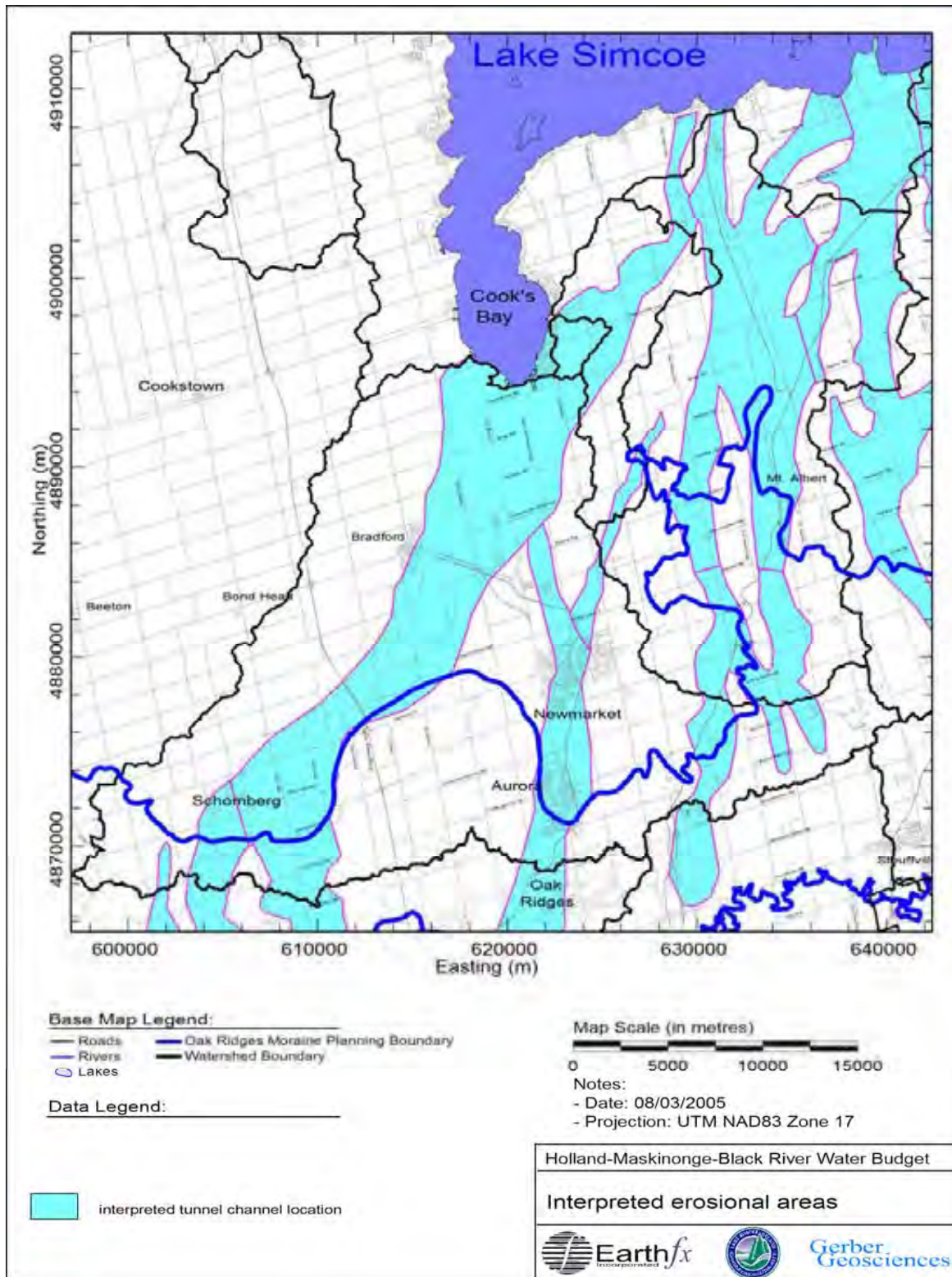


Figure 2-12 Interpreted subsurface erosional channel or tunnel channel locations where Newmarket Till and older deposits are either partially or completely eroded (Gerber or Earthfx, 2008).

Oak Ridges Aquifer complex and/or Mackinaw Interstadial deposits

The Oak Ridges aquifer complex occurs above the Newmarket Till and is the most prominent geologic feature in the subwatershed. The Oak Ridges aquifer complex is an interlobate glacial deposit that largely consists of sand and gravel layers that can be up to 150 m thick. To the north and south of the ORM, sand units overlying the Newmarket Till have been categorized as belonging to the Mackinaw Interstadial deposits. Mackinaw Interstadial sediments generally only occur locally within areas of low topography upon the surface of the underlying Newmarket Till (Gerber and Earthfx, 2008).

Surficial deposits and/or weathered Halton Till

The last glacial advance in the area, approximately 13,000 years ago, led to deposition of the Halton and Kettleby Tills which generally have a silt to clayey-silt matrix. These till deposits overlie the ORM and Mackinaw Interstadial units. The uppermost units, which form an intermittent surficial veneer over the underlying till deposits consist of glaciolacustrine sand, silt, and clay associated with local ponding of glacial meltwater, and with Glacial Lake Schomberg and subsequently Glacial Lake Algonquin (Gerber and Earthfx, 2008).

Figure 2-14 and Figure 2-15 show typical cross sections through the study area depicting the key features of the geologic and hydrogeologic system. Figure 2-13 shows the area the cross section depicts. Figure 2-15 shows a west-east cross section along Aurora Road, whereas Figure 2-15 shows a north-south cross section along Yonge Street. Key components of the geologic system include (1) thick deposits associated with the ORM; (2) erosional breaches (tunnel channels) through the Newmarket Till; and (3) thickening of the Scarborough Formation sand deposits within the bedrock valleys. The geologic formation names used in this study are from the Scarborough bluffs area situated along the shore of Lake Ontario (Karrow, 1967) and are also used by subsequent researchers (see, for example, Barnett et al., 1998). The term “or equivalent” is used to denote similar deposits situated to the north of the moraine that are interpreted to represent the approximate time or position in the sequence, as determined to the south of the Moraine.

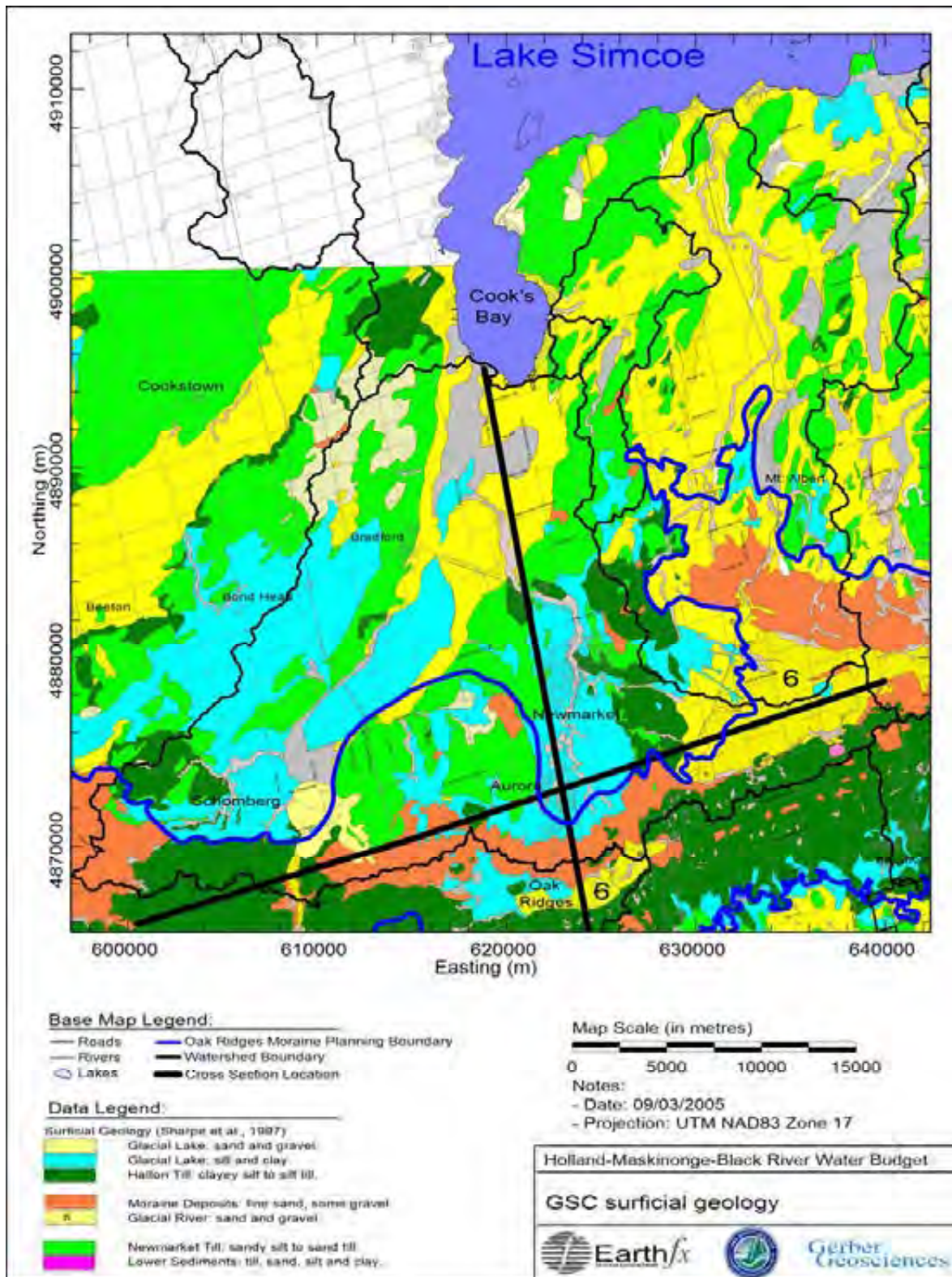


Figure 2-13 Surficial geology and north-south, west-east cross section lines (from Sharpe et al., 1997).

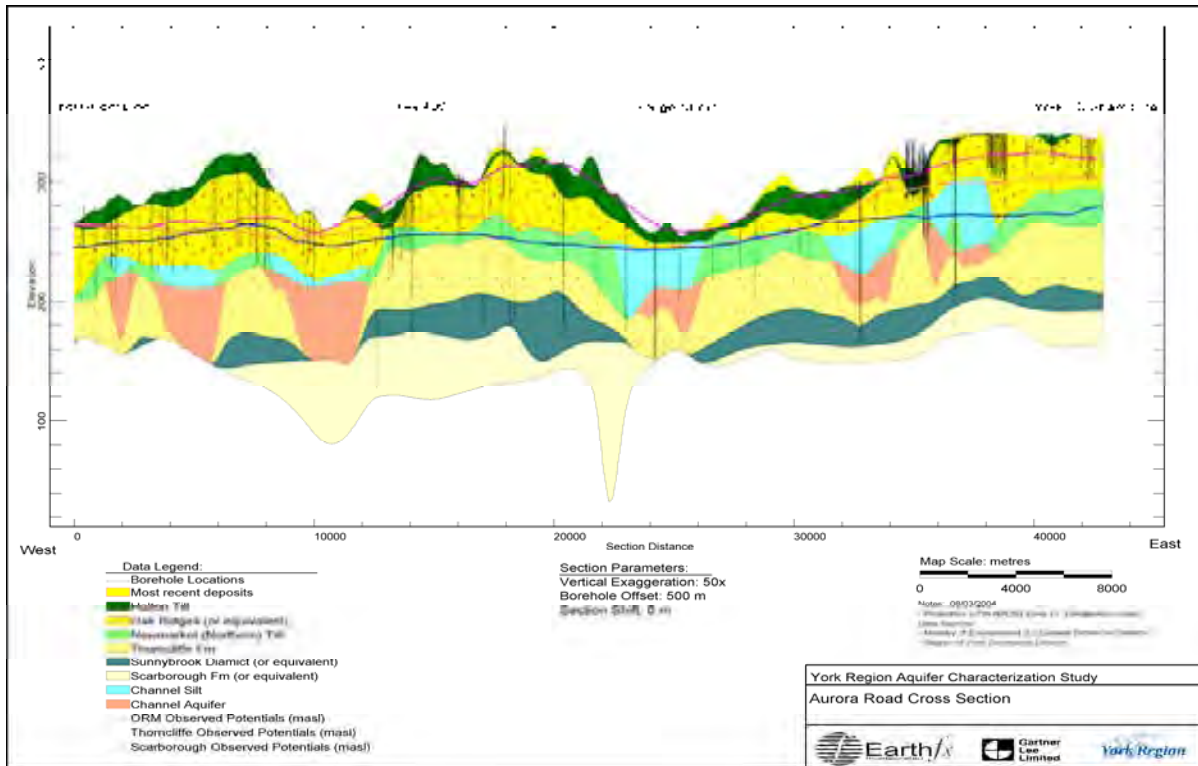


Figure 2-14 West-east cross section (Earthfx & Gerber Geosciences, 2008).

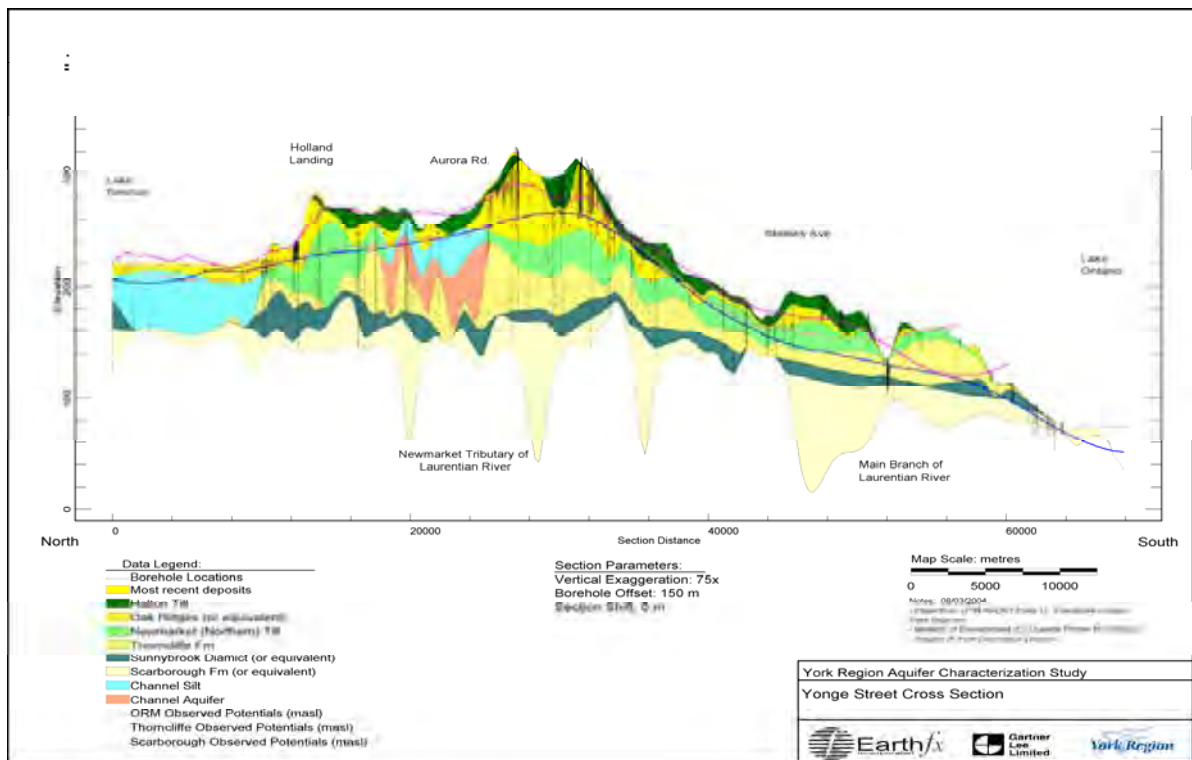


Figure 2-15 North-south cross section (Earthfx & Gerber Geosciences, 2008)

3 Best Management Practices for the Black River Subwatershed

3.1 Introduction

The remaining chapters of this plan characterize current condition of the five main parameters contributing to subwatershed health (water quality, water quantity, stream geomorphology, aquatic habitat and terrestrial natural heritage), and identifies some of the stressors leading to their current condition. For each of these parameters, a number of recommended actions have been identified in order to improve conditions. While these may include prohibition or restriction of specific activities, especially in environmentally sensitive areas, expanded use of best management practices (BMPs) will also be required to improve conditions. Best management practices can be defined as those measures intended to provide an on-the-ground practical solution to pollution and other environmental impacts from all sources and sectors. BMP refers to operational activities, physical controls or educational measures that are applied to reduce the discharge of pollutants or impacts (US EPA, 2004).

In this chapter we provide an overview of current rural/agricultural and urban BMPs. The chapter concludes by highlighting BMP opportunities within the Black River subwatershed, resulting from two recent studies by the LSRCA – Lake Simcoe Basin Best Management Practice Inventory (2009) and the Lake Simcoe Basin Stormwater Management and Retrofit Opportunities (2008).

3.2 Rural/Agricultural Best Management Practices and Controls - Phosphorus Reduction Opportunities

There are a number of Best Management practices that can be implemented in a rural setting to help improve water quality and quantity. These include manure storage and management, private septic system repair or replacement, construction of bypass channels or bottom draws for online ponds, streambank erosion control, cover cropping, tree and shrub planting, installation of cropland erosion control structures, clean water diversion, livestock access restriction, and the completion of nutrient management plans. Funding and professional assistance is available through the LSRCA's Landowner Environmental Assistance Program (LEAP) for a number of these activities. Each of these BMPs is discussed below and more detail can be found at <http://www.lsrca.on.ca/leap/>.

3.2.1 Streambank Erosion Control

Vegetation is often removed from streambanks in order to accommodate various activities (e.g. farming, urban development, recreation). This leaves the streambank vulnerable to erosion, which can affect the aquatic ecosystem and can be a source of phosphorus. Depending on the soil type, stormwater runoff and high flows in the watercourse can result in bank slumping and the loss of valuable land. The planting of trees and shrubs along a stream bank will prevent erosion by helping to bind the soil in place and slowing the flow of storm water.

3.2.2 Cropland Erosion Control Structures

These BMP projects are undertaken to reduce soil erosion, and to protect watercourses and waterbodies. Not only will they reduce the loss of valuable topsoil, but will reduce the deposition of soil particles containing phosphorus and other contaminants onto the lake and subwatershed. They can include grass waterways to slow the flow of water and cause sediment to settle; water and sediment control basins; terraces, which are built on a steep slope to enhance water retention and reduce erosion; and drop structures.

3.2.3 Cover Cropping

Cover cropping is a practice whereby plants are grown on agricultural lands where the fields would normally be left bare in between crops. Cover cropping can be used as a tool to manage soil fertility, soil quality, weeds, pests, and diseases.

Soil fertility can be improved through cover cropping – the cover crop takes up nutrients in the soil and maintains them in an inorganic form which is less likely to wash away during snow melt or precipitation events. These nutrients are then re-incorporated into the soil as the cover crop is decomposed, and made available to the newly planted crop, which is seeded over the residue of the cover crop. When used for cover crops, certain species (e.g. legumes) can be a significant source of nitrogen to the soil, as they have the capability to fix nitrogen. This can reduce, or in some cases negate, the need for chemical fertilization.

Soil quality is also improved through the use of cover crops as there are increases in organic matter; water holding capacity, as it reduces the rate and quantity of water that drains off the field; and nutrient holding and buffering capacity. As an added benefit it can also lead to increased soil carbon sequestration. Soil erosion is also reduced, as the roots help to create large soil aggregates and also hold the soil in place, and the plant material covers the soil surface when the cover crop dies off. Again, this helps to reduce the amount of soil and its associated contaminants reaching surface water through wind and water erosion.

3.2.4 Conservation Tillage

The traditional tillage method for agricultural operations generally involves tilling the soil in the fall after the completion of the harvest, and again in the spring to prepare for planting. This can result in high levels of soil erosion and nutrient loss, as large soil aggregations are broken up and left vulnerable to erosion, and the plant material which would normally aid in holding the soil in place is ploughed under during tillage. Conservation tillage is a practice where less or no tillage is undertaken, and a higher percentage of the plant residue is left on the field. This has several benefits: it requires less work and fuel, the stubble of the previous year's crop helps to hold the soil in place, increases moisture retention and infiltration, and increases the organic matter content of the soil.

There are some challenges associated with conservation tillage. These include soil compaction, increased need for pesticides to reduce the amount of weeds (which would normally be tilled under), carryover of diseases, and a possible increase in saturated or flooded soils, which can delay planting.

3.2.5 Livestock Access Restriction

Livestock that have access to watercourses can impact the water quality and affect the riparian area. The input of urine and manure directly into the water and onto low lying areas in the riparian area where it can be washed into the watercourse affect water quality. The livestock can trample streambanks, which contributes to instability, erosion, and sedimentation in the stream; while livestock in the stream can destroy spawning habitat. These issues can be avoided with the installation of fencing along watercourses to exclude livestock; cattle crossings; and alternate water sources, such as nose pumps.

3.2.6 Clean Water Diversion

These systems direct clean melt water and/or precipitation away from potential sources of contamination including manure storage and exercise yards. These consist of systems such as eavestroughs, ditches, or trenches; rainwater collection systems; or any other permanent technique for preventing rain and snow from becoming contaminated.

3.2.7 Milkhouse Waste Management

Milkhouse waste water includes excess milk, the soap and acids used to clean equipment and kill bacteria, manure, and, dirt. This waste water, when released to surface waters, can have significant impacts to water quality. There are methods, such as adding the washwater into manure storage, and installing treatment trenches and milkhouse wastewater treatment systems in combination with management practices. A common management practice is to save the first flush of milk washwater and use it as a diluted feed back to calves. These methods will prevent waste water from being discharged to surface waters.

3.2.8 Manure Storage and Management

Manure from beef and dairy operations is very high in nutrients, such as phosphorus, and bacteria. If left on the field, it can easily seep into ground and surface water sources with snow melt and/or precipitation. This can have considerable environmental and health impacts. Manure is stored in order to allow its application at the most beneficial time for crops, and to apply the manure at an appropriate time to minimize potential environmental impacts. The type of manure storage facility depends on what is being stored. Storage facilities can consist of open storage structures with runoff containment or roofed structures for solid manure; concrete or steel storage tanks for liquid manure; earthen manure storage and runoff storage; and the containment of runoff from exercise yards.

3.2.9 Private Septic Systems

Waste from the majority of residences in rural areas is treated by private septic systems. As they age, these systems can malfunction and fail, and can be a considerable source of nutrient and bacteria contamination to surface and groundwater. Malfunctions and failures of septic systems will be detected through regular inspections – if a problem is detected it should be resolved in a timely manner to minimize environmental impacts. LSWQIP provides funding for septic system repair or replacement for those systems within 100 metres of the lake or a watercourse in the watershed, as this is the zone where malfunctions can have the greatest impact.

3.2.10 Wellhead Protection and Well Decommissioning

Wellhead protection is undertaken in order to reduce the risk of contamination of well water by implementing proper construction and maintenance practices and safeguards for existing wells. Wellhead projects that can be undertaken include grading and permanently seeding the soil surface around the well, sealing the space around the well, upgrading or replacing a dilapidated well casing and/or extending a well casing 16 inches above the finished ground level, installing proper well caps, and earth moving to ensure that water is directed away from the well head.

Wells left unused or abandoned without being properly decommissioned leave the groundwater supply vulnerable to contamination. Wellhead decommissioning is undertaken in order to prevent groundwater contamination via improperly abandoned or unused wells. This is completed by properly plugging unused wells by a licensed well contractor.

3.2.11 Bypass Channels and Bottom Draw Structures for Online Ponds

Online ponds, created by damming a watercourse, can cause a host of issues on the watercourse. They can increase water temperatures, raise bacteria levels, and disrupt the natural movement of fish, invertebrates, sediment, and nutrients. The natural movement of each is imperative for a healthy aquatic system. It is possible to reduce or negate the environmental impacts caused by an online pond, without the complete removal of the pond (which is important if the pond is used for irrigation). This can be accomplished either through the

construction of a bypass channel around the pond or a bottom draw structure in the pond. A bypass channel is essentially a redirection of the watercourse around the pond, where the majority of the flow is diverted away from the pond, but enough flow is left going into the pond to maintain it. A bottom draw structure can be constructed where it would not be possible to put a bypass channel. These structures draw water from the cooler bottom waters of the pond, and this is discharged downstream to the watercourse, rather than the warm top waters from the pond flowing over the dam. While this does not negate the issues caused by the pond, it does improve conditions in the waters downstream of the pond.

3.3 Urban Environments – Stormwater BMPs

3.3.1 Background

Urban stormwater runoff occurs as rain or melting snow washes streets, parking lots, and rooftops of dirt and debris, minor spills, and landscaping chemicals and fertilizers. In the past it was common practice to route stormwater directly to streams, rivers, or lakes in the most efficient manner possible. This practice typically has negative impacts on the receiving watercourse. Over the last two decades this has changed and efforts are made to intercept and treat stormwater prior to its entering watercourses or water bodies. However, in many older urban areas stormwater typically still reaches watercourses untreated.

Urban stormwater runoff is also greatly affected by land use type. Commercial and industrial areas usually have more impervious area (e.g. paved parking lots, sidewalks, roof tops) than any other type of land use and consequently generate more urban runoff and pollution. In sharp contrast are open areas that have little, if any, paved surface area. In these areas, the natural hydrologic cycle occurs whereby water can infiltrate down into the ground to be filtered by the soil before entering local streams and watercourses or continue deeper to recharge the ground water aquifer.

The impact of stormwater runoff on stream ecosystems has been well documented and in almost every instance is detrimental to the health of local rivers and streams. Impacts to watercourses have been categorized as follows (Scheuler, 1992):

- changes to stream hydrology (flow),
- changes to stream form (channel morphology),
- degraded water quality, and
- aquatic habitat,

As the amount of impervious area increases, the natural water balance is disrupted. Evapotranspiration is decreased as there is little vegetation and the permeable soil surfaces are paved over; infiltration to groundwater is significantly reduced; and thus the runoff characteristics change. This change results in increases in the frequency and magnitude of runoff events, a decrease in baseflow, and an increase in flow velocities and energy. These changes further affect the form or morphology of the stream, including channel widening, down cutting, sedimentation, and channel braiding. These changes occur due to the increase in the erosive force associated with the increase in stream flow. As the velocity of a stream increases, the erosive force is transferred to the streambanks, and they may begin to erode. If the banks are well vegetated or armoured, the erosive force can be transferred to the stream bottom and down cutting of the streambed can occur. The results of this erosion will be additional sediment and bedload being introduced into the stream system causing a further imbalance. When deposited along the inside bend of a river, this additional sediment may transfer even more force along the outside bend. Further deposition can occur where the river gradient flattens out

and results in the creation of a braided channel. All of these changes can have significant impacts on the biological community in the watercourses (Figure 3-1).

Subwatersheds with less than 10% imperviousness should maintain surface water quality and quantity and preserve aquatic species density and biodiversity, as recommended in the Environment Canada's Areas of Concern (AOC) Guidelines (2005). The AOC Guidelines further recommend an upper limit of 30% as a threshold for degraded systems that have already exceeded the 10% impervious guideline. In the Black River subwatershed, approximately 2,100 ha (5.5%) is impervious. While the Black River subwatershed currently has a low level of imperviousness, it should be noted that research has shown that as impervious cover increases to eight to nine percent, there is a significant decline in wetland aquatic macroinvertebrate health (Hicks and Larson, 1997 in AOC Guidelines, 2005).

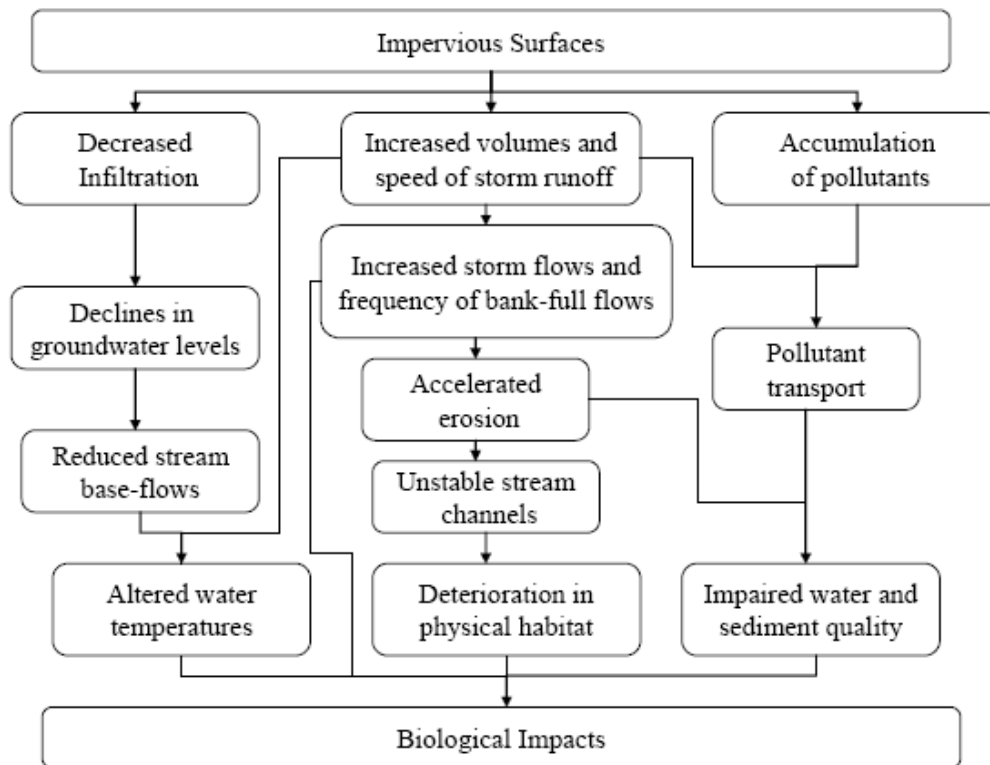


Figure 3-1 Pathways by which impervious surfaces may impact aquatic biological communities (ORM Technical Paper #13)

One of the most significant environmental impacts of stormwater runoff is to water quality. Problems with degraded water quality directly affect the aquatic ecosystem, recreational opportunities and aesthetics. This occurs as pollutants are washed off of streets, parking lots, rooftops, and roadways into storm drains or ditches which discharge to rivers, streams and lakes. Generally, concentrations of pollutants such as bacteria (e.g. *Escherichia coli*, faecal coliform, *Pseudomonas aeruginosa* and faecal streptococci), nutrients (e.g. phosphorus, nitrogen), phenolics, metals and organic compounds are higher in urban stormwater runoff than the acceptable limits established in the PWQO (MOE, 1994). Other harmful impacts include increased water temperature and the collection of trash and debris.

It is a combination of all the previously mentioned changes (hydrology, channel morphology, and water quality) that influence stream ecology and health. Impacts on the aquatic community

range from the outright destruction of habitat to reductions in stream productivity and species diversity. The destruction of habitat can occur as spawning beds, nursery areas and structure are covered with sediment. Another way in which habitat can be destroyed is through thermal degradation. Cold water streams are defined as having stable water temperatures that generally do not exceed 20°C, even in the warm summer months. Stormwater runoff can reach temperatures exceeding 30°C because it is draining off of warm pavement. These inputs of warm water can significantly impact the temperature regime within cold water systems. The reduced infiltration of precipitation due to the impervious surfaces can also result in lower groundwater levels, and a potential reduction in the amount available to be discharged as baseflow. Streams that once flowed permanently may become intermittent, and flow can disappear altogether.

3.3.2 Stormwater Control

There are various methods of controlling stormwater runoff, from small-scale single lot controls to larger scale end-of-pipe stormwater management facilities (SWMF). The most common types of SWMF include wet ponds, dry ponds, and artificial wetlands.

Based on the Stormwater Practices Manual (MOE, 1994, 2003), there are various levels of stormwater control established to ensure the protection of receiving waters (e.g. watercourse, ditch, lake). These guidelines were produced by the Ministry of Environment taking into consideration concerns from the Ministry of Natural Resources (MNR) (Fish Habitat Protection Guidelines for Developing Areas, 1994). Four levels of protection were established focusing on the ability of SWM pond to control and remove suspended solids.

Level 1 is the most stringent level of protection designed to protect habitat which is essential to the fisheries productivity (e.g. spawning, rearing and feeding areas) and requires 80% removal of suspended solids.

Level 2 protection calls for a 70% removal of suspended solids. In this instance the receiving water can sustain the increased loading without a decrease in fisheries productivity.

Level 3 controls are relaxed further requiring a 60% sediment removal rate again reflecting the lower quality of the receiving water for fish production.

Level 4 controls exclusively address retrofit situations where, due to site constraints the other levels of control cannot be achieved. Level 4 protection is not to be considered for any new development, only for instances where uncontrolled urban areas can implement some SWMF to improve environmental health.

It is important to realize that, while these guidelines are specific to suspended solids, other pollutants such as bacteria, metals, and nutrients (e.g. phosphorus) are reduced by the same controls. Due to severe water quality problems in Lake Simcoe, and the potential destruction of the cold water fishery (e.g. lake trout *Salvelinus namaycush*), the entire watershed has been deemed a special policy area. As a result, all new development in the watershed since 1996 has been required to construct SWMF that meet the most stringent criteria or Level 1 protection. This special policy designation was a result of a recommendation contained in the Lake Simcoe Environmental Management Strategy (LSEMS) "Our Waters, Our Heritage, 1995" report, which deals exclusively with efforts to reduce phosphorus inputs to Lake Simcoe.

Dry ponds, also referred to as quantity control facilities, provide negligible water quality improvement benefits, instead acting to control and slowly release stormwater runoff to receiving water bodies. These facilities reduce the risk of flooding and mitigate hydrologic and channel morphology impacts associated with stormwater runoff.

3.3.3 Urban Environments – Employing Other Urban Best Management Practices and Stormwater Control Measures

There are some sections of existing urban areas where stormwater pond retrofits are not possible. These are largely the old sections of towns including the downtown core, commercial and industrial areas developed long before stormwater management practices were developed. To ensure that these areas are addressed, existing control measures should be undertaken along with newer, innovative, and unconventional BMPs are being recommended.

Street Sweeping

Street sweeping is practiced in most municipalities within the subwatershed. Street sweeping involves mechanically removing dirt and debris from streets and parking lot surfaces, thereby reducing the amount of pollutant available to be washed into area watercourses during rain or snow melt events. While the effectiveness of street sweeping for pollutant removal is thought to be relatively low compared to other accepted stormwater BMPs (the estimated removal rate from a recent Environment Canada study is 10 – 30 grams per curb kilometre [Rochfort *et al.*, 2007]), this method does have the benefit from a water quality perspective in that it can be undertaken in areas where structural stormwater controls do not exist. Therefore, efforts to target additional street sweeping programs specifically within these uncontrolled areas will result in more effective water quality control. Targeted street sweeping in the uncontrolled areas in the Towns of Georgina and East Gwillimbury would result in an estimated phosphorus reduction of 26 to 77 kilograms per year, depending on the removal rate, though the actual reduction in the Black River subwatershed would be lower than this as portions of these municipalities lie in other subwatersheds.

Rainwater Harvesting

Canadians could be considered one of the more wasteful societies in the world with regard to water. For example, the use of potable water for flushing toilets and irrigating lawns and cropland is a waste of a valuable resource. One method of reducing this wasteful use of water is rainwater harvesting, which involves the collection and storage of rainwater, usually from rooftops and other hard impermeable surfaces. The water can then be stored in tanks and used for non-potable uses such as washing cars, irrigating lawns, and flushing toilets. The storage tanks can range from a barrel at the bottom of a home's downspout to a large industrial-size facility with multiple tanks, pipes, pumps, and controls.

In addition to the conservation of potable water, the benefits of rainwater harvesting include reducing pollution from stormwater runoff and flood control. Collecting and storing stormwater decreases the volume and rate of runoff, which reduces the potential for the runoff to pick up pollution, as well as reducing the risk of flooding.

Under their Water for Tomorrow program, designed to promote water conservation, York Region offers rain barrels at a reduced price. While the widespread use of this practice, combined with downspout disconnection and other water conservation measures, will reduce the demand for water at peak times and reduce the potential for stormwater related issues, a more aggressive and targeted approach is recommended to achieve significant improvements for the purpose of stormwater management. For example, in the City of Portland, Oregon, water harvesting for the purpose of stormwater management is encouraged through reduced development fees if the stormwater runoff is retained on site. This has led many commercial, industrial, and institutional landowners to undertake water harvesting projects based on the reduced fee and savings associated with a decrease in water use.

There are some concerns with large scale water harvesting, particularly with cost, maintenance, and public acceptance. Another concern is the potential harmful impact of these large-scale takings on baseflow and maintaining environmental flows to surface waters. These concerns can be mitigated by conducting a proper water balance for the affected site to ensure that there is adequate water to support baseflow.

Ditches/Grassed Swales

In the past, subdivisions were not built with curb and gutters which connected to storm sewers, but simple ditches to convey water away from roads and homes. Ditches have a number of benefits over curb and gutter systems. They are much less expensive to construct, reduce the size required for stormwater management facilities, allow water to infiltrate into the ground, and provide some snow storage during the winter months. The main drawbacks of ditches are that they use more space and are not as easy to maintain as curb and gutters.

The use of ditches and grassed swales is now making a comeback as resource managers and planners have realized the environmental benefits. Ditches and grassed swales have been estimated to remove 30% of the phosphorus, 70% of the suspended solids, and greater than 50% of certain metals and hydrocarbons contained in urban runoff (Low Impact Development Center, 2003 <http://www.lowimpactdevelopment.org/>).

When grassed swales and ditches are combined with bioretention facilities or infiltration galleries, there can be a greater benefit to water quality and quantity. These areas require more routine maintenance than do curb and gutter systems, and are therefore more costly, but the planting of native grasses, shrubs, and trees can also be undertaken to add aesthetic value and can significantly improve the public's acceptance of these features.

Roof Top Storage/Green Roofs

Providing roof top storage to retain rainfall is a common practice currently employed within the GTA and the Lake Simcoe watershed. The concept is to reduce the amount of runoff and subsequent pollution resulting from a building/structure. Roof top runoff is also controlled using a combination of other BMPs such as infiltration galleries, soakaway pits, and bioretention facilities. Infiltration galleries and soakaway pits can be constructed underneath existing infrastructure such as parking lots and boulevards and therefore don't constrain the developable area. Treating the runoff in a bioretention facility is probably the most effective method, but it requires land to construct and is therefore less attractive.

Green roofs were developed as an alternative to the above mentioned practices for treating roof top runoff. Green roofs have been described as the creation of a contained green space on a roof for the purpose of improving water quantity and quality control. Green roofs are constructed by first placing an impermeable membrane on the roof top followed by a drainage medium and soil. The roofs are then planted with a variety of ground covers. Research conducted into green roofs has documented that there are additional benefits associated with their construction. These include reduced energy consumption and cost, improved air quality, and a reduction in the urban heat island effect.

Soakaway Pits, Infiltration Galleries, Bioretention, and Permeable Pavement

These BMPs, while different, have a common objective – to reduce surface water runoff by infiltrating water back into the ground. They are more useful for quantity control, reducing peak runoff and flooding, and maintaining the water balance. There is also a benefit to water quality, by reducing the volume of runoff, they minimize water contamination.

Soakaway Pits

Soakaway pits are the smallest and least expensive of these BMPs. They are designed to control roof top runoff from smaller buildings. They should be located well away from building foundation drains, and require well-drained soils. They are sized according to the amount of roof runoff they will receive – a typical soakaway pit is 4-5 ft square, 3-4 ft deep, and can be covered in grass or stone. This is one of the few BMPs that a homeowner can install, with instructions for their construction easily accessible on the internet.

Infiltration Galleries

Infiltration galleries can include trenches, chambers, and large basins. They are generally designed to control larger volumes of runoff and are often twinned with some form of sediment control when involved with treating parking lot runoff. This ensures that they do not become plugged and increases their operational lifetime.

Bioretention

Bioretention is a BMP that is designed to control water quantity and improve water quantity using the chemical, biological, and physical properties of plants, microbes, and soils to removal pollutants from stormwater runoff and facilitate its infiltration. They are generally used in parking lots, road medians, and in conjunction with grassed swales, and can be significantly less expensive than traditional stormwater BMPs. While the design may vary, they generally consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. They are designed such that runoff (usually as sheet flow from a parking area, though they can be adapted to receive flow from a curb and gutter system) first reaches the grass buffer, where the flow of water is slowed and some particulates are filtered out. It then flows into a sand bed, which further slows the flow, and spreads the runoff along the length of the ponding area. The ponding area is designed for the water to pond to a depth of approximately 15 cm, where it is stored and may undergo a number of natural processes; it then infiltrates into the soil within approximately four days (US EPA, 1999). The processes that can take place in a bioretention facility include (Prince George's County, 2007):

- Sedimentation
- Adsorption of pollutants to soil particles
- Filtration
- Volatilization of hydrocarbons and other pollutants
- Plant uptake
- Cooling of runoff water
- Decomposition
- Phytoremediation
- Bioremediation
- Storage capacity

These facilities are not appropriate for some areas, such as those where the water table is within 1.8 m of the ground surface. There have been some concerns with their use in cold climates as the soil may freeze, preventing runoff from infiltrating into the soil during the winter months, though a recent study by the Toronto and Region Conservation Authority's Sustainable Technologies Evaluation Program (TRCA, 2008) found that the bioretention area was an effective means for draining melt water, so long as it is designed to prevent freezing at the inlet of the area. Temperatures generally remained above freezing in the bioretention area due to microbial activity in the soil and an insulating layer of snow. Other considerations include the salt tolerance of the plants used in the area, the phosphorus content of the soil (if this is high, the bioretention area may actually contribute to phosphorus loading), and the annual inspection and maintenance requirements.

Permeable Pavement

Permeable pavement is another option for reducing runoff through infiltration, particularly from parking lots, which can generate large volumes of runoff. Forms of permeable pavement include porous pavement, cement pavers, and other turf grass pavers. While there are obvious benefits to reduce runoff and prevent flooding and erosion problems, there can be concern over potential groundwater contamination from the oils, metals, and other contaminants that accumulate on pavement.

Oil Grit/Hydrodynamic Separators

A typical oil/grit separator (OGS) operates by settling sediments and large debris out of stormwater runoff, and ultimately separating oils from the water. The units generally consist of 3-4 chambers, each designed for a specific function. The first chamber, referred to as the Grit Chamber, settles coarse sediment and large debris by slowing the flow of the water and screening larger debris with a trash rack. From there, the stormwater moves to the second chamber, the oil chamber, which traps and separates surface oils and grease from the stormwater runoff. This separation occurs because oil is lighter than water and floats on the surface. The discharge pipe is located near the bottom of the chamber, allowing the oil to pool on the surface and be contained. The third chamber houses the stormwater outlet pipe that discharges the overflow to the storm drain system.

These systems are effective at removing oil and sediment, but their capacity for phosphorus removal is low. Therefore, they should be used in combination with other stormwater practices. Another important consideration is maintenance – their efficiency is dependent upon regular maintenance. This involves cleaning them out at least twice per year and as necessary after major storm events. The maintenance costs can be high because they can contain hazardous materials which need to be safely disposed of.

Some manufacturers have tried to increase the effectiveness of OGS for removing particulate and oil as well as additional contaminants such as phosphorus. An example of this is Imbrium Systems Incorporated's Jellyfish System. Systems such as this should be explored through pilot projects in the urban and industrial areas of the subwatershed.

Road Salt

Road salt has become an increasingly important issue as the urban areas of the Lake Simcoe watershed expand. The Canadian Environmental Protection Act defined road salt containing chloride salts as toxic under the Act (Environment Canada, 2001). Analysis of surface water quality throughout the Lake Simcoe watershed shows an increasing trend in chloride concentrations (see water quality section). The use, storage and application of road salt as well as disposal of snow should be conducted in accordance with the *Code of Practice for the Environmental Management of Road Salts* (Environment Canada, 2004). York Region does have a Salt Management Plan, aimed at ensuring the proper timing and amount of road salt in order to reduce the amount needed and the impacts to the environment from its use. Local municipalities should adopt similar plans and/or the *Code of Practice*. To reduce the area of roads requiring salt during the winter, and also to limit the amount of impervious area, municipalities should also explore the feasibility of varying road widths – narrower streets could be used on less travelled routes to reduce impervious area, rather than simply using a standard width.

3.4 Opportunities for BMPs in the Black River subwatershed

3.4.1 Urban BMP opportunities

The *Lake Simcoe Basin Stormwater Management and Retrofit Opportunities* report (LSRCA, 2008) identified and evaluated opportunities to control phosphorus from existing urban areas. In these urban areas, stormwater runoff should be addressed through stormwater pond retrofits. These include creating facilities in uncontrolled catchments or upgrading existing facilities or quantity only facilities to a higher level of control (i.e. Level 1). The report identified a total of 14 retrofit opportunities in the four urban areas in the Black River subwatershed. These have the potential to reduce over 300 kg/year of phosphorus entering the river, and ultimately the lake (Figure 3-3). Details on these retrofits can be seen in LSRCA's *Lake Simcoe Basin Stormwater Management and Retrofit Opportunities* report, published in 2007.

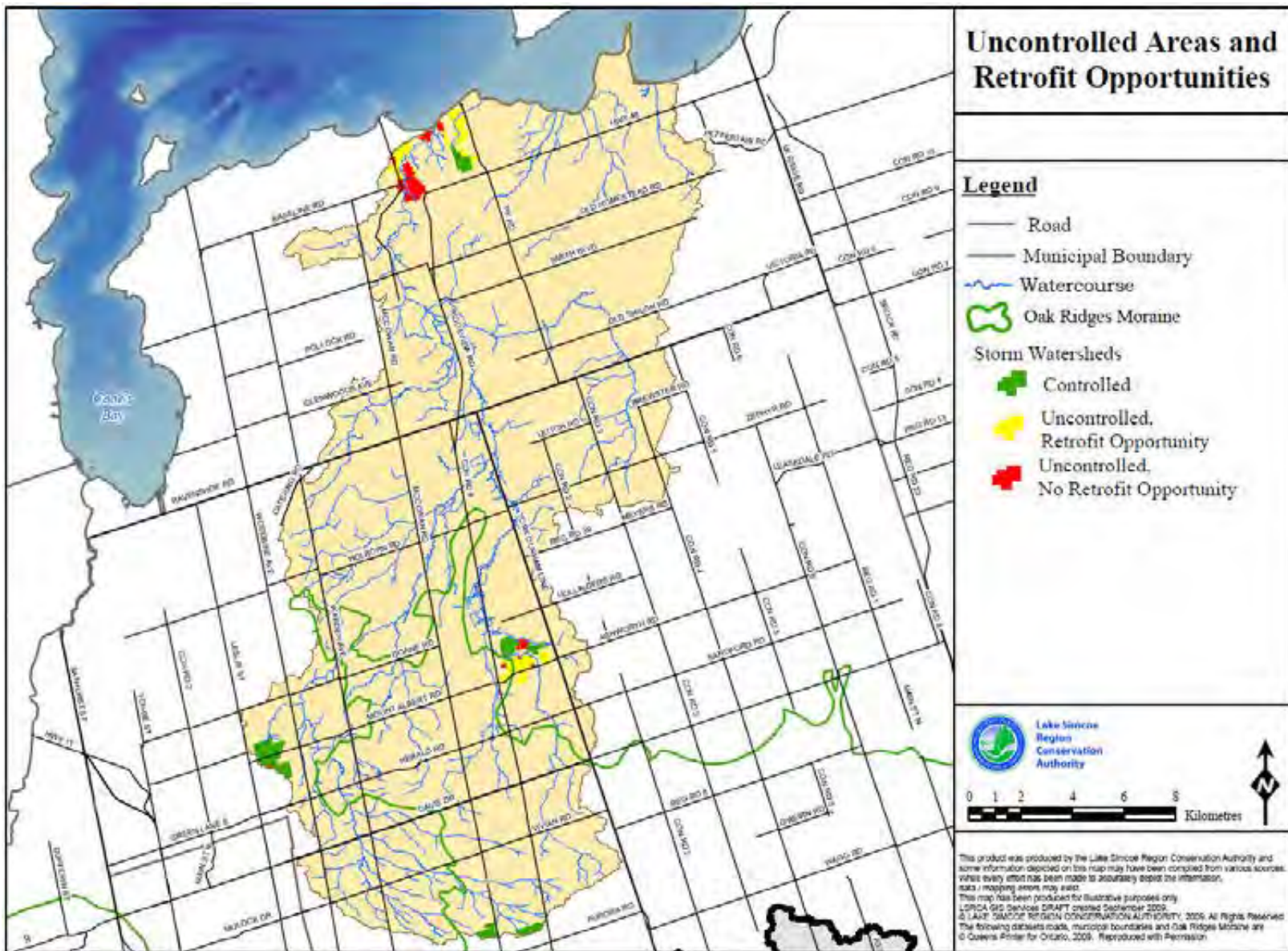


Figure 3-2 Stormwater retrofit opportunities in the Black River subwatershed

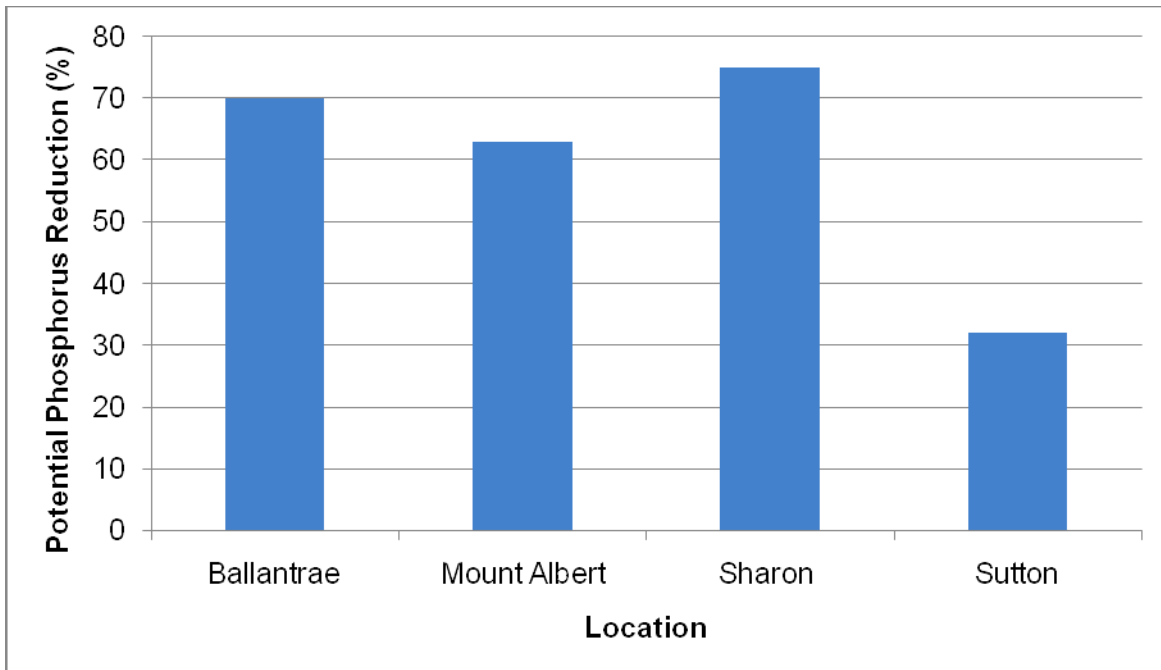


Figure 3-3 Estimated reduction in phosphorus loading as a result of completing the 14 stormwater retrofit opportunities identified in urban areas of the Black River subwatershed

3.4.2 Stream Corridor BMP Opportunities

The Lake Simcoe Region Conservation Authority (LSRCA) conducted a Best Management Practices (BMP) Inventory, spanning 12 sections of the 18 subwatersheds within the Lake Simcoe basin in 2008 (LSRCA, 2009). The purpose of the BMP Inventory was to identify opportunities for the reduction of nutrients or improvements to fish habitat within the Lake Simcoe basin. Three priority areas were identified to focus the scope of the Inventory. These three areas are agriculture, tributary, and urban. Agriculture areas include any farming and agricultural operations; tributary areas include tributaries of all orders with a variety of land use, excluding urban and agriculture; and urban areas include any section of watercourse within an urban environment, including drains, stormwater outfalls, and any other sources of nutrients that could require the implementation of BMPs to improve conditions. The BMP Inventory identified 2,420 waypoints containing 8,656 BMP opportunities throughout the entire Lake Simcoe watershed. Thirty four percent of the Black River subwatershed was surveyed, with the majority of the study area being in the middle and upper reaches of the subwatershed. A total of 490 BMP opportunities were located in the survey area, with the largest proportion of BMP opportunities being related to insufficient riparian cover (18%), impervious surface runoff (16%) and bank erosion (12%) – see Figure 3-5.

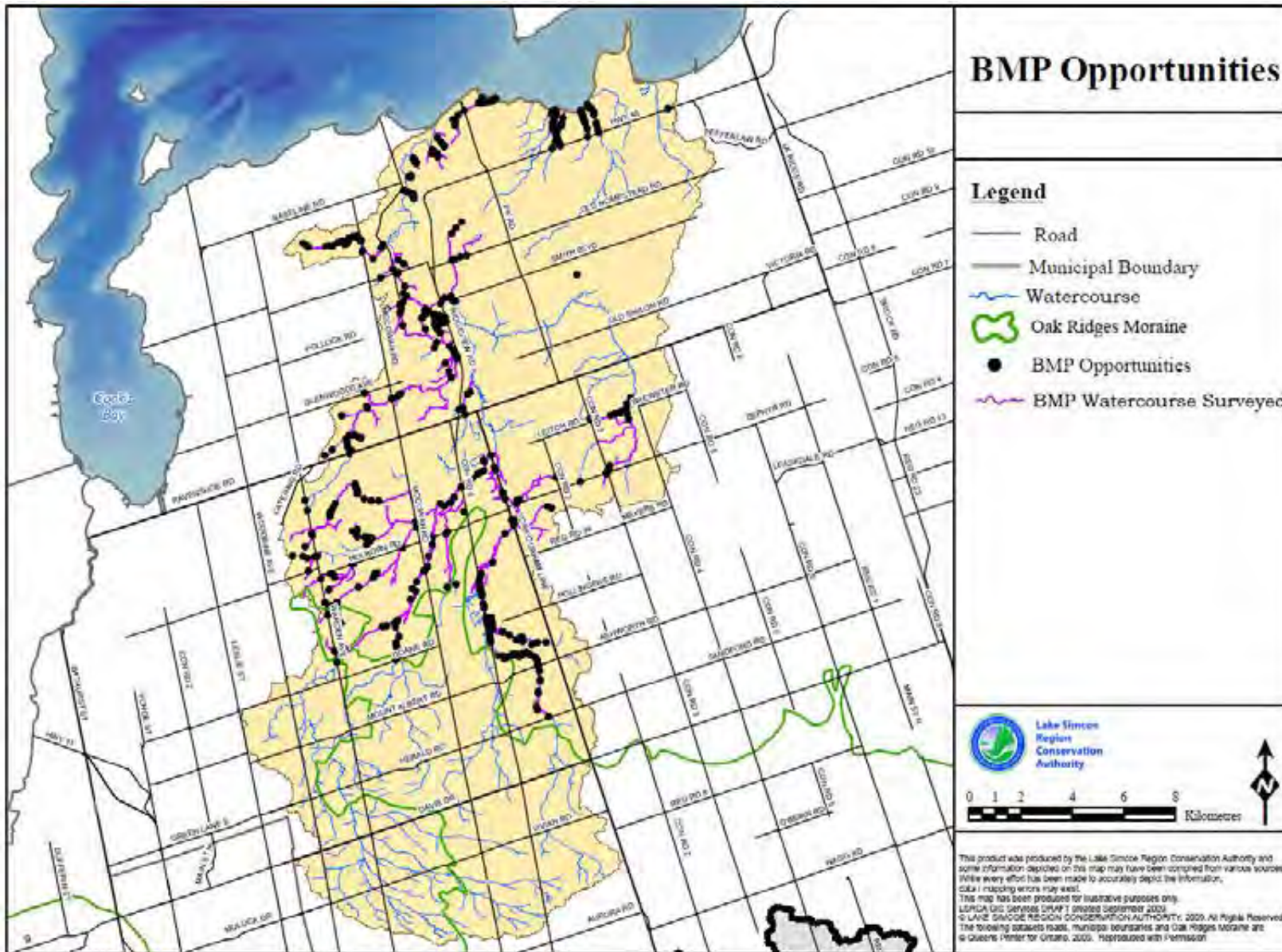


Figure 3-4 Areas of the Black River subwatershed surveyed for stream corridor BMP opportunities

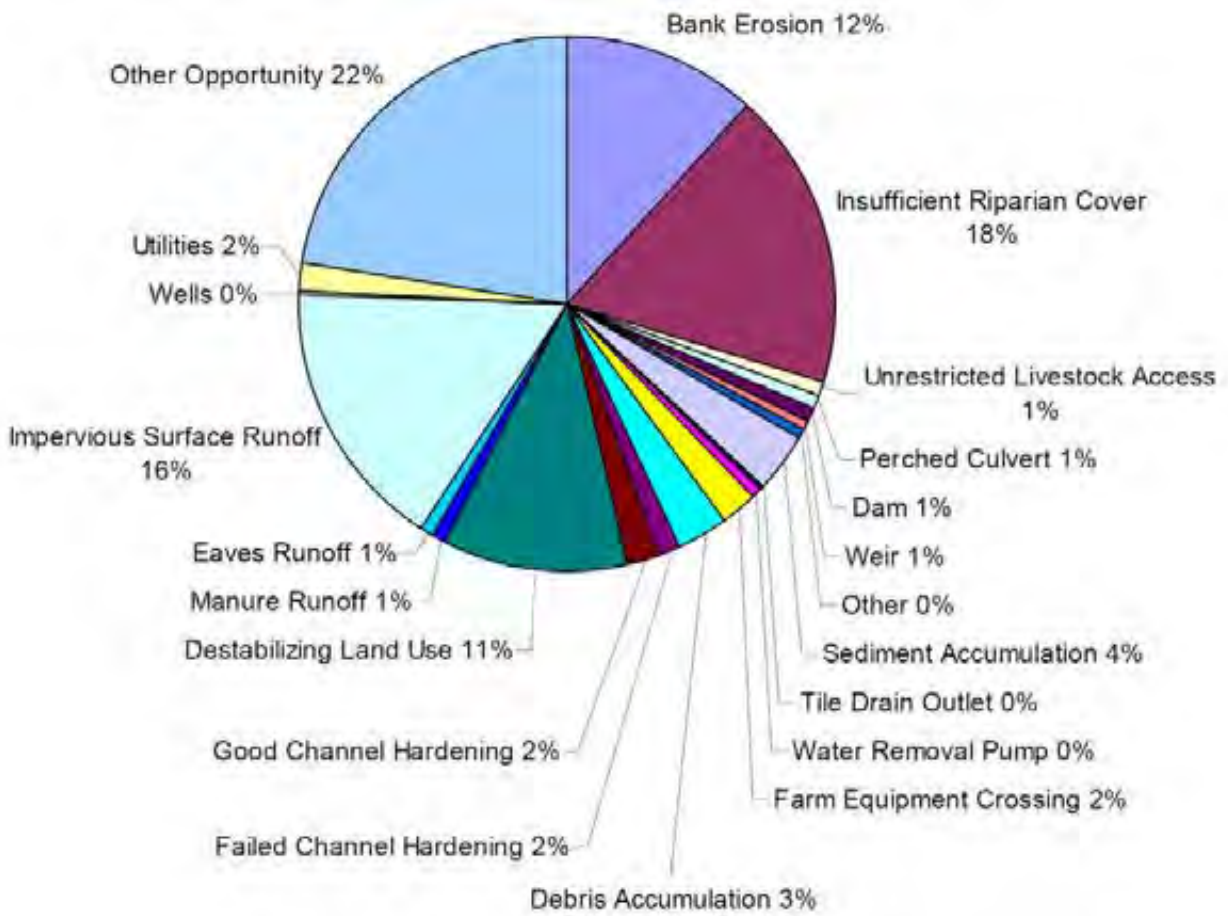


Figure 3-5 Types and relative proportion of stream corridor BMP opportunities identified in the Black River subwatershed

4 Water Quality (Surface and Groundwater)

4.1 Introduction and background

The chemical, physical and microbiological characteristics of natural water make up an integrated index we define as “water quality”. Water quality is a function of both natural processes and anthropogenic impacts. For example, natural processes such as weathering of minerals and various kinds of erosion are two actions that can affect the quality of groundwater and surface water. There are also several types of anthropogenic influences, including point source and non-point sources of pollution. Point sources of pollution are direct inputs of contaminants to the surface water or groundwater system and include municipal and industrial wastewater discharges, ruptured underground storage tanks, and landfills. Non-point sources include, but are not exclusive to, agricultural drainage, urban runoff, land clearing, construction activity and land application of waste that typically travel to waterways through surface runoff and infiltration. Contaminants delivered by point and non-point sources can travel in suspension and/or solution and are characterized by routine sampling of surface waters in the Lake Simcoe watershed. Surface water quality results are compared to guidelines relating to the protection of the aquatic ecosystem.

4.2 Current Status

4.2.1 Measuring Groundwater Quality

The LSRCA undertakes monitoring of groundwater quality at three sites in the Black River subwatershed through the Provincial Groundwater Quality Monitoring Network (PGMN).

4.2.2 Measuring Surface Water Quality and Water Quality Standards

Within the Lake Simcoe watershed there are 12 PWQMN stations, two of which are located in the Black River subwatershed. Samples are collected eight times a year on a monthly basis during the ice-free period. Each sample, analyzed for 32 chemical parameters in the Laboratory Services Branch of the Ministry of Environment, is assessed using the Provincial Water Quality Objectives (PWQO) (Ministry of Environment, 1994). As stated by the Ministry of Environment, the goal of the PWQO is to protect and preserve aquatic life and to protect the recreational potential of surface waters within the province of Ontario. Meeting the PWQO is generally a minimum requirement, as one has to take into account the effects of multiple guideline exceedances, overall ecosystem health, and the protection of site-specific uses. In instances where a chemical parameter is not included in the PWQO, the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG) is applied (Environment Canada, 2003). The CWQG were developed by the Environmental Quality Branch of Environment Canada to protect aquatic species by establishing acceptable levels for substances that affect water quality and are based on toxicity data for the most sensitive species found in streams and lakes of Canada.

Table 4-1 A summary of surface water quality variables and their potential effects and sources

Variable	Effects	Sources	Objective/Guideline
Chloride	Control of excess chloride levels is important to protect the aesthetics and taste of drinking water. High levels may also have an impact on aquatic life. Background concentrations in natural surface waters are typically below 10 mg/L.	The largest source of chloride is from road salt applications during the winter months. Other sources include waste water treatment, industry, potash used for fertilizers	➤ Env. Canada (2001): approx 210 mg/L for the protection of aquatic life.
Total Phosphorus	Phosphorus promotes eutrophication of surface waters by stimulating nuisance algal and aquatic plant growth, which deplete oxygen levels as they decompose resulting in adverse impacts to aquatic fauna and restrictions on recreational use of waterways.	Sources include lawn and garden fertilizers, animal wastes, eroded soil particles and sanitary sewage.	➤ Interim PWQO: 0.03 mg/L to prevent excessive plant growth in rivers and streams.
Total Suspended Solids (TSS)	Elevated concentrations reduce water clarity that can inhibit the ability of aquatic organisms to find food. Suspended particles may cause abrasion on fish gills and influence the frequency and method of dredging activities in harbours and reservoirs. As solids settle, coarse rock and gravel spawning and nursery areas become coated with fine particles, limiting the ecological function of these important areas. Many pollutants are readily adsorbed by suspended solids, and may become available to benthic fauna.	TSS originates from areas of soil disturbance, including construction sites and farm fields, lawns, gardens, eroding stream channels, and grit accumulated on roads	CWQG: 25 mg/L + background (approx 5 mg/L) for short term (<25 hr) exposures. EPA (1973(and EIFAC (1965): no harmful effects on fisheries below 25 mg/L
Metals	Heavy metals generally have a strong affinity to sediments and can accumulate in benthic organisms, phytoplankton, and fish. Several heavy metals are toxic to human health, fish and other aquatic organisms at low concentrations.	Most metals in surface runoff are associated with automobile use, wind-blown dusts, roof runoff and road surface materials	PWQOs: <ul style="list-style-type: none"> • Copper: 5 µg/L • Zinc: 20 µg/L • Lead: 5 µg/L • Iron: 300 µg/L • Cadmium: 0.5 µg/L • Chromium: 8.9 µg/L • Aluminium: 75 µg/L for clay free soils; 100 µg/L (CWQG)

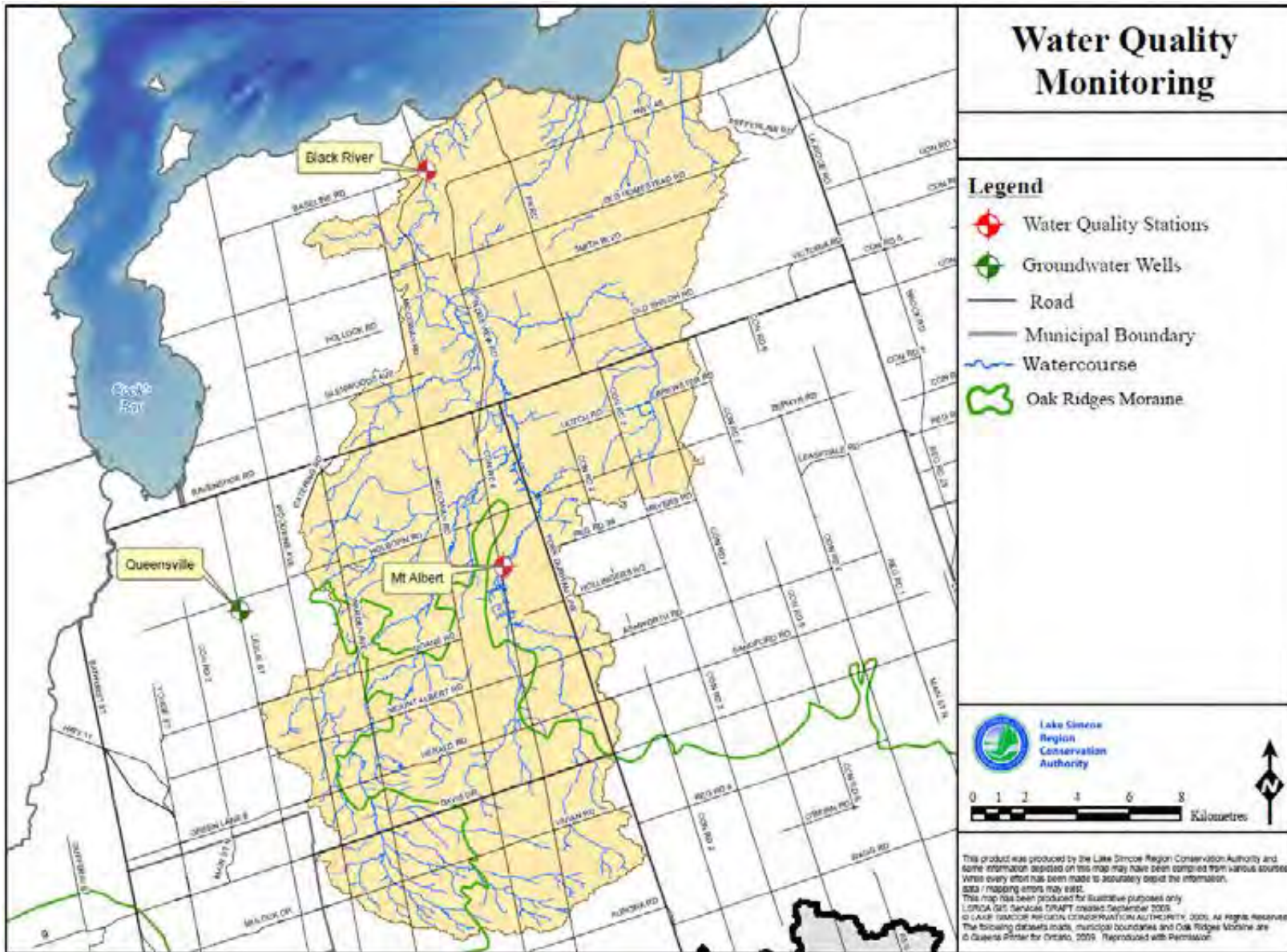


Figure 4-1 Water quality monitoring sites within the Black River subwatershed

4.2.3 Groundwater Quality Status

Few issues have been found in these samples, which are compared with drinking water guidelines. There have been some samples that have exceeded the sodium guidelines for restricted diets, though these have mainly been found in shallow wells in road right-of-ways, which would not be wells from which drinking water would be extracted. However, the site at Baldwin has shown exceedances of sodium guidelines for those with restricted diets which cannot necessarily be explained by proximity to a road right-of-way. It is important to note that this monitoring has only been undertaken for a short period of time, therefore there is not yet enough data from these sites to see any trends.

4.2.4 Surface Water Quality Status

Examination of the water quality data collected between 2002 and 2008 highlights phosphorus as the main parameter impacting water quality in the Black River and Mt. Albert Creek. Table 4-2 details the number of samples from this data set meeting the guidelines from this sampling period for the Black River Station and the Mt. Albert Creek Station, as well as other stations around the Lake Simcoe watershed. From this table, other notable parameters can be seen, these include iron and aluminium. It is also worth discussing chloride concentrations – although these currently meet the applicable objectives, chloride loads have been increasing in the subwatershed over the past several years. Current data also shows the number of cobalt exceedances has decreased and levels are typical of other Lake Simcoe stations.

Table 4-2 A comparison of Black River surface water quality to other tributaries within the Lake Simcoe watershed

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

Chloride

The Canadian Environmental Protection Act has defined road salts containing chloride as toxic under the Act (2001). This was based on research that found that the large amount of road salts being used can negatively impact ground and surface water, vegetation, and wildlife. While elevated chloride levels are primarily found around urban centres, chloride levels have been found to be steadily increasing across the Lake Simcoe watershed (LSRCA, 2007) (Table 4-2) as well as in the lake itself (Eimers and Winter, 2005). While concentrations recorded at both of the currently active monitoring stations are well below the Canadian Water Quality Guidelines value of 210 mg/L, an increasing trend in chloride is obvious in the long term data at the Mount Albert station. The trend for chloride can be seen for the Mount Albert station in Figure 4-2.

Reading & Interpreting Box Plots

A box plot presents a data set in graphical form. The shaded portion of the box represents the middle 50% of the data set showing where the majority of the values fall and the spread of the data. The line in the box is the median (50th percentile) of the data set. The whiskers show the lower and upper quartiles of the data set. The points above and below the whiskers represent outliers in the data set at the 5th and 95th percentile. A red line has also been included to highlight the applicable guideline for the parameter.

