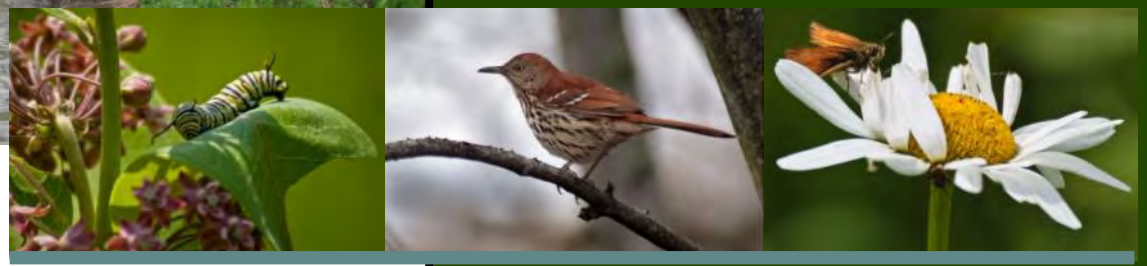
FINAL - May 2012

Lynde Creek Watershed Plan



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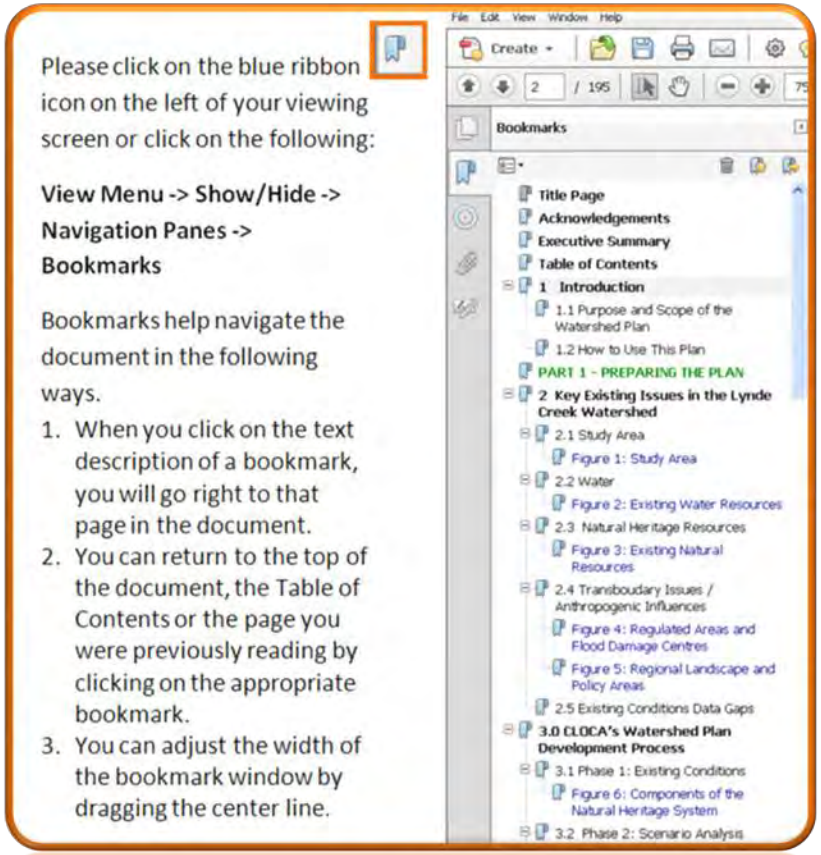

ACKNOWLEDGEMENTS AND SPECIAL THANKS

Many members of CLOCA's staff have played a role in the development of the Lynde Creek Watershed Plan. The fulsome nature of this Watershed Plan is reflective of the significant effort undertaken by CLOCA's Natural Heritage, Engineering, and Groudwater teams who collected field data, analyzed the findings, ran models, prepared reports and reviewed the Plan and its components. Special mention goes to the work of CLOCA's GIS staff who have generated the maps, managed the data, produced display material, provided statistics, and contributed many hours to the creation, evaluation and analysis of various models. Other members of CLOCA staff have provided their support, which has been invaluable with the consultation and communication of the Plan. Sincere appreciation and gratitude is expressed to Debbie Vandenakker Watershed Planner, and to former CLOCA staff Jonathan Staples and Tammy Chung. Their significant individual contribution to this Plan has been outstanding and is commended.

I also wish to thank those who have participated in the Lynde Creek Watershed Plan consultation process. Your insightful comments and suggestions have positively contributed to this Plan.

Without the expertise, advice, support and knowledge provided from the many contributors, this Plan would not be what it is today.

Thanks to all!

Heather Brooks, MCIP, RPP
Director, Watershed Planning and Natural Heritage
Central Lake Ontario Conservation Authority

EXECUTIVE SUMMARY

The goal of watershed planning is to provide a framework to protect, restore and enhance a healthy and resilient watershed. A Watershed Plan examines the environment and human activities within a watershed area and assesses the relationships between these activities to determine how the ecosystems of the watershed should be managed to ensure they retain their ecological integrity and health in a sustainable manner.

The purpose of the Lynde Creek Watershed Plan specifically is to be ***the definitive tool used by CLOCA, municipalities, planning authorities, agencies and all other stakeholders to guide decisions regarding the effective management of watershed resources in response to a changing environment.*** This Plan recognizes the unique urban, rural and natural environment conditions present in the watershed, considers future growth and planning policy, and recommends specific measures to protect our resources.

The goal of this Watershed Plan is to achieve healthy natural systems within the Lynde Creek Watershed which can positively respond to landscape changes and watershed conditions while sustaining its ecological health and integrity. This Plan provides the framework that will protect, restore and enhance the natural resources in the watershed to ensure it will continue to function as a system of healthy natural interactions in response to a quickly changing social, economic and natural landscape.

This Watershed Plan does not prescribe land use. Rather, at a watershed scale, it informs municipalities and makes recommendations regarding the natural features and functions necessary to achieve watershed health, which in turn helps protect the natural, social, cultural and economic capital of the watershed.

Implementation of the Watershed Plan will be carried out predominantly by CLOCA, the Region of Durham and the local municipalities through the Action Plans and policy recommendations described herein.

Sections 1, 2 and 3 – Preparing the Plan

The first three sections of this Watershed Plan provide some introductory context, review a summary of the watershed's existing conditions and review CLOCA's watershed plan development process. Together, these sections illustrate all of the background and process information regarding the development of the Watershed Plan.

Sections 4 through 7 – Managing the Watershed

Section 4 provides a look at a "Healthy Lynde Creek Watershed" through the identification of watershed health targets that, if achieved, would indicate that the watershed has achieved a healthy condition. To achieve these targets a "Watershed Management Plan" has been developed and depicted as a map in Figure 13. This map illustrates the key components of the watershed for protection, restoration and

enhancement that will allow health targets to be met. Components include the delineation of the Oak Ridges Moraine, the Lake Iroquois Beach, a 1km buffer of the Lake Ontario Shoreline, High Volume Recharge Areas (HVRAs), Regional Wildlife Movement Corridors, the Natural Heritage System (NHS) and Manicured Greenspace. Together, these elements represent all of the fundamental aspects of meeting key watershed health targets and have been amalgamated into one mapping product and translated into a Management Plan.

Section 5 – CLOCA Responsibilities describes CLOCA's strategic priorities for managing the watershed through the implementation of the Watershed Plan and describes 23 Action Plans for CLOCA to undertake that have been identified as necessary for achieving various watershed health targets.

Section 6 – Municipal Partners includes policies that have been created as tools for our partner municipalities to incorporate into their Official Plan documents. These policies translate watershed goals, objectives and targets into municipal policy language so that our municipal partners have the effective policy instruments to implement the recommendations of this Watershed Plan.

Section 7 – Other Partners and Stakeholders provides strategic priorities for affecting positive changes in the watershed with residents, land owners, schools, community groups, business and the development community.

Sections 8 and 9: Monitoring and Next Steps

These final two sections take us beyond watershed plan implementation, providing advice and guidance on performance monitoring and assessment of progress made in achieving the healthy watershed targets.

Consultation was undertaken to present and seek feedback on the *Phase 1: Existing Conditions*, *Phase 2: Scenario Analysis* and *Phase 3: The Watershed Plan* work. All comments and suggestions have been incorporated where appropriate and CLOCA looks forward to the continued engagement of our stakeholders to implement the recommendations of the Watershed Plan.

Stakeholders can gain a stronger understanding and appreciation of the natural environment and the incredible opportunities available within this watershed through the implementation of this Watershed Plan. Municipalities will be able to balance the environmental, economic and social/cultural needs of residents to ensure healthy, vibrant and sustainable communities into the future. The Conservation Authority can continue to fulfill its mandate to responsibly manage the resources of the watershed for all to enjoy. All other stakeholders can benefit from the vast opportunities a healthy watershed offers for economic, social and cultural enrichment. To ensure that a healthy watershed is available for all of these people, activities and opportunities, it must be supported through the strong implementation of this Plan.

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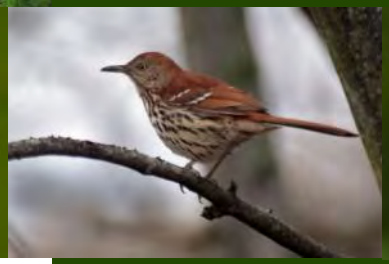
Lynde Creek Watershed Plan– Part 1: Preparing the Plan



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1 INTRODUCTION

The Central Lake Ontario Conservation Authority (CLOCA) is preparing updated Watershed Plans for each of the major watersheds within its jurisdictional boundaries. This document represents the third and final step in the development of the Lynde Creek Watershed Plan and aims to provide readers with a science-based compilation of recommendations to protect, preserve and enhance the Lynde Creek Watershed in compliance with the legislative requirements of the Oak Ridges Moraine Conservation Plan, and in the context of other provincial policies and legislative directions (see **Appendix A** for full details).

The goal of this Watershed Plan is to achieve healthy natural systems within the Lynde Creek Watershed which can positively respond to landscape changes and watershed conditions while sustaining its ecological health and integrity. This Plan provides the framework that will protect, restore and enhance the natural resources in the watershed to ensure it will continue to function as a system of healthy natural interactions in response to a quickly changing social, economic and natural landscape. Through the identification of watershed goals, targets and recommendations, the resources of the watershed can be managed in a sustainable manner. To support and direct watershed management, a detailed implementation plan identifying key stakeholders and providing a suite of implementation tools is provided. These tools include policy direction and action items to be used to actively pursue the realization of watershed goals, recommendations and targets. The key stakeholders of this watershed include CLOCA, municipalities and other partners (residents, NGO's, volunteers etc.) who all have a role to play in watershed health. Implementation of the recommendations of this Watershed Plan is crucial for achieving watershed health and requires stakeholder commitment in the form of approval/endorsement, financial and in-kind support and sharing of resources.

WHY IS WATERSHED PLANNING IMPORTANT?

- Everything is connected to everything else. Upstream activities affect the quality and quantity of water downstream.
- Surface and groundwater systems can be easily contaminated and have a limited tolerance for stress. Long term problems can develop that are costly and difficult to deal with in the future so preventative actions are required now.
- Water and natural heritage resources can be protected more efficiently if watersheds are managed as whole ecosystems. By using a watershed approach to managing our resources, harmful impacts on the system can be identified quickly so that prevention, remediation or improvements can be carried out right away.

http://conservationontario.on.ca/watershed_management/index.html

By participating in the pursuit of watershed health targets, stakeholders can gain a stronger understanding and appreciation of the natural environment and the incredible opportunities available within this watershed. Municipalities will be able to balance the environmental, economic and social/cultural needs of residents to ensure healthy, vibrant and sustainable communities into the future. Through the execution of this Watershed Plan, the Conservation Authority can continue to fulfill its mandate to responsibly manage the resources of the watershed for all to enjoy.

This document summarizes the background work conducted to prepare the Plan and presents it in Sections 1, 2 and 3. The

Watershed goals and targets which provide the basis for sustainable watershed management, are presented in Section 4. The information contained in this Section of the Plan sets out the various watershed goals, objectives, targets and indicators necessary to achieve a healthy watershed that is resilient to anticipated changes. Direction on how to manage the watershed to achieve these goals and targets is set out in Sections 5, 6 and 7, with each Section dedicated to one of the three key stakeholders identified for Watershed Plan implementation. The remaining two Sections take us beyond watershed plan implementation, providing advice and guidance on performance monitoring and assessment of progress made in achieving the healthy watershed targets.

1.1 Purpose and Scope of the Watershed Plan

The goal of watershed planning is to provide a framework to protect, restore and enhance a healthy and resilient watershed. A Watershed Plan examines the environment and human activities within a watershed area and assesses the relationships between these activities to determine how the ecosystems of the watershed should be managed to ensure they retain their ecological integrity and health in a sustainable manner.

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The Lynde Creek Watershed Plan is intended to be read and applied in its entirety as it is a comprehensive, integrated and long-term approach to watershed management.

1.2 How to Use This Plan

The main document has been separated into two parts. Part 1 discusses all aspects of preparing the Plan, while Part 2 provides all of the direction recommended for managing the watershed. Hyperlinks have been provided throughout the document to direct electronic readers to either external additional documentation or as an internal re-direct to the glossary of this document when an uncommon word is used for the first time. The document has been structured for ease of use and reference by the reader. Electronic use is encouraged wherever possible to avoid excess paper use through hard copy printing.

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2 Key Existing Issues in the Lynde Creek Watershed

This section will provide readers with an overview of the notable existing conditions within the watershed. For the full scope, methodology and data, please view the Phase 1: Lynde Creek Watershed Existing Conditions Report.

2.1 Study Area

Lynde Creek and its tributaries drain an area of approximately 130 km^2. **Figure 1: Study Area** illustrates that the watershed is located entirely within the Regional Municipality of Durham and traverses through five local municipalities: the Township of Uxbridge, Township of Scugog, City of Pickering, Town of Ajax, and the Town of Whitby. Lynde Creek's headwaters originate in the Oak Ridges Moraine (ORM) and the creek outlets into Lake Ontario through Lynde Creek Marsh. The Lake Iroquois Beach crosses in an east-west direction through the centre of the watershed. South of the Oak Ridges Moraine, the landscape is dominated by farmland. The urban area of the Town of Whitby occupies most of the south portion of the watershed, with Lynde Shores Conservation Area forming the dominant open space on the Lake Ontario waterfront. The Village of Brooklin is located within the central portion of the watershed, and has seen tremendous growth in the last 15 years. Heber Down Conservation Area also lies within the middle of the watershed. There are six hamlets located within the Lynde Creek Watershed: Ashburn, Macedonian Village, Almond Village, Kinsale, Myrtle, and Myrtle Station. Lake Ontario is the ultimate drainage point for the entire watershed and provides 100% of our municipal drinking water supply as well as other economic, recreational and ecological benefits. Protection of the Lake is an essential component in ensuring Durham Region's economic, social, and environmental health, as well as its sustainability into the future.

2.2 Water

Water is the cornerstone of protecting and enhancing a watershed. Every element of ecosystem health, and many elements of human health, depend on ground and surface water systems to support fundamental aspects of life.

2.2.1 Groundwater Quality and Quantity

Groundwater is a hidden resource beneath the earth's surface which helps to ensure streams flow year round and that stream temperatures are maintained at levels conducive for fish and other aquatic life. In the Lynde Creek Watershed, groundwater also provides drinking water to some rural residents, and is used in the operation and maintenance of agricultural activities and other rural land uses, including parks and recreation (golf/ski).

High Volume Recharge Areas (HVRAs) play an important role in the protection of groundwater resources. These areas are identified as having 15% or more groundwater recharge capability that the average areas of the watershed. These areas are needed to allow the infiltration of surface water into the ground to replenish aquifers but they also provide the conduit for carrying surface water contaminants into our groundwater sources. As such, these areas require special consideration for protecting watershed health.

FIGURE 1: STUDY AREA

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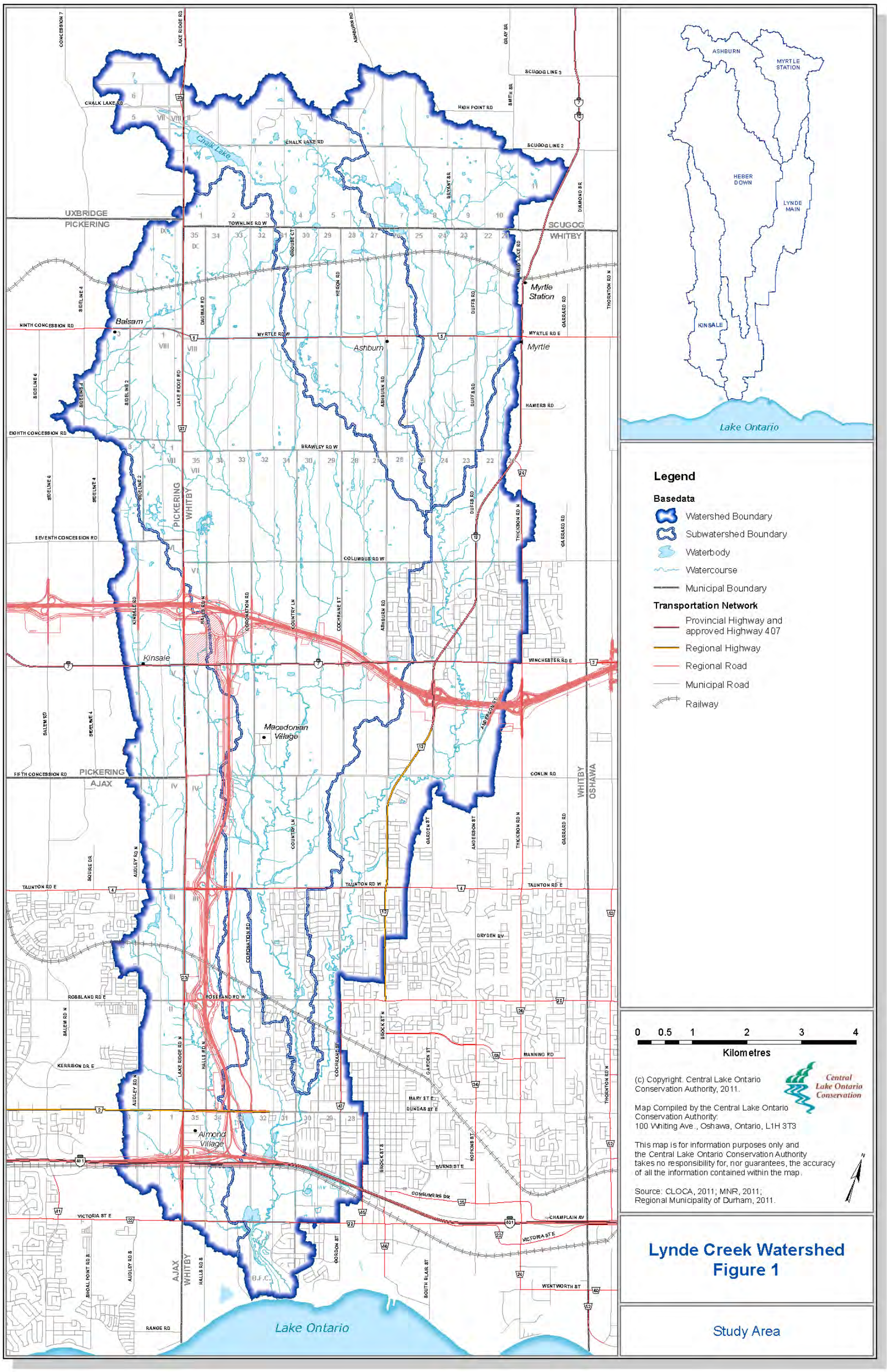

The following outlines key conditions found in the Lynde Creek Watershed regarding groundwater quality and quantity:

- High chloride concentrations in Heber Down Conservation Area and near Lake Ontario shoreline (potential road salt impact);
- High nitrate levels in Macedonian Village;
- Demand Stress Level = Moderate; and
- Approximately 8000 private groundwater wells.

2.2.2 Surface Water Quality

Surface water quality is a key indicator of watershed health and has particularly strong impacts on fish and other aquatic life. As all municipal drinking water is provided from Lake Ontario, the quality of the surface water flowing into the Lake from watershed streams becomes important for human health as well. Different types of water quality information (biological and chemical indicators) have been collected by CLOCA and MOE through the Provincial Water Quality Monitoring Network Program (PWQMN)since 1964.

The following outlines key conditions found in the Lynde Creek Watershed regarding surface water quality:

- **Benthics:** 14 sites sampled, 7 considered impaired; 75% of urban sites impaired; 83% of sites in natural areas unimpaired; and 50% of sites in agricultural areas unimpaired;
- **Biological Oxygen Demand:** The presence of a persistent organic load to the system in some reaches;
- **Dissolved Oxygen:** All sites measured at 8-10 mg/L indicating sufficient levels to support cold water systems;
- **Chloride:** Increasing trend but well below the 150 mg/L limit (higher in southern reaches of watershed and in winter months

Erosion… As a stream meanders through the watershed, the energy of the flowing water is able to pick up and transport sediment, and subsequently deposit the sediment where water flows more slowly. This process is on-going throughout the full reach of the stream, and generally stream banks erode on the outside meander bends, and sediment bars build on the inside of the meander bends. The position of the stream continuously moves through this sediment movement process. Spring rains, large rainfalls, or disturbances including beaver dams all influence the rate of stream movement. When a stream meanders into a trail or structure, a hazard is created. Similar to the flooding scenarios outlined above, allowances must be provided to minimize the hazard created by a meandering stream. As a simple rule of thumb, the meander belt for a stream is typically about 20 times the bank full width of the stream. By plotting the meander belt, and keeping new developments out of this hazard, future problems can be minimized.

Similarly, in a contained valley, a stream will sometimes meander into the valley slope. Over time, the stream flowing against the toe of the valley slope will undermine the slope, and may lead to a collapse of the slope. It is again important to provide allowances for a stream flowing in close proximity to the toe of the valley slope to ensure developments are kept a safe distance away from the potentially hazardous slope.

Our valley systems are formed by erosion processes either from glacial melt waters or more recent stream erosion. Some valleys are left with very steep slopes that can be unstable. These steep slopes may not show any signs of failure for long periods of time, but a wet season, or dying tree may be all that is needed to destabilize a steep slope. Once again, allowances are needed to ensure developments are situated a safe distance from a steep slope hazard.

between December and March). Surface water quality and shallow aquifer systems are susceptible to road salting.

- **Phosphorus:** Generally < 30 ug/L, meeting the Provincial Water Quality Monitoring Network (PWQMN) standards for streams;
- **Nitrates:** Increasing trend; and
- **Copper:** Decreasing trend (some exceedances of the 5 ug/L limit were recorded in SWQ9 in Lynde Creek).

2.2.3 Surface Water Quantity

A stream flow monitoring network has been established within the Lynde Creek watershed along with an extensive baseflow monitoring program. This monitoring network, coupled with low flow investigations of 140 sites, snow pack surveys, climate stations, and detailed hydrologic and hydraulic models, provides the basis from which surface water resources are managed within the watershed.

The following outlines key conditions found in the Lynde Creek Watershed regarding surface water quantity:

- "Significant" surface water stress (i.e. more demand than supply) especially in summer;
- Annual streamflow has been decreasing since 1998; and
- 11,554,667 L/day of reported surface water takings.

2.2.4 Water Temperature

Water temperature is one of many criteria used to assess the water quality of a stream and the health of the aquatic habitat within it. Many organisms require particular thermal regimes to survive, and cannot tolerate extreme changes in water temperature. Accurate temperature representation also provides key validation information with respect to identifying areas of potential groundwater discharge. This in turn supports the knowledge around potential groundwater flow path and recharge area identification. The Lynde Creek Watershed has predominantly cold/cool water thermal regimes throughout the watershed.

2.2.5 Fluvial Geomorphology

Fluvial Geomorphology is the study of how waterways react and evolve to changes. Stable stream systems (despite the term) are dynamic, with erosion, sediment transport and deposition all naturally occurring. These processes cause a stream to "migrate", although the rate of movement may be quite gradual.

The following outlines key conditions found in the Lynde Creek Watershed describing the fluvial geomorphology conditions:

- Typical geomorphology of moraine-fed streams;
- Headwater streams originate on the south shoulder of the Moraine where groundwater discharges to the surface;
- Private residential manicured lawns extend to the creek banks in the Winchester / Brooklin area;
- Lack of riparian vegetation in the Taunton Road, Rossland Road and Regional Road 23 areas; and
- Stream instability downstream of the SWM pond south of the Brooklin community centre.

Figure 2 illustrates the existing water resources in the Lynde Creek Watershed.