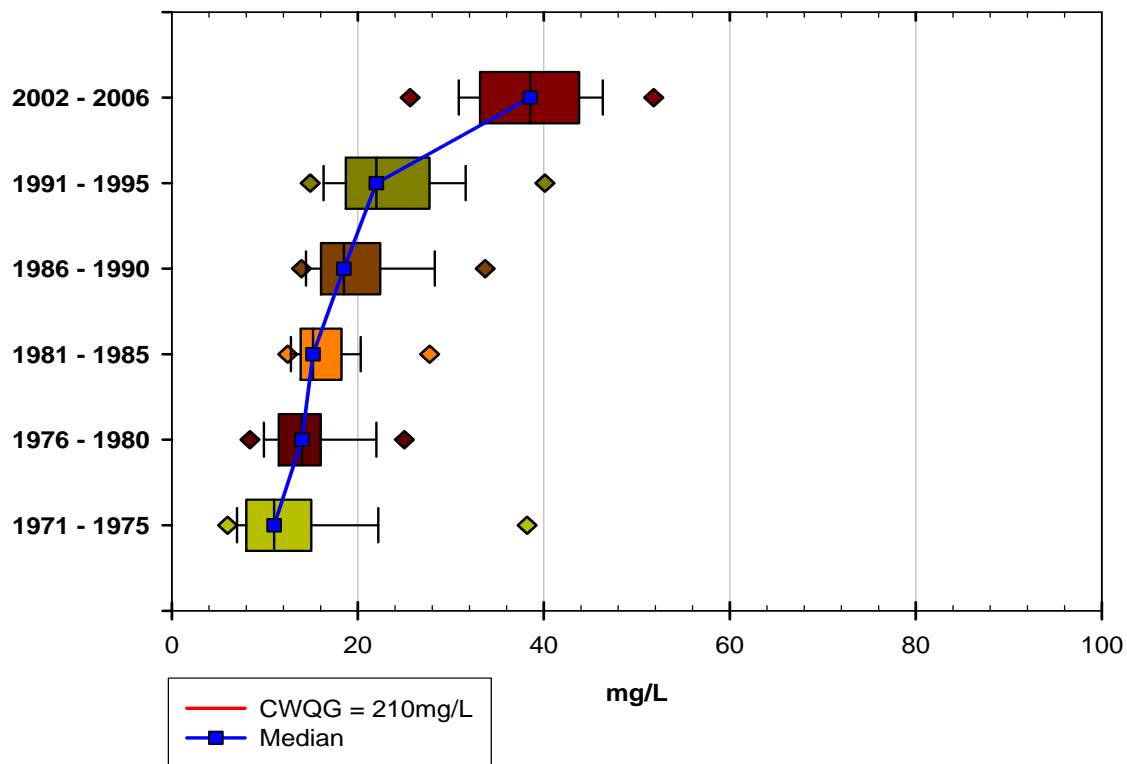


Figure 4-2 Mt. Albert Creek – chloride concentrations 1971 – 1995, 2002 – 2006 (mg/L)

Phosphorus

Total phosphorus is a measure of all forms of phosphorus (dissolved and particulate) in a water sample, including phosphates which are the most reactive (biologically accessible) form. Phosphorus is a nutrient essential to plant and animal life and is part of the natural cycle of decomposition and photosynthesis. Phosphorus binds to soil and is easily transported to

streams with eroding soil where it can be utilized by aquatic plants and algae. Excessive levels of phosphorus cause an over abundance of plants and algae which can impair the aesthetic and recreational opportunities of the lake. As the plant material dies off the resulting decomposition can lead to oxygen depletion (eutrophication) in surface waters. Eutrophication is one of the leading concerns regarding the health of Lake Simcoe (Scott *et al.*, 2006).

Historic data show a decreasing trend in phosphorus at the three historical stations through to 1995. Figure 4-3 shows concentrations at the Mount Albert station which has the longest period of record. While an obvious decrease in concentrations has occurred, closer examination shows this decrease to be slowing and possible reversing in the most recent data set. However, this is likely not due to a reversal of the long term trend, but to a change in sampling methodology. Sampling was formerly conducted on a set interval (i.e. every second Wednesday), but storm events are now being targeted. This methodology is preferred as it better characterizes the range of flows and concentrations that can occur within the subwatershed, but it has the potential to cause a bias in the data when compared with data collected under the former methodology. This is because there are more high flow samples in the data set under the new methodology. This may appear to be an increasing trend in the data, but is simply more accurate data. Further monitoring will clarify this trend.

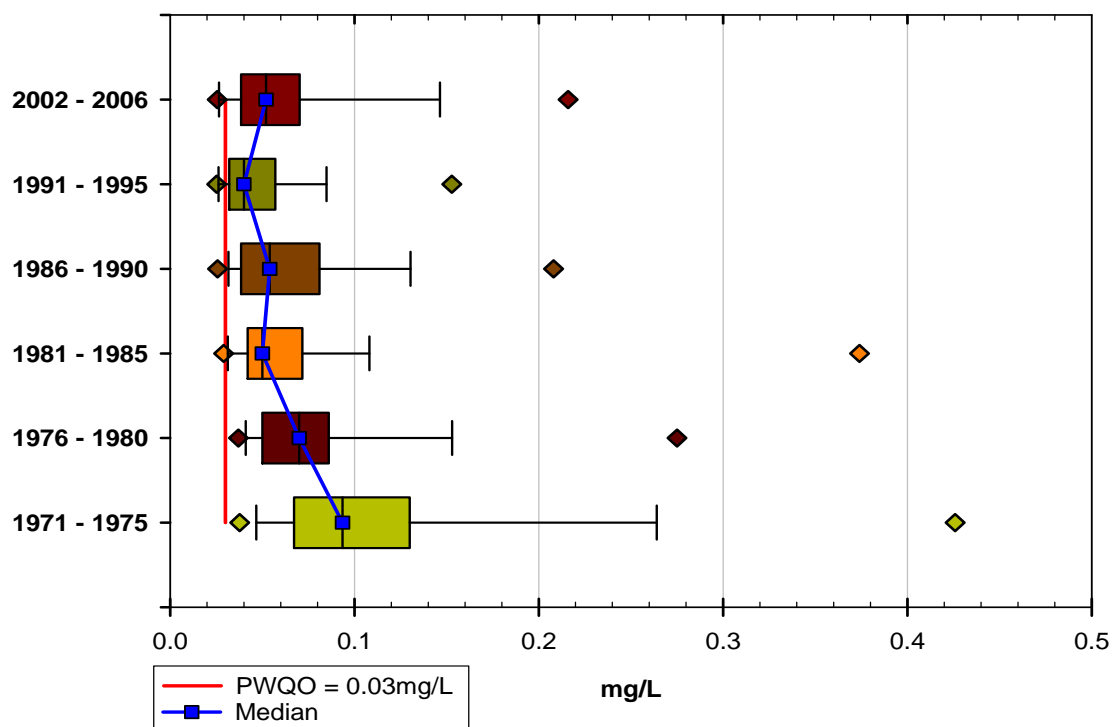


Figure 4-3 Mt. Albert – phosphorus concentrations 1972 – 1993, 2002 – 2006 (mg/L)

Water Temperature

Although it is not a substance that can be measured through water quality sampling, water temperature is another important water quality parameter. Increasing water temperatures, due mainly to impervious surfaces and ponds, can cause a number of issues. These include decreased dissolved oxygen concentrations, stress to sensitive fish and benthic invertebrate species, and the increased growth of algae. Water temperatures in the Black River are monitored using in-stream data loggers, which record the temperature at regular intervals throughout the summer.

The LSRCA has been collecting temperature data for approximately five years. While this has been sufficient for increasing our understanding of where coldwater systems are found in the subwatershed (see Chapter 6, Aquatic Habitat for more detail), it is difficult at this point to see any trends or patterns in the data. There are factors influencing water temperature in addition to upstream and surrounding land use, including air temperature and the amount of precipitation, which make it difficult to analyze trends in water temperature.

Key points - Current Water Quality Status:

- Few issues have been found in the Black River groundwater these samples, which are compared with drinking water guidelines. There have been some samples that have exceeded the sodium guidelines for restricted diets, though these have mainly been found in shallow wells in road right-of-ways, which would not be wells from which drinking water would be extracted, with the exception of the station at Baldwin which cannot necessarily be explained by proximity to a road right-of-way.
- Some surface water quality parameters within the Black River and Mt. Albert Creek have failed to meet the established objectives or guidelines. Phosphorous samples are the only samples that routinely exceed the PWQO.
- Median total phosphorus concentrations in surface water are above the PWQO, but there has been a significant decrease since high levels in the early 1970s
- Median total chloride concentration levels in surface water are well below the Canadian Water Quality Guidelines, though it should be noted that an increasing trend of chloride is obvious in the long term data.

4.3 Factors impacting status - stressors

4.3.1 Groundwater

Because groundwater moves more slowly and is subject to natural filtering as it moves through the soil, the quality of groundwater is most often better than that of surface water. As the water moves through the soil, contaminants are subject to the processes of adsorption, where they are bound to soil particles; precipitation; and degradation over time. These processes serve to improve the quality of the water.

There are some substances that can easily move through the groundwater system without attenuation by any of the aforementioned processes. The most notable of these is chloride from road salt. Further, if a contaminant source is located close to a discharge area, there may not be sufficient time and distance for natural filtering to occur prior to the water being discharged to the surface. There are also some parameters, including iron and chloride, which are naturally found within some groundwater aquifers.

Groundwater quality can also be impacted by anthropogenic factors. In rural areas, levels of contaminants including bacteria, phosphorus, nitrates, and road salt can become elevated where the groundwater is beyond the capacity of the natural filtration capability of the soils. Sources of contaminants in these areas are fertilizers, improperly functioning septic systems, manure storage facilities, and road salt application. In urban areas, groundwater can be subject to contamination by road salt, hydrocarbons, metals, phosphorus, and other nutrients. Groundwater contamination becomes an issue where it is discharged to the surface and is used by animals or humans. Source Water Protection Authorities are currently determining the

vulnerability of aquifers in the region to water quality stressors and identifying potential threats drinking water supply.

4.3.2 Surface Water

Natural Influences

Natural features in the environment generally serve to maintain water quality conditions. Naturally vegetated areas including grasslands, meadows, and woodland areas tend to improve water quality as it flows over land. The stems and roots of the vegetation slow the flow of water, enabling soil particles and other contaminants to be deposited, and increasing the amount of runoff that is infiltrated into the soil. Water is naturally filtered as it flows through the soil to the groundwater. Wetlands slow the flow of water, provide storage and can absorb some contaminants, including nutrients such as phosphorus; and thus have a natural filtering ability. The inputs of clean cool groundwater into lakes and streams also serve to improve water quality, by diluting the concentration of any pollutants in the portion of the flow coming from surface water.

Recreation

Natural areas such as streams and rivers are a popular location for recreational activities such as hiking, boating and snowmobiling. These activities if not managed correctly and undertaken in a responsible manner, can impair ecological condition of the surface water quality in the area. Impacts from recreational activities can include increased bank erosion and instability, loss of riparian area resulting in an increase in input of total suspended solids (TSS) and pollution. Stresses on these sensitive areas are increasing as a result of increasing population and diminishing natural heritage lands.

Rural and Urban Influences

Approximately 39% of the land within the Black River subwatershed is agricultural. There can be significant water quality concerns associated with agricultural land use. Runoff from pasture and cropland can contain high levels of nutrients, sediment, and bacteria, which end up in local watercourses if the appropriate BMPs are not implemented. These BMPs can include conservation tillage, the use of cover cropping, maintaining vegetated riparian buffers, cattle fencing and the appropriate use of fertilizers and pesticides.

Runoff in urban areas, particularly those built prior to the requirement for stormwater management, can carry a host of pollutants to local watercourses. These pollutants build up on roads, driveways, parking lots, and even lawns, and are washed to watercourses during precipitation events. The pollutants that can be carried by urban stormwater runoff include nutrients and pesticides from lawns, parks, and golf courses; road salts; tire residue; oil and gas; sediment; and nutrients and bacteria from pet and wild animal faeces. Paved surfaces increase the volume and velocity of surface runoff, which causes streambank erosion, contributing further more sediment to watercourses. The requirement for stormwater management facilities in all new developments will help to mitigate these issues in urban areas, however, the ongoing maintenance of these facilities is crucial to ensuring that they continue to reduce sediment and nutrient loads as designed, otherwise these new developments would be contributing additional phosphorus to the system. Additional best management practices should also be implemented in conjunction with stormwater management wherever possible to reduce the amount of these pollutants, as even a stormwater facility with the highest level of control does not achieve 100 % removal. Of the urban area approximately 50.3% is uncontrolled, 22.2% has quantity control only, and the remaining 27.5% is controlled by Level 1 stormwater facilities (Table 4-3, Figures 4-4 and 4-5).

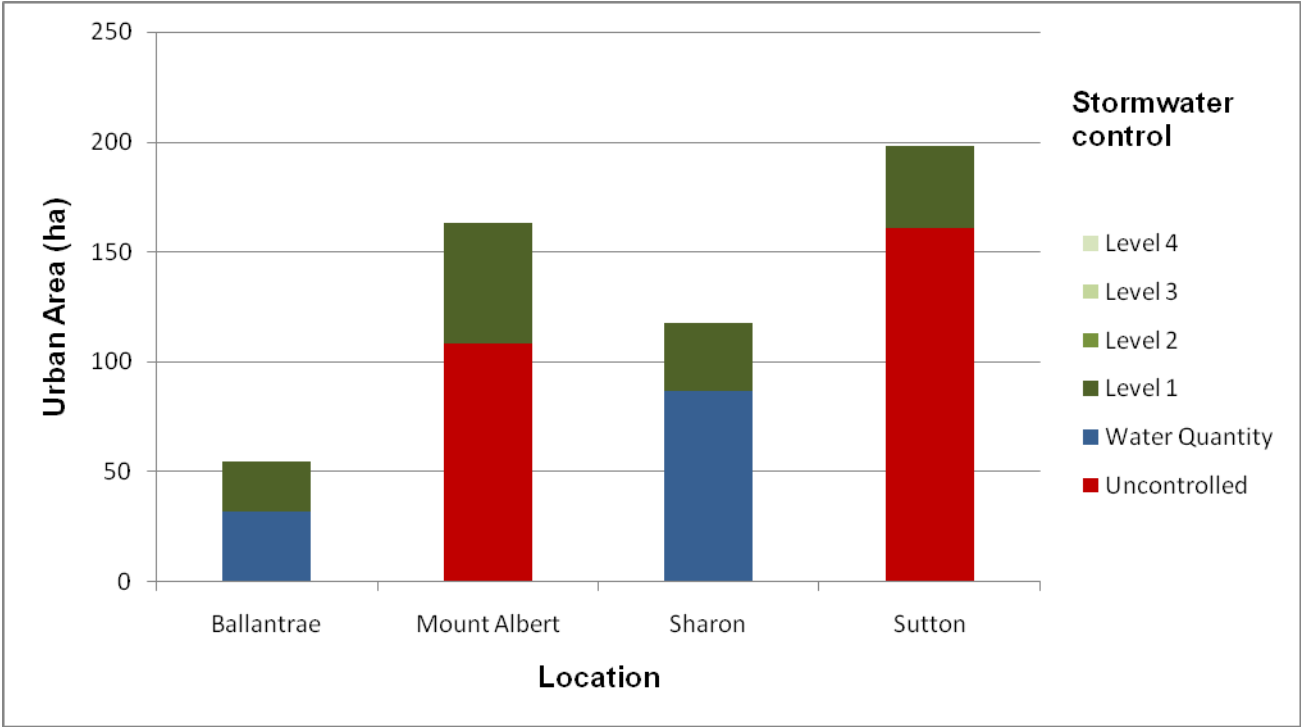


Figure 4-4 Area of stormwater control in urban regions of the Black River subwatershed

Table 4-3 Controlled vs. uncontrolled stormwater catchments in the Black River subwatershed

Location	Total Number of Catchments	Total Urban Area (ha) Used	Uncontrolled			Quantity			Level 1			Level 2			Level 3			Level 4			Controlled (Total of Levels 1 to 4)					
			#	Area (ha)	% (area)	#	Area (ha)	% (area)	#	Area (ha)	% (area)	#	Area (ha)	% (area)	#	Area (ha)	% (area)	#	Area (ha)	% (area)	#	Area (ha)	% (area)			
Ballantrae	3	55.06	0	0	0	2	31.87	58	1	23.19	42	0	0	0	0	0	0	0	0	0	0	0	0	1	23.19	42
Mount Albert	18	163.17	15	108.12	66	0	0	0	3	55.05	34	0	0	0	0	0	0	0	0	0	0	0	0	3	55.05	34
Sharon	2	117.92	0	0	0	1	86.69	74	1	31.23	26	0	0	0	0	0	0	0	0	0	0	0	0	1	31.23	26
Sutton	31	197.86	30	160.73	82	0	0	0	1	37.13	18	0	0	0	0	0	0	0	0	0	0	0	0	1	37.13	18
Totals	55	534.01	46	268.85	50.3	3	118.56	22.2	6	146.60	27.5	0	0	0	0	0	0	0	0	0	0	0	6	146.60	27.5	

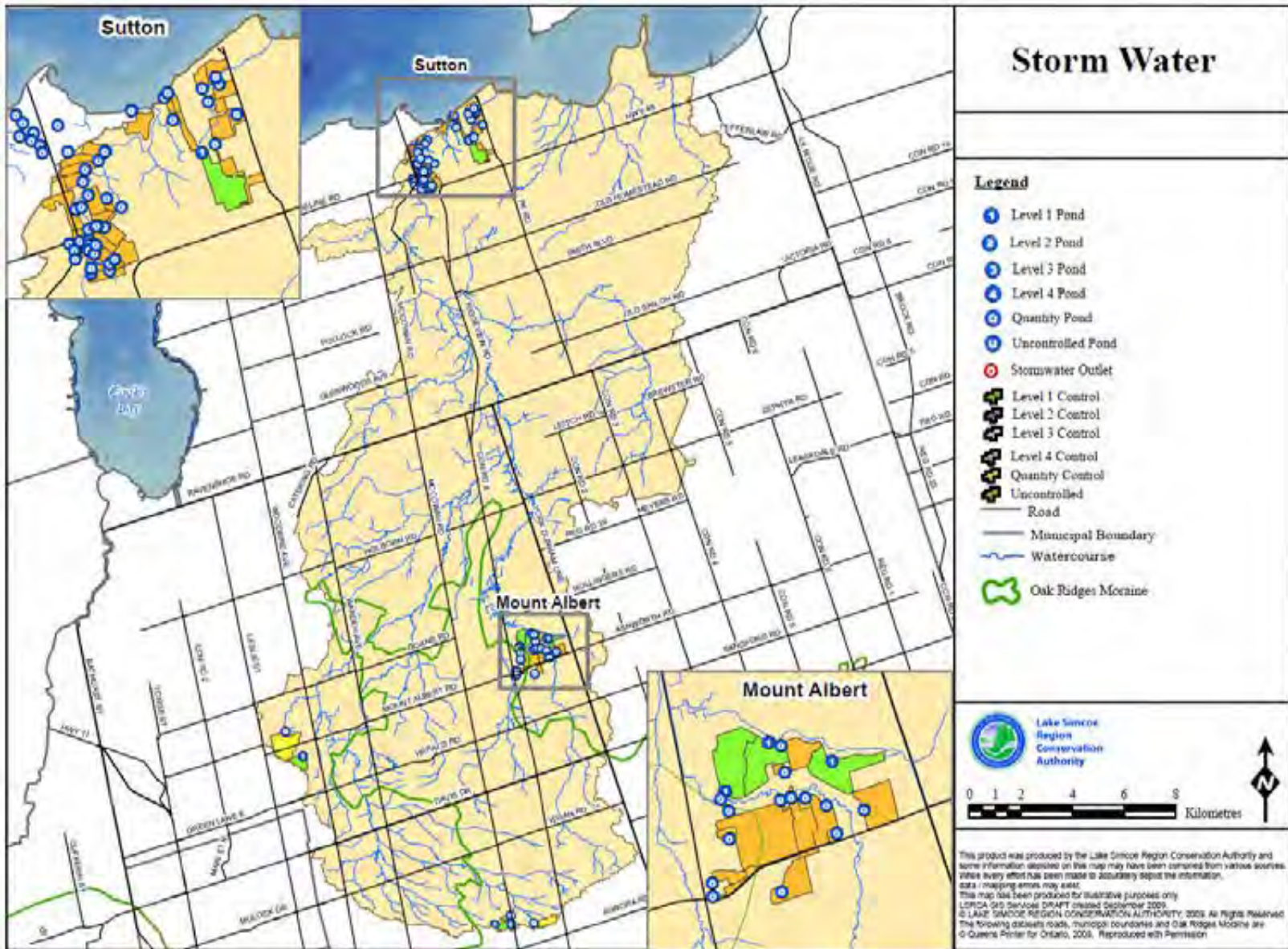


Figure 4-5 Stormwater controls in the Black River subwatershed

Phosphorus

Phosphorus load estimates are those calculated during the Assimilative Capacity Study (see text box for more information). The Assimilative Capacity Study used a watershed model (CANWET) that estimates nutrient loads based inputs such as land use, precipitation and soil type. The following table (Table 4-4) presents the average yearly phosphorus load derived from each source in the subwatershed under current conditions, the approved growth scenario, and the approved growth scenario with implementation of BMPs. The primary source of phosphorus in the Black River subwatershed under existing conditions is derived from cropland (41%) and groundwater (27%). Under the approved growth scenario, there is a projected increase in total phosphorus loads of 8% without the implementation of BMPs. The projected phosphorus load under the approved growth scenario can be reduced by approximately 33% through the implementation of BMPs. Taken together this suggests that with BMP implementation under the committed growth scenario, phosphorus loading will decrease from the current estimated load by 28% for this subwatershed

Table 4-4 Phosphorus loads by source in the Black River subwatershed

Source	Existing (kg/year)	Committed Growth Scenario (kg/year)	Change (Existing Condition to Committed Growth)	Committed Growth (with BMPs) (kg/year)	BMP Reduction Potential	Difference between Existing and Committed Growth w/BMPs	Phosphorus Load Allocation (kg/year)
Hay/Pasture	205	179	-26	171	-5%	35	171
Crop Land	1,196	1,124	-72	393	-65%	802	393
Other	235	222	-13	185	-17%	50	185
Low Intensity Development	73	94	22	76	-20%	-3	76
High Intensity Development	164	513	349	343	-33%	-180	343
Stream Bank Erosion	17	27	9	27	1%	-10	27
Groundwater	795	748	-47	688	-8%	107	688
Point Source	128	128	0	128	0%	0	
Septic System	94	94	0	94	0%	0	94
TOTAL	2,907	3,129	223	2,105	33%	802	1,977

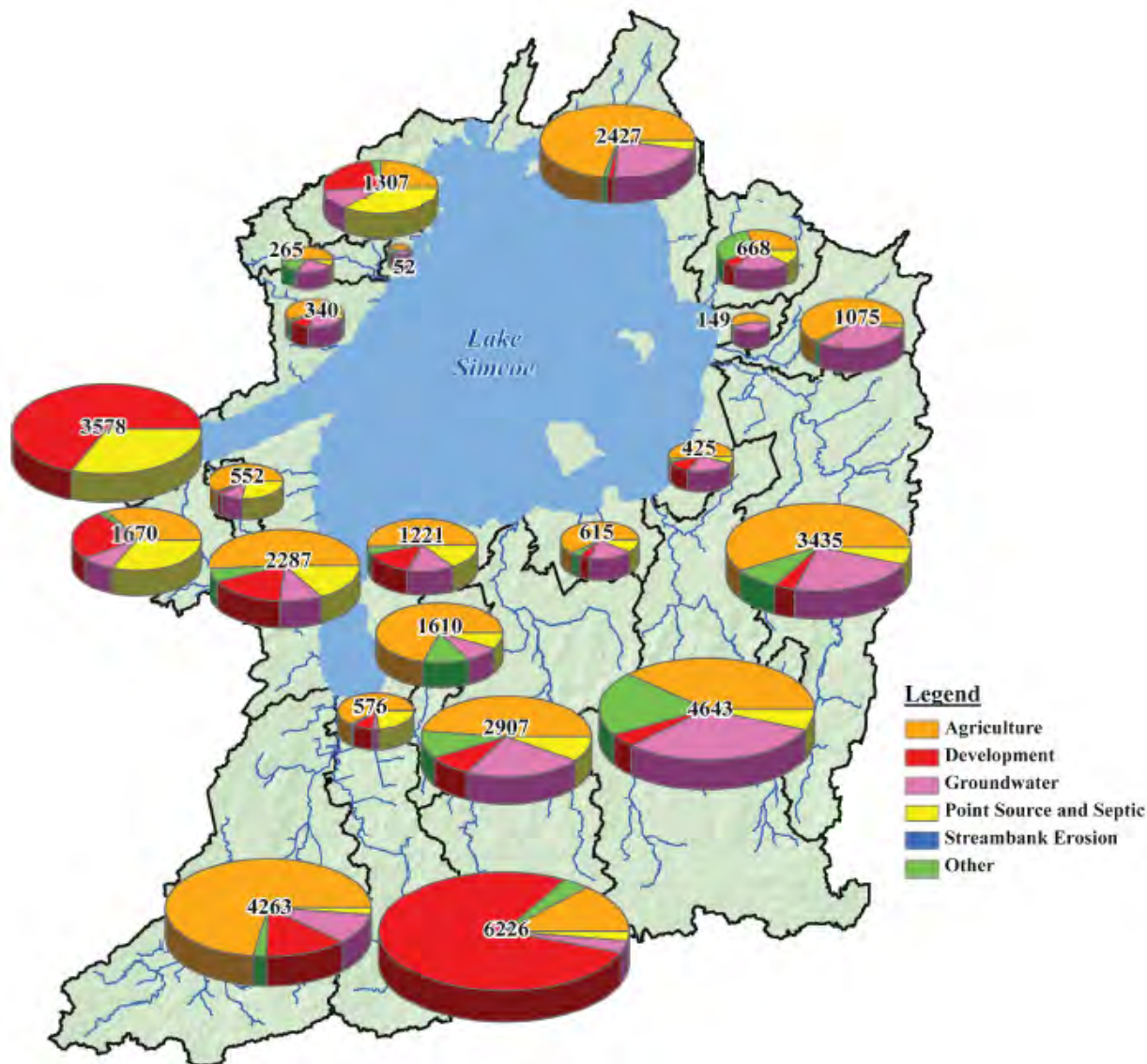


Figure 4-6 Phosphorus load estimates for all subwatersheds in the Lake Simcoe Basin, with relative contributions from various sources

Chloride

The main source of chloride, in its various compounds, in the environment is from road salt. It enters the environment through runoff from roadways as well as through losses from salt storage and snow disposal sites. Due to its high solubility, chloride very easily contaminates both surface and groundwater.

High levels of chloride, such as those found in runoff water draining from roads and salt storage yards, can damage the roots and leaves of aquatic and terrestrial plants, and can also have behavioural and toxicological impacts to animals. Continued exposure to high chloride levels can cause a shift from sensitive communities to those more tolerant of degraded conditions (including a number of invasive species that are able to thrive).

Chloride loads have been modelled for the Black River using the data from water quality samples combined with flow data. As can be observed in Figure 4-7, these loads have been increasing in recent years, although not at as high a rate as the East Holland River. Given that the urban area of the subwatershed is anticipated to expand in the coming years, it can be expected that these loads will also continue to increase unless new practices are instituted to reduce them.

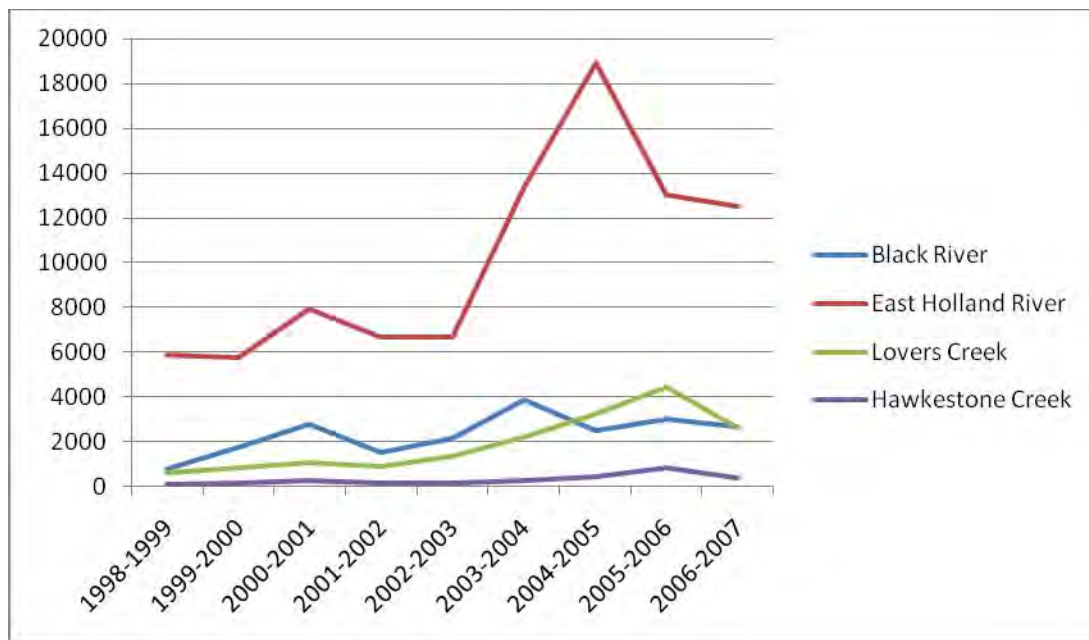


Figure 4-7 Modelled chloride loads for the several Lake Simcoe subwatersheds (tonnes/year) (1998-2007)

Sediment

While a certain amount of sediment input is normal in a natural system, in larger amounts it begins to cause a number of problems. Many contaminants, including phosphorus, bind themselves to soil particles, and eroding soil acts as a vector for introducing these particles to an aquatic system. There are also impacts to aquatic biota, which are discussed in greater detail in Chapter 8, Aquatic Habitat.

There are a number of sources of sediment in the Black River subwatershed:

Agricultural areas: fields are particularly vulnerable to erosion whenever they are bare (e.g. after tilling and in the spring prior to the establishment of crops). The flow of melt waters and precipitation over the fields during these periods can result in a huge influx of sediment. In addition, many farmers also remove treed windbreaks and much of the riparian vegetation along watercourses flowing through their properties in order to maximize the cultivable land, both of which help to prevent soil erosion. Practices such as conservation tillage and the use of cover crops, as well as the implementation of appropriate BMPs will help to reduce soil loss and its associated impacts on watercourses.

Development sites: these sites are often stripped of vegetation well in advance of development in an effort to reduce costs as the development is built in phases. These bare soils are then subject to erosion by both wind and water. The proper installation of erosion controls can prevent some of the soil from reaching watercourses, but need to be inspected and maintained regularly.

Urban areas: The use of sand as well as salt for maintaining safe road conditions during the winter is commonplace. However, large quantities of sand remain on the roadsides after all of the snow has melted in the spring, and if it is not removed (e.g. by street sweeping) in a timely manner, much of it will be washed away by surface runoff during rain events. This is of particular concern in areas without stormwater controls, as the sand will be transported directly to local watercourses.

Water temperature – thermal degradation

The warming of surface water can generally be attributed to one of two factors: flow over impervious surfaces, and/or the detention of water in a pond. During the summer, impervious surfaces such as parking lots and rooftops can become extremely warm. As water flows over these surfaces before discharging to a watercourse, its temperature increases as well. The detention of water in a pond increases the surface area of the water that is exposed to sunlight, and keeps it there for a prolonged period of time, leading to warming. Although online ponds are the greatest concern due to their direct impact on the watercourse, offline ponds (including stormwater ponds and detention ponds for irrigation) that discharge to watercourses are also a concern. While the planting of vegetation around a pond and along its outflow, and the installation of structures such as bottom-draws to ensure that the coolest water is being discharged can help to reduce the heating effect, ponds will still have an impact on the thermal regime of a watercourse. This issue will likely worsen as the amount of impervious area in the subwatershed increases in the coming years.

Pesticides

Given the large proportion of the subwatershed with agricultural and, to a lesser extent, urban land uses, pesticide use is a concern in the subwatershed. While pesticide for cosmetic purposes has been banned by the Province of Ontario, which is a very positive step, there are a number of exceptions to this law that allows for the use of pesticides for public health or safety (including the protection of public works structures), golf courses, specialty turf, specified sports fields, arboriculture and to protect natural resources, if certain conditions are met. There are also exceptions for agriculture, forestry, research and scientific purposes, and uses of pesticides for structural exterminations (e.g., in and around homes to control insects) and uses of pesticides required by other legislation. Due to the number of uses still allowed for pesticides, there is still the potential for these substances to end up in the subwatershed's surface waters. There can be a number of impacts to both terrestrial and aquatic systems due to pesticide contamination, including:

- Cancers, tumours and/or lesions on fish and animals;
- Reproductive inhibition/failure – reduced egg suppression and hatching, sterility;
- Nest and brood abandonment;
- Immune system suppression;
- Endocrine disruption;
- Weight loss;
- Loss of attention; and
- Loss of predator avoidance (Ongley, E., 1996, Helfrich *et al.*, 2009).

The use of best management practices for the storage and use of pesticides can limit the amount of pesticide required in a given area, and will also reduce the movement of the

pesticides from target areas. These practices should be promoted throughout the subwatershed.

The LSRCA has initiated sampling for pesticides in some subwatersheds; however there is currently little information for the Black River. It is therefore difficult to determine the state of this subwatershed with respect to pesticide levels. Continuation and enhancement of this program will enhance our understanding of the extent and fate of pesticides in this subwatershed, and may lead to the development of programs to prevent pesticides from reaching area watercourses.

Key points – Factors Impacting Water Quality - Stressors:

- The primary source of total phosphorus in the Black River subwatershed is from cropland (41%) and groundwater (27%). Under the approved growth scenario, there is a projected increase in total phosphorus loads of 8% without the implementation of BMPs.
- Most of the chloride in the subwatershed comes from the use of road salt, with the estimated annual loads increasing in recent years with the growing urban area in the subwatershed. Although increasing by much less than in more urban subwatersheds. It is expected that this load will continue to increase into the future as the urban area continues to expand.
- Sediment sources include sites stripped for development, agricultural areas, and sand used on roads in the winter. Sediment itself is a pollutant, and also acts as a vector for other pollutants, such as phosphorus.
- Increasing surface water temperatures can be attributed to overland flow across impervious surfaces and discharge from ponds. This is a trend that can be expected to increase in the coming years as the amount of impervious area increases.
- Extraction of peat from wetlands will limit the natural filtering ability of these areas.

Tools to Improve Water Quality: The Assimilative Capacity Study

The purpose behind the Assimilative Capacity Study (ACS) was to help the Lake Simcoe Environment Management Strategy (LSEMS) partners to determine how much development can be accommodated in the Lake Simcoe watershed and the management practices necessary to minimize future phosphorus loading from the watershed or to reduce current loadings, to meet the LSEMS remedial target for Lake Simcoe.

Study components

- The estimation of the assimilative capacity of the Lake Simcoe watershed required the completion of several steps. These included:
- Estimating the current contribution of phosphorus entering Lake Simcoe from all existing point and non-point sources
- Evaluating the potential reduction in phosphorus loading resulting from the implementation of BMPs throughout the watershed on the current load
- Estimating the impact of the future Official Plan designated population and urban area growth on phosphorus loading within the watershed with and without the implementation of BMPs
- Establishing phosphorus targets in the form of Total Maximum Monthly Loads (TMMLs) for individual subwatersheds within the basin which are in turn linked to the LSEMS lake phosphorus target load of 75 T/y
- Assessing whether the TMMLs can be achieved and maintained under the future growth scenario
- Recommending options for future growth based on the results.

These tasks were completed through the development of two water quality models, CANWET, a watershed water quality model; and MIKE3\ECO Lab, a hydrodynamic lake water quality model. These are discussed in further detail in the ACS reports, which can be found on the LSRCA website.

Phosphorus Targets: Developing Total Maximum Monthly Loads (TMMLs)

The practice of developing total maximum loads was first initiated by the United States Environmental Protection Agency (USEPA) to regulate and protect degraded water resources. Once a water quality indicator is identified, in this case total phosphorus, a target value for that indicator is determined that will allow for the attainment of water quality objectives. This target condition is established to provide measurable environmental management goals and a clear linkage to attaining water quality objectives (i.e. PWQOs). The development of TMMLs in the Lake Simcoe watershed represents the first time this method has been proposed for use in protecting water resources in Canada.

Two water quality objectives were necessary in the development of a Lake Simcoe TMML phosphorus target setting strategy. The first objective considered was the existing LSEMS lake target of 75 (T/y). The second was the PWQO for total phosphorus concentration guideline for the streams and rivers flowing into the lake (0.03 mg/L). It is important to understand that PWQO are not standards that must be met but rather objectives that are recommended to ensure healthy aquatic ecosystems

Summary of the Assimilative Capacity Study Results

Current Conditions

Sixteen out of 23 subwatersheds in the Lake Simcoe watershed exceed a PWQO-based load target. The Black River subwatershed meets the PWQO-based load target, but only by a few kilograms, and so was treated for the purposes of the target setting exercise as exceeding the target. The Black River subwatershed's modelled phosphorus loads exceeded the PWQO based target in all months but April, May and December. The loads in this subwatershed are highest in March through June. The concentration of total phosphorus is generally highest during the months of lowest flow, from June to October. The primary source of phosphorus in the Black River subwatershed was found to be cropland. The measured phosphorus load for the period 2004-2007 was found to be 3,705 kg. The overall target load for the Black River is 2,874 kg/year.

Committed Growth without Implementation of BMPs

Committed growth is the scenario involving population and urban expansion based on the municipal Official Plan designations into the future. It does not include implementation of enhanced BMPs to offset the impact of growth and is therefore the worst-case scenario option. Not surprisingly, phosphorus loads delivered to Black River increase under this scenario by approximately 8%. The majority of this increase is based on assumed increased stormwater runoff from approved development proposed for the subwatershed.

Committed Growth with Full Implementation of BMPs

The last scenario modelled involves the population and urban expansion along with a full implementation of BMPs to offset the impacts associated with development. The results of this scenario indicate that an estimated total reduction of up to 28% (from 41.5 to 37.2 T/y) could be achieved for the Lake Simcoe watershed. This result suggests that the continued growth within the watershed could occur without impacting negatively on water quality.

Modelling results suggest that with BMP implementation, the Black River subwatershed would observe a 33% decrease in its estimated total phosphorus load. The estimated cost of implementation of the BMPs in the Black River is \$13.3 million. Approximately 92% of this cost is derived from the implementation of urban BMPs, such as the installation or upgrades of stormwater management facilities. Approximately 8% would be derived from agricultural BMPs, such as nutrient management, cover cropping, and contour farming. Very little of this cost (<1%) would be associated with stream protection BMPs, which include fencing, buffer protection, and streambank stabilization.

4.4 Current management framework

There are numerous acts, regulations, policies and plans aimed at maintaining or improving water quality. These include the Provincial Policy Statement, the Ontario Water Resources Act, the Greenbelt Plan, Growth Plan for the Greater Golden Horseshoe, the Oak Ridges Moraine Conservation Plan, the Lake Simcoe Protection Plan, and the Nutrient Management Act.

This management framework relates to many different stressors that can potentially affect water quality, ranging from the discharge of material to urban development. In Table 4-3 we categorize 12 such stressors, recognizing that many of these activities overlap and that the list is by no means inclusive of all activities. The legal effects of this management framework broadly fall into one of two categories. The first broad category we define as those having little or no legal standing and are referred to as General or Have Regard to Statements in Table 4-3

and are shown in blue. The second category includes those that have legal standing and must be conformed to; these are referred to as Regulated / Existing Targets in Table 4-3 and are shown in green. In many cases an act, regulation, policy, or plan does not relate to the activity specified, these are shown in red.

Table 4-3 Summary of current regulatory framework as it relates to the protection and restoration of water quality

Stressor affecting water quality	Oak Ridges Moraine Conservation Plan (2002)	Greenbelt Plan (2005)	Lake Simcoe Protection Plan (2009)	Growth Plan for the Greater Golden Horseshoe (2006)	Provincial Policy Statement (2005)	Nutrient management Act (2002)	Ontario Water Resources Act (1990)	Environmental Protection Act (1990)	Clean Water Act (2006) – Source Water Protection [^]	LSRCA Watershed Development Policies (2008)	York Region Official Plan (2008)	Durham Region Official Plan (2008)
Growth, development and site alteration												
Application of road salt							3					
Loss of natural heritage features												8
Stormwater	1										6	
Impervious surface											7	9
Discharge of material												
Agriculture												
Restoration												
Septic systems					2		4			5		
Climate change												
General/Have regard to statement			Regulated/Existing targets				No applicable policies					

1 Gives specifics of what stormwater management plans are to include, but these are very general (e.g. ‘protect water quality’)

2 PPS specifies where private septic systems would be allowed, does not give details around inspections/restrictions

3 General policy regarding the discharge of any material that may impair the quality of water (not specific to road salt)

4 Septic systems >10,000 L/day are regulated under OWRA (smaller systems under building code)

5 one policy regarding replacement of septic systems that are in wetlands

6 There are specific policies within ORM planning area, otherwise this is a ‘have regard to’

7 Applies within ORM planning area

8 Policies apply within Greenbelt Natural System, key natural heritage features and key hydrologic features

9 Applies in Major Open Space Areas (including key natural heritage and hydrologic features) and in the Oak Ridges Moraine planning area (outside of the Settlement Area)

In this section we provide a summary of legislation as it pertains to activities affecting water quality. This summary is to give context to *future management considerations* and the *opportunities and recommendations to improve water quality* discussed in the following two sections. This summary is not intended to be comprehensive in terms of all the acts related to

water quality, or the polices within these acts – the reader is directed to each piece of legislation for a full assessment of the legislation as it relates to water quality.

4.4.1 Oak Ridges Moraine Conservation Plan (2002)

Among the objectives of the Oak Ridges Moraine Conservation Plan is to maintain, improve, or restore all of the elements that contribute to the ecological and hydrological functions of the ORM area, including the **quality** and quantity of its water and its other resources.

With respect to water quality this plan:

- Requires a natural heritage evaluation to demonstrate that the development or site alteration will have no adverse effects on key natural heritage features or their ecological functions, and to specify a minimum vegetation protection zone to ensure that the features are protected.
- Prohibits development and site alteration in hydrologically sensitive features such as streams, wetlands, kettle lakes, and seepage areas, and associated vegetative protection zone.
- Prohibits development and site alteration outside of Settlement Areas if it would cause the total percentage of the area of the subwatershed with impervious cover to exceed 10 per cent. Approval authorities should strive to maintain at least 30 per cent of the area outside of Settlement Areas in self-sustaining vegetation.
- Requires applications for major development include a sewage and water system plan that demonstrates that the quantity and quality of ground and surface water will be maintained, and that the project will comply with the applicable watershed plan.

The plan also includes specific requirements for Stormwater Management such as:

- Applications for development are required to demonstrate that planning, design and construction practices that protect water resources will be used, including; minimizing the removal of vegetation, grading, and soil compaction; keeping all sediment that is eroded during construction within the site.
- Stormwater Management Plans are to provide for an integrated treatment train approach that uses a planned sequence of methods of controlling stormwater and minimizing its impact by techniques that include lot level controls, conveyance controls, and end-of-pipe controls.
- Municipal development standards shall incorporate planning, design and construction practices that will reduce the portions of lots and sites that have impervious surfaces; and provide the flexibility to use alternative stormwater management techniques such as directing roof discharge to rear yard ponding areas and using grassed swales.
- The minimum standard for water quality is that 80 per cent of suspended solids shall be removed from stormwater runoff as a long-term average.
- Disposal of stormwater into a kettle lake is prohibited and new stormwater management ponds are prohibited within key natural heritage features and hydrologically sensitive features.

4.4.2 The Greenbelt Plan (2005)

One of the stated goals of the Greenbelt Plan is the 'protection, improvement or restoration of the quality and quantity of ground and surface water and the hydrological integrity of

watersheds.' This goal is supported by a number of policies in the plan that relates to the Protected Country side areas of the Greenbelt.

The Water Resource System Policies requires:

- Planning authorities to provide for a comprehensive, integrated and long-term approach for the protection, improvement or restoration of the quality and quantity of water,
- Municipalities are required to protect vulnerable surface and ground water areas, such as wellhead protection areas, from development that may adversely affect the quality and quantity of ground and surface waters.
- Policies specifically related to Stormwater Management Infrastructure include:
- Stormwater management ponds are prohibited in key natural heritage features or key hydrologic features or their vegetation protection zones.
- Applications for development and site alteration shall be accompanied by a stormwater management plan which demonstrates that:
 - Planning, design and construction practices will minimize vegetation removal, grading and soil compaction, sediment erosion and impervious surfaces
 - Where appropriate, an integrated treatment approach shall be used to minimize stormwater management flows and structures through such measures as lot level controls and conveyance techniques such as grass swales
 - The objectives of a stormwater management plan are to avoid, minimize and/or mitigate stormwater volume, contaminant loads and impacts to receiving water courses in order to protect water quality, minimize the disruption of pre-existing (natural) drainage patterns and prevent increases in stream channel erosion.

The plan also contains policies specifically related to natural heritage features which would also have an influence on water quality. See Chapters 6 and 8 for more information.

4.4.3 Lake Simcoe Protection Plan (2009)

The Lake Simcoe Protection Plan (LSPP) sets out very ambitious targets for improving water quality in the lake and its tributary rivers and streams, and a number of policies for achieving these targets.

The water quality targets in the Lake Simcoe Protection Plan are:

- To achieve 7 mg/L dissolved oxygen in Lake Simcoe (which equates to a phosphorus load to the lake from all sources of approximately 44 tonnes/year).
- Reduce pathogen loading to eliminate beach closures
- Reduce contaminants to levels that achieve Provincial Water Quality Objectives or better

The policies to achieve these targets include those around stormwater, septic systems, construction and aggregate extraction activities, and the development of a phosphorus reduction strategy. These are outlined in further detail below.

In regards to Stormwater the LSPP requires:

- Preparation and implement comprehensive stormwater management master plans for each settlement area in the Lake Simcoe watershed.

- Municipalities are to incorporate policies related to reducing stormwater runoff volume and pollutant loadings from major development and existing settlement areas into their official plans.
- Applications for major development must be accompanied by a stormwater management plan that demonstrates, among other requirements:
 - That an integrated treatment train approach will be used
 - How changes between the pre- and post-development water balance will be minimized
 - How phosphorus loadings will be minimized
- Every owner and operator of a new stormwater management works to inspect and maintain the works on a periodic basis.

In regards to *Septic Systems*, the LSPP requires development of a proposal for a regulation under the Ontario Building Code act to:

- Designate the lands within 100 metres of the Lake Simcoe shoreline, other lakes and any permanent stream of the watershed, as a prescribed area for required septic system maintenance and re-inspections.
- Investigate new standards for septic systems.
- Place limitations on when and where new septic systems can be built within this 100 metre buffer around the lake and its streams and rivers.

The LSPP contains policies to minimize the impacts from exposed soils at construction and mineral aggregate sites. These policies requires municipalities to ensure that the following measures are incorporated into subdivision and site plan agreements:

- the removal of vegetation, grading, and soil compaction; and stipulating that the removal of vegetation is not to occur more than 30 days prior to grading or construction
- structures to control and convey runoff are in place and exposed soils are seeded once construction is complete
- sediment and erosion controls are implemented effectively

Phosphorus Reduction Strategy

The LSPP has set ambitious targets for reducing the phosphorus load to the lake which will require a reduction from all sources in the watershed. To help accomplish this goal, the LSPP contains policies for the development of a phosphorus reduction strategy, which will support a phased, coordinated and adaptive management approach to reducing excess phosphorus loadings. The policies also consider the need for innovative solutions to reducing phosphorus.

The phosphorus reduction strategy will include the development of subwatershed phosphorus loading targets, an assessment of the sources of phosphorus loadings in the watershed (including tributary sources and stormwater runoff) and an identification of practical and effective actions that should be taken to address each source.

Additional Policies

The LSPP also contains a number of other policies which, while not directly related to water quality but, will help to protect and enhance water quality in the Black River subwatershed when they are implemented. These include:

Water conservation and efficiency initiatives, which will reduce surface runoff and improve the efficiency of sewage treatment plants and septic systems

- Natural heritage targets around shorelines, the amount of high quality vegetative cover and riparian cover, the protection of wetlands and other important features, restoration of natural areas or features, and overall ecological health
- Consideration of climate change and its potential effects throughout the Lake Simcoe watershed
- The coordination of stewardship efforts throughout the watershed in order to capitalize on the strengths of the various partners; increase effectiveness in cost-sharing, communication and co-marketing; enhance stewardship opportunities; and champion key new initiatives, technologies, and BMPs

4.4.4 *Places to Grow Act – Growth Plan for the Greater Golden Horseshoe (2006)*

Policies within this plan will help to maintain and/or improve water quality by directing development to built-up areas and those areas that already have municipal water and wastewater systems. Perhaps most important with regard to surface water quality are the Growth Plan's policies around Water and Wastewater. These include the following:

- The construction of new, or expansion of existing, municipal or private communal water and waste water systems should only be considered where the following conditions are met:
 - Strategies for water conservation and other water demand management initiatives are being implemented in the existing area
 - Plans for expansion or for new services are to serve growth in a manner that supports achievement of the intensification target and density target
- Municipalities that share an inland water source and/or receiving water body, should coordinate their planning for potable water, stormwater, and wastewater systems to ensure that water quality and quantity is maintained or improved
- Municipalities are encouraged to implement and support innovative stormwater management actions as part of redevelopment and intensification

The Growth Plan also supports and builds on the protection offered to natural features in plans such as the Greenbelt and ORMCP. Municipalities are encouraged to identify and develop policies to protect natural features, the linkages between, and areas that complement them.

4.4.5 *Provincial Policy Statement (2005)*

Policies that are directly related to maintaining and/or improving water quality in the Provincial Policy Statement (PPS) include:

- Planning authorities shall protect, improve, or restore the quality of water by implementing necessary restrictions on development and site alteration to:
 - Protect municipal drinking water supplies
 - Protect, improve or restore vulnerable surface water and groundwater, sensitive surface water features and sensitive groundwater features, and their hydrologic functions, including:
 - Promoting the efficient and sustainable use of water resources

- Ensuring stormwater management practices minimize stormwater volumes and contaminant loads, and maintain or increase the extent of vegetative and pervious sites
- Growth should be directed to promote the use of existing sewage and water services, ensuring that these services can be provided in a manner that can be sustained by the water resources on which they rely, and that protects human health and the natural environment.
- Growth is to be focused in settlement areas which, if implemented, should limit the amount of natural area removed, thus maintaining their functions. Development and site alteration are not permitted in features such as significant wetlands, woodlands and ANSIs, or the lands adjacent to them, unless it can be demonstrated that there will be no negative impacts on the natural features or their functions.

4.4.6 Nutrient Management Act (2002)

The goal of the Act is to set standards for nutrient management on farms that create nutrients (such as manure, biosolids, and fertilizers) and for farms that use these materials. The Act and its regulations are currently limited to farms that create over 300 nutrient units (one nutrient unit is equivalent to the amount of nutrient that is created by approximately one cow), or those smaller farms that are expanding and will be generating over 300 nutrient units.

Farms that generate manure are required to complete a Nutrient Management Strategy – a document that shows how much manure and/or other materials prescribed by the regulation are produced, how they will be stored, and where they will be used. Farms that use or store manure or other prescribed substances on their land, but do not generate manure for removal are required to complete a Nutrient Management Plan. These plans include many similar components to the Nutrient Management Strategies, but must also include contingency plans for situations such as weather preventing the application of the material on the field or if storage becomes too full.

This Act gives current best management practices the force of law, and creating comprehensive, enforceable, province-wide standards to regulate the management of all land-applied materials containing nutrients. Specific regulations of this Act include:

- Restrictions on how and where farmers can apply nutrients to their land.
- Setbacks from sensitive features such as wells and streams are required for new barns that will be storing manure.

4.4.7 Ontario Water Resources Act (1990)

With respect to water quality, the Ontario Water Resource Act (OWRA):

- Requires that construction of new water works (including sewage treatment works and stormwater management facilities) or alterations to existing works may proceed only after a Certificate of Approval under Section 53 of the Act has been issued by the MOE. This enables MOE to track the amount of pollutant being discharged into the water, and ensures that project designs meet the proper specifications.
- Prohibits the discharge of material of any kind into waters (or on the shore or bank of a water body) that may impair the quality of water
- States that every person that discharges or causes or permits the discharge of any material of any kind into or in any waters or on any shore or bank thereof or into or in any place that may impair the quality of the water of any waters is guilty of an offence.

The OWRA also enabled the development of water quality objectives to provide the basis upon which the limits of the uses of water resources can be established in order to protect water quality. The Provincial Water Quality Objectives (PWQO) established under this directive, provide a series of goals, policies and guidelines are intended to assist those making decisions under or related to the OWRA and the Environmental Protection Act (See EPA below). For example, they give directions that assist in defining site specific effluent limits, which may then be incorporated into Certificates of Approval or control orders. ***The policies and guidelines do not have any formal legal status.***

The PWQOs are numerical and narrative criteria which serve as chemical and physical indicators representing a satisfactory level for surface waters and groundwater (where it discharges to the surface). PWQOs are set at a level of water quality which is protective of all forms of aquatic life and all aspects of the aquatic life cycle during indefinite exposure to the water. PWQOs are intended to provide guidance in making water quality management decision such as the designation of surface waters which should not be further degraded. They are used to assess ambient water conditions, infer use impairment, assist in assessing spills, and in monitoring the effectiveness of remedial actions. The publication states that meeting the PWQO is a minimum requirement, and that considerations such as ecosystem health, the additive effects of more than one chemical, or the protection of other uses may lead to more stringent requirements.

4.4.8 Environmental Protection Act (1990)

The main policy of the Environmental Protection Act (EPA) that will help to protect water quality is that ‘...a person shall not discharge a contaminant or cause or permit the discharge of a contaminant into the natural environment, if the discharge causes or may cause an adverse effect.’ This does not apply to discharges that are authorized under this Act or the OWRA if the discharge does not cause and is not likely to cause an adverse effect. It also does not apply to a discharge of a contaminant that arises when animal wastes are disposed of in accordance with normal farming practices, when the only adverse effect that is caused or may be caused is the impairment of the quality of the natural environment for any use that can be made of it.

The EPA enables a Director of the MOE to:

- order someone who causes or allows the discharge of a contaminant that results in injury, damage, or endangerment to land, water, property, animal or plant life, or human health or safety to prevent or repair the injury or damage or (if water supplies are threatened) provide temporary or permanent water supplies.
- require a person who owns a property or has management of an undertaking to put in place equipment and/or precautionary measures to be in place to prevent the discharge of a contaminant or to minimize its impact if it is released into the environment.
- issues stop orders or control orders where a contaminant has been released in a concentration or level that exceeds that prescribed by the regulations.

4.4.9 Clean Water Act (2006) – Source Water Protection

While its aim is to protect sources of drinking water, a number of the initiatives included the Clean Water Act will help to improve water quality throughout the subwatershed. The goals of the Act are to identify threats to drinking water, and then implement changes to reduce or remove those threats. A Source Protection Plan will be prepared for each Source Protection Area. This plan may set out significant threat policies to which planning decisions must conform – they will affect future activities and land use planning around wellheads and water intakes. The plan may also provide for the prohibition of certain activities and the use of risk

management plans to impose conditions on certain activities, and may include policies for which municipalities must have regard in other vulnerable source water areas such as moraines, aquifers, headwaters and recharge areas. Implementation of Source Protection Plans will include the incorporation of the Plan's policies into municipal Official Plans, changes to zoning by-laws, and inspections and enforcement.

4.4.10 LSRCA Watershed Development Policies

Although not extensive, the LSRCA Watershed Development Policies do address the protection of water quality. Policies include:

- Requiring Enhanced Level 1 stormwater quality protection for all new developments in the watershed
- Requiring erosion and sediment control plans for plans of subdivision
- Protecting environmentally significant areas, wetlands and floodplains (as permitted under its mandate) and their functions, which will maintain water quality

4.4.11 York Region Official Plan (2009)

York Region's Official Plan (OP) includes a number of policies related to the protection of the quality of both ground and surface water. The policies within the OP related to water quality include:

- The preparation of a comprehensive regional water strategy for both piped services and surface and groundwater sources that will include long-term protection strategies, enhancement guidelines and monitoring requirements;
- That the natural quality and hydrological characteristics of watercourses and lakes (including water quality and temperature) will be maintained, and that development be designed with the goal of maintaining water balance
- Directing development away from sensitive surface water and groundwater features
- Continuing to partner with other regions and conservation authorities to study, analyze, and monitor ground and surface water resources to ensure a unified approach to protecting and enhancing water quality and quantity
- Monitoring the quantity and quality of surface and ground water systems in York Region, in co-operation with local municipalities and conservation authorities) by:
 - Assessing the sustainability of current activities and land uses
 - Identifying areas that are susceptible to, or currently experiencing, water quality and quantity problems
- Requiring local municipalities to establish policies and programs to protect, enhance, and monitor water systems
- Encouraging agricultural land management practices that minimize the application of pesticides and nutrients
- Working with partners in the implementation of stormwater management initiatives
- Requiring the preparation of comprehensive stormwater management plans as a component of secondary plans

- Requiring that development have an integrated and innovative approach to water management, be water efficient, and maximize stormwater quality, quantity, and infiltration through an integrated treatment approach
- Encouraging innovative approaches to stormwater within secondary plans
- Requiring owners and operators of stormwater management works to inspect, maintain, and monitor effluent quality on a periodic basis
- Working with local municipalities and LSRCA in the preparation and implementation of comprehensive stormwater master plans for each settlement area within the Lake Simcoe watershed by 2014
- Working in partnership with local municipalities, conservation authorities, adjacent municipalities and other agencies to co-ordinate watershed planning initiatives and implement watershed plan objectives; and supporting the goals and objectives of watershed plans

In addition to these policies, York Region's protection of the regional Greenlands System will help to ensure that the functions of the Region's natural features, such as the filtering effect of wetlands, will continue to protect and enhance water quality.

4.4.12 Durham Region Official Plan (2008)

In considering development applications, the impacts on surface water and groundwater resources are to be examined in order to maintain and/or enhance these resources in sufficient quality and quantity to meet the needs of the Region's residents on a sustainable basis.

4.5 Management gaps and limitations

Clearly there are already numerous legislations, regulations and municipal requirements aimed at protecting Black River water quality. Despite this strong foundation, there are a number of gaps and limitations in the management framework that need to be considered, including a number of emerging issues such as the effects of climate change and the potential for new water quality contaminants such as pharmaceuticals. This section provides an overview of factors that need to be considered in the future management of the subwatershed.

4.5.1 Growth, Development and Site Alteration

These activities are strongly regulated in areas such as key natural heritage features, key hydrologic features, and shorelines through the ORMCP, Greenbelt Plan, Lake Simcoe Protection Plan, York and Durham Region's Official Plans, and LSRCA Watershed Development Policies. The protection of these features and functions serves to protect the Black River's water quality. There are, however, limitations with these policies:

- For many natural heritage features (other than wetlands) it is only those considered significant that are protected, and in general only those considered provincially significant are protected. Although they are not considered to be significant, these features still perform important functions in the watershed, and the development of these areas and loss of these functions will have impacts to watershed health. Wetlands are now well protected through the Generic Regulation (179/06);
- The policies that apply to hydrologic features are not consistent across the subwatershed – the definition of a key hydrologic feature is different for the ORMCP area, the Greenbelt Plan area, and the LSPP area which covers the remainder of the subwatershed. Features such as seepage areas, springs, aquifers and recharge areas

are protected in the ORMCP area, but not the LSPP area, and the Greenbelt Plan includes seepage areas and springs but not aquifers and recharge areas. These discrepancies can leave some of these features unprotected.

- Some plans specify a minimum vegetation protection zone (e.g. the ORMCP and Greenbelt Plan), and also identify a further 'area of influence' (as it is referred to in the ORMCP) outside of the minimum vegetation protection zone. Within this area of influence, a proposal for development or site alteration triggers the requirement for a natural heritage and/or hydrologic evaluation. This evaluation is meant to describe the existing conditions, assess the potential impacts from proposed development/site alteration and determine if the minimum vegetation protection zone provides sufficient protection. If the minimum vegetation protection zone is not found to be sufficient, the evaluation should specify the dimensions of the required minimum vegetation protection zone. While the goal of these policies is undoubtedly to protect the features, in reality the required evaluations rarely specify anything greater than the minimum; in essence the minimum becomes the maximum distance. There is therefore little further protection gained through this process for these features and their functions by way of a buffer distance.

4.5.2 Road Salt

There is no legislation that specifically regulates the application of road salt. The ORMCP, Greenbelt Plan, Growth Plan for the GGH, and the OWRA address it either through broad 'have regard for' policies, or general water quality statements.

These are very general policies that in no way require the management of road salt and its impacts to water quality and aquatic biota. Urban areas have been expanding in the subwatershed, and thus the increasing chloride concentrations are not unexpected. However, while safety must obviously continue to be the priority for road salt use, municipalities should continue to explore the most environmentally friendly options for maintaining safe roads in order to protect the subwatershed's water quality and the aquatic communities residing within its watercourses. These options include ensuring the proper timing and amount of road salt application, as well as exploring the use of alternative de-icing substances. York Region has adopted a Salt Management Plan for this purpose. Local municipalities within the subwatershed should adopt similar plans and/or the *Code of Practice for the Environmental Management of Road Salts* (Environment Canada, 2004).

4.5.3 Stormwater

The ORMCP, PPS, Greenbelt Plan, Growth Plan, LSPP, Official Plans, and LSRCA Development Policies all contain some form of policy recommendation around requirements for stormwater management. Although some of these are 'have regard for' statements, there is policy support to require that all applications for development within the Lake Simcoe watershed are required to have Enhanced Level 1 stormwater control or better. The LSPP has gone a step further and contains several policies around reducing the impacts of stormwater. These are highlighted in the above section. While these policies are an important step in reducing the impacts of stormwater, there are some limitations:

- There are no required timelines for the implementation of the recommendations of stormwater master plans required through the LSPP
- There is no mention of funding support for the implementation of such activities as stormwater retrofits in the LSPP

- While municipalities are required to incorporate policies around stormwater including encouraging a hierarchy of treatment, the implementation of innovative stormwater management measures, allowing for flexibility in development standards around alternative community design and stormwater techniques, this does not necessarily mean that developers will adopt these standards. Municipalities should *require* some or all of these practices rather than encouraging their use in order to create a level playing field for all developers undertaking works in the watershed, otherwise there is little incentive to change standard practices.

4.5.4 Impervious Surfaces

The ORMCP, Greenbelt Plan and Regional Official Plans contain policies around that aim to limit impervious area to a certain level, while the PPS, LSPP and LSRCA Watershed Development Policies contain more general statements about striving to limit impervious area. These policies are limited in scope, and there are gaps in the geographic area covered. The issues with these policies include:

- The ORMCP and Greenbelt Plan do set a limit of 10 per cent, but these limits apply only outside of Settlement Areas in the ORMCP, and only in the Natural Heritage System of the Greenbelt. Thus there is no defined limit areas within the ORMCP and Greenbelt Plan areas not covered by these policies, as well as areas outside of the ORMCP and Greenbelt boundaries, and the subwatershed's impervious area could potentially exceed 10 per cent
- York Region's policies around impervious surfaces only apply in the ORMCP area, while Durham's applies only in its Major Open Space Areas
- There is no agency ensuring that subwatershed impervious areas do not exceed the defined limit
- Approval agencies should be striving for either a reduction in impervious areas on development sites or the mandatory use of practices that increase infiltration in order to reduce the impacts of impervious area within the subwatershed

4.5.5 Discharge of Material

The OWRA, EPA, Nutrient Management Act, Clean Water Act, and Official Plans all contain policies related to the discharge of materials that would impact water quality. Some are related to specific activities and/or contaminants; for example the Nutrient Management Act is mainly related to the phosphorus and bacterial contaminants from agricultural activities, whereas the Clean Water Act is concerned with the protection of drinking water. Others regulate the discharge of substances that have the potential to impair water quality. The limitations with these policies include:

- Much of the regulation is related to point sources of pollutant (e.g. WWTPs, industrial activities, stormwater ponds) and do not generally address non-point sources of pollutant
- Cumulative impacts are generally not considered – the Province has developed Provincial Water Quality Objectives under the EPA and OWRA, but the objectives and their related policies have no legal standing, and are generally seen as merely guidelines, not as limits to be strictly adhered to. There is no enforcement related to exceedances of these objectives. This has led to ever deteriorating water quality conditions in the subwatershed which will require a significant investment to rehabilitate

- The LSPP identifies a target of achieving the PWQO or better in its watersheds, but while it does include a number of policies aimed at improving water quality, there are none that specifically identify how the PWQO target will be reached
- The Nutrient Management Act only applies to farms of a certain size or that store and/or utilize a minimum amount of manure

4.5.6 Agriculture

The Nutrient Management Act contains the most stringent of the policies related to agriculture, as it requires plans for the management of contaminants created and/or stored on farms. Other policies relate to the protection of agricultural resources, but few relate to the management of contaminants from agricultural areas, with only 'have regard to' statements encouraging the use of agricultural BMPs.

- There are no policies that regulate or require the use of BMPs such as cover crops, conservation tillage/no tillage, wind breaks or other practices that would protect water quality
- Also lacking are policies requiring livestock to be fenced and kept out of watercourses, an activity that causes numerous water quality issues as well as causing bank instability
- There is nothing that requires farmers to test soils to ensure that the use of fertilizer is actually required – many farmers simply fertilize at certain times every year, without testing the soil to ensure that it is actually necessary, which may be resulting in unnecessary inputs of nutrients into the subwatershed.

4.5.7 Restoration

Most of the policies related to restoration are quite general in nature, and do not contain specific requirements. Some require applications for development in site alteration in key hydrologic features and key natural heritage features to be accompanied a natural heritage or hydrologic evaluation, which in some cases requires the applicant to include planning, design, or construction practices that will maintain and, where feasible, improve or restore the health, size and diversity of the feature.

4.5.8 Septic Systems

Policies relating to septic systems are included in the PPS, ORMCP, OWRA, LSPP, and the York Region Official Plan. These policies range from outlining the types of developments where septic systems may be constructed (as is the case in the PPS) to those policies in the ORMCP and LSPP which do not allow for the construction of any new septic systems, on the ORM and within 100 metres of Lake Simcoe or any of its permanent streams, respectively. The issues around the policy framework include:

- The ORM policy is the only one that will help to protect the quality of groundwater from malfunctioning septic systems, policies such as those in the Lake Simcoe Protection Plan will mainly serve to protect surface water
- These policies do not require the regular inspection of existing systems, leaving both surface and groundwater vulnerable to contamination. The LSPP's proposed regulation under the Ontario Building Code for required septic system maintenance re-inspections for systems within 100 metres of Lake Simcoe or any of the watershed's permanent streams is a good step. However the appropriate agency should ensure that funding is available to residents within these areas to undertake required system maintenance and/or repairs identified through this program

4.5.9 *Climate Change*

Climate change is generally not well addressed in the current management framework. The LSPP contains the most comprehensive policies related to this issue which, although it is still difficult to predict its impacts, may exacerbate water quality issues in this subwatershed. The adaptation strategy that will be developed through the LSPP is a significant first step in addressing this issue, and some of the Official Plan policies are beginning to consider climate change as well. While it may not be appropriate for some of the existing legislation to address climate change issues, it will be important to incorporate climate change considerations wherever possible in making management decisions for the subwatershed, and implement policies requiring, at the very least, the implementation of so called “no regrets” options should be incorporated into development and site alteration wherever possible.

Emerging Contaminants

As anthropogenic activities increasingly impact our natural areas, the potential for introduction of harmful substances becomes more of a concern. It is for this reason that a Toxic Pollutant Screening Program was initiated by the Lake Simcoe Region Conservation Authority in 2004. The goal of this project was to develop a better understanding of the location and prevalence of certain elements, chemicals, and chemical compounds that have the potential to negatively impact either human or aquatic life in the watershed. Sampling through this program revealed that there are currently some substances whose levels exceed regulatory guidelines in some Lake Simcoe tributaries. In addition, there were some substances, such as pharmaceutical products, that were not included in this monitoring work. Many of these substances have the potential to impact humans and affect aquatic life.

Endocrine Disrupting Chemicals

Endocrine disrupting chemicals (EDCs) are chemicals which adversely affect the endocrine system, which is a set of glands and the hormones they produce which guide development, growth, reproduction, and behaviour. Harmful effects have been observed on wildlife and humans including reproductive disorders, impacts on growth and development, as well as the incidence of some cancers. EDCs can come from both natural and man-made sources including pesticides; hormones, including both natural and synthetic which are used in oral contraceptives and in livestock farming; and can be the product of industrial processes such as incineration. In nature, EDCs including PCBs and other man-made chemicals have caused, among other issues, severe reproductive problems in fish and birds, swelling of the thyroid glands in numerous animal species, reduction in frog populations, and, in birds, the thinning of eggshells. The Lake Simcoe Region Conservation Authority's Toxic Pollutant Screening Program included monitoring for organochlorine pesticides, which are EDCs. These substances were not detected in any of the samples taken in the Black River subwatershed.

Pharmaceuticals and Personal Care Products

The presence of pharmaceuticals and personal care products (PPCPs) in the natural environment has been a growing concern over the past two decades, and will become more prevalent with the growing population and increasing use of these products. While the effects of pharmaceuticals on humans during the course of treatment are very well studied; the impacts of their by-products after use is not. Although some of the products and their by-products can be broken down incidentally at Waste Pollution Control Plants, the plants are generally not equipped to remove PPCPs from waste water. Studies have shown hormones, antibiotics, anti-inflammatory drugs, fragrances, antiseptics, sunscreen agents and a host of other PPCPs in varying amounts in the environment, though they are mostly seen within 100 metres of a waste water treatment plant discharge. In general, the levels in the environment are quite low; however, the effects of prolonged exposure to low levels are not well known. Some studies have shown that PPCPs have the potential to alter physiology, behaviour, and reproductive capacity. Concerns in the environment related to PPCPs include endocrine disruption in aquatic life and antibiotic resistance. Further understanding of these and other concerns is required in order to determine potential steps.