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FIGURE 2: EXISTING WATER RESOURCES

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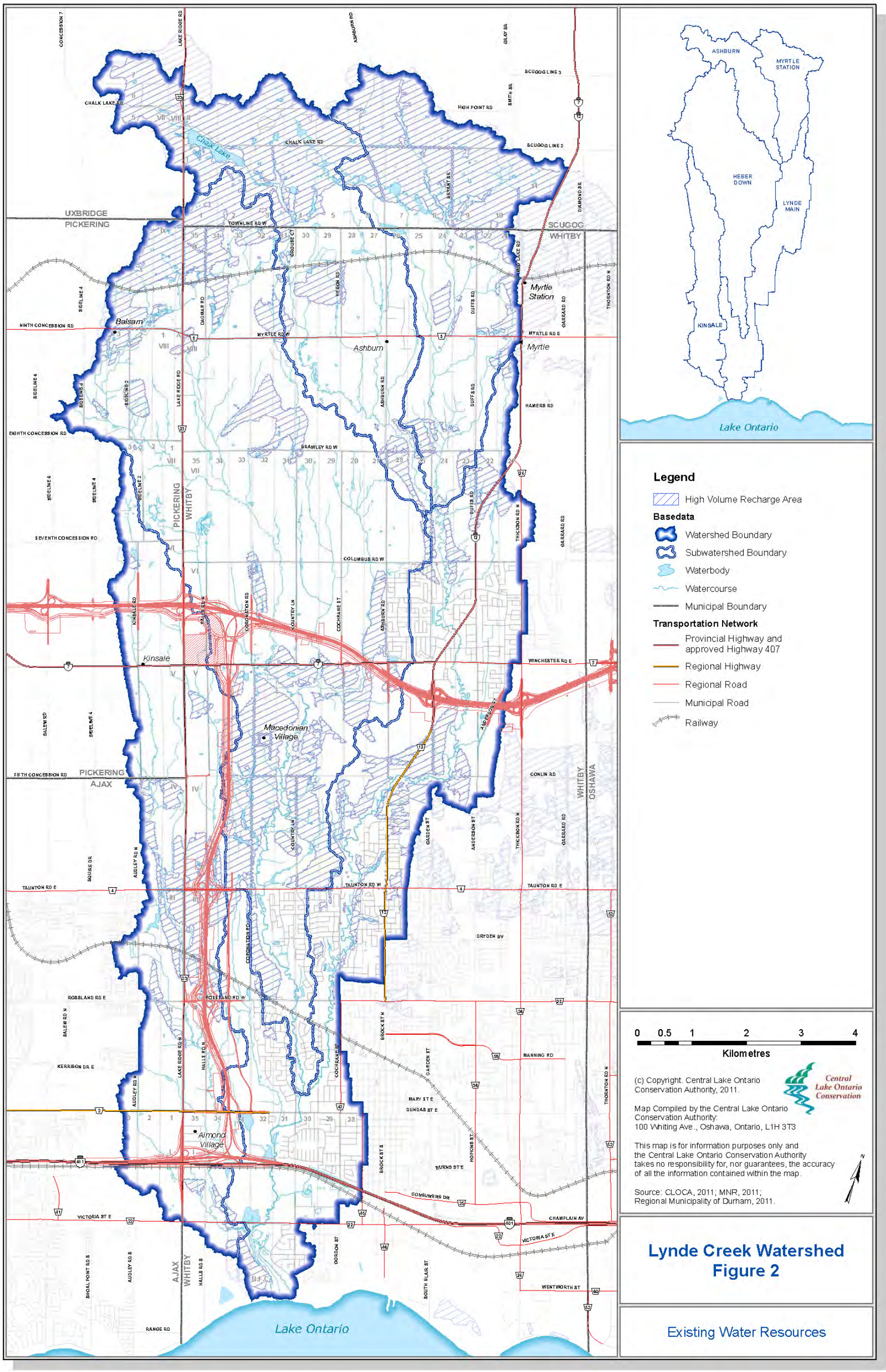

2.3 Natural Heritage Resources

The natural heritage resources in the watershed consist of the terrestrial, fisheries and aquatic features and functions as a system. These resources are pivotal components of a healthy watershed. **Figure 3** illustrates the existing natural heritage resources in the watershed.

2.3.1 Terrestrial Natural Heritage

Terrestrial natural heritage includes plants, animals and natural communities associated with the land. Terrestrial natural heritage elements are essential components of watershed health in general and can have a strong influence on water quality and quantity as well as biodiversity. Anthropogenic influences and uses of the land are considered part of the terrestrial system. A healthy terrestrial natural heritage system contributes to the strength of Durham Region's social and economic vitality.

Overall, the Lynde Creek watershed is in moderate condition from a terrestrial resources perspective. The following outlines key conditions found in the Lynde Creek Watershed describing the existing terrestrial natural heritage systems:

- Some high quality, well-connected habitat areas, many of which provide forest interior conditions and support Species at Risk (SAR);
- The quality of the entire terrestrial network is degraded as a result of habitat and corridor fragmentation from land use development;
- Numerous restoration opportunities exist, which could contribute significantly to the strength of the habitat network in this watershed;

- 29% natural cover;
- 17% forest cover;
- 10% wetland cover;
- Highly invasive species are present in the watershed;
- 20 ELC (Ecological Land Classification) communities present;
- Relatively well-distributed habitat;
- Variety of habitat types and shapes and majority of forest patches fragmented by roads and residential development. No existing 200 ha forest patches;
- 1% forest interior, 0.2% deep forest interior; and
- Landscape corridors are generally between 50 m and 100 m wide, but there are no corridors exceeding 100 m in width outside of the Oak Ridges Moraine, Lake Iroquois Beach and Lake Ontario Shoreline.

2.3.2 Fisheries and Aquatic Habitat

Familiar examples of aquatic ecosystems are lakes and rivers, but they also include areas such as floodplains, wetlands and riparian corridors. Wetlands help improve water quality, reduce flood peaks and recharge groundwater aquifers. Fisheries and aquatic habitat in general provide cultural, heritage and scientific values, as well as a rich diversity of plant and animal life. Additionally, they support a variety of human interests such as fishing and recreation.

The following outlines key conditions found in the Lynde Creek Watershed describing the existing fisheries and aquatic habitat systems:

- Urbanization and intensive agriculture land uses create water quality degradation, increased stream temperatures and other negative impacts to aquatic life;
- The watershed generally supports healthy fisheries including Brook Trout and Rainbow Trout populations, and designated Species at Risk (Redside Dace and Eastern Pond Mussel);
- Coastal wetland health indicators range from poor to good quality;
- Serious threat of dispersal of invasive species such as Rudd, Tubenose Goby, European Ruffe and Round Goby from Lake Ontario;
- 6 known physical barriers to fish and riparian habitat within watercourses; and
- 34% riparian cover along the 326 km stream lengths.

Lynde Main Subwatershed *© CLOCA*

Lynde Creek Marsh *© Lou Wise*

© CLOCA

Heber Down Subwatershed *©CLOCA*

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FIGURE 3: EXISTING NATURAL HERITAGE RESOURCES

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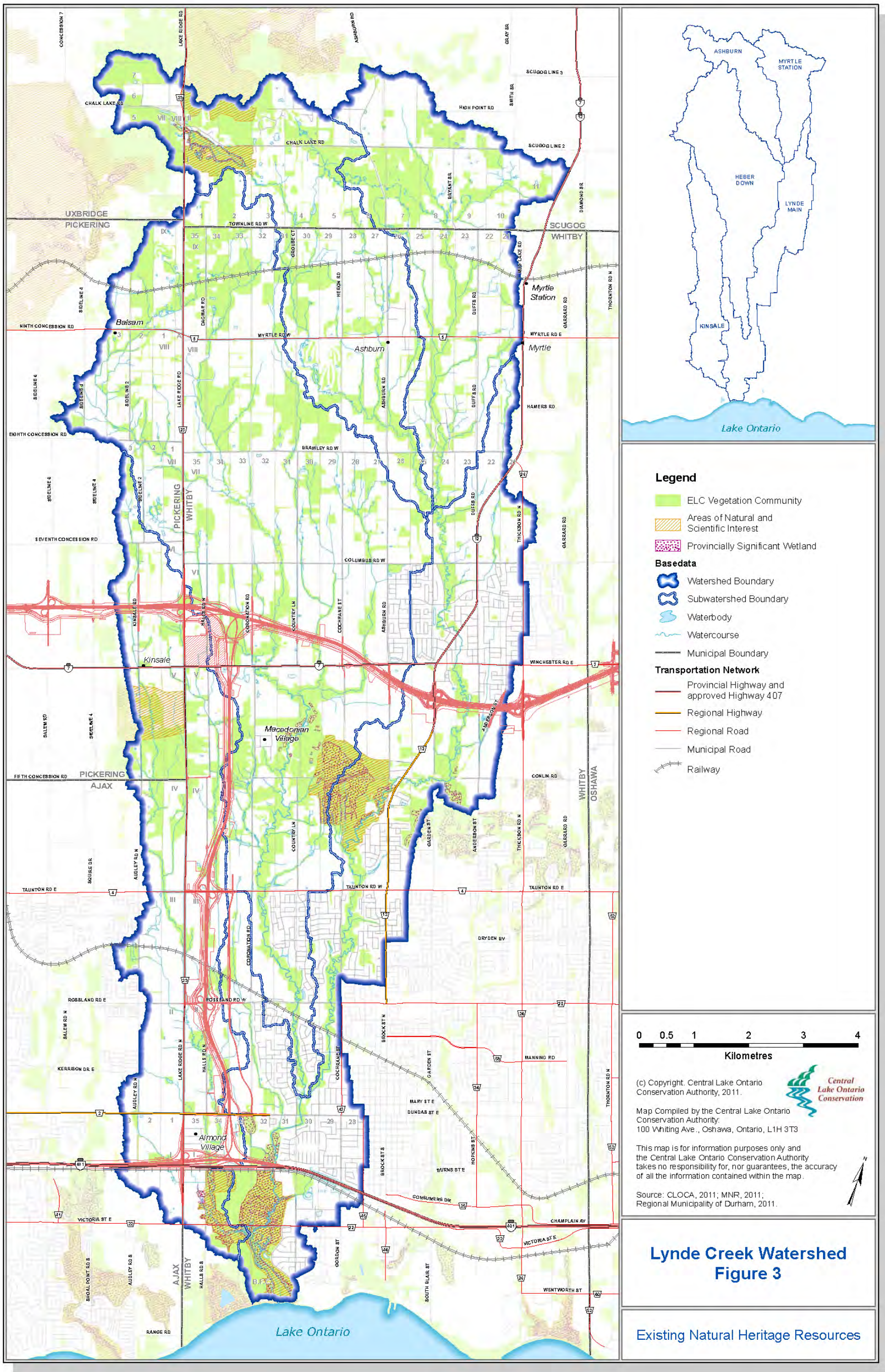

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2.4 Transboudary Issues / Anthropogenic Influences

The goal of this Watershed Plan is to protect, restore and enhance the Lynde Creek Watershed to a healthy and resilient state with ecological integrity. Ecological integrity means a natural state. This is the ultimate goal as features and functions of an ecosystem in their natural state offer the best quality features and the most efficient and effective functioning of resources. In light of this, it is important to recognize the significant impacts that humans have on ecosystems and plan for these impacts on watershed health. This section identifies some of the largest anthropogenic influences, as well as issues that reach beyond this watershed's boundaries, on the natural resources of the watershed and carries these components of watershed health through to the implementation recommendations of this Plan.

2.4.1 Impervious surfaces

Impervious surfaces (such as roads, buildings, parking lots etc.) interrupt the natural hydrologic cycle by preventing the infiltration of rainwater into the ground, increasing the volume, rate and temperature of stormwater runoff, and increasing the concentration of pollutants carried to the receiving watercourse. In addition, cumulatively, these changes adversely impact aquatic and other biological communities.

The following outlines key conditions found in the Lynde Creek Watershed describing existing impervious surfaces:

- 9.2% watershed imperviousness;
  - Lynde Main Subwatershed: 21.7% (most urban land area)
  - Kinsale Subwatershed: 5.6%
  - Heber Down Subwatershed: 5.4%
  - Ashburn Subwatershed: 3.6%
  - Myrtle Station: 3.0%
- 28.35% imperviousness in existing urban areas;
- 8.22% imperviousness in existing HVRA lands;
- Urban areas (lands with the greatest amount of impervious surfaces) predominate from Columbus Road south to Lake Ontario and are primarily situated within the easterly half of the watershed;
- The sum of paved roadway surfaces represents the majority of the watershed impervious areas (after urban land use); and
- Highway 407 and the Highway 401-407 west connecting link will cross through the Lynde Creek Watershed, increasing the amount of imperviousness in the watershed.

2.4.1 Stormwater Management (SWM)

SWM is the practice of controlling runoff (resulting from development) to prevent downstream erosion, flooding and water quality degradation. SWM can also assist in maintaining groundwater recharge where relevant and is a vital component of maintaining watershed health in a developing watershed. Stormwater Management is not the sole responsibility of any one organization but must be considered by several planning agencies and as such, CLOCA works with municipal partners to ensure that all development applications prepare a plan for managing urban runoff to minimize the surface water impacts of development.

The Ministry of the Environment (MOE) has published a Stormwater Management Planning and Design Manual (SWMPDM - MOE, 2003) that provides minimum design standards. In addition to the guidelines set by the province, CLOCA has its own watershed-specific guidelines. The CLOCA developed guidelines were created considering the specific characteristics and needs of each watershed. The stormwater management criteria set for Lynde Creek watershed is of the highest industry standards.

The following outlines key conditions found in the Lynde Creek Watershed describing existing stormwater management facilities:

- Twenty-two (22) SWM ponds;
- Ten (10) known Oil Grit Separators (OGSs);
- SWM ponds are designed to provide control for quality, quantity or both;
- Performance monitoring data is not available for most facilities; and
- Older parts of Brooklin and Whitby do not have SWM facilities.

2.4.2 Floodplains and Flood Damage Centres

A stream can turn into a raging floodpain when a significant weather event occurs. These events could be once in a lifetime floods, but can cause incredible damage and suffering. The Conservation Authorities develop floodplain mapping using computer models to simulate large flooding events. The Ontario Ministry of Natural Resources provides provincial guidance and established standards for floodplain modeling and mapping. For the CLOCA jurisdiction and the Lynde Creek Watershed, flood plain mapping is based upon the greater of a 100 year storm or Hurricane Hazel. It is important to determine the extent of floodplain throughout a watershed so that we can ensure new structures and development are located outside of the flood hazard. Similarly, when new bridges and roads cross our stream valleys, flood analysis must be completed to ensure that floods can be safely passed

Stormwater Management Pond s - Lynde Creek Watershed © CLOCA

through the structures without causing damage to the structures or the lands upstream and downstream.

A **flood damage centre** is an area consisting of residential, commercial and institutional development that is adjacent to a creek and prone to flooding that threatens the safety, welfare of people, and damage to public and/or private property. Using CLOCA's floodplain mapping developed for each watershed, structures within the floodplain were grouped into "Flood Damage Centres". The structure information along with the floodplain mapping data are combined into a database that is available to emergency management staff. During flooding events, agency staff have the ability to query the database and determine the people and/or structures that may require assistance. In the event of a flood emergency, CLOCA would continue to provide alerts and warnings to assist emergency response agencies with directing their efforts to the appropriate locations.

Figure 4 illustrates the Regulated Areas and Flood Damage Centres in the Lynde Creek Watershed.

2.4.3 Air Quality

Air pollution is an on-going concern for people living in Ontario. Airborne pollutants come from a variety of sources including fixed sources such as factories and power plants, mobile sources such as planes, trains, and automobiles, and natural sources such as fires, dust and biogenic emissions. One of the key measures of air quality is the Air Quality Index, as per Environment Canada, that notifies residents of general air quality conditions. The following outlines key conditions found in the Lynde Creek Watershed describing existing air quality conditions:

- Monitoring station in Oshawa had fewer air quality days rated as "moderate" to "poor" than the provincial average (88% very good, 12% moderate to poor); and
- Increasing trend of ground level ozone.

Storm Events and Floodplain Mapping

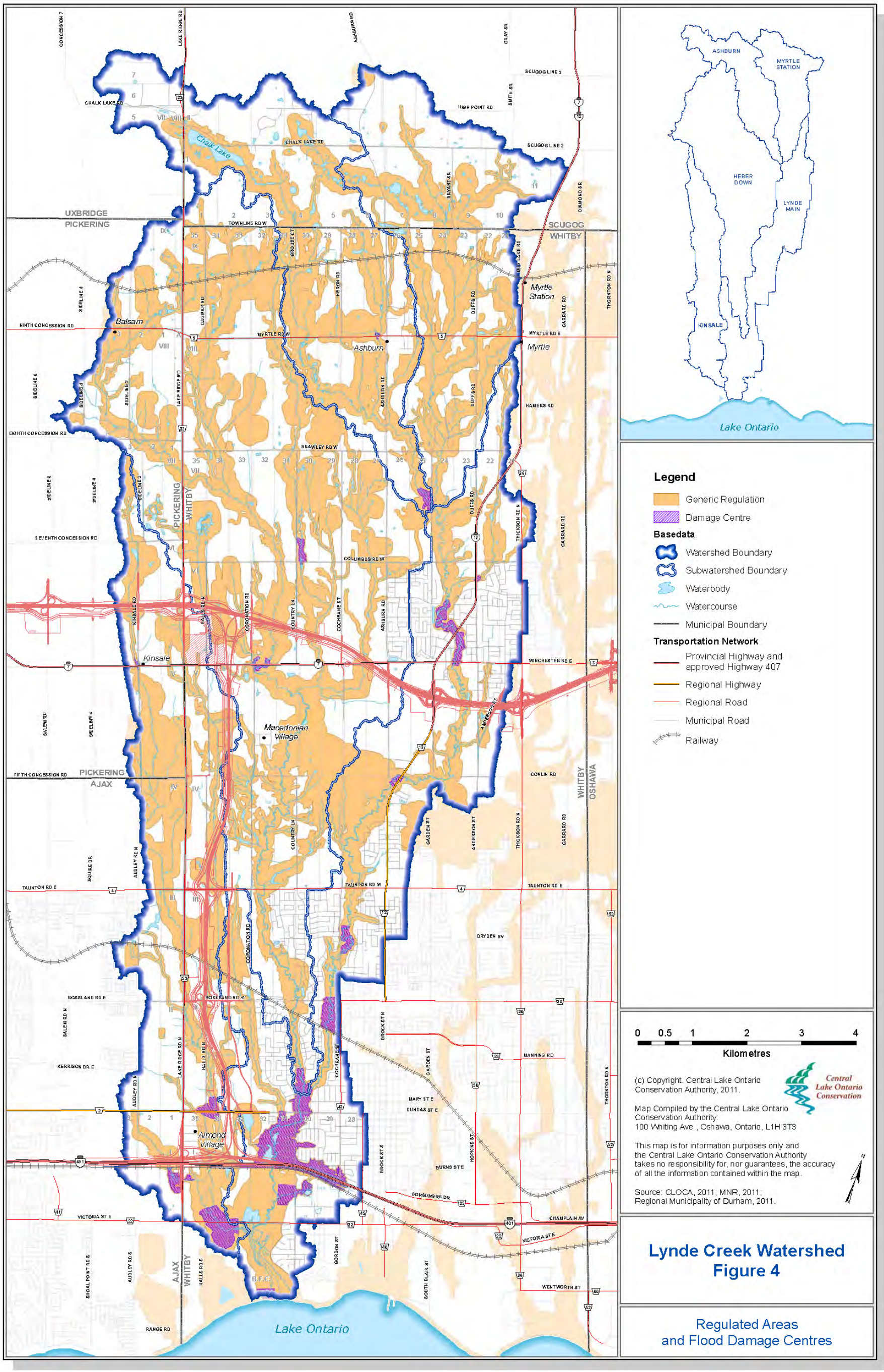
A 100 year storm is developed by assessing the intensity, duration, and frequency of precipitation events throughout the full period of weather records for our area and is the largest rainfall that would be expected to occur once every 100 years. It is not an actual recorded event, but rather a statistically developed theoretical storm.

Hurricane Hazel is an actual storm that caused massive damage to the Toronto area, including the destruction of homes, and loss of life. Hurricane Hazel was a 48 hour long rainfall event that saturated the watersheds over the first 36 hours, and then added a significant volume of rain through the last 12 hours. The recorded rainfall from Hurricane Hazel is used to simulate flooding. Although Hurricane Hazel is generally considered to be a larger rain event than a 100 year storm, the two rain events respond differently to land uses. Hurricane Hazel fully saturated the landscape before adding the most intense rainfall. Because the ground could not absorb any more moisture, all the rainfall from the last 12 hours of the storm directly converted to run-off. This storm is less sensitive to the land uses of the watershed, because all surfaces were saturated and converted rainfall to runoff during the last 12 hours of the storm. For this reason, Hurricane Hazel produces similar flood conditions from rural or urban landscapes.

The **100 year storm** in comparison is sensitive to land use. That is, rural areas that are able to absorb rainfall, will produce less runoff in a 100 year storm, than an urban area that has hard surfaces such as roadways, parking lots, and rooftops. For this reason, when a new development occurs in a watershed, the 100 year floodplain may increase. In some urban areas, the flooding produced from a 100 year storm can be greater than the Hurricane Hazel flooding.

FIGURE 4: REGULATED AREAS AND FLOOD DAMAGE CENTRES

Print Figure (11x17 recommended)



2.4.4 Climate Change

The work completed on the Water Budget indicates that the Lynde Creek Watershed would actually benefit from climate change from a water supply standpoint. The modeling suggests that increased temperatures and precipitation will allow for greater groundwater recharge during winter months, representing a net gain to our groundwater resources overall. This conclusion does not eliminate the need to prepare for climate changes and the many potential impacts it can have on the ecosystems of the watershed.

It is recognized that extreme weather such as heat waves, torrential rain storms, windstorms and even drought are increasing in frequency. These more intense weather events affect the natural systems within the watershed as they respond to impacts, such as concentrated rainfall events that increase run-off and test the capacity of our natural systems to retain the additional water volumes to prevent flooding and damage to property and human life.

This field of research is dynamic in that new information, recommendations, plans and strategies are being developed regularly to keep up with advances in knowledge, science and technology. An Action Plan recommended in this Watershed Plan will outline steps to gather, assess and report baseline data of existing conditions specifically for assessing indicators of climate change (precipitation, surface run-off, evapotranspiration, infiltration and air temperature) as this information is not currently collected for this purpose.

A water budget is an accounting of the amount and movement of water within and through the various reservoirs of the hydrologic cycle. In 2001, the Province of Ontario released the Oak Ridges Moraine Conservation Act accompanied by the Oak Ridges Moraine Conservation Plan (ORMCP). The ORMCP requires that water budget analyses be conducted for all watersheds with streams that originate on the Oak Ridges Moraine (ORM).

The Central Lake Ontario Conservation Authority (CLOCA) has conducted several studies to better characterize the water balance within the watersheds under its jurisdiction. Specifically, a watershed characterization study (CLOCA, 2006) and a conceptual water budget study (CLOCA, 2007) were completed by CLOCA staff. A more detailed water budget study using a continuous surface water flow model coupled to a regional groundwater flow model was conducted by Earthfx Incorporated (Earthfx, 2008) as a Tier 1 level water budget study under the Source Water Protection programme.

To supplement the watershed studies, CLOCA retained Earthfx Incorporated (Earthfx) to conduct analyses which applied the models developed for the watershed studies to analyze various land use development scenarios. These analyses meet the requirements set out in the ORMCP Technical Paper 10 'Water budgets'.

Source: Earth*fx* 2011

2.4.5 Land Use and Policy

Through watershed plans, a unique perspective on the cumulative impact of development within an ecological unit is obtained. Adoption of watershed plan recommendations into municipal planning documents such as Official Plans and Zoning By-Laws will ensure that the development approval process adequately reflects the protection that watershed systems require. Provincial environmental legislation such as the Oak Ridges Moraine Conservation Plan require municipalities to incorporate the policies of the Watershed Plan into their Official Plans. This further elevates the importance of land use and policy directives as a tool for protecting the health of the watershed.

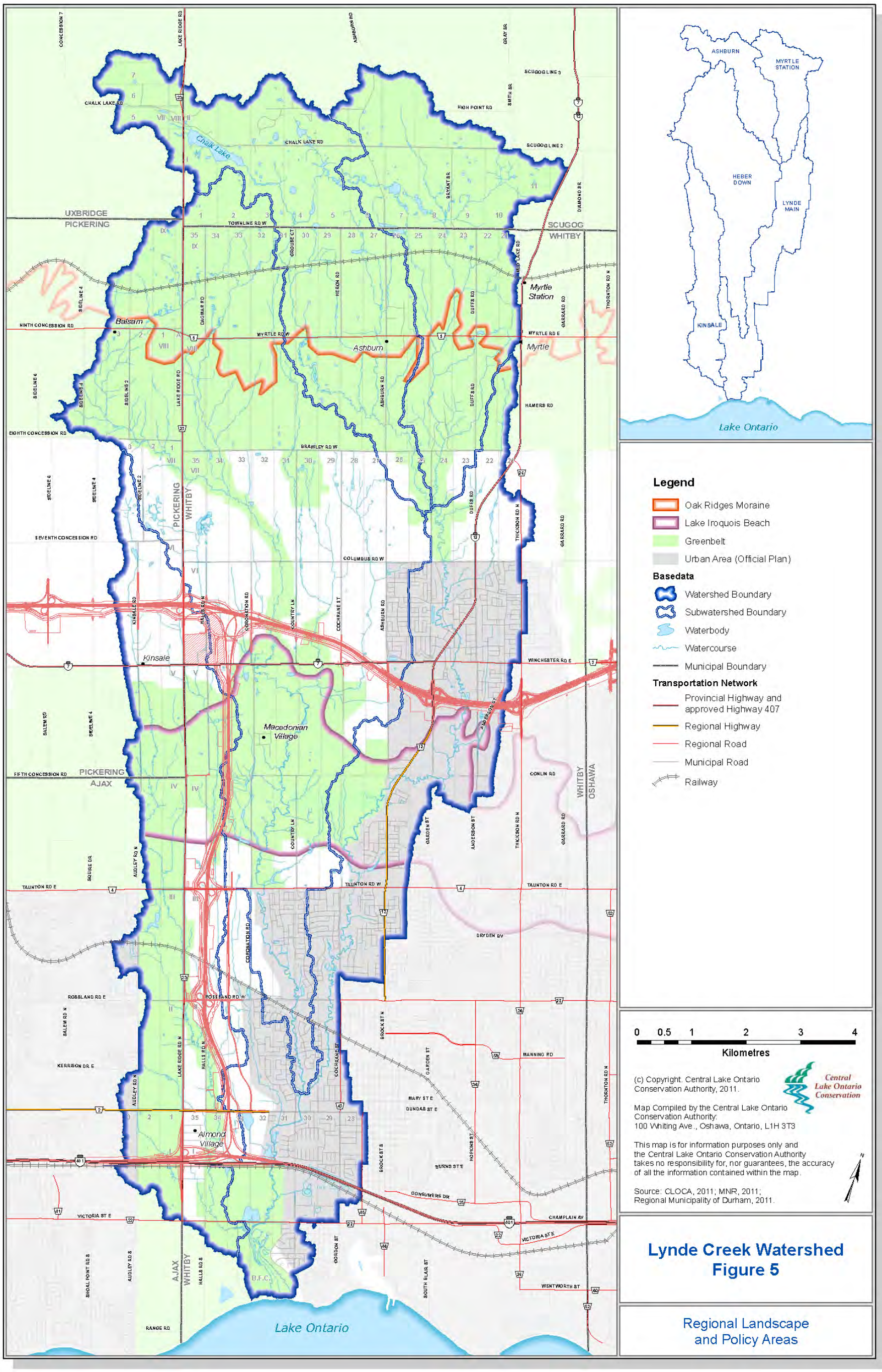
The following outlines key conditions found in the Lynde Creek Watershed describing existing land use and policy:

- The north part of the Lynde Creek Watershed is within the ORM and as such, development and land use is subject to the policies of the Oak Ridges Moraine Conservation Plan (ORMCP);
- The area just south of the Moraine is, for the most part, within the Provincial Greenbelt, and like the lands in the Moraine, development and land use will be subject to the policies of the Greenbelt Plan;
- The Ashburn and Myrtle Station subwatersheds will not see major development pressures due to provincial policy protection. This can also be said for the north portions of Kinsale, Heber Down and Lynde Main subwatersheds;
- Just over 20% of the Lynde Creek watershed is within an urban area, the remaining 80% is comprised of the ORM (26%), the Greenbelt (32%), and rural areas (22%);
- The Lake Iroquois Beach (LIB) comprises almost 12% of the watershed area;
- 4% of the watershed is in Conservation Areas such as Lynde Shores, Heber Down, Audley Woods, and Crow's Pass; and
- This watershed will be bisected by Highway 407 and the 401-407 west link:
  - Highway 407 will be built at first as a 6 lane highway and will ultimately be improved to 10 lanes plus a transitway corridor with the 401-407 west link having 4 lanes with a transitway corridor.
  - Interchanges are planned in a number of locations, connecting the Highway to the local road network.
  - Significant impacts to water quality, the thermal regime of surface water, movement of wildlife due to significant barriers, habitat loss and fragmentation, and other impacts to wildlife from noise and light influences are expected.
  - There will be short term and long term impacts felt within this watershed as a result of the construction, use and maintenance of this highway.
  - Every attempt should continue to be made to ensure connectivity and wildlife movement is maintained and that surface water flows and groundwater flows are not adversely affected.