Polybrominated Diphenyl Ethers

Polybrominated Diphenyl Ethers (PBDEs) are emerging as a chemical of concern to both human and environmental health due to their persistence and ability to bioaccumulate in the environment. PBDEs are a group of chemicals used as flame retardants in a number of manufactured products, particularly in plastics. They are found in most homes and businesses in products such as electronics, TVs, textiles, cars, aircrafts, construction products, adhesives, sealants, and rubber products. They have become an increasingly common pollutant and have been found in samples taken in air, water, and land. PBDEs have been also been detected in a number of species (including humans) worldwide and studies are finding that levels of PBDEs have been increasing steadily and substantially over time. In the Canadian environment the greatest potential risk from PBDEs is secondary contamination in wildlife from the consumption of prey with elevated PBDE levels as well as effects on benthic organisms through exposure to PBDEs in sediments.

Due to the environmental persistence and bioaccumulation of PBDEs they are defined as toxic to the environment as defined under the Canadian Environmental Protection Act (CEPA). Currently Canada is proposing a ban on the import and manufacture of a number of forms of PBDEs. This ban however does not include the decaBDE form, the most commonly used form. Efforts to control the release of decaBDE would involve working with industry and stakeholders to minimize the impact of PBDEs in the environment. Through the federal government, environmental objectives are also being proposed for virtual elimination of a number of forms of PBDEs detectable in the environment.

4.5.10 Agriculture

Although there are currently no requirements for farmers to undertake BMPs such as cover crops, conservation tillage, the planting of wind rows, and leaving riparian buffers intact, there are a number of available programs to assist farmers to implement these programs. In particular, the LSRCA's Landowner Environmental Assistance Program (LEAP) provides guidance and funding for a number of types of projects; and there are a number of policies in the Lake Simcoe Protection Plan related to agricultural stewardship.

4.5.11 Atmospheric deposition

The municipalities have requirements for sediment and erosion control from ongoing developments; and the LSPP is also proposing the use of best practices to minimize the amount of dust erosion from sites. There are few, if any, policies around preventing erosion from agricultural lands, although there are a number of funding programs for the implementation of BMPs.

Although there are some policies and/or by-laws in place, it will be important to ensure that there are sufficient resources for their enforcement in order to prevent inputs from this source.

4.6 Recommended Actions to Improve Water Quality

The following recommended actions were developed to improve water quality in the Black River subwatershed. The main parameter of concern identified through the development of the subwatershed plan was phosphorus, which exceeds the Provincial Water Quality Objective in the majority of water quality samples over the past number of years. Much of the impact on water quality is likely due to the percentage of agriculture in the subwatershed as well as the urban areas of Sutton and Mount Albert. These areas are scheduled to grow somewhat in the future, and much of the existing urban area has little or no stormwater controls. The implementation of the actions outlined below will help to mitigate the impacts of this growth, as well as that of the existing urban and rural land uses, on the water quality in this subwatershed.

These recommendations, which are grouped and numbered as described in Section 1.4, were developed to address the water quality issues and stressors that were identified throughout this chapter. In addition, they consider, and are consistent with applicable policies and recommendations in the province's Lake Simcoe Protection Plan, and the LSRCA's Integrated Watershed Management Plan. Each recommendation below also identifies the applicable 'detailed recommendations' as outlined in Chapter 10. These detailed actions will form the basis of the Implementation Plan for York Region's ORM subwatersheds, to be developed following the completion of this plan.

4.6.1 Planning and Policy

- 1) That the municipal partners and the LSRCA strive to reduce the impacts of stormwater through a number of methods including the implementation of policies and guidelines and enabling the use of new and innovative technologies, retrofitting of existing developments.
Detailed recommendations: A.1.1 – A.1.3
- 2) That the partner municipalities act to improve water quality by implementing measures to prevent and/or mitigate impacts from septic systems, development, and other activities that may cause impairment.
Detailed recommendations: A.2.1 – A.2.4
- 3) That the Province develop binding criteria for specific contaminants within the Lake Simcoe watershed, as well as criteria for addressing emerging substances of concern

Detailed recommendations: A.2.5 – A.2.9

- 4) That the municipal partners and the LSRCA strive to maintain natural hydrologic conditions on development sites

Detailed recommendations: A.3.1 – A.3.2

- 5) That the federal, provincial, and municipal governments, as well as the LSRCA, continue to evaluate and implement planning initiatives and practices aimed at reducing the impact of development on the condition of the Black subwatershed

Detailed recommendations: A.3.3 – A.3.5, A.3.7

- 6) That the value of the ecological goods and services (EGS) provided by ecological features be considered in decision making around growth and development

Detailed recommendation: A.3.6

- 7) That the rural/agricultural community be engaged in developing solutions for minimizing the impacts of practices on their lands

Detailed recommendation: A.4.1

- 11) That the Province, the municipal partners, and the LSRCA seek to gain an improved understanding of the impacts of climate change in the Black River subwatershed, incorporating this information into decision making scenarios and developing strategies to mitigate and adapt to its impacts.

Detailed recommendations: A.6.1 – A.6.2, G.1.1. – G.1.3

4.6.2 Use of Better Management Practices

- 12) That the LSRCA and its municipal partners continue working to mitigate the impacts of stormwater to water quality and quantity through tracking its sources, completing stormwater retrofits, promoting methods of minimizing stormwater volume, and continuing to research new and innovative solutions to stormwater control and implementing these solutions where appropriate.

Detailed recommendations: B.1.1 – B.1.5

- 13) That support for programs offered to assist rural landowners in implementing BMPs on their properties, such as LSRCA's LEAP program, be continued and/or expanded as resources permit

Detailed recommendations: B.2.1 – B.2.3

- 14) That sectors that have the potential to have significant impacts on conditions in the Black subwatershed be expected to undertake BMPs and other activities to mitigate their impacts, as required under the LSPP

Detailed recommendations: B.2.4 – B.2.5

4.6.3 Changing the Way things are done 'on the ground'

- 18) That the LSRCA and its partner municipalities strive to maximize the infiltration of stormwater where appropriate through development approvals and the use of practices and technologies

Detailed recommendations: C.1.1, C.2.1 – C.2.2

- 19) That the partner municipalities, the LSRCA, and the related stakeholders work to reduce the impacts of construction practices on the Black subwatershed's water quality

Detailed recommendations: C.3.1 – C.3.2

- 20) That the partner municipalities continue to work to minimize the environmental impacts of road maintenance activities (e.g. chloride levels, sediment, phosphorus) on local watercourses

Detailed recommendations: C.4.1 – C.4.6

4.6.4 Applied Research and Science

- 21) That the Province, LSRCA and the municipal partners continue to work to identify sources of phosphorus within the subwatershed in order to set targets and develop strategies and solutions for reducing loads within the Black subwatershed

Detailed recommendations: D.1.1 – D.1.4, D.1.8 – D.1.12

- 23) That all partners continue to research techniques that may be undertaken in the subwatershed for improving water quality

Detailed recommendations: D.1.6, D.1.7

4.6.5 Monitoring

- 29) That the water quality monitoring program undertaken by the LSRCA be continued into the future, with regular reviews to ensure that program goals are being met, and expanded as resources permit to undertake special projects or enhance the understanding of conditions in the subwatershed; with results to be report on annually.

Detailed recommendations: E.1.1 – E.1.6

- 31) That the LSRCA, partner municipalities, and developers undertake efforts to minimize the impacts of construction through the use of on-site practices aimed at protecting water quality; and by conducting monitoring to ensure the effectiveness of these practices.

Detailed recommendations E.3.1, E.3.2

4.6.6 Management, Rehabilitation and Restoration

- 38) That the LSRCA continue to utilize buffer requirements and timing guidelines as tools to protect aquatic resources, and that other activities such as stormwater retrofits, tree planting, and habitat enhancement be undertaken to enhance aquatic habitat

Detailed recommendation: F.1.14

- 39) That the LSRCA and the partner municipalities assess the feasibility of increasing natural cover (e.g. woodland, streambank vegetation, interior forest, grassland) in the subwatershed and set priorities and develop plans to undertake this enhancement, based on overall benefit to the subwatershed.

Detailed recommendations: A.5.3, F.2.1 – F.2.3.

- 47) That the LSRCA, the partner municipalities, and developers work to identify opportunities for undertaking restoration works on development sites, and incorporate these into proposals, where appropriate

Detailed recommendation: F.4.5

4.6.7 Adaptive Response

- 48) That the LSRCA and partner municipalities work to reduce their carbon footprint and to increase ecological resilience in the watershed

Detailed recommendations: G.1.1 – G.1.3

5 Water Quantity (surface and groundwater)

5.1 Introduction and Background

The effective management of water resources requires the accounting of the total quantity of water and its distribution within a watershed, known as a water budget. The input into the budget is the total amount of precipitation within a watershed and the outputs include evaporation, transpiration, infiltration (movement of water into the subsurface), and runoff (or overland flow) into rivers and streams, which all make up components of the hydrologic cycle.

Surface water quantity deals with components of the hydrologic cycle that move overland and are within lakes, streams and wetlands. Surface flow is comprised of groundwater discharge into rivers and streams, overland flow from rain, snow melt and precipitation that falls directly into lakes, rivers, streams and wetlands.

Groundwater quantity deals with components of the hydrologic cycle that are present below the earth's surface, in the spaces between rocks and soil particles. The discharge of groundwater to lakes and streams remains relatively constant from season to season; it therefore forms an important part of the surface water flow system, and is particularly important when surface runoff is at its lowest levels, when it can be the only source of water.

Many natural systems rely on a consistent supply of groundwater. Fish species that depend on coldwater conditions for their survival require a very high ratio of cold, clean groundwater to total stream flow. Many ponds and wetlands are maintained by groundwater flow during the dry summer months. In many areas throughout the subwatershed, humans are extremely dependent on a reliable supply of groundwater for many purposes including irrigation of fields, potable water, industry, as well as recreation

The physical properties of a watershed, such as drainage area, slope, geology and land use can influence the distribution of the water and the processes that function within a watershed. This chapter quantifies the surface and groundwater components within the hydrologic cycle for the subwatershed and also identifies how rural and urban land uses in the Black River subwatershed have altered the hydrologic cycle (Figure 5-1), including changes to the surface flow volumes, annual flow patterns and the risk of flooding.

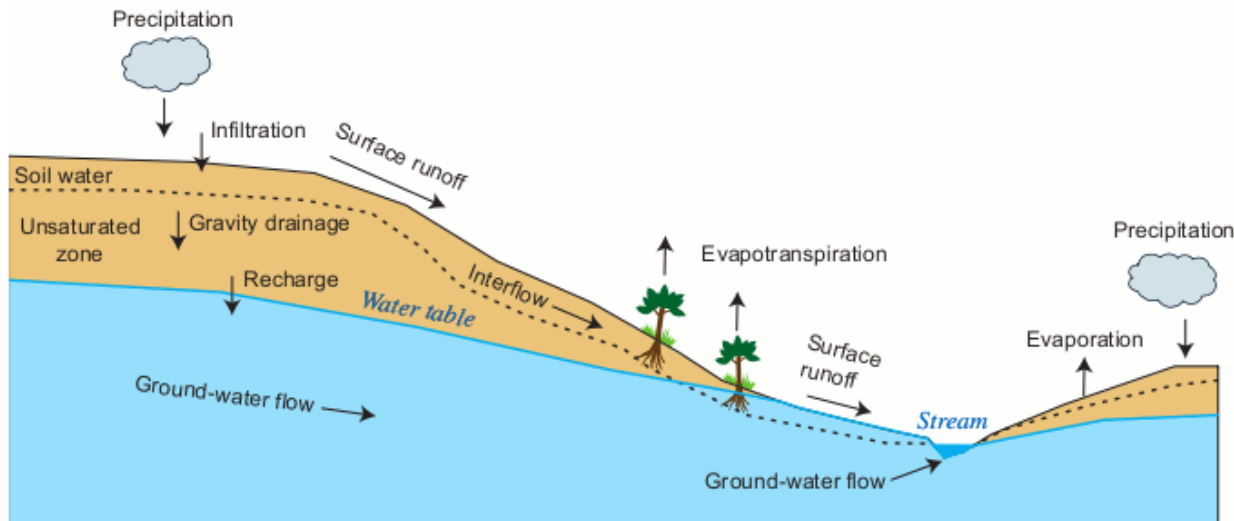


Figure 5-1 Hydrologic Cycle (USGS, 2008)

5.1.1 Understanding the Factors that Affect Water Quantity

There are several factors that influence the quantity of surface and groundwater available within a subwatershed. They are climate, geology, land use and water use.

Climate

Both surface and groundwater quantity can be influenced by a number of climatic factors, including precipitation, evaporation, and evapotranspiration. Precipitation is the main climate variable that has a direct influence on the quantity of water available, since it is the main input into the system. The amount of precipitation that falls, particularly in one event, will have a significant influence on how much infiltrates into the soil, and how much will runoff. In Southern Ontario, relatively little precipitation runs over the land to area watercourses, as a high percentage of the precipitation is either cycles back into the atmosphere through evapotranspiration or infiltrates into the soil. An intense storm event, where a large quantity of precipitation falls over a short time will direct most of the precipitation overland, as will a significant snowmelt event. This type of event is observed in March or April when the snow melts, or the onset of spring rains in April or May. The Black River subwatershed lies within the Simcoe and Kawartha Lakes Climatic Region (Brown et al., 1980). It is characterized by having relatively predictable precipitation patterns, with the mean annual precipitation for the subwatershed being approximately 815mm/year (Earthfx & Gerber, 2008). However, it should be noted that precipitation patterns have become less predicable in recent years, perhaps due to climate change. For example, in the last four years within the Lake Simcoe basin alone there have been three 100-year storm events.

There are other variables associated with climate that will influence water quantity. In particular, evapotranspiration is strongly influenced by climate and unlike precipitation it is considered an output or loss to the system. Evapotranspiration is the water lost to the atmosphere by two processes, evaporation and transpiration. Evaporation is the loss from open bodies of water, such as lakes and reservoirs, wetlands, bare soil, and snow cover; transpiration is the loss from living-plant surfaces. Several factors other than the physical characteristics of water, soil, snow and plant surfaces also affect the evapotranspiration process. The important factors include net solar radiation, surface area of open bodies of water, wind speed, density and type of vegetative cover, availability of soil moisture, root depth, reflective land-surface characteristics, and season.

Geology

Geology also has a significant influence on groundwater quantity. The underlying geology and the type of soil present at the surface will determine how much water will be infiltrated, during a precipitation event. For example, coarse-grained and loosely packed soils, such as sands and gravels will promote groundwater recharge, whereas fine-grained or hard packed soils, such as clay will allow less water to infiltrate to recharge the groundwater system. The surficial geology is an important factor in determining the amount of water that flows to and within a watercourse.

Land Use and Land Cover

Land cover is an important factor that can strongly influence both surface and groundwater quantity because it will affect several aspects of the water budget including; surface water runoff, evaporation and infiltration. Developed land will often have a higher proportion of impervious surface, such as roadways, parking lots, and buildings roofs. Increased runoff rates result in erosion and reduced infiltration to recharge groundwater reserves. In addition, groundwater pathways may also be affected because of development, which can result in decreased discharge to wetlands and streams.

The surface water in this subwatershed flows from the topographic high in the Oak Ridges Moraine north to Lake Simcoe. The land types present in the subwatershed will influence how much water remains at the surface and how fast it will be flowing. The land types present in the subwatershed include the Oak Ridges Moraine, wetlands, woodlands, and grasslands. The wetlands are found in areas of topographic lows, where the groundwater often intersects the surface in these areas. The intersection of the surface with the ground water table allows for a constant flow of surface water throughout these areas. Since the wetlands are in areas of topographic lows water flow in the areas are will be relatively slow compared to the slopes of the Oak Ridges Moraine.

As the population continues to grow, urbanized areas are expanding, resulting in numerous areas of impervious surfaces. These impervious surfaces such as parking lots, roads and rooftops lead to a decrease in time to peak flow following a rain event, as the ability to store and slowly release water has been eliminated. Undeveloped areas of the watershed have allowed the watercourses to exist under natural conditions making them less vulnerable to extreme changes in climatic events. For example, the time to peak flow will not occur as rapidly in the undeveloped portions of the subwatershed than in the more urban parts. As impervious surfaces increase in area, peak flow can also increase as water cannot infiltrate into the ground, and therefore runs off into surface water bodies, which can increase the risk of flooding, particularly during the spring freshet.

Water Use

In the Black River subwatershed both surface and groundwater is used for a variety of purposes, including municipal water supply, agricultural and industrial use, golf course irrigation and private water supplies. Many of these users withdrew large amounts of water and could potentially be putting stress on the system. Therefore, it is important to be able to identify the large water users by location, source water (surface or groundwater), type of water use, and amount of water takings to ensure the water within the subwatershed is managed in a sustainable manner. An effort to quantify these required water withdrawals has been undertaken as part of the Source Water Protection initiatives required under the Clean Water Act (discussed in section 5.5.6)

5.1.2 Previous Studies

Information from several groundwater and water budget studies were used to assess the hydrogeology of the Black Holland subwatershed. To date no studies have been conducted to assess the surface hydrology of the Black River subwatershed. The following are a list of key studies and reports that have influenced the information provided in this chapter:

York Peel Durham Toronto/Conservation Authorities Moraine Coalition (YPDT/CAMC) Groundwater Study

In 2000, the nine conservation authorities having jurisdiction on the ORM (Credit Valley, Nottawasaga Valley, Toronto and Region, Lake Simcoe Region, Central Lake Ontario, Kawartha, Ganaraska Region, Otonabee and Lower Trent) formed a coalition to investigate common issues pertaining to the groundwater flow systems associated with the ORM. The coalition is referred to as the Conservation Authorities Moraine Coalition (CAMC).

Around the same time, the Regional municipalities of York, Peel, Durham and the City of Toronto (YPDT), through a planning led process, were also looking at the common issues they faced with respect to development issues on the ORM. The need for more environmental protection on the moraine and greater access to groundwater related information was highlighted.

In 2001, the two groups came together to look at groundwater issues in a broad regional context. The project is referred to as the YPDT/CAMC Groundwater Management Program. The overall goal of this study is to provide a hydrogeological analysis system suitable for water resources management of the watersheds that drain off the ORM. The three main technical components that form the foundation of analysis system consist of:

1. A database of all water related information;
2. A geologic and hydrogeologic interpretation of the subsurface stratigraphy including development and refinement of a conceptual model; and
3. A numerical groundwater flow model. To date, four numerical models have been created. These four models, termed: i) the Core Model; ii) the Regional Model, iii) the Durham Model, and iv) the West extension Model, have different geographical extents and different resolutions (additional details regarding the numerical models are provided in Appendix A). Three of the models cover the south and east parts of the Lake Simcoe Watershed.

This modelling work is documented in the report completed by Earthfx (2006) and was used extensively throughout this report and forms the basis for much of the water budget work that was completed for the Black River Subwatershed ORMCP and Source Water Protection Studies.

Holland River, Maskinonge River, and Black River Watershed and Water Budget Study

This study was completed to address the water budget component required under the Oak Ridges Moraine Conservation Plans and is based on the previous modelling work by the YPDT-CAMC groundwater study (described above). The study details the movement of water through the East Holland, West Holland, Maskinonge and Black River subwatersheds, under five different groundwater and land use scenarios (Earthfx & Gerber, 2008).

Source Water Protection Studies

Much of the information presented throughout this chapter has been extracted from and is consistent with preliminary information, data and modeling results developed and reported through several Source Water Protection (SWP) water budget studies:

- Draft Preliminary Conceptual water budget (SGBLS, 2007)
- Draft Tier 1 Water Budget and Water Quantity Risk Assessment (LSRCA, 2009)
- Draft Tier 2 Water Budget Assessment of the Holland and Maskinonge River Watersheds (Earthfx, 2009)

These draft reports were developed consistent with provincial direction provided by the Ministry of the Environment (MOE) in the Technical Rules (MOE, 2009) prepared for the provincial SWP program under the Clean Water Act. Due to the overlapping information, every effort has been made to maintain a consistent interpretation of information reported in this chapter with that reported under the draft documents (above).

5.2 Current Conditions- Hydrogeology

5.2.1 Hydrogeologic Setting

The hydrogeology of the Black River subwatershed is shaped by the stratigraphic framework discussed in chapter two. In order to characterize the hydrogeological conditions across the ORM the CAMC-YPDT (Conservation Authorities Moraine Coalition- York, Peel, Durham, Toronto) study group constructed a database containing streamflow, climate, borehole, and

water well information. The database was used in the development of a hydrostratigraphic framework used in the numerical model development mentioned above.

For numerical modeling purposes, the hydrostratigraphy of the ORM complex was divided into the following eight layers; (1) surficial deposits and/or weathered Halton Till; (2) Halton Till or Kettleby Till; (3) Oak Ridges Aquifer Complex; (4) Newmarket Till; (5) Thorncliffe Aquifer Complex; (6) Sunnybrook Drift; (7) Scarborough Aquifer Complex; and (8) Weathered Bedrock. The regional stratigraphic framework and the local hydrostratigraphic units are summarized in Figure 5-1.

Table 5-1 Hydrostratigraphic framework

Layer	Name	Function	Description
1	Recent glaciolacustrine deposits	Aquitard	Thin deposits of sands, silts and clays; generally of low permeability and only used locally for minor water supply to private homes
2	Halton Till or Kettleby Till	Aquitard	Sandy silt to clayey silt till, typically 3 to 6 m thick but can range up to 30 m, low permeability
3	Oak Ridges Aquifer Complex	Aquifer	Mainly granular sediments interlayered with finer materials, up to 100 m thick, generally medium to high permeability, forms important local and regional aquifers
4	Newmarket Till	Aquitard	Dense, sandy silt to clayey silt till, up to 50 m thick, of low permeability. In lateral tunnel areas the infill material is primarily low permeability silts.
5	Thorncliffe Aquifer Complex	Aquifer	Sands and silt, up to 60 m thick in some areas, generally high permeability, forms important regional aquifers
6	Sunnybrook Drift	Aquitard	Silts and clays, generally less than 20 m thick, low permeability
7	Scarborough Aquifer Complex	Aquifer	Sands, silts and clays, up to 60 m thick, variable permeability, forms important aquifers in localized areas
8	Weathered Bedrock	Aquifer	Limestone and shale; limestone in northern part of Region act as an aquifer for private supplies

The groundwater system within the watershed consists of three principal aquifers: 1) the upper aquifer system or *Oak Ridges aquifer complex* occurs within deposits of the ORM and the Mackinaw Interstadial Unit, 2) the intermediate aquifer or *Thorncliffe aquifer complex* occurs within the Thorncliffe formation; and 3) the deep aquifer system or *Scarborough aquifer complex* occurs within the deposits of the Scarborough formation (Figure 2-8 and 2-9).

The Thorncliffe and Scarborough aquifers are separated from the Oak Ridges aquifer by the Newmarket till. The Newmarket till effectively forms a protective barrier for the deeper aquifers. However, within this subwatershed this aquitard has been breached by erosive processes, resulting in Channel Aquifers, also referred to as tunnel channels. These tunnel channels were infilled with sand and silt deposits as melt water energy waned. The nature of the infill material is important for understanding the groundwater flow system as it determines the amount of transfer between the shallow and deeper aquifer systems. It has been estimated that the rate at which water can move through these channels is an order of magnitude greater than that of the

Newmarket Till aquitard. Refer to Figure 2-9 and Figure 2-10 for a hydrogeologic profile of the Black River. From the diagram the location of the three aquifer complexes can be observed. The interpreted location of the tunnel channels within the subwatershed are shown in Figure 2-10.

The conceptual model of ground water flow within the subwatershed was presented above in Figure 2-8 and Figure 2-9. As a result of the model the cross sectional profile of the Black River was created (Figure 2-13 and Figure 2-14). The profile demonstrates how the thickness and depth of the aquifer complexes varies throughout the subwatershed.

5.2.2 Hydraulic Properties

Hydraulic properties such as hydraulic conductivity, specific storage (S_s), specific yield (S_y) hydraulic gradients, and porosity characterize the amount, rate and direction of groundwater flow through soil and rock. This numerical value below is referred to as hydraulic conductivity. Both the vertical and horizontal hydraulic conductivities for the Black River subwatershed have been calculated in meters per second (m/s). Anisotropy is a ratio of the vertical conductivity to the horizontal conductivity. It is useful in characterizing the properties of (k), of a unit layer which vary according to the direction of flow. Table 5-2 is a summary of the hydraulic conductivity estimates through all of the hydrogeologic layers derived from the CORE model, described in the water budget section below (i.e. Section 5.3).

Table 5-2 Summary of hydraulic conductivity (K) estimates used in the Core Model, (Earthfx & Gerber, 2008)

Unit	Model Layer	Horizontal K_h (m/s)	Vertical K_v (m/s)	Anisotropy (K_v/K_h)
Recent Deposits	1			1.0
Weathered Halton Till	1	5.0×10^{-6}	1.5×10^{-6}	1.0
Halton Till	2	5.0×10^{-7}	1.5×10^{-7}	0.3
Oak Ridges Moraine	3	5×10^{-7} to 2.4×10^{-4}	variable	0.5
Weathered Newmarket Till	3	5.0×10^{-6}	5.0×10^{-6}	1.0
Newmarket Till	4	5.0×10^{-8}	1.0×10^{-8}	0.2
Newmarket Till under ORM	4	5.0×10^{-8}	1.25×10^{-9}	0.03
Tunnel Channel Silt	4	5.0×10^{-7}	1.0×10^{-7}	0.2
Tunnel Channel Sand	5	1×10^{-4}	1×10^{-4}	1.0
Thornccliffe Fm.	5	1×10^{-5} to 1×10^{-3}	variable	0.5
Sunnybrook Drift	6	5.0×10^{-8}	5.0×10^{-9}	0.1
Scarborough Fm.	7	1×10^{-5} to 3×10^{-4}	variable	1.0
Weathered bedrock	8	7.0×10^{-6}	7.0×10^{-6}	1.0

5.2.3 Groundwater Flow

Groundwater flows from areas of high to low hydraulic head. The direction of movement at any point within the system is dependent on the distribution of hydraulic potential (Funk,1977). Groundwater moves continuously but at different rates based on the hydraulic properties of the formations mentioned above. Within each formation, groundwater can move in both the horizontal and vertical directions. Since the water table commonly follows the ground surface topography, horizontal flow can be topographically mapped using water table data obtained from shallow wells.

Groundwater flow within the three major aquifer systems is generally from the topographic highs associated with the ORM towards the topographic lows associated with the major stream channels and Lake Simcoe (Figure 5-2). In the shallow groundwater flow system, groundwater flow patterns are influenced by ground surface topography, but are more significantly influenced by the stream network. Local deflections in flow direction towards tributary streams and their associated valleys occur in all three aquifers (Earthfx & Gerber, 2008).

A geologic profile in the general north-south direction from the Oak Ridges Moraine to Lake Simcoe (Figure 5-6) shows the various components of the hydrogeologic system in this subwatershed. This is a simplified graphical presentation showing groundwater recharge, movement and discharge in the different lithologic layers underlying the subwatershed.

Groundwater flow within the deep groundwater flow system comprised of the Thorncliffe (Figure 5-3) and Scarborough (Figure 5-4) aquifer complexes exhibit a similar, but more subdued, pattern to the shallow flow system with flow converging on the lower reaches of the major streams, particularly the middle reaches of the Black River. The southern boundary of the regional study area (Holland Watershed divide) along the ORM appears to approximate a groundwater flow divide for all three aquifers. This divide is less pronounced between Schomberg and Oak Ridges perhaps because of the influence of the bedrock valley system and the presence of tunnel channel in this area (Figure 5-4). It should be noted that the potentiometric surface for the Scarborough aquifer complex is the least certain as it is based on fewer data points than the two overlying aquifers, which may explain the lack of clear channel flow dominated system in the observed data. Note that in the report water levels in wells are herein referred to as potentials. Observed potentials will refer to measured water levels in wells and simulated potential will refer to Core Model (discussed in Section 5.3) estimated water levels (Earthfx & Gerber, 2008).

The relative rates of vertical groundwater flow between the shallow and deep aquifer systems, as simulated by the numerical groundwater flow model, is displayed on Figure 5-5. This flow (referred to as vertical leakage) occurs through the Newmarket Till aquitard, or the aquitard material formed by the silt infill following tunnel channel erosion through the Newmarket Till. Vertical hydraulic gradients in the York Region study area are mainly downward between the shallow and deep aquifers under the ORM and till highlands and upward in the vicinity of river valleys associated with topographic lows, particularly the Holland Marsh area. The vertical gradients in all aquifers are also locally enhanced by municipal groundwater pumping. The major area within the subwatershed that has upward groundwater flow from the deep aquifer complexes to the shallow groundwater flow system occurs along the Holland Marsh area (Earthfx & Gerber, 2008).

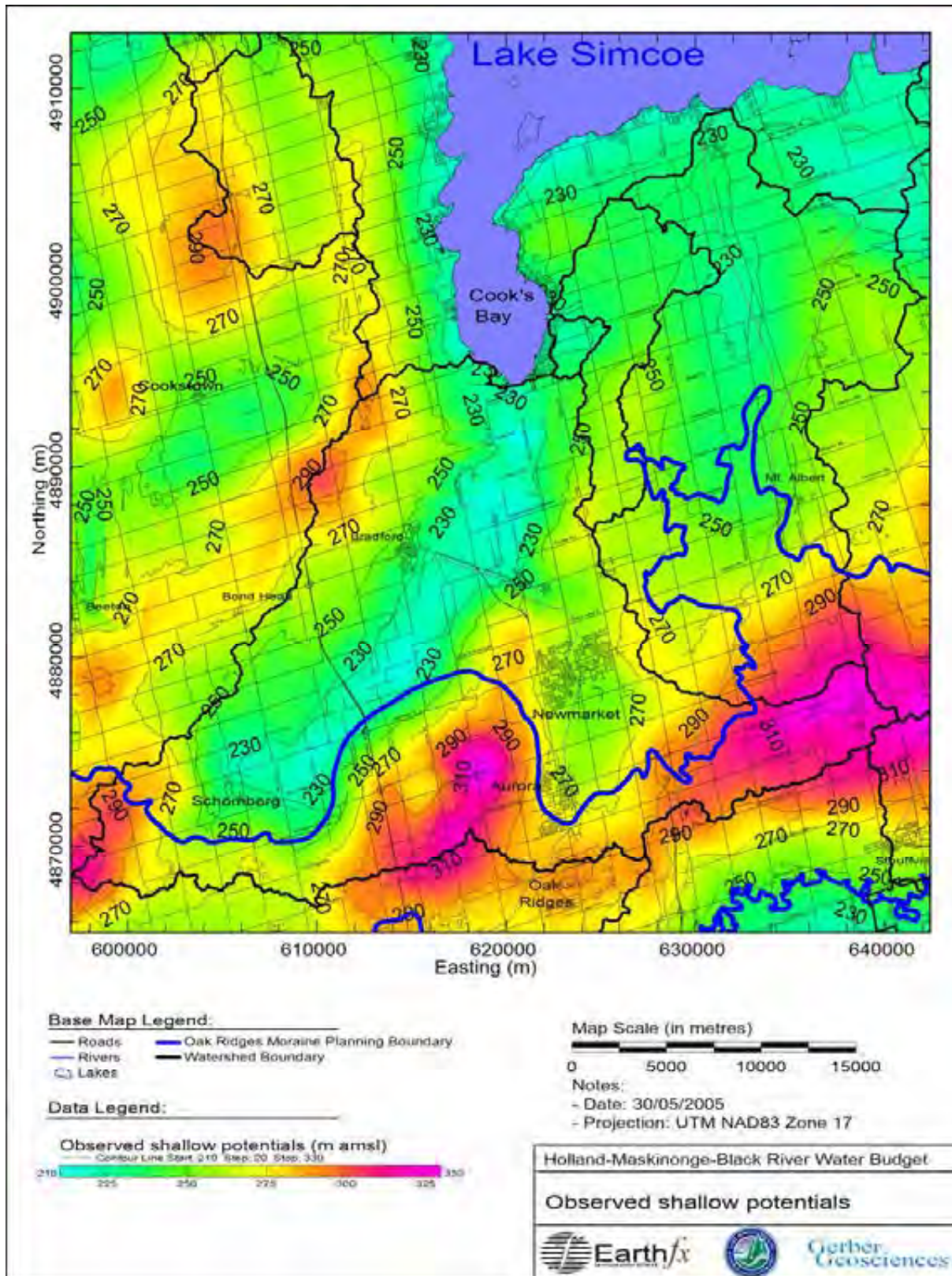


Figure 5-2 Observed potential within the shallow groundwater flow system. Water levels in wells are referred to as potentials (Earthfx & Gerber, 2008)

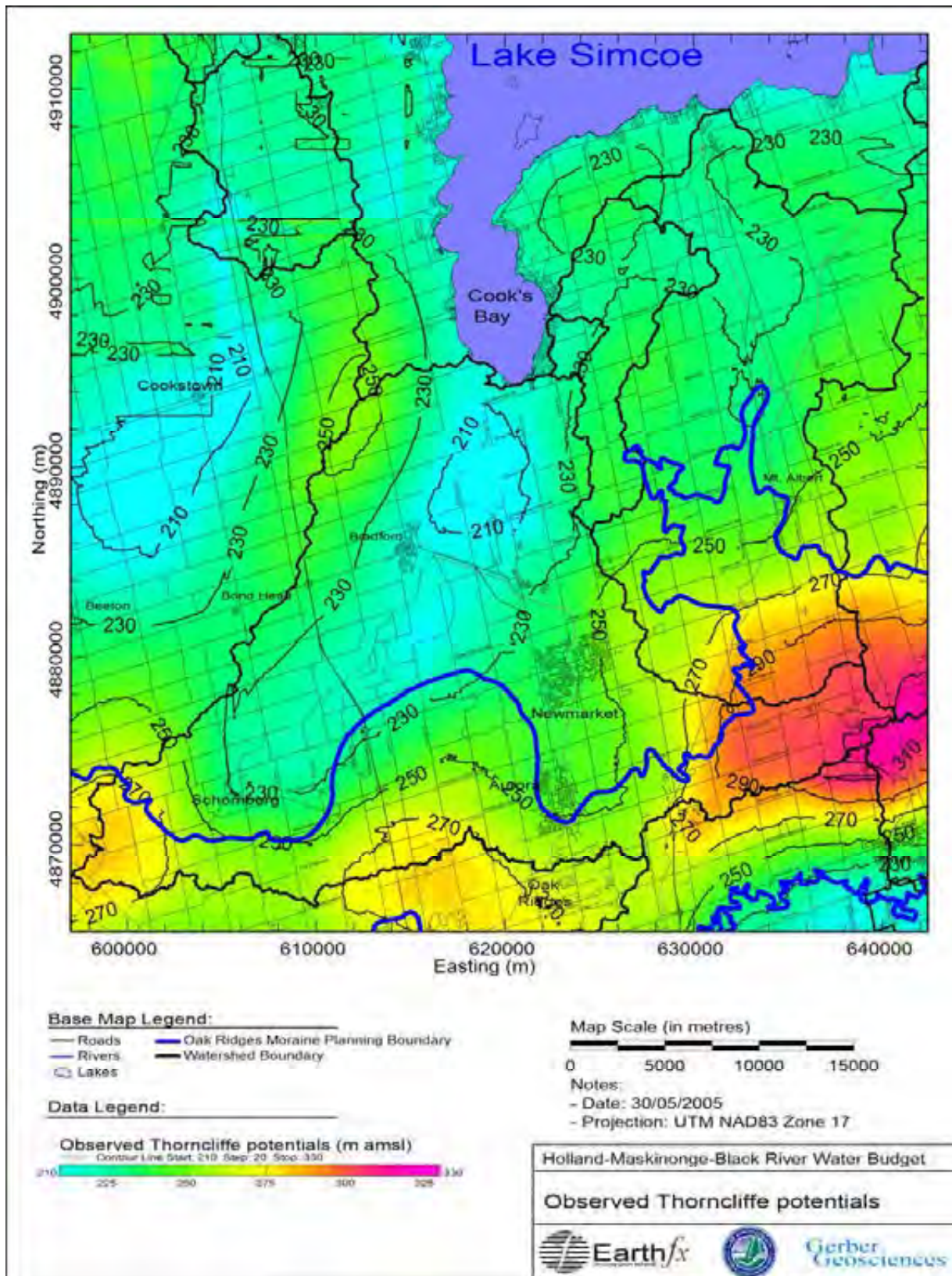


Figure 5-3 Observed potentials within the Thornclyffe aquifer complex (Earthfx & Gerber, 2008)

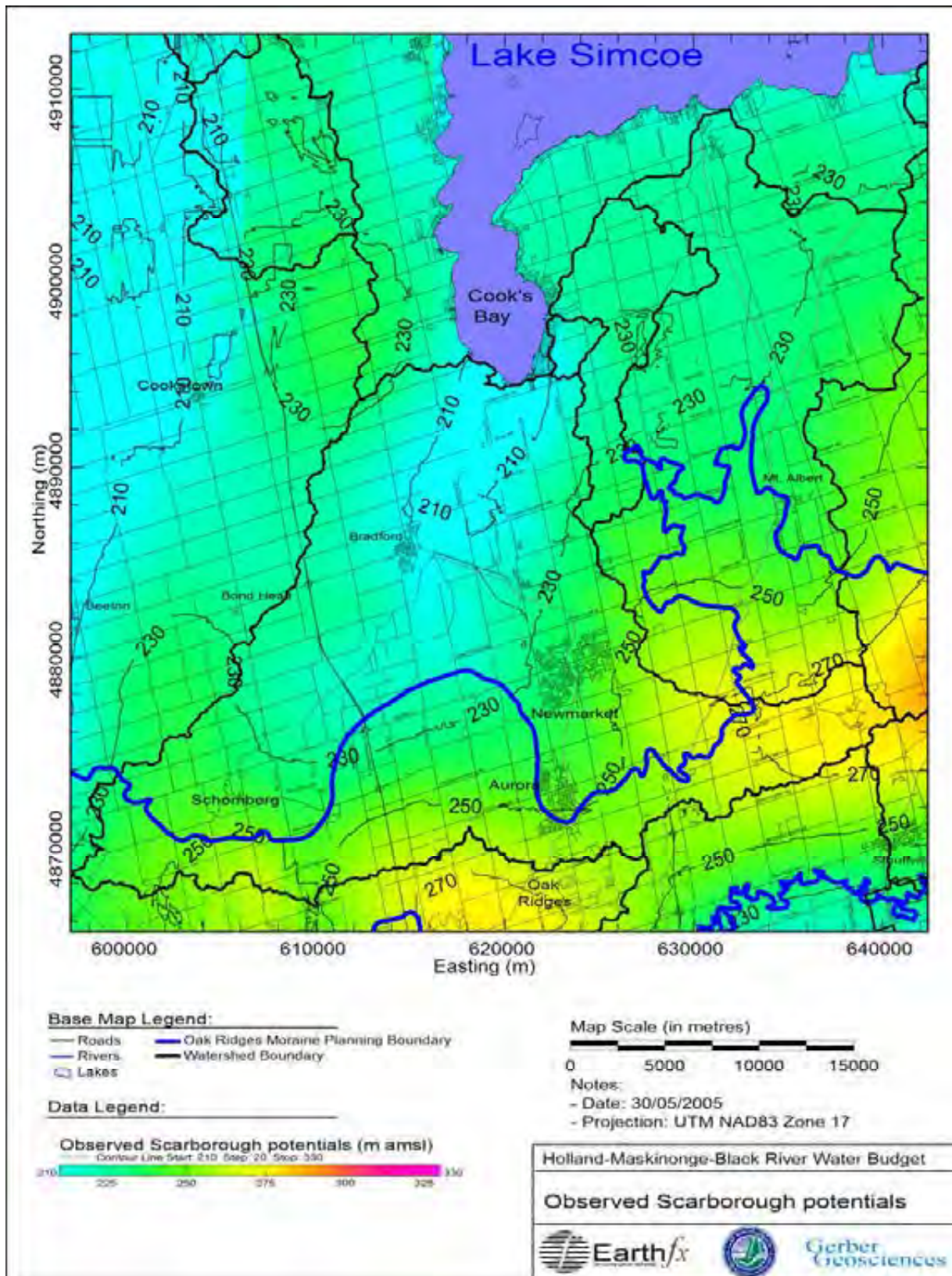


Figure 5-4 Observed potential within the Scarborough aquifer complex (Earthfx & Gerber, 2008)

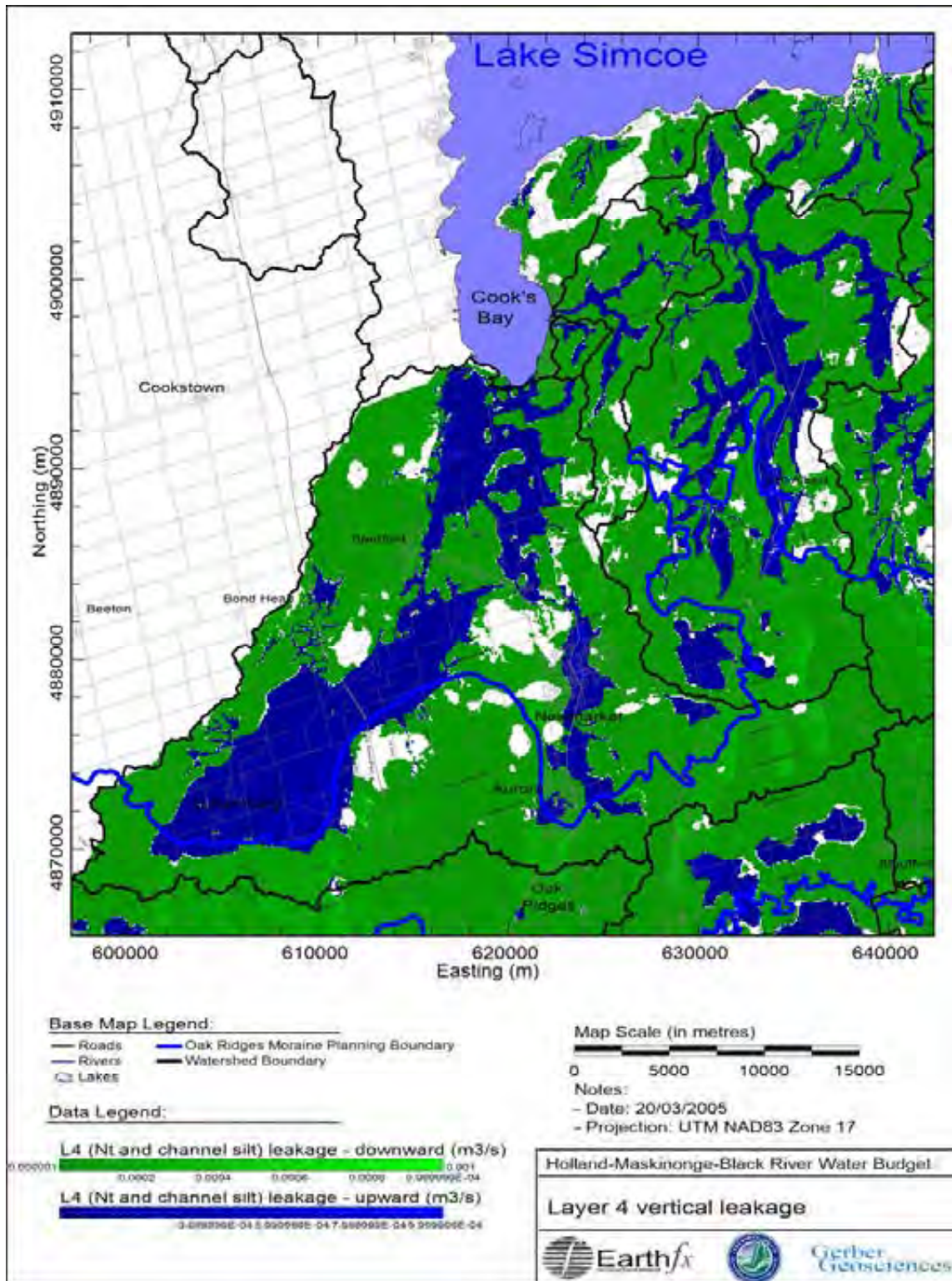


Figure 5-5 MODFLOW calculated vertical groundwater flow between the shallow and deep groundwater flow system through the Newmarket Till (N_t) and Channel Silt deposits (White zones= no leakage) (Earthfx & Gerber, 2008)

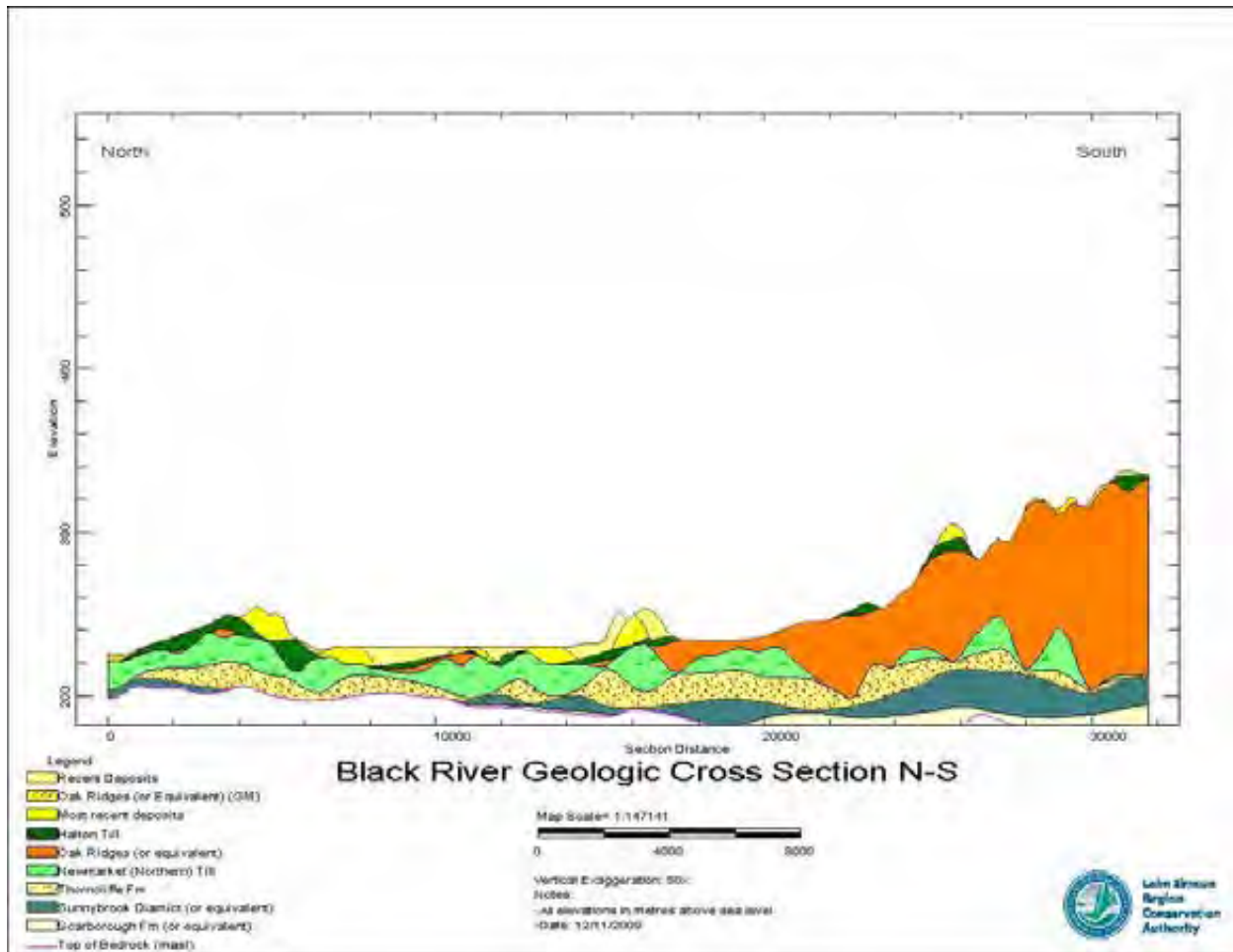


Figure 5-6 Black River profile (Earthfx & Gerber, 2008)

5.2.4 Stream Flow

The Black River at Sutton (02EC0120) and Black River at Baldwin (02EC008) are the only HYDAT streamflow gauging stations with long term continuous streamflow measurements within the Black River subwatershed (Earthfx & Gerber, 2008). Figure 5-11 summarizes the observed streamflow data from the Baldwin station.

The 1964- 2007 data set for the Black River at Baldwin shows no statistically significant trend in either increase or decrease in mean annual flows. Precipitation data also shows no significant trend, suggesting that the lack of a trend in flow data is not due to a masking effect from climatic data.

Total streamflow measured at the two stations is equivalent to approximately 200mm/year when averaged over the drainage area. Range of average annual stream flow over the past 40 years is approximately 120mm/year to 330mm/year (Earthfx, 2008).

Runoff/Impervious Surfaces

A change in the amount of impervious surface in a catchment may show up as a change in the seasonal flow volumes through a river system. Frozen ground during winter acts as an impervious surface limiting infiltration. Evapotranspiration effects will be minimal due to dormant or absent vegetative cover. In a watershed with minimal impervious surfaces streamflow through winter will make up the majority of the yearly flow volume, while summer will contribute

the least volume due to the affect of infiltration and evapotranspiration. As a watershed becomes more urbanized it can therefore be expected that this seasonal variation will lessen as more of the area becomes impervious.

Land use and Stream Flow

Changes in land use and water taking (both surface and groundwater takings) can dramatically alter flow characteristics and morphology of a stream. The land use changes associated with urbanization can have a significant impact on surface flows. This is due in large part to the increase in impervious surfaces, which include roads, parking lots, and rooftops. The increase in impervious surfaces leads to a significant reduction in evapotranspiration and infiltration of water into the soil, as there is little vegetation and the paved surfaces do not provide opportunities for the water to reach the soil, thereby disrupting the natural hydrologic balance. This disruption creates conditions for a higher volume of precipitation to be converted to surface water runoff, which flows at a faster velocity to receiving watercourses than it naturally would. The reduced infiltration of precipitation due to impervious surfaces can also result in lower groundwater levels and a reduction in the volume of water that is discharged as baseflow. Streams that once flowed permanently may become intermittent, or flow can disappear altogether for periods of time.

Approximately half of the lands within the Black River subwatershed have been changed significantly to accommodate various land uses, the most prevalent of which is agriculture. The activities associated with agriculture that place stress on groundwater resources include the pumping of surface water for irrigation and creation of ponds to intercept surface flow has reduced the amount of surface flow reaching watercourses in the Black River subwatershed. Tile drains also alter drainage characteristics at the site due to the efficiency at which they remove water from the field. Factors such as soil moisture and type, precipitation amount and intensity, amount of area tile drained, and the size of the subwatershed will influence whether the influence of tile drains on water quantity will be seen at the subwatershed scale.

Another factor that should be considered is the loss of wetland complexes to other land uses, including peat extraction. Wetlands have multiple benefits to the ecological health of a watershed. Those benefits that directly influence water quantity include flood attenuation, enhanced groundwater infiltration, and baseflow augmentation. The loss of these functions may be difficult to detect through flow data at the subwatershed scale, however, the continued loss of wetlands will inevitably impact the quality and quantity of stream flow in the entire Black River

To investigate if impervious surfaces have had any effect on the hydrology of stream seasonal flow volumes from 1965-1969 with 1998-2007 were compared (Figure 5-7). It was found that there is relatively little change in seasonal flow volumes, suggesting minimal change or impacts of impervious surfaces on the stream hydrology over the period of record. As well the low summer flow volumes are typical of a more rural catchment which aggress with the land use data for the catchment.

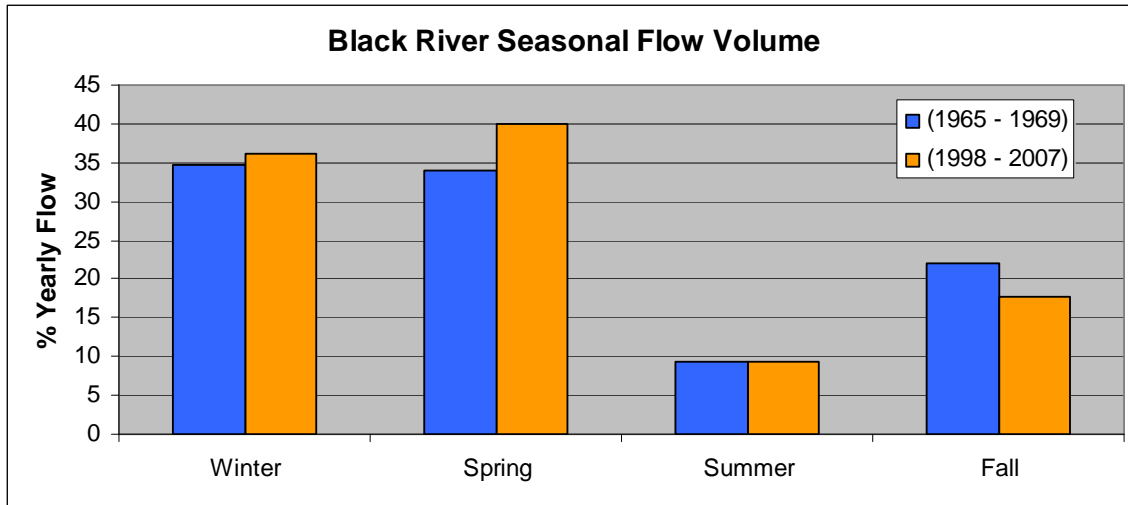


Figure 5-7 Seasonal flow volume in the Black River subwatershed

5.2.5 Baseflow

Baseflow is the portion of stream flow that is derived from groundwater discharge, from sources such as springs and seepages that release the cool groundwater. The baseflow component within streams is vital for fish populations that require cold water habitat and can be affected by localized pumping as the aquifers are drawn down and less baseflow is released. Groundwater discharge for the Black River was estimated as being equivalent to approximately 150mm/year over the drainage area. There may be some groundwater underflow occurring at this gauge location within the deeper aquifers and limestone bedrock (Earthfx & Gerber, 2008)

Streamflow data can be used to estimate the baseflow component at a flow station through baseflow separation (Figure 5-8). From this the proportion of baseflow in the stream can be determined as a percent of total flow. This metric is called the Baseflow Index. Applying a 10-year moving average to the Baseflow Index at the Baldwin Flow station shows a fairly stable trend in the baseflow contribution to total stream flow for the applicable period of record (Figure 5-9).

While flow gauges are a very effective tool for examining baseflow there are too few to accurately describe baseflow across the entire subwatershed. For this reason, spot baseflow discharge measurements were conducted on the Black River subwatershed in August 2004 and September 2005. Low flow stream surveys have also been conducted by Golder Associates in 2004 for the South Simcoe Groundwater Study, the Geological Survey of Canada (GSC), and Conestoga Rovers and Associates (CRA, 2003) for the CAMC- YPDT ORM Study. Discharge measures were collected at least 72 hours after precipitation to ensure they were representative of baseflow. For the purposes of analysis each measure was gaining or losing flow. Gaining reaches typically indicate groundwater contribution to the stream while losing reaches could be due to water taking, groundwater infiltration, or impoundments. Figure 5-10 shows the 2004 survey locations and the results are depicted on Figure 5-11.

A number of reaches were found to be dry or contain standing water both years. Most notable are the north-west headwater reaches which were found to contain no baseflow. The majority of the southern headwaters of the Black River originate on the Oak Ridges Moraine, many of which are large gaining reaches, particularly the eastern Mount Albert branch. These gaining reaches are the result of groundwater discharge into the streams which is a benefit typical of

Oak Ridges Moraine geology. Biologic monitoring, including fish sampling and temperature data, also recognize these gaining reaches as valuable coldwater habitat.

This relationship between Oak Ridges Moraine baseflow discharge and cold water habitat is exemplified on the western headwater reach. Figure 5-11 shows that gaining reaches and good cold water habitat exist in the headwaters flowing off the Moraine. As this branch flows further off the Moraine gaining reaches diminish and cold water habitat degrades. However, where the branch once again crosses the Moraine a large gain in baseflow occurs along with a return of quality cold water habitat, thus demonstrating the value of the Moraine.

Low flow stream flow surveys measure the discharge at various points along a river reach during a period without influence from storm events. All or most of the flow in the stream during this period of time is assumed to represent groundwater discharge. The objective of these surveys was to identify those reaches receiving significant groundwater discharge and to determine relative rates of groundwater discharge to the various ungauged tributaries and stream reaches.

These relative rates were used as guides in the calibration of the groundwater flow model discussed in section 5.3.4. While it was recognized that the measured flows tend to underestimate annual average groundwater discharge, the observations provided calibration targets for the spatial distribution of groundwater discharge and minimum groundwater discharge quantities to streams.

The position of the Baldwin and Sutton stream flow gauging stations within the flow system are shown on the river profile included as (Figure 2-13). From the geologic section it can be seen that most of the groundwater discharge at the streamflow gauging station is from the upper aquifer unit. However, not all groundwater recharge that occurs within the station drainage areas is realized as groundwater discharge at the stream flow gauging stations. A portion of the recharge likely moves to the deep aquifers and ultimately discharges to the stream downstream of the gauge. (Note: surface water catchments do not always align with groundwatersheds).

The ability of a river system to withstand drought depends largely on the baseflow volume the system can generate. Extremely dry conditions existed in 2007, creating low flow levels in the Black River, and record low flow levels in neighbouring subwatersheds to the west. Examination of the Baseflow Index for the Black River shows a stable trend in baseflow over the period explaining its ability to better withstand the dry conditions of 2007 (Figure 5-12).

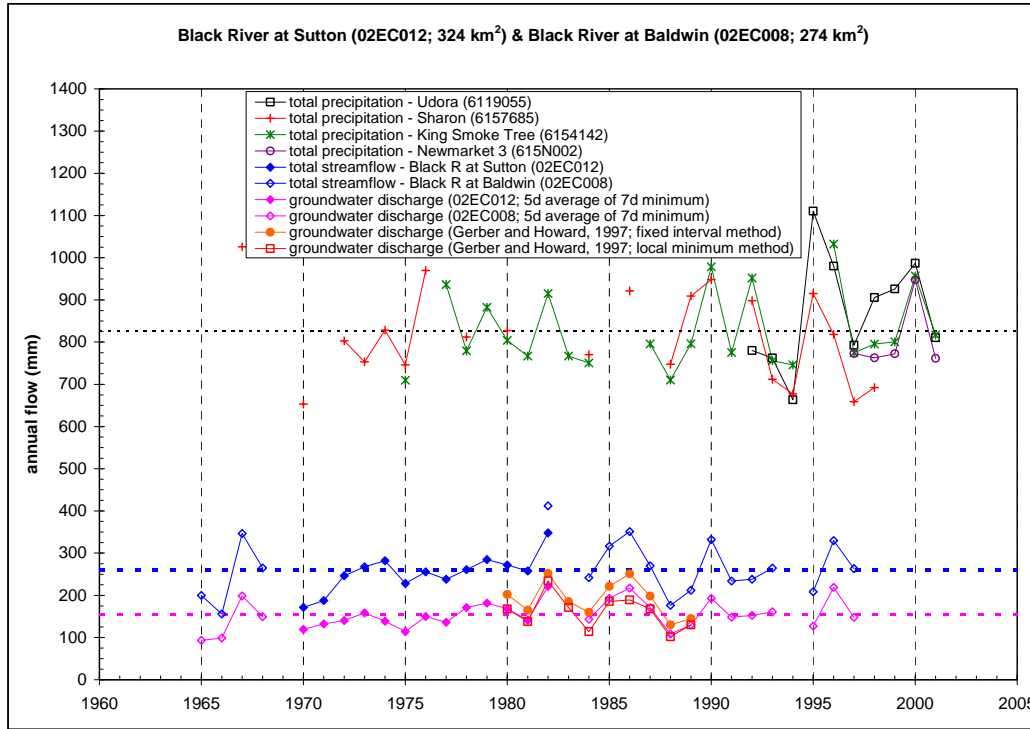


Figure 5-8 Streamflow and groundwater discharge for the Black River HYDAT gauging stations. Groundwater discharge estimates from Gerber and Howard (1997) obtained using a computer program now known as HYSEP (Sloto and Crouse, 1996).

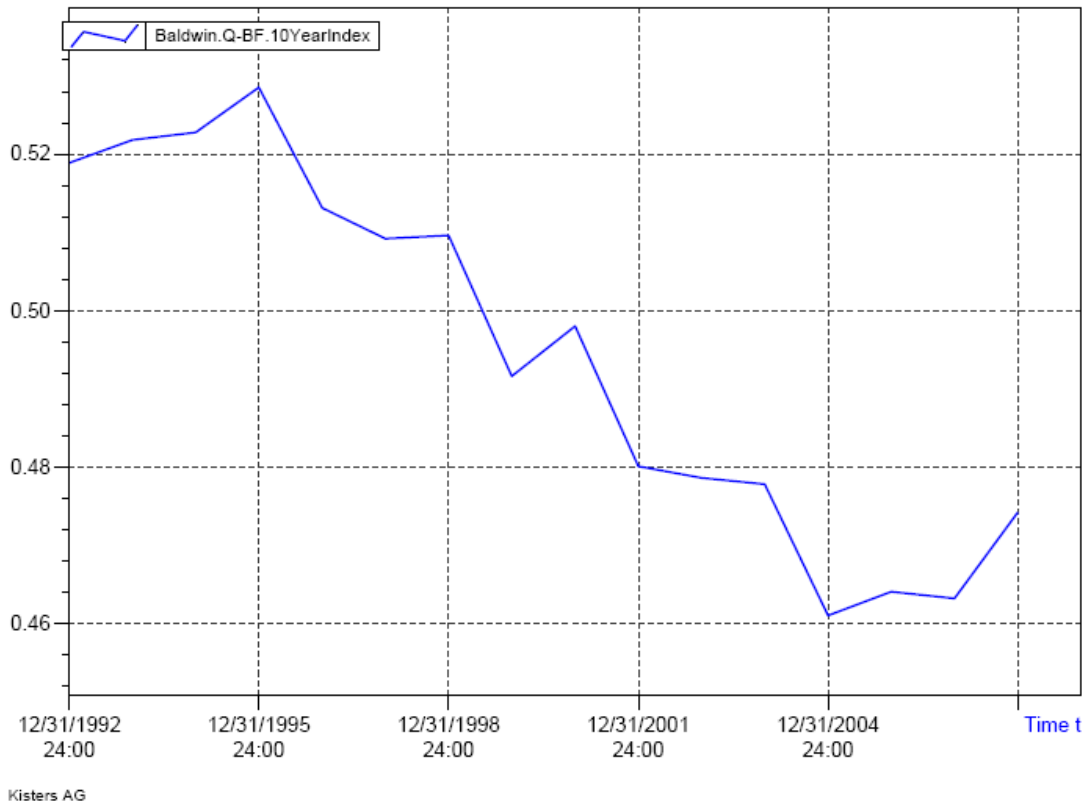


Figure 5-9 Black River baseflow index (10 year moving average) from the Baldwin gauge (LSRCA, 2009)

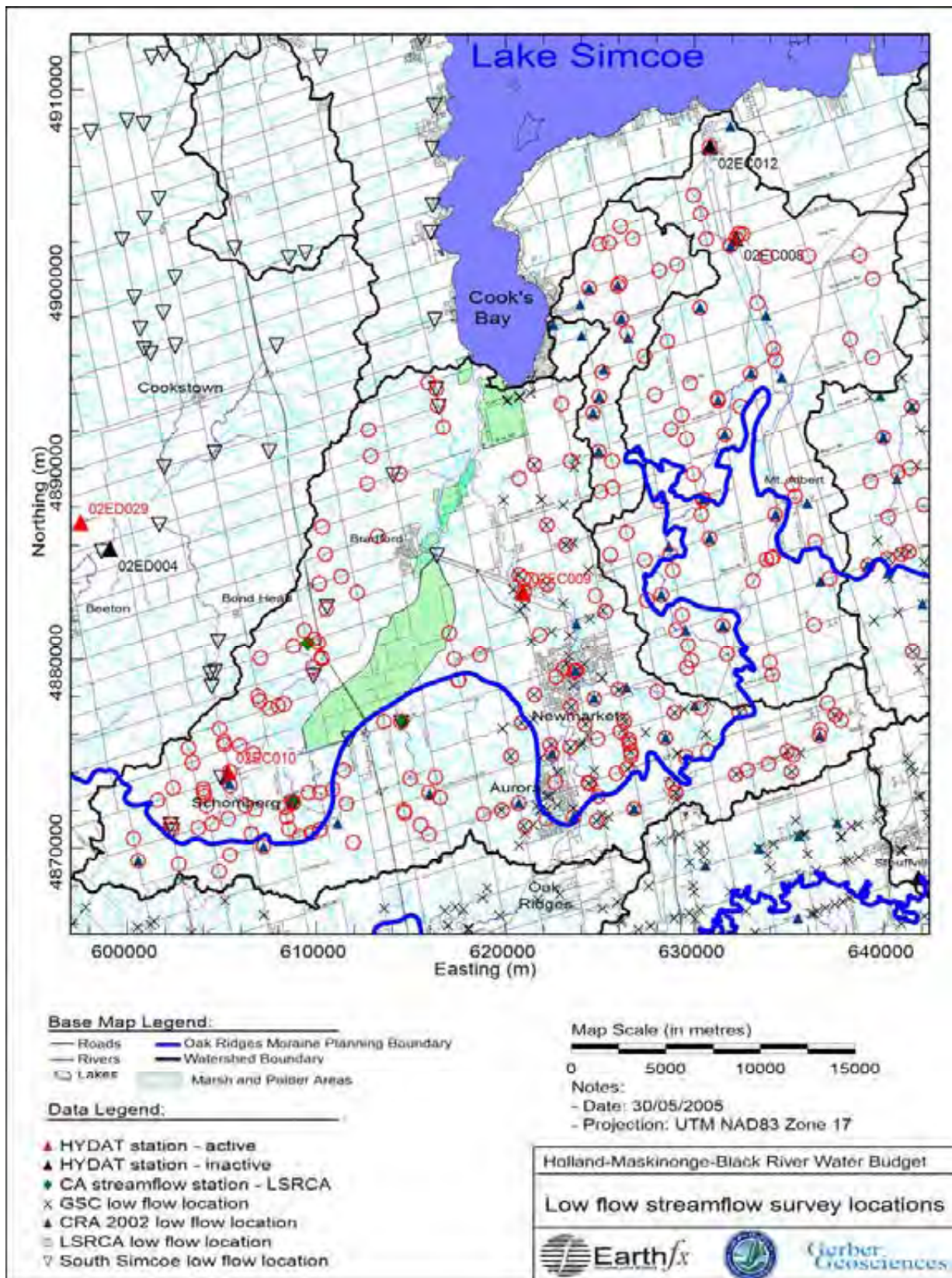


Figure 5-10 Low flow streamflow survey locations in the Black subwatershed and surrounding area (Earthfx & Gerber, 2008).

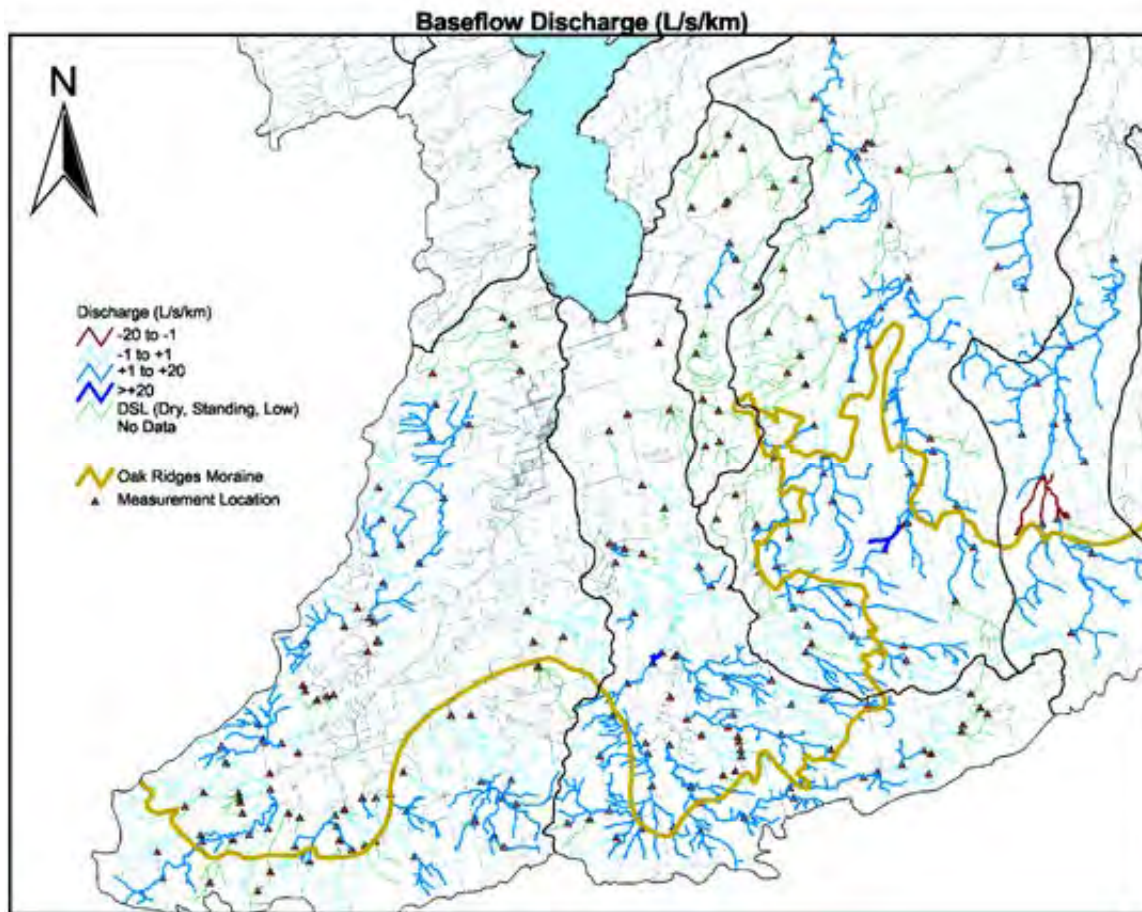


Figure 5-11 Low flow stream survey results for 2004. Figure provided by LSRCA.

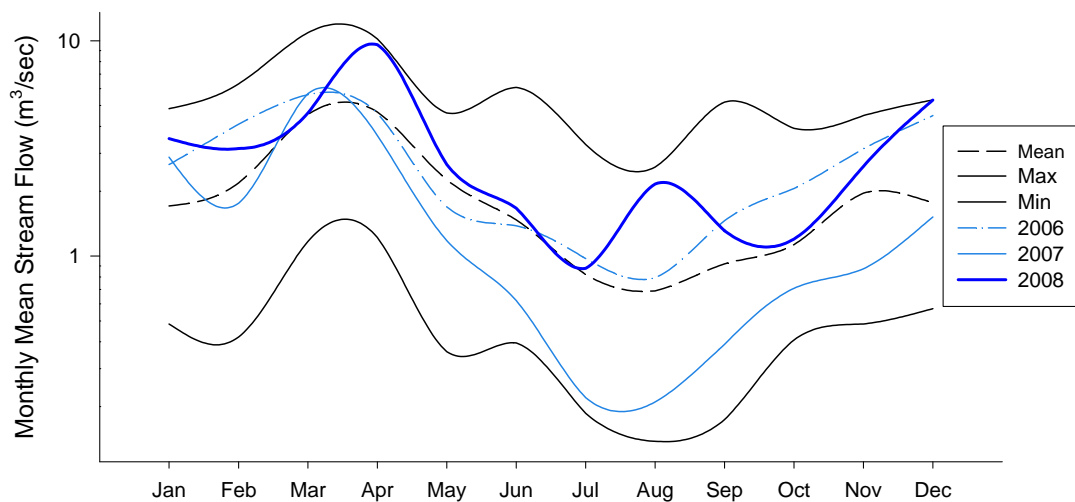


Figure 5-12 Streamflow at Black River (1964-1969, 1983-2008)

5.2.6 Groundwater Discharge Areas

In areas where the static water table intersects the ground surface there is potential for discharge to occur. Groundwater discharge areas are often in low topographic areas and can be observed in and around watercourses in the form of springs and seeps, or as baseflow to streams. These areas are characterized by upward vertical hydraulic gradients. The portion of water that is contributed from groundwater is referred to as baseflow and provides clean cool water to streams and wetlands.

Groundwater discharge rates vary throughout the year due to seasonal and longer-term changes in recharge and groundwater potentials. Hydrograph separation techniques applied to long term surface water flow records are the best methods for quantifying the portion of streamflow derived from groundwater discharge to streams. However, there are few long-term gauges within the study area and not all significant stream tributaries are monitored.

A discharge map (Figure 5-13) was created using the potentiometric surface produced from shallow wells in the MOE water well database in conjunction with the topographic mapping. Potential discharge zones are where the water levels are within two metres of the surface (topographic mapping).

Groundwater discharge zones are associated with the north flank of the ORM along the break in slope and further downstream in the Black River Valley. Numerical models have been used to predict the location and rates of groundwater discharge throughout the subwatershed.

5.2.7 Groundwater Recharge

Groundwater is replenished as precipitation or snowmelt infiltrates into the ground surface. The rate and direction of groundwater movement is dependent upon several factors, such as soil permeability, surface topography, land use, and vegetation cover. For example, water will move more readily through coarse loose material and bedrock fractures than through material such as clay or unfractured rock.

Significant groundwater recharge can be described as areas that can effectively move water from the surface through the unsaturated soil zone to replenish available groundwater resources. The mapping of these recharge zones is necessary to ensure the sustainability of

groundwater supplies. In turn, land development plans should consider the protection of these areas in order to maintain the quantity and quality of groundwater required by a healthy subwatershed.

The most significant areas for groundwater recharge within the Black River subwatershed are located on the Oak Ridges Moraine. As demonstrated on Figure 5-14, the southern end of the subwatershed on the Oak Ridges Moraine, specifically the northern flank, provides the highest recharge rates. This area is capable of infiltrating approximately 400 millimetres of water per year due to the sandy soils and hummocky topography (Earthfx, 2006).

The mappings of these recharge zones and the policies that protect them are necessary to ensure the sustainability of groundwater supplies and a healthy subwatershed. In the version of the Core Model described in Earthfx (2004), groundwater recharge to the Core Model was initially estimated considering land use, climate and soil properties, and published values from previous modelling studies. These estimates were adjusted during model calibration. The spatial distribution of applied recharge within the study area is provided in Figure 5-16 (Earthfx & Gerber, 2008).

Methods to determine significant recharge areas have been developed based on geology and topography, and continue to be refined to better understand and protect groundwater.

Groundwater Monitoring

The static water levels measured in monitoring wells characterize the amount of water stored in an aquifer, aquifer complex or saturated portion of the subsurface system. Groundwater levels can fluctuate due to precipitation, barometric pressure, temperature, and water withdrawal.

Monitoring these ambient groundwater levels can help understand baseline conditions and assess how groundwater is affected by climate change, seasonal fluctuation, land and water use. Monitoring helps to identify trends and emerging issues, and provides a basis for making informed resource management decisions. The data can also be used to measure the effectiveness of the programs and policies that are designed to manage and protect groundwater resources.

Under the Provincial Groundwater Monitoring Network (PGMN), the LSRCA, in partnership with the Ministry of Environment, currently operates one monitoring well in the Black River subwatershed. Well, WQ298-2/3/4 is screened in overburden and bedrock. Groundwater conditions are monitored at three depths in this well, characterizing conditions in each of the aquifers.

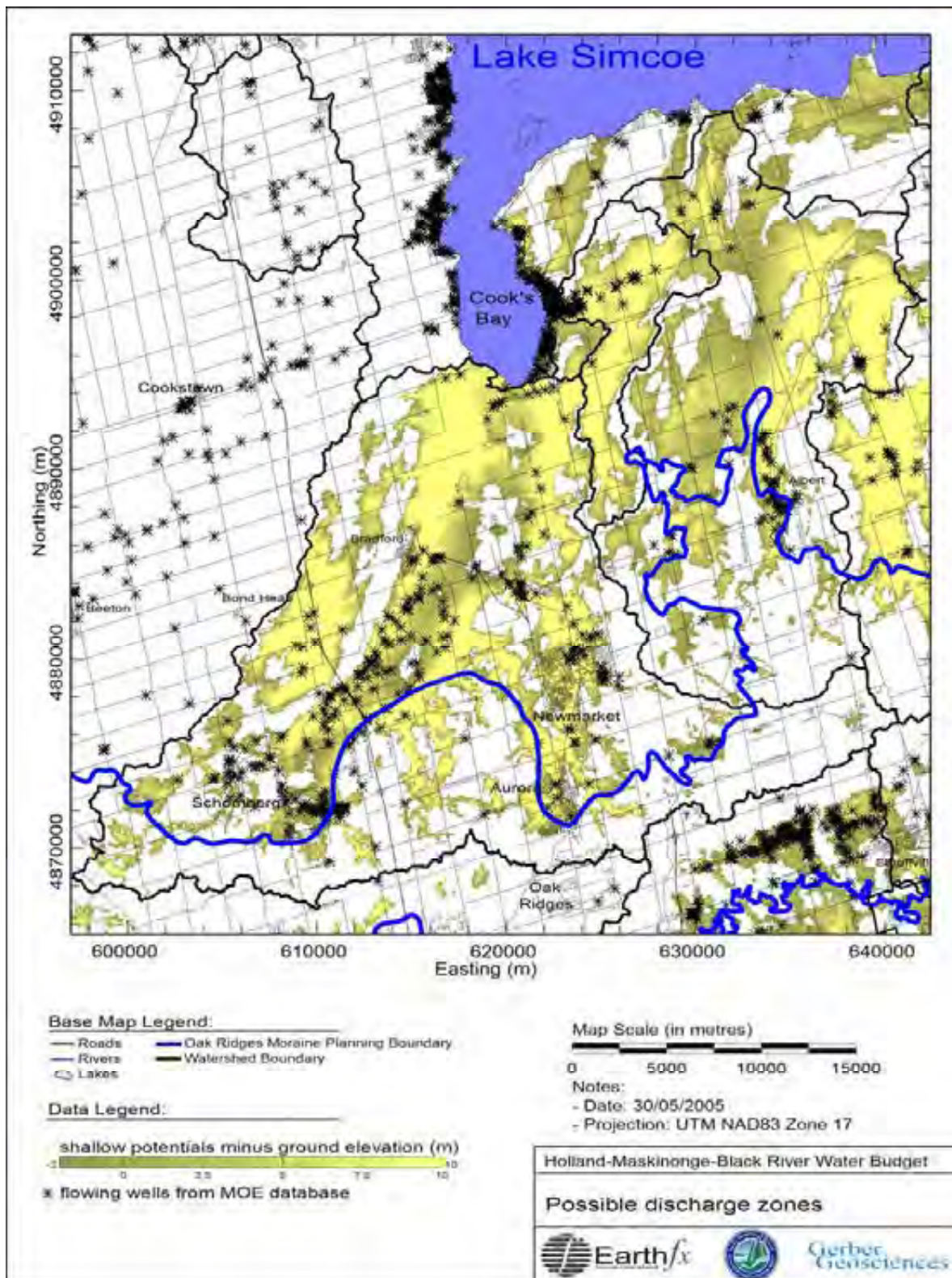


Figure 5-13 Shallow groundwater flow system potentials minus ground surface elevation illustration possible groundwater discharge zones. Discharge verified by location of flowing wells from MOE database (Earthfx & Gerber, 2008).

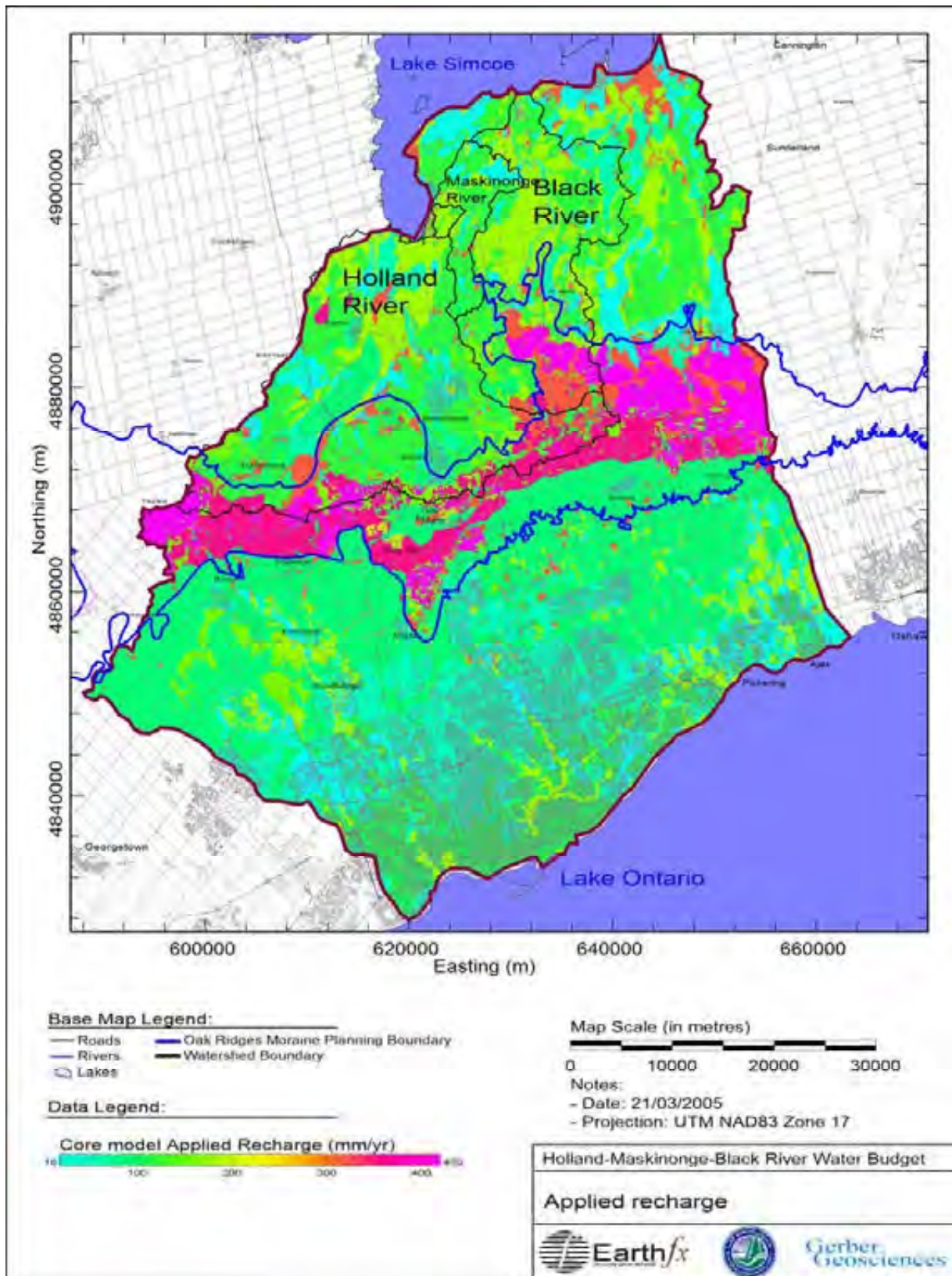


Figure 5-14 Applied recharge in the Core Model (from Earthfx, 2004)

Key points – Current Hydrogeologic Status:

- The physical properties within a watershed, such as drainage area, slope, geology and land use can influence the distribution of water and the processes that function within a watershed.
- Groundwater discharge is the main component of streamflow during dry periods and as such maintains an environment that allows cold water fish to survive even during the dry summer months.
- The water table map for the Black River shows that on a regional scale groundwater flows within the major aquifer systems is generally from the topographic highs associated with the ORM towards the topographic lows associated with the major stream channels and Lake Simcoe.
- Surface water flow are a function of overland runoff and groundwater discharge (baseflow). As impervious surfaces are increased within an urban area the quantity of runoff increases as does the rate of overland flow (i.e. peak flow). This also causes a decrease in groundwater infiltration or recharge and less groundwater is available to sustain the streams during the dry summer months.
- Groundwater recharge can be described as areas that can effectively move water from the surface through the unsaturated soil zone to replenish available groundwater resources. The mapping of these recharge zones show that the most significant recharge within the subwatershed occurs on the ORM.
- Monitoring groundwater levels can characterize baseline conditions, and assess how groundwater is affected by climate change, seasonal fluctuation, land and water use. Monitoring groundwater levels can help identify trends and emerging issues, and can provide a basis for making informed resource management decisions, measure the effectiveness of the programs and policies that are designed to protect these groundwater resources.
- A refined understanding of the aquifer systems and groundwater flow as part of the subwatershed components and the processes is vital in maintaining the ecological balance and sustainability of resources within a watershed.

5.3 Water Budget

A water budget characterizes the hydrologic conditions within a subwatershed by quantifying the various elements of the hydrologic cycle, including precipitation, interception, and evapotranspiration. Therefore, the water budget can be used to identify areas where a water supply could be under stress, now or in the future, and help protect the ecological and hydrological integrity of an area by establishing water supply sustainability targets and strategies.

The following section provides information regarding the water budget study that was completed for the Black River subwatershed. York Region enlisted the assistance from LSRCA to complete the water budget studies for the subwatersheds that originate in the ORM. Earthfx & Gerber (2008) completed the water budget study on behalf of the LSRCA, which included the East and West Holland River, Maskinonge River and the Black River subwatersheds. The water budget

addresses the requirements set out in Section 25 of the Oak Ridges Moraine Conservation Plan and those requirements specifically related to the Yonge Street area.

The general water budget may be expressed as an equation with water Inputs = Outputs + Change in Storage; or

$$P + SW_{in} + GW_{in} + ANTH_{in} = ET + SW_{out} + GW_{out} + ANTH_{out} + \Delta S$$

Where:

P = Precipitation

SW_{in} = surface water flow into the watershed

GW_{in} = groundwater flow into the watershed

ANTH_{in} = anthropogenic or human inputs such as waste discharges

ET = evapotranspiration

SW_{out} = surface water flow out (includes runoff)

GW_{out} = groundwater flow out

ANTH_{out} = discharge to wells (i.e. drinking water supplies)

ΔS = change in storage (surface water, soil moisture)

Source: (OMOE, 2005b)

The project objectives were to provide estimates of each component of the hydrologic cycle from the subwatershed based on various land and water use scenarios. Estimates were completed using a water budget analysis program (VL-WABAS) and a three-dimensional numerical groundwater flow model (MODFLOW).

The five groundwater and land use scenarios analysed within this study include:

- 2002 land use and groundwater use (current conditions);
- estimated 1950 land use and groundwater use conditions;
- estimated 2002 drought conditions;
- estimated 2026 land use and groundwater use conditions; and,
- estimated 2026 drought conditions (with future pumping levels).

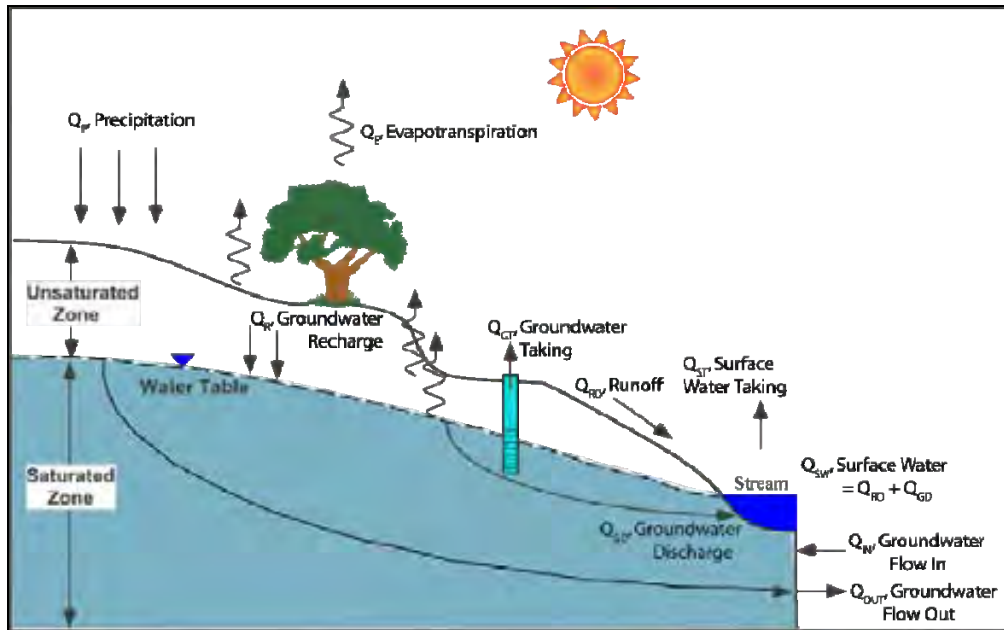


Figure 5-15 Water budget components (Earthfx & Gerber, 2008)

5.3.1 Local Water Budget Initiatives

The water budget methodology presented in this chapter includes an assessment of existing hydrologic conditions within the subwatershed using both a conceptual model and numerical modelling information developed through the Source Water Protection program and the CAMC-YPDT Groundwater study (discussed in Section 5.1.2).

Water budgets are generally developed using an approach that estimates the amount and location of water conceptually, however they can be refined by using surface and groundwater models. These models are referred to as numerical models that use mathematical equations to approximate existing hydrogeologic conditions. While models can quantify the various components of the hydrologic cycle they can also be used to estimate the direction of groundwater or surface water flow within a subwatershed and therefore aid in the identification of potentially stressed areas. Numerical model outputs are intended to provide estimates of possible conditions that may exist within the subwatershed; these estimates or predictions may point to possible areas of concern and may also be considered when providing solutions to identified problems.

The numerical model used to assess the Black River subwatershed was developed through the CAMC-YPDT Study group. A major part of this investigation included the construction of two three-dimensional numerical groundwater flow models (Figure 5-15) (Earthfx, 2006). The initial five-layer Regional Model covers the entire ORM, while the more recent model has been expanded to an eight-layer Core Model that covers much of the western portion of the ORM.

Both the Regional and Core Models include portions of the Lake Simcoe Region Conservation Authority (LSRCA) subwatersheds situated within York Region (Figure 5-16). The Core Model was the tool used in the study completed by Earthfx and Gerber (2008) to quantify the water budget components within the Black River subwatershed. The Core Model was created using the United States Geological Survey (USGS) MODFLOW code to solve the equations for groundwater flow (McDonald and Harbaugh, 1988; Harbaugh and McDonald, 1996). The model was created using geologic data supplied by the Ontario Geologic Survey, and the Geologic Survey of Canada. The MODFLOW groundwater Core Model is unable to predict the surface

water components necessary to complete a detailed water budget analysis, so a WABAS surface water model was used.

The WABAS model was used to quantify the surface water components necessary to complete the water budget. A VL-WABAS model was used to estimate the following parameters (Earthfx & Gerber, 2008)

- actual evapotranspiration (ET);
- snowmelt;
- surface runoff (RO);
- infiltration (GWI); and
- storage within each water reservoir (pervious and impervious interception storage, surficial soil storage, and snowpack storage).

Further information about the model and its limitations can be obtained from Earthfx & Gerber (2008) and Earthfx (2006).

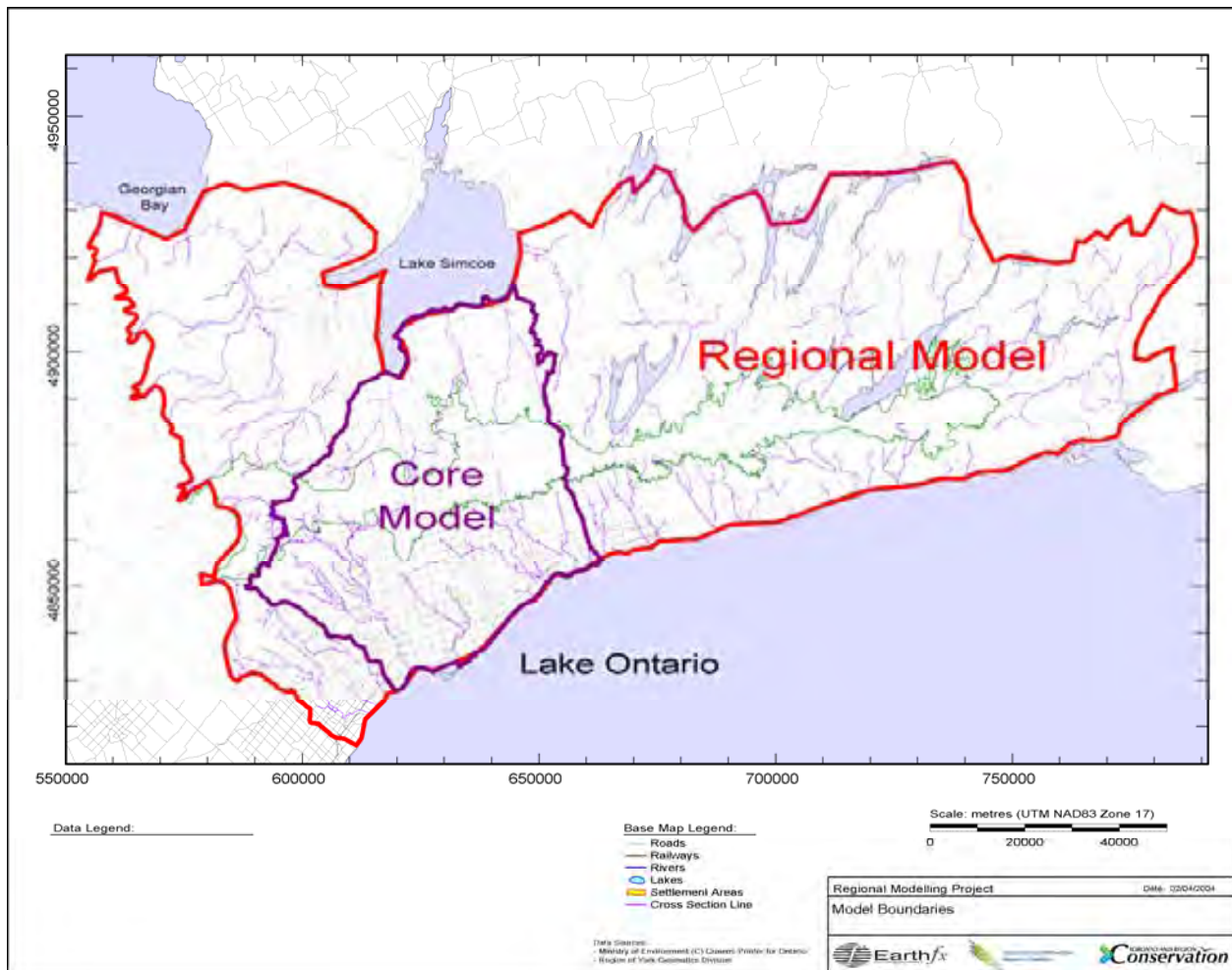


Figure 5-16 Regional ORM Model and Core Model boundaries (figure from Earthfx, 2006)

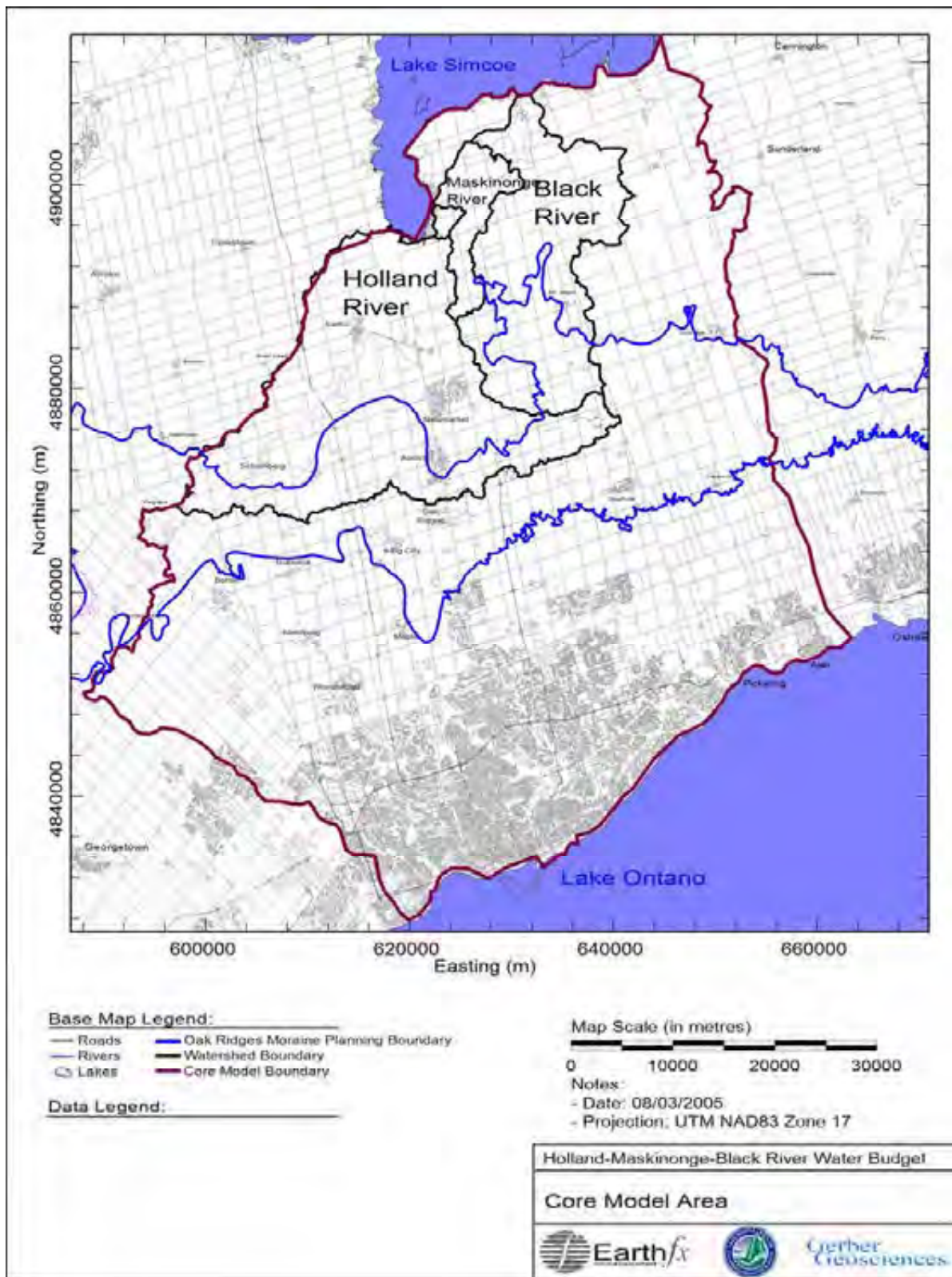


Figure 5-17 The Black River subwatershed location within the Core Model area (Figure from Earthfx & Gerber, 2008)

5.3.2 Precipitation and Evapotranspiration

Precipitation in the form of rain or snow is the source of all water within a subwatershed. Typically, precipitation will vary seasonally and from year to year due to climatic factors. Precipitation is often measured at one or more meteorological stations within a subwatershed using precipitation gauges.

There are nine active Environment Canada climate stations situated near the Black River subwatershed. However, only six of these stations have a period of record greater than 20 years. The total annual precipitation for these six stations ranges from 785 to 837 mm/year. Two stations situated near the Black River subwatershed, Sharon and King Smoke Tree, have average total precipitation of 814 and 826 mm/year, respectively. Data from inactive stations within or near the subwatershed were used to supplement the active station data in the detailed water budget analyses (Earthfx & Gerber, 2008).

The average annual precipitation and evapotranspiration is shown in Figure 5-17, and Figure 5-18 respectively. Table 5-3 and Table 5-4 show the water budget estimates for different scenarios calculated under steady state conditions (Earthfx & Gerber, 2008). The tables also show the annual precipitation and evapotranspiration for the Black River subwatershed.

A comparison of the current 2002 average conditions to the estimated 2002 drought conditions reveals a 7.8% and 9.0% decrease in total precipitation, a 10.5% and 12.05% decrease in evapotranspiration (AET), an increase in runoff of 10.4% and 4.5% and a decrease in recharge of approximately 3.2% and 7.15% for the upper and lower black river subwatersheds respectively. The reduction in recharge and increase in pumping again leads to a reduction in groundwater discharge to streams (Earthfx & Gerber, 2008).

Table 5-3 Water budget estimates for different scenarios in the Upper Black River. (Note: All estimates were calculated under steady state conditions Earthfx & Gerber, 2008)

Condition	Precipitation	ET (mm/a)	RO(mm/a)	GWl (mm/a)
Current	809	551	77	190
1950	809	553	74	192
2002 Drought	746	493	85	184
2026 Predicted "current"	809	548	80	190
2026 Predicted "drought"	746	491	87	184
All units in mm/annum ET=Evapotranspiration RO= Runoff GWl= Groundwater Infiltration				

Table 5-4 Water budget estimates for different scenarios in the Lower Black River. (Note: All estimates were calculated under steady state conditions Earthfx & Gerber, 2008)

Condition	Precipitation	ET	RO	GWI
Current	834	558	110	170
1950	834	561	105	172
2002 Drought	759	491	115	158
2026 Predicted "current"	834	554	114	170
2026 Predicted "drought"	759	488	119	157
All units in mm/annum ET= Evapotranspiration RO= Runoff GWI= Groundwater Infiltration				

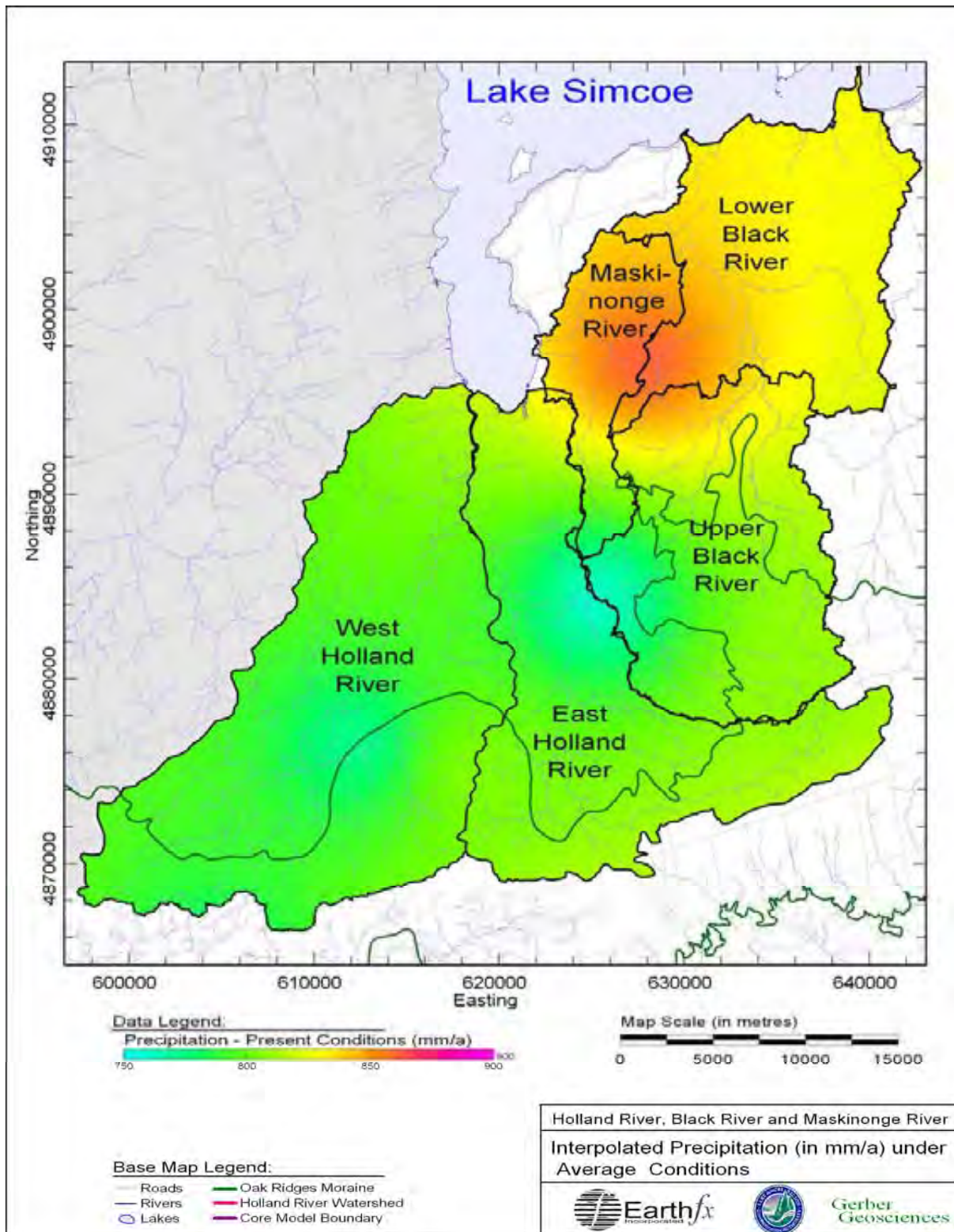


Figure 5-18 Average annual precipitation over a 20 year period (1980-1999) in mm/annum (Earthfx & Gerber, 2008)

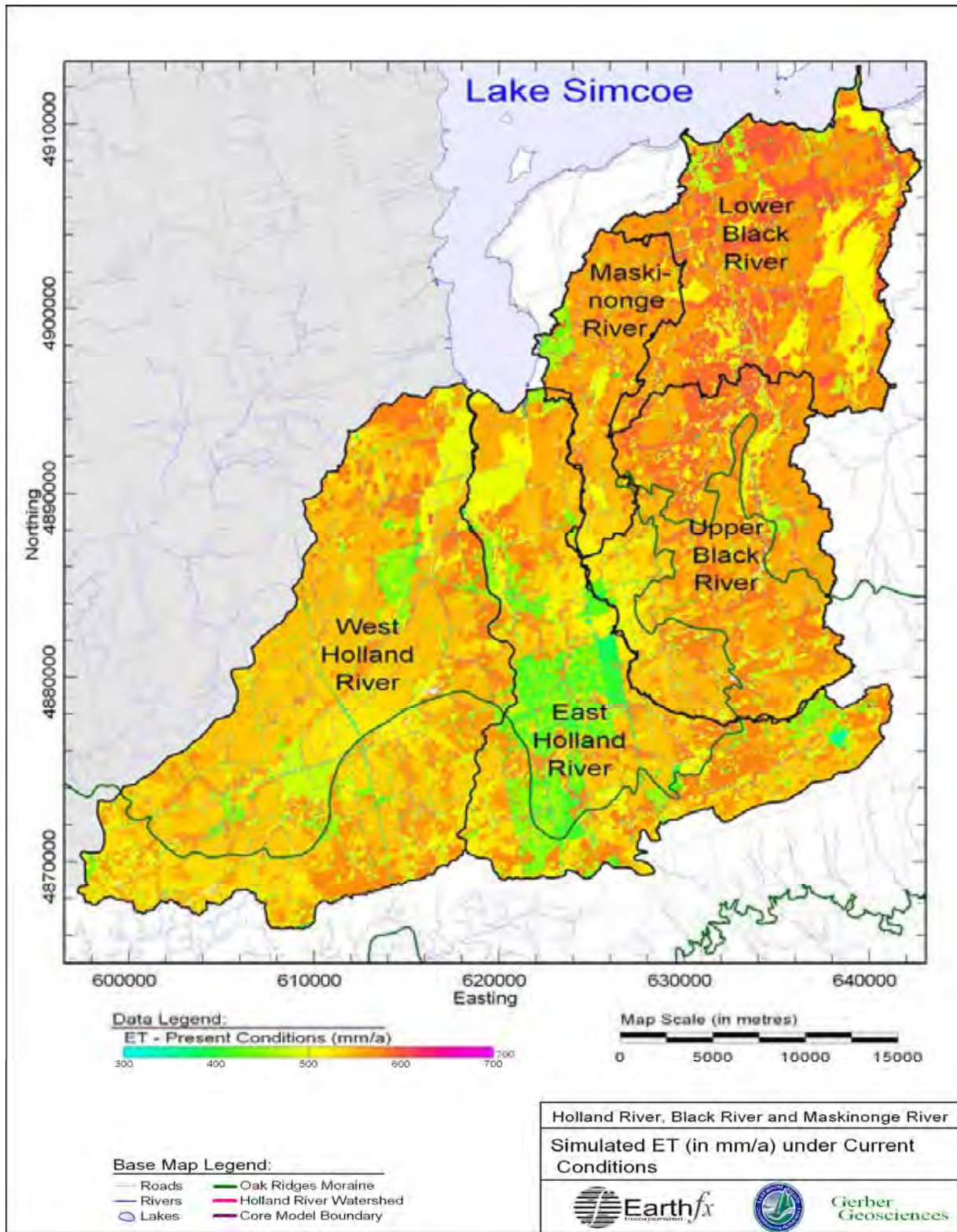


Figure 5-19 Simulated (VL-WABAS) annual average evapotranspiration in mm/annum with 2002 land use (Earthfx & Gerber, 2008)

5.3.3 Infiltration

Groundwater infiltration (GWI) is influenced by the distribution and thickness of surficial deposits and associated soil properties, topography, land cover and use. In areas where there is imperviousness, such as within urban areas, the amount of infiltration is reduced, while infiltration rates are increased in areas of sands and sandy loams, particularly within the ORM.

The groundwater recharge input file for the Core Model was modified by replacing the original recharge estimates with the GWI rates (Table 5-3 and Table 5-4) calculated by VL-WABAS within the study area. The groundwater model was then run with the modified recharge file to simulate groundwater flow under 2002 land use conditions (Earthfx & Gerber, 2008).

The groundwater flow model is a steady-state model and uses estimates of annual average net recharge (GWI) as input to the model (Figure 5-20). The recharge is initially applied to model Layer 1 which represents the weathered Halton/Kettleby Till and surficial sands. If this layer is missing in a particular area, or if the model cells go dry in that layer during the simulation (i.e. the simulated water-table drops below the base of the layer), the recharge is passed on to the next layer down. This allocation of recharge to the different layers is shown in Figure 5-19 and was determined from the final distribution of recharge in the Core Model/VL-WABAS results (Earthfx & Gerber, 2008).

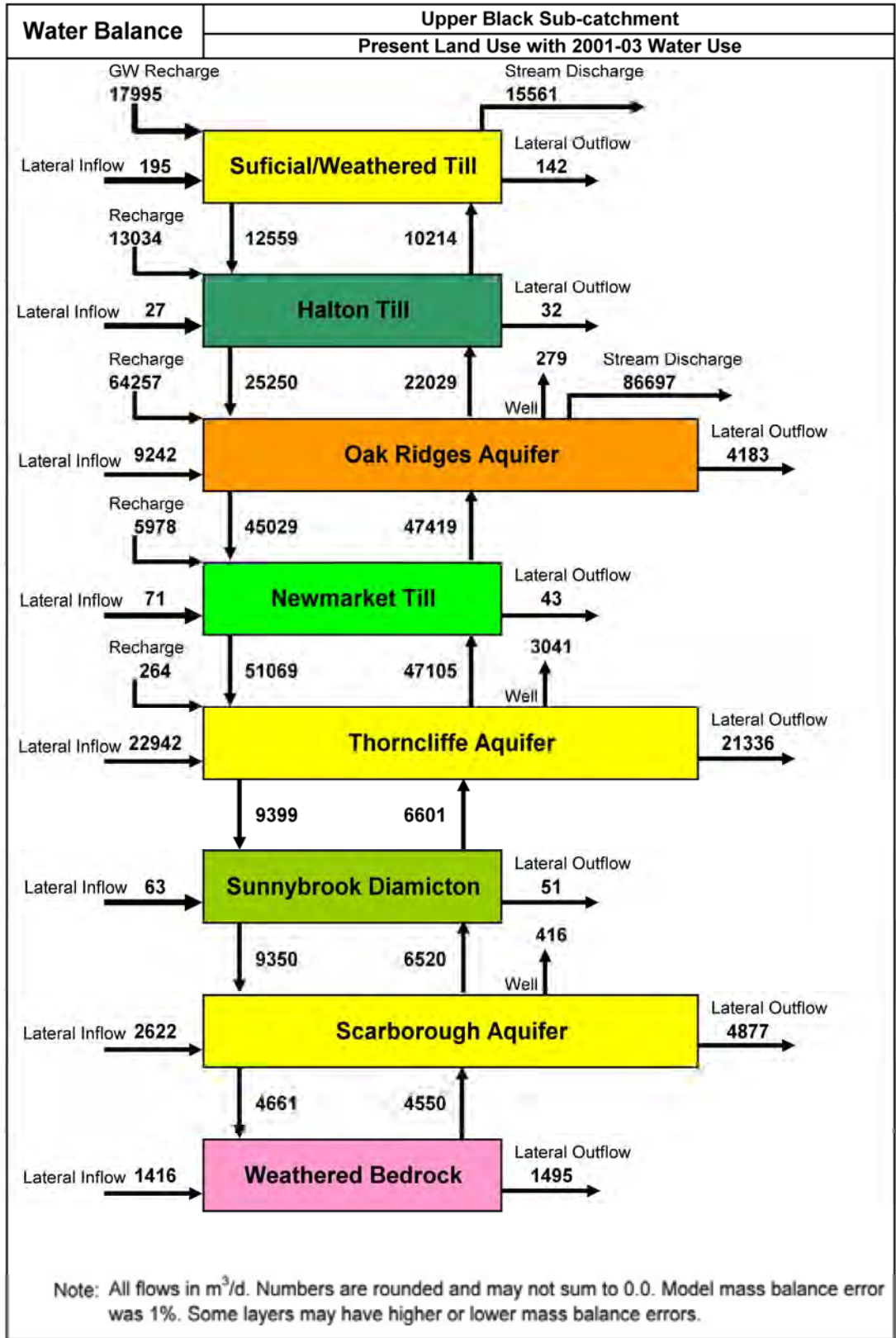


Figure 5-20 Detailed water budget for the Upper Black River 2002 conditions (Earthfx & Gerber, 2008)

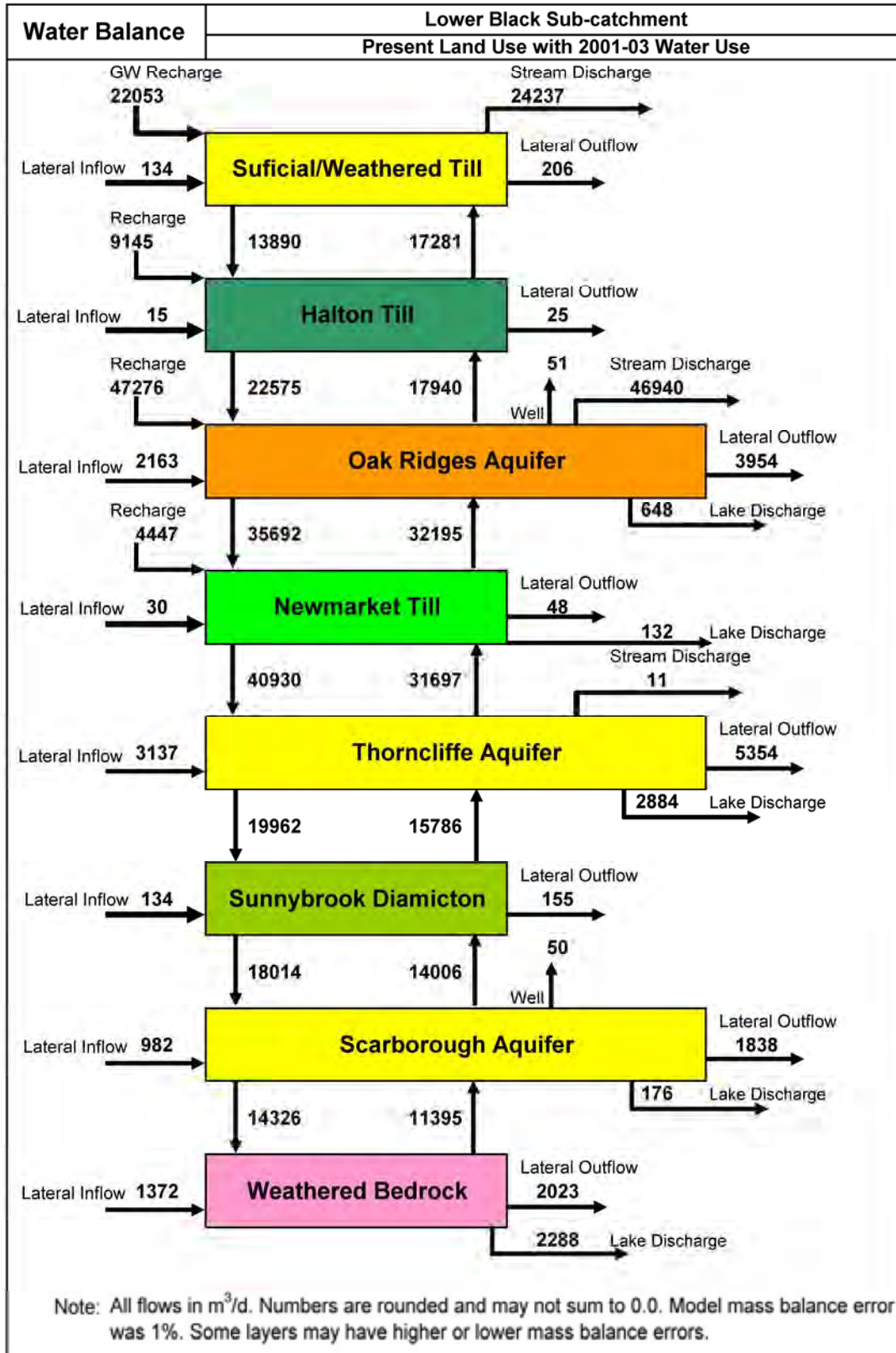


Figure 5-21 Detailed water budget for the Lower Black River 2002 conditions (Earthfx & Gerber, 2008)

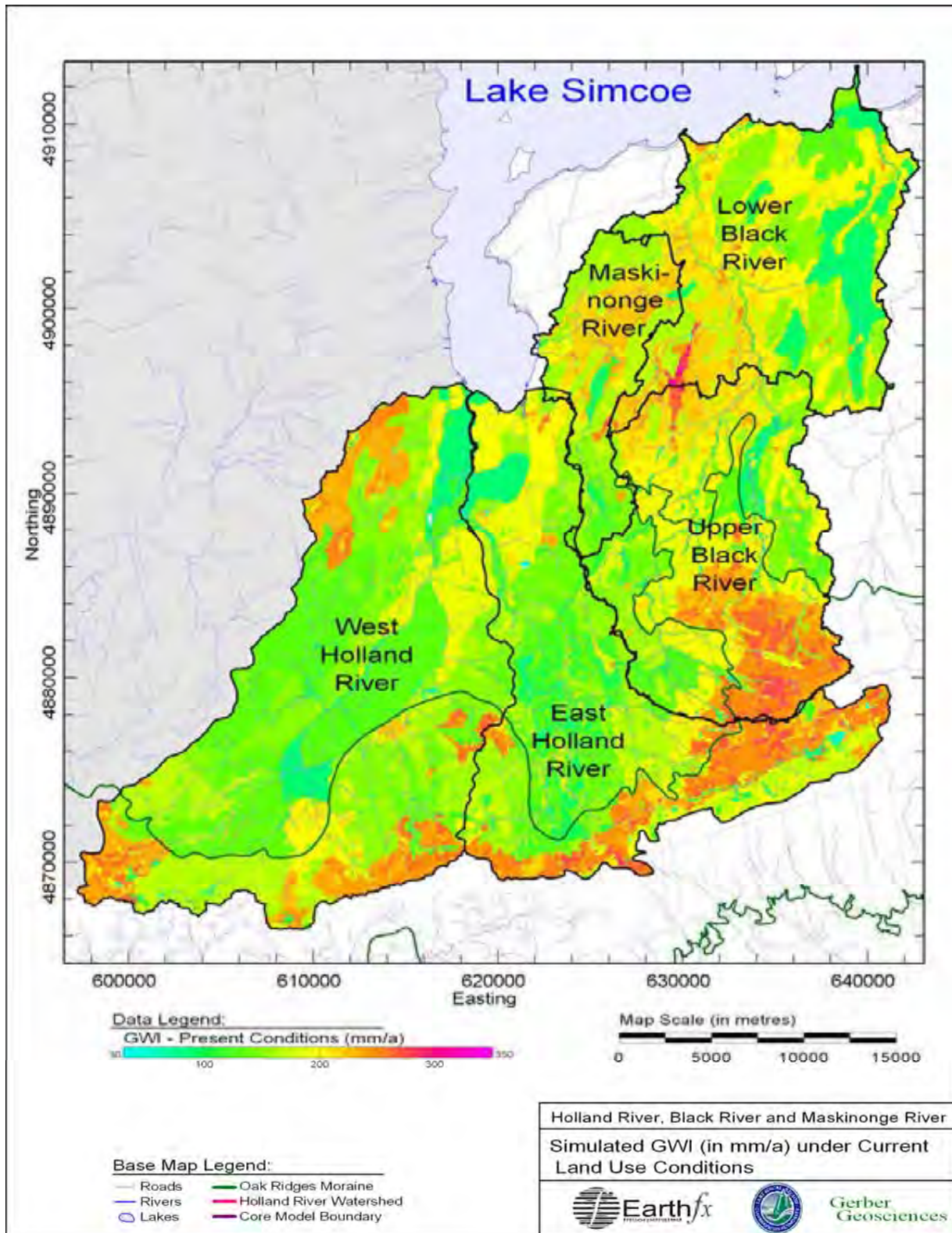


Figure 5-22 Simulated (VL-WABAS) annual average groundwater infiltration (GWI) in mm/annum with 2002 land use (Earthfx & Gerber, 2008)

5.3.4 Discharge

Simulated discharge to streams (Figure 5-23) was generated from the groundwater model in cubic metres per second (m^3/s). Discharge to streams includes discharge to drains (smaller creeks) and discharge to river (larger tributaries) where the creek may be either gaining groundwater discharge or losing streamflow to the groundwater system depending on the depth to groundwater. Groundwater discharge to drain segments (which were used to represent the smaller, but more numerous, tributaries) was about 42% of the total discharge. The remaining 58% was to river segments which represented the larger tributaries and main stream reaches. Recharge from the river to the aquifer was negligible at less than 2% of the total stream/aquifer water exchange. A qualitative comparison of model results to LSRCA baseflow estimates indicates that there is a good correlation between model-predicted discharge locations and field measured discharge, particularly in the upper reaches of the watersheds. In particular, the model matches the very high discharge along the central reach of the Black River where it crosses the ORM planning boundary (Earthfx & Gerber, 2008).

Figure 5-16 shows the potential discharge zones within the Black River subwatershed overlain with flowing wells. These zones are areas where the water table is at or near the ground surface.

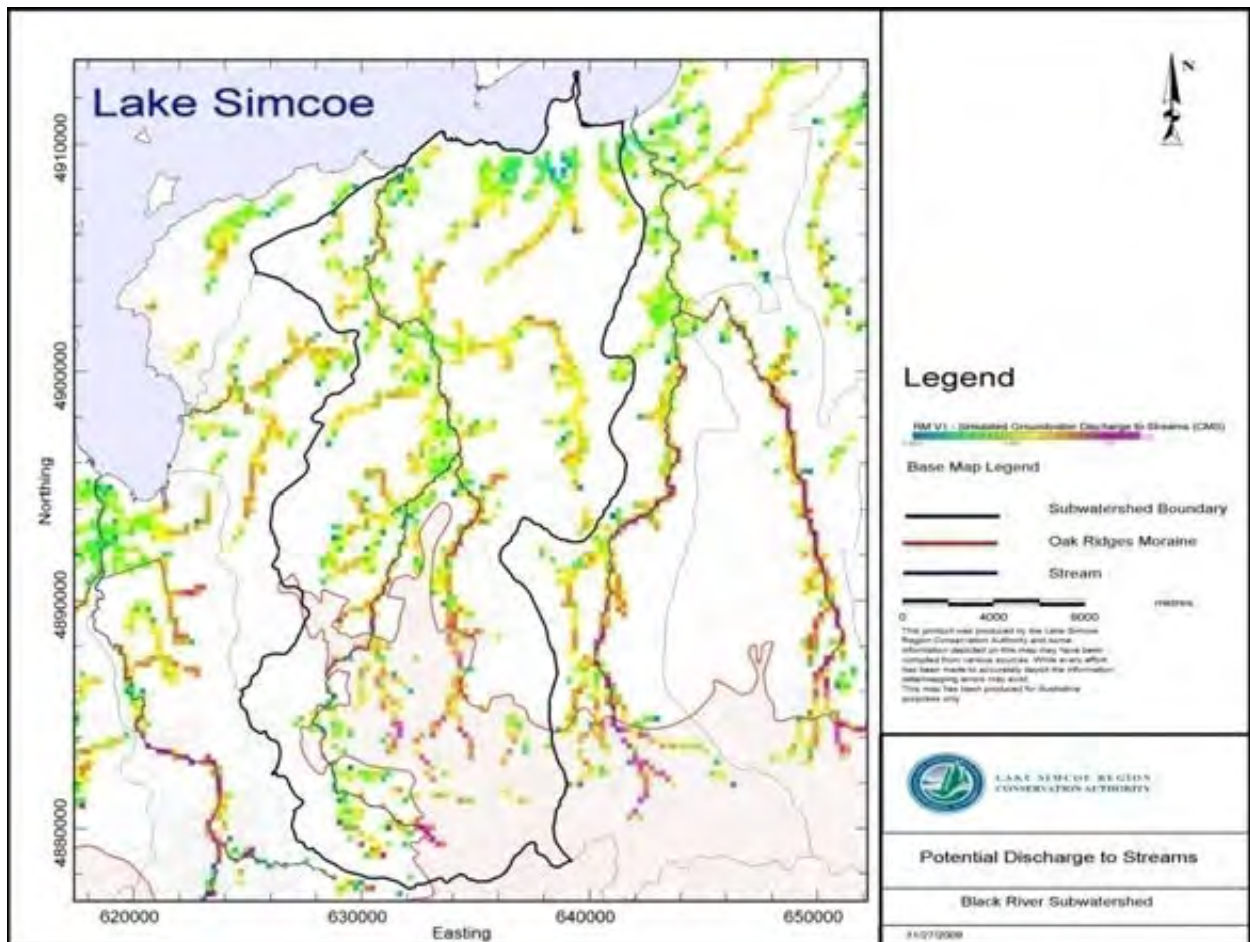


Figure 5-23 Potential discharge to streams in the Black River subwatershed (LSRCA, 2009)

5.3.5 Water Takings- Groundwater and Surface Water Consumption

Municipal water supply services are typically not available within rural areas and therefore residents and businesses rely solely on private water wells or surface water to meet their water needs. Any person/business taking more than 50,000 litres of water per day (L/day) are required by law to obtain a permit to take water (PTTW) from the Ministry of the Environment (MOE).

Municipal and other water supplies are obtained from both surface water (lakes and rivers) and groundwater. Section 34 of the Ontario Water Resources Act (OWRA) requires that any person or business taking more than 50,000 litres of surface or groundwater per day (L/day) are required to be permitted by the Ministry of the Environment (MOE) by obtaining a Permit to Take Water (PTTW). Permits are not required to take water for domestic purposes, livestock watering, or firefighting. Significant efforts have been made to quantify the amount of water takings within the subwatershed and York Region through studies such as, Marshall Macklin Monaghan and Golder Associates (2003), SGBLS (2009), and Earthfx and Gerber (2008).

Along with municipal supply groundwater is extracted from aquifers and surface water within the study area for a number of uses including agricultural use, industrial/commercial use, golf course irrigation, and private domestic supply. The groundwater model simulated only the large water users such as, municipal, golf courses, industrial and agricultural irrigation. Domestic wells and other small users were not represented (Earthfx & Gerber, 2008.)

Municipal Water Supply

There are three municipal water supply wells that service the communities within the study area. Data on average daily water takings from most of the municipal wells within the subwatershed were obtained and used to estimate actual annual average pumping rates. Actual pumping rates are often less than the permitted rates. The numerical groundwater flow model, discussed previously, incorporated average pumping rates where the data were available (Earthfx & Gerber, 2008).

Permit To Take Water (PTTW)

There are a number of large groundwater and surface water takings within the subwatershed that require a Permit to Take water for uses such as, industrial and golf course irrigation. Some of the water pumped for these uses is lost to evapotranspiration while some may infiltrate back to the subsurface as irrigation return flow (actual consumption, i.e. water removed from the watershed, will differ by the specific application). The rates used in the model for simulating consumptive use from these wells were obtained from Marshall Macklin Monaghan and Golder Associates (2003) (Earthfx & Gerber, 2008).

Key points – Current Water Quantity Status

- Water budget drought scenarios indicated an increase in RO (runoff) and a decrease in GWI (recharge) when compared to the current conditions.
- Within the model severe drought conditions affected simulated groundwater potentials and groundwater discharge to streams over a broad area but mostly along the crest of the Oak Ridges Moraine.
- The estimated future land use changes (modelled scenario) indicated a decrease in evaporation, an increase in runoff and no change in recharge. Therefore having a minor impact on the regional groundwater balance.
- Seasonal streamflow volumes from (1965-1969) to (1998-2007) were compared to see if impervious surfaces were effecting stream hydrology. It was found that there is relatively little change in seasonal flow volumes, suggesting minimal change or impacts of impervious surfaces on the stream hydrology over the period of record.
- The 10 year baseflow moving average graph shows a fairly stable trend in the baseflow contribution to total stream flow for the period of record at the Baldwin Flow Station.

5.4 Factors Impacting Status- Stressors

Land use change, increased water use, short-term summer droughts and long-term climate change can all result in stress on the quantity of water within a watershed. Potential impacts of these stressors include reduced groundwater recharge or discharge, increased surface water runoff, well interferences, and changes to groundwater flow patterns and groundwater-surface water interaction.

The purpose of completing a water budget and water quantity risk assessment is to determine if the watershed can support current or future water takings without exhibiting a continued long-term decline in groundwater levels or surface water flow. The most basic definition of stress is whether a watershed can support the current levels of pumping without exhibiting a continued long term decline in water levels.

5.4.1 Water Demand

Potential water quantity stress is being estimated on a subwatershed scale through the Source Protection Planning process. Several water budget initiatives have been undertaken to identify potential water quantity stress within the subwatershed. The indicators of stress presented in this report are based on these studies and for more information can be obtained from the following reports: SGBLS (2009), Earthfx Inc. (2009), and Earthfx and Gerber (2008).

The water demand component of the water budget refers to water taken as a result of an anthropogenic activity (e.g. municipal drinking water takings, private water well takings, as well as other permitted takers). Water demand can be estimated from a number of information sources, including the Permit To Take Water applications, municipal pumping records, water well records, population estimates, and agricultural censuses.

The percentage of quantity demand can be expressed as in the following equation:

$$\%WaterDemand = \frac{Q_{DEMAND}}{Q_{SUPPLY} - Q_{RESERVE}}$$

where:

- Q_{Demand} = amount of water consumed (pumped);
- Q_{Supply} = recharge plus lateral groundwater inflow into the subwatershed ($Q_r + Q_{in}$); and
- $Q_{Reserve}$ = the portion of available surface water or groundwater reserved for other needs such as navigation, assimilative capacity, and ecosystem health. This is estimated as 10% of the model predicted baseflow discharge to the streams in the subwatershed

Considerable effort was made in the Tier 1 (SGBLS, 2009) and Tier 2 (Earthfx, 2009) water budgets indicated above to document the various sources of water demand. Marshall Macklin Monaghan and Golder Associates (2003) analyzed the PTTW data to estimate water use in York Region. Table 5-5 summarizes the groundwater takings in the Black River subwatershed. Surface and groundwater takings within the Black River subwatershed include the following uses:

- Municipal supply
- Agricultural use
- Private domestic supply
- Other permitted takings (e.g. industrial use, golf course irrigation)

Table 5-5 Estimates of annual current & future consumptive groundwater use (Earthfx, 2009)

	Municipal (m ³ /a)	Domestic (m ³ /a)	Permits (m ³ /a)	Agriculture (m ³ /a)	Total (m ³ /a)	Total (m ³ /s)
Current Consumptive Use	297,000	351,000	566,000	1,421,000	2,635,000	0.084
Future Consumptive Use	622,000	492,000	566,000	1,421,000	3,101,000	0.098

Municipal Water Supplies

There are three municipal supply wells that service the community of Mt. Albert within the Black River subwatershed. The municipal water takings account for approximately three quarters of the estimated total groundwater withdrawal in the East and West Holland River, Maskinonge River and Black River study area. Municipal well locations are shown on (Figure 5-21). Some of the wells listed are used primarily as backup wells. For example, York Region often installs two wells in close proximity such that if one is off-line for repairs, the other well can be used. The data presented in this report was analyzed to estimate actual annual average pumping rates

which are often less than the permitted rates. The numerical groundwater flow model, discussed in Section 5.3, incorporated average pumping rates where the data were available.

Agricultural

Agricultural practices also place a huge demand on the water supply for livestock watering and irrigation. The water used for irrigation is often supplied by surface water where available. To obtain a surface water supply many farms construct on-line ponds. On-line ponds are built in an existing watercourse and allow water to flow in and out. The volume of water in the pond is controlled by a berm or other form of control structure. On-line ponds restrict the natural streamflow as a large volume of water becomes contained in the pond. When surface water is unavailable large volumes of water are pumped from the ground. Some of the water used for irrigation infiltrates back into the groundwater system. Water extracted for irrigation generally leads to an overall water loss in a water budget.

Other Permitted Uses

The rolling hills of the Oak Ridges Moraine have made the southern end of the subwatershed an ideal setting for golf courses. Irrigation water for these golf courses is predominantly supplied by groundwater and surface water from the Black River. As with the agricultural irrigation some of the water applied over the golf course will infiltrate back into the groundwater system, and some will be lost to the atmosphere through evapotranspiration.

Some of the water pumped for industrial, agriculture and golf course irrigation is lost to the atmosphere via evapotranspiration. While some may infiltrate back to the subsurface as irrigation return flow (actual consumption, i.e. water removed from the watershed will differ by the specific application). Water consumption rates from these wells are shown in Table 5-5 and were obtained from Marshall Macklin Monaghan and Golder Associates (2003).

The study results suggest that current water taking rates are broadly sustainable. Lateral inflows and a significant decrease in discharge to streams have been developed to balance the high rates of groundwater extraction in the subwatershed, which would indicate that a new equilibrium has been reached. However, the new equilibrium may be impacting the surface water quantity. Groundwater takings reduce baseflow volumes by extracting water that would otherwise find its way to the stream through groundwater discharge. Both surface and groundwater taking can cause stress on the baseflow, limiting the stream's ability to withstand periods of low water or drought thereby affecting the ecological health and sustainability of the stream.

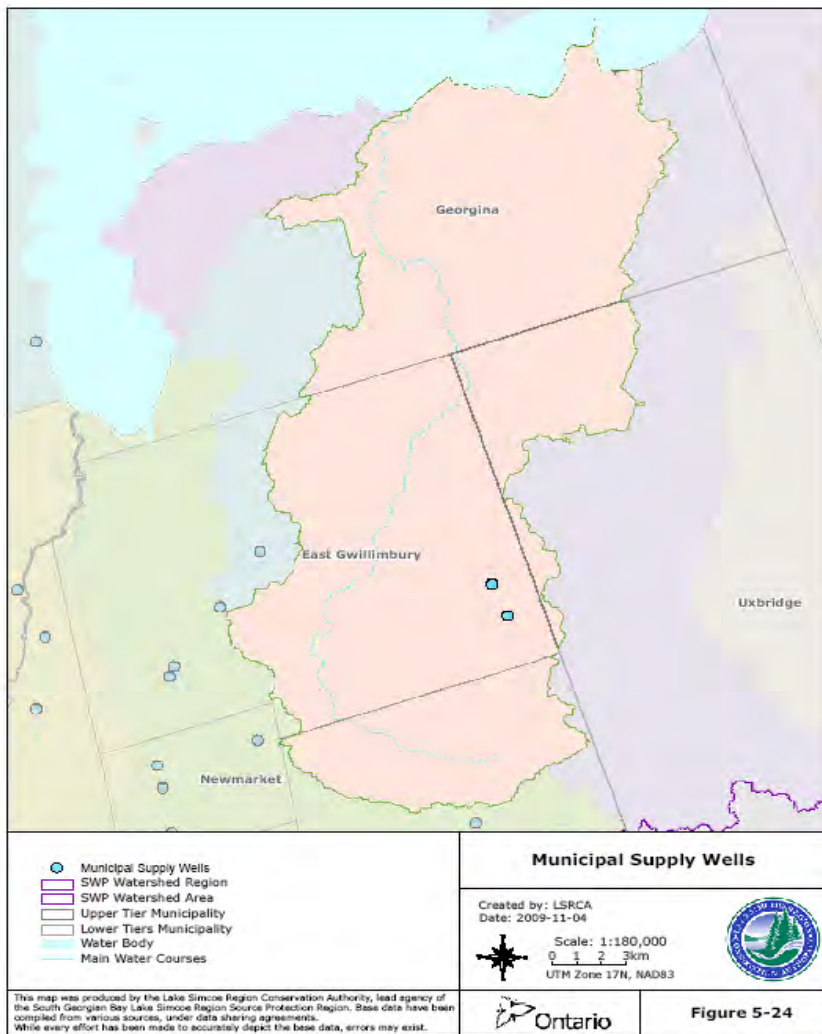


Figure 5-24 Municipal well locations in the Black River subwatershed (LSRCA, 2009)

5.4.2 Land Use

It is important to consider land cover within a water budget study because it affects several aspects of the water budget including surface water runoff, evaporation and infiltration. Often Developed land will often have higher proportion of impervious surface, such as roadways, parking lots, and building roofs. Increased runoff rates result in erosion and reduced infiltration to recharge groundwater reserves. The potential for the introduction of contaminants to both groundwater and surface water must be a consideration when a new land use is being proposed. Each type of land use can affect the quantity of both ground and surface water in the subwatershed.

Impervious Land Cover

Impervious areas were estimated based on the land use data for the Lake Simcoe basin as well as for the Black River subwatershed. Table 5-6 below illustrates the percentage of impervious land cover within the basin (the surface of the lake was not included for the purpose of this analysis) and within the Black subwatershed. It should be noted that although the most accurate

available land use information was used, these numbers will continue to change as development occurs.

Table 5-6 Comparison of impervious land cover within the Lake Simcoe watershed and Black River subwatershed

	Area (km ²)	Impervious (km ²)	Impervious (%)
Lake Simcoe watershed	2,601*	238	9.2
Black River	375	22	5.8

* Area does not include the surface of Lake Simcoe

The following sections describe urban and agricultural land uses within the Black River subwatershed. Details concerning the location and extent of impervious and pervious land cover in the subwatershed and how specific land cover effects surface water runoff is also provided.

Urban Development

Urban development is not widespread throughout the subwatershed, comprising only 2.3% of the land use. However, the characteristic features of an urban landscape do exist throughout the subwatershed as roads, parking lots, sidewalks, rooftops and hardened channels. Impervious surfaces affect the quantity of both ground and surface water in the watershed. When a precipitation event occurs impervious surfaces do not allow water to penetrate the ground, this causes the water to remain at the surface. The elimination of water penetrating the soils in these urban areas has a ripple effect on the distribution of water within the subwatershed. Groundwater recharge has been significantly reduced in the urban centres. The absence of groundwater recharge in these urban areas can have an impact on the baseflow of the Black River and its tributaries. Baseflow in the river can be particularly important in drought years.

Impervious surfaces also decrease the time to peak surface flow following a precipitation/snow melt event. Since the water is unable to infiltrate the ground it must remain at the surface, increasing the overall quantity of water at the surface. The water from the precipitation travels to the streams and river quickly through overland run off and through a series of stormwater drains. The rapid increase in surface water can lead to localized flooding if the system becomes overburdened. As the water moves downstream the wetlands in the lower reaches of the subwatershed will exhibit flooding.

Urban centres have placed demand on the available water within the subwatershed for domestic purposes. The water supply for these centres mainly comes from a series of municipal wells and waste water is sent to sewage treatment plants. After treatment the water is released back into the surface water system. Although impervious surfaces and urban areas are not currently significant issues in the subwatershed, water supply and the effects of impervious area should be considered with the future growth that is planned.

While the impervious area of the subwatershed is not very high, at 5.8%, impervious surfaces account for a much higher percentage of the land within the urban areas. Within the built boundaries of Sutton and Mount Albert, impervious surfaces account for 44.5 and 48.7 percent of the land area, respectively. At these levels, impervious surfaces are very likely having an impact on aquatic biota and the hydrology of the area.

Agricultural Areas

Like urban development, agricultural development can influence the quantity of both surface and ground water within a subwatershed. Agricultural land use leaves the ground in a more

natural state allowing for groundwater infiltration to occur. Because groundwater infiltration does occur in rural areas, the ground can become supersaturated following a prolonged precipitation event leading to the ponding of water at the surface. In the pre and post growing season the land is left open allowing for increased erosion and runoff following a precipitation event. During the growing season a large volume of water will be lost to the atmosphere through evapotranspiration. The water lost through evapotranspiration is removed from the ground as the plants draw the water up through their root system. As mentioned in section 5.4.1 agricultural practices also place a huge demand on the water supply for livestock watering and irrigation.

5.4.3 Climate

The climate of the Black River subwatershed directly determines the quantity of surface and groundwater present in the system. When the spring melt occurs, a large volume of water is released. This water will first infiltrate the ground. When the soil becomes supersaturated the remaining water will flow overland until it reaches the tributaries and main branch of the river.

The temperature in the subwatershed can directly affect the quantity of water present in the system. In the cold winter months the water is frozen at the surface so the quantity of available water is reduced. While in the hot summer months the water is flowing but an overall loss is occurring due to the high rates of evaporation.