Figure 5 illustrates the regional landscape and policy areas of the watershed.

FIGURE 5: REGIONAL LANDSCAPE AND POLICY AREAS

Print Figure (11x17 recommended)



2.4.6 Physical Geography

In the context of watershed planning, physical geography explores the physical characteristics of the land surface through the local physiography, topography and soils.

The Lynde Creek Watershed falls within three physiographic regions that, from north to south include the ORM, the South Slope, and the Lake Iroquois Beach (LIB). From an ecological and hydrological perspective, the ORM plays an important role as a controlling environmental feature in most subwatersheds. It is an irregular ridge of sandy hills that contains the largest concentration of headwater streams in the Greater Toronto Area and acts as a recharge area for groundwater. The South Slope physiographic region extends southward from the base of the moraine and is characterized as being much flatter than the ORM with southerly drainage, sharply incised valleys and numerous gullies. The LIB is marked by low-lying shoreline bluffs and gravel bars that overlay a till material. The Lynde Main, Kinsale and Heber Down subwatersheds cross the sensitive LIB feature. As such, these subwatersheds rely heavily its functions.

The following outlines key conditions found in the Lynde Creek Watershed describing existing physical geographical conditions:

- The ORM and the Lake Iroquois Beach areas represent 38% of the total watershed area;
- The spatial extent of the South Slope and LIB represents approximately 62% of the total watershed area;
- The South Slope region is contributing significantly to groundwater recharge;
- Large areas of the watershed are covered by highly productive soils with approximately 63% comprised predominately of moderate to high infiltration soils (A to B/C) located generally within the ORM, LIB and South Slope physiographic regions; and
- The ORM and Greenbelt provide excellent ecological opportunities and encompass the most intricate natural cover network as well as headwater areas in the watershed.

Bedrock Outcrop in the Lynde Creek *© CLOCA*

2.5 Existing Conditions Data Gaps

Throughout the process of developing the Watershed Plan, CLOCA staff identified where gaps in the existing data offer the opportunity to strengthen watershed management recommendations. This preliminary list of data gaps has also lead to the recommendation to complete a more fulsome review of data use, gaps and sharing within CLOCA and with our partner stakeholders as one of CLOCA's Action Plans. The following is a preliminary list of opportunities for improvement of the Existing Conditions work to help future watershed plan updates and decision-making:

- An inventory of the locations of springs and seeps to better illustrate groundwater contributions to surface water bodies;
- Reporting the water budget for each aquifer unit to better quantify water resources for the different aquifers;
- Integration of recently commissioned stream flow gauging and low flow data into the model calibration efforts to enhance these data sets;
- Continued investigation and monitoring of baseflow to identify stream reaches which are gaining or losing streamflow to groundwater;
- Further refinement of the tools for assessing potential impacts of existing and proposed local water takings to better quantify impacts of Permits to Take Water (PPTWs) in the watershed;
- Increase biological and chemical monitoring of a full array of contaminants as well as minimally impacted reference sites for Ontario Biological Benthos Network (OBBN) comparison and for trend analysis in future updates;
- Development of a connected imperviousness percent cover to link percent imperviousness to aquatic habitat quality, surface water quality and quantity;
- Enhance monitoring of stormwater management facilities and oil/grit separators to determine performance and effectiveness of existing facilities;
- Additional/continued recording of stream temperature data to enable further refinement of thermal classifications;
- Integration of existing monitoring incorporating climate change parameters to provide baseline data for future comparisons, identification of related impacts and a foundation for an adaptive management plan;
- Implementation of Lichen Mapping to establish baseline conditions of air quality within the watershed;
- Refinement of a methodology to more accurately determine percent riparian cover to inform recommendations, stewardship, and restoration efforts; and
- Development of a suspended solids methodology and monitoring network to help quantify development impacts to surface water quality and fish habitat.

3.0 CLOCA's Watershed Plan Development Process

CLOCA's process for developing watershed plans involves three distinct phases as shown below. These phases are designed to allow us to gather all of the background, technical, policy and consultation information necessary to assess various management options for the watershed and develop recommendations, implementation and monitoring programs contained in Sections 5 through 8 of this Watershed Plan. Throughout this process, public and other stakeholder participation and input was encouraged.

Phase 1: Existing Conditions Report	• Provides an assessment of the existing state of the watershed • A science-based report prepared by technical experts and available to stakeholders for comment and review
Phase 2: Scenario Analysis	• Establishes the Natural Heritage System and High Volume Recharge Areas in the watershed • Assesses various future growth scenarios to evaluate ecological impacts
Phase 3: Watershed Plan	• Confirms the recommended management option (future scenario) • Includes an implementation plan to protect, restore and enhance the ecological integrity of the watershed

3.1 Phase 1: Existing Conditions

The Existing Conditions Report provides an assessment of the state of the watershed by examining the following components: human heritage; green space; land use and policy; impervious surfaces; air quality; climate; physical geography; water budget; water temperature; surface water quality; surface water quantity; stormwater management; fluvial geomorphology; hydrogeology; aquatic habitat and fisheries; terrestrial natural heritage; and wetlands. Each component is briefly discussed in Section 2 of this Watershed Plan, and detailed in its own stand-alone chapter in the Existing Conditions Report, finalized in June 2008. This report is the basis for establishing the current state of the Lynde Creek Watershed with other CLOCA studies supplementing some of the data to take full advantage of the most recent information available for creating this Watershed Plan.

3.2 Phase 2: Scenario Analysis

The ORMCP requires Authorities developing watershed plans to set watershed targets and develop management alternatives to assess whether or not the existing or predicted conditions within the watershed satisfy the targets identified. The examination of the management options is meant to evaluate the ability of each option to maintain, improve or restore water quality and quantity, ecological integrity, feasibility of the alternative, and implementation mechanisms. (ORMCP Technical Paper #9). In compliance with these requirements, Phase 2 was undertaken in four steps.

Step 1: Set Watershed Health Targets;

Step 2: Develop computer models as tools to illustrate potential changes in the watershed;

Step 3: Develop Scenarios for use with the models to predict ecological changes in the watershed; and

Step 4: Analyze the scenarios with the data provided from the models to determine what future scenario(s) provides the opportunity to achieve the watershed health targets.

3.2.1 Step 1 of Scenario Analysis: Setting Targets

It was first necessary to identify ecological targets to recognize the conditions that need to be achieved in a healthy watershed. A combination of guidance documents from the federal and provincial governments were used to set natural heritage, water and impervious surfaces targets.

It is important to note that these watershed targets are a broad representation of the minimum ecological standards necessary for a healthy watershed. More detailed targets for each watershed component that contribute to these broader health targets are discussed in Section 4 of this Watershed Plan.

3.2.1.1 Natural Heritage Targets

To establish natural heritage targets, Environment Canada's "How Much Habitat is Enough, A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern" (AOC Guidelines) was used as a reference helping to establish forest cover, wetland and riparian targets.

Natural Cover

The AOC Guidelines recommend that 30% forest cover is needed to maintain a healthy watershed. Currently, the Lynde Creek Watershed has 17% forest cover so it is recognized that attempting to nearly double the current amount of forest in an urbanizing watershed is very difficult. In light of this, a 30% natural cover target (currently, we have 29% natural cover in the watershed and 21% natural cover within the Natural Heritage System) was determined to be appropriate. In this watershed "natural cover" lands have the long-term ability to naturalize into forest cover if left undisturbed. Achieving 30% natural cover will support a diverse suite of natural communities that provide cumulative value to the terrestrial and aquatic natural systems in the watershed.

The AOC Guidelines also recommend 10% interior forest and 5% deep interior forest cover targets. Currently, there is 1.19% interior forest and 0.23% deep interior forest cover in the Lynde Creek Watershed. These areas are by definition at least 100 m for interior and 200 m for deep interior forest away from the edge of the feature. These parameters are extremely difficult to achieve as they would require large tracts of additional forest cover lands added to existing features. In an urbanizing watershed characterized by an urban landscape in the southern portion and a large transportation project crossing both east-west and north-south through the watershed, the opportunities for achieving such interior forest areas are limited to the northern portions of the watershed and/or on lands owned by the Conservation Authority. While these types of habitats will be encouraged, it is recognized that achieving the suggested AOC Guideline for interior and deep interior forest will be very difficult but nevertheless represents an important long-term

target that supports a healthy watershed and is consistent with federal and provincial guidance.

Wetland Targets

10% wetland cover in the watershed is recommended in the AOC Guidelines and has been carried forward as a target for the Lynde Creek Watershed. Currently, with 10% wetland cover in this watershed, this target represents the protection and enhancement of existing wetland features and functions.

Riparian Cover Targets

The AOC Guidelines recommends 75% adequate riparian cover along stream reaches throughout a watershed, which is described as a 30m buffer along both sides of the stream. Riparian cover positively impacts water quality by reducing nutrients and suspended solids entering the stream. It protects stream temperatures and supports healthy fish populations and habitat. As only 34% of the watershed's stream lengths have been determined to have existing riparian cover, this target requires aggressive restoration efforts and robust policy protection to achieve. This recommendation has been carried forward at 75% because lack of adequate riparian cover will have significant ecological impact on the watershed. To support the accurate monitoring and reporting of riparian cover in future, efforts to update and standardize the methodology for calculating adequate riparian cover are currently underway. The results of this work will be used in the 5-year update of this Plan.

3.2.1.2 Water Quality and Quantity Targets

Water quality and quantity targets represent provincial drinking water standards, the standards and science behind the Clean Water Act for Water Budgets, and ecological requirements for streamflow and baseflow. For the purpose of the scenario testing, the focus was placed on providing adequate water quantity to support ecological features and functions in the watershed (as the Water Budget work can predict these impacts). It is not possible in this exercise to include water quality targets as such a modeling tool is not available for this level of work. The level of detail provided by the Water Budget work is sufficient to assess the management options. Recommendations from the scenarios were translated into more detailed ground and surface water quality targets in Section 4 of this Watershed Plan.

3.2.1.3 Impervious Surfaces Targets

The AOC guidelines and the ORMCP recommend a target of less than 10% imperviousness on a watershed basis and non-settlement areas on the ORM respectively.

The 2008 existing conditions in the Lynde Creek Watershed were 9.2% imperviousness with the most urbanized Lynde Main Subwatershed having 21.7% impervious surfaces. Conversely, the subwatersheds that are largely protected through the ORM and Greenbelt Plans have an approximate average imperviousness of 4.5%. It was therefore determined to be appropriate to set imperviousness targets based on the ORMCP direction for the watershed's rural areas and to encourage and support retrofit opportunities and ensuring future development impacts are appropriately mitigated in the urban areas where impervious values are well past the 10% target.

3.2.2 Step 2 of Scenario Analysis: Developing the Models

CLOCA developed three computer models to scientifically represent key components of watershed health to be used as tools during the scenario analysis:

1. The Natural Heritage System,
2. The Water Budget , and
3. An Imperviousness Analysis.

3.2.2.1 Model #1: The Natural Heritage System

The development of a Natural Heritage System (NHS) for managing natural resources has become a widespread tool used by Conservation Authorities and planning authorities. A NHS provides a scientifically defensible tool to manage watershed resources in accordance with the Conservation Authorities Act. A NHS can also be used by Municipalities to update municipal environmental policies, to inform the development of a municipal NHS, and the identification of significant features. The NHS CLOCA developed offers a connected system consistent with the direction of other provincial land use plans including the ORMCP and Greenbelt Plan and can be used as support in the implementation of the Natural Heritage section of the Provincial Policy Statement (PPS). It can also be used for refinement of the Greenbelt NHS used in the Durham Region Official Plan.

CLOCA's NHS represents a healthy, self-sustaining, connected system that supports: a diversity of native terrestrial, wetland and aquatic species, communities and habitats; natural healthy fish and riparian habitats; and a natural and healthy watershed hydrological cycle. It is a connected system consisting of PSWs, provincially significant ANSIs, important aquatic habitat, riparian corridors, core

SUPPORTING A SYSTEMS AND PRECAUTIONARY PRINCIPLE APPROACH TO WATERSHED MANAGEMENT

"Natural Heritage System: means a system made up of natural heritage features and area, linked by natural corridors which are necessary to maintain biological and geological diversity, natural functions, viable populations of indigenous species and ecosystems. These systems can include lands that have been restored and areas with the potential to be restored to a natural state." (Provincial Policy Statement, 2005)

"…not only is a systems approach an appropriate approach to determining the boundaries of a [sic] NHS in developing urban area, it is the best approach. It is clearly the best approach given what experts now understand about environmental biology. No longer can society afford to look at the "natural environment" as isolated pockets of green which have been fortunate enough to have survived in an urban landscape. The Board is convinced by the evidence adduced in this hearing, that for the natural environment to have a chance of sustainability in developing urban areas, a systems approach must be taken to delineating boundaries… the use of a systems approach substantially increases sustainability of the natural environment in an urban context, by supporting the diversity of species and making the natural area more resilient to the effects of urbanization." (Ontario Municipal Board Decision by S.B. Campbell, 2008)

"The development of a natural heritage system should inform and support land use planning and resource management while providing a strategic focus for restoration, stewardship, securement and the conservation of biodiversity." (Natural Heritage Reference Manual, 2010)

"To protect the ecological function and biodiversity of natural heritage systems and the health and integrity of natural heritage features of their associated ecological functions for the long term, planning authorities should apply decision making approaches that incorporate the precautionary approach where appropriate". (Natural Heritage Reference Manual, 2010)

habitat areas and terrestrial corridors, woodlands >/= 0.5ha, wetlands >/= 0.5ha, and areas identified for natural cover regeneration/restoration which will improve connectivity and habitat. This approach of identifying a NHS that includes existing features as well as regeneration/restoration lands is widely supported by provincial authorities and extensively referred to in the *Natural Heritage Reference Manual for Natural Heritage Policies of the Provincial Policy Statement, 2005 Second Edition*. CLOCA has identified a NHS that if protected, can achieve the minimum watershed health targets as set out in the Watershed Plan and provincial and federal policies. **Figure 6** below illustrates the components of the Natural Heritage System.

3.2.2.2 Model #2: The Water Budget

A Water Budget quantifies the major components of the hydrologic cycle, estimates where the water is within the watershed and how much water is in the system. It determines the water inputs, outputs and changes in storage. The water budget may be expressed as an equation with water inputs to the watershed equaling water outputs plus the change in water storage (as per the Ministry of Environment's Technical Paper #9 of the Oak Ridges Moraine Conservation Plan). A Water Budget will always balance according to this equation and in doing so identifies changes in each component of the equation resulting from land cover changes in the watershed.

The Water Budget work provided the information needed to assess three impact categories (as discussed in Table 2): surface run-off, baseflow and aquifer drawdown during the scenario analysis work. The Water Budget also highlighted the protection of High Volume Recharge Areas (HVRAs) and their associated impact on water system health. HVRAs are areas with recharge higher than 15% of the average recharge of the watershed. The identification, delineation and management of HVRAs is essential for the protection of drinking water sources and maintenance of water quantity and quality in streams, rivers and wetlands. **Appendix C** of this document provides a more in-depth discussion of the Water Budget and all its detailed components as well as the impacts of each component based on the 8 scenarios identified in Table 1.

3.2.2.3 Model #3: Imperviousness Analysis

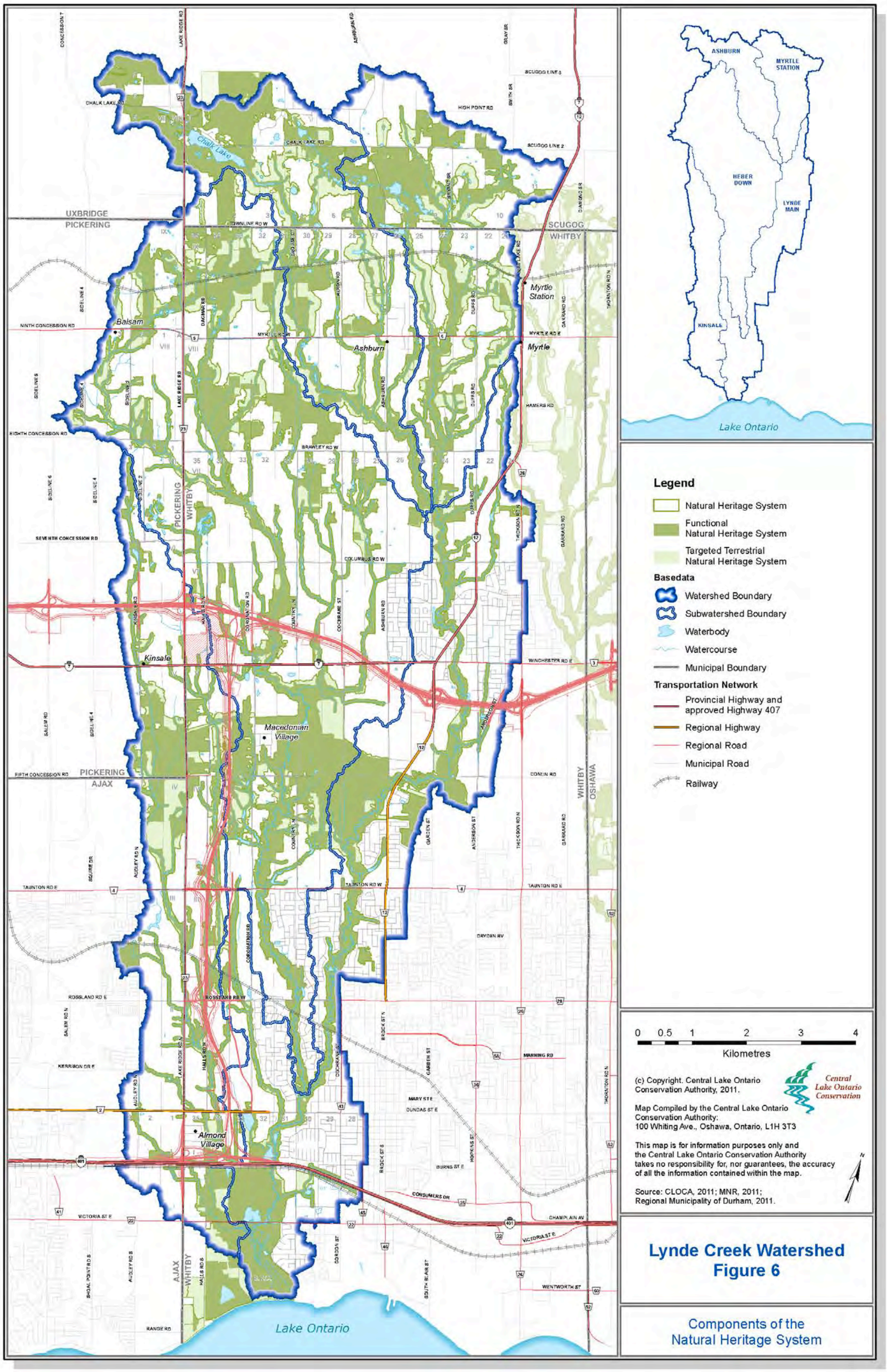
Imperviousness is a key indicator of watershed health because of the severe negative impacts impervious surfaces have on ecological features and functions. CLOCA developed a model to quantify and map the existing surfaces in the watershed and to predict the impact of future development on levels of imperviousness as required by the ORMCP. This tool provides the ability to determine if impervious targets are being met and was used for the Water Budget work described above. It will be utilized in future monitoring and impervious Action Plans as discussed in Section 5. Essentially, the model predicts the level of imperviousness relative to the following watershed targets:

- <10% imperviousness on the Oak Ridges Moraine;
- <10% imperviousness on Greenbelt Lands; and
- A decreasing trend in imperviousness by landform, land cover, watershed and subwatershed (specific targets / levels will be determined for watershed updates).

Please see **Appendix D** for a full description of the model and how it was developed for use analyzing the watershed scenarios.

FIGURE 6: COMPONENTS OF THE NATURAL HERITAGE SYSTEM

Print Figure (11x17 recommended)



Central Lake Ontario Conservation

3.2.3 Step 3 of Scenario Analysis: Developing the Scenarios

In order to predict future impacts to the watershed given planned and anticipated development, scenarios were developed to quantify potential impacts to inform decision-making on how the watershed can best be protected. The scenarios are predicated on two development possibilities – full build-out of the planned urban areas identified in Official Plans and full build-out of the planned urban areas plus development of the Whitebelt lands. This analysis sought to determine what potential impacts to the watershed's natural resources would result from each development option if a) the Natural Heritage System was protected and b) if the Natural Heritage System and the pre-development recharge rates of High Volume Recharge Areas (HVRAs) were protected. Additionally, to examine Climate Change impacts, a scenario assessing potential effects on the watershed was added for information purposes moving forward. Existing Conditions were used as a comparison for each scenario. **Table 1** describes all eight scenarios used in the analysis.

Table 1: Scenarios for Analysis

Scenario		Description
1	Existing Conditions	2008 watershed conditions (provides baseline conditions for comparison)
2a	Full Official Plan (OP) Build-out	Conditions of the watershed if all of the development approved in the OP occurred
2b	Full Official Plan (OP) Build-out + Natural Heritage System (NHS)	Conditions of the watershed with full OP Build-out plus protection of the NHS
2c	Full Official Plan Build-out + the Natural Heritage System + High Volume Recharge Areas (HVRAs)	Scenario 2b + the protection of HVRA function
3a	Full Official Plan and Whitebelt Build-out	Scenario 2a + full Whitebelt development
3b	Full Official Plan and Whitebelt Build-out + the Natural Heritage System	Scenario 3a + protection of the NHS
3c	Full Official Plan and Whitebelt Build-out + the Natural Heritage System + the High Volume Recharge Areas	Scenario 3b + protection of HVRA function
3d	Full OP and Whitebelt Build-out under Climate Change conditions	Scenario 3a under Climate Change conditions

3.2.4 Step 4 of Scenario Analysis: Analyzing the Scenarios

To analyze the 3 models and the 8 scenarios, impact categories were identified. To assess watershed changes when applying the NHS, differences in land cover were measured (Urban, Agricultural, Natural Cover, Transportation, Landfill/aggregate, Manicured Greenspace and Rural). Measuring the increase in urban land cover was used to quantify changes in imperviousness. Three components of the water budget work were carried forward in this analysis; run-off, baseflow and aquifer drawdown. **Table 2** identifies

each impact category and describes its importance in determining watershed health.

In order to understand how the possible changes resulting from each scenario could impact the ecology of the watershed, the analysis assessed these impact categories to answer the following questions.

1. What is the baseline information for each impact category (Scenario 1)?

2. What will happen in each impact category if there is full OP build-out and we;
   a) don't protect the Natural Heritage System (Scenario 2a)?
   b) do protect the Natural Heritage System (Scenario 2b)?
   c) do protect the Natural Heritage System and the pre-development recharge rates of High Volume Recharge Areas (HVRAs) (Scenario 2c)?

3. What will happen in each impact category if there is full OP build-out + full Whitebelt build-out and we;
   a) don't protect the Natural Heritage System (Scenario 3a) ?
   b) do protect the Natural Heritage System (Scenario 3b)?
   c) do protect the Natural Heritage System and the pre-development recharge rates of High Volume Recharge Areas (HVRAs) (Scenario 3c)?

4. What will happen in each impact category if we have full OP build-out + full Whitebelt build-out, under predicted climate change conditions (Scenario 3d)?

The answers to these questions provided the information necessary to determine which scenario would serve to protect, enhance and restore the watershed in the fullness of time.