5.4.4 Water Budget Estimates

The Holland River, Maskinonge River and Black River Watersheds Water Budget Study 2008 conducted a comparison analysis of past, current average, drought, and future average and drought conditions. The completion of the analysis helps to determine whether stress on the groundwater resources can be anticipated under various scenarios. The VL- WABAS model a water budget analysis program was used to simulate the water budget estimates. The simulated VL- WABAS estimates for the Black River water budget under different conditions is summarized in Table 5-3 and

Table 5-4 (Earthfx & Gerber, 2008).

In general, the modelled scenarios analyzed indicated that increased groundwater takings had the most significant, but localized, impact on aquifer potentials (levels). Modelled simulations of severe drought conditions showed an increase in runoff, a decrease in infiltration and evapotranspiration. The simulated drought conditions affected groundwater potentials (levels) and groundwater discharge to streams over a broad area but mostly along the crest of the Oak Ridges Moraine. The estimated future land use changes (modelled scenario) indicated a decrease in evaporation, an increase in runoff and no change in recharge, which indicates a minor impact to the regional groundwater balance (Earthfx & Gerber, 2008). However, this could have implications to stream flow. Increased runoff can lead to a decrease in time to peak flow, increasing the risk for flooding.

The results of the model simulation can be compared to any available historical observations (e.g. fisheries and stream headwater mapping) to assess the accuracy of the simulation and the suitability of the existing monitoring network, particularly streamflow measurements, to detect change in the flow system. This analysis conducted over time will allow more confidence to be placed in estimates of future change to the hydrologic cycle (Earthfx & Gerber, 2008).

Key points – Factors Impacting Water Quantity status - stressors:

- The use of large amounts of groundwater and surface water throughout the Black River subwatershed can cause reduced flow in streams, lowering the water table and aquifer levels and reduces the total inflow of water to the lake.
- With the increasing urban growth and impervious surfaces the amount of water available for infiltration to the groundwater system decreases, while the increase of flow in streams during storm events increases.
- The Tier 1 water budget estimated the current GW use within the Black River is 2,635,000m³/annum, which represents 4% of the total available GW supply for the subwatershed. Future GW use is projected to be 3,101,000m³/annum which represents 5% of the available GW supply.
- The Tier 1 water budget estimated the current SW use within the Black River is 1,345,000m³/annum, which represents 4% of the total available SW supply. Future SW use is projected to be 3,556,704m³/annum which represents 11% of the available SW supply.
- Tile drainage for agriculture may be having some impact on the hydrologic cycle on a small scale (field or individual stream reach).
- Agricultural irrigation may reduce surface water flow and the shallow groundwater supply.
- Extraction of peat may be influencing water quantity characteristics as more water is being stored at the surface, filling the holes in the ground where the peat was. The extraction of peat may also lead to increased runoff.

5.5 Current Management Framework

There are numerous acts, regulations, policies and plans aimed at maintaining or improving water quantity. These include the Provincial Policy Statement, the Ontario Water Resources

Act, the Greenbelt Plan, Growth Plan for the Greater Golden Horseshoe, the Oak Ridges Moraine Conservation Plan, the Lake Simcoe Protection Plan, and the Clean Water Act.

This management framework relates to many different stressors that can potentially affect water quantity, ranging from the urban development to the demand for water resources. In Table 4-3-8 we categorize six such stressors, recognizing that many of these activities overlap and that the list is by no means inclusive of all activities. The legal effects of this management framework broadly fall into one of two categories. The first broad category we define as those having little or no legal standing and are referred to as General or Have Regard to Statements in Table 4-3-8 and are shown in blue. The second category includes those that have legal standing and must be conformed to; these are referred to as Regulated / Existing Targets in Table 4-3-8 and are shown in green. In many cases an act, regulation, policy, or plan does not relate to the activity specified, these are shown in red.

Table 5-6 Summary of current regulatory framework as it relates to the protection and restoration of water quantity

Stressor affecting water quantity	Oak Ridges Moraine Conservation Plan (2002)	Greenbelt Plan (2005)	Lake Simcoe Protection Plan (2009)	Growth Plan for the Greater Golden Horseshoe (2006)	Provincial Policy Statement (2005)	Ontario Water Resources Act (1990)	Clean Water Act (2006) – Source Water Protection	LSRCA Watershed Development Policies (2008)	York Region Official Plan (2008)	Durham Region Official Plan (2008)
Growth, development and site alteration										
Loss of natural heritage features										2
Impervious surface									1	3
Agricultural use										
Water demand										
Climate change										
	General/Have regard to statement			Regulated/Existing targets			No applicable policies			

1 Applies within ORM planning area

2 Policies apply within Greenbelt Natural System, key natural heritage features and key hydrologic features

3 Applies in Major Open Space Areas (including key natural heritage and hydrologic features) and in the Oak Ridges Moraine planning area (outside of the Settlement Area)

In this section we provide a summary the various acts, regulations, policies and plans as they pertain to activities affecting water quantity. This summary is to give context to *future management considerations* and the *opportunities and recommendations to maintain and improve water quantity*. This summary is not intended to be comprehensive in terms of all the

legislative pieces that relate to water quantity, or of the acts, regulations, policies and plans that are discussed below – the reader is directed to each act, regulation, policy, or plan for a full assessment of how it relates to water quantity.

5.5.1 Oak Ridges Moraine Conservation Plan

The objectives of the Oak Ridges Moraine Conservation Plan include maintaining, improving or restoring all of the elements that contribute to the ecological and hydrological functions of the ORM area, including the quality and quantity of its water and other resources.

The policies of this Plan that will protect the quantity of water resources include:

- Municipalities are required to complete water budgets and conservation plans which include:
 - Quantification of components of the water balance equation
 - Characterization of the groundwater and surface water flow systems
 - Identification of targets to meet the water needs of the affected ecosystems; the availability, quantity and quality of water sources; and goals for public education and for water conservation
 - Development of a water-use profile and forecast
 - Identification and evaluation of various water conservation measures
 - Requirement for the use of specified water conservation measures and incentives
 - Plans for implementation and monitoring
- Development and site alteration is prohibited in hydrologically sensitive features and their related minimum vegetation protection zones, including streams, wetlands, kettle lakes, and seepage areas and springs, with exceptions for activities such as fish and wildlife management, conservation projects, transportation and infrastructure, and low-intensity recreational uses.
- Except with respect to land in Settlement Areas, development and site alteration with respect to land in a subwatershed are prohibited if they would cause the total percentage of impervious area in the subwatershed to exceed 10 per cent. Planning authorities are also to consider the desirability of having at least 30 per cent of the area of a subwatershed in natural self sustaining vegetation. Within Settlement areas, planning authorities should consider the importance of ensuring that natural vegetation is maintained, and improved or restored wherever possible, and should attempt to keep impervious surfaces to a minimum.

The ORMCP also contains policies for the protection of key natural heritage features and their functions, similar to those for hydrologically sensitive features. By protecting the ecosystem holistically, the implementation of the ORMCP will help to conserve water resources and ensure that there is enough available to sustain the needs of the ecosystem as well as those who reside within it.

5.5.2 Greenbelt Act and Plan (2005)

One of the Greenbelt Plan's Environmental goals is the 'protection, improvement or restoration of the quality and quantity of ground and surface water and the hydrological integrity of watersheds.' This goal is supported by a number of policies that relate to the Protected Countryside areas of the Greenbelt.

The following policies related to water quantity apply for lands within the Natural Heritage System of the Protected Countryside:

- New development or site alteration shall demonstrate that:
 - There will be no negative effects on...key hydrologic features
 - The removal of other natural features...should be avoided
 - The disturbed area of any site does not exceed 25%, and impervious surfaces do not exceed 10% of the developable area
- Where non-agricultural uses are contemplated, applicants shall demonstrate that:
 - At least 30% of the total developable area will remain or be returned to natural self-sustaining vegetation (this will encourage infiltration and slow runoff), and that buildings and structures are to occupy less than 25% of the total developable area of the site

Policies of the Water Resources system (within the Protected Countryside) that relate to water quantity include:

- Planning authorities shall provide for a comprehensive, integrated and long-term approach for the protection, improvement or restoration of the quality and quantity of water
- Cross-jurisdictional and/or cross-watershed impacts should be considered, and should be integrated with ORM subwatershed plans
- Municipalities shall protect vulnerable surface and groundwater areas

The Greenbelt Plan also limits development in Key Natural Heritage Features and Key Hydrologic Features, which will protect the important watershed functions that they perform:

- Development and site alteration are not permitted within these features, including any associated vegetation protection zone (with some exceptions, such as conservation and flood control works)

5.5.3 Lake Simcoe Protection Plan

The Water Quantity policies of the Lake Simcoe Protection Plan (LSPP) focus on ensuring sufficient water supply to maintain healthy aquatic ecosystems and promoting the conservation and efficient use of water.

They include:

- The MOE and MNR will be developing in-stream flow targets for water quantity stressed watersheds in the Lake Simcoe basin. This includes the development of targets for in-stream flow regimes and water extraction limits, and will build on watershed information and assessments developed through the Drinking Water Source Protection Program.
- The MAFRA, in cooperation with key stakeholders, will assist and encourage water conservation and efficiency efforts in the agricultural community through stewardship programs aimed at promoting the adoption of BMPs
- The MOE will work with other water use sectors (including recreational, commercial, and industrial users) to encourage the development and implementation of water conservation and efficient use practices.

LSPP policies around stormwater management will also help to protect water quantity. Applications for major development will be required to include a stormwater management plan, which demonstrates, among other things, consistency with water budgets; an integrated treatment train approach to minimize stormwater management flows and reliance on end-of-pipe controls through measures such as source and lot-level controls and conveyance techniques; and how anticipated changes in water balance will be minimized.

The LSPP also provides protection to key natural heritage and hydrologic features which will, in turn, protect their functions related to water quantity.

5.5.4 – Growth Plan for the Greater Golden Horseshoe (2006)

Under its policies for managing growth, the Growth Plan specifies that population and employment growth will be accommodated by directing growth to built-up areas through intensification – this may help to limit the spread of impervious area, reducing its impacts on stream flow and infiltration to groundwater. Specific policies within this plan related to water quantity include:

- That the construction of new, or the expansion of existing, municipal or private communal water and wastewater systems should only be considered where the following conditions are met:
 - Strategies for water conservation and other water demand management initiatives are being implemented in the existing area
 - Plans for the expansion or for new services are to serve growth in a manner that support the achievement of the intensification target and density target
- Municipalities that share an inland water source and/or receiving water body should coordinate their planning for potable water, stormwater and wastewater systems to ensure that water quality and quantity is maintained or improved.
- Municipalities are encouraged to implement and support innovative stormwater management actions as part of redevelopment and intensification
- Municipalities will develop and implement official plan policies and other strategies in support of the following conservation objectives:
 - Water conservation, including water demand management for the efficient use of water; and water recycling, to maximize the reuse and recycling of water

5.5.5 Provincial Detailed recommendation Statement (2005)

Policies that are directly related to the management of water quantity in the PPS include:

- Implementing necessary restrictions on development and site alteration to
 - Protect municipal drinking water supplies (i.e. quantity)
 - Protect, improve or restore vulnerable surface and groundwater, sensitive surface water features and sensitive groundwater features and their hydrologic functions
 - Maintaining linkages and related functions among surface water features, groundwater features, hydrologic functions and natural heritage features and areas
 - Promoting efficient and sustainable use of water resources, including practices for water conservation and sustaining water quality
- Directing growth to promote the use of existing sewage and water services, ensuring that these services can be provided in a manner that can be sustained by the water resources on which they rely, and that protects human health and the natural environment
- Focusing growth in settlement areas, a Detailed recommendation which, if implemented, should limit the amount of natural area removed, thus maintaining the natural functions of these areas. Development and site alteration are not permitted in features such as significant woodlands and ANSIs, or the lands adjacent to them, unless it can be demonstrated that there will be no negative impacts on the natural features or their functions

- Ensuring stormwater management practices minimize stormwater volumes and contaminant loads, and maintain or improve the extent of vegetative and pervious surfaces

5.5.6 Clean Water Act (2007)

The recently enacted Clean Water Act (CWA) ensures the safety of drinking water by identifying potential risks to local water sources. A key focus of the CWA is to identify where long-term municipal water supplies could be threatened, identify the causes of concern and possible management strategies that will ultimately aid in the development of the source protection plans.

The Ministry of Environment (2009) indicates that this legislation is designed to promote voluntary initiatives but does require mandatory action where needed. The legislation sets out a basic framework for communities to follow in developing an approach to protecting their water supplies that works for them:

Identify and assess risks to the quality and quantity of drinking water sources and decide which risks are significant and need immediate action, which need monitoring to ensure they do not become significant, or which pose a low or negligible risk.

Develop a source protection plan that sets out how the risks will be addressed. Broad consultation will involve municipalities, conservation authorities, property owners, farmers, industry, businesses, community groups, public health officials, First Nations and the public in coming up with workable, effective solutions.

Carry out the plan through existing land use planning and regulatory requirements or approvals, or voluntary initiatives. Activities that pose a significant risk to drinking water sources may be prohibited or may require a site specific risk management plan. This plan will set out the measures that a property owner will take to ensure the activity is no longer a threat.

Stay vigilant through ongoing monitoring and reporting to measure the effectiveness of the actions taken to protect drinking water sources and ensure they are protected in the future.

5.5.7 Ontario Water Resources Act (1990)

Section 34 of the Ontario Water Resources Act (OWRA) deals with the issue of water taking. The OWRA stipulates that a person shall not take more than 50,000 litres of water on any day by any means except in accordance with a permit issued by the Director (the permit is issued under Section 34 (1) of the OWRA. This Detailed recommendation applies to all uses except for domestic or farm purposes, which includes ordinary household purposes or the watering of livestock, poultry, home gardens, or lawns; or to use for firefighting. The irrigation of crops grown for sale is not included under 'domestic and farm purposes.' A permit is however required for takings for domestic and farm purposes if the amount of water taken exceeds 379,000 litres per day.

A Director has discretion to issue, refuse to issue, or cancel a permit, and can impose a number of terms and conditions in issuing a permit as he or she considers proper, and can also alter the terms and conditions of a permit after it has been issued.

The following are some of the terms and conditions that a Director may include in a permit:

- Limiting the amount and rate of water taking
- Governing the manner in which water may be taken
- Governing the return, after use, of water taken under the permit

- Governing the monitoring and reporting of the amount, rate, use, and effects of water taking (including effects on water quantity and quality)
- Governing the use and conservation of water taken, including requiring the implementation of specified measures to promote the efficient use of water or reduce the loss of water through consumptive use or to prepare a water conservation plan
 - Requiring the holder to implement specified measures to prevent the water taking from causing interference with other water takings and/or to remedy any interference with other water takings that is caused by the water taking under the permit

Section 34 (4) of the OWRA states that where the taking of water for any purpose, other than for domestic or farm use or for firefighting, interferes, in the opinion of a Director, with any public or private interest in any water, the Director may...prohibit the person from so taking water without a permit issued by the Director.

5.5.8 LSRCA Watershed Development Policies (2008)

LSRCA's Watershed Development Policies address issues of water quantity in a number of ways:

- Requiring Enhanced Level 1 stormwater controls of all new developments
- Noting that stormwater management plans accompanying development proposals must make all feasible efforts to maintain pre-development infiltration and evapotranspiration rates to the receiving watershed
- Stipulating that peak discharges are to be controlled to a minimum of pre-development levels
- Requiring a minimum 24-hour detention of runoff from a 25 mm storm for erosion protection and baseflow maintenance
- Protecting natural features, thus promoting infiltration for the slow release of water after storm events and the maintenance of aquifer levels

5.5.9 York Region Official Plan (2009)

York Region's Official Plan (OP) includes a number of policies related to the protection of the quality of both ground and surface water. The policies within the OP related to water quality include:

- The preparation of a comprehensive regional water strategy for both piped services and surface and groundwater sources that will include long-term protection strategies, enhancement guidelines and monitoring requirements;
- That the natural quality and hydrological characteristics of watercourses and lakes (including water quality and temperature) will be maintained, and that development be designed with the goal of maintaining water balance
- To direct development away from sensitive surface water and groundwater features
- To continue to partner with other regions and conservation authorities to study, analyze, and monitor ground and surface water resources to ensure a unified approach to protecting and enhancing water quality and quantity
- To monitor the quantity and quality of surface and ground water systems in York Region, in co-operation with local municipalities and conservation authorities) by:

- Assessing the sustainability of current activities and land uses
 - Identifying areas that are susceptible to, or currently experiencing, water quality and quantity problems
- Requiring local municipalities to establish policies and programs to protect, enhance, and monitor water systems
- To work with the province, local municipalities, conservation authorities and other in establishing procedures for water taking permits that protect and enhance water resources
- To require the preparation of comprehensive master environmental servicing plans as part of secondary plans to protect and enhance the natural hydrologic function of water systems. These plans will emphasize water reuse and incorporate innovative technologies with the goal that the water balance and hydrologic functions will be maintained
- Working with partners in the implementation of stormwater management initiatives
- Requiring the preparation of comprehensive stormwater management plans as a component of secondary plans, and encouraging innovative approaches to stormwater management within secondary plans
- That development have an integrated and innovative approach to water management, be water efficient, and maximize stormwater quality, quantity, and infiltration through an integrated treatment approach
- Work with local municipalities and LSRCA in the preparation and implementation of comprehensive stormwater master plans for each settlement area within the Lake Simcoe watershed by 2014
- Requiring all new buildings to achieve 10% greater water efficiency than the Ontario Building Code, and encouraging all new buildings to achieve 20% greater efficiency
- To restrict the use of potable water for lawn watering
- Requiring the installation of rainwater harvesting and re-circulation/reuse systems on all new residential buildings for outdoor irrigation and outdoor water use
- Encouraging the use of water efficient, drought resistant landscaping by:
 - providing a minimum 6" of topsoil
 - installing drought resistant sod
 - providing landscape features that minimize the demand for water and chemicals by utilizing native and drought resistant species
 - installing permeable driveway surfaces
- Encouraging all developments to incorporate green roofs into building design
- Supporting the goals and objectives of subwatershed plans

In addition to these policies, York Region's protection of the regional Greenlands System will help to ensure that the functions of the Region's natural features, such as the water retention and infiltration capacity of natural features such as wetlands and forests, will continue to protect and enhance water quantity within the subwatershed.

5.5.10 Durham Region Official Plan (2008)

The policies contained within Durham Region's Official Plan around water quantity include:

- Requiring an examination of the impacts on surface water and groundwater resources in the consideration of development applications in order to maintain and/or enhance such resources in sufficient quality and quantity to meet the existing and future needs of the Region's residents on a sustainable basis
- Placing restrictions on development within key hydrologic features and their associated vegetated protection areas
- Promoting and supporting water resource conservation and management initiatives
- Ensuring that local municipalities require stormwater management plans as part of pre-servicing development proposals
- Promoting groundwater infiltration, where appropriate, through improved stormwater design
- Encouraging development that maintains hydrological functions and minimizes direct alteration to groundwater flows
- Requiring that development applications to demonstrate the groundwater quality and quantity will be protected, improved, or restored in areas where groundwater discharge could be impacted
- Requiring development applications that require a permit to take water, or that have the potential to impact water quantity to be accompanied by a study verifying that there is a sufficient water supply to support the proposed use and, on a cumulative sustainable basis, confirm that there will not be a negative impact on surrounding water users and the natural environment which cannot be appropriately mitigated
- The OP also contains a number of policies around the protection of Wellhead Protection Areas and Highly Vulnerable Aquifers

5.6 Management Gaps and Limitations

5.6.1 Water Demand

The Source Water Protection initiative will help to address potential concerns around water quantity, although these policies will pertain to drinking water resources, and not the flows that are required to sustain healthy aquatic ecosystems within the subwatershed. The Lake Simcoe Protection Plan also contains a Detailed recommendation around maintaining adequate flows, with the development of in-stream flow targets for water quantity stressed subwatersheds. It does not, however, stipulate timelines for any subwatershed other than the Maskinonge, it is therefore not clear when this work and any associated limitations on water takings would be in place, or how they would be enforced and by whom. Another limitation in managing water demand is the Permit to Take Water process. These permits are only required when a user is taking more than 50,000 L/day, and are not required for most domestic and agricultural uses. This makes it difficult to track the cumulative use for a subwatershed, leading to the potential for stress at certain times of the year.

5.6.2 Land Use

There are few policies in the framework that deal specifically with the issue of impervious cover that accompanies development. The ORMCP sets a limit of 10% impervious cover, but this only applies outside of Settlement Areas, and it stresses minimizing impervious surfaces and their

impact on water quantity within Settlement Areas, but does not set actual targets. The Greenbelt Plan limits impervious area to 10% for development and site alteration, but only within its Natural Heritage System; and in the Protected Countryside requires a stormwater management plan which demonstrates how impervious surfaces will be minimized in a development. The policies within the current planning framework around impervious cover generally do not require any concerted effort on the part of developers to move beyond traditional designs for developments and measurably reduce impervious surfaces, nor do they require the use of techniques aside from stormwater controls to increase infiltration.

With respect to water demand, the policies being developed through Source Water Protection will be most protective of the quantity of water resources within the subwatershed, although these policies will only pertain to drinking water resources. Currently, the Ontario Water Resources Act is the main Detailed recommendation piece that considers water quantity. However, it only requires a permit for users taking greater than 50,000 L/day, and is not required for most domestic and agricultural uses. There is the potential for significant stress on a system due to the cumulative takings of both permitted and un-permitted users in a subwatershed, and these cumulative uses are generally not considered as part of the permitting process. This issue may be addressed through policies in the LSPP requiring the development of in-stream flow targets for water quantity stressed subwatersheds, which may lead to policies that require the development of targets for in-stream flow regimes, and set out how much water can be allocated among users in a subwatershed, including an allocation to support the natural functions of the ecosystem. The LSPP, however, does not define what constitutes a water quantity stressed subwatershed, nor does it specify timelines for the completion of this work with the exception of the Maskinonge River subwatershed. The LSPP also contains policies around reducing water demand by new and expanded major recreational uses, such as golf courses, through limiting grassed, watered and manicured areas; requiring the use of grass mixtures that require less water (where applicable); the use of water conserving technologies; and water recycling. As well, the LSPP contains policies aimed at undertaking stewardship activities with the agricultural community and other water use sectors, such as recreational, to encourage the implementation of best management practices to conserve water.

5.6.3 Climate

While it would be extremely difficult to account for variations in climate and their effects on water quantity within the Detailed recommendation framework, Source Water Protection and the LSPP have begun to consider the potential impacts of climate change on this important resource. Modelling undertaken for Source Protection has included drought scenarios, and the LSPP includes a section on climate change, including a Detailed recommendation to develop a climate change adaptation strategy for the Lake Simcoe watershed. This will include an assessment of the risks of climate change impacts, additional research to better understand the impacts of climate change, the development of an integrated climate change monitoring program to inform decision making, and finally to develop adaptation plans. These are important first steps in what should now become a routine consideration for all activities.

5.6.4 Water Budget Estimates

While the water budget determined water taking rates to be broadly sustainable, they also indicated a potential impact on stream flow due to these takings. The OWRA does enable Ministry of the Environment staff to limit takings through the PTTW process; however, this is rarely done. This may be addressed through the LSPP's policies around developing targets for environmental flows.

5.7 Recommended Actions to Improve Water Quantity

The following recommended actions were developed to improve water quantity in the Black River subwatershed. The main issues with respect to water quantity in the Black River subwatershed are water demand for residential and agricultural uses, and the impervious area that accompanies urban areas, which limits infiltration. While there are not currently significant issues with respect to water quantity in the Black River subwatershed, measures to reduce stresses on water quantity will help to prevent issues from occurring into the future as the urban area expands and existing uses continue. The implementation of the following recommended actions will help to mitigate these impacts on the quantity of water in this subwatershed.

These recommendations, which are grouped and numbered as described in Section 1.4, were developed to address the water quality issues and stressors that were identified throughout this chapter. In addition, they consider, and are consistent with applicable policies and recommendations in the province's Lake Simcoe Protection Plan, and the LSRCA's Integrated Watershed Management Plan. Each recommendation below also identifies the applicable 'detailed recommendations' as outlined in Chapter 10. These detailed actions will form the basis of the Implementation Plan for York Region's ORM subwatersheds, to be developed following the completion of this plan.

5.7.1 Planning and Detailed recommendation

- 1) That the municipal partners and the LSRCA strive to reduce the impacts of stormwater through a number of methods including the implementation of policies and guidelines and enabling the use of new and innovative technologies, retrofitting of existing developments.
Detailed recommendations: A.1.1 – A.1.3
- 4) That the municipal partners and the LSRCA strive to maintain natural hydrologic conditions on development sites
Detailed recommendations: A.3.1 – A.3.2
- 5) That the federal, provincial, and municipal governments, as well as the LSRCA, continue to evaluate and implement planning initiatives and practices aimed at reducing the impact of development on the condition of the Black River subwatershed
Detailed recommendations: A.3.3 – A.3.5, A.3.7
- 6) That the value of the ecological goods and services (EGS) provided by ecological features be considered in decision making around growth and development
Detailed recommendation: A.3.6
- 7) That the rural/agricultural community be engaged in developing solutions for minimizing the impacts of practices on their lands
Detailed recommendation: A.4.1
- 11) That the Province, the municipal partners, and the LSRCA seek to gain an improved understanding of the impacts of climate change in the Black subwatershed, incorporating this information into decision making scenarios and developing strategies to mitigate and adapt to its impacts.
Detailed recommendations: A.6.1 – A.6.2, G.1.1 – G.1.2

5.7.2 Use of Better Management Practices

- 12) That the LSRCA and its municipal partners continue working to mitigate the impacts of stormwater to water quality and quantity through tracking its sources, completing stormwater

retrofits, promoting methods of minimizing stormwater volume, and continuing to research new and innovative solutions to stormwater control and implementing these solutions where appropriate.

Detailed recommendations: B.1.1 – B.1.5

- 13) That support for programs offered to assist rural landowners in implementing BMPs on their properties, such as LSRCA's LEAP program, be continued and/or expanded as resources permit

Detailed recommendations: B.2.1 – B.2.3

- 14) That sectors that have the potential to have significant impacts on conditions in the Black subwatershed be expected to undertake BMPs and other activities to mitigate their impacts, as required under the LSPP

Detailed recommendations: B.2.4 – B.2.5

- 17) That the LSRCA work with large users of water (e.g. sod farms, market gardens) to develop solutions for decreasing water consumption, such as the installation of retention ponds

Detailed recommendation: B.2.5

5.7.3 *Changing the way things are done 'on the ground'*

- 18) That the LSRCA and its partner municipalities strive to maximize the infiltration of stormwater where appropriate through development approvals and the use of practices and technologies

Detailed recommendations: C.1.1, C.2.1 – C.2.2

5.7.4 *Applied Research and Science*

- 22) That all partners study the requirements for environmental flows within the Black subwatershed, explore innovative solutions, and undertake works and practices where possible in order to ensure adequate baseflow to support ecological function

Detailed recommendations: D.1.5, D.1.7, D.2.2

- 24) That the partners explore the subwatershed to determine where reductions in groundwater discharge, excessive water takings and other impacts to aquatic habitat have occurred and undertake activities to mitigate these impacts

Detailed recommendations: D.2.1

- 25) That measures be taken at site level to reduce demands on water resources

Detailed recommendation: D.2.3

5.7.5 *Monitoring*

- 33) That the amount of impervious area in the subwatershed be assessed on a regular basis by the LSRCA and its partner municipalities.

Detailed recommendation: C.2.1, E.3.3

5.7.6 *Management, Rehabilitation and Restoration*

- 39) That the LSRCA and the partner municipalities assess the feasibility of increasing natural cover (e.g. woodland, streambank vegetation, interior forest, grassland) in the subwatershed and set priorities and develop plans to undertake this enhancement, based on overall benefit to the subwatershed.

Detailed recommendations: A.5.3, F.2.1 – F.2.3

- 43) That the partner municipalities adopt policies to encourage the use of native species, particularly those drought tolerant species, through development approvals and property management programs.

Detailed recommendation: F.3.2

5.7.7 Adaptive Response

- 48) That the LSRCA and partner municipalities work to reduce their carbon footprint and to increase ecological resilience in the watershed

Detailed recommendations: G.1.1 – G.1.3

- 49) That the LSRCA and the partner municipalities promote and support water conservation initiatives, such as York Region's 'Water for Tomorrow' program.

Detailed recommendation: G.2.1

- 50) That the LSRCA in conjunction with the MNR and MOE undertake initiatives to understand the environmental flow needs within the Black subwatershed, and develop programs and policies to ensure that these needs are met, including the continuation of the Low Water Response Program, setting environmental flow targets, and ensuring that water taking activities do not exceed the available supply.

Detailed recommendations: G.2.2 – G.2.4

- 51) That the LSRCA and its partners work to ensure that flood mapping is up to date; that the data needed for assessing flood risk is sufficient and that new monitoring equipment is added to the monitoring network as required; and that there be available programs to assist landowners in flood proofing their homes.

Detailed recommendations: G.2.5 – G.2.6

6 Aquatic Habitat

6.1 Introduction and background

Habitat can be described as a place where an animal or plant normally lives, often characterized by a dominant plant form or physical characteristic. All living things have a number of basic requirements in their habitats including space, shelter, food, and reproduction. In an aquatic system, good water quality is an additional requirement. In a river system, water affects all of these habitat factors; its movement and quantity affects the usability of the space in the channels, it can provide shelter and refuge by creating an area of calm in a deep pool, it carries small organisms, organic debris and sediments downstream which can provide food for many organisms and its currents incorporate air into the water column which provides oxygen for both living creatures and chemical processes in the water and sediments. Habitat features also frequently affect and are affected by other features and functions in a system. For instance, the materials comprising a channel bed can affect the amount of erosion that will take place over time; this in turn affects the channel shape and the flow dynamics of the water. The coarseness of the channel's bed load can also affect the suitability for fish habitat – some species require coarse, gravelly deposits for spawning substrates, while finer sediments in the shallow fringes of slow moving watercourses often support wetland plants that are required by other species.

The Black River is one of the largest subwatersheds in the Lake Simcoe basin. Tributaries are numerous and include Zephyr Creek, the Baldwin Branch, Harrison Creek, Mount Albert Creek and Vivian Creek. The river meanders through the Townships of Uxbridge, Whitchurch-Stouffville, and East Gwillimbury and the Town of Georgina.

Table 6-1 A summary of aquatic environments found in the Black River subwatershed and their habitat features

Aquatic Environment	Habitat Features	Examples in the Black River Subwatershed
Rivers and streams	<ul style="list-style-type: none"> • Vegetation • Food sources – algae, benthic invertebrates, fish • Flow • Cover • Spawning/nursery habitat • Vegetation • Water quality • Temperature refugia 	Main branch of the Black River and tributaries
Lakes	<ul style="list-style-type: none"> • Temperature refugia • Shelter • Spawning/nursery habitat 	<ul style="list-style-type: none"> • No known named examples for the Black River subwatershed
Wetlands	<ul style="list-style-type: none"> • Spawning/nursery habitat 	<ul style="list-style-type: none"> • Zephyr-Egypt PSW Complex • Black River PSW Complex • Franklin Pond Wetland • Vivian Bog • Mount Albert Wetland

There are numerous causes of stress in an aquatic environment. Any type of land use change from the natural condition will place a strain on the system, and can cause significant changes to the aquatic community. The conversion of natural lands such as woodland and wetland to agriculture or urban uses eliminates the functions that these features perform, such as

improvement of water quality, water storage, and increasing the amount of infiltration to groundwater. This can result in impacts to water quality and a reduction in baseflow, resulting in watercourses that are unable to support healthy communities of native biota.

6.2 Current Status

To assess the impact of the aforementioned stresses on the biological community, monitoring of the fish and benthic invertebrate communities is undertaken at sites throughout the subwatershed. The results of these studies are discussed in the following sections.

6.2.1 Fish Community

There are over 80 known sites which have been subject to fisheries data collection on the Black River and its tributaries. These sites have not only been explored by the OMNR and LSRCA but also by private industry in support of various development proposals.

There have been 35 fish species captured in the Black River subwatershed since 1973 (Table 6-2). The Black River ranges from cold headwater communities featuring such species as brook trout (Figure 6-2) and mottled sculpin to diverse warm large order systems displaying such species as largemouth bass (*Micropterus salmoides*) and brown bullhead (*Ameiurus nebulosus*). Generally, the Black River displays cold to coolwater tributaries within larger wetlands and forested areas feeding a warmwater Main Branch (Figure 6-1). The white sucker (*Catostomus commersoni*) is a migratory species found throughout most of the subwatershed where barriers do not impede migration. The communities appear to be fairly healthy, with coldwater species being found as would be expected at sites recording coldwater temperatures, and warm water species at the sites displaying warm water temperatures.

6.2.2 Rare and Endangered Species

There are no known rare or endangered fish species that reside in the Black River.

Table 6-2 Fish species captured in the Black River subwatershed 1973-2007

Common Name	Scientific Name
Brook Trout	<i>Salvelinus fontinalis</i>
Northern Pike	<i>Esox lucius</i>
Central Mudminnow	<i>Umbra limi</i>
Common White Sucker	<i>Catostomus commersoni</i>
Northern Redbelly Dace	<i>Phoxinus eos</i>
Finescale Dace	<i>Phoxinus neogaeus</i>
Common Carp*	<i>Cyprinus carpio</i>
Brassy Minnow	<i>Hybognathus hankinsoni</i>
River Chub	<i>Nocomis micropogon</i>
Golden Shiner	<i>Notemigonus crysoleucas</i>
Emerald Shiner	<i>Notropis atherinoides</i>
Common Shiner	<i>Luxilus cornutus</i>
Blacknose Shiner	<i>Notropis heterolepis</i>
Spottail Shiner	<i>Notropis hudsonius</i>
Bluntnose Minnow	<i>Pimephales notatus</i>
Fathead Minnow	<i>Pimephales promelas</i>
Blacknose Dace	<i>Rhinichthys atratulus</i>
Longnose Dace	<i>Rhinichthys cataractae</i>
Creek Chub	<i>Semotilus atromaculatus</i>
Pearl Dace	<i>Margariscus margarita</i>
Yellow Bullhead	<i>Ameiurus natalis</i>
Brown Bullhead	<i>Ameiurus nebulosus</i>
Banded Killifish	<i>Fundulus diaphanus</i>
Brook Stickleback	<i>Culaea inconstans</i>
Rock Bass	<i>Ambloplites rupestris</i>
Pumpkinseed	<i>Lepomis gibbosus</i>
Smallmouth Bass	<i>Micropterus dolomieu</i>
Largemouth Bass	<i>Micropterus salmoides</i>
Black Crappie^	<i>Pomoxis nigromaculatus</i>
Yellow Perch	<i>Perca flavescens</i>
Iowa Darter	<i>Etheostoma exile</i>
Blackside Darter	<i>Percina maculata</i>
Johnny Darter	<i>Etheostoma nigrum</i>
Mottled Sculpin	<i>Cottus bairdi</i>
Slimy Sculpin	<i>Cottus cognatus</i>
Round Goby*	<i>Neogobius melanostomus</i>

* = non-native invasive species

^ = non-native species

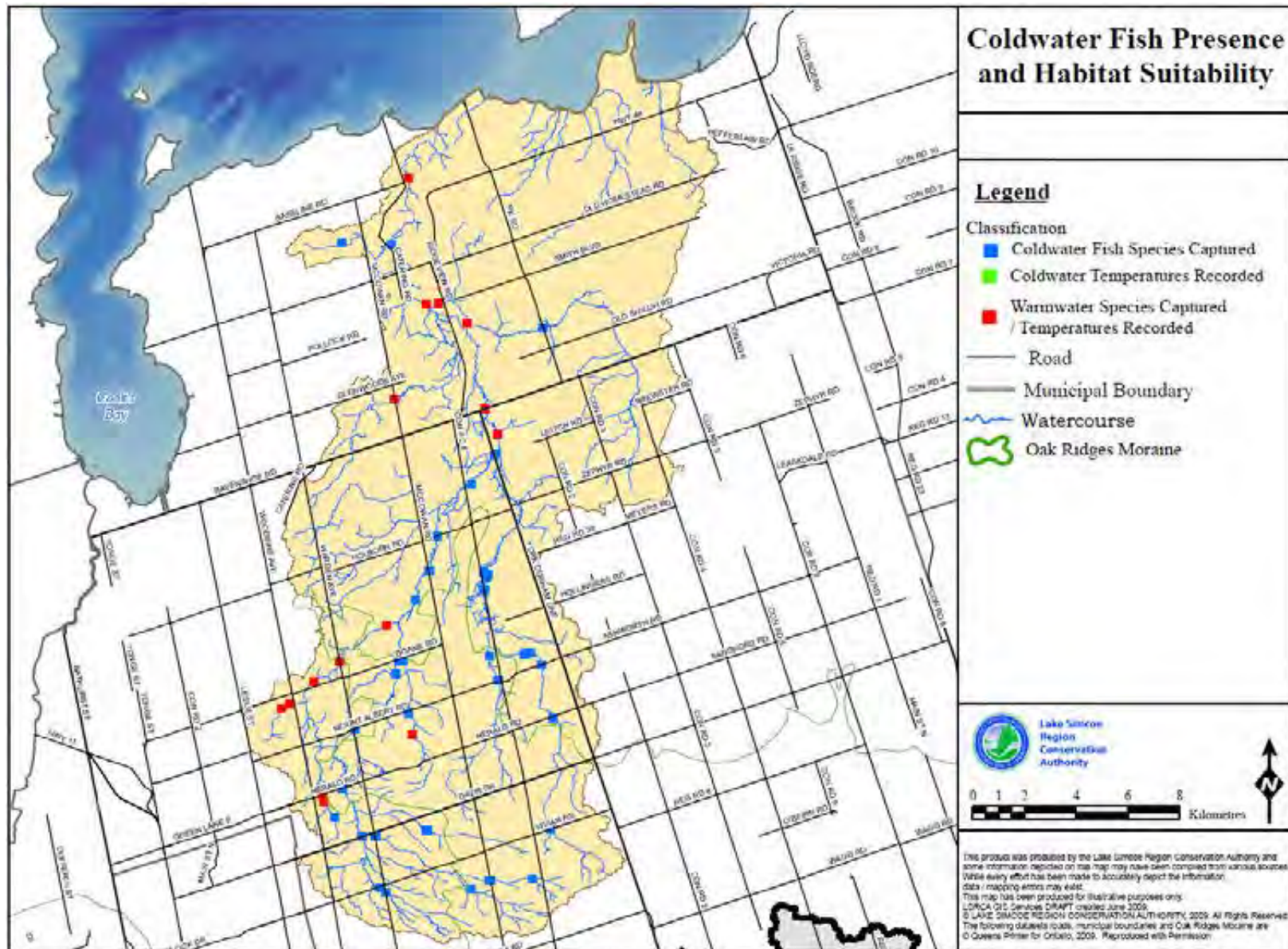


Figure 6-1 Fish communities in the Black River subwatershed (2004 – 2007)



Figure 6-2 The brook trout is a native coldwater fish indicative of high water quality and low summer water temperatures

6.2.3 Benthic Invertebrates

Aquatic insects, or benthic invertebrates, are an ideal indicator of water quality as different species have different tolerances to factors such as nutrient enrichment, dissolved solids, oxygen and temperature. The presence or absence of certain species is used to determine water quality at a given site. Of the indices developed to assess water quality in relation to benthic invertebrate communities, BioMAP was selected as it provides a means to locate pollution sources without the large investment of time and resources required by some other indices.

Benthic invertebrates have been collected from the Black River subwatershed since 2004 employing a consistent and standard collection method (Ministry of the Environment and Conservation Ontario, 2003). Figure 6-3 is a compilation, standardization and summary of this data with the results reported as “Impaired”, “Unimpaired” or “Inconclusive”. It is difficult to draw conclusions from this small data set, thus benthic reference site collection is expected to continue. There does appear to be a trend in that the reference site within the mid-reaches of the system has gone from unimpaired in 2004 to impaired in 2005 and 2006.

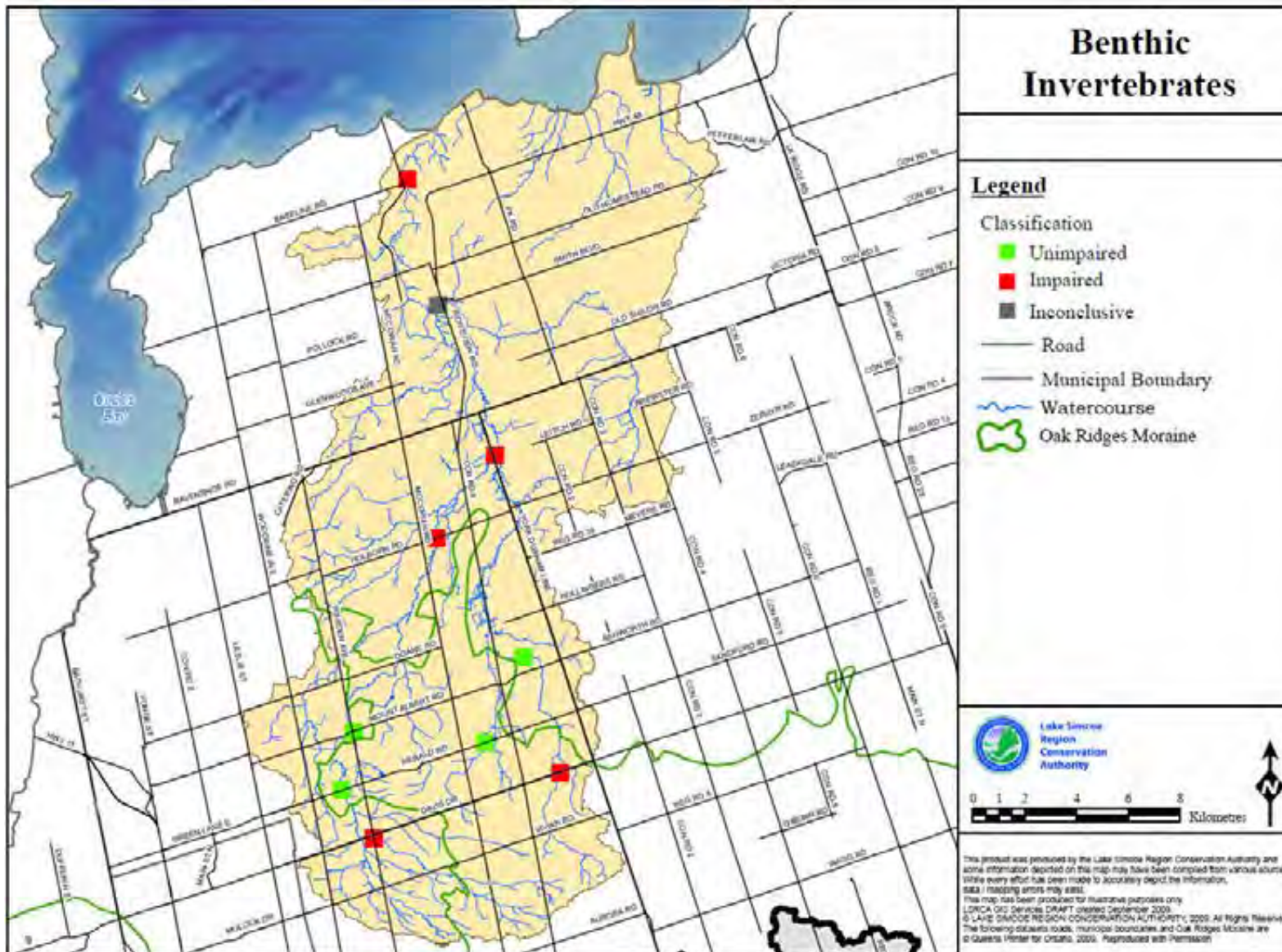


Figure 6-3 Benthic invertebrate communities in the Black River subwatershed (2002-2007)

Key Points – Current Aquatic Habitat Status:

- There are over 80 known sites which have been subject to fisheries data collection on the Black River and its tributaries and there have been 35 fish species captured within the Black River subwatershed since 1973
- Fish communities range from cold headwater communities to diverse warm large order systems
- Generally, the Black River displays cold to coolwater tributaries within larger wetlands and forested areas feeding a warmwater Main Branch
- The white sucker (*Catostomus commersoni*) is a migratory species found throughout most of the subwatershed where barriers do not impede migration.
- There are no known aquatic species at risk within the Black River subwatershed
- With a relatively small data set for benthic invertebrates, it is difficult to draw conclusion. There does appear to be a trend though, in that the reference site within the mid-reaches of the system has gone from unimpaired in 2004 to impaired in 2005 and 2006
- Together, the limited benthic data and the fish community data indicates that Black River aquatic habitat varies between locations, with some areas recording good habitat quality and other areas exhibiting poor habitat quality.

6.3 Factors impacting status - stressors

There are a number of land uses, activities and other factors that can have an effect on the health of the aquatic community in the subwatershed. These include:

- Changes to instream habitat and habitat fragmentation
- Removal of riparian vegetation
- The introduction of invasive species
- Impacts to the hydrologic regime
- Water quality and thermal degradation

These factors are discussed in detail in the following sections.

6.3.1 Changes to Instream Habitat and Habitat Fragmentation

Barriers

Barriers to fish movement in the form of dams, perched culverts, and enclosed watercourses serve to fragment a fishery by preventing fish from accessing important parts of their habitat. The impoundments created by dams serve to warm water temperatures, raise bacteria levels, and disrupt the natural movement of fish, invertebrates, sediment, and nutrients. The natural movement of each is imperative for a healthy aquatic system.

Sixty-seven such barriers to fish movement have, thus far, been identified in the Black River, however, it is anticipated that this number will grow incrementally upon study of individual systems. These barriers take many forms ranging from concrete structures associated dams to

perched culverts (Figure 6-4). Some structures represent on-line, or in-river, stormwater management.

On-line dams are especially prevalent in the Oak Ridges Moraine where 11 structures are located, mainly for irrigation and, to a lesser degree, recreation. The Sutton Dam and the Baldwin Dam (Figure 6-5) are two large dams originally built to power mills in the early 1900s.

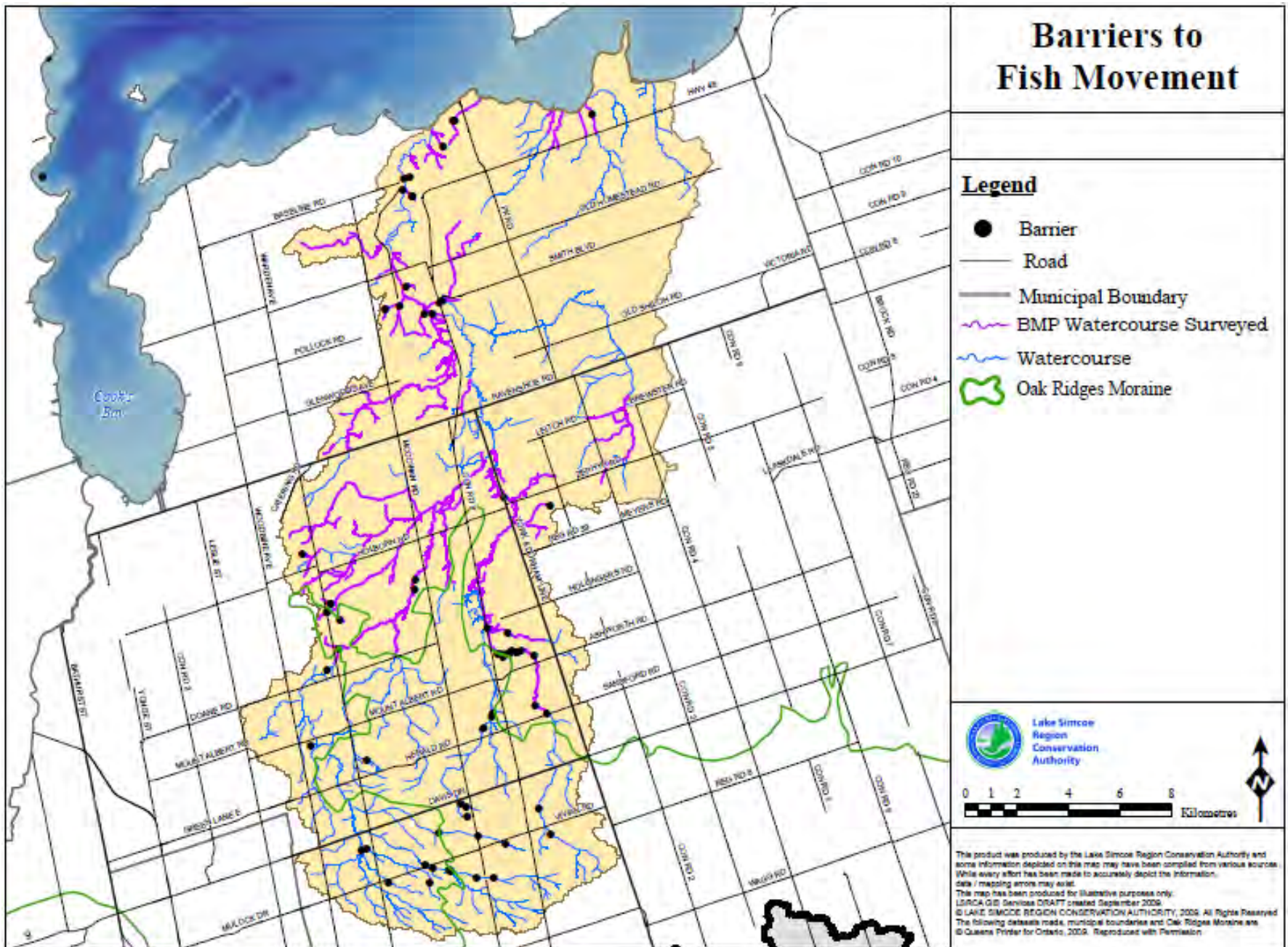


Figure 6-4 Known barriers in the Black River subwatershed



Figure 6-5 The Baldwin Dam, one of two large barriers to fish migration on the Black River

Bank Hardening and Channelization

In the past, it has been common practice to straighten watercourses to accommodate various landuses, and to harden banks with a view to preventing streambank erosion. While we now know that these practices are harmful to the environment and can cause more issues than they resolve, there are several areas in the subwatershed where these practices have been utilized.

Water generally flows more quickly through a channelized section of stream, particularly during high flow events. This increase in flow can have several effects:

- Unstable banks in the channelized section (if they are not hardened)
- Flooding downstream of the channelized section (water is confined to the channel, which results in larger volumes of water flowing more rapidly than under natural conditions being conveyed to downstream sections)
- Bank erosion downstream of the channelized section
- Sedimentation downstream of the channelized section where the flow of water slows

These effects result in the degradation of aquatic habitat. The riffle/pool sequences that occur in natural channels are lost in the channelized section as well as downstream. Much of the natural cover in the watercourse can be lost. Fluctuating flow levels can place stress on aquatic biota, and in many cases can cause a shift from a more sensitive community to one that is better able

to tolerate adverse conditions. Finally, the deposition of sediment as the water slows coming out of the channelized section can blanket the substrate, interfering with spawning activities and affecting the benthic invertebrate community.

Fifty five sites with bank hardening and/or channelization were identified through the BMP Inventory in the Black River subwatershed (Figure 6-6).

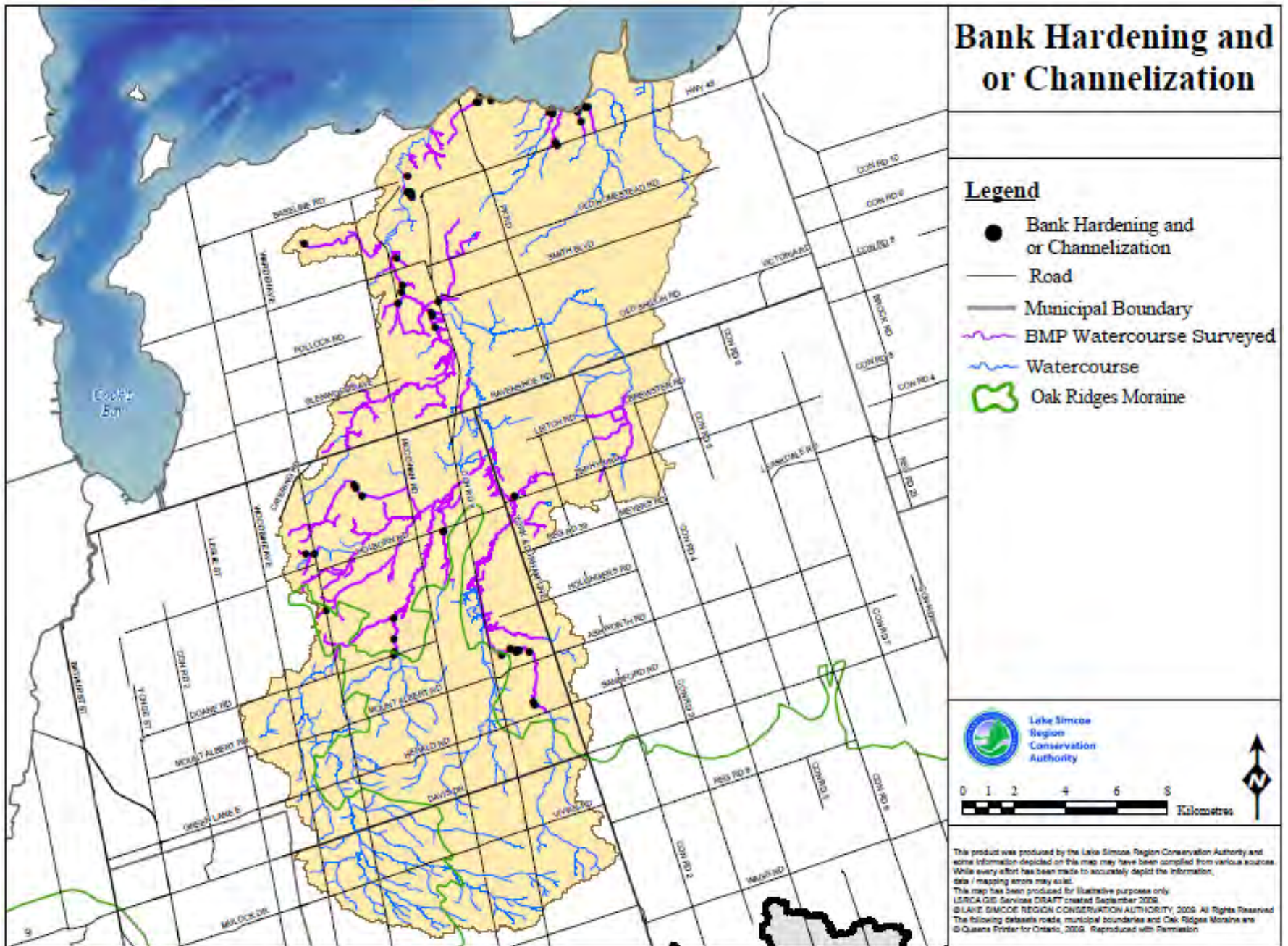


Figure 6-6 Areas of bank hardening and channelization in the Black River subwatershed

Removal of Riparian Vegetation

While the LSRCA's policies currently afford some protection to the riparian areas adjacent to watercourses, this has not always been the case. In many instances, vegetation in the riparian areas of the subwatershed's watercourses has been removed to accommodate development and agricultural activities, leaving the bank vulnerable to erosion due to the removal of the stabilizing influence of the roots of the vegetation. This can result in inputs of sediment into the watercourse, which can settle and smother the substrate, thus eliminating important habitat used by fish for spawning and inhabited by benthic invertebrates. Sediment in suspension in the water can also interfere with the feeding of those fish species that are visual feeders.

Riparian vegetation is also an important source of allochthonous material such as leaves and branches that serve as a food source for benthic invertebrates, and can also provide cover for fish.

In addition, riparian vegetation serves to enhance water quality – it filters the water flowing overland, causing sediment and other contaminants to settle out or be taken up prior to their reaching the watercourses; and also helps to moderate water temperatures through the shade it provides. Removal of this vegetation can have an influence on the type of aquatic community able to inhabit the watercourse – a reach that may have been able to support a healthy coldwater community may no longer be able to do so, and the community may shift to a cool or warm water community containing less sensitive species. There were 290 sites in the subwatershed that were identified in the BMP Inventory as having insufficient riparian cover; these are identified in Figure 6-7. The subwatershed is fairly healthy in terms of natural cover in the riparian area. In Lake Simcoe's Watershed Report Card – 2009 Update, the Black River received a grade of 'B,' as approximately 73% of the area within a 30 metre buffer on either side of its watercourses is comprised of natural cover.

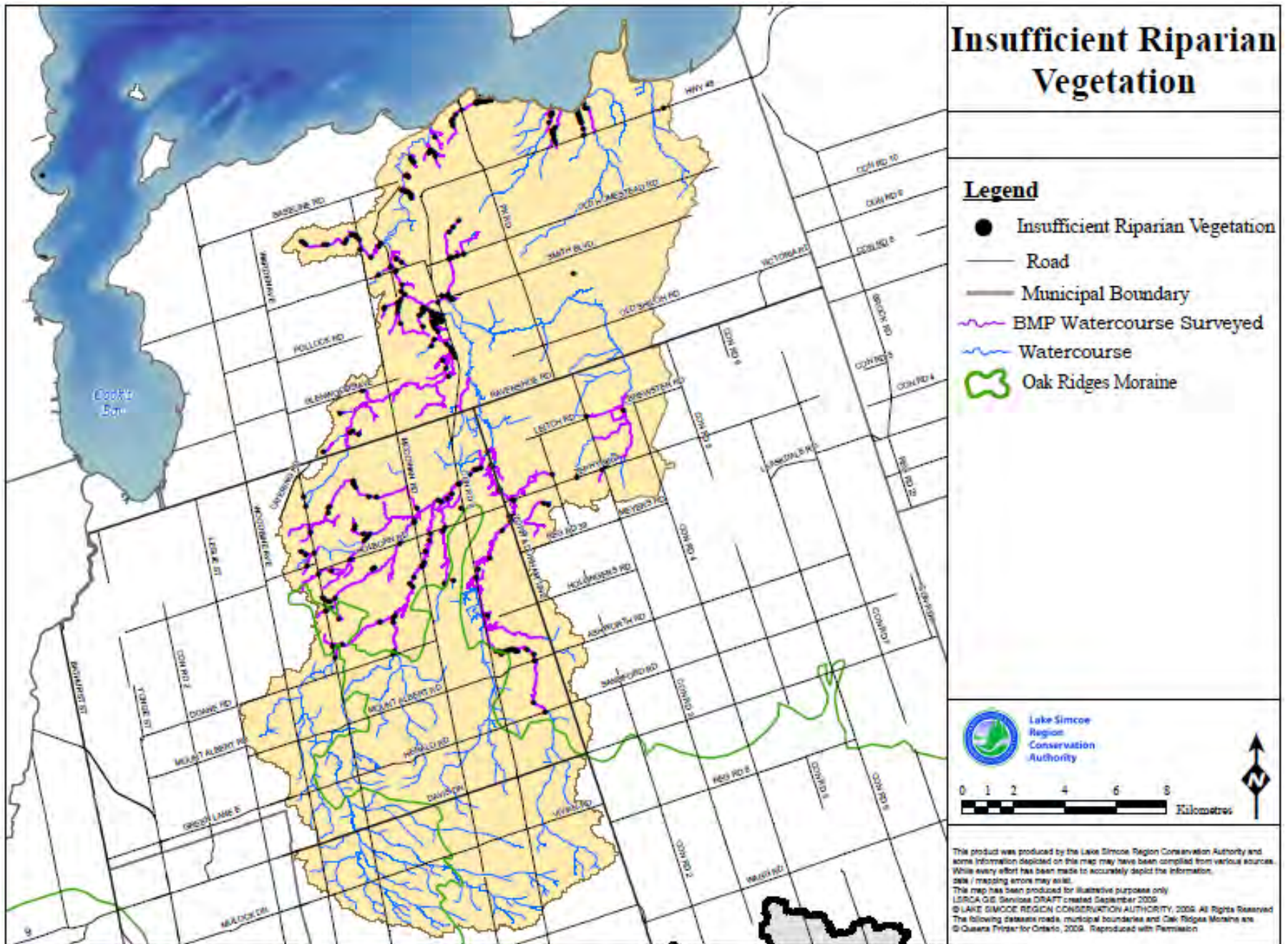


Figure 6-7 Sites identified in the Black River subwatershed as having insufficient riparian vegetation

Invasive Species

The traits possessed by non-native invasive species, including aggressive feeding, rapid growth, prolific reproduction, and the ability to tolerate and adapt to a wide range of habitat conditions enable them to outcompete native species for food, water, sunlight, nutrients, and space. This may result in the eventual reduction in the number and abundance of native species. The replacement of native species with introduced affects the balance of the ecosystem, as species that relied on the native species for food, shelter and other functions now either have to move to another area with these species, or must utilize another source that is perhaps less appropriate. This cycle reverberates throughout the ecosystem, and can be exacerbated by the introduction of additional invasive species. Ecosystems that are already under stress are particularly vulnerable to invasion by non-native species, as the existing ecosystem is not robust enough to maintain viable populations of native species as the invasive species become established. The process may happen more quickly in already disturbed systems than it would in a healthy community.

Currently there are two known invasive fish species within the Black River - carp (*Cyprinus carpio*) and the round goby (*Neogobius melanostomus*). Carp were stocked into Ontario waters as early as the late 1800s and were subsequently released into public waters through a dam break in 1896 (Scott and Crossman, 1973). The carp now flourishes in most warmwater systems in southern Ontario and disrupts native fish through their violent spawning activities which tend to uproot vegetation and cause increased turbidity in the water column. The round goby is an invasive species native to Eurasia that was transported to the Great Lakes in ballast water, and was recently transplanted from Lake Erie to Lake Simcoe, most probably via a baitfish transfer. Up until recently, the species had only been noted within the Pefferlaw River and its mouth in Lake Simcoe, however, due to the mouth of the Black being suitable habitat and the proximity of the systems, the round goby is now found in the Black River.

Impacts to the hydrologic regime

Changing hydrologic conditions, including reduced baseflow and the higher peak flows brought about by increasing levels of impervious surfaces as well as water takings, can cause considerable stress to aquatic biota, and can cause a shift from a community containing more sensitive species to one containing species more tolerant of degraded conditions. Changes to the hydrologic regime are discussed in greater detail in Chapter 5.

Water quality and thermal degradation

Inputs of contaminants including high levels of chloride and suspended sediment to watercourses can be harmful to many species of fish and benthic invertebrates, particularly the more sensitive species. Through contemporary studies and recent changes to development law, much of this system has been identified as cold or coolwater habitat. As both the OMNR and LSRCA support the re-establishment of natural coldwater systems, most of the subwatershed is managed as coldwater. The removal of riparian vegetation and the shade it creates, as well as the warming of water as it drains from paved areas causes 'thermal pollution' in watercourses, and can make some waters uninhabitable by coldwater species. Specific information on water quality issues can be found in Chapter 4.

Key Points - Factors impacting Aquatic Habitat – stressors:

- Physical changes such as artificial barriers, online ponds, channelization and removal of riparian vegetation are some of the significant stressors to the Black River – e.g. thus far, there have been 67 barriers identified, but it is anticipate that this number will grow incrementally upon study of individual systems. It should also be noted that online dams are especially prevalent in the Oak Ridges Moraine where 11 structures are located, mainly for irrigation and , to a lesser degree, recreation
- The BMP inventory project found 290 areas of insufficient riparian cover and 55 areas of bank hardening/ channelization within the Black River subwatershed.
- Habitat quality and quantity is also impacted by changes in flow regime resulting from land use changes and water taking. Increased flow degrades habitat through processes such as bank erosion. Decreased flow can lead to a temporary or permanent reduction in the amount of aquatic habitat present.
- A water quality concern is the thermal degradation occurring due to land use changes (online ponds, impervious areas). These issues are discussed in more detail within Chapter 4, Water Quality.
- The common carp (*Cyprinus carpio*) is negatively affecting native communities by occupying and/or destroying the habitat of native species, consuming their eggs and young, and by outcompeting them for resources
- Another invasive species, the round goby (*Neogobius melanostomus*), has been found in the Black River. The round goby is easily identifiable by it characteristic pelvic fin which is joined underneath the body. This species is a bottom feeder and is competing with the native species for food.

6.4 Current Management Framework

There are numerous pieces of legislation that include policies aimed at maintaining or improving aquatic habitat. These include the Fisheries Act, Endangered Species Act, the Greenbelt Plan, Growth Plan for the Greater Golden Horseshoe, the Oak Ridges Moraine Conservation Plan, and the Lake Simcoe Protection Plan. The policies within the legislation relate to many different activities that can potentially affect aquatic habitat, with activities ranging from the loss of riparian areas to urban development. In Table 6-3 we categorize 11 such activities, recognizing that many of these activities overlap and that the list is by no means inclusive of all activities. The legal affect of policies within these varying pieces of legislation broadly fall into one of two categories. The first broad category we define as those having little or no legal standing and are referred to as General or Have regard to Statements in Table 6-3 and are shown in blue. The second policy category includes those that have legal standing and must be conformed to; these are referred to as Regulated / Existing Targets in Table 6-3 and are shown in green. In many cases a piece of legislation does not have policies of either category that relate to the activity specified, these are shown in red.

Table 6-3 Summary of current legislation and acts that relate to the protection and restoration of aquatic habitat

Stressor affecting aquatic habitat	Oak Ridges Moraine Conservation Plan (2002)	Greenbelt Plan (2005)	Lake Simcoe Protection Plan (2008)	Growth Plan for the Greater Golden Horseshoe (2006)	Provincial Policy Statement (2005)	Endangered Species Act (2008)	Ontario Water Resources Act (1990)	Fisheries Act (1985)	Ontario Fisheries Regulations (1989)	LSRCA Watershed Development Policies (2008)	York Region Official Plan (2008)	Durham Region Official Plan (2008)
Growth, development and site alteration												
Introduction of invasive species			3									
Loss of natural heritage features						7		9				
Loss of riparian areas	1	1	4			7						
Stream alteration	2	2	4									
Instream barriers	2	2	4									
Bank hardening	2	2	4							10		
Changing hydrologic conditions			5							11		
Degradation of water quality (including thermal impacts)			6									
Restoration						8				12		13
Climate change												
General/Have regard to statement				Regulated/Existing targets					No applicable policies			

¹ Protected through required buffers around streams/waterbodies
² Development/site alteration restricted within 30 metres of streams, presumably would prohibit channelization, other in-stream and riparian activities
³ Discusses developing proposed regulations (to be considered by fed gov under fisheries act), conducting studies/risk assessments, developing response plans, education programs, but nothing banning use/etc
⁴ Implied under buffer restrictions
⁵ Instream flow targets and water conservation, but nothing around impervious areas/reducing peak flows
⁶ Only contains specific policies and targets about phosphorus reduction, none about other contaminants
⁷ Related to those features that are part of SARO listed species' habitat
⁸ Person holding a permit to conduct an activity may be required to rehabilitate habitat damaged/destroyed in undertaking the activity; is also mentioned in policy pertaining to Species at Risk in Ontario Stewardship Program
⁹ would only apply to those areas that can be classified as fish habitat
¹⁰ not directly stated, but stream alteration policies would cover this

¹¹ stormwater controls required, application must demonstrate every effort made to achieve pre-development hydrologic conditions

¹² Required for valleyland applications, may be required in other cases

¹³ Required in some instances, but generally encouraged

In this section we provide a summary of legislation as it pertains to activities affecting aquatic habitat. This summary is to give context to *future management considerations* and the *opportunities and recommendations to improve water quality* discussed in the following two sections. This summary is not intended to be comprehensive in terms of all the acts related to aquatic habitat, or the policies within these acts – the reader is directed to each piece of legislation for a full assessment of the legislation as it relates to aquatic habitat.

6.4.1 Oak Ridges Moraine Conservation Plan (2002)

This plan designates Natural Core and Natural Linkage Areas for the purpose of maintaining and improving the ecological integrity of the plan area. Approximately 3,900 ha (or 17%) of the subwatershed is designated ORMCP Natural Core and Linkage areas. The policies that apply in the Natural Core and Linkage Areas include:

- Every application for development or site alteration shall identify planning, design and construction practices that ensure that buildings or site alterations do not impede the movement of plants and animals among key natural heritage features (a designation which includes fish habitat), hydrologically sensitive features and adjacent land.
- A minimum area of influence and minimum vegetation protection zone, which are 30 metres and 120 metres, respectively. An application for development or site alteration within the minimum area of influence that relates to a key natural heritage feature, but is outside of that feature and the minimum vegetation protection zone, are to be accompanied by a natural heritage evaluation. A natural heritage evaluation shall:
 - Demonstrate that the development or site alteration will have no adverse affects on the key natural heritage feature or the related ecological functions
 - Identify planning, design and construction practices that will maintain and, where possible, improve or restore the health, diversity and size of the key natural heritage feature and its connectivity with other key natural heritage features
 - Demonstrate how connectivity within and between key natural heritage features will be maintained and, where possible, improved or restored before, during and after construction
 - Determine if the dimensions of the minimum vegetation protection zone as specified in the ORMCP are sufficient, and specify the dimensions necessary to provide for the maintenance and, where possible, improvement or restoration of natural self-sustaining vegetation within it

Policies related to water conservation and the protection of water quality and quantity will have the added benefit of helping to maintain a great number of important natural heritage features, such as wetlands (see chapter 4 and 5).

The ORMCP also details a number of requirements for those uses that are permitted within Natural Core and Linkage Areas, such as gravel pits, agricultural uses, and low-intensity recreational uses to ensure that they have minimal impact on these important areas.

6.4.2 Greenbelt Plan (2005)

One of the stated goals of the Greenbelt Plan is the protection, maintenance and enhancement of natural heritage, hydrologic and landform features and functions, including the protection of habitat for flora and fauna, as well as protecting and restoring natural and open space connections.

Wetlands, seepage areas and springs, fish habitat, permanent and intermittent streams, lakes, and significant woodlands, are all considered to be key natural heritage or key hydrologic features. Under the policies for the Natural Heritage System areas, the Plan states that:

- The minimum vegetation protection zone shall be a minimum of 30 metres wide measured from the outside boundary of these key natural heritage feature or key hydrologic features. Thus, areas within the Greenbelt boundaries within the Black River require a minimum 30 metre buffer.
- For development or site alteration within these features, as permitted by the Plan's policies, the application shall demonstrate that there will be no negative effects on Key Natural Heritage or Key Hydrologic Features, and that connectivity shall be maintained or enhanced wherever possible.
- The amount of disturbed and impervious area of sites where development and site alteration is permitted is limited; stating that they should not exceed 25 and 10 per cent of the site's developable area, respectively.
- Applicants are to demonstrate, where non-agricultural uses are contemplated, that
 - At least 30 per cent of the total developable area will remain in or be returned to natural, self-sustaining vegetation
 - Connectivity along the system and between key natural heritage and hydrologic features located within 240 metres of each other is maintained or enhanced
 - Buildings and structures are not to occupy more than 25 per cent of the total developable area

There are also a number of policies under the Water Resource System area of the Natural System that relate to the protection and enhancement of fish habitat. These are discussed in greater detail in Chapters 4 and 5. The external connections policies in the Water Resource System section includes encouraging planning approaches that increase or improve fish habitat and to avoid, minimize or mitigate the impacts associated with urban runoff, and the integration of watershed planning and management approaches for lands both within and beyond the Greenbelt.