Central Lake Ontario Conservation

TABLE 2: IMPACT CATEGORIES AND WATERSHED HEALTH

Impact Category	Importance for Assessing Watershed Health
Urban Land Cover	Describes how much land in the watershed is covered by urban development (urban residential and industrial/commercial). This land cover category interferes with achieving watershed health as it impacts ecological integrity for features and functions; impedes achieving watershed targets for forest cover, wetlands etc.; increases impervious surfaces that increase run-off and stormwater management requirements; interferes with recharge and discharge functions; and impacts water quality in general. It is important to note that the purpose of the watershed plan is to protect the health and resiliency of the watershed while working in the context of economic, cultural and social objectives of each municipality.
Agricultural Land Cover	Describes how much land in the watershed is agricultural (crop/improved, pasture/unimproved). This is important for ecological health as agricultural land supports the natural systems of the watershed. Agricultural lands can become more beneficial to the health of a watershed through Best Management Practices that decrease potential negative ecological impacts and increase connections and healthy interactions with natural systems.
Natural Cover	Describes forest, wetland, meadow and beach/bluff communities. Natural cover supports all areas of watershed health.
Transportation Land Cover	Describes how much land in the watershed is dedicated to transportation facilities. This is an important category for informing discussions on wildlife corridor barriers, run-off, impervious surfaces, water quality, recharge and discharge.
Landfill and/or Aggregate Land Cover	Describes how much land in the watershed is dedicated to landfills or aggregate operations. This is an important classification in that these uses impact ecological integrity and can have large impacts on water resources.
Manicured Greenspace Land Cover	Describes how much land in the watershed is used for recreation such as parks, golf-courses, ski hills, nature trails etc. These areas are impacted by human use but can provide some natural features and functions that contribute to watershed health.
Rural Land Cover	Describes how much land in the watershed is dedicated to rural development. This land cover category captures lands that are not in the urban areas but have some development on them.
Impervious Surfaces	Describes how much land in the watershed is impervious to water. This impact category is a key illustrator of the impacts of an urban landscape as it describes increased runoff and "flashiness" due to decreased infiltration and groundwater recharge, which in turn decreases stream baseflow and increases channel erosion and sedimentation, downstream flooding, stream water quality and stream temperature. The cumulative effects of impervious surfaces alter the aquatic habitat to a degraded state providing limited function.
Run-off	Describes the amount of surface water overland flow during precipitation events anticipated within the watershed based on impervious surfaces, stormwater management and natural cover functions that mitigate run-off.
Change in Baseflow	Describes if there is a change in the amount of baseflow to streams. This category indicates where there are groundwater impacts due to development that result in a reduction of groundwater discharge to streams.
Aquifer Drawdown	Quantifies the impact of a development on groundwater storage capabilities / characteristics of an area. A drawdown is depicted as a "zone of influence" that illustrates the depth and area of impact on groundwater storage in aquifers.

As per the requirements of the ORMCP and as a predictive tool, each of the 8 scenarios described in **Table 1** were analyzed and mapped to illustrate potential impacts to the watershed. The analysis offered insight into the effects each scenario's growth and watershed management options will have on the impact categories identified for the watershed. **Table 3** below provides summary results of each scenario analysis.

TABLE 3: SUMMARY SCENARIO ANALYSIS BY IMPACT CATEGORY

Impact Category (% of Land Cover in Watershed)		**Scenario 1** (Existing Conditions)	**Scenario 2a** (Full OP Build-out)	**Scenario 2b** (Full OP Build-out + NHS)	**Scenario 2c** (Full OP Build-out + NHS + HVRAs)	**Scenario 3a** (Full OP and Whitebelt Build-out)	**Scenario 3b** (Full OP and Whitebelt Build-out + NHS)	**Scenario 3c** (Full OP and Whitebelt Build-out + NHS + HVRAs)	**Scenario 3d** (Full OP and Whitebelt Build-out in 2080 Climate Change conditions)
Natural Cover *		21.4%	19.9%	36.1%	36.1%	19.4%	36.0%	36.0%	19.4%
Urban Land Cover		10.4%	25.5%	23.1%	22.8%	31.2%	27.8%	27.3%	31.2%
Transportation		3.8%	8.5%	8.5%	8.5%	8.5%	8.5%	8.5%	8.5%
Rural Land Cover		4.9%	3.9%	3.9%	3.9%	3.5%	3.5%	3.5%	3.5%
Manicured Greenspace		4.4%	4.3%	3.7%	3.7%	3.3%	2.7%	2.7%	3.3%
Aggregate / Landfill		1.1%	0.8%	0.8%	0.9%	0.7%	0.7%	0.9%	0.7%
Agriculture Land Cover		54.0%	37.1%	24.0%	24.2%	33.4%	20.8%	21.1%	33.4%
Impervious Surfaces		9.1%	19.0%	17.7%	16.3%	22.6%	20.7%	19.2%	22.6%
Surface Run-off (% change in run-off from S1)		N/A	23%	20%	16%	31%	23%	20%	37%
Change in Baseflow (% change in baseflow from S1)		N/A	-8%	-7%	-6%	-11%	-9%	-7%	18%
Aquifer Drawdown (% area where drawdown exceeds 0.5m)	ORM Aquifer Complex	N/A	10%	8%	7%	12%	11%	10%	6%
	Thorncliffe Aquifer Complex	N/A	32%	28%	20%	43%	35%	27%	5%
	Scarborough Aquifer Complex	N/A	28%	22%	16%	40%	32%	24%	4%

**** Refers to the Natural Heritage System and any mapped ELC communities outside of the NHS.***

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Figure 7 illustrates Scenario 1, the existing conditions of the watershed as a baseline for comparing the anticipated impacts of each scenario. As can be seen in **Table 3** above, failure to protect the NHS and HVRAs in either growth scenario (S2a and S3a) represents significant and likely irreparable harm to the features and functions of the watershed. **Figure 8** illustrates Scenario 2c describing the protection of the NHS and the recharge function of HVRAs in the context of full OP build-out. **Figure 9** illustrates Scenario 3c that describes the protection of the NHS and protection of the recharge function of HVRAs in the context of full OP build-out + full Whitebelt Build-out.

Scenario 3c has been chosen to carry forward for planning purposes as it reflects the realities of a quickly urbanizing watershed while providing an opportunity to protect, restore and enhance the health and resiliency of the watershed. This scenario represents a balanced management approach suitable for promoting environmentally, economically, socially and culturally vital communities. The precautionary principle is being applied in terms of managing the watershed as full OP and Whitebelt Build-out is not a foregone conclusion but rather it represents the long-term largest impact to the watershed that CLOCA must be prepared to address and manage if it does eventually come to pass. Watershed Planning is a process that must consider the very long-term consequences of a changing landscape (growth, climate) on the natural heritage and water resources in the watershed.

From an ecological perspective, the scenario analysis revealed that the protection and preservation of the NHS and protecting the recharge function of the HVRAs can maintain a healthy watershed in the context of either full OP build-out or full OP build-out + Whitebelt Build-out. Management of the Lynde Creek Watershed will therefore focus on:

- ensuring the long-term protection, restoration and enhancement of the NHS;
- maintenance of groundwater recharge rates in HVRAs;
- supporting municipalities in their efforts to reduce the ecological impacts of existing urban areas, and
- supporting municipalities to ensure that new development and growth respects the recommendations of this Watershed Plan to protect watershed health in the long-term.

It is important to note that the scenario analysis mapping represented in Figures 7, 8 and 9 illustrate a “snap-shot” in time for the specific purpose of completing the scenario analysis. The NHS is a dynamic system and minor mapping changes have been completed in Figure 13 of this Watershed Plan representing the most current available information. It has been determined that these changes would not impact the scenario analysis calculations in any significant way. Mapping updates to the NHS (Figure 13) will be completed during the 5-year review process.

FIGURE 7: SCENARIO 1 – EXISTING CONDITIONS

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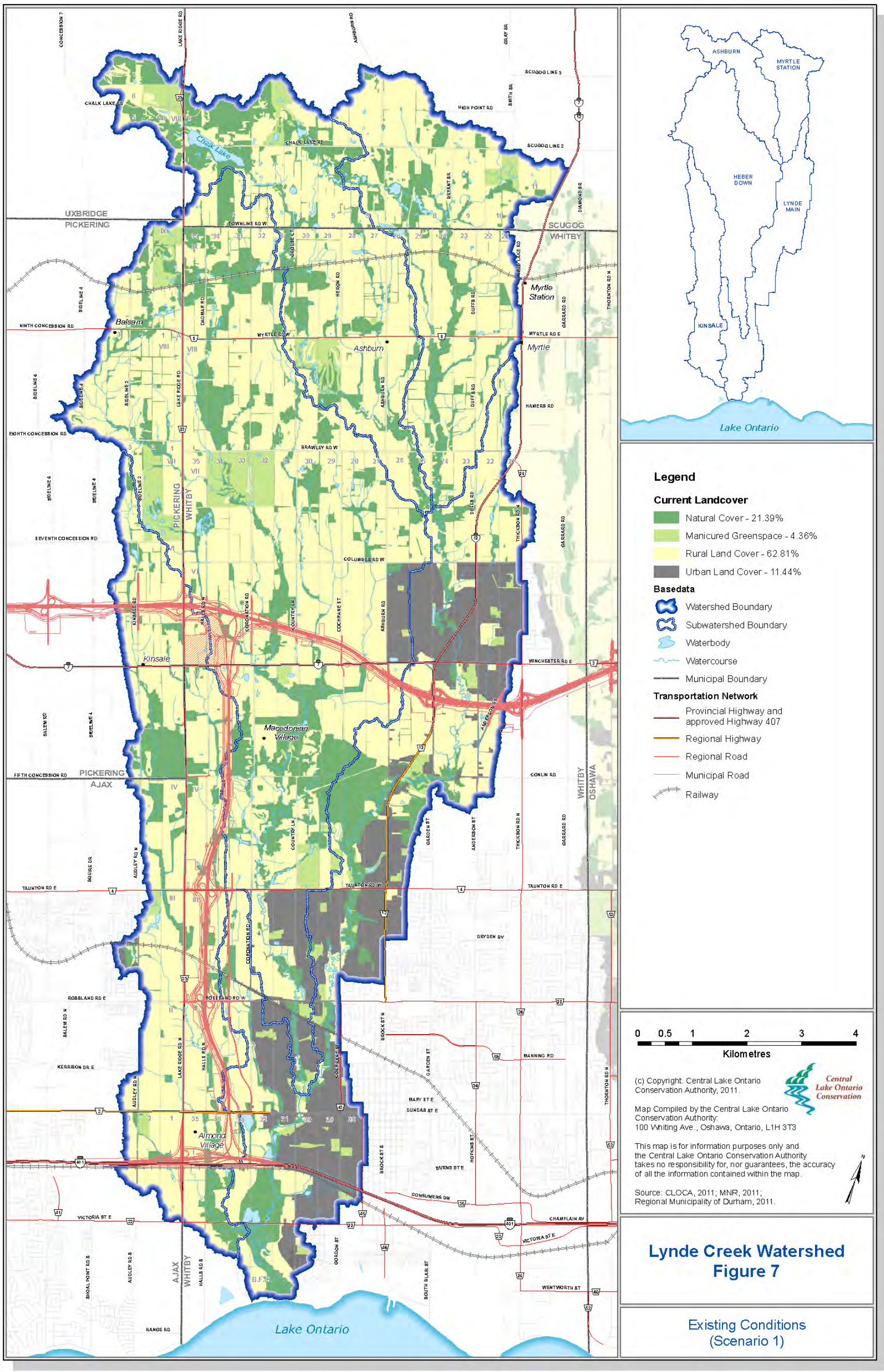

FIGURE 8: SCENARIO 2C – IDENTIFICATION OF THE NHS AND PROTECTION OF RECHARGE RATES OF HVRAS + OFFICIAL PLAN BUILD-OUT

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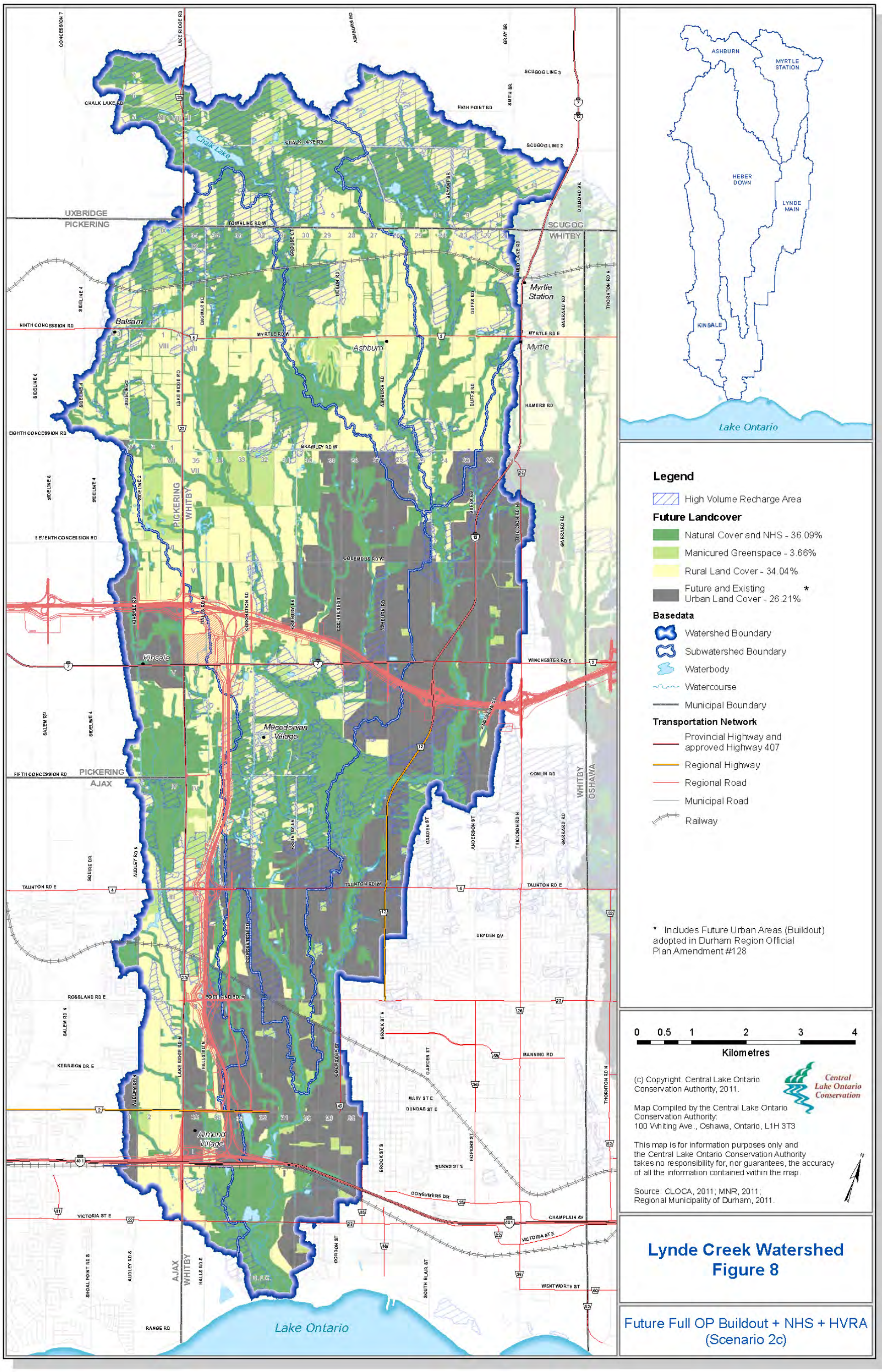

FIGURE 9: SCENARIO 3C – IDENTIFICATION OF THE NHS AND PROTECTION OF RECHARGE RATES OF HVRAS + OFFICIAL PLAN BUILD-OUT + WHITEBELT BUILD-OUT

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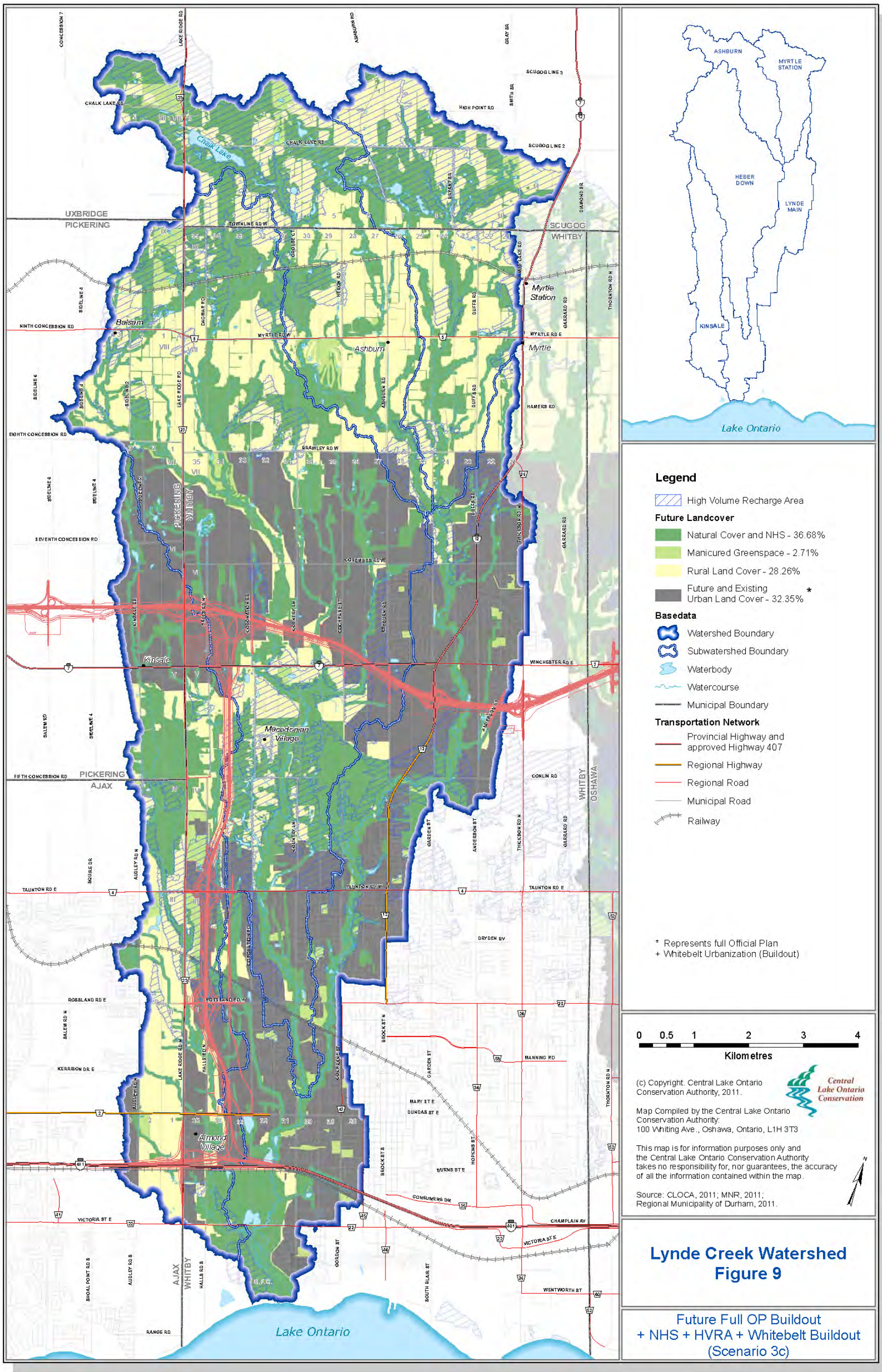


3.2.4.1 Climate Change Conditions:

As another predictive tool to assess potential impacts to the watershed, the "Climate Change" scenario represents the impact of full OP and Whitebelt build-out in the context of 2080 climate change conditions. Forecasted climate change data was extrapolated from the Hadley Center for Climate Change and Research model (CM3 model, scenario A1F1) and used to show the impacts of a 19% increase in precipitation and an increase in minimum and maximum temperatures by 7°C. This method of climate alteration does not consider the seasonal forecasted changes in climate; however, since the forecasted changes were applied to the observed weather patterns between 1980 and 1999, seasonality is preserved.

The impacts of climate change appear to increase all the hydrological components of the water budget: increased recharge equates to increased water availability to vegetation, and increased baseflow. Increased evapotranspiration may result in a more humid climate, while increased summer/fall runoff may be mitigated through common storm water management practices. Springtime decreases in runoff will likely have detrimental effects to aquatic and riparian ecosystems. For example, high instream flows during the spring, otherwise known as the spring freshet, are critical in that they clean stream substrate, signal spawning times, and allow fish passage to areas that are not accessible during most of the year. Without the annual freshet, sediment quality will degrade and threaten microhabitat availability and instream health.

The climate change scenario, S3d, has shown an increase in groundwater recharge predominantly during the winter. This climate change scenario has greatly increased water levels in non-developed areas. Drawdowns in groundwater aquifers / resources continue to occur in the areas of proposed development. As detrimental as climate change may be to many parts of the world, the CLOCA jurisdiction would appear to benefit from increase precipitation and temperature from a water supply standpoint.

This Watershed Plan supports the development of a climate adaptation strategy through recommendations for additional monitoring, reporting and the development of an adaptive management strategy discussed in Section 5 as one of CLOCA's Action Plans.

3.3 Phase 3: Watershed Plan

The third and final phase of CLOCA's watershed planning process is the compilation of the Watershed Plan itself. This Plan is based on reports from Phases 1 and 2 and is completed in compliance with provincial policies relating to watershed planning. **Exhibit 1** illustrates the 17 topics/components to be considered in a Watershed Plan according to the Oak Ridges Moraine Conservation Plan Technical Paper Series, #9 – Watershed Plans. All 17 requirements are addressed within this Watershed Plan and are described in more detail in **Appendix A**.

Various engagement techniques have been and will continue to be employed to ensure all interested, affected and engaged stakeholders have access to the Plan and CLOCA staff to answer any questions or provide additional information where needed. This Watershed Plan has been written and structured to enhance implementation of the Watershed Plan policies, targets and strategies by CLOCA, municipalities and other stakeholders.

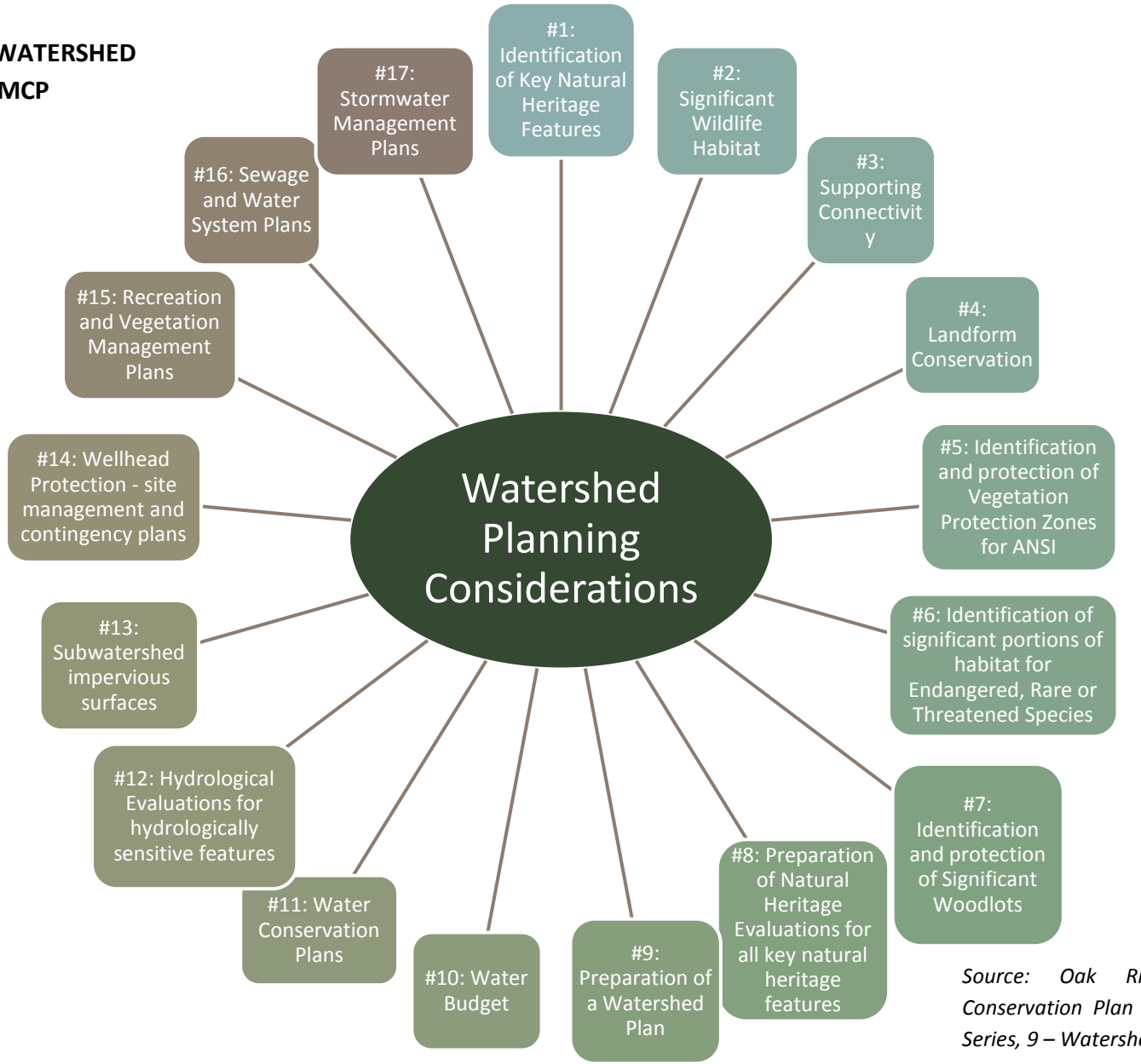
3.3.1 Consultation Efforts

With the start of the Existing Conditions work in Phase 1, a questionnaire was sent to stakeholders and agencies and was posted on CLOCA's website. The questionnaire enabled stakeholders to submit completed surveys either electronically or by mail regarding existing conditions in the watershed. In all, 57 questionnaires were mailed out and 12 responses were received. In addition, the survey posted on CLOCA's website generated 5 responses for a total of 17 completed surveys. A Public Information Centre (PIC) was held December 13th, 2007 at the Town of Whitby's Council Chamber to present the findings of the Existing Conditions report, and to gain additional information from the public. Copies of the display boards were made available digitally as a PowerPoint presentation and participants were provided with a copy of the report on CD and a detailed watershed map. Based on the comments received, revisions to the draft report were undertaken during early 2008 and culminated in the release of the final version of the report in June, 2008.

During the *Phase 2: Scenario Analysis* stage of the process, a PIC was held on December 2, 2010 again at the Town of Whitby's Council Chambers. Staff presented background information and the Alternative Management Options to participants, followed by a question and answer period. Copies of the presentation were made available at the meeting and were posted on the CLOCA website for easy download. Participants were encouraged to provide written feedback on the *Phase 2: Alternative Management Options*. Prior to the December 2010 PIC, a presentation to Town of Whitby staff was given detailing the methodologies used in Phase 2. Meetings with other parties were conducted as requested throughout the Phase 1 and Phase 2 stages of the Watershed Plan development process.

On December 15 2011, the Draft Watershed Plan was presented to the public. Municipalities and other engaged stakeholders were met with prior to and following the Public Information Centre in December to discuss the Plan and obtain feedback. Several meetings and conversations with municipalities and the development community were undertaken to consult with these stakeholders on the policies recommended for inclusion in Official Plans or other planning documents as outlined in Section 6 of this Plan. The consultations were undertaken to facilitate the implementation and use of these policies upon approval of the Watershed Plan. Comments from all stakeholders on the Draft Watershed Plan were considered and changes made to the final document as appropriate.

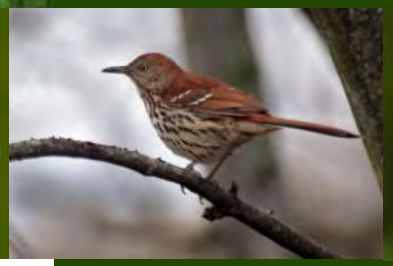
EXHIBIT 1: TOPICS / COMPONENTS OF A WATERSHED PLAN AS PER THE ORMCP



Source: Oak Ridges Moraine Conservation Plan Technical Paper Series, 9 – Watershed Plans

Lynde Creek Watershed Plan–

Part 2: Managing the Watershed



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Conservation Ontario Natural Champions

DURHAM REGION

4.0 THE HEALTHY LYNDE CREEK WATERSHED

Achieving a healthy watershed that is resilient with ecological integrity is a vital component of the environmental, economic, social and cultural success of a community. There is no doubt that protecting, restoring and enhancing the features and functions of the watershed will benefit all residents of, and visitors to, the Lynde Creek Watershed. The challenge is to identify key targets of watershed health, develop a plan to reach these targets, and ultimately implement those plans in an effective way that will ensure the integrity of this watershed in the long-term. The following sections outline the goals, objectives, indicators and targets for each core component of the watershed that is integral to maintaining, restoring and enhancing the health of the watershed.

4.1 WATERSHED TARGETS

The universal target is to achieve a healthy and resilient watershed with ecological integrity. In order to achieve this, watershed-wide targets have been set based on federal and provincial guidance customized to the Lynde Creek Watershed. Symbols have been added beside each watershed target that will be used throughout the implementation plan to represent the target a recommendation supports.

30% Natural Cover: Supports the achievement of increased forest cover to 30%, 10% interior forest, 5% deep interior forest through long-term naturalization, provides run-off retention, erosion control, wildlife habitat, natural system connectivity, air quality improvements, social / cultural / economic benefits and climate change mitigation impacts.

10% Wetland Cover: Provides run-off retention, erosion control, water quality filtration, wildlife and fish habitat, social / cultural / economic benefits and mitigates impacts associated with climate change.

< 10% Imperviousness on the ORM and Greenbelt: Limiting impervious surfaces allows for better run-off retention, groundwater infiltration, ground and surface water quality and sediment. Limiting built or paved areas can have a positive impact on the amount of natural areas contributing to ecosystem health.

75% Riparian Cover: Protecting, restoring and enhancing riparian cover provides run-off retention; enhances water quality, fish habitat and diversity, increases system connectivity, and provides water temperature benefits.

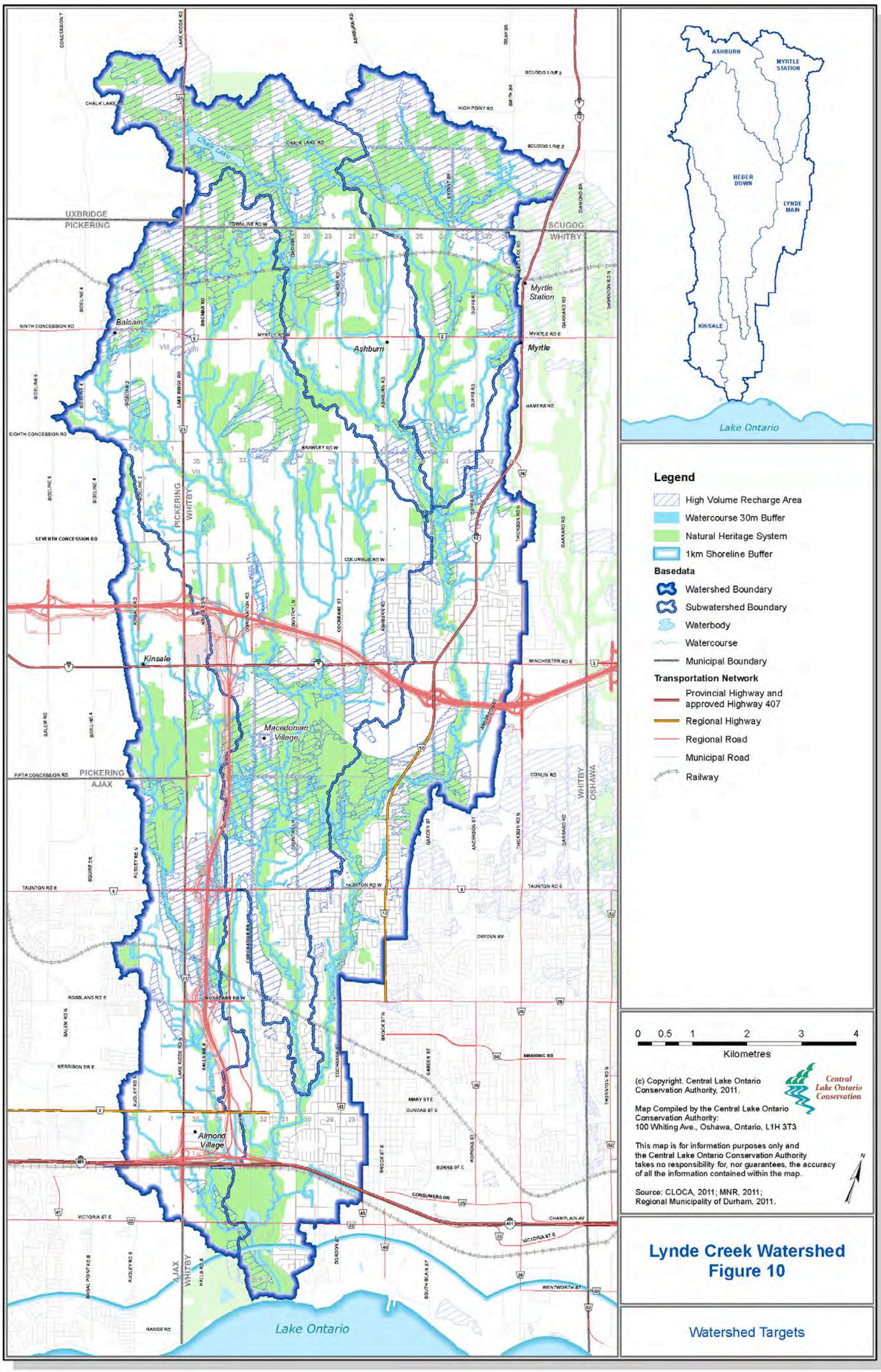
A Healthy Water System: Water quantity and quality to support ecological and human health as well as protect human life and property.

All Watershed Health Targets

Figure 10 below illustrates the Natural Heritage System and High Volume Recharge Areas in the watershed which, if protected, will achieve the watershed health targets discussed above.

FIGURE 10: WATERSHED TARGETS

Print Figure (11x17 recommended)



4.1.1 Water Resources

Groundwater Goal: A self sustaining hydrogeological system consisting of sufficient groundwater quality and quantity to support: healthy aquatic and terrestrial ecosystems and their ecological functions; clean drinking water for rural watershed residents; and sustainable human use of groundwater resources for non-drinking water purposes.

Surface Water Quality Goal: A sustainable, functioning hydrological system consisting of surface water quality, that supports: healthy aquatic and terrestrial ecosystems and their ecological functions; clean water that will contribute to the maintenance of Lake Ontario as a domestic drinking water source; and sustainable human use of surface water resources for non-drinking water purposes.

Surface Water Quantity Goal: A sustainable, adaptable, functioning hydrological system consisting of sufficient surface water quantity, and flows that supports: healthy aquatic and terrestrial ecosystems and their ecological functions; sustainable human use of surface water resources for non-drinking water purposes, having no adverse impact on ecological features and function and/or to Lake Ontario surface water intake zones, and; public safety and protection of infrastructure and private/public properties from unacceptable changes in flooding and erosion hazards as determined by the Conservation Authority.

Water Temperature Goal: To maintain/reduce water temperatures in surface water bodies in order to protect or enhance the quantity and quality of native/naturalized aquatic life.

Fluvial Geomorphology Goal: Natural stream channels and corridors that allow for natural stream flow patterns and channel migration (where possible), support diverse aquatic habitat, limit sediment loadings and protect human life, property and infrastructure from risks associated with erosion and slope instability.

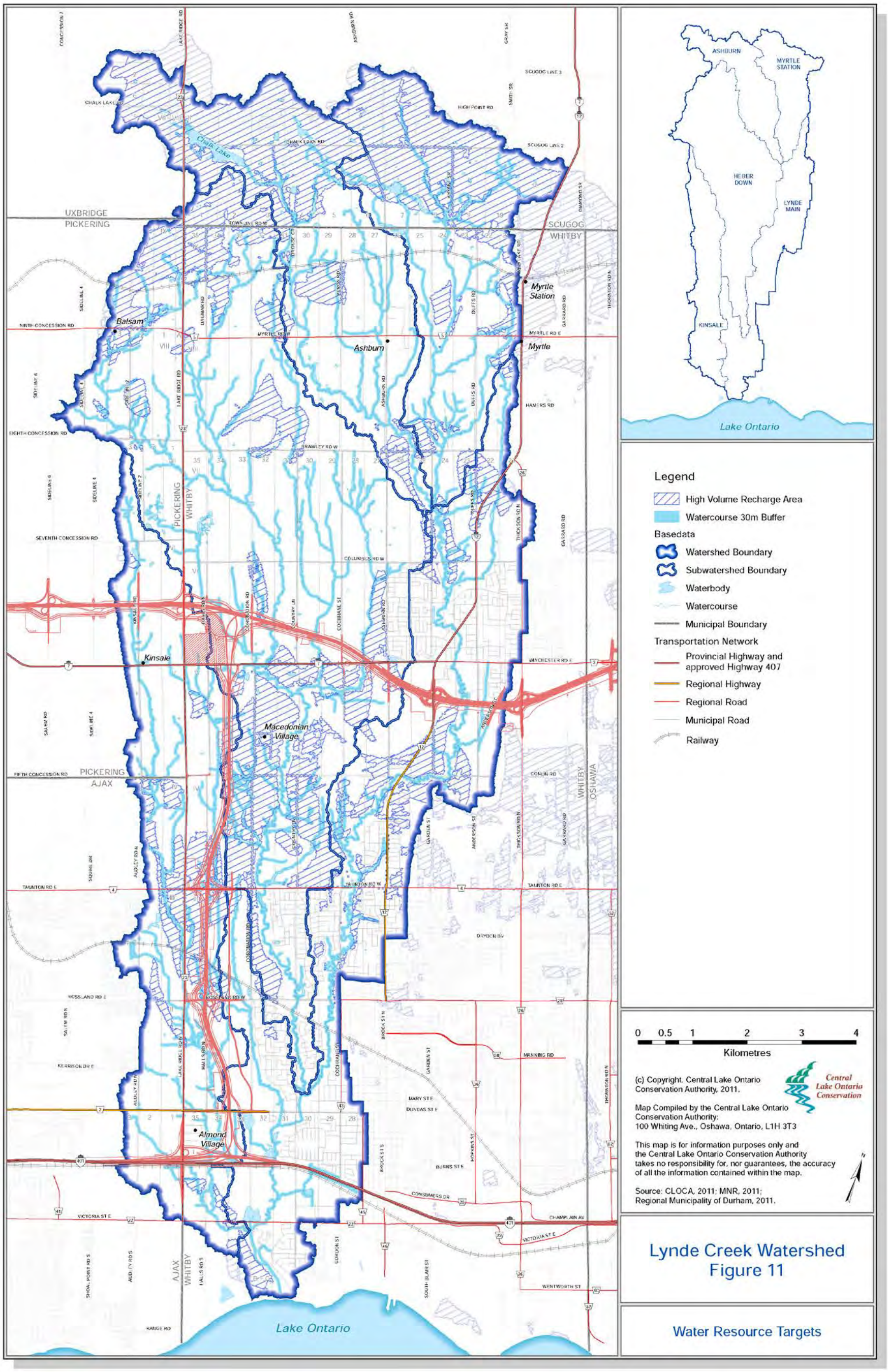
WATER		
Objectives:	**Indicators:**	**Targets:**
Protect and enhance public safety, private property and infrastructure from erosion and flooding	• Risk to public and private property	• Protect private / public property and public safety.
Protect, restore and enhance groundwater recharge and discharge features	• High Volume Recharge Areas (HVRAs)	• Maintain pre-development infiltration / recharge rates.
	• Discharge Areas	• Maintain average annual baseflow rates.
Protect, restore and enhance groundwater quality	• Groundwater Chemistry (metals, nutrients)	• Meet Provincial Water Quality Standards. • Prevent future deterioration beyond recorded current / ambient background nutrient levels.
Ensure ground and surface water demand does not exceed calculated watershed thresholds for ground and surface water supply	• CLOSPA (Central Lake Ontario Source Protection Authority) Stress Assessment	• Reduce current Stress Assessment Level to "Low" vs. the current condition of "Moderate".
Protect natural baseflow	• Baseflow levels	• Maintain long-term average and seasonal baseflow levels.
Protect and restore surface water quality to meet approved (current) standards	• Benthic invertebrate community	• Improve all surface water benthic quality ratings to un-impaired.
	• Biological Oxygen Demand (BOD)	• Maximum BOD of 2 mg/L.
	• Dissolved Oxygen (DO)	• Maintain DO requirements needed to support fisheries. ➢ 4 – 7 mg/L in warm water streams. ➢ 5 – 8 mg/L in cold water streams.
	• Chloride	• <150 mg/L and/or a decreasing trend.
	• Phosphorus	• <30 ug/L for streams and <20 ug/L for lakes and/or a decreasing trend.
	• Nitrates (NO_3)	• <10 mg/L and/or a decreasing trend.
	• Copper	• 1-5 ug/L depending on hardness and/or a decreasing trend.
	• Suspended Solids	• Not currently available.

WATER		
Objectives:	**Indicators:**	**Targets:**
		See Section 5 of this report for more detail on future work to set targets.
Reduce / mitigate negative road salt impacts in sensitive areas of the watershed	• Water Quality	• Improve baseline water quality values to achieve a reduction in road salt contaminants in sensitive areas.
Protect / restore / reduce stream temperatures to support aquatic life	• Stream Temperature	• Restore or maintain cold / cool water temperatures. • Restore and maintain seasonal temperature variations to natural fluctuations.
Protect, enhance and restore natural channel morphology and stability	• Rapid Geomorphic Assessment (RGA) and Rapid Stream Assessment (RSA)	• Achieve: ➢ Stability Index (SI) or <0.2 or "in regime". ➢ RSA health classification of excellent (40-50) or good (30-39).

Figure 11 below illustrates the healthy water resource targets in the watershed. These targets directly relate to the objectives for realizing each watershed component goal. For example, by maintaining pre-development infiltration / recharge rates, we will support the objective of "**Protect, restore and enhance groundwater recharge and discharge features"** that contributes to the goal of overall health of water quality and quantity. These more specific targets have been developed to provide specific actions that direct CLOCA's Action Plans as discussed in detail in Section 5 of the Watershed Plan. The High Volume Recharge Areas (HVRAs) are the identified indicator of these targets and will be used to measure progress during future updates of the Watershed Plan to ensure positive gains are being made towards achieving a healthy watershed. In this example, municipal policies have also been developed to support these targets as municipal policies are the most effective tool for dealing with HVRAs.

FIGURE 11: WATER RESOURCE TARGETS

Print Figure (11x17 recommended)



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4.1.2 Natural Heritage

Terrestrial Natural Heritage Goal: A healthy, self-sustaining, connected natural terrestrial system with ecological integrity. Development within the watershed shall not result in a net loss to the overall natural heritage system.

Fisheries and Aquatic Habitat Goal: A healthy, self-sustaining/resilient aquatic ecosystem that supports a diversity of native / naturalized fish and benthic communities; natural, healthy fish and riparian habitat; and the sustainable use of aquatic resources for recreational or commercial purposes that do not adversely affect the ecosystem.

NATURAL HERITAGE		
Objectives:	**Indicators:**	**Targets:**
Protect, restore and enhance the ecological integrity of natural areas (including wetlands)	• Percent Natural Cover	• Achieve a minimum 30% natural cover in the watershed.
	• Percent Forest Cover	• Continual increases of forest cover to achieve the long term target of 30% forest cover in the watershed.
	• Percent Wetland Cover	• Increase existing wetland cover in headwater areas and no net loss of wetland cover in the watershed. • Achieve and maintain a minimum of 10% wetland cover in the watershed and greater than 6% wetland cover in each subwatershed.
	• Invasive Species	• Continual improvement in the mitigation of invasive species impacts. • Implement CLOCA's Invasive Species Management Strategy.
Protect, restore and enhance the ecological integrity of wildlife habitat (non-aquatic)	• Habitat Diversity	• No loss of Ecological Land Classification (ELC) system community series types.
	• Habitat Distribution	• Maintain and enhance even distribution of natural and forest cover throughout the watershed.
	• Habitat Quality	• Enhance habitat patches to have better shape vs. area ratios. • At least one 200 ha forest patch within the watershed that is a minimum of 500 m wide.
	• Percent Forest Interior and Deep Forest Interior	• Achieve and maintain greater than 10% interior forest in the watershed. • Achieve and maintain greater than 5% deep interior forest in the watershed.
	• Corridor width	• Achieve and maintain naturalized local corridors >/= 60m x 60m. • Achieve and maintain naturalized landscape corridors >/= 100m x 100m wide.

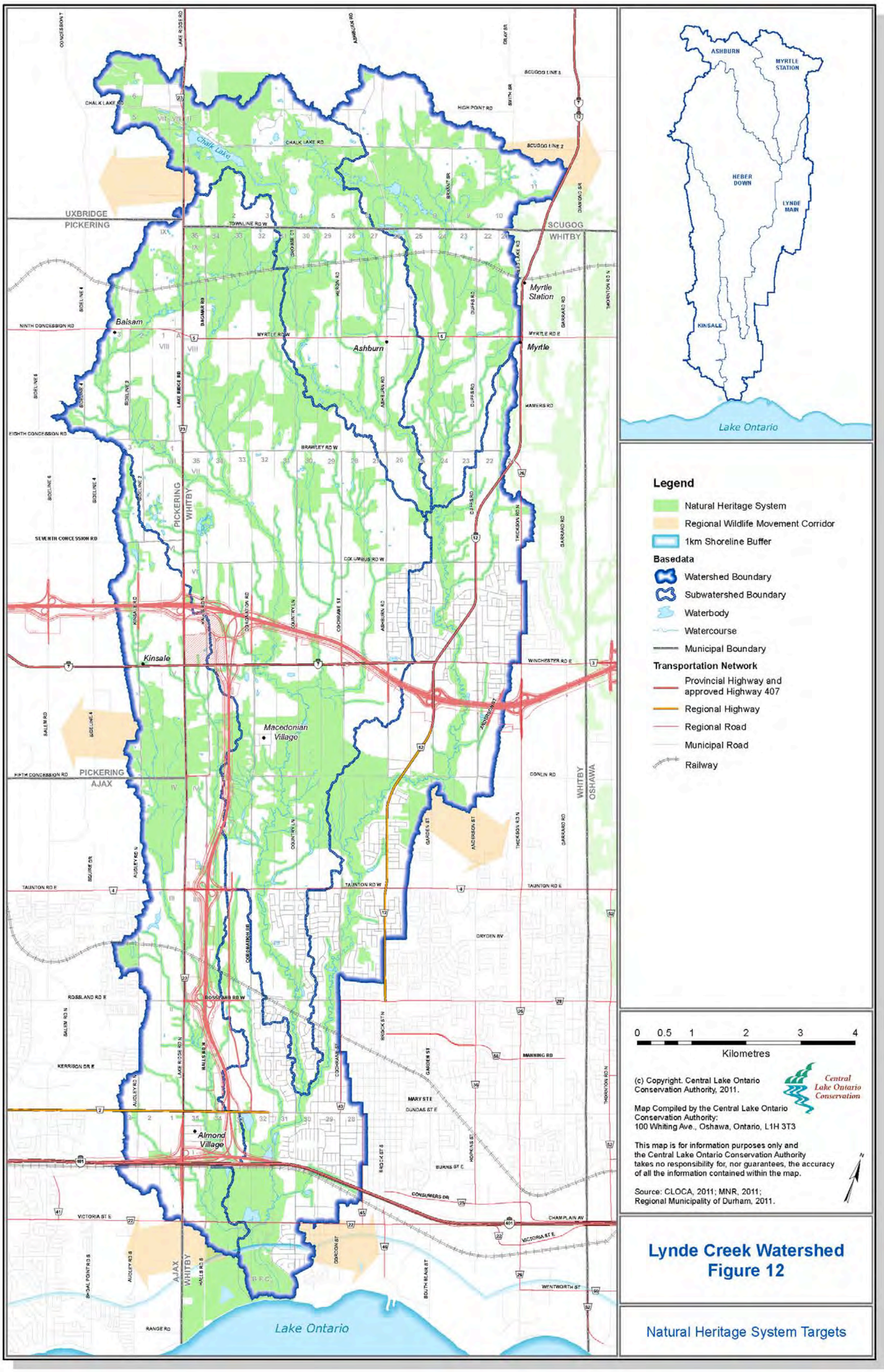
NATURAL HERITAGE		
Objectives:	**Indicators:**	**Targets:**
		• Maintain and enhance 1 km of naturalized habitat along the Lake Ontario Shoreline where possible.
	• Terrestrial and wildlife Species At Risk	• Support, in partnership, the protection, restoration and enhancement of the distribution of Species at Risk (SAR). • Support, in partnership, the identification, restoration and preservation of sensitive habitat as defined in species specific recovery strategies.
Protect, restore and enhance the ecological integrity of Coastal Wetlands	• Water quality	• Achieve and maintain a Water Quality Index (WQI) of 0 to 1 (good condition) or higher.
	• Sediment quality	• Maintain a Sediment Quality Index (SQI) score of 87.8 or higher (excellent condition).
	• Submerged Aquatic Vegetation (SAV) Community	• Achieve and maintain a Submerged Aquatic Vegetation (SAV) IBI of 40-60 (good condition) or higher.
	• Fish community	• Maintain a fish IBI of 47.8 or higher (good condition).
	• Bird community	• Maintain a bird IBI of 47.44 or higher (good condition).
	• Amphibian community	• Achieve and maintain an amphibian IBI of 40-60 (good condition) or higher.
	• Aquatic macroinvertebrate community	• Achieve and maintain a macroinvertebrate IBI of 40-60 (good condition) or higher.
Protect, restore and enhance the health and diversity of native / naturalized fish communities	• Diversity and Distribution of fish communities	• Continued presence and abundance of all native fishes. • Steady or increased abundance and distribution of Brook Trout.
	• Aquatic Species At Risk	• Support, in partnership, the protection, restoration and enhancement of the distribution of Species at Risk (SAR). • Support MNR to achieve compliance with the Redside Dace Ontario Recovery Strategy, MNR, 2009 and the 2011 MNR Habitat regulation. • Provide support to responsible authorities to apply habitat regulation for

NATURAL HERITAGE		
Objectives:	**Indicators:**	**Targets:**
		Eastern Pond Mussel. • Support, in partnership, the identification, restoration and preservation of sensitive habitat as defined in species specific recovery strategies.
	• Invasive / non-native species (not applicable to naturalized species)	• Absence and/or decline in abundance and distribution of invasive / non-native species. • Implement Invasive Species Management Strategy.
Protect, restore and enhance fish habitat and riparian habitat	• Stream Barriers	• Remove in-stream barriers where appropriate in priority sequence. • Protection of the ability of Salmonids, as well as native non-jumping fish from Lake Ontario, to spawn upstream in the watershed.
	• Percent riparian habitat per stream length	• Increase quality and range of fish habitat to achieve a target of 75% riparian cover along streams with a 30 m vegetated buffer on either side of the stream. • improve upon or maintain Subwatershed Riparian Cover Targets of: ➢ Ashburn: 17.73 km ➢ Heber Down: 46.43 km ➢ Kinsale: 25.64 km ➢ Lynde Main: 26.84 km ➢ Myrtle Station: 15.48 km

Figure 12 below illustrates the Natural Heritage targets for health in the watershed. This figure is a visual representation of the watershed health targets that will be achieved through the more detailed watershed component targets noted in the table above. These component targets directly relate to the objectives for realizing each watershed component goal. For example, by enhancing habitat patches to have better shape vs. area ratios and realizing at least one 200 ha forest patch within the watershed that is a minimum of 500 m wide, we will be directly supporting the objective of "**Protect, restore and enhance the ecological integrity of wildlife habitat (non-aquatic)"** which contributes to the larger watershed health target of 30% natural cover (moving to 30% forest cover), 10% interior forest and 5% deep interior forest. These more detailed targets have been developed to provide specific actions that direct CLOCA's Action Plans as discussed in Section 5 of the Watershed Plan as well as municipal policies discussed in Section 6. Habitat quality is the indicator that will be measured in future updates of the Watershed Plan to ensure positive gains are being made towards the targets and goal.