6.4.3 Lake Simcoe Protection Plan (2009)

The Lake Simcoe Protection Plan (LSPP) includes numerous designated policies that will help protect aquatic habitat: Those related to the protection of permanent and intermittent streams include:

- Restrictions to structures along or within streams if it impedes flow or harmfully alters fish habitat.
- Requires any shoreline alteration required for drainage or stabilization only be completed if remediation will maintain natural stream contours and a vegetated riparian area will be established (with the exception of agricultural activities that are not required to establish riparian areas).

- Any development and site alteration within 120m of a stream should integrate with stewardship and remediation activities.

The policies in the plan that will support healthy aquatic communities in Lake Simcoe's tributaries (such as those in the Black subwatershed) include:

- The development of fish community objectives, to be used by public bodies to inform decisions relating to the management of land, water and natural resources, increase the resilience of the aquatic communities to future impacts of invasive species and climate change, and ensure sustainable resource use and social benefit
- The completion of baseline mapping of aquatic habitat will be completed, building on existing monitoring programs and established databases
- The development and implementation of an annual aquatic community monitoring program, which will build upon existing monitoring programs in order to support an adaptive management approach

The LSPP also deals explicitly with issues around invasive species, with a target of preventing the introduction of new invasive species in the watershed. The policies aimed at meeting this target include:

- The delivery of annual information and education programs for the general public and key stakeholders on how to prevent the spread of, and how to detect, invasive species
- The development of a community based social marketing project to identify effective methods to engage stakeholders for the purpose of modifying their behaviour to reduce the introduction and spread of invasive species
- The development of a regulatory proposal that would require anglers who are fishing with live bait in the Lake Simcoe watershed to only use live bait caught in the watershed
- The completion of a study to evaluate the potential risk of movement of invasive species through the Trent-Severn Waterway resulting from natural dispersal and boat traffic
- A mobile boat wash/education program will be developed and implemented

LSPP policies described in other chapters of this plan, particularly around the protection of natural heritage features and water quality and quantity, as described in their respective chapters, will also support healthy aquatic environments throughout the watershed.

6.4.4 Places to Grow Act – Growth Plan for the Greater Golden Horseshoe (2006)

The Growth Plan does not contain any policies related to aquatic habitat, except that the population density target calculation will exclude such areas as fish habitat and other natural heritage and hydrologic features that are otherwise protected through measures such as the Provincial Policy Statement or applicable Official Plans.

6.4.5 Provincial Policy Statement (2005)

By focusing growth within settlement areas and away from significant or sensitive resources, the implementation of the Provincial Policy Statement (PPS) will help to protect aquatic habitat within the Black River subwatershed. The policies that support this in the PPS include:

- Directing growth to settlement areas and requiring planning authorities to identify and promote opportunities for intensification and redevelopment

- Supporting a coordinated, integrated and comprehensive approach between municipalities when dealing with managing natural heritage and water resources, and ecosystem, shoreline and watershed related issues.

Under its 'Wise Use and Management of Resources' policies, the PPS specifies that:

- Natural heritage features and areas (which includes fish habitat, among other features) shall be protected for the long term
- The diversity and connectivity of natural features in an area, and the long-term ecological functions and biodiversity of natural heritage systems, should be maintained, restored or, where possible, improved, recognizing the linkages between and among natural heritage features and areas, and surface and groundwater features
- Development and site alteration shall not be permitted in fish habitat except in accordance with provincial and federal requirements.

Policies around the protection of water resources will also protect quality aquatic habitat for biota. See Chapter 4 for PPS policies related to protecting water quality and Chapter 5 for water quantity.

6.4.6 Ontario Water Resources Act (OWRA) – Permit to Take Water

The issuance of Permits to Take Water occurs under the *Ontario Water Resources Act (OWRA)*. In relation to aquatic habitat, the *OWRA* states (see section 34 (1)) that when issuing permits, a MOE Director should consider the following:

- i. The impact or potential impact of the water taking on
 - a. the natural variability of water flow or water levels
 - b. minimum stream flow
 - c. Habitat that depends on water flow or water levels, and
- ii. Groundwater and surface water and their interrelationships that affect or are affected by...the water taking or proposed water taking, including its impact or potential impact on water quantity or quality.

As discussed in Chapter 5, Surface Water Quantity, the issuance of permits to take water is the responsibility of the Ministry of the Environment. It is only necessary to obtain a permit for water takings exceeding 50,000 L/day, and permits are not required for takings for household use or for watering livestock and poultry. While this legislation specifically addresses the quantity of water, as well as the quality with respect to certain activities, the management of water resources can have a significant influence on the health of aquatic habitat. This is discussed in greater detail in Chapter 4, Water Quantity.

6.4.7 Fisheries Act (1985)

The *Fisheries Act* is federal legislation that deals with the management of Canada's fisheries resources and the conservation and protection of fish and fish habitat. Section 35 of the *Act* states that no one may carry on any work or undertaking that results in the harmful alteration, disruption or destruction (known as a HADD) of fish habitat, unless authorized to do so by the Minister of Fisheries and Oceans Canada. It is among the oldest and strongest environmental legislation in the country. The enforcement of this *Act* limits the work that can be done in and around a watercourse, including channelizing and hardening activities, relocation of stream channels, and the creation of barriers, thus ensuring that habitat quality is protected and that aquatic systems do not become fragmented.

Ontario Fisheries Regulation (1989) (created under the federal Fisheries Act)

These regulations set out the rules around fishing (both recreational and commercial) and possessing fish in the province of Ontario. Aside from rules around fishing licenses, fishing quotas and acceptable methods, the regulations most applicable to this subwatershed plan mainly focus on preventing the introduction of invasive species and protection of endangered species, and include:

- Regulation 6 (1) states that no person shall possess a live invasive fish without a license.
- Regulation 28 states that it is illegal for anyone to deposit live fish into a body of water other than the body of water from which they were caught. There is also a specific regulation regarding bait fish – it is illegal to release baitfish into any waters, or within 30 metres of any waters.
- Regulation 29 stipulates that it is against the regulations for any person to use as bait or even possess for use as bait, an invasive species.
- Regulation 7 (1) states that no person shall fish for or possess a specially protected fish without a licence.

The enforcement of these regulations, though difficult, is an important tool for preventing the introduction and spread of invasive species and the protection of endangered species in the subwatershed.

6.4.8 Timing restrictions for in-water works

The Ontario Ministry of Natural Resources (OMNR) is responsible for determining in-water works restrictions such that fish and other aquatic life are permitted to carry out their life processes undisturbed. These restrictions are based on the presence of warm and cold water thermal fish communities as determined by contemporary thermal regime and fisheries studies (Figure 6-8).

In-water works timing restrictions for the Black River include warmwater timing (no in-water works between April 1st and June 30th of any given year) in the main branch to the confluence with the Harrison Creek tributary. All other tributaries are considered coldwater habitat wherein in-water works are permitted only between May 31st and September 15th of any given year. These restrictions are mandated by the Aurora District Ministry of Natural Resources.

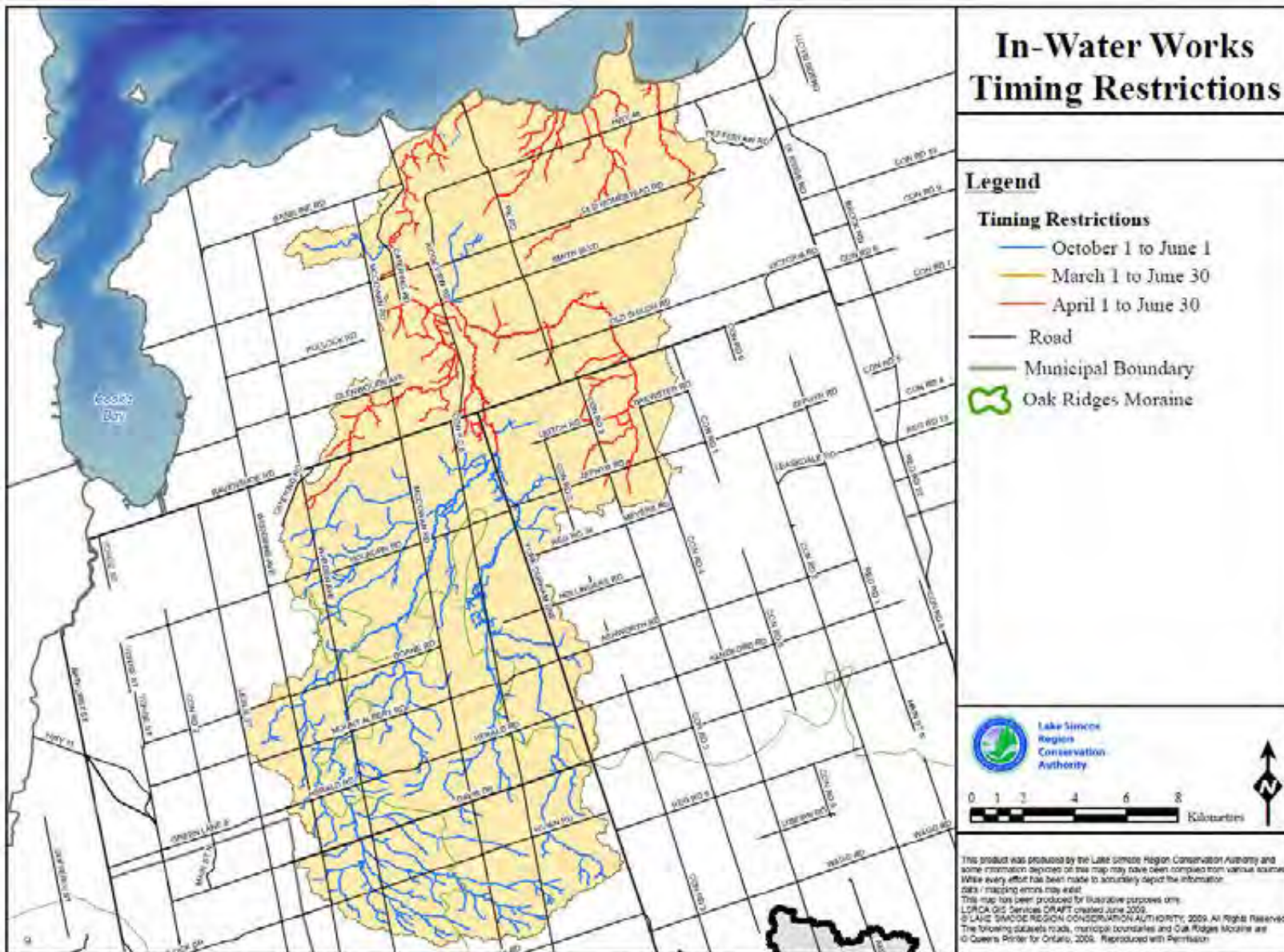


Figure 6-8 Timing restrictions for in-water works

6.4.9 LSRCA Watershed Development Policies

The Authority does have buffer requirements through its Watershed Development Policies; however, these are superseded in the Black River subwatershed by the Greenbelt Plan and LSPP, which both require a minimum 30m vegetative protective zone for all key natural heritage and hydrological features.

6.4.10 York Region Official Plan (2009)

There are a number of policies in York Region's Official Plan that pertain to the protection of fish and aquatic habitat. These policies include:

- The protection and enhancement of the Regional Greenlands System and its functions and to direct new development and site alteration away from the Greenlands System. The Greenlands System contains many of the Black's watercourses
- Requiring local municipalities to develop local Greenlands Systems that identify enhancement areas and linkage opportunities and include policies, initiatives and mapping that protect and complement the regional system
- Prohibiting development and site alteration within key natural heritage features (which includes fish habitat) and adjacent lands, unless it is demonstrated that the activity will not result in a negative impact to the feature or its functions
- Prohibiting the removal of key natural heritage features
- Being consistent with federal and provincial regulations regarding fish habitat
- Cooperating with conservation authorities, the province, and local municipalities to further define and better understand key natural heritage features and their functions and to promote improved stewardship and protection strategies
- Encouraging private and public landowners with lands containing key natural heritage features to manage their lands in a manner that conserves and enhances features in accordance with the policies of the OP
- Protecting and enhancing aquatic habitats, including fish and wildlife habitats, in co-operation with the province and conservation authority through the implementation of fisheries management plans, watershed plans, and other resource management plans
- Supporting the goals and objectives of subwatershed plans

Policies related to the protection of water resources will also help to protect aquatic habitat, by ensuring that there is enough water of sufficient quality to support healthy aquatic ecosystems.

6.4.11 Durham Region Official Plan

To protect aquatic habitat, the Durham Region Official Plan:

- Specifies a minimum 30 metre buffer for fish habitat, and requires that applications for development within 120 metres of fish habitat complete an environmental impact study to determine whether the buffer should be wider than 30 metres in order to protect that feature and its functions
- Provides the same protection for other natural features such as forests and wetlands, which will maintain and enhance the state of aquatic habitat

- In assessing development, the Region requires that streams and their adjoining lands be retained in or rehabilitated to a natural state and that fish and wildlife habitat are protected, and also discourages alterations to watercourses.

6.4.12 Additional legislation and policies that address aquatic habitat issues

The policies discussed in the water quantity, water quality, and natural heritage chapters, if implemented, will all serve to protect and enhance the quality and quantity of aquatic habitat in the Black River. Readers should refer to these chapters for specific information around the policies that protect the quality and quantity of water that the aquatic community depends on, as well as the protection of the amount and quality of natural heritage features and their functions.

6.5 Management gaps and limitations

As can be seen in the above section, there are a number of pieces of legislation, regulations and municipal requirements aimed at protecting the aquatic habitat of the Black River. Despite this strong foundation, there are a number of gaps and limitations in the management framework that need to be considered, such as the effects of climate change. This section provides an overview of factors that need to be considered in the future management of the subwatershed.

6.5.1 Growth, Development and Site Alteration

These activities are strongly regulated in areas such as key natural heritage features, key hydrologic features, and shorelines through the ORMCP, Greenbelt Plan, Lake Simcoe Protection Plan, York and Durham Region's Official Plans, and LSRCA Watershed Development Policies. Fish habitat is often considered a key natural heritage feature within this framework, in addition to the other features that will help to protect and enhance fish habitat. There are, however, limitations with these policies:

- For many natural heritage features (other than wetlands) it is only those considered significant that are protected, and in general only those considered provincially significant are protected. Although they are not considered to be significant, these features still perform important functions in the watershed, and the development of these areas and loss of these functions will have impacts to watershed health. Wetlands are now well protected through the Generic Regulation (179/06);
- The policies that apply to hydrologic features are not consistent across the subwatershed – the definition of a key hydrologic feature is different for the ORMCP area, the Greenbelt Plan area, and the LSPP area which covers the remainder of the subwatershed. Features such as seepage areas, springs, aquifers and recharge areas are protected in the ORMCP area, but not the LSPP area, and the Greenbelt Plan includes seepage areas and springs but not aquifers and recharge areas. These discrepancies can leave some of these features unprotected, which could have impacts to aquatic habitat.
- Some plans specify a minimum vegetation protection zone around key natural heritage and key hydrologic features (e.g. the ORMCP and Greenbelt Plan), and also identify a further 'area of influence' (as it is referred to in the ORMCP) outside of the minimum vegetation protection zone. Within this area of influence, a proposal for development or site alteration triggers the requirement for a natural heritage and/or hydrologic evaluation. This evaluation is meant to describe the existing conditions, assess the potential impacts from proposed development/site alteration and determine if the minimum vegetation protection zone provides sufficient protection. If the minimum

vegetation protection zone is not found to be sufficient, the evaluation should specify the dimensions of the required minimum vegetation protection zone. While the goal of these policies is undoubtedly to protect the features, in reality the required evaluations rarely specify anything greater than the minimum; in essence the minimum becomes the maximum distance. There is therefore little further protection gained through this process for these features and their functions by way of a buffer distance.

6.5.2 Introduction of Invasive Species

Only the Lake Simcoe Protection Plan and Ontario Fisheries Regulations under the Fisheries Act contain policies around the introduction of invasive species. The following are some of the gaps and limitations with the policies as they currently stand:

- The Ontario Fisheries Regulations do set strict rules around the possession, transport, and release of invasive species. However, the list of invasive species on the list included with the regulations is very limited – it does not include common carp, for example. This list also only contains invasive fish species, which means that there are no rules around species such as rusty crayfish, for example.
- It is very difficult and expensive to enforce these regulations.
- The LSPP notes the importance of identifying funding sources for the implementation of invasive species response plans, but there is currently not a guaranteed fund for undertaking these activities.

6.5.3 Loss of Natural Heritage Features

As discussed in section 6.5.1 above, a number of the natural features that contribute to healthy aquatic habitat in the subwatershed are protected through the existing management framework. The loss of those features not protected because they are not of significance or don't fall within certain geographic regions as identified by the various pieces of legislation could contribute to the degradation of aquatic habitat.

6.5.4 Loss of Riparian Areas

With the release of the Lake Simcoe Protection Plan, which builds upon the protection already existing through the ORMCP and Greenbelt Plans, development within 30 metres of a permanent or intermittent stream is not permitted anywhere in the Lake Simcoe watershed, with the exception of a few activities, most of which would have little impact. However, one of the permitted activities, if the need for the project has been demonstrated, is infrastructure. The undertaking of an infrastructure project could result in a significant loss of riparian area.

6.5.5 Stream Alteration, Instream Barriers, and Bank Hardening

As any of these activities would be considered to be a harmful alteration, disruption or destruction of fish habitat, they would be strictly regulated under the Fisheries Act. These activities would also be regulated under the policies of the ORMCP, Greenbelt Plan, and LSPP.

6.5.6 Changing Hydrologic Conditions

The policies related to changing hydrologic conditions are generally 'have regard to' statements. The LSRCA Watershed Development Policies require applicants to make every effort to limit impervious surface and maintain pre-development hydrologic conditions, and the LSPP will set Instream flow targets and does include requirements for water conservation plans. However, there are limitations:

- The total amount of impervious surface is generally not accounted for through a subwatershed
- All development will have a certain amount of impervious surfaces, regardless of efforts to limit it. None of the policies applicable in the watershed *require* the use of innovative BMPs to encourage infiltration (such as soakaway pits) and water conservation practices (such as dual-flush toilets, rainwater harvesting, and water recycling). These are the types of activities will be needed to ensure consistent hydrologic conditions that will maintain aquatic habitat.

6.5.7 Degradation of Water Quality

As is discussed in Chapter 4, a number of the Acts, regulations and policies that apply in the watershed are aimed at preventing the degradation of water quality. There are, however, some significant gaps, which has resulted in declining water quality in the subwatershed. This, combined with a number of other factors, has had an impact on the subwatershed's aquatic community. These gaps and limitations include:

- Aside from requiring Level 1 stormwater control for all new developments, there are no policies around non-point source inputs of pollutants.
- Point source discharges are well regulated, requiring permits to be issued, but the cumulative impacts of these discharges to the receiving watercourse and their aquatic habitat may not be thoroughly considered.
- There is no policy support or related enforcement for the Provincial Water Quality Objectives – the degradation of water quality due to the input of contaminants as well as thermal degradation has continued despite the objectives that have been set. The LSPP sets a target of achieving the PWQOs or better in the watershed, but generally does not include policies to meet this target.

6.5.8 Restoration

Most of the policies related to restoration are quite general in nature, and do not contain specific requirements. Some require applications for development or site alteration in key hydrologic features or key natural heritage features to be accompanied by a natural heritage or hydrologic evaluation, which in some cases requires the applicant to include planning, design or construction practices that will maintain and, where feasible, improve or restore the health, size, and diversity of the feature. The limitations to this approach include:

- Resources are needed to ensure that the specified design practices are being undertaken during and after construction
- It may be difficult to measure whether the health, size and diversity of a feature has been maintain or restored – this would require a significant input of resources, and impacts may not be seen for some time after the construction has been completed.

6.5.9 Climate Change

Climate change is generally not well addressed in the current management framework. The LSPP contains the most comprehensive policies related to this issue which, although it is still difficult to predict its impacts, may cause considerable stress to the aquatic communities in this subwatershed. The adaptation strategy that will be developed through the LSPP is a significant first step in addressing this issue, and some of the Official Plan policies are beginning to consider climate change as well. While it may not be appropriate for some of the existing legislation to address climate change issues, it will be important to incorporate climate change

considerations wherever possible in making management decisions for the subwatershed, and implement policies requiring, at the very least, the implementation of so called “no regrets” options should be incorporated into development and site alteration wherever possible.

6.6 Recommended Actions to Improve Aquatic Habitat

The following recommended actions were developed to improve habitat for aquatic biota in the Black River subwatershed. The aquatic communities in the subwatershed are, for the most part, fairly healthy. Where there are signs of stress, it can generally be attributed to anthropogenic activities. Sources of stress in the urban areas include online ponds and other barriers, removal of riparian vegetation, channelization and bank hardening, changing flow regimes because of increasing impervious area, and the input of harmful chemicals and sediment. In agricultural areas, many similar issues are present, including removal of riparian vegetation, online ponds, channelization and the input of sediment and nutrients, as well as cattle in watercourses and the extraction of water for irrigation. With both Sutton and Mount Albert slated to experience growth, these stresses can be expected to increase, unless measures are undertaken to prevent them. The implementation of the actions below will help to mitigate the impacts of this growth, as well as that of the existing urban and rural land uses, on the quality of aquatic habitat in this subwatershed.

These recommendations, which are grouped and numbered as described in Section 1.4, were developed to address the water quality issues and stressors that were identified throughout this chapter. In addition, they consider, and are consistent with applicable policies and recommendations in the province’s Lake Simcoe Protection Plan, and the LSRCA’s Integrated Watershed Management Plan. Each recommendation below also identifies the applicable ‘detailed recommendations’ as outlined in Chapter 10. These detailed actions will form the basis of the Implementation Plan for York Region’s ORM subwatersheds, to be developed following the completion of this plan.

6.6.1 Planning and Policy

- 1) That the municipal partners and the LSRCA strive to reduce the impacts of stormwater through a number of methods including the implementation of policies and guidelines and enabling the use of new and innovative technologies, retrofitting of existing developments.
Detailed recommendations: A.1.1 – A.1.3
- 4) That the municipal partners and the LSRCA strive to maintain natural hydrologic conditions on development sites
Detailed recommendations: A.3.1 – A.3.2
- 5) That the federal, provincial, and municipal governments, as well as the LSRCA, continue to evaluate and implement planning initiatives and practices aimed at reducing the impact of development on the condition of the Black River subwatershed
Detailed recommendations: A.3.3 – A.3.5, A.3.7
- 6) That the value of the ecological goods and services (EGS) provided by ecological features be considered in decision making around growth and development
Detailed recommendation: A.3.6
- 7) That the rural/agricultural community be engaged in developing solutions for minimizing the impacts of practices on their lands
Detailed recommendation: A.4.1

- 11) That the Province, the municipal partners, and the LSRCA seek to gain an improved understanding of the impacts of climate change in the Black subwatershed, incorporating this information into decision making scenarios and developing strategies to mitigate and adapt to its impacts.

Detailed recommendations: A.6.1 – A.6.2, G.1.1. – G.1.2

6.6.2 Use of Better Management Practices

- 12) That the LSRCA and its municipal partners continue working to mitigate the impacts of stormwater to water quality and quantity through tracking its sources, completing stormwater retrofits, promoting methods of minimizing stormwater volume, and continuing to research new and innovative solutions to stormwater control and implementing these solutions where appropriate.

Detailed recommendations: B.1.1 – B.1.5

- 13) That support for programs offered to assist rural landowners in implementing BMPs on their properties, such as LSRCA's LEAP program, be continued and/or expanded as resources permit

Detailed recommendations: B.2.1 – B.2.3

- 14) That sectors that have the potential to have significant impacts on conditions in the Black subwatershed be expected to undertake BMPs and other activities to mitigate their impacts, as required under the LSPP

Detailed recommendations: B.2.4 – B.2.5

- 15) That the LSRCA and the partner municipalities encourage the use of natural channel designs and 'soft solutions' wherever possible for preventing or mitigating streambank erosion and accommodating channel realignments; and that technical and financial resources be made available for retrofitting where appropriate to undertake these activities.

Detailed recommendations: B.3.1 – B.3.4

6.6.3 Changing the way things are done 'on the ground'

- 19) That the partner municipalities, the LSRCA, and the related stakeholders work to reduce the impacts of construction practices on the Black subwatershed's water quality

Detailed recommendations: C.3.1 – C.3.2

6.6.4 Applied Research and Science

- 22) That all partners study the requirements for environmental flows within the Black subwatershed, explore innovative solutions, and undertake works and practices where possible in order to ensure adequate baseflow to support ecological function

Detailed recommendations: D.1.5, D.1.7, D.2.2

- 24) That the partners explore the subwatershed to determine where reductions in groundwater discharge, excessive water takings and other impacts to aquatic habitat have occurred and undertake activities to mitigate these impacts

Detailed recommendations: D.2.1

- 28) That all partners cooperate to determine the presence and extent of invasive species in the subwatershed, and work to prevent their establishment and spread

Detailed recommendations: D.3.7 – D.3.8

6.6.5 Monitoring

- 30) That the LSRCA continue to undertake the aquatic monitoring program, with expansions to the program in order to further understand conditions in the subwatershed; and cooperate with partner agencies on additional initiatives as required

Detailed recommendations: E.2.1 – E.2.2

6.6.6 Management, Rehabilitation and Restoration

- 35) That the MNR, with the support of LSRCA and the partner municipalities, undertake initiatives aimed at maintaining the health of the subwatershed's fish community. These may include the development of fish community goals and objectives, fisheries management plans, or other plans aimed at protecting the habitat of species at risk in applicable catchments.

Detailed recommendations: F.1.1 – F.1.4, F.1.7

- 36) That the LSRCA and its partners continue monitoring the aquatic community and habitat in the Black subwatershed, assessing the monitoring program on a regular basis and undertaking targeted monitoring where appropriate to fill data gaps.

Detailed recommendations: F.1.5 – F.1.6

- 37) That that LSRCA, in cooperation with its partner municipalities, prioritize and undertake activities to improve and restore aquatic ecological functions within the subwatershed, including barrier removal, natural channel design, restoring floodplain functions, and wetland creation. This could include undertaking pilot/demonstration projects to assess the feasibility of such works.

Detailed recommendations: F.1.8 – F.1.13

- 38) That the LSRCA continue to utilize buffer requirements and timing guidelines as tools to protect aquatic resources, and that other activities such as stormwater retrofits, tree planting, and habitat enhancement be undertaken to enhance aquatic habitat

Detailed recommendation: F.1.14

- 39) That the LSRCA and the partner municipalities assess the feasibility of increasing natural cover (e.g. woodland, streambank vegetation, interior forest, grassland) in the subwatershed and set priorities and develop plans to undertake this enhancement, based on overall benefit to the subwatershed.

Detailed recommendations: A.5.3, F.2.1 – F.2.3

- 42) That the LSRCA support the work of MNR and OFAH with respect to invasive species and encourage the distribution of promotional materials.

Detailed recommendation: F.3.1

- 45) That the LSRCA request the Ministry of Natural Resources to undertake the development of watershed rare lists and protection policies for species at risk in the subwatershed.

Detailed recommendation: F.4.3

- 47) That the LSRCA, the partner municipalities, and developers work to identify opportunities for undertaking restoration works on development sites, and incorporate these into proposals, where appropriate

Detailed recommendation: F.4.5

6.6.7 Adaptive Response

48) That the LSRCA and partner municipalities work to reduce their carbon footprint and to increase ecological resilience in the watershed

Detailed recommendations: G.1.1 – G.1.3

7 Fluvial Geomorphology

7.1 Introduction and background

Fluvial geomorphology is the study of the processes that influence the shape and form of streams and rivers. It describes the processes whereby sediment and water are transported from the headwaters of a watershed to its mouth. These processes govern and constantly change the form of river and stream channels, and determine how stable the channels are. Fluvial geomorphology provides a means of identifying and studying these processes, which are dependent on climate, land use, topography, geology, vegetation, and other natural and human influenced changes.

An extensive understanding of geomorphic processes and their influences is required in order to protect, enhance, and restore stream form in a watershed. Changes in land use, and urbanization in particular, can significantly impact the movement of both water and sediment, and can thus cause considerable changes to the geomorphic processes in the watershed. Changes to the morphology of stream channels, such as accelerated erosion, can impact the aquatic community, which has adapted to the natural conditions, and can also threaten human lives, property, and infrastructure.

The Black River subwatershed is a fairly stable system, but there are some issues such as bank instability, erosion, stream widening, and aggradation. These issues are thought to be due land use changes including agriculture and urban, and activities such as mowing or cultivating to the edge of streambanks.

7.1.1 Geomorphic Processes

All streams and river systems are constantly in a state of transition, influenced by the flow of water and the amount of sediment entering into the system. The amount of water in a natural watercourse is influenced by both climate and geology. The amount of water delivered to the surface of a watercourse, as well as how and when it arrives is influenced by climate. Typical patterns are high flow events during the spring freshet, and low flow conditions during the winter and summer months.

The surficial geology of an area influences the path of water once it reaches the ground surface. The underlying geology establishes the volume and proportion of groundwater and surface water available to flow through a watershed through its effect on infiltration. Geology also shapes the amount and type of sediment that enters a watercourse, and the strength and erodibility of the surficial material through which the watercourse flows. A complex underlying geology and topography can result in considerable variation in channel character, as well as sensitivity to potential impacts, within the same drainage system.

Natural watercourses respond to continually changing conditions in flow and sediment supply with adjustments in shape and channel position. These changes take place through the processes of erosion and deposition. This ability to continually change is an inherent characteristic of natural systems that allows the morphology of the channels to remain relatively constant. The state in which flow and sediment supply are balanced to achieve this stable channel form is referred to as “dynamic equilibrium.” While in a state of dynamic equilibrium, channel morphology is stable but not static, since it makes gradual changes as sediment is deposited and moved throughout the watercourse. For example, many natural watercourses can be seen to “migrate” within their floodplain over time. This is due to the erosion of the outsides of channel bends, but with corresponding deposition of material on the insides of bends. This process maintains the balance between flow and sediment supply in the system.

Riparian and aquatic biota are adapted to and depend on the habitats provided by a system in dynamic equilibrium.

7.2 Current Status

PARISH Geomorphic Ltd. was retained by the LSRCA to compile spatial information on the Black River subwatershed. This assessment involved two components: desktop analysis and field reconnaissance. The desktop analysis involved classifying the streams into stream order, valley segmentation, reach breaks for 3rd and higher order streams, belt width corridor delineation, and historic analysis using aerial photography (2002) and other digital datasets such watercourses, contour lines (5 m interval), quaternary geology, soils, roads, land-use, and watershed boundaries (Table 7-1). Desktop analysis also involved assessing historical changes in the planform. In this case three sets of aerial photographs, spanning 43 years, were used. The field reconnaissance component of the assessment built upon the desktop analysis by field truthing random reaches to confirm the results of the desktop work and identify areas of unusual channel conditions such as excessive erosion or deposition.

Table 7-1 A summary of geomorphologic features investigated

River Feature	Description	Method
Planform	The shape of a watercourse as viewed from above	Assessment of historical aerial photos
Stream Order	A measure of the degree of stream branching within a watershed	Assessment of aerial photos
Valley Segments	Relatively homogenous sections of watercourses that exhibit distinct and similar physical elements	Assessment of aerial photos
Reach Break Determination	Reaches are lengths of channel that display similarity with respect to valley setting, planform, floodplain materials, and land use or land cover.	Assessment of aerial photos
Meander Belt Width	The stream corridor that the river channel potentially has had in the past and, more importantly, could occupy in the future	Assessment of aerial photos
Rapid Geomorphic Assessment	Assesses the geomorphic condition of the reach by evaluating the occurrence of four geomorphic processes: aggradation, degradation, widening, and planform adjustment	Field survey
Rapid Stream Assessment Technique (RSAT)	Assesses the overall stability of the reach from both a geomorphic and ecological perspective by evaluating channel dimensions	Field survey

7.2.1 Planform

Historic analyses were conducted by Parish Geomorphic Ltd. using aerial photographs from three sets of coverages (1959/61, 1976, and 2002) to identify changes in channel planform.

The following is a detailed description of the historical change for each watershed from 1959 to 2002. This includes an examination of changes to planform through the examination of aerial photographs as well as channel widths to verify planform changes where necessary. Reaches where channel planform appears to have changed are an indication of channel sensitivity and this should be taken into account when examining meander belt widths and buffer widths. There were four areas of channel planform change identified in the Black River subwatershed.

The downstream section of the Black River is in a fairly urban area; however, the extent of the urbanization appears to have remained fairly constant over the past 43 year with the exception of one new development. The river was moderately sinuous from Lake Simcoe to the Sutton Dam, an area surrounded by residential neighbourhoods, and primarily by agricultural lands in the area just upstream. The sinuosity increased dramatically upstream of the dam on the main branch. For all years, the river flows through a mix of agricultural lands and forested lots. The 2002 aerial photos showed that Mount Albert Creek flows through agricultural and forested lands, as well as the community of Mount Albert. Changes for Mount Albert Creek could not be evaluated due to a lack of coverage in the historical aerial photographs.

Planform change was examined for the Black River between all years of aerial photographs. Minor amounts of planform change were observed despite the winding nature of most of the channel.

7.2.2 Stream Order

Stream order is a measure of the degree of stream branching within a watershed; a first-order stream is an unbranched tributary, a second-order stream is a tributary formed by the connection of two or more first-order streams, a third-order stream is a tributary formed by the connection of two or more second-order streams, and so on. Stream orders for the Black River subwatershed were calculated manually as part of the desktop exercise.

Bifurcation ratio is the rate at which a stream divides, which influences the pattern of sediment delivery and the shape of the hydrograph. Bifurcation ratio values between three and five are typical for areas in southern and eastern Ontario with glacial deposits (Chorley, 1969 as referenced in Parish, 2007). The Black River subwatershed falls within these typical ratio values, with a bifurcation ratio of 4.46. Stream order and average bifurcation ratio for the subwatershed can be seen in Table 7-2 below.

Table 7-2 Summary of stream order and bifurcation ratio for the Black River

Stream Orders	Black River
1	379
2	84
3	22
4	4
5	1
Average Bifurcation Ratio	4.46

7.2.3 Valley Segments

Valley segments are defined as relatively homogenous sections of watercourses that exhibit distinct and similar physical elements. As such, valley segment boundaries are determined by primary features of the watersheds such as topography, geology, climate, and hydrography/drainage networks (Kilgour and Stanfield, 2000 as referenced in Parish, 2007). Climate is considered to have only minor influence on local scales and was not considered as part of the valley segment assessment.

The attributes that were used to identify valley segment breaks were defined by the differences in stream slope, catchment size, and surficial geology. These properties were categorized using GIS software, and subsequently overlaid to determine the locations of valley segment breaks, although some adjustments to correct errors due to GIS issues were necessary.

Valley segments were delineated using a hierarchy of rules as outlined by Kilgour and Stanfield (2000), whereby segments were first partitioned based on the drainage network/hydrography.

Segment boundaries were identified where two tributaries merged, resulting in an increase based on the Horton System (1945). Digital mapping was used to determine and allocate stream order. All third-order (and larger) streams were considered in this subwatershed due to the large catchment size. Additional segment boundaries were also placed where watercourses crossed a boundary that separated two distinct geological units of differing porosity (e.g. sandy material to clayey material), provided the boundaries were not in conjunction with an existing hydrological junction. Finally, segments were also identified where gradients changed dramatically within one of the previously identified segments. This typically occurred where channels dramatically changed confinement, such as where it passed onto a large floodplain.

The Black River drains through large areas of glacial outwash and lake bed materials. Adjacent surficial geology type was considered to be a better characteristic for delineating river segments, as it would pick up local sources or sinks of baseflow. Therefore additional segment boundaries were placed where watercourses crossed a boundary that separated two distinct geological units of differing porosity (e.g. sandy material to clayey material), provided the boundaries were not in conjunction with an existing hydrological junction. For this analysis, digital surficial geology maps (Ontario Geological Society) were used.

A total of 76 valley segments were identified within the Black River subwatershed, ranging in length from as short as 251 metres to as long as 15,000 metres

7.2.4 Reach Break Determination

Reaches are lengths of channel (typically ranging between 200 m and 2 km in length) that display similarity with respect to valley setting, planform, floodplain materials, and land use or land cover. Reach length will vary in scale given that the morphology of low-order watercourses traverse a smaller distance compared to higher-order watercourses. The delineation of reaches along a drainage network is beneficial, as it enables grouping and the identification of general reach characteristics. It is also an ideal starting point from which the effect of subwatershed changes can be assessed.

At the reach scale, characteristics of the river corridor (i.e. valley setting, vegetation, etc.) exert a direct influence on channel form, function, and processes (PARISH Geomorphic Ltd., 2001). At this scale, the watercourse strives to obtain a form that is in quasi-equilibrium with the physical properties of its local setting and the hydrologic and sediment regimes. For example, a comparison of two reaches situated immediately up and downstream of each other but in different physical settings (i.e. scrubland versus forest) may exhibit considerable variation in channel form.

Location of reach breaks are presented in Figure 7-1.

7.2.5 Meander Belt Width

The meander belt width represents the stream corridor that the river channel potentially has had in the past and, more importantly, could occupy in the future. This is determined by identifying the spatial extent of the meander pattern within a reach. Widths are measured at right angles to the trend of the valley. Additional factors, such as remnant channel (ox-bow lakes) and meander scars also assist in identifying the maximum extent the channel may occupy within its floodplain.

As part of best management practices, it is imperative to establish maximum allowable setbacks as a means to preserve stream margin habitats, including floodplains and wetland environments. Encouraging setbacks such as vegetation buffer strips in zoning regulations and controlling urban and agricultural development in the stream corridor will minimize potential property damage while enhancing and protecting overall natural habitat.

The widest meander belt width (between 241-300 m) was found several kilometres upstream of the mouth on the main branch, in the reach running between Frog Road and Ridgeview Road. Other wide reaches (between 161 and 240 m) are mainly found toward the mouth, although there one section upstream of the widest reach upstream of Frog Road. Narrowest meander belt widths (0 – 40 m) tended to occur in the headwaters of the subwatershed, with some narrow reaches also falling just downstream of Mount Albert.

7.2.6 Field Reconnaissance

Because of the large area and high number of reaches in the Black River subwatershed, walking all of the reaches was not feasible. A variety of methods were used to determine the reaches that would be walked. Rapid stream assessments were carried out to verify features observed in aerial photographs (such as changes in landuse and planform). A matrix was constructed to identify representative reaches to be walked based on catchment area and stream gradient, both of which have a significant influence on reach characteristics. Sites were selected to ensure there was representation from combinations of small, medium, and large catchment areas and low, moderate, and high channel gradient. Within each category, reaches exhibiting planform change in the historic analysis were selected for rapid assessments. As there was a minimal amount of planform change observed in the subwatershed, additional reaches were selected randomly. The rapid assessments of the selected reaches were used to assess the overall health and condition of each of them.

A Rapid Geomorphic Assessment (RGA) assesses the geomorphic condition of the reach by evaluating the occurrence of four geomorphic processes: aggradation, degradation, widening, and planform adjustment. A score is determined for each process and the four scores are averaged to yield an RGA score (Table 7-3).

Table 7-3 RGA scores and their definitions

RGA Score	State description	geomorphic condition
0 - 0.20	in regime	Reach is in good condition, in a state of dynamic equilibrium
0.21 – 0.4	transitional	Showing signs of stress and that it may undergo an adjustment
>0.4	adjustment	Geomorphology is adjusting or changing to new conditions

A Rapid Stream Assessment Technique (RSAT) assesses the overall stability of the reach from both a geomorphic and ecological perspective by evaluating channel dimensions, substrate composition of riffles and pools, and evaluating the quality of available habitat in the reach based on physical, chemical, and biological criteria. Each category is given a rating of excellent, good, fair, or poor with an associated numerical value. These values are summed to give an RSAT score (Table 7-4)

Table 7-4 RSAT scores and their definitions

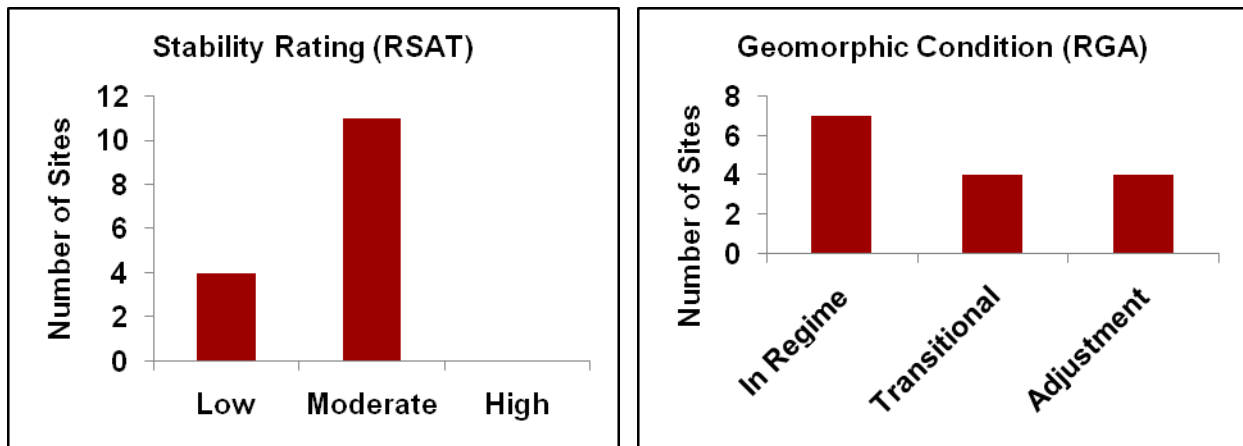
RSAT Score	Stability rating
<20	low stability rating
20-35	a moderate level of stability
>35	a high stability rating

In some cases, the RGA and RSAT scores may appear to be contradictory as some reaches yield good RGA scores and poor RSAT scores. However, RGA scores rate the stream purely from a geomorphic perspective whereas RSAT scores rate the stream from an ecological perspective. Therefore streams that flow through agricultural areas will often receive scores indicating that they are fairly stable as they are often highly vegetated but will score poorly on the RSAT due to poor water quality and low scores on the biological criteria, which will lower the overall score. RGA and RSAT scores for the Black River subwatershed are summarized in Figure 7-2.

Fifteen reaches throughout the Black River subwatershed, mostly flowing through residential and agricultural areas, were walked during the fall of 2006 and RGA and RSAT scores were

completed for each reach. Several reaches were found to be in adjustment with poor RGA scores. The dominant process found within the subwatershed was stream widening, with aggradation also prevalent. This was evidenced by exposed tree roots, bank slumping, large woody debris, siltation in pools, and basal scour on the inside of meander bends. RSAT scores were mostly found to indicate moderate stability. Bed substrate consisted of a mixture of cobble, boulders, and riprap materials composing the riffles, and silt and sands making up the pools. In the residential areas the watercourse is surrounded by manicured lawn to the edges of the banks. The agricultural areas have some fencing interference, cattle crossings, and online ponds adjacent to the watercourses. Buffer zones were lacking in the residential areas and composed of a mixture of tall and short grasses and herbaceous vegetation in those areas not affected by farmland and residential land uses, with a few trees and shrubs present as well in some areas. Portions of this subwatershed consisted of instream vegetation including cattails and other macrophytes. There were several examples of bank hardening, some of which was failing, and urban debris in the channel.

Figure 7-2 Summary of field survey results



All of the reaches that were walked exhibited some erosion, with one third exhibiting high levels of erosion. These signs of erosion included fallen and leaning trees, basal scours on inside meander bends, exposed clay in the stream bed and at the bank toe, and exposed tree roots and undercut banks. Other signs of channel instability were observed, such as reworked and removed bar forms, large organic debris in the channel, and suspended armour layer in the banks. Entrenchment was low throughout most of the subwatershed but there were areas where the channel contacted a valley wall. Detailed descriptions of the conditions in the reaches surveyed can be seen in Table 7-5. Figures 7-3 and 7-4 demonstrate some of these conditions.

Table 7-5 Fluvial geomorphology assessment: field observations in the Black River subwatershed

Reach Name	Location	RSAT	RGA	Length (m)	Riffle Substrate	Pool Substrate	Erosion	Notes
BKR-3	South of Black River Road to High Street	24.5	0.24	899	NA	Cobble, sand, gravel and pebbles	Moderate – siltation in pools, fallen and leaning trees and exposed tree roots	Manicured lawn surrounding portion of river, urbanized channel with urban debris in channel, valley wall contact on right bank
BKR-12-5	Between Crydermans Sideroad and Glenwoods Avenue west of Ridgeview Road	16.5	0.19	507.37	NA	Silt, very fine sand and muck	Low – siltation in pool, poor longitudinal sorting of bed materials and bar forms reworked/ removed	Junk heap upstream, right bank was low with manicured lawn on left bank
BKR-13	Between Valley View Drive and Ridgeview Road north of Baldwin Road	21.0	0.48	672.43	Very coarse sand, medium sand, cobbles and boulders	Clay, sand, pebble and silt	High – embedded riffles, siltation in pools, exposed bedrock, exposed roots, leaning trees, basal scour on inside of meander bend	Reach was bog like with a lot of cattails growing in channel, channel itself was un-wadable
BKR-21	North of Ravenshoe Road, east of Miles Road	22.0	0.16	538.08	Silt and fine sand	Silt, fine sand and muck	Low – siltation in pool, leaning trees and bar forms are re-worked/removed	Reach very silty and un-consolidated, bar forms were lacking/reworked
BKR-22	South of Ravenshoe Road, east of Miles Road	21.0	0.14	756.29	Organics and cobble	Fine sand and silt	Low – siltation in pools, poor longitudinal sorting of bed materials, large organic debris in channel and bar forms reworked/ removed	Presence of artificial riffles deflecting flow from bridge and hairpin turns, bar forms lacking or removed, some channel hardening of angular cobbles in channel
BKR-25-8	Between York/Durham Line and Queensville Sideroad	19.5	0.17	755.78	NA	Silt and organic matter	Low – siltation in pools, large organic debris, single to multiple channel	Reach is fed by a lot of small tributaries, large farm upstream of reach which might be affecting water quality, large pond adjacent to watercourse but unsure if it was on-line
BKR-25-18	Between Centre Street and Ashworth Road	27.5	0.39	1375.04	Cobbles, pebbles and gravel	Silt, sands, gravel and cobbles	High – leaning trees and exposed tree roots in the banks, suspended armour layering in the banks	Urban debris in channel, large concrete slabs in channel, residential housing on right bank, basal scour in some areas, valley wall contact on left bank, fish observed in channel, cedar thicket has bar features, small tributary entering in lower limits of the reach near the town
BKR-25-28	North of Davis Drive	21.5	0.41	429.68	Gravel, pebbles	Silt and sands	High – leaning trees and exposed roots, basal scour on inside of meander bend, formation of multiple threads	There were farms on either side of the channel, general substrate consisted of pebbles silt and clay, more coarse substrate downstream, left bank was fenced off, urban debris in channel
BKR-25-41	Midway between Doane Road and Mount Albert Road	22.5	0.37	694.98 m	NA	Silt and sands	Moderate – removed/reworked bar forms, scour pools downstream of culverts, leaning trees and exposed	Major woody debris in channel, bed was mostly sandy, small tributary entering channel from left bank in the middle of the reach, minor basal scour

Reach Name	Location	RSAT	RGA	Length (m)	Riffle Substrate	Pool Substrate	Erosion	Notes
							roots	on outside of the meander bend
BKR-28	West of Highway 48 between Boad Road and Holborn Road	30.5	0.09	1172.21	NA	Silt, very fine sand and clay	Low – leaning trees and re-worked bar forms	Lot of vegetation in channel, some basal scour, substrate in river was very fine sands, toe of bank was unconsolidated clay
BKR-30-13	North-East of Boag Road, west of Kennedy	18.0	0.09	1132.05	NA	Silt and very fine sands	Low – large organic debris in channel	Channel was dry , on-line pond on right bank of channel, manicured lawn in upper limits of reach, cattails in channel
BKR-32	South of Holborn Road between Hwy48 and McCowan Road	29.0	0.00	592.82	Fine and medium sands	Fine sands	Low – there was no distinctive erosion features observed	Sand ripples were observed in the fine sand substrate, on-line pond
BKR-39	Between Queensville Sideroad and Kennedy Road	28.0	0.58	931.13	NA	Silt and sands	High – leaning trees, exposed roots, large organic debris in channel, formation of chutes and reworked/ removed bar forms	Some un-consolidated clay in toe of banks of channel, cow farm in upstream section of the reach
BKR-56-7	East of Warden Avenue	23.0	0.22	573.92	NA	Silt, very fine sand and clay	Moderate – large organic debris in channel, basal scour on inside of meander bends	Channel was adjacent to farm fields, exposed clay on outside of meander bend, channel travels through well vegetated grass lands
BKR-58	South east of Davis Drive and Warden Avenue	19.5	0.54	1195.99	Cobble, rip rap, boulders	Fine and medium sands	High – leaning trees, exposed roots, basal scour on inside of meander bend, basal scour greater than 50% of reach	On line pond on right bank, residential property on banks, debris in channel, fresh deposit on point bar, unconsolidated clay on toe of banks



Figure 7-3 Eroding banks in the Black River subwatershed



Figure 7-4 Eroding banks, fallen trees, and large organic debris in the Black River subwatershed

Key Points – Current Fluvial Geomorphology Status:

- The Black river subwatershed is a fairly stable system, with the majority of the sites surveyed having a moderate stability score. No sites had high stability and only a few had low stability.
- An assessment of the geomorphic condition (RGA) shows that approximately ½ of sites surveyed were in good condition (a state of dynamic equilibrium), though approximately 26.5% were in a state of transition and 26.5% were found to be in adjustment
- There are several impacted sections within the subwatershed with the most prevalent process being stream widening, along with aggradation. This was evidenced by exposed tree roots, bank slumping, large woody debris, siltation in pools and basal scour on the inside of meander bends

7.3 Factors impacting status - stressors

The changes exerted by humans on natural landscapes can significantly alter the geomorphic processes in watercourses. Land use changes result in a shift in the balance of runoff, evapotranspiration, and infiltration of precipitation. The removal of trees and other natural cover for agriculture will result in a reduction in evapotranspiration; while the paving of natural surfaces for urbanization will reduce the amount of surface water infiltrating into the ground and cause an increase in runoff. Impervious surfaces are not as prevalent in the Black River subwatershed as in other subwatersheds, however there is some increase in urban area (and thus in the area of impervious surfaces) in the subwatershed, which will have an impact. Agricultural such as removing riparian vegetation, the use of tile drains, and water use for irrigation will have impacts on channel stability and flow regimes, thus influencing the characteristics of watercourses in the subwatershed. In addition, the presence of numerous dams has affected flow dynamics within the system.

Land use changes will also alter the sediment regime in the watercourse, which will contribute to unnatural shifts in the geomorphology of stream and river systems, resulting in changes far beyond those experienced in a system in dynamic equilibrium. The changes also tend to occur much more quickly than they would in a natural system, and can result in impacts to the biotic communities living in and around the watercourse, public safety issues, and damage to property.

The effects of land use changes on instream function and the ability to self regulate can be exacerbated by additional activities directly adjacent to or within watercourses. In urban areas, the common practice of straightening and realigning stream channels in order to accommodate development eliminates natural habitat and enhances channel instability, because the new channel form lacks the natural adjustment mechanisms that would maintain stability. In agricultural areas, channels are often realigned and channelized to maximize the area available for crops, riparian vegetation is often removed, and land is tilled up to the edge of the bank. The results of these practices are unstable banks, the loss of natural channel form and correction ability, and the loss of habitat. The extent to which Black River streams have been channelized is discussed in more detail in Chapter 8 (Aquatic Habitat).

While the land use changes that have been and continue to be undertaken in the Lake Simcoe watershed have caused channel instability and erosion; the traditional methods to manage these issues have themselves caused problems. The use of engineered solutions to protect

banks and stream channels such as hardening the river bed and/or banks with concrete, riprap, gabion baskets or armourstone; and weirs and other structures to control flows often fail, as the structures are undermined by the watercourse as it moves to adjust to changing conditions. These structures also reduce the quality and quantity of riparian and aquatic habitat. The hardening of the watercourse increases the velocity of flows, and reduces the potential for natural attenuation of flows along the length of the watercourse. This serves to exacerbate the impacts of urban land uses, resulting in failure of the structures and ongoing degradation of the stream, resulting in the continual need for repair of existing structures, and damage elsewhere in the system that also requires repair.

Traditional stormwater management practices also interfere with natural processes. The goal has commonly been to remove stormwater as quickly and efficiently as possible and convey it to a watercourse. To accomplish this, many watercourses have been hardened and channelized. This has resulted in increase flow velocities and volumes, and most often causes erosion in downstream areas that do not have the natural ability to accommodate these flows. Issues with stormwater are further discussed in **Chapter 3, Best Management Practices**.

7.3.1 Recreation

Natural areas such as streams and rivers are a popular location for recreational activities such as hiking, boating and snowmobiling. These activities, if not managed correctly and undertaken in a responsible manner, can reduce ecological condition of the fluvial geomorphology in the area. Impacts from recreational activities can include increased bank erosion and instability, loss of riparian area resulting in an increase in input of total suspended solids and pollution and an increase in runoff as the banks are pounded down from man-made trails. Stresses on these sensitive areas are increasing as a result of increasing population and diminishing natural heritage lands.

7.3.2 Mitigating Morphology Issues Associated with Land Use Changes

It has become increasingly understood that, in many cases, engineered structures may not be the best solution for mitigating streambank erosion. There has been an increasing consideration of the natural geomorphic processes that shape watercourses, as well as consideration for ecological conditions and potential impacts on those areas that lie upstream and downstream in the design and construction of erosion protection works. It is now common practice to re-route watercourses that have been straightened and/or hardened, through a practice called “Natural Channel Design.” Through this practice, channels are designed to mimic natural conditions, taking into account what is understood of the physical conditions in the watercourse. This creates habitat, and will also help to prevent further impacts in the downstream sections of the watercourse. Figure 7-4 below displays a site where natural channel design was implemented.



Figure 7-5 An example of Natural Channel Design

Stormwater management has become a requirement in the Lake Simcoe watershed, in an attempt to mitigate some of the impacts of an urbanizing environment. The most commonly used type of stormwater management is end-of-pipe stormwater ponds, which serve to detain the excess runoff from urban areas and release it slowly to a receiving watercourse. This is thought to help prevent the erosion that results from the high flows received by watercourses in areas without stormwater management. However, there are issues associated with these facilities, including the increase in water temperature and the required maintenance to ensure that the pond continues to function as designed. Minimizing land use change, particularly in the vicinity of watercourses, is the best way to prevent impacts to stream form.

Key Points– Factors Impacting Fluvial Geomorphology - stressors:

- In agricultural areas, channels are often realigned and channelized to maximize the area available for crops, riparian vegetation is often removed, and land is tilled up to the edge of the bank. The results of these practices are unstable banks, the loss of natural channel form and correction ability, and the loss of habitat.
- Urbanization within the watershed is leading to increased flow velocities and volumes, which can cause erosion in downstream areas that do not have the natural ability to accommodate these flows. The removal of riparian vegetation also creates issues of bank stability.
- Straightening and realigning stream channels in order to accommodate development is eliminating natural habitat and enhancing channel instability.
- A number of online ponds, particularly the Sutton and Baldwin dams, are having an impact on stream flow.

7.4 Current management framework

While the majority of the policies in the relevant legislation and regulations relate to water quality and quantity and natural heritage, the implementation of a number of these policies will have the added benefit of protecting riparian areas and other natural features that help to maintain stable watercourses, or by helping to reduce some of the stresses that cause channel movement and bank instability, such as large volumes of storm water. These policies include the Fisheries Act, Endangered Species Act, the Greenbelt Plan, Growth Plan for the Greater Golden Horseshoe, the Oak Ridges Moraine Conservation Plan, and the Lake Simcoe Protection Plan. The policies within the legislation relate to many different activities that can potentially affect stream geomorphology, with activities ranging from the stream alteration to urban development and site alteration. In Table 7-4 we categorize eight such activities, recognizing that many of these activities overlap and that the list is by no means inclusive of all activities. The legal affect of policies within these varying pieces of legislation broadly fall into one of two categories. The first broad category we define as those having little or no legal standing and are referred to as General or Have regard to Statements in Table 7-4 and are shown in blue. The second policy category includes those that have legal standing and must be conformed to; these are referred to as Regulated / Existing Targets in Table 7-4 and are shown in green. In many cases a piece of legislation does not have policies of either category that relate to the activity specified, these are shown in red.

Table 7-6 Summary of current legislation and acts that relate to the protection and restoration of stream geomorphology

	Oak Ridges Moraine Conservation Plan (2002)	Greenbelt Plan (2005)	Lake Simcoe Protection Plan (2008)	Growth Plan for the Greater Golden Horseshoe (2006)	Provincial Policy Statement (2005)	Fisheries Act (1985)	Ontario Water Resources Act (1990)	LSRCA Watershed Development Policies (2008)	York Region Official Plan (2008)	Durham Region Official Plan (2008)
Development and site alteration										
Impervious surfaces									4	6
Removal of riparian vegetation										
Stormwater controls									5	
Channelization/stream alteration								1		
Bank hardening								2		
Restoration								3		7
Climate change										
General/Have regard to statement		Regulated/Existing targets				No applicable policies				

¹ would be considered in some cases, but generally discouraged

² not a policy directly addressing bank hardening, but follows from policies regarding stream alteration

³ required for valleyland applications, may be required in other cases (case-by-case basis)

⁴ within ORM planning area

⁵ specific policies within ORM planning area, otherwise this is a 'have regard to'

⁶ within Major Open Space Areas and Greenbelt Natural Heritage System

⁷ required in some instances, otherwise it is encouraged

In this section we provide a summary of legislation as it pertains to activities affecting stream geomorphology habitat. This summary is to give context to *future management considerations* and the *opportunities and recommendations to improve water quality* discussed in the following two sections. This summary is not intended to be comprehensive in terms of all the acts related to aquatic habitat, or the policies within these acts – the reader is directed to each piece of legislation for a full assessment of the legislation as it relates to stream geomorphology.

7.4.1 Oak Ridges Moraine Conservation Plan (2002)

This plan designates Natural Core and Natural Linkage Areas for the purpose of maintaining and improving the ecological integrity of the plan area. Approximately 3,900 ha (or 17%) of the subwatershed is designated ORMCP Natural Core and Linkage areas. The policies that apply in the Natural Core and Linkage Areas include:

- Development and site alteration are prohibited if they would cause the impervious area of the subwatershed, outside of designated settlement areas, to exceed 10%.

- A minimum area of influence and minimum vegetation protection zone around key natural heritage features (such as wetlands or fish habitat) and hydrologically sensitive features (such as a stream), which are 30 metres and 120 metres, respectively. An application for development or site alteration within the minimum area of influence that relates to a key natural heritage feature, but is outside of that feature and the minimum vegetation protection zone, are to be accompanied by a natural heritage and/or hydrological evaluation. These evaluations are required to:
 - Demonstrate that the development or site alteration will have no adverse effects on the feature or the related functions
 - Identify planning, design and construction practices that will maintain and, where possible, improve or restore the health, diversity and size of the feature and its connectivity with other key natural heritage features
 - Determine if the dimensions of the minimum vegetation protection zone as specified in the ORMCP are sufficient, and specify the dimensions necessary to provide for the maintenance and, where possible, improvement or restoration of natural self-sustaining vegetation within it

The ORMCP requires applications for major development to demonstrate how the removal of vegetation will be kept to a minimum, which will help to promote infiltration; and also to minimize the amount of impervious area on the site.

The ORMCP also details a number of requirements for those uses that are permitted within Natural Core and Linkage Areas, such as gravel pits, agricultural uses, and low-intensity recreational uses to ensure that they have minimal impact on these important areas.

7.4.2 The Greenbelt Plan (2005)

Among the goals stated for the Environmental Protection area of the Greenbelt is the protection, maintenance and enhancement of natural heritage, hydrologic and landform features and functions. Although this does not state the protection of the stability of watercourses, that will be one of the outcomes of achieving this goal. Applications for development under Greenbelt Plan Policies are required to demonstrate that:

- There will be no negative effects on key natural heritage or hydrologic features
- Connectivity is maintained or enhanced wherever possible
- Removal of other natural features...should be avoided
- The disturbed area of any site does not exceed 25% and the impervious surface does not exceed 10% of the total developable area

Though these policies do not apply in the Greenbelt's identified Settlement Areas, they will help to limit impacts outside of settlement areas.

The Greenbelt Plan also limits development and site alteration within key natural heritage features and key hydrologic features, and identifies a minimum vegetative protection zone around them to afford further protection.

The Plan also encourages municipalities to support planning approaches that establish or increase the extent of vegetation protection zones in natural, self sustaining vegetation; increase or improve fish habitat; and avoid or minimize the impacts associated with urban runoff.

7.4.3 Lake Simcoe Protection Plan (2009)

The implementation of a number of the policies in the Lake Simcoe Protection Plan will benefit conditions in the subwatershed with respect to fluvial geomorphology.

The Stormwater Management policies will likely have the greatest benefit. Among these that relate to fluvial geomorphology are:

- Municipalities are to prepare and implement comprehensive stormwater management master plans for each settlement area. These are to include:
 - An evaluation of the cumulative environmental impact of stormwater from existing and planned development
 - A determination of the effectiveness of existing stormwater management works at reducing the negative impacts of stormwater on the environment
 - An examination of stormwater retrofit opportunities
- Municipalities are to incorporate into their official plans policies related to reducing stormwater runoff volume, including:
 - Encouraging the implementation of a hierarchy of source, lot-level conveyance and end-of-pipe controls
 - Encouraging the implementation of innovative stormwater management measures
 - Allowing for flexibility in development standards to incorporate alternative community design and stormwater techniques
 - Support implementation of source control programs, which are targeted to exiting areas that lack adequate stormwater controls
- Stormwater management works that are established to serve new major development shall not be permitted unless the works have been designed to satisfy the *Enhanced Protection Level* specified by MOE
- Owners of stormwater control structures are required to inspect and maintain the works to ensure they are functioning properly

The LSPP also contains policies around water conservation and efficiency. This includes requiring municipalities to identify and evaluate methods for promoting water conservation such as water reuse and recycling, which will reduce the volume and velocity of stormwater runoff.

There are also policies which place limitations and restrictions around placing structures and altering the shore of watercourses within the Lake Simcoe watershed. Where works are allowed, the proposal must enhance ecological features; and minimize erosion, sedimentation, and the introduction of excessive nutrients or other pollutants and utilize planning and design practices that maintain and improve water quality.

The MNR and LSRCA are required to delineate priority areas for riparian area restoration. The implementation of these restoration works will help to provide stability to the Black River's watercourses.

7.4.4 Places to Grow – Growth Plan for the Greater Golden Horseshoe (2006)

While the Growth Plan does not deal directly with issues of fluvial geomorphology, there are policies within it that, when implemented, will help to prevent these issues. Most notable among these:

- Municipalities are encouraged to implement and support innovative stormwater management actions as part of their redevelopment and intensification activities.
- The identification of natural systems for the Greater Golden Horseshoe and the potential development of additional policies for their protection. The protection of these natural systems and their associated functions will help to mitigate storm flows and maintain stable watercourses.
- Water conservation measures, including water recycling, are encouraged. The widespread adoption of these practices will reduce the volume of stormwater flowing to watercourses, helping to prevent issues such as instability and erosion.

7.4.5 Provincial Policy Statement (2005)

By encouraging development patterns that protect resources and the quality of the natural environment, such as directing growth within settlement areas and away from significant or sensitive resources, the policies of the PPS can help to protect the stability of the subwatershed's watercourses. Relevant policies include:

Settlement areas are to be the focus of growth.

- Natural heritage features and areas shall be protected for the long term
- The diversity and connectivity of natural features in an area, and the long term ecological function and biodiversity of natural heritage systems should be maintained, restored or, where possible, improved, recognizing the linkages between and among natural heritage features and areas, surface water features and groundwater features.
- Restrictions on development in features such as natural heritage features such as significant woodlands and valleylands, significant wildlife habitat, and fish habitat, or lands adjacent to these features.
- Planning authorities are to protect, improve, or restore the quality and quantity of water by (not all listed):
 - Implementing necessary restrictions on development to protect, improve or restore vulnerable surface and groundwater features, sensitive surface water features and their hydrological functions
 - Maintaining linkages and relative functions among surface water features, groundwater features, hydrologic functions, and natural heritage features and areas
 - Ensuring stormwater management practices minimize stormwater volumes...and maintain or increase the extent of pervious surfaces
- Development shall generally be directed away from hazardous land adjacent to river, stream and small inland lake systems which are impacted by flooding and/or erosion hazards.

7.4.6 Ontario Water Resources Act (1990)

The Ontario Water Resources Act deals with the approval of stormwater management works under Section 53. Under this Act, the MOE reviews applications for stormwater works, and provides a Certificate of Approval if the application and associated studies are deemed to be sufficient.

7.4.7 Fisheries Act

The *Fisheries Act* is federal legislation that deals with the management of Canada's fisheries resources and the conservation and protection of fish and fish habitat. Section 35 of the *Act* states that no one may carry on any work or undertaking that results in the harmful alteration, disruption or destruction (known as a HADD) of fish habitat, unless authorized to do so by the Minister of Fisheries and Oceans Canada. It is among the oldest and strongest environmental legislation in the country. The enforcement of this *Act* limits the work that can be done in and around a watercourse, including channelizing and hardening activities, relocation of stream channels, and the creation of barriers, thus ensuring that habitat quality is protected and that aquatic systems do not become fragmented.

Through an agreement with the Department of Fisheries and Oceans (DFO), the LSRCA administers the *Fisheries Act* through its permitting process. LSRCA staff, acting on behalf of DFO, review applications for proposed works occurring in and around water and provide guidance and ensure that the works adhere to the requirements of the *Act*. Where in-water works are permitted, LSRCA staff work closely with the proponent to ensure that there is no loss of fish habitat due to the works, and that the works have minimal impact during the time that the site is disturbed.

7.4.8 LSRCA Watershed Development Policies

The Authority requires an undisturbed vegetative buffer strip running consistently along both sides of all watercourses. The buffer is to be measured perpendicularly outwards from the edge of the annual average high water mark as follows: a) a minimum 15 metre buffer for all watercourses, b) a minimum 30 metre buffer for all coldwater or marginally coldwater (coolwater) watercourses. Where watercourses have not been studied as to thermal regimes or fish population, the 30 metre buffer will be required. Note that this policy has largely been superseded by LSPP which requires a minimum 30m vegetative protective zone for all key natural heritage and hydrological features (see below).

These required buffers will help to maintain the integrity of streambanks, thus protecting their form and function.

7.4.9 York Region Official Plan (2009)

The implementation of a number of the policies in this plan will help to ensure the stability of streams within York Region. These include:

- Numerous policies around the protection and enhancement of the features and functions of the Regional Greenlands System will help to maintain the stability of the watercourses in the subwatershed by enhancing infiltration, thus reducing the velocity and volume of overland flows, and by providing stability to streambanks
- Provisions providing for the protection of significant woodlands and wetlands identified in the OP
- Maintaining the natural quality and hydrological characteristics of watercourses and lakes...and that development will be designed with the goal of maintaining water balance
- Maintaining linkages and related functions among surface water features, groundwater features, hydrologic function, and natural heritage features
- Requiring the preparation of comprehensive Master Environmental Servicing Plans as a component of secondary plans and major development and redevelopment to minimize

stormwater volume and contaminant loads, and maximize infiltration through an integrated treatment approach

- Requiring owners and operators of stormwater management works to inspect, maintain, and monitor effluent quality on a periodic basis
- Requiring that development have an integrated and innovative approach to water management, be water efficient, and minimize stormwater and contaminant loads and maximize infiltration through an integrated treatment approach

7.4.10 Durham Region Official Plan (2008)

With respect to policies that will contribute to the stability of watercourses, the Durham Region Official Plan:

- Stipulates a minimum 30 metre vegetation protection zone around key natural heritage and hydrologic features such as streams, wetlands and significant woodlands – development and site alteration are not permitted in these areas, with the exception of activities such as fish and wildlife management, flood management activities, infrastructure and some agricultural uses. The OP also requires an environmental impact study for proposed development and site alteration within 120 metres of any other key natural heritage or hydrologic feature to determine the appropriate minimum vegetation protection zone in addition to the prescribed 30 metres.
- Requiring that lakes and streams and their adjoining lands be retained in or rehabilitated to a natural state, that fish and wildlife habitat be protected, and that alterations to natural drainage systems and sediments entering a watercourse are minimized
- Provides protection to woodlands and wetlands to provide environmental, recreational, and economic benefits to the Region
- Discourages alterations to watercourses
- Ensures that stormwater management plans are prepared by area municipalities where appropriate
- Promotes groundwater infiltration through improved stormwater management design

7.5 Management gaps and limitations

As can be seen in the above section, there are a number of pieces of legislation, regulations and municipal requirements aimed at maintaining stream stability in the Black River. Despite this strong foundation, there are a number of gaps and limitations in the management framework that need to be considered, such as the effects of climate change. This section provides an overview of factors that need to be considered in the future management of the subwatershed.

7.5.1 Growth, Development and Site Alteration

These activities are strongly regulated in areas such as key natural heritage features, key hydrologic features, and shorelines through the ORMCP, Greenbelt Plan, Lake Simcoe Protection Plan, York and Durham Region's Official Plans, and LSRCA Watershed Development Policies. The protection and potential enhancement of these features will help to prevent the damaging flows that lead to instability in the system. There are, however, limitations with these policies:

- For many natural heritage features (other than wetlands) it is only those considered significant that are protected, and in general only those considered provincially significant are protected. Although they are not considered to be significant, these features still perform important functions in the watershed, and the development of these areas and loss of these functions will have impacts to watershed health. Wetlands are now well protected through the Generic Regulation (179/06);
- The policies that apply to hydrologic features are not consistent across the subwatershed – the definition of a key hydrologic feature is different for the ORMCP area, the Greenbelt Plan area, and the LSPP area which covers the remainder of the subwatershed. Features such as seepage areas, springs, aquifers and recharge areas are protected in the ORMCP area, but not the LSPP area, and the Greenbelt Plan includes seepage areas and springs but not aquifers and recharge areas. These discrepancies can leave some of these features unprotected.
- Some plans specify a minimum vegetation protection zone around key natural heritage and key hydrologic features (e.g. the ORMCP and Greenbelt Plan), and also identify a further ‘area of influence’ (as it is referred to in the ORMCP) outside of the minimum vegetation protection zone. Within this area of influence, a proposal for development or site alteration triggers the requirement for a natural heritage and/or hydrologic evaluation. This evaluation is meant to describe the existing conditions, assess the potential impacts from proposed development/site alteration and determine if the minimum vegetation protection zone provides sufficient protection. If the minimum vegetation protection zone is not found to be sufficient, the evaluation should specify the dimensions of the required minimum vegetation protection zone. While the goal of these policies is undoubtedly to protect the features, in reality the required evaluations rarely specify anything greater than the minimum; in essence the minimum becomes the maximum distance. There is therefore little further protection gained through this process for these features and their functions by way of a buffer distance.