FIGURE 12: NATURAL HERITAGE RESOURCE TARGETS

Print Figure (11x17 recommended)



4.1.3 Transboundary Issues / Anthropogenic Influences

Impervious Surfaces Goal: To limit the amount of impervious surfaces in the watershed and mitigate negative impacts where possible.

Floodplains & Flood Damage Centres Goal: To model and predict the impact of severe weather events to protect human life and property.

Stormwater Management Goal: Effective, low impact management of stormwater run-off to protect the ecological health of the watershed and contribute to the protection of human life and property during storm events.

Air Quality Goal: To support programs to improve air quality levels that relate to ecological and human health.

Climate Change Goal: To establish a healthy, adaptable watershed that is resilient to the impacts of climate change.

IMPERVIOUS SURFACES		
Objectives:	**Indicators:**	**Targets:**
Limit impervious land cover in watershed	• Percent imperviousness	• < 10% on ORM and Greenbelt Lands. • <28.35% in existing urban areas. • Increase the use of Low Impact Development (LID) / green technologies for future development and retrofits to existing development where applicable.
	• Connected imperviousness	• TBD *See Section 5 of this report for more detail on future work to set targets".*
STORMWATER MANAGEMENT		
Objectives:	Indicators:	Targets:
Protect human life and property	• Flood Damage Centres	• Limit flood damages and prevent further flood damage centres.
	• New infrastructure	• All new infrastructure to have no impediment to natural overland / surface water flows.
Protect & maintain existing watershed / subwatershed catchment boundaries	• Drainage patterns	• Maintain existing watershed boundaries and drainage patterns. • All new infrastructure to mitigate potential impacts and risk to human life and property from increased surface flows.
Maintain pre-development peak flow rates from stormwater runoff	• Peak flow rates	• Peak flow rates on receiving streams to not exceed corresponding pre-development rates for the 1:2-year through 1:100-year design storm events and the Regional Event (Hurricane Hazel).

IMPERVIOUS SURFACES		
Objectives:	**Indicators:**	**Targets:**
		Note: exceptions include areas in proximity to Lake Ontario or where Master Plans exist and state otherwise.
Protect Ecological Health	• Existing infrastructure	• Improve existing stormwater management facilities to reduce adverse ecological impacts of development.
	• New infrastructure	• New stormwater management facilities to mitigate all impacts to water quality including stream temperature.
Effective and efficient performance of Stormwater Management Facilities	• Existing and new facilities	• Achieve enhanced Level 1 requirements. • Reduce thermal impacts. • Achieve intended designed flow control. • Reduce the number of structures impacted by flooding. • Reduce the number of flooding complaints.
AIR QUALITY		
Objectives:	**Indicators:**	**Targets:**
Sustain healthy levels of air quality for human health	• Ground level ozone	• Reduction in average annual Ozone levels. • Monitoring of Nitrogen Oxides and Volatile Organic Compounds.
Sustain healthy levels of air quality for ecological health	• Lichens	• TBD *See Section 5 of this report for more detail on future work to set targets.*
CLIMATE CHANGE		
Objectives:	**Indicators:**	**Targets:**
Protect, restore and enhance existing natural conditions to mitigate negative climate change impacts	• Precipitation • Surface Run-off • Evapotranspiration • Infiltration • Air temperature	• N/A *Monitoring and climate change observations to be recorded to assist in future assessment of impacts and included in an adaptive management strategy. See "CLOCA Action Plans" section of this report for more detail on future work to set targets".*

4.2 Protecting the Natural Heritage System (NHS) and High Volume Recharge Areas (HVRAs)

Protection, restoration, and enhancement of a watershed's natural heritage and water resources will sustain a healthy and resilient ecological system. In the Lynde Creek Watershed this is primarily achieved by protecting the NHS and HVRA recharge rates which also supports the attainment of other watershed health targets. For example, the protection, restoration and enhancement of the NHS will allow for the achievement of 30% natural cover and the 75% riparian cover targets (as well as others). Protecting the pre-development recharge rates of HVRAs will allow us to meet our groundwater quantity goals as well as ensure availability of water resources needed to support the NHS.

The extensive work completed to date to identify the NHS and HVRAs provides a solid, scientific foundation for advancing the health of the watershed. CLOCA can now strategically prioritize core areas of protection, restoration and enhancement that will provide the most strategic gains in watershed health. This approach of systems planning and protection offers opportunities and advantages well beyond protecting individual features, a practice from the past. We now have two very robust planning tools to help direct, focus and prioritize the protection of the natural resources of the watershed. These tools will serve not only CLOCA but our municipal implementation partners who can use this to achieve environmental sustainability through systems planning. The NHS and HVRA mapping also provides a valuable tool to the development community, offering a clear illustration of the systems that require protection in the watershed. Additionally, residents, community groups, educators and all other stakeholders of the watershed have the ability to visually understand how this watershed will be managed to ensure ecological integrity and how it will be protected for their use and enjoyment into the future.

4.2.1 Managing the NHS

The NHS is a connected system of features and functions that represents attainment of watershed health targets. Protecting the NHS means achieving watershed targets which will:

- ensure adequate natural cover with a target of 30% (to be achieved within the NHS and will consist of an assembly of any of the following communities; forest, wetland, meadow and beach/bluff communities);
- protect, restore and enhance riparian buffers to achieve a target of 75% of stream length having adequate cover achieved through stream buffer requirements and stewardship initiatives;
- provide habitat for wildlife through the protection, restoration and enhancement of habitat areas and corridors;
- protect water quality for human and ecological purposes through the protection and enhancement of water features and functions;
- protect wetlands that provide specialized habitat for a variety of species and support habitat needs associated with various life cycle stages; provide flood attenuation; and maintains the 10% wetland cover that currently exists in the watershed;
- protect life and property through the management of flooding, erosion and hazards and enhancement of natural cover for attenuating surface water flows;

- help to sustain ground and surface water quality and quantity supporting stream contribution, and aquatic habitat and fishery resources; and
- ensure that there is a connected natural system that supports biodiversity and ecological integrity while also contributing to the economic, social and cultural components of communities in this watershed.

Protecting the NHS is a critical means of ensuring that the Lynde Creek Watershed can function with ecological integrity in the long-term. As such, CLOCA will reference the NHS, (in addition to other Authority generated information) to provide informed comments on development applications within this Watershed.

During consultation on this Watershed Plan, a need to provide guidance when dealing with the Natural Heritage System was identified. Specifically, the translation of the landscape-level Natural Heritage System mapping into site-specific confirmation of NHS limits was identified as a particular challenge. The following guidance has been provided to assist stakeholders in completing Environmental Impact Studies (EISs). This guidance is not meant to be an exhaustive checklist of requirements; rather it is a high-level list of considerations for stakeholders undertaking EIS work in this watershed and is based on the policy recommendations provided in Section 6. The following guidance is based on the premise that the analysis, conclusions and recommendations of the EIS satisfies the requirements of the Municipality and the Conservation Authority.

- An EIS will delineate the features and functions within and adjacent to the Natural Heritage System (as illustrated in this Watershed Plan).
- The EIS shall demonstrate no negative impact to a feature and its function.
- As supporting information, mapping will be provided upon request by CLOCA that identifies the subject lands, ELC, and the limits of both the Functional Natural Heritage System (FNHS) and the Targeted Natural Heritage System (TNHS) as described in Appendix B (representing the NHS).
- Where the EIS confirms and refines ELC communities that are different from the information provided by CLOCA, and The Authority concludes the findings of the EIS to be satisfactory, the groundtruthed conditions as reported in the EIS will be accepted.
- Where the findings of an EIS recommend a revision to the FNHS, the NHS limits will be amended to the satisfaction of CLOCA to reflect the EIS delineation of the FNHS. Subsequently, revisions to the TNHS may be considered provided the EIS demonstrates the change to the FNHS is significant enough to warrant a change to the limits of the TNHS to the satisfaction of CLOCA.
- With the exception of riparian buffers, buffers adjacent to features have not been mapped as part of the Natural Heritage System. In accordance with applicable legislation and policy, buffers are a required element of planning approval. The size of the buffer will equal the greatest extent of applicable legislation, policy, and EIS recommendations.
- Riparian buffers have been included as part of the Natural Heritage System as they are fundamental requirements to achieve connectivity and watershed health targets (i.e. riparian cover, water quality, natural cover). These corridors will be protected with 30m buffers on either side of the stream where the thermal regime is confirmed as cool / cold. 15m buffers will be required where warm water regimes have been confirmed. The size of the buffer will equal the greatest extent of applicable legislation, policy, and EIS recommendations.

- Where features are groundtruthed as larger than the NHS mapping indicates, the delineation of the feature will be recorded as an addition to the NHS.
- Where all other opportunities for development have been exhausted and the only remaining option for development is to proceed on lands identified for natural cover regeneration/restoration within the NHS, then the EIS shall identify:
  - additional lands to be added to the NHS, that will exceed the area of lands removed and be contiguous with the NHS on the subject lands and/or;
  - corridor connectivity will be enhanced/restored and protected.
- CLOCA will update the NHS map at the 5-year review of the Watershed Plan with the most recent ortho-photography and to reflect any refinements to the NHS limits resulting from site plan approvals based on EIS work. CLOCA will track changes (additions and removals) to the NHS throughout the 5 year implementation period of the Watershed Plan and then use these changes as inputs to the model during the update to accurately reflect groundtruthed areas of the watershed.
- The Landscape Analysis Model (LAM) will be re-run at the five-year update of the Plan to ensure that the changes in the landscape and NHS still allow for watershed health targets to be met. Following the execution of the LAM, CLOCA staff will undertake a review of the NHS and make any necessary manual edits to the system where appropriate. It is not possible to re-run the model following every site-specific change in the watershed.

It is recognized that the NHS will require updates or confirmation to the limits of the system as development applications are put forward and other alterations to the landscape occur. It is important that the value of the Natural Heritage System as a whole is protected and preserved in order to reach long-term watershed health targets. **Exhibit 2** below provides a sample of the provincial support provided for protecting a Natural Heritage System, from the *Natural Heritage Reference Manual for Natural Heritage Policies of the Provincial Policy Statement, 2005 Second Edition,* as opposed to the historical approach of protecting individual features.

Exhibit 2: Provincial Support for Natural Heritage Systems

Planning Concern	Description and Potential Natural Heritage System Benefits
Landscape fragmentation	Loss of landscape connectivity, commonly known as landscape fragmentation, refers to the process by which large, interconnected natural areas are converted to a series of smaller, often isolated natural areas. Fragmentation is a severe threat to the survival of many wildlife species, particularly area-sensitive species and/or those with large home ranges. As habitat is lost or fragmented, residual habitat patches become smaller and more isolated from each other (measured as a reduction in total habitat area, reduction in patch size, increasing number of patches and distance between patches) (Bailey, 2007). The resultant isolation of one wildlife population from another can: • prevent, or make difficult or more dangerous, movement among areas used for feeding, shelter or resting; • disrupt seasonal movements needed to complete life cycles of some wildlife (e.g., amphibians, which overwinter • in woodlands but migrate to ponds in the spring to breed); • prevent dispersal of juveniles to other habitats in the area where better habitat conditions may exist; • lead to inbreeding that, over time, may reduce the ability of the population to adapt to changing environments; and • prevent the recolonization of an area after local extinctions. Fragmentation limits the movement of species in several ways: (1) many species avoid or cannot cross boundaries; (2) species' ability and willingness to move between patches and the degree of success species have in doing so are affected by the distance between patches and by the nature and use of the intervening landscape matrix; and (3) species' ability to detect and successfully settle in a different suitable habitat patch is affected by the distance between patches (Baguette and Van Dyck, 2007). These fragmentation outcomes lead to habitat degradation and modification, edge effects, overcrowding and invasion by non-native species. Increased isolation of species, compounded with other stresses, puts them at greater risk of disappearing from a region (Wilderness Society, 2004). Planning for natural heritage systems addresses fragmentation by identifying and protecting core areas, ecological linkages and landscape features that contribute to a system. This facilitates not only the maintenance of ecological function and biodiversity, but also the restoration and improvement of these things through stewardship (e.g., by identifying ecologically appropriate areas for enhancement and/or reconnection).
Biodiversity	The effects of landscape fragmentation have been well documented and are recognized as one of the leading causes of biodiversity decline (Noss et al., 2006). Indicators of biodiversity loss include the numbers of species that are identified as "at risk" (i.e., extirpated, endangered, threatened or of special concern; see section 5) and the pace at which species are added to the at-risk categories. These indicators and other global measures suggest a worsening situation for biodiversity. With appropriate mechanisms for protection of the features and maintenance of the linkage aspects of natural heritage systems, biodiversity values can be protected for the long term.
Climate	Stress due to climate change forces organisms (including humans) to adapt or relocate. An increase in the frequency of extreme weather events (e.g.,

Change	intense storms, drought) may affect habitats, particularly habitats that are localized (i.e., separated from other natural areas). Organisms (particularly those in localized habitats) that cannot adapt or relocate face extirpation or extinction. Protecting natural heritage systems – encompassing areas within which species can successfully carry out their life processes and potentially adapt, facilitating their movement to more suitable habitat, or enabling a destroyed habitat/population to be replenished – will improve species' ability to adjust to climate change.
Ecosystem health and healthy communities	Ecosystem health and healthy communities are inextricably linked, as is emphasized in Ontario's Biodiversity Strategy (see section 15 to access an electronic copy). Ecosystem health can be characterized as a measure of the level of distress in the ecosystem, its resilience and adaptability, the ability to sustain itself, the degree to which adjacent ecosystems are affected and the extent to which the ecosystem supports healthy human communities. To support the resource demands (e.g., food, water and shelter) of local communities, planning authorities need to maintain the ecological health of the natural environment to ensure that it can withstand the stresses that present and future human populations place on it. By protecting a natural heritage system that includes surface- and groundwater features (see section 3.2.1), planning authorities promote the resiliency of natural features to function for the long term and maintain overall ecosystem and human health. Healthy, resilient and diverse natural environments are important land use components that influence human activity, facilitate health and mental well-being and promote social interaction and inclusion (Ministry of Municipal Affairs and Housing and Ontario Professional Planners Institute, 2009).
Ecosystem Services	Ecosystem services are the benefits that people gain from ecological systems. These services are the basis for human well-being and the economic value of our landscape and economy (Troy and Bagstad, 2009). Natural heritage systems deliver essential ecosystem services such as clean water and air, productive soils and flood attenuation. Degradation of Ontario's ecosystem services can lead to unacceptable risks (e.g., soil erosion and flooding) to human well-being. Maintaining a natural heritage system is a precautionary approach that reduces risk and is more cost-effective than addressing problems after development has occurred and the ecosystem services are lost. At a basic level, natural heritage systems provide ecosystem services required for healthy, vibrant communities that include: • photosynthesis: capturing the sun's energy and converting it to biomass; • transpiration: cleaning the air and releasing clean water vapour into the atmosphere; to make rain and drive • the hydrological cycle; and • nitrogen fixation: capturing nitrogen for plant growth; and decomposition: returning nutrients to the soil.
Planning process efficiencies	Natural heritage system planning can assist with the identification of the most important natural heritage features within a planning area (e.g., key features for achieving representation within the study area, key features that contribute to connectivity). Taking a comprehensive landscape-level approach allows planning authorities to identify a community's priorities and inform subsequent site-level planning, which can focus subsequent studies on the areas most likely to be sensitive to impacts. This comprehensive approach can also assist a planning authority to proactively identify significant natural heritage features and areas as part of being consistent with PPS policies 2.1.3, 2.1.4, 2.1.5 and 2.1.6.

Source: Natural Heritage Reference Manual for Natural Heritage Policies of the Provincial Policy Statement, 2005 Second Edition

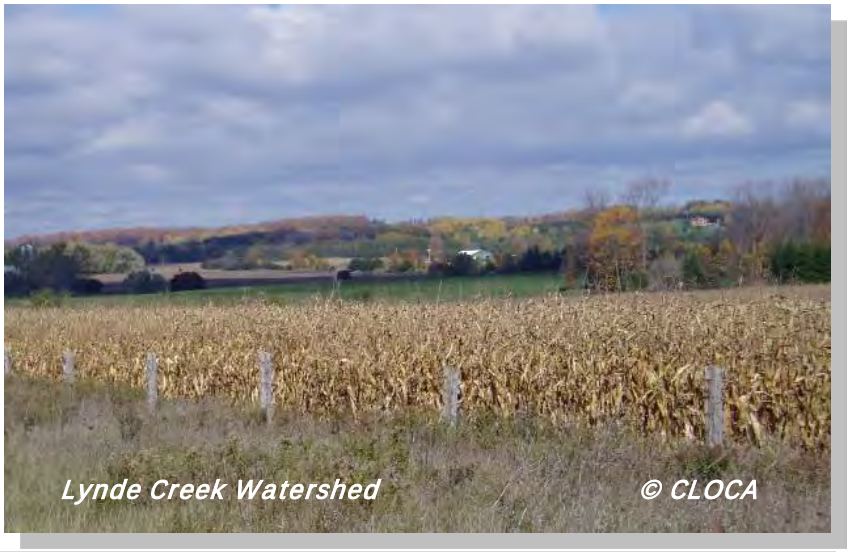
4.2.2 Managing HVRAs

Using the best information available at the time of the Water Budget report, the following key conclusions from the Water Budget work lead to the recommendation of protecting the pre-development recharge rate of HVRAs as a key mechanism for ensuring watershed health:

- Increased runoff appears to be the most significant consequence of development for water resources (decreased stability and health of stream corridors);
- Unless water is somehow introduced into the aquifers, groundwater will be reduced from current levels due to development;
- The recharge function of High Volume Recharge Areas (HVRAs) should be maintained everywhere to allow water to infiltrate from the surface into the ground to support groundwater recharge; and
- Preservation of the NHS, maintenance of the recharge function of HVRAs, and stormwater management practices offer the most beneficial solutions for mitigating runoff impacts as these measures benefit water recharge, enhance water quality, improve aquatic habitat, and manage sediment supply and channel form.

The Water Budget identified a correlation between groundwater drawdowns and the recharge function of HVRAs. As groundwater drawdowns extended across multiple watersheds, it is difficult to determine the interconnectedness or relationship between a specific HVRA and the drawdown of the aquifer. As such, it is recommended that the recharge rate of all HVRA's be maintained. It is important to note that development in HVRA's is not

Lynde Creek Watershed *© Lou Wise*


Lynde Creek Watershed *© CLOCA*

prohibited, rather the proponent must ensure that pre-development recharge rates can be maintained post development. Implementing measures to maintain pre-development recharge rates, such as the use of LID design and technology can be considered as a viable option. It is recognized that implementing measures which achieve groundwater recharge and protecting the NHS is the best approach to maintain CLOCA's groundwater resources and ecosystems.

A Hydrogeological Impact Assessment that will characterize the existing water balance and delineate the boundaries of the HVRA shall be prepared to the satisfaction of the Municipality and Conservation Authority. Development within HVRAs may be permitted if this study can demonstrate that there will be no loss to the recharge function as a result of the development.

The following guidance is provided to assist stakeholders in completing Hydrogeological Impact Assessments. This guidance is not meant to be an exhaustive checklist of requirements; rather it is a high-level list of guiding considerations for stakeholders undertaking hydrogeological work in this watershed and is based on the policy recommendations provided in Section 6.

- Hydrogeological Impact Assessments will confirm the extent of an HVRA where the undertaking is proposed within or adjacent to currently mapped HVRAs (as illustrated in this Watershed Plan);
- Mapping will be provided by CLOCA upon request that identifies the subject lands and the associated HVRA;
- All proposed work shall demonstrate no loss to the pre-development recharge rate of the HVRA through development design, mitigation methods such as LIDs and other appropriate techniques and technologies;
- Amendment of the HVRA limits shall be considered upon completion of the Hydrogeological Impact Assessment; and
- CLOCA will update the HVRA map at the 5-year review of the Watershed Plan based on HVRA mapping confirmations obtained from completed Hydrogeological Impact Assessment and other appropriate hydrogeological work undertaken in the watershed.

4.3 The Watershed Management Plan

Figure 13 below illustrates the Watershed Management Plan that includes:

- the Natural Heritage System (NHS),
- the High Volume Recharge Areas (HVRAs),
- water bodies and watercourses,
- Regional wildlife and landscape corridors on the Oak Ridges Moraine, Lake Iroquois Beach and the Lake Ontario Shoreline; and
- The 1km buffer of the Lake Ontario shoreline.

The Watershed Management Plan visually represents the key ecological systems in the Lynde Creek Watershed that will allow the watershed health targets to be met in the future. The CLOCA Action Plans outlined in Section 5, the recommended municipal policies provided in Section 6 and the recommendations in Section 7 for Other Stakeholder involvement were developed to ensure that the watershed targets can be realized within the challenging context of future growth and development pressures.

It is the recommendation of this Plan that municipalities incorporate the NHS and HVRA mapping into their Official Plans to provide a foundation for protecting these essential areas of the watershed.

Exhibit 3: Watershed Plan Implementation for Watershed Health

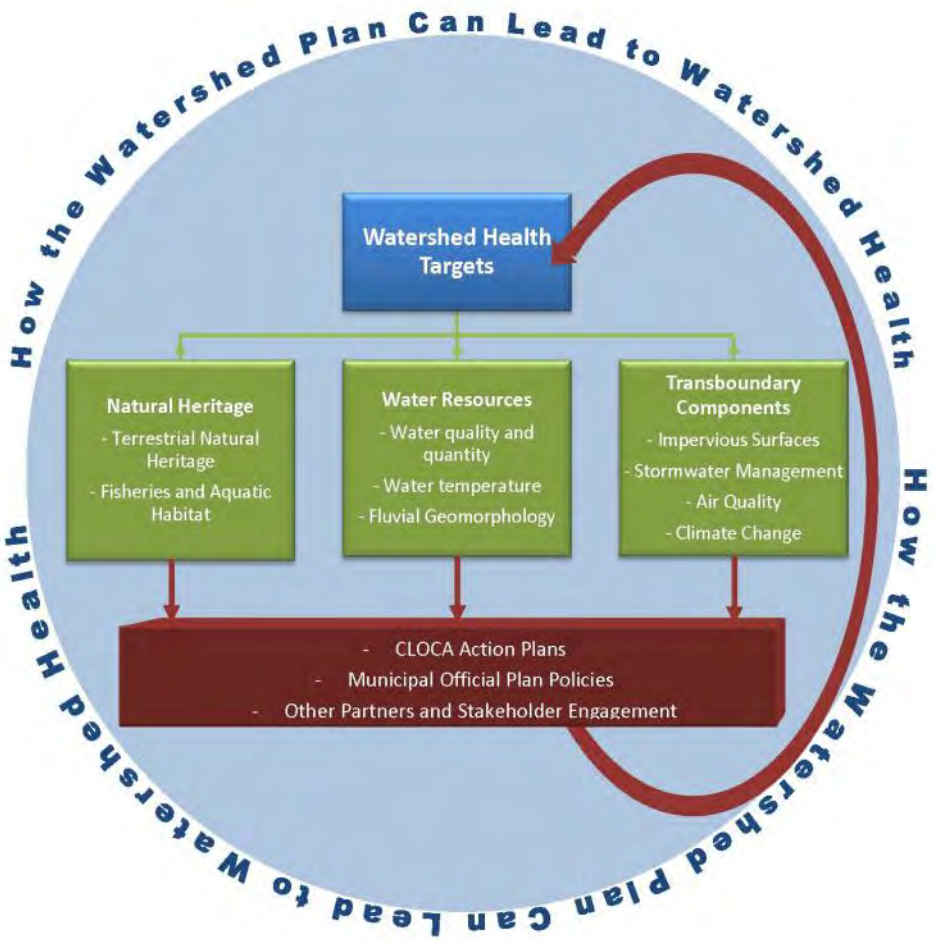
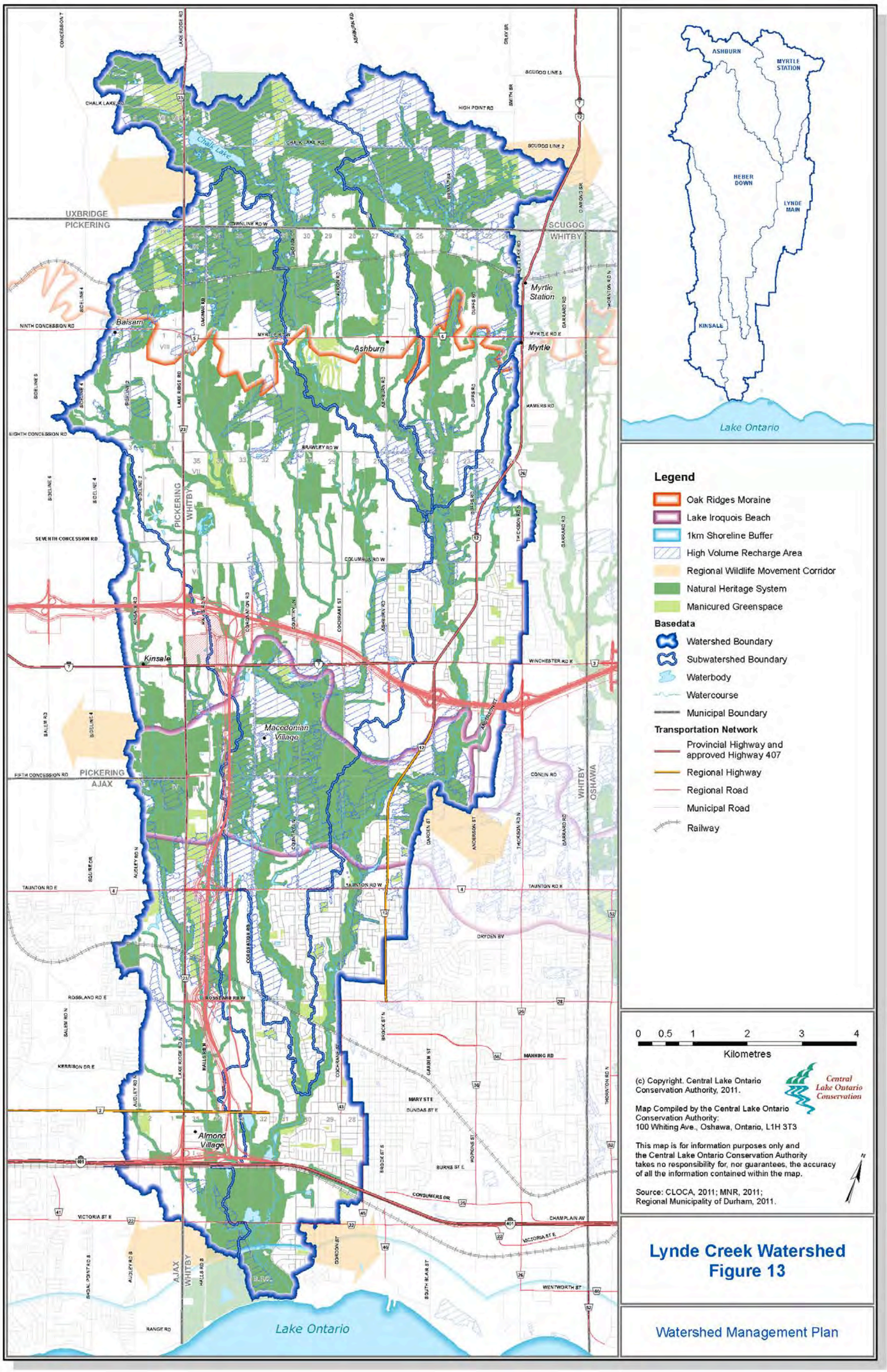


Exhibit 3 illustrates the process in which the Watershed Plan will be implemented through the various tools outlined in the following sections.

FIGURE 13: THE WATERSHED MANAGEMENT PLAN

Print Figure (11x17 recommended)



5.0 Watershed Implementation Plan – CLOCA Responsibilities

Seven strategic priorities have been identified to direct and focus work in this watershed for the next five years. These priorities will be reviewed and updated reflecting on progress over the next few years and adapted to any changing conditions.

1. Protect, Enhance and Restore the Lynde Creek Watershed To Be A Resilient Ecosystem with Ecological Integrity

At the core of all of the work done to date, and the recommendations contained in this Plan, is the guiding vision of managing the Lynde Creek watershed so it is resilient and continues to have ecological integrity. All efforts are focused on the multitude of tasks and dedication of resources required by CLOCA, municipalities and all stakeholders to achieve this vision to protect our natural capital, enhance our social and economic prosperity and protect human life and property from flooding. One way CLOCA will manage the resources of the watershed will be through the protection, restoration and enhancement of the Natural Heritage System by ensuring that the significance, value and system as a whole is maintained with no significant losses to features or functions over time. The NHS will guide stewardship, education and engagement activities and priorities to further advance, focus and prioritize on-the-ground implementation undertakings. In that all the ecological components of the watershed are either directly or indirectly linked to the NHS, protecting and restoring the NHS will have positive impacts on both surface and groundwater resources, and will be beneficial in reducing and mitigating flood and erosion hazards.

2. Implementation, Acceptance and Support for the Watershed Plan

The success of this Watershed Plan is dependent upon the effectiveness of its implementation. To implement the Plan, it must first be accepted by municipalities with full support provided so that the recommendations of the Plan can be put into action through planning policy. Secondary to this priority, is the broader acceptance and understanding of the Plan by the development community, residents and other interested stakeholders. The structure of this Plan provides a focus on the end-user. The Watershed Plan contains CLOCA Action Plans that detail how the Conservation Authority will be fulfilling the watershed goals and targets, municipal planning policies developed for ease of incorporation into Official Plan documents, and a section dedicated to how other stakeholders can take action to achieve a healthy Lynde Creek Watershed. The intention is that all stakeholders in the watershed will be able to easily access, understand and act upon the specific tasks to help us get closer to the long-term protection of our natural assets in the Lynde Creek Watershed.

3. Long-Term and Sustainable Funding

Long-term protection requires long-term funding in order to sustain the level of work and commitment required to protect the natural systems that sustain our way of life in the Lynde Creek watershed. Research is beginning to address ecological goods and services by putting dollar values on natural features and functions. For example, the forests in the Credit River Watershed provide a climate regulation service with an estimated value of $11.4 million annually, ecological services provided by their wetlands have an estimated worth of $187 million per year, and natural features in

north and south Mississauga provide an increase in property values of $255,446,966. (CVCA, Pembina Institute, 2009). There is a necessary shift in recognizing that the protection and restoration of natural capital is an economic investment that has proven to have good returns on that investment.

4. Consistent and Long-Term Monitoring

The landscape of the Lynde Creek watershed is rapidly changing as our population continues to grow. In order to fully understand the impacts of these changes, consistent and long-term monitoring of our groundwater, streams, wetlands, natural cover (including forests) and wildlife is required. Future changes create cumulative impacts that require monitoring on a watershed scale to effectively track and assess watershed health trends as well as to protect the property and human safety of residents. Consistent and long-term monitoring is the only way to track the effectiveness of the Watershed Plan for affecting change.

5. Engaging Stakeholders through Stewardship & Education

Educating, engaging and inspiring action in residents and other stakeholders are critical to affect positive change in the watershed. All stakeholders from grade-school students to seniors and property owners have an essential role to play in protecting and preserving natural features and their functions through their everyday activities, volunteer efforts and community undertakings. Capitalizing on the knowledge and experience of our residents to enhance ecologically sound land use, water conservation and education efforts will provide the most effective means of ensuring a healthy watershed for generations to come.

6. Filling Data Gaps

Even though there is an immense amount of data available to assess components of watershed health, critical data gaps need to be filled in order to best arm decision-makers in the future for protecting the watershed as a whole. A key means of filling these gaps can be found in increasing coordination efforts between government agencies, academic institutions, municipalities, the development community and individual residents. Resources need to be dedicated to establishing data sharing and gathering efficiencies between all contributing parties. Technological advances in modeling as well as increased standardized reporting of specific watershed components are opportunities to take advantage of to advance our knowledge and reporting capabilities on the health of the watershed.

7. Public Land Acquisition

Land securement is a tangible way of protecting valuable natural capital. It has been noted that even where costs of land securement are high, there is still positive economic returns in protecting the land through purchase (Marbek, 2010). Efforts to expand on the existing momentum for acquiring sensitive areas for protection in perpetuity need to continue as CLOCA has a very good foundation of success to build on. Acquiring land also offers the opportunity to enhance the environmental, social and cultural aspects of a community through initiatives that provide locally accessible passive recreational opportunities and environmental education and awareness programs.

5.3 CLOCA Action Plans

Priority Action Plans have been described and outlined below. Each of these Plans represents an undertaking to help achieve specific watershed health objectives and contribute to the fundamental goal of a healthy and resilient watershed. Many of the Action Plans can be undertaken on a CLOCA jurisdiction basis to gain all efficiencies possible, or they may be undertaken for a specific area (subwatershed, municipality etc.) where appropriate. All Action Plans will address individual watershed concerns, issues and actions. Some Action Plans will also compliment, support and / or inform Regional and Municipal program, project and corporate priorities. These Action Plans will provide a greater level of detail for achieving specific watershed goals and targets. The Action Plans will also provide the framework and implementation planning necessary to complete the on-the-ground monitoring, research, restoration and rehabilitation work in future.

To help communicate and describe the key watershed targets these plans will help achieve, the following symbols are noted adjacent to the Action Plan name:

30% Natural Cover: Supports the achievement of increased forest cover to 30%, 10% interior forest, 5% deep interior forest through long-term naturalization, provides run-off retention, erosion control, wildlife habitat, natural system connectivity, air quality improvements, social / cultural / economic benefits and climate change mitigation impacts.

10% Wetland Cover: Provides run-off retention, erosion control, water quality filtration, wildlife and fish habitat, social / cultural / economic benefits and mitigates impacts associated with climate change.

< 10% Imperviousness on the ORM and Greenbelt: Limiting impervious surfaces allows for better run-off retention, groundwater infiltration, ground and surface water quality and sediment. Limiting built or paved areas can have a positive impact on the amount of natural areas contributing to ecosystem health.

75% Riparian Cover: Protecting, restoring and enhancing riparian cover provides run-off retention, water quality, fish habitat and diversity, system connectivity, and water temperature benefits.

A Healthy Water System: Water quantity and quality to support ecological and human health as well as protect human life and property.

All Watershed Health Targets

#1: Natural Heritage System Restoration Plan

The watershed will be protected through policy and regulation and enhanced through stewardship initiatives. This Action Plan will lay out the framework for restoring the Natural Heritage System as defined through our watershed planning process and identified in Figure 13 to achieve the overall targets of 30% natural cover, 75% riparian cover, less than 10% impervious surfaces on the ORM and Greenbelt lands, and 10% wetland cover. This Restoration Plan will at a minimum include the following work:

- Identify opportunities and priorities for wetland restoration with consideration given to restoring historical wetland cover when making restoration recommendations;
- Support the long- term Durham Region Coastal Wetland Monitoring Project (DRCWMP) work , including data collection and future restoration activities;
- Identify opportunities to rehabilitate existing forest communities to optimize forest distribution, size, shape, matrix of influence, interior and deep interior habitat and achieve forest cover quantity gains. This work will include consideration of and coordination with Conservation Area Lands Management Plans where appropriate;
- Identify restoration and/or enhancement opportunities lands within the NHS;
- Identify areas with high imperviousness values within, or in close proximity to HVRAs or other sensitive features, and assess impacts. Results to be applied to or incorporated from the **Urban Land Use Low Impact Development (LID) Retrofits Plan,** the **Imperviousness Report Cards,** and the recommendations of the **Stormwater Management Performance Monitoring and Maintenance Plan;**
- Identify restoration opportunities in wildlife corridors in coordination with the **Wildlife Corridor Protection and Enhancement Plan**;
- Identify key riparian restoration priorities or opportunities in coordination with the **Riparian Corridors Restoration Plan**;
- Identify opportunities for land acquisition to achieve watershed goals in coordination with the **CLOCA Land Securement Strategy;**
- Document any data gaps to be included in the **CLOCA Data / Analytical Needs and Coordination Assessment** document;
- Identify short and long-term stewardship opportunities based on the wetland, forest, corridor and sensitive area work noted above and in coordination with the **CLOCA Stewardship and Education Priorities and Plan**;
- Ensure that restoration and enhancement recommendations include biodiversity considerations;
- Incorporate the recommendations of the **Highway 407 East Post-Construction Monitoring Plan**; and
- Coordinate recommendations with marketing and engagement efforts.

Consistent with Strategic Priorities:

1. *Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity*
3. *Long-Term and Sustainable Funding*
4. *Consistent and Long-Term Monitoring*
5. *Engaging Stakeholders through Stewardship and Education*
6. *Filling Data Gaps*
7. *Public Land Acquisition*

#2: Riparian Corridors Restoration Plan

Riparian corridors are part of the Natural Heritage System and, due to the various pressures on surface water systems in the watershed, and the substantial impact these corridors have on watershed health, a specific effort will be focused on achieving the 75% riparian cover target. The work will be done in coordination with the **Natural Heritage System Restoration Plan** and will include at a minimum the following work:

- Development of an updated methodology for reporting riparian cover as per Environment Canada's recommendations in "How Much Habitat is Enough";
- Development of an updated methodology for reporting "adequate" riparian cover for protecting stream health;
- Identification of historical, existing and probable Redside Dace habitats;
- Identification of best management and restoration opportunities for improving riparian corridors in urban, rural and agricultural properties; and
- Creation of a riparian corridors restoration opportunities map.

Consistent with Strategic Priorities:

1. Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity
3. Long-Term and Sustainable Funding
4. Consistent and Long-Term Monitoring
5. Engaging Stakeholders through Stewardship and Education
6. Filling Data Gaps
7. Public Land Acquisition

#3: CLOCA Community Engagement Plan

The development of a Community Engagement Plan has been identified as a priority for implementing the Watershed Plans. This plan is a fundamental tool for enhancing the success of all of CLOCA's strategic priorities for implementation and will include at a minimum the following work:

- Identification of strategic directions, key audiences, themes, messages, marketing methods, measurable metrics, tactics and priorities for engaging stakeholders;
- Identification of watershed specific audiences and a committed group of interested stakeholders to support / contribute to the implementation of Watershed Plan recommendations;
- Development of a stakeholder management system utilizing the available CLOCA database tools and functionality to manage stakeholder interactions;
- Development of standardized, recognizable templates for watershed planning communications; and
- A review of Regional, municipal and community group initiatives to identify opportunities suitable for cooperative efforts.

Consistent with Strategic Priorities:

1. Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity
2. Implementation, Acceptance and Support of the Watershed Plan
3. Long-Term and Sustainable Funding
4. Consistent and Long-Term Monitoring
5. Engaging Stakeholders through Stewardship and Education
6. Filling Data Gaps
7. Public Land Acquisition

#4: CLOCA Regulation & Plan Review Policies and Procedures Manual

To formalize the policies developed through this Watershed Plan, existing regulation plan review policies and procedures, as well as the commonly accepted standards applied during the regulation and plan review process, CLOCA is in the process of completing a Regulation & Plan Review Policies and Procedures Manual. This document will be shared with municipalities and used as the internal review manual for all future regulation & plan review applications reviewed and commented on by CLOCA.

Consistent with Strategic Priority:

2. Implementation, Acceptance and Support of the Watershed Plan

#5: Wildlife Corridor Protection and Enhancement Plan

Wildlife corridors are mapped as part of the Natural Heritage System. Additional work is needed to identify the wildlife crossing "hot spots" in the watershed at existing or approved future road crossings. Work is currently underway to: document the existing conditions in the watershed; conduct a corridor assessment and barriers to movement analysis; identify corridor enhancement, culvert improvement and stewardship opportunities; and develop key implementation tasks and priorities. This report will contribute to the **Natural Heritage System Restoration Plan** and inform the **Stewardship and Education Priorities and Plan**.

Consistent with Strategic Priorities:

1. Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity
6. Filling Data Gaps

#6: High Volume Recharge Area (HVRA) Case Study

As growth proceeds within CLOCA's jurisdiction, CLOCA can be proactive by investigating methods, technologies, techniques and tools for protecting High Volume Recharge Areas (HVRAs) within the watershed. CLOCA will research various approaches and prepare a discussion paper with recommendations regarding BMPs for the protection of HVRAs identified within the Lynde watershed. Recommendations will be tailored to Lynde site specific soils/conditions and will include monitoring suggestions to promote and encourage the ability to assess and report on the performance of the various measures. CLOCA will review relevant case studies as part of background for the establishment of local BMPs and also and look for local research opportunities for testing of various methods. This project will provide recommendations for a future case study to assess the effectiveness of applied BMPs.

Consistent with Strategic Priorities:

1. Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity
4. Consistent and Long-Term Monitoring
6. Filling Data Gaps

#7: CLOCA Data / Analytical Needs and Coordination Assessment

It is recognized that there is a lot of very useful data available for protecting, enhancing and restoring the watersheds within CLOCA's jurisdiction. However, some significant data gaps have been identified as barriers to effectively advise decision-makers on ecological impacts.

There are many opportunities to coordinate monitoring and data sharing efforts between government agencies and the private sector to gain substantial efficiencies. This assessment of CLOCA's data needs and coordination opportunities will holistically look at what data we have, what we need, where to get it, how to share it and how to use it. The assessment will include at a minimum a look at the following issues:

- What information we currently have, the duration of data collection, how we access it, what we do with it and who we share it with;
- Identification of data gaps within the current monitoring/reporting structure;
- Identification of opportunities to enhance current data or fill gaps including acquisition of data from public and private agencies;
- The need for a mechanism to collect localized information on the surficial geology through information sharing with consultants on a site specific basis (geotechnical borehole data).
- Updating geological maps using local geotechnical borehole data / models with local information in coordination with the YPDT (York, Peel, Durham, Toronto) team;
- Update, maintenance of numerical models;
- Developing data sharing protocols with the private sector where opportunities are identified;
- Gain a more comprehensive understanding of the 'water demand' component of the Water Budget, including updating permit data and assessing actual water use;
- Refining groundwater and surface water stress calculations with moderately stressed watersheds;
- Encouraging the development of a Provincially approved Inland Fill Quality Guideline document;
- Working with the MOE to provide permit 'conditions' information and update PTTW (Permit to Take Water) demand data to more accurately reflect actual water taking quantities;
- Liaising with MOE regarding the PTTW approval process;
- Updating ELC community mapping and data;
- Incorporating ELC data and mapping collected by other agencies or consultants into CLOCA's ELC dataset;
- Coordination and data sharing efforts between federal, provincial and CLOCA monitoring programs;
- Confirm population and habitat threats and identify Redside dace restoration needs;
- Improving coordination with MNR and DFO to protect Redside Dace habitat and other aquatic species at risk habitat within the Lynde Creek watershed;
- Investigation of genetic work/research on Brook Trout isolated populations.
- Partnering opportunities with academic institutions including Species at Risk.

Consistent with Strategic Priorities:

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3. *Long-Term and Sustainable Funding*
4. *Consistent and Long-Term Monitoring*
5. *Engaging Stakeholders through Stewardship and Education*
6. *Filling Data Gaps*

#8: CLOCA Water Monitoring Program Review

Monitoring ecological trends in the watershed is the primary means of recognizing impacts to features and functions. Various provincial policies and the Clean Water Act have identified the need to monitor water resources to protect human and ecological health. In order for CLOCA to continue to advise municipalities on water-related issues, a comprehensive review of CLOCA's water monitoring is required. This should include an investigation of what additional water monitoring and resources are needed to fulfill the recommendations of policies and legislations within the province. This assessment will include at a minimum the following components:

- Review potential expansion of the Provincial Ground Water Monitoring Network (PGMN) in priority areas;
- Prepare PGMN program revision rationale and equipment needs proposal for submission and approval by the Province;
- Installation of new monitoring equipment and inclusion into the data management system including liaison with GIS for on-line retrieval;
- Discuss with the Province the potential for an increase in frequency of water quality testing as part of provincial monitoring protocols including PWQMN as well as the addition of event based monitoring;
- Installation of additional gauges in priority areas;
- Assess the need to expand surface water monitoring system to include upper stream reaches to better understand groundwater discharge patterns for ongoing maintenance of baseflow and stream sustainability;
- Review low flow data with modelling products to map stream recharge /discharge patterns and determine the need for additional monitoring;
- Additional biological monitoring to assess changes to un-impaired reaches;
- Determination of appropriate measurement/reporting methodologies for monitoring and implementing Suspended Solid Load (turbidity levels) to support Stormwater Management activities;
- Establish links between CLOCA's low water response program and SWP stress calculations and PTTW monitoring;
- Assessment of CLOCA water data storage and sharing mechanisms (CUASHI); and
- Expansion of water temperature monitoring network.

Consistent with Strategic Priorities:

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#9: CLOCA Urban Land Use Low Impact Development (LID) Retrofits Plan

Since much of the southern portions of the watershed are already developed, retrofits become an important mechanism for restoring ecological function in these reaches. This report will identify LID opportunities based on existing land use and ecological conditions with priority assigned to undertakings that provide the most efficient and effective means of restoring or rehabilitating aquatic function. This Retrofit Plan can be used by municipalities as a tool for mitigating impacts of older, developed areas. The report, at a minimum, will include:

- Analysis of stormwater run-off patterns, flows and impact areas as a means of identifying priority restoration areas;
- Identification / prioritization of impacted areas and LID opportunities and recommendations;
- Preparation of an impervious / HVRA identification map by land cover illustrating key retrofit opportunities by jurisdiction, municipality, watershed and landform;
- Recommendations for monitoring of impervious surfaces and stormwater quality and quantity; and
- Recommendations for stewardship and education material for development and distribution in targeted retrofit areas.

Consistent with Strategic Priorities:

1. *Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity*
4. *Consistent and Long-Term Monitoring*
5. *Engaging Stakeholders through Stewardship and Education*
6. *Filling Data Gaps*

#10: Stewardship and Education Priorities and Plan

Stewardship Priorities:

It is clear that residents, landowners, community groups, business owners, educational institutions and other stakeholders can actively contribute to the achievement of watershed goals and health targets. As part of a comprehensive review of stewardship priorities and opportunities, this report will include at a minimum:

- Delivery of strong community stewardship programs on urban lands to promote watershed health, demonstrate restoration techniques and engage community volunteers;
- Development and delivery of a long term strategic private land stewardship program in rural communities to provide landowners with support to achieve watershed health goals;
- Coordination with Conservation Area Management Plans to enhance learning opportunities;
- Establishment of a pre and post monitoring and reporting mechanism to assess the success of private and public land stewardship projects; and
- Integration of ecological recommendations from other Action Plans to pursue stewardship opportunities to achieve measurable, physical improvements within CLOCA.

Education Priorities:

A very important component of implementing this Watershed Plan is actively educating stakeholders through curriculum and non curriculum programs and activities that focus on the positive and negative impacts of humans on the ecological integrity of the

CLOCA's watersheds. The comprehensive education plan will, at a minimum, include the following:

- Continued delivery and expansion of innovative and curriculum linked experiential education programs that promote life-long learning;
- Building on existing and new relationships with the education sector to examine program opportunities;
- Develop and deliver hands-on workshops to include creation and distribution of new and existing printed and electronic information on current and priority issues like invasive species, well water protection and species at risk; and
- Continued delivery of seasonal special events to meet the needs of individuals, students, seniors and families.

Consistent with Strategic Priorities:

1. *Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity*
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#11: CLOCA Land Securement Strategy

Through concentrated efforts, CLOCA has made great strides in acquiring land within our jurisdiction for long-term protection of priority features and functions. As a continuation of the on-going effort to grow CLOCA's land holdings, this report will at a minimum include the following:

- Identification of priority acquisition areas and opportunities;
- Identification of long-term funding strategies;
- Dissemination and coordination of plan, strategies and priorities with municipalities; and
- Identification of appropriate and achievable linkages and corridors;

Consistent with Strategic Priorities:

1. *Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity*
7. *Public Land Acquisition*

#12: Lynde Creek Watershed Imperviousness Report Card

As the natural landscape is paved over, a chain of events is initiated that typically results in degraded water resources. Imperviousness is one of the most meaningful indicators of how healthy a watershed can be as impervious surfaces affect water quality, quantity, temperature, sedimentation, erosion, fish habitat, soil composition / compaction and terrestrial growth. As development pressures continue to grow in combination with expected impacts of climate change (i.e. more intense storm events), tracking how much of our lands are covered with impervious surfaces, where these areas are, and how they are affecting surface-water run-off and groundwater recharge and discharge, becomes increasingly important. Equally important is the investigation of how to mitigate the impacts of already developed/impervious lands. This report card will at a minimum include work to:

- Document the % imperviousness of: urban areas, urbanizing areas, HVRAs, the ORM, the Greenbelt lands, subwatersheds, and the full Lynde Creek Watershed;
- Establish a monitoring program and protocol to assess change in imperviousness in the above noted areas;
- Set out an information sharing protocol between CLOCA and municipalities;
- Identify and coordinate impervious mitigation priorities with the **Urban Land Use Low Impact Development (LID) Retrofits Plan;**
- Coordinate mitigation priorities with Connected Imperviousness Best Management Strategy; and
- Make recommendations for short and long term impervious mitigation strategies.

Consistent with Strategic Priorities:

1. *Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity*
3. *Long-Term and Sustainable Funding*
4. *Consistent and Long-Term Monitoring*
6. *Filling Data Gaps*

#13: CLOCA Connected Imperviousness Best Management Strategy

Connected imperviousness is a developing area of study that looks not only at the overall percent imperviousness of a given area, but at the amount of connected impervious surfaces in relation to the proximity of these connected areas to streams. It has been documented that "urban development that minimizes the amount of connected impervious surface and establishes undeveloped buffer areas along streams should have less impact than conventional types of development." (Wang, 2001). This Action Plan proposes to:

- Establish a Connected Imperviousness Methodology for documenting existing conditions and identifying priority restoration and mitigation areas;
- Document connected imperviousness values and results through a GIS mapping exercise to be incorporated into the **Imperviousness Report Card** discussed above;
- Set out connected impervious targets and include in the 5-year review of this Watershed Plan; and
- Identify priority mitigation measures and a best management strategy for the most connected urban impervious areas within the watershed.

Consistent with Strategic Priorities:

1. *Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity*
3. *Long-Term and Sustainable Funding*
4. *Consistent and Long-Term Monitoring*
6. *Filling Data Gaps*

#14: CLOCA Ecological Goods and Services Inventory

It is difficult to communicate or even calculate the "value" of natural resources. In a growing field of study, researchers are beginning to put economic dollar values on not only ecological features but the functions that these features play in our economic and social lives. The Credit Valley Conservation Authority in cooperation with the Pembina Institute is a great example of how Conservation

Authorities are using this new understanding of natural capital to communicate value to partners and residents as a means of furthering ecological understanding.