7.5.2 Impervious Surfaces

The ORMCP, Greenbelt Plan and Regional Official Plans contain policies around that aim to limit impervious area to a certain level, while the PPS, LSPP and LSRCA Watershed Development Policies contain more general statements about striving to limit impervious area. Since all new developments – and hence new impervious areas – are required to have Level 1 stormwater control that will collect and mitigate flows, storm flows from these areas should not have a significant impact on stream stability. Issues from overland storm flows mainly stem from the existing, uncontrolled, urban areas. However, increases in impervious area affect baseflow, which can also have impacts on stream form, so it is therefore still important to limit impervious areas to the extent feasible. The policies around limiting impervious surfaces are limited in scope, and there are gaps in the geographic area covered. The gaps and limitations with these policies include:

- The ORMCP and Greenbelt Plan do set a limit of 10 per cent, but these limits apply only outside of Settlement Areas in the ORMCP, and only in the Natural Heritage System of the Greenbelt. Thus there is no defined limit areas within the ORMCP and Greenbelt Plan areas not covered by these policies, as well as areas outside of the ORMCP and Greenbelt boundaries, and the subwatershed’s impervious area could easily exceed 10 per cent
- York Region’s policies around impervious surfaces only apply in the ORMCP area, while Durham’s applies only in its Major Open Space Areas

- There is no agency ensuring that subwatershed impervious areas do not exceed the defined limit
- Approval agencies should be striving for either a reduction in impervious areas on development sites or the mandatory use of practices that increase infiltration in order to reduce the impacts of impervious area within the subwatershed

7.5.3 Removal of Riparian Vegetation

With the release of the Lake Simcoe Protection Plan, which builds upon the protection already existing through the ORMCP and Greenbelt Plans, development within 30 metres of a permanent or intermittent stream is not permitted anywhere in the Lake Simcoe watershed, with the exception of a few activities, most of which would have little impact. However, infrastructure is one of the permitted activities, if the need for the project has been demonstrated and there are no viable alternatives. The undertaking of an infrastructure project could result in a significant loss of riparian area.

7.5.4 Stormwater Controls

The ORMCP, PPS, Greenbelt Plan, Growth Plan, LSPP, Official Plans, and LSRCA Development Policies all contain some form of policy recommendation around requirements for stormwater management. Although some of these are 'have regard for' statements, there is policy support to require that all applications for development within the Lake Simcoe watershed are required to have Enhanced Level 1 stormwater control or better. The LSPP has gone a step further and contains several policies around reducing the impacts of stormwater. These are highlighted in the above section. While these policies are essential for reducing further damaging impacts of stormwater on stream form, there are some limitations:

- There are no required timelines for the implementation of the recommendations of stormwater master plans required through the LSPP
- There is no mention of funding support for the implementation of such activities as stormwater retrofits in the LSPP
- While municipalities are required to incorporate policies around stormwater including encouraging a hierarchy of treatment, the implementation of innovative stormwater management measures, allowing for flexibility in development standards around alternative community design and stormwater techniques, this does not necessarily mean that developers will adopt these standards. Municipalities should *require* some or all of these practices rather than encouraging their use in order to create a level playing field for all developers undertaking works in the watershed, otherwise there is little incentive to change standard practices.

7.5.5 Channelization/Stream Alteration/Bank Hardening

As these activities would be considered to be a harmful alteration, disruption or destruction of fish habitat, they would be strictly regulated under the Fisheries Act. They would also be regulated under the policies of the ORMCP, Greenbelt Plan, and LSPP.

7.5.6 Restoration

Most of the policies related to restoration are quite general in nature, and do not contain specific requirements. Some require applications for development or site alteration in key hydrologic features or key natural heritage features to be accompanied by a natural heritage or hydrologic evaluation, which in some cases requires the applicant to include planning, design or

construction practices that will maintain and, where feasible, improve or restore the health, size, and diversity of the feature.

7.5.7 Climate Change

Climate change is generally not well addressed in the current management framework. The LSPP contains the most comprehensive policies related to this issue which, although it is still difficult to predict its impacts, some of the predicted changes, such as intense storm events, may exacerbate issues of channel stability in this subwatershed. The adaptation strategy that will be developed through the LSPP is a significant first step in addressing this issue, and some of the Official Plan policies are beginning to consider climate change as well. While it may not be appropriate for some of the existing legislation to address climate change issues, it will be important to incorporate climate change considerations wherever possible in making management decisions for the subwatershed, and implement policies requiring, at the very least, the implementation of so called “no regrets” options should be incorporated into development and site alteration wherever possible.

7.6 Recommended Actions to Improve Fluvial Geomorphology

The following recommended actions were developed to improve fluvial geomorphology in the Black River subwatershed. There are a number of reaches within the subwatershed experiencing issues with respect to fluvial geomorphology. These issues include channelization, the absence of riparian vegetation, bank hardening, streambank erosion, channel downcutting, and aggradation. Much of this condition can be attributed to urban and agricultural land uses. The increasing impervious area in urban catchments contributes significantly to streambank erosion due to increasing peak flows. These channels are often straightened and/or hardened in an attempt to mitigate these issues, which can cause problems in other areas. In an agricultural setting, riparian vegetation is often removed, resulting in bank instability and erosion, cattle in some areas are allowed to access stream channels, and the erosion of sediment from fields can cause an imbalance in the watercourse. The implementation of the actions below will help to mitigate the impacts of the growth that is scheduled for this subwatershed, as well as that of the existing urban and rural land uses, on the stability of watercourses in this subwatershed.

These recommendations, which are grouped and numbered as described in Section 1.4, were developed to address the water quality issues and stressors that were identified throughout this chapter. In addition, they consider, and are consistent with applicable policies and recommendations in the province’s Lake Simcoe Protection Plan, and the LSRCA’s Integrated Watershed Management Plan. Each recommendation below also identifies the applicable ‘detailed recommendations’ as outlined in Chapter 10. These detailed actions will form the basis of the Implementation Plan for York Region’s ORM subwatersheds, to be developed following the completion of this plan.

7.6.1 Planning and Policy

- 1) That the municipal partners and the LSRCA strive to reduce the impacts of stormwater through a number of methods including the implementation of policies and guidelines and enabling the use of new and innovative technologies, retrofitting of existing developments.

Detailed recommendations: A.1.1 – A.1.3

- 4) That the municipal partners and the LSRCA strive to maintain natural hydrologic conditions on development sites

Detailed recommendations: A.3.1 – A.3.2

- 5) That the federal, provincial, and municipal governments, as well as the LSRCA, continue to evaluate and implement planning initiatives and practices aimed at reducing the impact of development on the condition of the Black subwatershed

Detailed recommendations: A.3.3 – A.3.5, A.3.7

- 6) That the value of the ecological goods and services (EGS) provided by ecological features be considered in decision making around growth and development

Detailed recommendation: A.3.6

- 7) That the rural/agricultural community be engaged in developing solutions for minimizing the impacts of practices on their lands

Detailed recommendation: A.4.1

- 11) That the Province, the municipal partners, and the LSRCA seek to gain an improved understanding of the impacts of climate change in the Black subwatershed, incorporating this information into decision making scenarios and developing strategies to mitigate and adapt to its impacts.

Detailed recommendations: A.6.1 – A.6.2

7.6.2 Use of Better Management Practices

- 12) That the LSRCA and its municipal partners continue working to mitigate the impacts of stormwater to water quality and quantity through tracking its sources, completing stormwater retrofits, promoting methods of minimizing stormwater volume, and continuing to research new and innovative solutions to stormwater control and implementing these solutions where appropriate.

Detailed recommendations: B.1.1 – B.1.5

- 13) That support for programs offered to assist rural landowners in implementing BMPs on their properties, such as LSRCA's LEAP program, be continued and/or expanded as resources permit

Detailed recommendations: B.2.1 – B.2.3

- 14) That sectors that have the potential to have significant impacts on conditions in the Black subwatershed be expected to undertake BMPs and other activities to mitigate their impacts, as required under the LSPP

Detailed recommendations: B.2.4 – B.2.5

- 15) That the LSRCA and the partner municipalities encourage the use of natural channel designs and 'soft solutions' wherever possible for preventing or mitigating streambank erosion and accommodating channel realignments; and that technical and financial resources be made available for retrofitting where appropriate to undertake these activities.

Detailed recommendations: B.3.1 – B.3.4

- 16) That the LSRCA assist partner municipalities in reducing the risk of flooding in the Black subwatershed

Detailed recommendations: B.3.3 – B.3.4

7.6.3 Changing the way things are done ‘on the ground’

- 18) That the LSRCA and its partner municipalities strive to maximize the infiltration of stormwater where appropriate through development approvals and the use of practices and technologies

Detailed recommendations: C.1.1, C.2.1 – C.2.2

7.6.4 Monitoring

- 32) That the LSRCA assess the impacts of land use change on fluvial geomorphology in the subwatershed.

Detailed recommendation: E.3.2

7.6.5 Management, Rehabilitation and Restoration

- 37) That that LSRCA, in cooperation with its partner municipalities, prioritize and undertake activities to improve and restore aquatic ecological functions within the subwatershed, including barrier removal, natural channel design, restoring floodplain functions, and wetland creation. This could include undertaking pilot/demonstration projects to assess the feasibility of such works.

Detailed recommendations: F.1.8 – F.1.13

- 38) That the LSRCA continue to utilize buffer requirements and timing guidelines as tools to protect aquatic resources, and that other activities such as stormwater retrofits, tree planting, and habitat enhancement be undertaken to enhance aquatic habitat

Detailed recommendation: F.1.14

- 39) That the LSRCA and the partner municipalities assess the feasibility of increasing natural cover (e.g. woodland, streambank vegetation, interior forest, grassland) in the subwatershed and set priorities and develop plans to undertake this enhancement, based on overall benefit to the subwatershed.

Detailed recommendations: A.5.3, F.2.1 – F.2.3

- 47) That the LSRCA, the partner municipalities, and developers work to identify opportunities for undertaking restoration works on development sites, and incorporate these into proposals, where appropriate

Detailed recommendation: F.4.5

7.6.6 Adaptive Response

- 48) That the LSRCA and partner municipalities work to reduce their carbon footprint and to increase ecological resilience in the watershed

Detailed recommendations: G.1.1 – G.1.3

- 51) That the LSRCA and its partners work to ensure that flood mapping is up to date; that the data needed for assessing flood risk is sufficient and that new monitoring equipment is added to the monitoring network as required; and that there be available programs to assist landowners in flood proofing their homes.

Detailed recommendations: G.2.5 – G.2.6

8 Terrestrial Natural Heritage System

8.1 Introduction

Terrestrial natural heritage features are extremely important components of subwatershed health, as they not only provide habitat for many of the species residing in the subwatershed, but also influence subwatershed hydrology. They are among the most important parts of the ecosystem, and are the most likely to be directly impacted by human activities.

A terrestrial natural heritage system is composed of natural cover (features), natural processes (functions), and the linkages between them. The matrix of agricultural, rural, urban, and natural areas within the Black River subwatershed's terrestrial system interacts with other hydrological and human systems, and serves as habitat for flora and fauna throughout the subwatershed. The system includes not only large tracts of natural features, but also the small features that can be found within urban and agricultural areas. Measuring the quantity, quality and distribution of natural heritage features within the subwatershed can tell us a great deal about its health. Figure 8-1 details the distribution of natural features in the subwatershed. This chapter describes the natural heritage features of the Black River subwatershed, detailing the current conditions; and also describes the Natural Heritage System (NHS) that has been developed by the LSRCA and Beacon Environmental to protect the integrity of the natural heritage features throughout the Lake Simcoe watershed. The NHS is discussed in detail in Section 8.4.7.

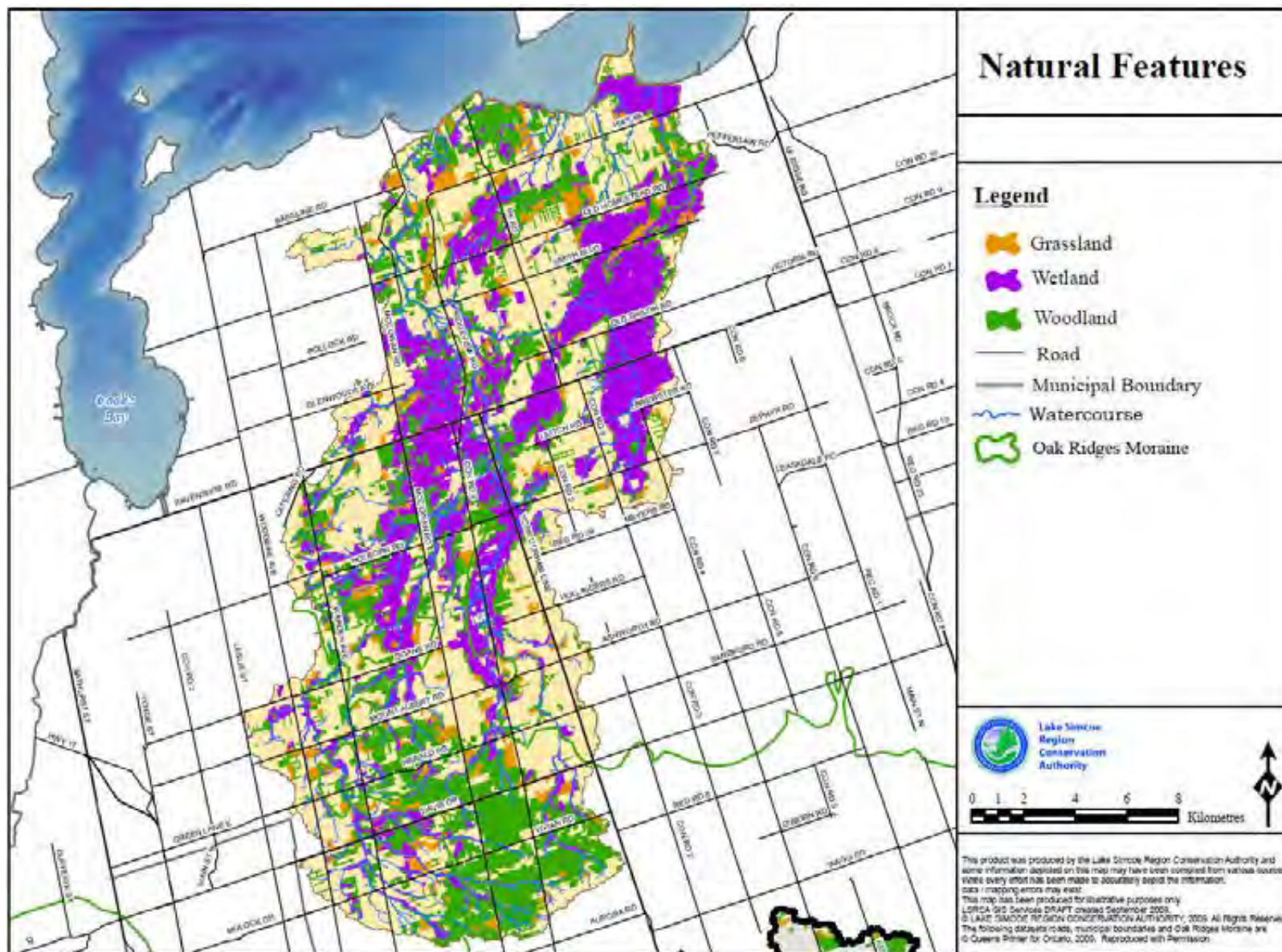


Figure 8-1 Natural features of the Black River subwatershed

8.2 Current Status

The natural heritage contribution to watershed health can be described using the Provincial Policy Statement components of the natural environment. Those related to terrestrial natural heritage are Habitat for Species at Risk, Wetlands, Woodlands, Valleylands, Wildlife Habitat, Areas of Natural and Scientific Interest, and Linkages. Also included is a discussion on imperviousness.

The following paragraphs provide a summary of each of these components.

8.2.1 Species at Risk

Information regarding Species at Risk housed with the Ministry of Natural Resources' (MNR) Natural Heritage Information Centre (NHIC). Two species on the NHIC "Species at Risk" list have been identified within the Black River subwatershed within the last 20 years—a turtle and a tree (Table 8-1).

<u>Species at Risk – MNR Status</u>	
Extirpated	- a native species that no longer exists in the wild in Ontario, but still exists elsewhere
Endangered	- a native species facing extinction or extirpation
Threatened	- a native species at risk of becoming endangered in Ontario
Special Concern	- a native species that is sensitive to human activities or natural events which may cause it to become endangered or threatened

Table 8-1 NHIC Endangered and Threatened Element Occurrences for the Black River subwatershed

Common Name	Species	MNR Status	Occurrences in the Lake Simcoe Watershed	Occurrences in the BRS	Habitat
Blanding's Turtle	<i>Emys blandingii</i>	THR	2	1	Wetlands
Butternut	<i>Juglans cinerea</i>	END-NR	1	1	Hardwood forest

Despite only a single occurrence of Butternut, it is known that this species occurs throughout the Black River subwatershed. Despite the large areas of natural features, the Black River subwatershed has relatively few reported occurrences of Species at Risk. This is likely due to the fact that many wetland evaluations were undertaken more than 20 years ago, which is outside of the cut off for 'current' records.

A majority of the reported occurrences of Species at Risk are from areas that have been studied, such as through wetland evaluations or Areas of Natural and Scientific Interest studies. It is likely that more occurrences will be forthcoming when increased efforts are made to document the natural history elements of the area.

The Planning Act protects these species and their habitats when they are found in an area that is proposed for land use change. Furthermore, the new provincial Endangered Species Act

(also known as the Species at Risk Act in Ontario or SARO) extends protection for these species (the Act came into force in June 2008).

8.2.2 Wetlands

Many of Ontario’s fish, fauna, and flora species use wetlands during all or part of their life cycles. A high proportion of designated “Species at Risk” are wetland-associated species. This is not surprising given that wetland loss within the Great Lakes basin is estimated at 68% south of the pre-Cambrian shield (Snell, 1987 as cited in Detenbeck *et al.*, 1999). Wildlife functions include critical fish nursery and spawning areas, habitat for relatively specialized species, habitat for a wide range of attributes such as area-sensitive forest breeding birds, winter deer yards, and amphibian breeding pools.

Today, there are approximately 8,970 ha of wetlands in the Black River subwatershed, which is approximately 24% of the landscape. Of these, a relatively high proportion (approximately 41%) have not been evaluated using the Ontario Wetland Evaluation System (Table 8-2).

What is a Provincially Significant Wetland?

The Ontario Wetland Evaluation System was developed by the Ontario Ministry of Natural Resources (1993). It was implemented in a response to an increasing concern for the need to conserve wetland habitats in Ontario. The wetland evaluation system aims to evaluate the value or importance of a wetland based on a scoring system where four principal components each worth 250 points make a total of 1000 possible points.

The four principal components that are considered in a wetland evaluation are the biological, social, hydrological, and special features. Based on scoring a wetland can fall into one of two classes, Provincially Significant or Locally Significant. It takes 600 total points or full points (200) in any one component for a wetland to be classed as Provincially Significant. The Province of Ontario, under the Provincial Policy Statement (PPS) protects wetlands that rank as Provincially Significant. The PPS states that “*Development and site alteration shall not be permitted in significant wetlands.*”

Table 8-2 Wetlands in the Black River subwatershed

Status	Area (ha)	Percentage of BRS
Provincially Significant Wetlands (PSWs)	5,265	14.0
Evaluated Non-Provincially Significant Wetlands	0.6	<1%
Additional wetlands identified using ELC	3,708	9.9
Total	8,974	23.9

The majority of wetlands within the Black River subwatershed are swamps (wetlands with trees and/or shrubs). The distribution of wetlands by wetland type is provided in Table 8-3.

Table 8-3 Wetland type distribution in the Black River subwatershed

Wetland Type	Area (ha)	Percentage of Wetlands	Characteristics (source: Environment Canada)
Bog	0.8	<1%	A type of wetland that accumulates appreciable peat deposits. It depends primarily on precipitation for its water source and is usually acidic and rich in plant matter, with a conspicuous mat or living green moss.
Fen	12.4	<1%	A high water table with slow internal drainage. Fens are not as low in nutrients as bogs and as a result are more productive. Although fens are dominated by sedges they may also contain shrubs and trees.
Marsh	701.4	7.8%	Periodically or permanently covered by standing or slowly moving water. Marshes are rich in nutrients and are characterized by an emergent vegetation of reeds, rushes, cattails and sedges.
Swamp	8,084.2	90.1%	Swamps are dominated by shrubs or trees. They may be flooded seasonally or for long periods of time. Swamps are both nutrient rich and productive.
*Other	175.4	2.0%	*These are wetlands that have been identified through interpretation of aerial photography, but have not been interpreted to the community level.

The Black River subwatershed has a relatively high proportion of the Lake Simcoe watershed's swamp (20.6%), owing largely to the wooded valley wetlands. Of note is that it contains some rare fen communities as well as the more scarce bog communities.

According to the various sources cited in the Areas of Concern (AOC) Guidelines developed by Environment Canada (Environment Canada, 2004), a subwatershed with over 10% wetland cover is in relatively fair shape from a hydrological and biological perspective although there are other factors, such as distribution of wetlands within the subwatershed, which are also important. However, the 10% target must also be tempered with the historical cover of wetlands. This subwatershed is in relatively good shape with 23% of wetlands still present, one of the healthiest levels in the Lake Simcoe watershed. Wetlands presently in the Black River subwatershed are important contributors to the health of the subwatershed and the health of Lake Simcoe itself.

Of the wetlands within the Black River subwatershed, approximately 50% are concentrated in two general areas, the Zephyr-Egypt Provincially Significant Wetland (PSW) Complex and the Black River PSW Complex #1. These areas make up approximately 80% of the PSWs in the Black River subwatershed and are large areas of swamp located south of Baldwin and Egypt, running southward to Mount Albert and Zephyr.

There are also areas with wetland concentrations such as the Franklin Pond Wetland, Vivian Bog, Mount Albert Wetland and the Black River Wetlands # 2 through # 4, which are on the Oak Ridges Moraine. Notable is the lack of wetlands in the headwater areas on and adjacent to the Oak Ridges Moraine, as well as in north Georgina.

8.2.3 Woodlands

Prior to European settlement the dominant land cover type of Southern Ontario was woodland. Estimates of total cover were in the 80% range. In 1978, woodland cover in York Region was estimated at 18.5% (Larson *et al.*, 1999). The current distribution of woodlands in the Black River subwatershed is depicted in Figure 8-1.

Woodland Composition

Woodlands include all treed communities, whether upland or wetland. The ELC communities that were considered to represent woodlands are forest, swamp, plantation, and cultural woodland. The breakdown of these types is shown in Table 8-4. Some woodlands that were counted as wetlands in the previous section may also be counted as woodlands (e.g., wooded swamps) as the two terms are not mutually exclusive.

Woodlands of all types combined comprise approximately 14,200 ha, or 37.8%, of the total area of the Black River subwatershed. Of this area, approximately 2,100 ha (i.e., 15% of woodland cover) could be considered to be of lower ecological quality. These woodlands are plantations (which are standing crops) or are cultural woodlands (which are woodlands that have broken canopies). While these areas may not be as beneficial ecologically, they still have high intrinsic value as they are part of a functioning landscape. They also present opportunities for future restoration projects.

Deciduous and mixed forest accounts for almost half of the all the woodland cover while just over one-third is swamp forest. A relatively small amount (just over 10%) is plantation, although it accounts for just over a quarter of the Lake Simcoe watershed's plantation. The Black River subwatershed contains approximately 20% of the Lake Simcoe watershed's total woodland cover.

Table 8-4 Woodland cover by type

Woodland Type	Woodland Cover			
	Area in Sub'shed (ha)	Cover within Subwatershed (%)	Cover By Woodland Type (%)	Percentage of Woodland Type of the Lake Simcoe Watershed
Cultural Plantation (CUP)	1,548	4.1	10.9	29.4
Cultural Woodland (CUW)*	550	1.5	3.9	13.8
Conifer Forest (FOC)	632	1.7	4.5	14.4
Deciduous Forest (FOD)	2,866	8	20.2	16.9
Mixed Forest (FOM)	2,351	6.3	16.6	17.7
Conifer Swamp (SWC)	732	1.9	5.2	20
Deciduous Swamp (SWD)	3,172	8.4	22.3	24.8
Mixed Swamp (SWM)	2,349	6.3	16.5	22.4
Total	14,198	38.2		20.0

**This category includes substantial hedgerows that are continuous with other natural features (ca. 122 ha).*

Woodlands have many important functions

The *Natural Heritage Reference Manual* (OMNR, 1999) lists a variety of important functions associated with woodlands and Larson *et al.* (1999) summarize the importance of woodlots. These important functions can generally be described as follows:

Economic Services and Values

Oxygen production, carbon sequestration, climate moderation, water quality and quantity improvements, woodland products, economic activity associated with cultural values;

Cultural/Social Values

Education, recreation, tourism, research, spiritual and aesthetic worth; and

Ecological Values

Diversity of species, structural heterogeneity, energy (photosynthesis), nutrient and energy cycling.

Structural diversity of habitat is a key driver of biodiversity. In woodlands, habitat niches can range from microhabitats such as the surfaces of fissured trunks, leaves and rotting logs to macrohabitat features such as the horizontal layers within the woodland (e.g., supercanopy, canopy, subcanopy). In addition, woodlands are present in a wide variety of topographic settings and soil and moisture regimes. These can range from talus slopes to heavy clay soils; from saturated organics to very dry sandy soils. For all of these reasons it is not surprising that many woodland species are obligates (i.e., they are only found in woodlands), or that woodlands provide habitat for a wide range of flora and fauna. They form important building blocks of the natural heritage system.

In an overview of the science regarding the function of woodlands the LSRCA NHS document discusses in detail factors relating to fragmentation (the splitting of larger woodlands into ever smaller pieces), patch size (the requirement of woodland pieces to be of a certain area for the maintenance of some functions), woodland quality (such as shape, interior habitat, age, composition, structure and the presence of invasive species), and total woodland cover (i.e., the woodland area within a jurisdiction or watershed).

Of these factors there is increasing scientific evidence that the total woodland cover of a landscape may exert the most important influence on biodiversity. Obviously the loss of woodland cover results in a direct loss of habitat of that type. This reduction in habitat can result in proportionally smaller population sizes, and animals in habitat remnants may experience altered dispersal rates, decreased rates of survival, decreased productivity, altered foraging behaviours and decreased mating opportunities (Brooker and Brooker, 2002). Research that has examined the independent effects of habitat loss *versus* habitat fragmentation suggests that habitat loss has a greater effect than habitat fragmentation on the distribution and abundance of birds (Fahrig, 2002) and there is now substantive evidence that total woodland cover is a critical metric (e.g., Austen *et al.* 2001; Golet 2001; Fahrig 2002; Lindenmayer *et al.* 2002; Trzcinski *et al.* 1999; Friesen *et al.* 1998, 1999; Rosenburg *et al.* 1999; Radford *et al.* 2005).

Woodland Patch Size Analysis

A woodland patch is defined as the total area of a contiguous patch of wooded habitat as mapped by the LSRCA natural heritage and land use mapping project. This analysis does not incorporate other parameters of “quality” that can generally only be established with detailed field work.

Contiguous woodland areas have been calculated and the distribution of woodland patch sizes is displayed in the graph below. While the total area of woodland represents the amount of forest completely within the subwatershed, the number of patches includes any patches touching the subwatershed rather than those that are entirely within the subwatershed. This methodology was used because it is important to properly capture the number of large forest patches and if only patch sizes within the subwatershed boundaries were considered, the number of large patches would be underestimated.

This analysis does not in any way incorporate the benefits of adjacent or nearby natural areas, nor does it discount woodland patches that have exurban development envelopes within them. The results of this analysis are provided in Figure 8-2.

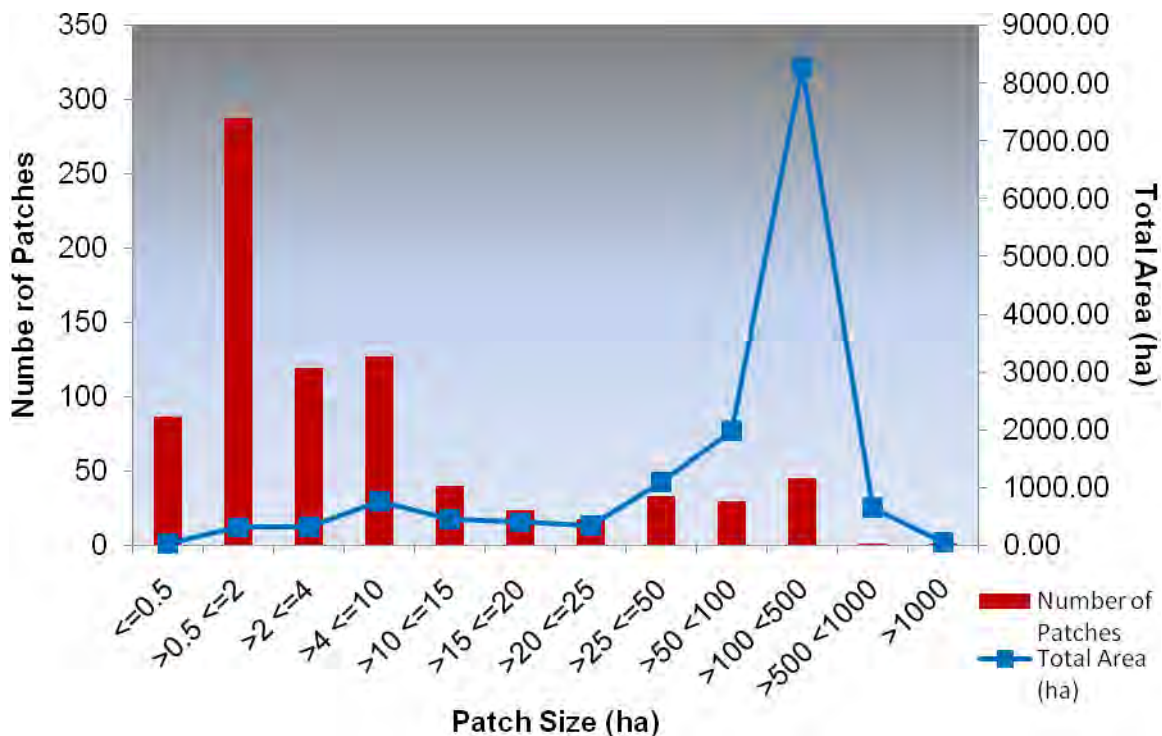


Figure 8-2 Woodland patch analysis – Black River

In Figure 8-2 the red bars represent the number of woodland patches and the blue line represents the total area of woodland (right hand axis is provided in ha). This analysis demonstrates that for the entire subwatershed, approximately 12,071 ha of woodlands in patches of 25 ha or greater are distributed among just 109 patches. This represents 82% of the woodland cover of the subwatershed. The loss of these patches would result in the loss of four fifths of the woodland cover in the Black River subwatershed.

There is one unbroken woodland patch that is greater than 500 ha in area within the Black River subwatershed (with a total area of 658.28 ha). Aggregations of woodland patches and/or the presence of extensive woodland patches may be critically important for the productivity of

woodland associated flora and fauna. Extensive areas of woodland cover provide much of the core woodland function in this subwatershed, such as productive breeding grounds for area-sensitive woodland bird species and other wildlife requiring large woodlands. This area could be a focus for restoration efforts in the future. This large patch of woodland has been identified as the Black River Big Woods Area in the LSRCA NHS. Additional Big Woods Areas are shared between the Black River subwatershed and the East Holland River subwatershed (the Whitchurch-Stouffville Big Woods Area) across the ORM; and further north, within the Pefferlaw River subwatershed, the Pefferlaw Brook Big Woods Area.

Big woods are important natural areas within the subwatershed that should be protected. They have two components. The first are the large, dense woodland areas that offer the kind of nesting, shelter and foraging opportunities that are not available in smaller woods, and are needed by species including the red-shouldered hawk and southern flying squirrel. The second are the smaller patches of woodland that can contribute to big woods habitat if they are dense enough and close enough to a large wooded area.

The analysis also indicated that approximately 1,434 ha (9.7% of the total woodland) are accounted for in patches up to 10 ha, (i.e., the first four columns in Figure 9-1). The (unlikely) total loss of these 619 patches (and without the “recruitment” of new patches) would reduce the percent of the subwatershed that is wooded from the current 37.9% to 34.2%. These smaller patches are not critical to woodland function in this subwatershed.

Forest Interior Habitat

Forest interior habitat is the part of a wooded area that is deeper than 100 metres from the perimeter of the woodland. Areas within the first 100 metres from the perimeter of a forest are considered to be ‘edge’ habitat and not suitable for species that require deeper forests. Many of these species are declining as their interior habitat disappears. Certain bird species such as the northern parula, black and white warbler, and Blackburnian warbler for example, avoid small fragmented forests when breeding. In smaller forests they are subject to predators, parasites, harsh winds, lack of food, and a higher susceptibility to fire and human interference.

Through its AOC guidelines, Environment Canada recommends that interior forest occupies more than 10% of the area of a subwatershed, which would ensure that sufficient habitat is available for more sensitive species that require this habitat. The interior forest cover of the Black River subwatershed is currently 11.54%, which exceeds the Environment Canada target. It will be important to maintain this high level of interior forest habitat wherever possible into the future.

Overall, the literature indicates that one primary woodland cover threshold for maintaining woodland-related biodiversity and function is probably somewhere in the 30 to 40 percent cover range. The Lake Simcoe watershed presently has 27.4% woodland cover. In terms of total woodland cover, at 38% the Black River subwatershed is in relatively good. The extensive Black River subwatershed woodlands still support species such as the Snowshoe Hare, River Otter, and Black Bear that are largely absent in many other subwatersheds. These species indicate that wildlife functions are probably very high in the Black River subwatershed and it likely serves as an important source for a wide array of flora and fauna that are much less frequently encountered elsewhere in the Lake Simcoe watershed.

It is important that these existing woodlands, and particularly the larger ones, are not further fragmented and that they are preserved and their functions maintained.

8.2.4 Valleylands

A valleyland is a natural depression in the landscape that is often, but not always, associated with a river or stream. Valleylands act as an important part of the framework of a watershed as the landscape is generally a mosaic of valleylands and tablelands.

The *Natural Heritage Reference Manual* (OMNR, 1999) refers to valleylands as the “backbone” of a watershed because of the many important ecological functions they perform, such as channelling water and wildlife, providing a connection between natural heritage features, providing important migration corridors, providing microclimates, transporting sediment and nutrients, acting as natural drainage areas, maintaining water levels by acting as floodplains and seepage areas, and maintaining water quality through riparian vegetation communities.

Valleylands are also often associated with cultural significance. Whether they were the location of aboriginal travel routes or settlements, or post-settlement development patterns, they often strongly influence human settlement patterns.

The Black River subwatershed is dominated by a significant and substantial valley feature in the mid-portion of the subwatershed, north of the Oak Ridges Moraine, associated with the main branch of the Black River. This prominent feature has a mix of upland woodland, treed swamps and cultural thickets. The LSRCA NHS has identified approximately 4,900 ha of significant valleylands within the subwatershed, the majority of which encompass the valleyland described above.

8.2.5 Wildlife Habitat

Significant Wildlife Habitat (SWH) is an area that is considered to be an important habitat of a particular species or group of species. Examples of SWH include unique habitats such as bat hibernacula or important winter habitat for White-tailed Deer. The importance of SWH is based on the premise that some habitat types are no longer plentiful and it also encompasses areas where species concentrate to breed or to hibernate, as well as unique habitat.

The driving force for the designation of SWH is the protection of biodiversity. The provision of habitat is one of the main functions of natural heritage features (OMNR, 1999). There are five principal types of SWH suggested by the *Natural Heritage Reference Manual* (OMNR, 1999) and the *Significant Wildlife Habitat Technical Guide* (OMNR 2000). These are seasonal concentrations of animals, rare vegetation communities, specialized habitats for wildlife, habitats of species of conservation concern, and wildlife movement corridors.

The Lake Simcoe NHS uses four criteria, based on available sources of information, to identify SWH, which are Winter Deer Yards, Colonial Waterbird Nesting Sites, Rare ELC communities (bog, fen, prairie, and alvar), and Grasslands. The Black River subwatershed has some representation of each of these.

Because White-tailed Deer (*Odocoileus virginianus*) do not move well in deep snow, they sometimes remain in sheltered areas during the winter, which typically consist of a core area of coniferous forest (over 60% canopy cover), surrounded by mixed or deciduous forest. Yards can persist over many years and can be critical to the survival of White-tailed Deer in some parts of the Province (OMNR, 2000). A Deer Yard (Stratum 1) is often referred to as the core of a deer yard. Deer use this area when mobility is most restricted under severe winter conditions (when snow reaches depths greater than 46 centimetres). A Deer Wintering Area (Stratum 2) is the area occupied by deer in early winter or occasionally all winter during mild winters. A mild winter occurs when the snow cover in the area is light and fluffy, and less than 30 centimetres deep. There is no Stratum 1 area, but there are approximately 8,971 ha of deer wintering area (Stratum 2) area within the Black River subwatershed, as identified by the MNR. LSRCA's

Natural Heritage System, discussed later in this chapter, recommends that Stratum 1 areas are Level 2 features, however, Stratum 2 areas are not afforded protection unless identified in official plans.

Colonially-nesting waterbirds concentrate in relatively small areas for nesting purposes. These species include cormorants, herons, terns and gulls. Individual colonies may support the entire breeding population for a given species across a relatively large area. Because colonial waterbirds typically nest in relatively confined areas, they can be particularly susceptible to disturbance, disease or habitat destruction. There is one noted occurrence of a colonial waterbird nesting site known from this watershed, it is for the Great Blue Heron.

Table 8-5 Seasonal concentrations of animals in the Black River subwatershed

Habitat Type	Area in BRS (ha)	Percentage of BRS
Deer Yard (Stratum 1)	0	0%
Deer Wintering Area (Stratum 2)	8,971	23.9%
Colonial Waterbird Nesting Sites (BSC)	One occurrence – Great Blue Heron	

There are two rare ELC communities known to occur within the Black River subwatershed, fen and bog. Both communities are very small in area, the bog contributing about one hectare (less than one percent of the subwatershed) and the fen 12 ha (approximately 0.2%). These constitute 2.7% of the Lake Simcoe watershed's fen and 3.1% of the watershed's bog communities. Fens and particularly bogs are relatively rare in southern Ontario and are host to a range of plants and wildlife that require the unique parameters found only in these communities.

Grassland communities (which in this case refers to upland ELC communities of Cultural Meadows and Cultural Thickets) in the Lake Simcoe watershed are generally dominated by non-native cool season grasses, native and non-native forbs, and a variety of native and non-native shrubs. Shrub cover may vary from 0 to 100%. Grasslands generally do not include pasture lands, which, to the extent possible, are mapped separately within the Lake Simcoe watershed as an agricultural use (i.e., they are actively grazed by livestock) (Beacon and LSRCA, 2007).

However, despite the fact that grasslands are often dominated by non-native vegetation species, many native flora and fauna species use them. Indeed, many of these species (e.g., Bobolink [*Dolichonyx oryzivorus*] and Eastern Meadowlark [*Sturnella magna*]) are not found in any other habitat types and are therefore considered habitat specialists. Presumably, in pre-settlement times these species were confined to habitats such as burns, previously flooded areas, prairie habitats and then, today, in human-altered environments (Beacon and LSRCA, 2007).

Table 8-6 Specialized habitats for wildlife: grasslands

Habitat Type	Area in BRS (ha)	Percentage of BRS
Cultural Meadow	1,744	4.6%
Cultural Thicket	553	1.5%

With nearly 2,300 ha of meadow and thicket, the Black River subwatershed accounts for 28% of the Lake Simcoe watershed's grassland communities.

There are likely additional occurrences of significant wildlife habitat in the Black subwatershed; these will be identified through further exploration of the subwatershed's natural heritage features.

8.2.6 Areas of Natural and Scientific Interest

To encourage the protection of unique natural heritage features and landscapes in southern Ontario, the Ontario Ministry of Natural Resources developed the provincial Areas of Natural and Scientific Interest (ANSI) program.

There are two types of ANSIs, life science and earth science. Life science ANSIs are based on biological and ecological characteristics. Earth science ANSIs are based on geological landform characteristics.

The selection criteria used by the MNR to define ANSIs are:

1. Representation;
2. Diversity;
3. Condition;
4. Ecological function; and
5. Special features.

ANSIs can be designated within one of two levels of significance, regional or provincial. These levels are based on ecoregions and ecodistricts. Provincial significance relates to the whole province, while regional significance is assigned at the ecoregional level.

The Black River subwatershed presently has one approved provincially significant ANSI, which makes up approximately 1% of the subwatershed, one regionally significant ANSI, occupying just over 7%, and a candidate ANSI (which is an area that has not yet received MNR approval), as shown in the table below. Some ANSIs are also Provincially Significant Wetlands (e.g., Zephyr Creek Swamp). Several are located within the ORM.

Lying on the south shore of Lake Simcoe three kilometres northwest of Pefferlaw, Duclos Point is characterized by a beach spit and backshore marsh and an extensive swamp extending inland from the storm beach. A progression of community types ranging from the open water of the lake and creeks to shallow marsh to deep marsh to thicket swamp and to deciduous and coniferous swamp forest occurs (Hanna, 1984).

The Zephyr Creek Swamp is a lowland river swamp complex south of Lake Simcoe, north of Zephyr.

Table 8-7 ANSIs in the Black River subwatershed (BRS)

ANSI	Significance Level	Status	Total Area in LS Watershed (ha)	Area in BRS (ha)	Percentage of BRS
Duclos Point Park Reserve and Adjacent Lands	Provincial	Approved	402.5	359.9	1.0
Zephyr Creek Swamp	Regional	Approved	3,317.1	2,729.1	7.3
Vivian Bog	Regional	Candidate	21.4	21.4	0.1
Total			3,741	3,110.4	8.4

8.2.7 Landscape Connectivity

Landscape connectivity refers to the inter-connectivity of the natural heritage features on the landscape. Landscapes having greater connectivity (where more features are better connected) are likely to have higher functioning ecosystem processes. While greater connectivity is

generally strived for, landscapes that are not currently 'connected' should be restored in a deliberate manner to ensure that connecting features does not result in degradation of one feature or another that could arise from transfer of invasive species or viruses, for example.

A detailed landscape connectivity assessment has not been undertaken in the subwatershed to date. A preliminary analysis indicates that the Black River subwatershed is generally well connected through the landscape. The features on the Oak Ridges Moraine are connected to the feature to the north through a large vast valley feature as well as the Zephyr wetlands. Connectivity in the upper section of the subwatershed has been compromised, although there are connections, and opportunities to enhance them exist.

Key Points - Current Terrestrial Natural Heritage Status:

- Wetlands occupy approximately 21% of the subwatershed area – 65% of these are provincially significant. Approximately one third of wetlands have not been evaluated using OWES.
- There are four different types of wetland present in the Black River subwatershed: Bog (<0.1%), Fen (0.2%), Marsh (9.0%) and Swamp (90.9%)
- Woodland cover in the Black River subwatershed is 32%, but approximately 16% of this can be considered to be of lower ecological quality (e.g. plantations or cultural woodland). Excluding these lower quality forest types, woodland cover is 27%, just under the 30% generally recommended
- Forest interior habitat is currently 11.54%, which exceeds the 10% target recommended by Environment Canada
- There are two known species at risk that have been identified in the subwatershed in the past 20 years: Blanding's Turtle and Butternut tree. There are likely more, but they have not been verified.
- The subwatershed contains three significant types of wildlife habitat: deer wintering areas (23.9% of the subwatershed), colonial waterbird nesting sites (one known site), and grassland communities that support specialized bird species (6.1% of the subwatershed area).
- There are several Areas of Natural and Scientific Interest (ANSIs) in the subwatershed – two are approved (Duclos Point Park Reserve and Adjacent Lands and Zephyr Creek Swamp), and there is one candidate site.
- Approximately 5.5% of the subwatershed is impervious, which is well within Environment Canada's 10% recommendation

8.3 Factors impacting status - stressors

There are numerous factors that can affect natural heritage features. They range from natural factors such as floods, fires, and droughts; and human influences, such as outright destruction, water use, the introduction of invasive species, and climate change. Natural factors are generally localized and short in duration, and a natural system is generally able to recover within a relatively short period. Some degree of natural disturbance is often a part of the life cycle of natural systems. Conversely, human influences are generally much more permanent – a forest can not regenerate after it has been paved over, natural communities have a great deal of difficulty recovering from the introduction of an invasive species, and wetlands may be unable to

survive when their water source has been drawn down. The Natural Heritage System for the Lake Simcoe Watershed (Beacon and LSRCA, 2007) provides an important tool for reducing the impact of human influences by ensuring that the functions of natural systems can be preserved and/or restored.

8.3.1 Land use changes and habitat fragmentation

The Black River subwatershed is one of the healthiest subwatersheds in the Lake Simcoe basin in terms of wetland and woodland cover. This can be partly attributed to the fact that a large valley spans the central portion of the subwatershed. It can also partly be attributed to this area being one of the first regions to have its wetland cover evaluated and classified as provincially significant, in the early 1980s. As well, 20% of this subwatershed is part of the Oak Ridges Moraine and is therefore protected through the Oak Ridges Moraine Conservation Plan (ORMCP).

The largest component of land cover in the Black River subwatershed is natural heritage features at approximately 51%. Intensive and non-intensive agriculture comprise approximately 39% of the land base. The remainder of the breakdown of the land use of the watershed is shown in Figure 8-2.

Historic analyses were conducted by Parish Geomorphic Ltd. using aerial photographs from three sets of coverages (1959/61, 1976, and 2002) as part of an analysis of the subwatershed's fluvial geomorphology. Aerial photography helps to identify natural changes and human alterations in channel planform, and changes in land use. There were four areas of channel planform change identified in the Black River subwatershed; and changes in land use were also analyzed.

The downstream section of the Black River is in a fairly urban area; however, the extent of the urbanization appears to have remained fairly constant over the past 43 year with the exception of one new development. The river was moderately sinuous from Lake Simcoe to the Sutton Dam, an area surrounded by residential neighbourhoods, and primarily by agricultural lands in the area just upstream. The sinuosity increased dramatically upstream of the dam on the main branch. For all years, the river flows through a mix of agricultural lands and forested lots. The 2002 aerial photos showed that Mount Albert Creek flows through agricultural and forested lands, as well as the community of Mount Albert. Changes for Mount Albert Creek could not be evaluated due to a lack of coverage in the historical aerial photographs.

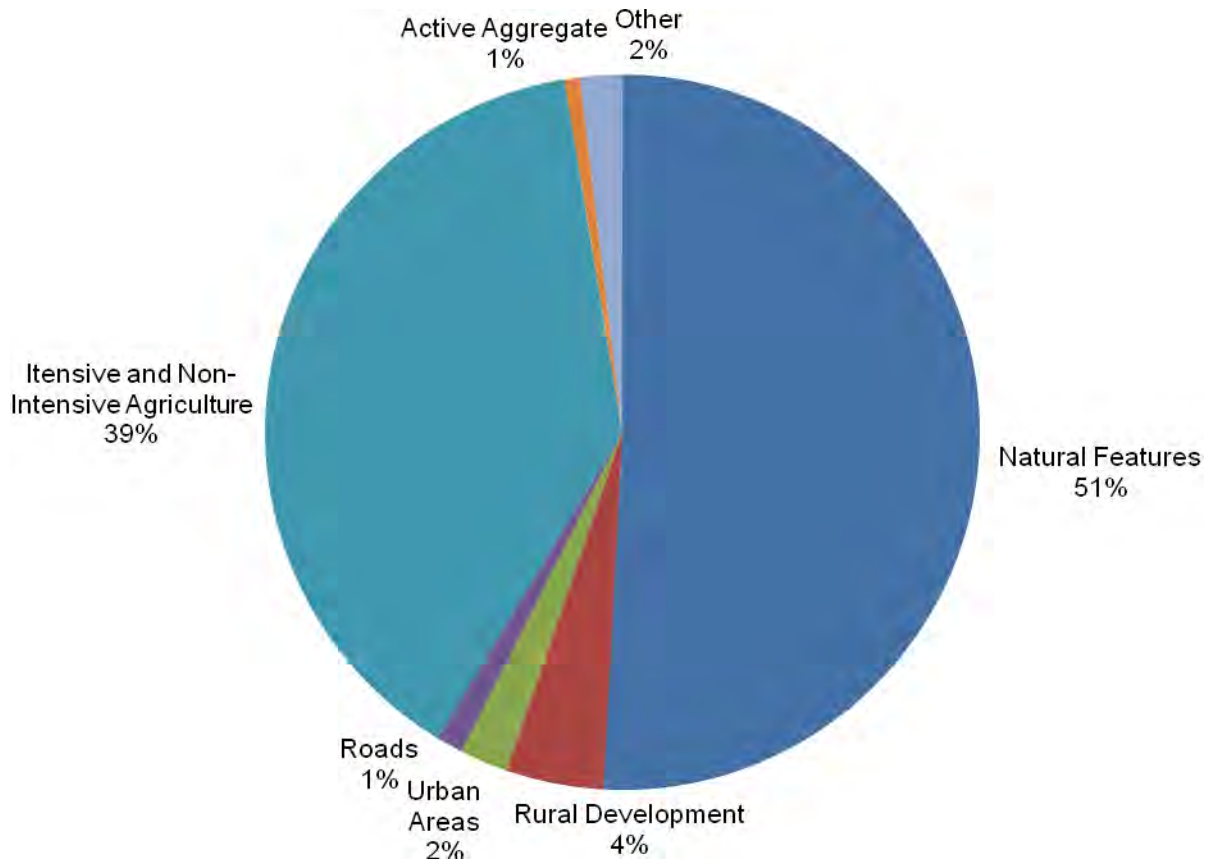


Figure 8-2 Land use distribution in the Black River subwatershed

Based on future land use projections, urban areas are anticipated to expand by roughly 4% (an additional 1,197 ha) with this increase evenly split between low and high intensity development. Forested lands are projected to decrease by approximately 284 ha and wetlands by 15 ha (Louis Berger Group, 2006).

Highway 48 is the only major road to run through the Black River subwatershed. It runs east/west near Sutton, and north/south passing through Baldwin and Vivian, eventually continuing through the subwatershed. Average road density across the watershed is 1.2 km/km², and the total length of highways and local roads is 433 km.

The land use of the Black River subwatershed can also be expressed in terms of imperviousness (the inability for water/moisture to permeate the surface). Levels of less than 10% imperviousness in an urbanizing subwatershed should maintain surface water quality and quantity and preserve aquatic species density and biodiversity, as recommended by Environment Canada's Areas of Concern (AOC) Guidelines (2005).

In the Black River subwatershed, approximately 2,100 ha (5.5%) is impervious which is well within the lower guideline to protect surface water quality and aquatic biodiversity. While imperviousness is not the only measure or indicator of water quality and aquatic biodiversity, hydrology is of particular importance in the Black River subwatershed given the large proportion of high quality wetlands and extensive areas of woodlands (many of which are associated with wetlands). It will be important to ensure that impervious area does not dramatically increase in this subwatershed in order to protect its health. The impacts of impervious surfaces are discussed further in **Chapter 3, Best Management Practices**.

8.3.2 Changes to hydrologic regime

Of all the natural heritage types identified above, changes to hydrologic regime will have the greatest impact on wetlands. Wetlands types (fen, marsh, swamp etc) and their associated vegetation are dependent upon natural variations in hydrologic conditions such as baseflow rates, seasonal flooding and drainage. Any alteration to the hydrologic regime can lead to loss of wetlands and/or changes in wetland condition. Factors leading to changes in hydrology include extraction of water from rivers and streams, increased impervious surface, and deforestation. Processes leading to changes in surface and ground water quantity are discussed in more detail within **Chapter 5 – Water Quantity**.

8.3.3 Peat Harvesting

Another factor impacting wetlands, specifically in the Black River subwatershed, is the removal of peat wetlands for harvesting purposes. This build up of organic matter can usually be found in wetlands that are cold and waterlogged with organic materials that have been accumulating over centuries and are in varying stages of decomposition. While peat extraction may be a source of income for some individuals, there are serious impacts on the hydrologic regime and surrounding natural heritage areas. As peat is considered a non-renewable resource, the large, deep holes that are left in wake of extraction rarely return to their previous, ecologically functional state. Peat extraction also causes wetland fragmentation, loss of species richness and possibly destroying unique and sensitive habitats.

Furthermore, altering peat wetlands also changes the hydrology of the surrounding area. Wetlands normally improve water quality, by acting as a filtration system, and influence water quantity by retaining large amounts of water, enhancing ground water infiltration and augmenting baseflow. This all changes as the extraction areas, now void of peat and wetland material, no longer filter water, but instead become pools that are warm (due to lack of vegetation) and may become a source of algae blooms that will decrease water quality. Figure 8-4 illustrates the changes occurring at a peat wetland from 1999 – 2007. While peat extraction is now limited to approved extraction areas, it will have local impacts, and may impact the subwatershed as a whole.



Figure 8-4 Peat extraction in the Mount Albert Provincially Significant Wetland (1999-2007)

8.3.4 Invasive species

Invasive non-native species are a threat to biodiversity. While each species plays a specific role within their native ecosystems, once out of that setting and into a new ecosystems, these species can grow into enormous populations, if unchecked by the evolved predatory/prey relationships of their native systems. Invasive species can dominate a habitat niche, preventing other species from surviving, thereby reducing biodiversity. The presence of invasive species can be an indicator of disturbance in an ecosystem as there are generally very few if any non-native species present in less disturbed features. Invasive species are usually highly effective at transporting themselves. For example, plants can disperse their seeds through such tactics as hitching a ride with an unsuspecting dog or person, through wind dispersal or by a tenacious root system. Therefore, woodlands and wetlands that have been visited by very few people often have few to no invasive species and therefore, higher biodiversity.

While there is very little information related to terrestrial invasive species in the Black River specifically, the following are a few notable species within the Lake Simcoe watershed:

A threatening upland species that has shown rapid increase recently is dog-strangling vine (*Vincetoxicum rossicum*). Its strong vine-like structure creates a thicket blanket on the ground and can grow over small shrubs and trees leading to their death. This species is highly effective at crowding out other species; it is difficult even to walk through and blocks light from penetrating the ground.

Japanese knotweed (*Polygonum cuspidatum*) is a highly invasive perennial that has escaped from gardens. This species will inhabit any type of habitat from roadsides, building sites and abandoned lands to meadows and woodland edges. It grows very aggressively, out-competing other species. It spreads rapidly by way of its thick and vigorous underground rhizomes, making it difficult to remove (OFAH 2006).



Japanese Knotweed (photo: Kentucky Division of Forestry)

Capable of growing in a range of habitats, the Common Buckthorn (*Rhamnus cathartica*) has a rapid growth rate that allows it to create a thick cover, blocking shrubs and plants in the lower canopy and groundcover from sunlight. It has 'allelopathic' properties that inhibit the growth of nearby native plants, further allowing its own species to take over. Buckthorn is also a concern for the agricultural community as it is a host over the winter for soybean aphids and is an alternate host of oat rust.



Garlic Mustard (photo: Kentucky Division of Forestry)

In the past Garlic Mustard (*Allaria petioloata*) was used for medicinal purposes and as an herb in food. Now it is a persistent invasive species that threatens native groundcover in large areas and the species that depend on them. Garlic mustard has several properties that allow it to successfully replace large amounts of native groundcover in an area including: the ability to self-pollinate, production of over 100 seeds per plant and production of phytotoxic chemicals that inhibit the growth of nearby vegetation. Because of the sticky nature of its seeds, it is easily transported by human activity and the passing wildlife. This plant prefers shady sites with fertile, low pH soils such as savannahs, upland and floodplain forests, and along roadsides.

Giant Hogweed (*Heracleum mantegazzianum*) is an ornamental plant found in many gardens. As an individual plant can produce over 100,000 seeds that can stay viable up to seven years in the seed bank, it can easily spread over an area and replace the native species. While similar looking to the native Angelica and Cow parsnip, it is much larger, growing up to five metres in height. It also presents a health hazard to individuals that touch its clear sap. The sap contains toxins that cause photodermatitis and temporary or permanent blindness if it comes in contact with eyes (Pridham, 2009).

8.3.5 Recreation

Natural areas such as woodlands are a popular location for recreational activities such as hiking, cycling and snowmobiling. These activities if not managed correctly and undertaken in a responsible manner, can reduce ecological condition of the natural heritage features. Impacts from recreational activities can include increased soil erosion, loss of habitat area (especially for species sensitive to human presence), introduction of invasive species and pollution. Stresses on these sensitive areas are increasing as a result of increasing population and diminishing natural heritage lands. Within the Black River subwatershed areas that are stressed by recreational activities include tracts of the York Region Forest.

Key Points – Factors impacting Terrestrial Natural Heritage - stressors

- While there are multiple stressors to natural heritage systems, the greatest impact has been due to changes in land use, particularly agricultural and urban subwatersheds.
- Black River subwatershed is considered one of the healthiest with approximately 51% of its land use being natural heritage features
- Invasive species can have a significant impact of natural heritage systems by out competing and displacing native species. The extent and impact of terrestrial invasive species in watershed is poorly defined.
- Recreational activities in natural heritage areas can lead to impacts such as erosion, species exclusion and invasive species introduction.
- Peat extraction has been a main stressor to the wetlands in the area
- Sod farming is a growing concern.

8.4 Current Management Framework

Several policy documents have shaped the identification and protection of the terrestrial natural heritage in the Black River subwatershed. Those having most impact on natural heritage features are summarized in Table 8-1. The policies within the legislation relate to many different activities that can potentially affect natural heritage, with activities ranging from the discharge of material to urban development. In Table 8-8 we categorize 8 such activities, recognizing that many of these activities overlap and that the list is by no means inclusive of all activities. The legal effect of policies within these varying pieces of legislation broadly fall into one of two categories. The first broad category we define as those having little or no legal standing and are referred to as General or Have regard to Statements in Table 8-1 and are shown in blue. The second policy category includes those that have legal standing and must be conformed to; these are referred to as Regulated / Existing Targets in Table 8-1 and are shown in green. In

many cases a piece of legislation does not have policies of either category that relate to the activity specified, these are shown in red.

Table 8-1 Summary of current legislation and acts that relate to the protection and restoration of terrestrial natural heritage

Stressor affecting natural heritage features	Oak Ridges Moraine Plan (2002)	Greenbelt Plan (2005)	Lake Simcoe Protection Plan (2009)	Growth Plan for the Greater Golden Horseshoe (2006)	Provincial Policy Statement (2005)	Endangered Species Act (2008)	LSRCA Watershed Development Policies (2008)	York Region Official Plan (2008)	Durham Region Official Plan (2008)
Growth/development/site alteration									
Habitat fragmentation		1	2						
Connectivity									9
Impervious areas								8	10
Introduction of invasive species			3						
Impacts from recreation						4	6		9
Restoration						5	7		
Climate change									
General/Have regard to statement		Regulated/Existing targets			No applicable policies				

¹ The only policy relates to lot creation within the Protected Countryside

² Development not permitted in wetlands, *significant* forests, *significant* valleylands (e.g. other than wetlands, features not considered significant are not afforded the same protection)

³ Discusses developing proposed regulations (to be considered by fed gov under fisheries act), conducting studies/risk assessments, developing response plans, education programs, but nothing banning use/etc

⁴ States that no person may damage or destroy the habitat of a species at risk, but does not specifically list any potential activities that may be permitted within habitat

⁵ Person holding a permit to conduct an activity may be required to rehabilitate habitat damaged/destroyed in undertaking the activity; is also mentioned in policy pertaining to Species at Risk in Ontario Stewardship Program

⁶ Along watercourses

⁷ required for valleyland applications, may be required in other cases (case-by-case basis)

⁸ Only within Oak Ridges Moraine planning area (as specified in the ORMCP)

⁹ Related to paths and their potential impact on key natural heritage features and key hydrologic features

¹⁰ Within Major Open Space Areas and Greenbelt Natural Heritage System

In this section we provide a summary of legislation as it pertains to protection and restoration of terrestrial natural heritage. This summary is to give context to *future management considerations* and the *opportunities and recommendations to improve water quality* discussed in the following two sections. This summary is not intended to be comprehensive in terms of all the acts related to natural heritage, or the polices within these acts – the reader is directed to each piece of legislation for a full assessment of the legislation as it relates to natural heritage.

8.4.1 Oak Ridges Moraine Conservation Plan (ORMCP)

This plan designates Natural Core and Natural Linkage Areas for the purpose of maintaining and improving the ecological integrity. Approximately 3,900 ha (or 17%) of the subwatershed is designated ORMCP Natural Core and Linkage areas. The policies that apply in the Natural Core and Linkage Areas include:

- Every application for development or site alteration shall identify planning, design and construction practices that ensure that buildings or site alterations do not impede the movement of plants and animals among key natural heritage features, hydrologically sensitive features and adjacent land.
- A minimum area of influence and minimum vegetation protection zone. An application for development or site alteration within the minimum area of influence that relates to a key natural heritage feature, but is outside of that feature and the minimum vegetation protection zone, are to be accompanied by a natural heritage evaluation. Factors natural heritage evaluation shall include:
 - Demonstrate that the development or site alteration will have no adverse affects on the key natural heritage feature or the related ecological functions
 - Identify planning, design and construction practices that will maintain and, where possible, improve or restore the health, diversity and size of the key natural heritage feature and its connectivity with other key natural heritage features
 - Demonstrate how connectivity within and between key natural heritage features will be maintained and, where possible, improved or restored before, during and after construction
 - Determine if the dimensions of the minimum vegetation protection zone as specified in the ORMCP are sufficient, and specify the dimensions necessary to provide for the maintenance and, where possible, improvement or restoration of natural self-sustaining vegetation within it

ORMCP Key Natural Heritage Features

- Wetlands
- Significant portions of the habitat of endangered, rare and threatened species
- Fish habitat
- ANSIs (Life Science)
- Significant valleylands
- Significant woodlands
- Significant wildlife habitat
- Sand barrens, savannahs, and tallgrass prairies

Policies related to water conservation and the protection of water quantity and quality will have the added benefit of helping to maintain a great number of important natural heritage features, such as wetlands.

The Black River subwatershed also contains Landform Conservation Areas (both Categories 1 and 2), for which there are a number of policies:

- Applications for development or site alteration with respect to land in a landform conservation area shall identify planning, design and construction practices that will keep disturbance to landform character to a minimum, including
 - Maintaining significant landform features such as steep slopes, kames, kettles, ravines and ridges in their natural undisturbed form
 - Limits on the portion of the developable area of the site that is disturbed and the area of the site that has impervious surfaces
- Applications for development in landform conservation areas are to be accompanied by a landform conservation plan, that details (through maps) elevation contours; analysis of the site by slope type; significant landform features such as kames, kettles, ravines and ridges; and all water bodies including intermittent streams and ponds.
- Landform conservation plans should also include a development strategy that identifies appropriate planning, design and construction practices to minimize disruption to landform character

The ORMCP also details a number of requirements for those uses that are permitted within Natural Core and Linkage Areas, such as gravel pits, agricultural uses, and low-intensity recreational uses to ensure that they have minimal impact on these important areas.

8.4.2 Greenbelt Act (2005)

Ninety eight percent (just under 37,000 ha) of the Black River subwatershed lies within the Greenbelt Act Area. The Greenbelt Act area also includes the ORMCP areas (see below), but does not include designated urbanizing areas (known as the “White Belt”) that are not within the ORM. Within the Greenbelt Plan’s Natural System areas of the Protected Countryside (which includes towns, hamlets and villages), there are a subset of lands that are identified as the Natural Heritage System. This Natural Heritage System includes the areas of the Protected Countryside with the highest concentration of the most sensitive and/or significant natural heritage features and functions. The Greenbelt Plan identifies a number of policies related to the protection of the features within this system. These include:

- New development or site alteration (as permitted by the policies of the Greenbelt Plan) are required to demonstrate that
 - There will be no negative effects on key natural heritage features or key hydrologic features
 - Connectivity is maintained or enhanced wherever possible
 - The removal of other natural features should be avoided
 - The disturbed area of any site does not exceed 25%, and the impervious surface does not exceed 10% of the total developable area of the site
- Where non-agricultural uses are contemplated, the applicants must demonstrate that

Greenbelt Plan: Key Natural Heritage Features

- Significant habitat of endangered species, threatened species, and special concern species
- Fish habitat
- Wetlands
- Life Science Areas of Natural and Scientific Interest
- Significant valleylands
- Significant woodlands
- Significant wildlife habitat
- Sand barrens, savannahs and tallgrass prairies
- Alvars

- At least 30% of the total developable area will remain in or be returned to natural self sustaining vegetation
- Connectivity along the system and between key natural heritage features and key hydrologic features located within 240 metres of each other is maintained or enhanced
- Buildings or structures will occupy less than 25% of the total developable area
- Development of lands within wetlands, seepage areas and springs, fish habitat, permanent and intermittent streams, lakes, and significant woodlands is not permitted (there are several activities which are allowed within these areas, such as conservation activities, fish and wildlife management, etc), including any associated vegetation protection zone.
- A proposal for development or site alteration within 120 metres of a key natural heritage feature within the Natural Heritage System requires a natural heritage evaluation and/or hydrological evaluation, which will identify a vegetation protection zone which is sufficient to protect the feature from the impacts of the proposed change (including before, during, and after construction), and restore or enhance the feature and/or its function wherever possible.

8.4.3 Lake Simcoe Protection Plan

The LSPP contains a number of policies aimed at protecting the natural features of the watershed. The Plan's natural heritage targets include:

- Achieving a greater proportion of natural vegetative cover in high quality patches
- Achieving a minimum 40 percent high quality natural vegetative cover in the watershed
- Protecting wetlands
- Naturalized riparian areas
- Restoration of natural areas or features
- Increased ecological health based on the status of indicator species and maintenance of natural biodiversity

The following are the policies set out by the plan that will help to meet these targets:

- Restricting the activities that can be undertaken in shoreline and riparian areas, and encouraging the re-naturalization of these areas
- The possible development of a shoreline regulation(s), which could address such issues as fertilizer use, activities contributing to the spread of invasive species, peat extraction, the filling and draining of existing wetlands, and vegetation removal
- The protection of key natural heritage and key hydrologic features (including wetlands, significant woodlands, significant valleylands and natural areas abutting Lake Simcoe) by prohibiting development and site alteration within these features and delineating a vegetation protection zone for each. A very limited number of land uses are permitted within this vegetation protection zone, these include forest, fish, and wildlife management; stewardship, conservation, restoration and remediation; flood or erosion control projects; stormwater retrofits; and low intensity recreational uses.
- The minimum vegetation protection zone is the area within 30 metres of the key natural heritage or hydrologic feature, but this may be larger if determined appropriate through a

natural heritage evaluation, which is required of all applications for development or site alteration within 120 metres of a key natural heritage feature or hydrologic feature.

- Within identified settlement areas, an application for development shall, where applicable:
 - Increase or improve fish habitat in streams, lakes and wetlands, and any adjacent riparian areas
 - Include landscaping and habitat restoration that increase the ability of native plants and animals to use valleylands or riparian areas as wildlife habitat and movement corridors
 - Seek to avoid, minimize and/or mitigate impacts associated with the quality and quantity of urban run-off into receiving streams, lakes, and wetlands

8.4.4 Places to Grow Act – Growth Plan for the Greater Golden Horseshoe (2006)

The policies of this plan are meant to direct growth in such a manner as to protect natural heritage features and other significant areas from the issues associated with urban sprawl. This plan builds on the natural systems of the Greenbelt Plan, with policies that strive for a healthy natural environment with clean air, land, and water.

There are several Natural Systems policies in the Growth Plan that will support the protection of the subwatershed's natural areas. These include:

- The Ministry of Public Infrastructure Renewal will work with municipalities to identify natural systems for the Greater Golden Horseshoe, and where appropriate will develop additional policies for their protection
- The Greenbelt Policies apply throughout the natural system
- Planning authorities are encouraged to identify natural heritage features and areas that complement, link or enhance natural systems

8.4.5 Provincial Policy Statement (PPS) 2005

By focusing growth within settlement areas and away from significant or sensitive resources, the implementation of this piece of legislation will help to protect terrestrial natural heritage features within the Black River subwatershed. The policies that support this can be found under Section 2.0 of the PPS and include:

- Policies stating that natural heritage features and areas shall be protected for the long term, and that the diversity and connectivity of natural features in an area, and the long term ecological function and biodiversity of natural heritage systems, should be maintained, restored or, where possible, improved.
- Policy 2.1.3 provides direction to regional and local municipalities regarding planning policies for the protection and management of natural heritage features and resources. The PPS defines seven natural heritage features (listed below) providing planning policies for each.
 - significant habitat of Species at Risk;
 - significant wetlands;
 - significant woodlands;
 - significant valleylands;

- significant wildlife habitat;
- Areas of Natural and Scientific Interest (ANSIs); and
- fish habitat.
- The habitat of Species at Risk as well as provincially significant wetlands are designated and delineated by the Ontario Ministry of Natural Resources. These features and habitats are afforded provincial protection and are precluded from development under the *Planning Act*. Proposed development in non-provincially significant features, such as wetlands and woodlands, are subject to the demonstration of no negative impact on the ecological function.

Municipal and local planning authorities are responsible for the identification and designation of these features within their Official Plans (with the exception of provincially significant wetlands and the significant habitat of Species at Risk).

The Greenbelt Plan and Oak Ridges Moraine Conservation Plan (ORMCP) are provincially legislated areas that take precedence over the PPS.

8.4.6 Endangered Species Act

The purposes of the Endangered Species Act (ESA) are to protect species that are at risk and their habitats, as well as promoting the recovery of those species. Through the implementation of the policies of the ESA, protection will be afforded to the habitats of the Black River subwatershed's rarest species, thus helping to preserve the subwatershed's biodiversity. These policies state that no person shall:

- Kill, harm, harass, capture or take a living member of a species that is listed on the Species at Risk Ontario (SARO) list as an extirpated, endangered, or threatened species
- Possess, transport, collect, buy, sell, lease, trade or offer to do the same with any specimen (living or dead) or part of a species that is listed on the SARO list as an extirpated, endangered, or threatened species
- damage or destroy the habitat of a species listed as endangered, threatened, or extirpated

The policies of the ESA also require that a recovery strategy be prepared for each of the species on the SARO list as an endangered or threatened species. These strategies are to include an identification of the habitat needs of the species, a description of the threats to the survival and recovery of the species. The ESA includes a policy that states that the precautionary principle should be used in the development of recovery plans – where there is a threat of significant reduction or loss of biological diversity, a lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat.

8.4.7 The Role of the LSRCA

LSRCA Watershed Development Policies (2008)

The LSRCA has a number of policies aimed at protecting natural heritage features. Wherever possible, the LSRCA directs development away from features such as Environmentally Significant Areas, ANSIs, wetlands, significant valleylands, significant woodlands, sensitive or significant wildlife habitat, and the habitat of Species at Risk.

Depending on the location and scope of a plan of subdivision, the LSRCA may require the submission of a number of materials be included in the application, such as planting or

vegetation plans, vegetation preservation plans, and environmental impact studies. The completion of these studies will help to protect features or minimize the impact of the development on the important features and functions within the subwatershed.

There are policies that deal specifically with maintaining valleylands by minimizing site alteration. Through these policies, the LSRCA may require a number of studies (such as Vegetation Plans, Tree Preservation Plans) and can place additional restrictions on development proposals within or in proximity to valleylands.

The Authority endeavours through its policies to encourage municipalities to identify ESAs and to work with them to develop appropriate environmental protection policies to incorporate into their Official Plans. The LSRCA does not support development in Group 1 biological ESAs, unless it can be shown (through an environmental impact study) that there will be no negative impacts on the ESA. The LSRCA has other requirements for Group 2 and 3 ESAs that seek to minimize impacts of development.

Floodplains are also well protected through these policies, although development in this area may be permitted under some circumstances. However, the policies stipulate that within this area, cutting and filling will generally not be permitted in ESAs, wetlands, ANSIs, significant woodlands and valleylands, sensitive wildlife habitats, habitats of Species at Risk, and on steep slopes.

With respect to wetlands, the LSRCA's policy statement is that new development and/or interference in any way shall be prohibited within all PSWs, and that such activities will be prohibited within all other wetlands except under several circumstances. These include demonstrating the need to develop within the wetland, the absence of an alternate location for the proposed development, the design of the proposed development minimizes disturbance to the site, drainage patterns are maintained, and the completion of an appropriate EIS demonstrating that there will not be an effect on the control of flooding, or pollution or the conservation of land due to the development.

The policies also stipulate that some infrastructure projects may be permitted within wetlands. Where development is permitted, the LSRCA may also require wetland creation at a 3:1 ratio.

The LSRCA requires a 120 metre setback from all PSWs and a 30 metre setback from all other wetlands, unless it can be demonstrated through submission of hydrological studies that there will be no negative impacts to the wetland.

Lake Simcoe Natural Heritage System

LSRCA has recently developed a Natural Heritage System for the Lake Simcoe watershed. The *Natural Heritage System for the Lake Simcoe Watershed Phase 1: Components and Policy Templates* is used by LSRCA staff to guide plan review, though the main intent is for adoption through municipal Official Plans. The foundation of the NHS is the *Provincial Policy Statement 2005* (PPS), the principal tool designed by the Province to incorporate natural heritage planning across the watershed. Science is the support structure of the NHS and supporting documentation (Beacon and LSRCA, 2007) provides comprehensive criteria based on recent scientific concepts in order to identify lands of ecological value within the watershed.

A four-tiered policy approach was developed to direct the protection of the natural features of the Natural Heritage System (Table 8-2). The first two levels of this policy approach are assigned a "provincially significant" designation and are considered to be those features that would be identified if following the guidelines and intent of the PPS. Level 3 of this approach represents significance at the watershed level, while Level 4-supporting features are those that are considered to be supporting the natural heritage system of the watershed. Finally, Big

Woods Policy Areas are target areas for replacement, restoration and stewardship priorities (Beacon and LSRCA, 2007).

Table 8-2 Policy guidelines of the LSRCA Natural Heritage System Phase 1

Significance	Policy Level	Guideline
Provincial	Level 1	Provincially significant, retention and protection
	Level 2	Provincially significant, retain and demonstrate no negative impact
Watershed	Level 3	Watershed significant, retain and avoid; demonstrate no net negative impact, replacement may be acceptable
Supporting	Level 4	Not necessarily a constraint to development but replacement encouraged
Big Woods Policy Areas	BWPA	Retain, no net loss of woodland

Approximately 19,500 ha (52%) of the Black River subwatershed is within the four-tier LSRCA NHS, the breakdown is as follows (Table 8-3 and Figure 8-3):

Table 8-3 LSRCA Natural Heritage System Policy Levels in the Black subwatershed

Policy Level	Area in the EHS (ha)	Percentage of the EHS
Level 1	14,091	37.5
Level 2	3,300	8.8
Level 3	1,111	3.0
Level 4 - supporting	1,020	2.7
Total	19,522	52.0

Approximately 90% of the Natural Heritage System within the Black River subwatershed is comprised of significant Level 1 and Level 2 features and much lesser amounts of Level 3 and Level 4 – supporting features.

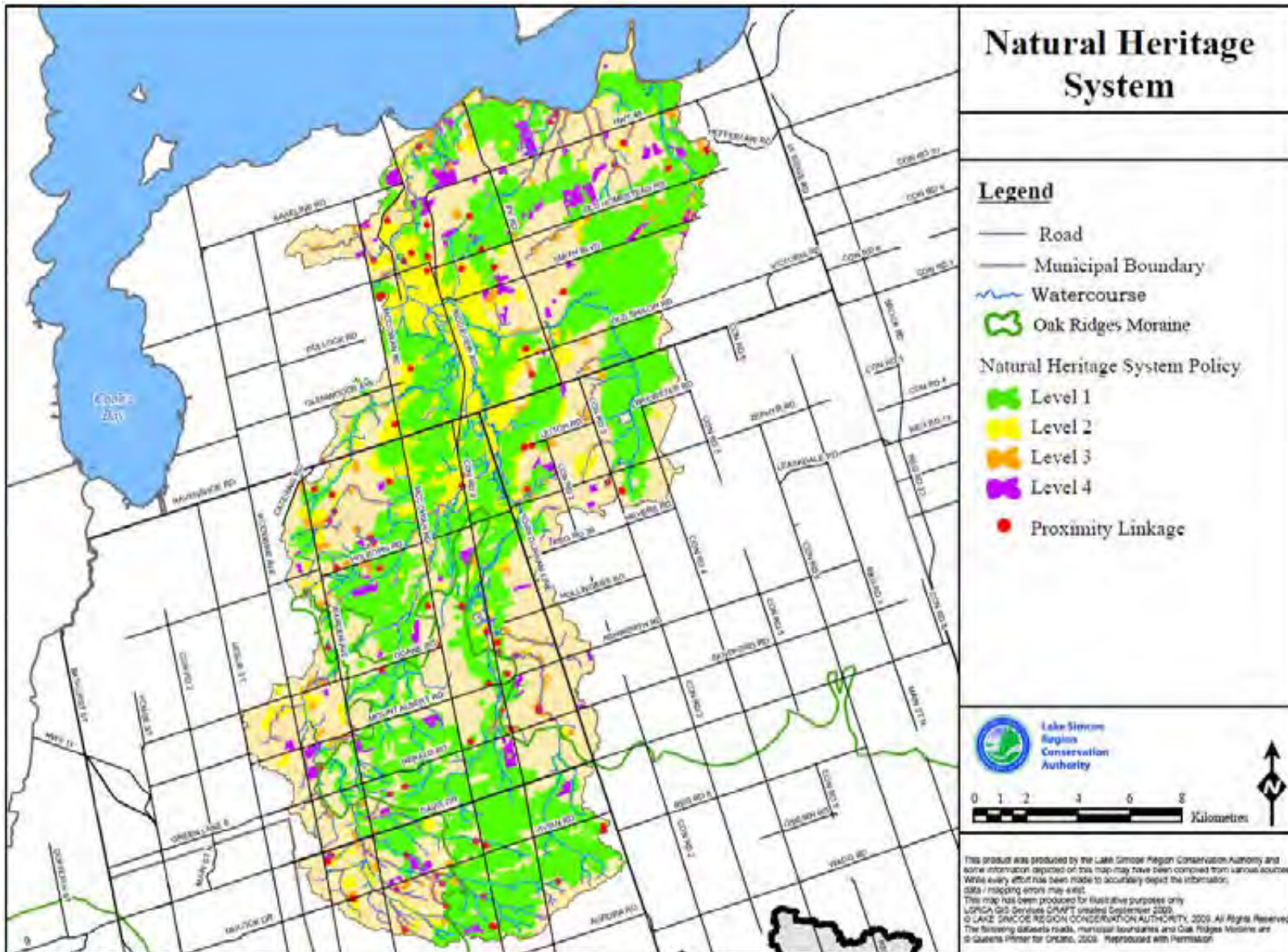


Figure 8-3 LSRCA Natural Heritage System in the Black River subwatershed

8.4.8 York Region Official Plan (2009)

Most of the Black River subwatershed (89%) is located within the Regional Municipality of York. The York Region Official Plan protects the natural heritage features of the landscape through a set of policies that apply to an identified Regional Greenlands System as well as to identified Environmental Policy Areas (EPAs), Wetland Areas, Forest Resource Areas, and Landform Conservation Areas.

Of the lands of the Black River subwatershed that are in York Region, 28% (approximately 10,500 ha) form part of the Greenlands System and 37% (13,900 ha) are included as "Significant Forested Areas". These two designations are not mutually exclusive.

The plan's policies related to the protection of natural heritage features and functions include:

- Directing new development and site alteration away from the Greenlands System
- The Greenlands System is to be enhanced through greening initiatives, partnerships, infrastructure projects and urban development to achieve ecological gains for the system
- Development applications within 120 metres of the Greenlands System must be accompanied by an Environmental Impact Study, and include details of enhancement opportunities and mitigative measures
- Requiring that the Regional Greenlands Strategy be identified more specifically for Urban Towns and Villages, in local OPs and secondary plans, and integrated into community design. These plans are to contain policies and detail initiatives that encourage system remedial works and enhancement opportunities
- Encouraging links and enhancements in local OPs for new community areas
- Requiring infrastructure projects that are permitted within the Greenlands System to be designed and constructed to be sensitive to the features and functions of the system, and include context sensitive design and innovative technologies to minimize impacts and enhance the Greenlands System
- Prohibiting development and site alteration within key natural heritage features and key hydrologic features and adjacent lands, unless it can be demonstrated that the activity will not result in a negative impact on the feature or its functions.
- Co-operating with conservation authorities, the Province, and local municipalities to further define and better understand key natural heritage features and key hydrologic features and their functions and to promote improved stewardship and protection strategies
- Prohibiting development and site alteration within the wetlands identified in the OP mapping and to require a minimum vegetation protection zone of 30 metres; and placing restrictions on development within 120 metres of these wetlands. Under certain circumstances, development will be permitted (e.g. no loss of wetland function, or contiguous wetland area).
- Increasing woodland cover in York Region to 25% of the land area
- Prohibiting development and site alteration within significant woodlands and their associated vegetation protection zone (with some conditions). In circumstances where these activities are permitted, a woodland compensation plan must be completed
- Managing York Region forests sustainably in a manner that enhances ecological, educational, and recreational functions to ensure their health in perpetuity

- Supporting the goals and objectives of subwatershed plans

8.4.9 Durham Region Official Plan

Approximately 4,200 ha (11 %) of the Black River subwatershed is located on the Oak Ridges Moraine within the Regional Municipality of Durham. The Durham Region Official Plan (2004) protects its natural environment through areas designated as Oak Ridges Moraine, Waterfronts, Major Open Space, and features such as environmentally sensitive areas, valley systems, water resources and plant and animal habitats.

8.5 Management gaps and limitations

As can be seen in the above section, there are a number of pieces of legislation, regulations and municipal requirements aimed at protecting and enhancing the natural heritage features in the Black River. Despite this strong foundation, there are a number of gaps and limitations in the management framework that need to be considered, such as the effects of climate change. This section provides an overview of the factors that need to be considered in the future management of the subwatershed.

8.5.1 Growth, Development and Site Alteration

These activities are strongly regulated in areas such as key natural heritage features, key hydrologic features, and shorelines through the ORMCP, Greenbelt Plan, Lake Simcoe Protection Plan, York and Durham Region's Official Plans, and LSRCA Watershed Development Policies. The protection and potential enhancement of these features will be extremely important in maintaining all aspects of ecosystem health in the subwatershed. There are, however, limitations with these policies:

- For many natural heritage features (other than wetlands) it is only those considered significant that are protected, and in general only those considered provincially significant are protected. Although they are not considered to be significant, these features still perform important functions in the watershed, and the development of these areas and loss of these functions will have impacts to watershed health. Wetlands are now well protected through the Generic Regulation (179/06);
- The policies that apply to hydrologic features are not consistent across the subwatershed – the definition of a key hydrologic feature is different for the ORMCP area, the Greenbelt Plan area, and the LSPP area which covers the remainder of the subwatershed. Features such as seepage areas, springs, aquifers and recharge areas are protected in the ORMCP area, but not the LSPP area, and the Greenbelt Plan includes seepage areas and springs but not aquifers and recharge areas. These discrepancies can leave some of these features unprotected.
- Some plans specify a minimum vegetation protection zone around key natural heritage and key hydrologic features (e.g. the ORMCP and Greenbelt Plan), and also identify a further 'area of influence' (as it is referred to in the ORMCP) outside of the minimum vegetation protection zone. Within this area of influence, a proposal for development or site alteration triggers the requirement for a natural heritage and/or hydrologic evaluation. This evaluation is meant to describe the existing conditions, assess the potential impacts from proposed development/site alteration and determine if the minimum vegetation protection zone provides sufficient protection. If the minimum vegetation protection zone is not found to be sufficient, the evaluation should specify the dimensions of the required minimum vegetation protection zone. While the goal of these policies is undoubtedly to protect the features, in reality the required evaluations rarely

specify anything greater than the minimum; in essence the minimum becomes the maximum distance. There is therefore little further protection gained through this process for these features and their functions by way of a buffer distance.

8.5.2 Habitat Fragmentation

A number of the policies of the ORMCP, Greenbelt, LSPP and York Region's Greenlands System protect key natural heritage features, which will aid in preventing the fragmentation of terrestrial habitat within the Black River subwatershed. However, the main limitation of this framework is that:

- Those features not subject to the application of these policies (such as regionally or locally significant forests) are vulnerable to being lost to development pressures. The loss of these features, although they are not considered to be significant under the regulatory framework, could cause considerable fragmentation of the natural landscape of the subwatershed, which could subsequently impact in the subwatershed.

8.5.3 Connectivity

The ORMCP, Greenbelt, and LSPP all contain policies requiring the completion of natural heritage evaluations for proposals within the minimum vegetation protection zone of key natural heritage features. These policies generally state that a natural heritage should identify planning, design and construction practices that will maintain and, where possible, improve or restore the health, diversity and size of the key natural heritage feature and its connectivity with other natural heritage features. The ORMCP also includes a policy stating that applications outside of Settlement Areas are to ensure that no buildings or other site alterations impede the movement of plants and animals among key natural heritage features, hydrologically sensitive features and adjacent land within Natural Core and Linkage Areas. Again, the limitation to these policies is that they only apply to those features identified as key natural heritage features and the linkages between, leaving many natural areas unprotected. There are additional general statements regarding protecting connectivity in the plans, but none containing specific policies that would protect features other than those identified as key natural heritage features.

8.5.4 Impervious Areas

The ORMCP, Greenbelt Plan and Regional Official Plans contain policies around that aim to limit impervious area (and hence its impacts on the natural features of the subwatershed) to a certain level, while the PPS, LSPP and LSRCA Watershed Development Policies contain more general statements about striving to limit impervious area. These policies are limited in scope, and there are gaps in the geographic area covered. The issues with these policies include:

- The ORMCP and Greenbelt Plan do set a limit of 10 per cent, but these limits apply only outside of Settlement Areas in the ORMCP, and only in the Natural Heritage System of the Greenbelt. Thus there is no defined limit within the ORMCP and Greenbelt Plan areas not covered by these policies, as well as areas outside of the ORMCP and Greenbelt boundaries, and the subwatershed's impervious area could easily exceed 10 per cent
- York Region's policies around impervious surfaces only apply in the ORMCP area, while Durham's applies only in its Major Open Space Areas
- There is no agency ensuring that subwatershed impervious areas do not exceed the defined limit

- Approval agencies should be striving for either a reduction in impervious areas on development sites or the mandatory use of practices that increase infiltration in order to reduce the impacts of impervious area within the subwatershed

8.5.5 Introduction of Invasive Species

There are few policies related to the introduction of invasive species in the current management framework, and only the Lake Simcoe Protection Plan contains policies related to terrestrial invasive species. The limitations of the policies contained in this plan are as follows:

- Most of the policies are related to aquatic invasive species.
- The policies around terrestrial invasive species are focused on monitoring to determine the extent of invasive species and developing a watch list and associated response plan for species expected to be introduced into the watershed, but not on preventing the introduction of these species. The policies around aquatic invasive species are more comprehensive.
- The LSPP notes the importance of identifying funding mechanisms for the implementation of invasive species response plans, but there is currently not a guaranteed fund for undertaking these activities.

8.5.6 Impacts from Recreation

A number of the plans allow for low impact recreation within key natural heritage features. The issues with these policies include:

- Although these policies are aimed at protecting these features from the impacts of other types of recreation, there are still potential issues that may arise from allowing activities such as non-motorized trails within these features, such as erosion from the trails themselves, introduction and spread of invasive species.
- These policies apply only in key natural heritage features, leaving other features more susceptible to damage from recreation activities

8.5.7 Restoration

Most of the policies related to restoration are quite general in nature, and do not contain specific requirements. Some require applications for development or site alteration in key natural heritage features to be accompanied by a natural heritage, which in most cases requires the applicant to include planning, design or construction practices that will maintain and, where feasible, improve or restore the health, size, and diversity of the feature. The limitations to this approach include:

- Resources are needed to ensure that the specified design practices are being undertaken during and after construction
- It may be difficult to measure whether the health, size and diversity of a feature has been maintain or restored – this would require a significant input of resources, and impacts may not be seen for some time after the construction has been completed.

8.5.8 Climate Change

Climate change is generally not well addressed in the current management framework. The LSPP contains the most comprehensive policies related to this issue which could potentially cause shifts in the vegetative communities in the subwatershed, impact the hydrologic regimes that sustain wetlands, and make the subwatershed ecosystem more susceptible to stresses

such as disease and insect infestation. The adaptation strategy that will be developed through the LSPP is a significant first step in addressing this issue, and some of the Official Plan policies are beginning to consider climate change as well. While it may not be appropriate for some of the existing legislation to address climate change issues, it will be important to incorporate climate change considerations wherever possible in making management decisions for the subwatershed, and implement policies requiring, at the very least, the implementation of so called “no regrets” options should be incorporated into development and site alteration wherever possible.

8.6 Recommended Actions to Improve Terrestrial Natural Heritage

The following recommended actions were developed to improve terrestrial natural heritage in the Black River subwatershed. Although there is a relatively high level of natural heritage features in this subwatershed, the anthropogenic land uses that are present may be causing stress to the natural heritage features. In addition to the natural heritage features that are removed to accommodate uses such as urban and agriculture, other issues include the resultant changes to hydrologic regime, which can affect features such as wetlands; the fragmentation of natural heritage features; the introduction of invasive species; and stresses from the increasing population utilizing natural heritage features for recreational opportunities. Given that the urban area and population in this subwatershed are expected to increase somewhat in both Sutton and Mount Albert in the coming years, measures must be undertaken to mitigate these impacts. The implementation of the actions below will help to mitigate the impacts of the growth that is scheduled for this subwatershed, as well as that of the existing urban and rural land uses, on the natural heritage features of the Black River subwatershed.

These recommendations, which are grouped and numbered as described in Section 1.4, were developed to address the water quality issues and stressors that were identified throughout this chapter. In addition, they consider, and are consistent with applicable policies and recommendations in the province’s Lake Simcoe Protection Plan, and the LSRCA’s Integrated Watershed Management Plan. Each recommendation below also identifies the applicable ‘detailed recommendations’ as outlined in Chapter 10. These detailed actions will form the basis of the Implementation Plan for York Region’s ORM subwatersheds, to be developed following the completion of this plan.

8.6.1 Planning and Policy

- 6) That the value of the ecological goods and services (EGS) provided by ecological features be considered in decision making around growth and development
Detailed recommendation: A.3.6
- 7) That the rural/agricultural community be engaged in developing solutions for minimizing the impacts of practices on their lands
Detailed recommendation: A.4.1
- 8) That the municipal partners, the LSRCA, and the Province support a common framework and develop and endorse policies and programs for the protection and enhancement of the Black subwatershed’s natural heritage system and its functions
Detailed recommendations: A.5.1 – A.5.2, A.5.5 – A.5.6
- 9) That the partners, including the municipalities, LSRCA, and the Province, seek to gain an improved understanding of the natural heritage features of the Black subwatershed
Detailed recommendations: A.5.3 – A.5.4

- 10) That the LSRCA and its partner strive to maintain cover of peat wetlands in the subwatershed

Detailed recommendation: A.5.7

- 11) That the Province, the municipal partners, and the LSRCA seek to gain an improved understanding of the impacts of climate change in the Black subwatershed, incorporating this information into decision making scenarios and developing strategies to mitigate and adapt to its impacts.

Detailed recommendations: A.6.1 – A.6.2, G.1.1 – G.1.2

8.6.2 Use of Better Management Practices

- 13) That support for programs offered to assist rural landowners in implementing BMPs on their properties, such as LSRCA's LEAP program, be continued and/or expanded as resources permit

Detailed recommendations: B.2.1 – B.2.3

- 14) That sectors that have the potential to have significant impacts on conditions in the Black subwatershed be expected to undertake BMPs and other activities to mitigate their impacts, as required under the LSPP

Detailed recommendations: B.2.4 – B.2.5

8.6.3 Applied Research and Science

- 26) That the partners (LSRCA, MNR, NRCAN, etc) undertake studies to enhance understanding of natural heritage resources within the Black subwatershed in support of management strategies related to unique and/or significant features

Detailed recommendations: D.3.1 – D.3.4, D.3.6 – D.3.7

- 27) That LSRCA and its partner municipalities assess the feasibility of increasing and/or enhancing natural cover, and develop strategies to prioritize these undertakings in order to achieve the greatest benefit to the subwatershed

Detailed recommendations: D.3.2, D.3.5

- 28) That all partners cooperate to determine the presence and extent of invasive species in the subwatershed, and work to prevent their establishment and spread

Detailed recommendations: D.3.7, D.3.8

8.6.4 Monitoring

- 34) That the LSRCA undertake regular updates to its Natural Heritage and Land Use mapping to ensure the most up-to-date information is being used.

Detailed recommendation: E.4.1

8.6.5 Management, Rehabilitation and Restoration

- 39) That the LSRCA and the partner municipalities assess the feasibility of increasing natural cover (e.g. woodland, streambank vegetation, interior forest, grassland) in the subwatershed and set priorities and develop plans to undertake this enhancement, based on overall benefit to the subwatershed.

Detailed recommendations: A.5.3, F.2.1 – F.2.3

- 40) That the LSRCA identify opportunities for land securement of priority sites.

Detailed recommendation: F.2.3, F.4.1

- 41) That the partner municipalities, in cooperation with the LSRCA, look to enhance existing woodland areas through replacing plantation species with appropriate native species through succession in order to provide higher quality habitat while maintaining the functions that plantation areas perform. These include maintaining water quality, providing shelter, encouraging infiltration and stabilizing soils.

Detailed recommendation: F.2.4

- 42) That the LSRCA support the work of MNR and OFAH with respect to invasive species and encourage the distribution of promotional materials.

Detailed recommendation: F.3.1

- 43) That the partner municipalities adopt policies to encourage the use of native species, particularly those drought tolerant species, through development approvals and property management programs.

Detailed recommendation: F.3.2

- 44) That the LSRCA continue to undertake stewardship initiatives, priority areas for which may be identified through Phase II of LSRCA's Natural Heritage System.

Detailed recommendation: F.4.2

- 45) That the LSRCA request the Ministry of Natural Resources to undertake the development of watershed rare lists and protection policies for species at risk in the subwatershed.

Detailed recommendation: F.4.3

- 46) That LSRCA and its municipal partners investigate initiatives to improve the long term benefit and environmental sustainability of public properties and facilities.

Detailed recommendation: F.4.4

- 47) That the LSRCA, the partner municipalities, and developers work to identify opportunities for undertaking restoration works on development sites, and incorporate these into proposals, where appropriate

Detailed recommendation: F.4.5

8.6.6 Adaptive Response

- 48) That the LSRCA and partner municipalities work to reduce their carbon footprint and to increase ecological resilience in the watershed

Detailed recommendations: G.1.1 – G.1.3

9 Black River Subwatershed's Natural Capital: The Value of the Subwatershed's Ecosystem Services

9.1 Introduction

In 2008, the Lake Simcoe Region Conservation Authority partnered with the David Suzuki Foundation and the Greenbelt Foundation to determine the value of the ecosystem goods and services provided by the features in the watershed. The value of the services provided by the entire Lake Simcoe watershed was estimated to be a minimum of \$975 million dollars each year. As part of the subwatershed planning exercise, the conservation authority has completed a more specific analysis of the value of the services provided by the ecosystems of the Black River subwatershed.

9.2 What is Natural Capital?

Natural capital refers to our natural assets, and the ecosystem goods and services that those assets provide. Natural assets and ecosystem services are the foundations of life – including human life. The benefits provided by natural capital include the storage of floodwaters by wetlands, water capture and filtration by forests, the absorption of air pollution by trees, and climate regulation.

Forests, wetlands, and rivers that make up watersheds are essentially giant utilities providing ecosystem services for local communities as well as regional and global processes that we all benefit from. Ecosystems provide many services including carbon storage and sequestration, water storage, rainfall generation, climate buffering, biodiversity, soil stabilization, and more (Global Canopy Programme. <http://www.globalcanopy.org/main.php?m=3>, as referenced in Wilson, 2008). The goods and services provided by the Black River subwatershed were estimated to be worth \$178 million annually.

The most highly valued natural assets are the forests and wetlands, worth \$319 and \$435 million per year, respectively for the Lake Simcoe basin and \$65.5 and \$98 million, respectively for the Black River subwatershed. The high value for wetlands reflects the many important services they provide, such as water regulation, water filtration, flood control, waste treatment, recreation, and wildlife habitat. Forests provide high value because of their importance for water filtration, carbon storage, habitat for pollinators, and recreation.

As the watershed plan is developed for the Black River, this study reinforces the importance of ensuring meaningful protection of natural features, including through the implementation of the Natural Heritage System and policies through local official plans. The ecosystem values in this report can also be a useful tool for other regions to determine the hidden wealth of their respective ecological systems and plan more strategically for healthy and sustainable communities. By measuring or quantifying the value to communities of ecosystem services, we can more accurately account for land use changes which thereby help to inform land use and other decisions related to altering the landscape.

9.3 Valuing Ecosystems

Ecosystem goods and services are the benefits derived from ecosystems. These benefits are dependent on ecosystem functions, which are the processes or attributes that maintain the ecosystems and the species that live within them. Humans are reliant on the capacity of natural processes and systems to provide for human and wildlife needs (De Groot, 2002, as referenced in Wilson, 2008). These include products received from ecosystems (e.g. food, fibre, clean air and water), benefits derived from processes (e.g. nutrient cycling, water purification, climate

regulation), and non-material benefits (e.g. recreation and aesthetic benefits) (Millennium Ecosystem Assessment, 2003 as referenced in Wilson, 2008).

There have been several techniques developed to determine economic values for non-market ecosystem services. The method used for this study uses avoided cost and replacement cost for ecosystem service valuation, as well as contingent valuations or willingness-to-pay studies for cultural values. Some of the values were derived using direct analysis and some values were adapted from other studies. All ecosystem service values are reported in 2005 Canadian dollars.

The estimated values provided are likely a conservative estimate because our knowledge of *all* the benefits provided by nature is incomplete, and because without the earth's ecosystems and resources, life would not be possible, so essentially the value of nature is priceless. It is also important to note that the value of natural capital and its services will increase over time, as services such as water supply become increasingly scarce due to population growth and the anticipated effects of climate change, for example. The valuations of ecosystem services, however, provide an opportunity to rigorously assess the current benefits and the potential costs of human impact.

1. Water Quality, Supply, and Regulation

Forests and wetlands can reduce non-point source water pollution because they filter, store, and absorb pollutants, such as nitrogen and phosphorus. Studies by the U.S. Environmental Protection Agency show that forests in rural areas improve water quality because trees divert rainwater into the soil where bacteria and microorganisms filter out pollutants. This filtering significantly reduces the sediment, pollutants, and organic matter that reach streams.

i. Water Filtration Services

Natural cover in watersheds is vital for a clean and regular supply of safe drinking water. While there are no drinking water intakes in the Black River, the water does drain to the lake, where eight communities draw their drinking water supply – cleaner water from the rivers will result in reduced treatment requirements. Studies have shown that treatment costs increase as forest and wetland cover decreases in watersheds.

The value of the current forest/wetland cover for water filtration services, based on the estimated daily residential water use in the Lake Simcoe watershed, is \$209.86 per hectare.

ii. Water Regulation and Flood Control

Forests and wetlands also regulate the flow of water, providing protection against flooding and erosion. The loss of forest affects stream flows leading to instability in drainage systems, reduced infiltration of water into soils, and increased peak flows. Wetlands act as natural retention reservoirs for water, slowing its release. Changes in stream flow due to forest and wetland loss results in lower water levels in dry seasons, higher than normal water levels in wet seasons or storms, greater amounts of sediment entering rivers, and increased water temperatures (Ribaud, 1986 as referenced in Wilson, 2008).

The value of water regulation by forests is calculated as a replacement value, which represents the construction costs for water runoff control if the current forest cover was removed and converted for urban land use. The forest cover provides savings because it provides green infrastructure for the region. The total annual savings are \$1,886 per hectare. For each five per cent of forest cover converted to urban land use, the incremental cost is an estimated \$458 per hectare per year.

The annual value of flood control by wetlands is based on an average (\$4,039 per hectare), a value which was derived from the review of four different studies.

iii. Waste Treatment

Wetlands are effective waste treatment systems – constructed wetlands are often used to treat human and agriculture wastes. Depending on the type, size, plants, and soils, wetlands can regulate, filter, and absorb a significant amount of nitrogen, phosphorus, and other contaminants. In the absence of wetlands, these nutrients would otherwise need to be removed by treatment plants. The combined annual total for waste treatment of nitrogen and phosphorus by wetlands is estimated at \$2,148 per hectare (based on a range of \$1,061 to \$3,235/ha/year).

2. Clean Air

Trees are essential because they produce oxygen for our air. On average, one tree produces nearly 260 pounds of oxygen each year. Forests and trees also provide improvements in air quality. Trees remove air pollution such as carbon monoxide and sulphur dioxide by adsorption through their leaves and they also intercept airborne particles by retaining them on their leaves. These pollutants can have significant economic impacts in terms of health damage costs, economic losses due to agricultural crop damages, visibility reduction, and soil damage.

The amount of air pollutants removed by the tree canopy cover was calculated for the report using CITYgreen software. This software calculates the value of air cleansing by trees using average removal rates of various pollutants by trees. The annual value of the service of pollutant removal by tree canopy cover is estimated at \$377 per hectare.

3. Carbon Services

Globally, forests and wetlands function as large terrestrial banks of carbon, preventing increases in the level of greenhouse gases in the atmosphere. Forests and wetlands play an integral role in the global carbon cycle by pulling carbon from the atmosphere. As a result, large amounts of carbon are stored in trees, plants, roots, and soils.

i. Forests

Carbon storage and annual carbon sequestration by forests are often misunderstood. Forest carbon storage refers to the total amount of carbon contained in an ecosystem at a given time. Carbon sequestration refers to the annual amount of carbon uptake by an ecosystem after subtracting the carbon released to the atmosphere due to respiration, disturbance, and decomposition.

The economic value of the carbon stored by forests was calculated using the avoided cost (i.e. the damages avoided by the carbon stored). The Intergovernmental Panel on Climate Change reported that the average cost of global damages due to the level of carbon dioxide in the atmosphere in 2005 was \$52 per tonne of carbon (IPCC, 2007). Lake Simcoe's forests store 220 tonnes of carbon per hectare. Therefore, the annual value of the carbon stored was worth an estimated \$919 per hectare) in 2005.

The annual uptake of carbon (i.e. net carbon sequestration) was calculated using CITYgreen software. The average annual value of the carbon sequestered (approximately 0.75 tonnes of carbon per hectare) is \$39 per hectare based on the average cost of carbon emissions (\$52 per tonne of carbon).

ii. Wetlands

Carbon storage by wetlands was determined using Canada's Soil Organic Carbon Database (Tarnocai and Lacelle, 1996 as referenced in Wilson, 2008). Using data

extracted from this database, the annual value of the carbon stored based on the average damage cost of carbon emissions (\$52/tonne of carbon) was determined. The value per hectare ranges from \$524 to \$1,302 per year depending on the type of wetland, and the soil carbon ranges from 125 to 312 tonnes per hectare.

Based on average global carbon sequestration rates for wetlands of 0.25 tonnes per hectare per year (<http://www.aswm.org/science/carbon/quebec/sym43.html> as referenced in Wilson, 2008), the rate of carbon uptake in the Lake Simcoe watershed was estimated to be worth \$13 per hectare. This is most likely a very conservative estimate because other studies have found higher rates of carbon uptake (Fluxnet Canada, http://www.trentu.ca/academic/bluelab/research_merbleue.html as referenced in Wilson, 2008).

iii. Agricultural Land and Grasslands

Organic carbon stored in the agricultural soils of the Lake Simcoe watershed was extracted from the Canadian Soil Organic Carbon Database (Tarnocai and Lacell, 1996 as referenced in Wilson, 2008). The average annual value of the carbon stored by agricultural soils was calculated to be \$547 per hectare. The average soil carbon content is 131 tonnes of carbon per hectare, ranging from 125 tonnes to 252 tonnes of carbon per hectare depending on the type of agricultural land cover.

Grasslands, a classification which in this report includes cultural meadow, alvar meadow, and tallgrass prairie land covers, store an average of 100 tonnes of carbon per hectare. The annualized value of carbon storage is worth an estimated \$438 per hectare per year.

4. Biodiversity

i. Habitat

Wetlands are well known for the important habitat they provide for many species, especially birds, amphibians, and reptiles. The Lake Simcoe watershed is home to at least 32 of the 175 species at risk in southern Ontario.

The annual value for wetland habitat services is \$5,830 per hectare based on the average annualized wetland habitat restoration costs for a group of relevant Great Lakes Sustainability Fund projects (IJC Study Board, 2006 as referenced in Wilson, 2008). The annualized value of restoring habitat represents the value of wetland habitat in terms of the avoided cost of damages to habitat.

The avoided cost of the loss or degradation of wetland habitat is also significant because of the importance of wetlands for many species, especially species at risk. In Canada, more than 200 bird species (including 45 species of waterfowl) and over 50 species of mammals depend on wetlands for food and habitat; many of these are species at risk.

ii. Pollination

Pollination is the transfer of pollen from one flower to another, which is critical for fruit and seed production in most plants. Approximately 80 per cent of all flowering plant species are specialized for pollination by animals, mainly insects. Without this service, many interconnected species and ecosystems functioning within an ecosystem would collapse (Commission on Genetic Resources for Food and Agriculture, 2007 as referenced in Wilson, 2008). Insect pollination is necessary for most fruits and vegetables including many annual crops grown in the watershed.

Several studies have documented the significance of the proximity of natural habitat to cropland for optimum yield and increased farm production. A Canadian study found that canola yield is correlated to the proximity of uncultivated areas. The researchers found that optimum yield and profit would be attained if 30 per cent of the field areas were set aside for wild pollinator habitat (Morandin and Winston, 2006 as referenced in Wilson, 2008).

The annual value of pollination services for the subwatershed was estimated based on 30 per cent of farm crop value (global average of crop production dependent on pollination). Given the significance of natural cover for pollinator biodiversity, nesting habitat, food, and nectar, the total value of pollination services was allocated proportionally to idle agricultural lands, grazing lands, hedgerows/cultural woodland, forest lands, and grasslands with an average annual value per hectare of \$951.

5. Recreation and Tourism

The most important industries associated with Lake Simcoe are tourism and recreation. Approximately \$200 million is spent annually on tourism and recreation on the watershed. The many recreation activities undertaken in and around Lake Simcoe depend largely on the health of the watershed and the lake itself. Based on the annual value of tourism, the natural cover (forests/wetland/grassland) in the subwatershed is worth \$1,231 per hectare. This value assumes that without natural areas, tourism and recreation would not be viable in the region.

6. Other Ecosystem Services

There are a number of other ecosystem services provided by the subwatershed. These are listed below:

- Mitigation of air pollution by grasslands and urban recreational areas
- Water regulation services by grasslands and urban recreational areas
- Erosion control and sediment retention by grasslands, pasture lands, hedgerows, and cultural woodlands
- Soil formation by grasslands, forests, and soil building by earthworms for cropland, pasture, and hedgerows
- Seed dispersal (i.e. the natural regeneration by trees)
- Nutrient cycling by pasture land and hedgerows
- Recreation values for pervious urban recreational areas (estimated at 50 per cent of the value for natural cover)

A summary of the value of the various ecosystem services by land cover type in the Black River as well as for the whole Lake Simcoe watershed is provided in Table 9-11 below.

Table 9-11 Summary of non-market ecosystem service values by land cover type

Land Cover Type	Value per hectare (\$/ha/yr)	Area (ha) in subwatershed	Total subwatershed value (\$million/yr)	Area (ha) in Lake Simcoe basin	Total basin value (\$/yr)
Forests	4,798	13,648	65.5	66,835*	320.7
Grasslands	2,727	1,465	4.0	7,576	20.7
Wetlands	11,172	8,799	98.3	41,472*	463.3
Water	1,428	118	0.2	994	1.4
Cropland	529	12,566	6.6	94,986	50.2
Hedgerows/Cultural Woodland	1453	550	0.8	3,995	5.8
Pasture	1479	1,973	2.9	25,989	38.4
Urban Parks	824	286	0.2	3,543	2.9
Total		33,153	178.5	218,421	903.50**

* Swamps were included in the calculations for both forest and wetland

** Does not include Lake Simcoe

9.4 Conclusions

As has been demonstrated, the natural systems of the Black River subwatershed provide a number of goods and services. These so-called “free” ecosystem services have, in fact, significant value. The analysis in this report provided a first approximation of the value of the non-market services provided – totalling at least \$178 million each year. This results in a significant cost savings to the watershed residents and users.

It is critical that the true value and the costs of potentially damaging these ecosystem services be taken more directly into account in decision making by the municipal and provincial government, and also by the business community. We also have the opportunity to build on existing ecosystem services by enhancing the natural capital of the subwatershed through the restoration of woodlands, wetlands, and other forms of natural cover, as well as through stewardship activities.

The ecosystem values presented in this report can be a useful tool for determining the potential changes in ecosystem services due to policy and land use decisions. For example, land use planning at the subwatershed scale can utilize the physical supply of services (e.g. tonnes of carbon stored or nutrients absorbed) and the service values (e.g. dollars per hectare) to assess the loss of services and the cost due to changes in the natural cover of the watershed to an alternate use. It is important to note that ecosystem values should not be relied on solely, but considered in conjunction with other sources of information, such as biophysical and non-monetary ecological information

Measuring the value of, and monitoring, natural capital and the ecosystem services that it provides will become even more important as the climate changes. The IPCC’s latest report states that human pressures on natural ecosystems need to be reduced in order for our ecological systems to cope with the changing climate. Landscape scale protection of land and ecosystems will provide the additional benefit of our greater ability to cope and adapt in the face of climate change.

10 Detailed Recommendations for the Black River Subwatershed

This chapter includes the detailed recommendations discussed in the previous chapters of this subwatershed plan. These are the recommendations that will be brought forward in the development of the implementation plan for the four subwatersheds originating on the ORM within York Region, these being the West Holland, East Holland, Maskinonge, and Black Rivers. All subwatershed partners, including the LSRCA, applicable provincial ministries, the municipalities, community groups, citizens, and other stakeholders will be involved in the development of this implementation plan, through which the details regarding these recommendations will be defined. These details may include, but are not limited to, estimating timelines and costs, prioritizing activities, and identifying the partners that will be involved in the implementation of the various activities. When completed, this implementation plan will provide a road map for all partners to follow in order to improve conditions in the West Holland River subwatershed over the coming years.

As in previous chapters, the recommendations have been grouped into eight categories in order to facilitate clarity and consistency. In addition, the separate sections will help focus the development of a comprehensive Implementation Plan in the near future.

The recommendations have been placed into the following categories:

- A Planning and Policy
- B Use of Better Management Practices
- C Changing the Way Things Are Done 'On the Ground'
- D Applied Research and Science
- E Monitoring (Reporting and Compliance)
- F Management, Rehabilitation and Restoration
- G Adaptive Response (Climate, Social, Political)
- H Communications

It is recognized that many of these undertakings are dependent on funding from all levels of government. Should there be financial constraints, it may affect the ability of the partners to achieve these recommendations. These constraints will be addressed through the development of the implementation plan.

10.1 Black River subwatershed plan recommendations

A PLANNING AND POLICY

A.1 Stormwater Management

- A.1.1 That the applicable partner municipalities, in conjunction with the LSRCA, develop stormwater master plans that include maintenance schedules and funding requirements, as per the requirements set out by the LSPP
- A.1.2 That the Province of Ontario, through the implementation of the Lake Simcoe Phosphorus Reduction Strategy, provide significant incentive funding to the related municipalities and/or the LSRCA to maintain, construct and /or retrofit stormwater facilities as identified by the LSRCA Stormwater Rehabilitation program
- A.1.3 That the partner municipalities, in conjunction with LSRCA, re-evaluate stormwater management techniques and practices to determine whether a standard better than Level 1 can be achieved (e.g. through the implementation of new and innovative technologies)

A.2 Water Quality

- A.2.1 That the partner municipalities, through the LSRCA, create a roundtable (or multiple groups, as appropriate) made up of municipalities, OMAFRA, MOE, OFA, BILD and related landowner representatives and other stakeholders, or through existing frameworks such as the Lake Simcoe Phosphorus Reduction Strategy, to determine co-operative ways of implementing phosphorus reduction measures in York Region's subwatersheds within the Lake Simcoe basin (or at another scale that is deemed appropriate) and to develop an 'action plan' for their implementation within the subwatershed's urban and rural areas
- A.2.2 That the Province of Ontario and the partner municipalities support the maintenance and/or repairs required for septic systems within 100m of Lake Simcoe and its watercourses. LSRCA, through its stewardship program, will provide technical assistance and funding support as appropriate to complete upgrades and replacement of systems as required.
- A.2.3 If required by the Lake Simcoe Protection Plan, the partner municipalities will provide staff in support of conducting mandatory inspections for septic systems within 100 metres of Lake Simcoe and any of its watercourses
- A.2.4 That the Province, through the Ministry of the Environment and the Lake Simcoe Phosphorus Reduction Strategy, develop a Cumulative Effects Strategy for the Lake Simcoe basin.
- A.2.5 That the MOE move forward a position statement regarding the Provincial Water Quality Objectives that supports their incorporation as legal requirements under the Lake Simcoe Phosphorus Reduction Strategy or provides phosphorus targets that must be adhered to. Given that the PWQO for phosphorus is an interim target, individual targets should be developed on a catchment basis as part of the Lake Simcoe Phosphorus Reduction Strategy
- A.2.6 That the MOE move forward a position statement regarding the Provincial Water Quality Objectives that supports the inclusion of phosphorus, chloride, other than that used for winter road maintenance purposes, total suspended solids targets as values that must be adhered to throughout the Lake Simcoe basin

- A.2.7 That the Province of Ontario, through the Lake Simcoe Phosphorus Reduction Strategy, incorporate mandatory criteria that reflect the PWQO targets as part of the effort to address the water quality targets for Lake Simcoe, as outlined in the Lake Simcoe Protection Plan
- A.2.8 That the partner municipalities request that the Province of Ontario develop criteria for identifying concerns related to newly emerging contaminants, and further that guidelines be developed as appropriate to address these contaminants as they emerge

A.3 Planning and Policy Development

- A.3.1 That the partner municipalities recognize that the objective of maintaining water recharge and minimizing the impact of impervious surfaces. This can be achieved by maintaining the water balance on a development site or improving site conditions. However, this will require the development industry to use innovative solutions for future growth to meet this recommendation. In addition, the municipality, in conjunction with LSRCA, will continue to research methods of maintaining pre- and post-development water balance in the subwatersheds
- A.3.2 That where appropriate partner municipalities will ensure that the amount of impervious cover in new developments in the Black River subwatershed is kept to a minimum through the required use of new technologies
- A.3.3 That the partner municipalities adopt Low Impact Development (LID) practices for new developments throughout the Lake Simcoe watershed to further mitigate the impacts of urban development
- A.3.4 That the LSRCA work with federal, provincial, municipal government, and granting agencies to investigate and implement LIDs aggressively within the Lake Simcoe watershed
- A.3.5 That the Province promote the Adoption of Smart Growth Urban Design Guidelines and/or LID practices within the watershed
- A.3.6 With respect to the value of ecosystem goods and services, the municipalities should: include a system of values of ecosystem goods with respect to policy development; integrate the value of 'ecosystem goods' into their growth strategy development, land use planning and decision-making; and create an integrated 'natural capital' account as a means of establishing a baseline from which planning and development decisions can be compared (i.e. the value of the loss of ecosystem goods)
- A.3.7 That, where resources permit, LSRCA undertake enhanced enforcement of existing laws within the Black River subwatershed and simplify review and approval procedures for municipal and private sector development proponents

A.4 Agriculture

- A.4.1 That the partner municipalities, through the LSRCA, create a roundtable made up of municipalities, OMAFRA, MOE, OFA, BILD, and related landowner representatives, or through existing frameworks such as the Lake Simcoe Phosphorus Reduction Strategy, to determine co-operative ways of implementing phosphorus reduction measures in York Region's subwatersheds within the Lake Simcoe basin and to develop an 'action plan' for their implementation within the agricultural and rural communities

A.5 Natural Heritage

- A.5.1 That a concerted effort be made to identify opportunities to reconnect the natural features of the Oak Ridges Moraine (ORM) to Lake Simcoe, through a 'Natural Heritage System for Lake Simcoe'
- A.5.2 That the applicable partner municipalities will encourage the use of a standard framework for the protection of Natural Heritage cover and functions in the Lake Simcoe basin such as the 'Lake Simcoe Natural Heritage System' (LSRCA, 2007) and its related policies, and reflect its guidance in their OPs and other appropriate instruments (EIS guidelines etc) as part of their routine planning process
- A.5.3 That the partner municipalities and LSRCA request the Ministry of Natural Resources to undertake targeted wetland evaluations and wetland evaluation updates
- A.5.4 That the partner municipalities and LSRCA request the Ministry of Natural Resources to undertake Species at Risk surveys, habitat mapping and monitoring
- A.5.5 That the LSRCA utilize its authority through the [Generic Regulation (179/06)] under the Conservation Authorities Act to prevent the conversion of wetlands into other land uses, such as agriculture
- A.5.6 As part of the Lake Simcoe Protection Plan (LSPP), that the Province of Ontario develop regulations for shoreline development and a Shoreline Management Plan for Lake Simcoe, in conjunction with the stakeholders
- A.5.7 That the LSRCA and its partner municipalities strive to maintain the cover of peat wetlands and its important functions within the Black River subwatershed

A.6 Climate Change

- A.6.1 That the Province of Ontario, in consultation with the partner municipalities and the LSRCA, develop a climate change adaptation strategy to deal with future change and to build resilience in the municipal system. This strategy should include targets and a funding strategy to address the required actions.
- A.6.2 That the LSRCA, the partner municipalities and the province develop and incorporate climate change scenarios into long-range strategies

B USE OF BETTER MANAGEMENT PRACTICES

B.1 Stormwater Management

- B.1.1 That the LSRCA continue to undertake the completion of stormwater retrofit projects in partnership with municipalities, subject to budget allocations. Further that the federal and provincial governments throughout the watershed be requested to share in the cost of undertaking these projects
- B.1.2 That the LSRCA and its partners recognize that while the construction and/or retrofit of quality control facilities is extremely important, quantity control is also an important consideration in some areas of the subwatershed; therefore, quantity control facilities should be constructed in those areas where it is deemed appropriate but it is not possible to construct a full quantity/quality control facility.
- B.1.3 That the municipalities of the subwatershed are encouraged to work with the LSRCA to promote the increased use of innovative solutions to address stormwater management and retrofits such as requiring enhanced street sweeping and catch basin maintenance, particularly in those areas currently lacking stormwater controls; improving or restoring vegetation in riparian areas; rainwater harvesting; construction of rooftop storage and/or

green roofs; the use of bioretention areas and vegetated ditches along roadways; where conditions permit, the use of soakaway pits, infiltration galleries, and permeable pavement; the on-going inventory, installation and proper maintenance of oil grit/hydrodynamic separators combined with the use of technologies to enhance their effectiveness where this is appropriate; and where practical and feasible, enhance measures to control TSS

- B.1.4 That the partner municipalities establish a database of oil/grit separators in the subwatershed in order to track the number and location of these structures and to ensure that regular maintenance is being undertaken as per the design specifications of the structures
- B.1.5 That LSRCA initiate and monitor a pilot project to evaluate the effectiveness of reducing flooding and improving water quality by creating natural linear wetland facilities and/or reconnecting river floodplains. Should it be found to be effective, that further opportunities for undertaking these practices be explored and be implemented based on a cost/benefit analysis

B.2 Rural Water Quality

- B.2.1 That the LSRCA continue to implement programs to address rural non-point sources of pollution by providing landowners with financial and technical assistance from the federal, provincial, municipal governments and the Lake Simcoe Conservation Foundation, to implement best management practices on their lands. Further that a review of the current level of financial incentives and eligible projects be reviewed in partnership with the agricultural and rural communities
- B.2.2 That the LSRCA 'Landowner Environmental Assistance Program' (LEAP) which offers technical advice and financial assistance to the residents of the Lake Simcoe watershed, continue to be supported by the municipalities and various local committees for the Black subwatershed
- B.2.3 That the LSRCA work with federal, provincial, municipal governments, the Lake Simcoe Conservation Foundation and granting agencies to investigate and implement BMPs aggressively within the Lake Simcoe watershed
- B.2.4 That aggregate and major recreational uses, particularly in rural areas, be encouraged to utilize BMPs to ensure no runoff and dust control as part of the Lake Simcoe Phosphorus Reduction Strategy
- B.2.5 That the LSRCA assist in the creation of water reservoirs on agricultural properties, such as sod farms and market gardens, in order to capture water when it is most available and decrease the strain on water resources due to the requirements for irrigation

B.3 In-Channel

- B.3.1 That all channel alterations and realignments will undertake natural channel design and stream restoration where possible, to mimic to the extent possible, natural conditions, in accordance with the Ontario Regulation 179/06 under the Conservation Authorities Act and LSRCA's Watershed Development policies
- B.3.2 That LSRCA encourage the use of natural solutions and work with proponents to develop a balance between engineered solutions and natural solutions with the goal of minimizing erosion potential when structures require replacement

- B.3.3 That LSRCA will assist partner municipalities where technically feasible, to reduce the risk in flood-prone areas throughout the implementation of Natural Channel Design and other BMPs
- B.3.4 That LSRCA develop programs to provide technical and financial assistance to implement BMPs to reduce flooding

C CHANGING THE WAY THINGS ARE DONE 'ON THE GROUND'

C.1 Land Use Change

- C.1.1 That the partner municipalities adopt Low Impact Development (LID) practices for new developments throughout the watershed

C.2 Increased Infiltration

- C.2.1 That the LSRCA and the partner municipalities, as part of the implementation of the Lake Simcoe Phosphorus Reduction Strategy, ensure that the development industry maximizes the infiltration of stormwater where conditions permit, through the use of but not limited to the following: construction of rooftop storage and/or green roofs; the use of cisterns to store water; the use of bioretention areas and vegetated ditches along roadways; the use of soakaway pits, infiltration galleries, and permeable pavement
- C.2.2 That member municipalities in consultation with LSRCA review the practice of roadside 'ditch cleanouts' which leave existing vegetation in place to increase water infiltration, reduce ditch maintenance costs and reduce nutrient inputs into Lake Simcoe against the increases in road maintenance costs associated with imperfectly draining road beds and other liabilities; further to develop a strategy to reach a balance between environment and roads maintenance, and construction costs and public liability on adjacent lands

C.3 Construction Practices

- C.3.1 That the LSRCA and partner municipalities promote the adoption of sustainable site alteration and construction practices in the Lake Simcoe watershed, potentially through the use of grading permits
- C.3.2 That the partner municipalities work with the LSRCA, the development industry, and contractors to prepare a construction practices code, including a database that will deal with but not be limited to: the phased stripping of land; the use of dust suppressants; the control of runoff and sediment movement across the site; the design and use of temporary sediment basins; the on-site protection of existing natural features; the storage of topsoil and overburden materials; acceptable de-watering techniques; the populating of the database; and enforcement of these activities. In addition, this system should be monitored at selected sites to ensure its effectiveness

C.4 Operations

- C.4.1 That the partner municipalities and the Province should continue to explore the most environmentally friendly options for maintaining safe winter roads in order to protect the subwatershed's water quality and the aquatic communities residing within its watercourses. These options include ensuring the proper timing and amount of road salt application, as well as exploring the use of alternative de-icing substances, piloting and field testing options and effective salt management plans
- C.4.2 That the partner municipalities in the Black River subwatershed adopt the Code of Practice for the Environmental Management of Road Salts (Env. Canada, 2004) as a way of preventing increasing chloride concentrations in the Black River

- C.4.3 That the partner municipalities, where feasible, consider secondary treatment (eg constructed wetlands) for runoff from snow dumps; and monitor the effectiveness of any such facilities
- C.4.4 That the partner municipalities consider options for addressing the application of de-icing agents to private parking lots of a certain size (e.g. shopping malls)
- C.4.5 That the federal and provincial governments provide financial incentives to allow municipalities to implement an enhanced street sweeping program targeted to uncontrolled urban areas
- C.4.6 That the LSRCA work with its member municipalities to enhance efforts to reduce the input of sediments and contaminants into Lake Simcoe and its tributaries through activities including stormwater management, and the protection and enhancement of riparian buffers

D APPLIED RESEARCH AND SCIENCE

D.1 Rehabilitation Opportunities Identification (P reduction / Nutrient Offsetting)

- D.1.1 That in order to prevent an increase in P loading, the LSRCA and its partners need to research and undertake innovative methods of P reductions and/or trading
- D.1.2 That the LSRCA, Province of Ontario and member municipalities implement policies and actions developed from the results of the Assimilative Capacity Studies (Total Maximum Monthly Loads)
- D.1.3 That the LSRCA, its partner municipalities and the Province of Ontario encourage the implementation of the Lake Simcoe Phosphorus Reduction Strategy
- D.1.4 That the LSRCA undertake a more detailed catchment level analysis of phosphorus loading as well as that of BMP opportunities
- D.1.5 That the LSRCA with support of the partner municipalities, develop a framework for the development of environmental flow targets in the Black River subwatershed
- D.1.6 That while the current techniques used to improve water quality will remain important tools to try to meet water quality objectives, all partners (municipalities, Ministry of the Environment and LSRCA) must explore new and innovative practices being used around the world that can be used in conjunction with current practices, or perhaps where these practices are not feasible or practical to enhance water quality. These new techniques should be thoroughly researched to ensure that they are appropriate for use in the subwatersheds and achieve their stated purpose. Once this is verified, new practices should be used wherever it is appropriate and cost effective in order to achieve improvements in water quality
- D.1.7 That the partner municipalities involved in service delivery and the LSRCA, in partnership with the Ministry of the Environment, undertake a study to assess the feasibility of water reuse (e.g. the reuse of STP effluent) within the Lake Simcoe basin
- D.1.8 That the results from this BMP inventory should be prioritized and fed into the development of a stewardship plan for the subwatershed in order to focus the efforts of the LSRCA and its partners and ensure the greatest possible phosphorus reduction.
- D.1.9 That the LSRCA combine the findings of Phases I and II of the Best Management Practices Inventory with the GIS exercise that was undertaken to determine the amount of natural cover within 30 metres of the watercourses in the subwatershed to develop an implementation plan to restore naturally vegetated buffers within the subwatershed

- D.1.10 That the LSRCA continue to inventory priority subwatersheds for maximum nutrient reduction opportunities in both urban and rural areas
- D.1.11 That the LSRCA, MOE, and watershed municipalities work with the agricultural, development, and aggregate sectors to develop a wind erosion\dust control strategy to reduce phosphorus contributions from atmospheric deposition. Further that additional scientific monitoring and research be conducted to better qualify and quantify potential sources of atmospheric deposition
- D.1.12 That a strategy be developed by MOE in conjunction with LSRCA and the municipalities to enhance infiltration to supplement baseflow in watersheds where baseflow is insufficient to maintain stream health (quantity stressed). Technical and financial assistance should be provided to landowners wishing to implement BMPs, and further consideration should be given to requiring development in areas adjacent to these quantity stressed areas to maintain or improve the water balance in these priority areas
- D.1.13 That a strategy be developed by MOE, in conjunction with LSRCA and the municipalities, to protect hydrologic function in gaining reaches of stressed watersheds and enhance infiltration wherever possible to protect baseflow, locations of upwelling in order to maintain thermal stability

D.2 Aquatic

- D.2.1 That the LSRCA and its partners identify/review sites where reduction of discharge to streams has occurred and look for opportunities, through development, to potentially re-use, restore/retrofit a source of water for that specific part of the system
- D.2.2 That guidelines and policies to complement the Permit To Take Water (PTTW) regulation should be developed by MOE in conjunction with LSRCA, to restrict surface water (stream) takings from losing stream reaches to protect ecological integrity in those streams
- D.2.3 That LSRCA, in cooperation with the partner municipalities would support the use of rain water harvesting devices, such as cisterns, as a stormwater management option to be undertaken, and that an incentive program be created for landowners within the watershed willing to construct water harvesting devices

D.3 Terrestrial – Natural Heritage System

- D.3.1 That a field-based monitoring program be developed and undertaken by watershed partners (eg. LSRCA, MNR, Natural Resources Canada) to improve the analysis of natural heritage values across the Lake Simcoe watershed
- D.3.2 That the LSRCA and the partner municipalities investigate innovative ways and appropriate locations to increase the size of woodland patches in the Black subwatershed
- D.3.3 That the Ministry of Natural Resources ensure that rare and unique Natural Heritage features, be managed and protected through the development of Rare Communities Management Plans
- D.3.4 That the Ministry of Natural Resources undertake a study to update the status (presence and extent) of the Species at Risk in the subwatershed to be completed, the results of which would lead to some level of recognition in the municipal Official Plans and the incorporation of their habitat into the future Natural Heritage System
- D.3.5 That the LSRCA complete and implement its Natural Heritage System Phase 2: Restoration, Enhancement and Securement Strategy

- D.3.6 That a detailed landscape connectivity assessment be undertaken by LSRCA and the partner municipalities, as part of Phase II of the Natural Heritage System
- D.3.7 In conformance with the LSPP, that the LSRCA participate in further research to determine the extent and prevalence of invasive species within the Lake Simcoe watershed
- D.3.8 In conformance with the LSPP, that the LSRCA cooperate with partners and universities to research methods for preventing the establishment and spread of invasive species

E MONITORING (Reporting and Compliance)

E.1 Water Quality

- E.1.1 That the LSRCA continue to maintain and / or enhance the existing monitoring network. This sampling should be continued into the future to assess the state of water quality in the subwatershed, and determine/monitor any trends (including seasonal trends), emerging contaminants, or new substances of concern that may arise
- E.1.2 That expansion of the PWQMN be considered in the Lake Simcoe watershed to capture proposed land use changes that could impact water quality
- E.1.3 That the current LSRCA monitoring network be reviewed annually to ensure it meets the surveillance/compliance goals of the monitoring strategy and as required, allow for special projects to be undertaken to address emerging trends
- E.1.4 That the LSRCA expand the sampling programs for toxic substances within the watershed in cooperation with the Ministry of the Environment, the municipalities, and other partners for the purpose of evaluating the potential human health threats and reporting on the results to all watershed stakeholders and the public
- E.1.5 That LSRCA expand the water sampling program for pesticides and herbicides within the watershed, in cooperation with the Ministry of the Environment, and other partners
- E.1.6 That water quality results are analyzed and reported annually and that the information be used to update the LSRCA Watershed Report Card. Further, that stakeholders be provided access to the water quality data collected via the world wide web to increase distribution

E.2 Aquatic

- E.2.1 That the LSRCA develop and support a monitoring plan to expand the benthic sampling network throughout the Lake Simcoe watershed, including the Black River subwatershed
- E.2.2 That the LSRCA participate on recovery teams and implement local projects to enhance and protect Species and Risk within the Lake Simcoe watershed, as required at the request of the Ministry of Natural Resources

E.3 Development related

- E.3.1 That the LSRCA and its partner municipalities develop a protocol for the monitoring and compliance of current and existing facilities and future development sites pre, during and post construction to ensure continued maintenance and operational optimization. Monitoring would include phosphorus, sediment, and dust.
- E.3.2 That the LSRCA identify and assess representative fluvial geomorphic sites, and use them for long-term monitoring and assessment of change in stream /channel stability, channel form, sediment delivery, etc as a result of development in the Lake Simcoe watershed

E.3.3 That the LSRCA, in conjunction with the member municipalities, maintain a role in monitoring and reporting on the status of % impervious area, reporting in 5 year cycles as part of the update of the Black River Subwatershed Plan

E.4 Terrestrial

E.4.1 That LSRCA, in conjunction with the partner municipalities, undertake refinements, field verifications and updates of Natural Heritage and Land Use mapping

F MANAGEMENT, REHABILITATION, AND RESTORATION

F.1 Aquatic

F.1.1 In conformance with the LSPP, that the Ministry of Natural Resources lead the development of fish community goals and objectives for Lake Simcoe and its tributaries, in conjunction with the LSRCA and partner municipalities

F.1.2 In conformance with the LSPP, that the Ministry of Natural Resources investigate the fish community use of the lake-river interface to determine the importance of the Black River 'estuary'

F.1.3 That the LSRCA, in conjunction with the Ministry of Natural Resources, develop the fish community goals and objectives for coldwater and warmwater fish communities in the Black River and identify enhancement opportunities for each

F.1.4 That the LSRCA, in conjunction with the Ministry of Natural Resources support the development of a publicly supported, scientifically defensible Fisheries Management Plan for the Lake Simcoe watershed

F.1.5 That LSRCA and the Ministry of Natural Resources continue current co-operative fish community monitoring, assess information gaps and determine activities necessary to fill them

F.1.6 That the Ministry of Natural Resources and LSRCA work together to quantify and assess the quality of critical fish habitats in the lake and its tributaries

F.1.7 That the LSRCA evaluate and prioritize specific restoration/enhancement projects within the watershed to improve fish community and aquatic habitats within Lake Simcoe and its tributaries

F.1.8 That the LSRCA, in conjunction with the Ministry of Natural Resources and local partners, investigate opportunities to rehabilitate / restore estuary functions at the mouths of tributaries to Lake Simcoe

F.1.9 That the LSRCA initiate a study to investigate the feasibility of improving the hydrologic structure and restoring floodplain functions to the system of the lower Black River

F.1.10 That LSRCA work with municipal partners to improve in-stream habitat and connectivity through a priority setting exercise specific to barrier/dam removal or retrofitting. Further, that the LSRCA use the LEAP stewardship program to provide technical and financial support to willing participants. Targets for this 'reconnection' program may include (as examples): reducing the number of online ponds by 20% by 2015; and, where appropriate and consistent with municipal culvert reconstruction priorities and budgets, fix/replace documented perched culverts as opportunities arise

F.1.11 That as part of the current LSRCA BMP Inventory project, in locations where channel stability is already considered to be 'low', assess those sites, develop priorities, assess the possibility of using 'new'/innovative solutions and then repair

- F.1.12 That the LSRCA continue to work with owners of recently documented channelized reaches of stream to develop priority list and implement solutions, such as Natural Channel Design
- F.1.13 That LSRCA and its relevant partners support as a Pilot Project, the creation of wetland using tile drainage as the supply of water
- F.1.14 That the LSRCA continue to utilize buffer requirements and timing guidelines as part of its protection of coldwater resources and that the LSRCA undertake other programs including stormwater management upgrades and retrofits, riparian tree planting programs, and stewardship in the form of in-stream fish habitat works. These programs should be continued and enhanced into the future, with financial assistance and technical support provided by the LSRCA LEAP Program

F.2 Terrestrial

- F.2.1 That the LSRCA look for opportunities through development proposals and stewardship initiatives to increase streambank vegetation in the Black River subwatershed
- F.2.2 That the Black River subwatershed's woodland (approximately 38% of the subwatershed area) be protected to the extent possible in order to maintain the ecological functions it performs
- F.2.3 That the LSRCA identify opportunities for restoration, enhancement and securement of priority sites to support the needs of the Natural Heritage System for Lake Simcoe as it relates to the Black River subwatershed; specific to the catchment, woodlands restoration efforts should focus on enhancing the 'Big Woods' area to enhance its function
- F.2.4 That the partner municipalities, in conjunction with the LSRCA, develops a plan to replace plantation species with preferred native species through succession, in a manner that will maintain the water quality, provide habitat, encourage infiltration and soil stability functions of the plantations. Plan implementation will take advantage of both stewardship and private land development opportunities

F.3 Invasive Species

- F.3.1 That LSRCA support the work of MNR and the OFAH with respect to Invasive Species and encourage the promotion and distribution of information regarding the status of and management options for their control
- F.3.2 That the partner municipalities adopt policies to promote and encourage the planting of native species (particularly drought tolerant species) through development approvals and property management programs.

F.4 Water and Land Management

- F.4.1 That the LSRCA continue to undertake Land Securement activities in order to protect target areas. The LSRCA will use a criteria screening tool to determine those lands that are currently not protected and where purchase is the most appropriate protection action. In addition, alternatives to purchase should be considered, eg. Alternative Land Use Services (ALUS) as another means of long term protection
- F.4.2 That the LSRCA continue to undertake stewardship initiatives throughout the Lake Simcoe watershed. Priority areas for undertaking stewardship activities maybe identified through Phase 2 of LSRCA's Natural Heritage System

- F.4.3 That LSRCA request the Ministry of Natural Resources to undertake the development of watershed rare lists and protection policies for all flora and faunal groups
- F.4.4 That the LSRCA work with its municipal partners to investigate efforts that could be made to improve public properties for long term environmental benefit and sustainability
- F.4.5 That the LSRCA, the partner municipalities, and developers work to identify opportunities for undertaking restoration works as part of development applications (e.g. re-establishing riparian buffers, naturalizing farmed areas)

G ADAPTIVE RESPONSE (climate, social, political)

G.1 Climate Change

- G.1.1 That LSRCA and partners develop mitigation and adaptation strategies for various sectors that incorporate the research of scientists, resource managers and other stakeholders to enhance the ability of our systems to adapt to the changing conditions and increase the resilience of the system
- G.1.2 That LSRCA work with university partners to refine the anticipated impacts of climate change in the Lake Simcoe watershed. This information can then be used to develop management strategies to address these impacts
- G.1.3 That the LSRCA and the partner municipalities will work with watershed partners to reduce their carbon footprint and to increase the ecological resilience of the Lake Simcoe watershed

G.2 Water Studies

- G.2.1 That the LSRCA and the partner municipalities promote and support water conservation initiatives, such as York Region's 'Water for Tomorrow' program
- G.2.2 That the Low Water Response program be continued to ensure that water supply and ecosystem integrity can be protected and maintained in low water conditions; further that the Provincial / LSRCA Low Water Response system and municipal lawn watering bans and advisories be better integrated to provide consistent messaging and better adoption of water restrictions during dry or drought periods. Also that the municipal partners consider the utility of enacting a water conservation by-law
- G.2.3 That interim targets for water takings should be established by the Ministry of the Environment based on environmental flows
- G.2.4 That the LSRCA undertake and update flood control studies within the Lake Simcoe watershed to identify opportunities to reduce the potential for flooding by reducing peak flows, as scheduled in the LSRCA business plan
- G.2.5 That the Province of Ontario reinvest in flood warning and flood plain mapping programs within the watershed. Further that the current flood warning network be expanded throughout the watershed including the addition of at least two full meteorological stations
- G.2.6 That the LSRCA develop a program to provide technical and financial assistance to landowners wishing to flood-proof their homes in floodplain and prone areas

H COMMUNICATIONS

H.1 Web-based

- H.1.1 That the LSRCA will update its website with findings and recommendations of the Black River Subwatershed Plan

H.1.2 That the LSRCA investigate the feasibility of using 'Facebook' and other non-conventional means of web-based communication to improve uptake and understanding of the subwatershed plans and their future implementation

H.2 Community / Partnership Outreach

H.2.1 That the LSRCA and the partner municipalities will engage the community of the Black subwatershed through public information sessions and invite/encourage their participation in developing the future implementation plans

H.2.2 That LSRCA investigate new and innovative ways of reaching target audiences in the local community and engage/involve them in restoration programs and activities eg high school environmental clubs, through Facebook groups, hosting a Lake Simcoe Environment Conference for high schools/science community interaction

H.2.3 That the LSRCA continue to ensure transparency and reasonable access to data, reports, and decisions of the LSRCA related to the subwatershed plans and their implementation

H.2.4 That co-ordinated, widespread education and outreach should be implemented; focused on using best management practices to prevent the spread of invasive species and the destruction of aquatic habitat in order to protect the integrity of the Lake Simcoe watershed. These programs should be targeted to their audiences, from school groups to residents and recreational users to ensure that they are effective

H.2.5 That the LSRCA work with partner agencies (eg. OFAH, MNR) to enhance communications to prevent the introduction and spread of invasive species in the watershed

H.2.6 That the LSRCA promote programs encouraging people to return pet fish to stores, rather than releasing them to area watercourses, in order to prevent the introduction of non-native species to the subwatershed

H.3 Promotion

H.3.1 That the LSRCA promote enhanced relationships between all sectors to work towards the goal of more sustainable development

H.3.2 That LSRCA undertake more widespread promotion of the LEAP and other programs that it undertakes

H.3.3 That LSRCA hold workshops/seminars to educate landowners about key issues and inform them of the programs available to resolve these issues

H.4 Print/Air/TV

H.4.1 That LSRCA expand its media network to enhance the promotion of its stewardship programs and research to a wider audience

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