The emerging research shows very clearly that it is a sound and necessary investment to protect, restore and preserve natural capital as a means of: reducing costs from flooding, erosion, and degraded water quality; and as a means of increasing revenue resulting from increased property value and generated through culture and tourism opportunities. In an assessment of the value of protecting the Great Lakes Ecosystem, it was noted that "the most significant policy implication emerging from this analysis is that there are positive economic returns on restoration and protection of all habitat types evaluated." (Marbek, 2010).

Within the CLOCA jurisdiction, there exists many unique features such as the Oak Ridges Moraine (ORM), Chalk Lake, the Greenbelt, the Lake Iroquois Beach (LIB), coastal wetlands and Lake Ontario that can now be "valued" in a more traditional economic dollars and cents way. This information would put into perspective the value of protecting our existing features as well as the cost of restoring what has already been impacted by development. Using the methodology already established by the CVC and Pembina Institute, this work would involve at a minimum:

- Inventorying the existing NHS features and functions;
- Determining value estimates for landscape features such as the ORM, Greenbelt, LIB and coastal wetlands;
- Estimating the cost of restoring priority lands where appropriate as identified through the **Natural Heritage System Restoration Plan**;
- Developing priority protection and restoration areas in the context of the cost estimates and coordinating these conclusions with other Action Plans; and
- Preparing a report for municipalities illustrating the natural capital in the watershed.

Canada's wetlands provide flood control work of $2.7 billion annually. A Washington State study estimated the value of wetlands for flood control at $89,000 to $126,000 per hectare per year *(Environmental Law Clinic, University of Victoria Faculty of Law, and Deborah Curran & Company, 2007).*

Consistent with Strategic Priorities:

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7. *Public Land Acquisition*

#15: CLOCA Salt Management Plan

Evidence of increasing sodium levels in ground and surface water in the Watershed has been documented. Noticeably higher concentrations are recorded during December through to March. While there are various natural and anthropogenic sources that may account for elevated sodium and chloride in water, road salt application and storage is considered the activity with the most potential to impact water quality. Municipalities are the leaders when dealing with salting practices in terms of addressing safety concerns and costs of both application and various products. In cooperation with municipalities, CLOCA will address the negative impacts of salt use as it relates to ecological features and functions, and find opportunities including the creation of a landowner education package to reduce these identified impacts. At a minimum, this work will include:

- Coordination of research on current Best Management Practices regarding salt storage, application and mitigation;
- Implementation of a CLOCA properties salt management strategy;
- Provision of mapping products and data associated with salt sensitive areas for municipal and provincial salt management decision making;
- Documentation of historical impacts;
- Development of recommended mitigation measures; and
- Development of a Private Lands Salting Best Management Practices Information Kit to be distributed to land owners and building tenants/managers outlining Salting Best Management Practices.

Consistent with Strategic Priorities:

1. *Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity*
5. *Engaging Stakeholders through Stewardship and Education*
6. *Filling Data Gaps*

#16: CLOCA Implementation of the Invasive Species Management Strategy

Invasive Species are an on-going concern and threat across the Province of Ontario. It is now estimated that the spread of invasive species is second only to habitat loss as the major cause of biodiversity decline. In response to this threat, CLOCA has developed an Invasive Species Management Strategy that was approved and endorsed by the CLOCA Board of Directors in November 2010. An implementation plan is currently in development. The document sets out eight underlying strategies: Prevention; Communication; Best Management Practices; Prioritization; Implementation; Collaboration; Policy; and Research & Monitoring. Several items of the work-plan have already been completed including:

- Development of Best Management Practices for CA staff and construction workers;
- Invasive Species Removal Pilot Projects on CA lands;
- Communication outreach programs with local industries and organizations;
- Work with Federal, Provincial, Municipal and non-profit organizations to develop communication pieces on invasive species; and

- Installation of engaging and interactive communication pieces on CA lands.

The draft implementation plan sets out a five-year plan to address the actions listed within the strategy. Invasive Species management is a long term commitment, involving committed resources, partnerships and community involvement. Continued education, awareness and management are essential, and as such will be achieved through the continued implementation of the Invasive Species Management Strategy.

Consistent with Strategic Priorities:

1. *Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity*
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#17: Lynde Creek Watershed In-Stream Barriers Action Plan

There are 6 known in-stream barriers in the Lynde Creek watershed. Each of these barriers will be investigated to confirm their impact, evaluate the need to maintain or remove the barrier based on the impacted systems, and prioritize the removal of barriers where appropriate.

Consistent with Strategic Priorities:

1. *Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity*

#18: CLOCA Ecological Compensation Protocol

As compensation is required on development approvals where all other mitigation options have been exhausted, it is important to develop a standard protocol for use within CLOCA to ensure that compensation requirements minimize any negative **impacts** to the Natural Heritage System, HVRAs or groundwater quality or quantity and maximize restoration potential. This protocol will support the policies in Section 6 of this Plan as well as the **CLOCA Regulations and Plan Review Policy and Procedures Manual** described as CLOCA Action Plan #4. Together, these documents will provide all the guidance required by stakeholders involved in the planning, review and execution of development proposals for dealing with issues of "compensation".

Consistent with Strategic Priorities:

1. *Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity*

#19: CLOCA Lichen Pilot Project

Air pollutants cause adverse effects to global, regional and local ecosystems, to human health and in some cases property. Lichens are useful monitors of temporal change, spatial distribution, and ecosystem effects from air pollution that can help CLOCA more actively monitor air quality within the watershed. This Action Plan will develop a Lichen Map for the CLOCA jurisdiction to illustrate lichen populations, develop a long-term lichen monitoring program and reporting strategy, and make recommendations once enough monitoring data / map updates

have been completed. The potential for stakeholder monitoring and reporting of lichens will be investigated.

Consistent with Strategic Priorities:

1. *Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity*
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#20: CLOCA Climate Change Monitoring / Adaptive Management Strategy

Climate change impacts require consistent and long-term monitoring to understand impacts from this global phenomenon. In 2011, Ontario released "Climate Ready: Ontario's Adaptation Strategy and Action Plan" that outlines 37 actions to be implemented throughout the province to ensure that Ontario is in a position to minimize negative impacts and capitalize on opportunities resulting from climate change. CLOCA will develop a climate change monitoring and adaptive management strategy that will, at a minimum:

- Consider Climate Ready's recommended actions for the CLOCA jurisdiction;
- Continue monitoring basic indicators of climate change to establish baseline data (precipitation, surface run-off, evapotranspiration, infiltration, and air temperature);
- Coordinate with municipal, regional, provincial and Conservation Ontario initiatives where possible;
- Develop an adaptive management strategy to communicate to stakeholders ways to mitigate negative climate change impacts within the watershed;
- Develop a framework for a future Climate Change Report Card; and
- Assess the current monitoring abilities of CLOCA and make recommendations for future/additional monitoring where warranted.

Consistent with Strategic Priorities:

1. *Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity*
3. *Long-Term and Sustainable Funding*
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#21: CLOCA Stormwater Management Performance Monitoring and Maintenance Plan

Stormwater management is a key component of protecting human life and property as well as protecting ecological features and functions. As such, CLOCA will undertake an exercise to identify underperforming and untreated areas and develop monitoring and maintenance recommendations to promote improved stormwater management performance. This work will build on the positive proactive approach taken by the Town of Whitby (through the implementation of their Stormwater Quality and Erosion Control Enhancement Study completed by Marshal, Macklin, Monaghan, 2001) to identify untreated areas and take action to retrofit these areas to improve stormwater quality. This Plan will include at a minimum:

- An investigation into areas not treated for stormwater quality with consideration for the work completed to date by the Town of Whitby and other municipalities where applicable;
- Investigation of the need for stormwater management plans in areas of Brooklin and Whitby where none currently exist;
- Mapping results showing untreated areas;
- Recommendations for a monitoring framework and performance indicators, to assess the effectiveness of existing stormwater management facilities; and
- Continuation of cooperation with municipalities to fund, update and implement retrofit programs on existing stormwater management facilities to improve stormwater catchment and treatment.

Consistent with Strategic Priorities:

1. *Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity*
3. *Long-Term and Sustainable Funding*
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#22: Highway 407 East Post-Construction Monitoring Plan

Highway 407 East is one of the largest highway construction projects ever to take place in Ontario. The project will extend Highway 407 from Brock Road in Pickering to Highway 35/115 in Clarington, with two north-south connections to Highway 401. The vast majority of this highway expansion will take place within CLOCA's jurisdiction.

CLOCA has been working with the Ministry of Transportation (MTO) to ensure that the protection of the natural environment is recognized and considered during the construction and operation of this roadway. CLOCA will develop a post-construction monitoring plan that will at a minimum:

- Monitor impacts on the watershed to ensure that mitigation measures of the highway design and operation are effective;
- Assess the impact of the Highway 407 East facility on the opportunities and limitations for protecting, restoring and enhancing the ecological integrity of the watersheds within CLOCA's jurisdiction; and
- Develop implementation recommendations for specific restoration and enhancement opportunities and include as part

of the **Natural Heritage Restoration Plan** and the **Stewardship and Education Priorities and Plan**.

Consistent with Strategic Priorities:

1. *Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity*
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#23: Flood Damage Centres Upgrading

As part of CLOCA's mandate, the effective monitoring and reporting of flooding conditions and "flood damage centres" is undertaken. An effort is currently underway to update our modelling and communication abilities to continue to provide accurate and available information and services to our municipal partners, emergency service providers and the public. At a minimum, the following work will be undertaken as part of the upgrading:

- Update existing flood damage centres data and mapping;
- Development of recommendations to manage, minimize and monitor flood damage; and
- Implementation of effective two-way, on-line communication tools and strategies.

Consistent with Strategic Priorities:

1. Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity
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5. *Engaging Stakeholders through Stewardship and Education*
6. *Filling Data Gaps*

5.3 Potential Barriers to Implementation

The above Action Plans represent a comprehensive and dedicated effort directed at achieving watershed health. The fundamental barrier to creating and executing each of these Action Plans is commitment. Regional and Municipal endorsement of the Watershed Plan, as well as resources support is the level of commitment needed to effectively implement this Watershed Plan and see measurable gains toward watershed health. CLOCA is well positioned to undertake the majority of work with our current level of in-house expertise but it is anticipated that additional staffing resources will be necessary to develop and execute all the Action Plans within the 5 year review period. The Watershed Plan will support the achievement of the corporate objective for sustainability / livable communities, satisfy Regional and Municipal natural heritage responsibilities, as well as integrate well with many environmental programs and services currently offered by our municipal partners.

As is the current standard of practice, CLOCA will continue to seek outside funding sources to supplement the available and required resources where appropriate. A comprehensive review of funding and other resource needs will take place upon completion of the Watershed Plan to investigate efficiencies that can be gained from external cooperation and internal scheduling and dedication of resources for each Action Plan.

5.4 CLOCA Guiding Principles

Watershed planning and management requires a holistic approach to dealing with current conditions and trends as well as planning for future ecological impacts and trends. The following sections provide the guiding principles through which CLOCA will manage the protection, restoration and enhancement of ecological features and functions within the watershed. These principles are in addition to the municipal implementation policies provided in **Section 6.2** of this Watershed Plan and aim to support implementation initiatives by all stakeholders to achieve watershed health. CLOCA will continue to regulate and enforce ecologically appropriate actions within our Authority and jurisdiction as well as support municipal implementation of the Watershed Plan through the comment and review process for development approvals. The achievement of a healthy and resilient watershed with ecological integrity requires both CLOCA and our municipal partners to fully support and implement this Watershed Plan, its policies and recommendations.

Table 4: CLOCA Guiding Watershed Management Principles

Ref	Guiding Policy
WSP1	CLOCA supports the implementation of the Watershed Plan through incorporation of the municipal policies into Official Plans.
WSP2	CLOCA shall continue to be the guiding authority with respect to management of the watershed in an ecologically sustainable manner, providing the science, technical advice and leadership necessary to achieve a healthy watershed.
WSP3	CLOCA shall continue to engage the public and stakeholders in watershed stewardship and education initiatives for improving environmental awareness and encouraging positive action.
WSP4	CLOCA shall protect the Natural Heritage System as identified in **Figure 13** of this Plan to ensure "no net loss" to the watershed's Natural Heritage System in order to achieve watershed health targets.
WSP5	CLOCA shall protect the function of High Volume Recharge Areas (HVRAs) as identified in **Figure 13** of this Plan by preserving pre-development recharge rates in these areas.
WSP6	CLOCA shall support all efforts to achieve 30% natural cover to work towards 30% forest cover; 10% interior forest; 5% deep interior forest; 10% wetland cover; <10% imperviousness on the Oak Ridges Moraine and Greenbelt Lands; and 75% riparian cover along stream lengths.
WSP7	CLOCA shall continue to implement the requirements of Ontario Regulation 42/06 "Development, Interference with Wetlands and Alteration to Shorelines and Watercourses".
WSP8	CLOCA shall continue to adhere to and implement applicable legislation and regulations to protect human health and property and ecological integrity.

WSP9	CLOCA will continue to adhere to and implement all fisheries related legislation and policies, including the Federal Fisheries Act. CLOCA shall continue collaboration with the Department of Fisheries and Oceans Canada in accordance with the Level III agreement currently in place.
WSP10	CLOCA shall promote the implementation of appropriate buffers and set-backs from ecological features.
WSP11	CLOCA shall protect, restore or enhance significant geological, physiological and corridor features and functions within its jurisdiction.
WSP12	CLOCA shall conform to all internal protocols during the plan review process that protect the Natural Heritage System and enhance the ecological integrity of the CLOCA jurisdiction.
WSP13	CLOCA will continue to work with partners to acquire land for long-term protection.
WSP14	CLOCA shall monitor the key indicators of watershed health as appropriate and communicate existing and future trends to municipalities and partners.
WSP15	CLOCA shall endeavor to protect the quality and quantity of water resources through effective monitoring, reporting, plan review process, conservation and mitigation / restoration efforts to ensure human and ecological health.
WSP16	CLOCA shall continue to monitor and manage invasive species through the implementation of applicable management plans and strategies.
WSP17	CLOCA shall continue to manage Conservation Authority owned lands through established management plans that provide long-term protection and restoration recommendations. The enhancement of existing features of these lands supports the ecological health of the larger watershed.
WSP18	CLOCA shall encourage the use of best stormwater management techniques and technologies for protecting human safety and property as well as ecological health.
WSP19	CLOCA shall encourage all development to limit impervious surfaces within a watershed through encouraging Low Impact Development (LID), green technologies and any other suitable methods or tools.
WSP20	Lake Ontario is recognized as the ultimate drainage point of CLOCA watersheds with a fundamental ecological role to play in the environmental, social and economic health of the CLOCA jurisdiction. It is also recognized that Lake Ontario provides 100% of municipally supplied drinking water to residents. As such, CLOCA shall continue to strive to improve watershed conditions to support the features, function and overall health of Lake Ontario.
WSP21	CLOCA shall continue to support provincial and federal efforts to protect, manage and identify Species at Risk (SARs) and their habitat.

6.0 Watershed Implementation Plan – Municipal Partners

The success of a Watershed Plan is dependent on its effective implementation. This Watershed Plan has been written in a manner which directs practitioners to the specific recommendations and actions they are responsible for to ensure a healthy and sustainable watershed. The previous section of this Plan provided recommendations and actions that the Conservation Authority will be undertaking. This section provides municipalities with policies supporting municipal implementation of the Watershed Plan. These policies have been developed as tools to achieve the identified watershed targets, based on science and established through consultation.

The final implementation section of the Watershed Plan provides opportunities for other watershed stakeholders to participate in the protection, restoration and enhancement of the watershed.

6.1 Memorandum of Understanding with CLOCA

Currently, CLOCA has a Memorandum of Understanding with the Region of Durham that sets out the following goals with respect to natural heritage and hazard issues:

- To effectively address issues of provincial interest in the decision-making process on planning applications and planning documents for which the Region prepares, is the approval authority, or otherwise comments on;
- To ensure the implementation of Regional and Area Municipal Official Plan policies;
- To share information which would assist and expedite decision-making; and
- To ensure that each step of the process implementing the Plan Review function is complementary and adds value to the decision-making process.

The Conservation Authority will provide advice and comments to the Region which shall include; recommendations from this Watershed Plan, flood plain management, the need for and adequacy of stormwater management plans, requirements under the Federal Fisheries Act, and information on the significance of natural heritage and hazard features and functions.

The Conservation Authority would support entering into similar Memorandums of Understanding with area municipalities to confirm the cooperation, support and partnership between the Authority and municipalities for implementing the Watershed Plan.

6.2 Municipal Implementation through Policy Adoption

This Watershed Plan is a "science first" plan, documenting existing conditions, anticipating future changes and evaluating the impact these changes will have on the long term sustainability of the watershed. Goals, objectives and targets are set out in this Plan to ensure that the Lynde Creek Watershed remains healthy and resilient in a changing landscape. Management recommendations are provided which will achieve the goals, targets and objectives identified in the watershed plan. Taking action to fulfill watershed plan recommendations cannot be done solely by CLOCA. Implementation relies on the participation of our partners, including Municipalities.

Direction is provided in provincial and municipal planning policy that watershed plans be implemented through municipal Official Plans. Official Plans set out the goals, objectives and policies to guide, manage and direct change (growth) over time in a responsible manner balancing social, economic and environmental needs. Durham Region's Official Plan guides future development throughout the Region and coordinates growth across 8 municipalities and 30 watersheds. Official Plans for the lower tier municipalities are more detailed, providing specific direction regarding community form, development type, location, density and design.

Adoption of the Lynde Creek Watershed Plan into Municipal Official Plans makes certain that the goals, recommendations, and targets of the Watershed Plan will be implemented through development approvals triggered by the Planning Act.

Watershed Planning Directions from the Durham Region Official Plan, 2008

2.3.8 The preparation and implementation of *watershed plans* is supported as an effective planning tool in the protection of the region's natural resources.

2.3.11 The Region, in co-operation with the conservation authorities, shall, where necessary, ensure that the appropriate policies to implement individual *watershed plans* are incorporated into the Regional and area municipal official plans.

Support for the development and protection of a Natural Heritage System from the Durham Region Official Plan, 2008

1.3.1 The goals of this Plan will be achieved through the following directions:

c) protecting significant features and functions of the natural environment;
d) encouraging development that will not have adverse cumulative impacts on the natural, built and cultural environments;
i) encouraging stewardship of land;
l) coordinating and managing the development of the Region in a manner that is consistent with provincial planning policies;
m) identifying and protecting resources in the Region;

2.3.2 The development of a connected and functional natural system comprised of the Greenlands System and additional linkages and corridors as identified in area municipal plans is encouraged.

Taking a "science first" watershed plan and ensuring that the goals and recommendations are effectively translated into planning policy is challenging. Since 2005, there has been significant effort by municipal planners and Conservation Authority planners to translate watershed plan recommendations into municipal plan policies. Using the *Watershed Planning – From Recommendations to Municipal Policies* document (as referenced in Technical paper series #9 of the ORMCP), CLOCA staff recommendations, policies developed by other Conservation Authorities, and consultation with stakeholders, a suite of municipal planning policies translating the Lynde Creek Watershed Plan goals, objectives and targets is offered in this Section as a tool supporting Municipal implementation of this Plan. The policies developed implement this Watershed Plan, CLOCA plan review and regulation policies. Municipalities will need to ensure that other environmental land use planning policies such as buffer setbacks established through the Greenbelt and Oak Ridges Moraine Conservation Plan are satisfied as these policy requirements have not been incorporated in the suite of policies offered. All recommendations of this Watershed Plan are predicated on meeting the specific health targets for the Lynde Creek Watershed. Therefore, there may be instances where provincial or municipal policies are more restrictive than those recommended in this Plan. For instance, this Watershed Plan allows for a 10m buffer to be provided from the dripline of a wooded area, whereas the ORMCP and Greenbelt Plan require a 30m buffer from vegetated communities. It is the responsibility of the implementers of this Plan to ensure they are meeting all of their legislated planning requirements.

The various sections of this Watershed Plan are structured by Water Resources, Natural Heritage Resources and Transboundary / Anthropogenic Influences. To maintain consistency, the municipal policy recommendations follow this format as well as being further categorized as "Fundamental", "Key" and "Voluntary". This structure has been developed as a response to municipal consultation with our partners that suggested municipalities would benefit from knowing which policies are fundamentally important for inclusion in official plan documents versus those policies that could be used as guidance in other municipal documents. All "Fundamental" and "Key" policies are recommended to be included in upper and lower-tier municipal policies. "Voluntary" policy recommendations are generally more appropriate for lower-tier municipalities or other municipal guidance documents due to their level of detail, but can be applied in upper-tier OPs as well. Notes regarding specific implementation have been provided where appropriate to address any anomalies.

- **Fundamental** policies represent the high level goals and targets of this Plan. All upper and lower-tier municipalities should include these policies in their Official Plans as a minimum for achieving watershed health.
- **Key** policies are more detailed, directly impact the achievement of watershed health targets, and provide direct support for the fundamental policies. It is recommended that municipalities incorporate key policies wherever possible in their OPs to further strengthen the implementation of this Watershed Plan.
- **Voluntary** policies were developed to provide municipalities more specific policy guidance for dealing with detailed planning situations or operating stand. While these policies are fully

supported by CLOCA for enhancing the implementation of the Key and Fundamental policies, they have been developed to provide specific guidance where additionally detailed policies were requested.

To illustrate how the policy relates to the watershed health targets identified through the development of the Watershed Plan, symbols representing broad health targets are provided beside each policy. Please note that the symbols are the same that have been used throughout the Plan as follows:

30% Natural Cover

10% Wetland Cover

< 10% Imperviousness on the ORM, and Greenbelt

75% Riparian Cover

A Healthy Water System

All Watershed Health Targets

It is fully understood that municipalities may alter some wording within the policies to better conform to their existing official plan wording. However, it is important that these revisions do not alter the meaning or intent of the provided policies.

For the most part, the existing official plans within the Lynde Creek Watershed have strong environmental policies. An Official Plan review process offers an excellent opportunity to incorporate the recommendations of this Watershed Plan to ensure legislative compliance and provide full implementation support to achieve a healthy and sustainable watershed. Through the cooperative efforts of municipal partners, CLOCA and other watershed stakeholders, significant and tangible gains in watershed health can be made that enhance the natural, social, economical and cultural strength of watershed resources, municipalities and the Region.

Central Lake Ontario Conservation

TABLE 5: MUNICIPAL OFFICIAL PLAN POLICIES

Ref	Fundamental Municipal Official Plan Policies
Watershed Plan (General)	
F1	The Lynde Creek Watershed Management Plan provides the foundation upon which to make environmentally sound decisions to maintain, improve, and enhance the watershed's future health. The goals, targets and recommendations for implementation and monitoring contained within this Watershed Plan shall be supported.
F2	To achieve a healthy watershed, the Municipality supports the following minimum watershed targets: 30% forest cover; 10% wetland cover; 10% interior forest; 5% deep interior forest; and 75% riparian cover along stream lengths. On lands within the Oak Ridges Moraine and Greenbelt, the percentage impervious surfaces shall not exceed 10%.
Water Resources	
F3	Water is recognized as a vital component of a healthy watershed and the protection of this valuable resource is necessary to ensure a sustainable, functioning hydrological and hydrogeological system consisting of sufficient water resources (quality, quantity and temperatures) to support and protect: healthy aquatic and terrestrial ecosystems and ecological functions; clean drinking water for watershed residents; sustainable human use of groundwater resources for non-drinking water purposes; Lake Ontario as a drinking water source; human life, property and infrastructure from flooding and erosion hazards.
F4	Ground and surface water features include: • groundwater recharge areas including High Volume Recharge Areas (HVRAs); • groundwater discharge areas including seeps, springs, and baseflow contribution zones (baseflow to streams); • highly vulnerable aquifers; and • all watercourses including headwater drainage features, lakes, and wetlands. Watercourses, headwater drainage features, lakes and wetlands and some groundwater discharge areas are mapped as part of the Natural Heritage System. HVRAs are an important component of the Natural Heritage System, but for policy implementation, have not been incorporated into the mapped Natural Heritage System, but are identified on Schedule XX to this plan.
F5	New development within watercourses, wetlands, and lakes is prohibited except flood and erosion control work and development permitted in accordance with applicable Provincial and/or Federal legislation.

Ref	Fundamental Municipal Official Plan Policies
F6	Development shall maintain a 30m buffer from each side of the watercourse. A reduction in the buffer may be considered to a minimum of 15m adjacent to warm water streams if it can be demonstrated that there will be no negative impact to the feature and function, and/or the Natural Heritage System, and that hazard and floodplain requirements can be met to the satisfaction of the Conservation Authority and the Municipality. The limit of the watercourse is describe as: • for a meandering stream with defined bed and banks, the line that connects the outside curve of the bank at bankfull stage; • for a non-meandering stream with defined bed and banks, the normal high water mark; • for lakes, the normal high water mark; • for a intermittent stream with no defined bed and bank, including headwater drainage feature, the centre line of a channel or depression that concentrates flow Where possible, headwater drainage features shall generally be protected. Notwithstanding, development may be considered provided the necessary technical studies are completed to the satisfaction of the Municipality and the Conservation Authority that assesses the aquatic, hydrologic and geomorphic attributes of the feature and function including management options.
F7	Removal or disruption to HVRAs will impact groundwater and surface water resources as well as those natural heritage features and habitat which rely upon groundwater inputs and surface water quality and quantity. Development within HVRAs may be permitted provided an Hydrogeological Impact Assessment is conducted which characterizes existing water balance and demonstrates that development will result in no loss to recharge functions attributed to the HVRA.
Natural Heritage Resources	
F8	Achieving a healthy, self-sustaining, connected Natural Heritage System is integral in ensuring a healthy and resilient watershed. Protection of this system is necessary to support ecological integrity including healthy terrestrial, wildlife, wetland and aquatic ecosystems.
F9	The Natural Heritage System (NHS) as identified on Schedule XX of this Plan is a connected system consisting of PSWs, provincially significant ANSIs, important aquatic habitat, riparian corridors, core habitat areas and terrestrial corridors, woodlands >/= 0.5ha, wetlands >/= 0.5ha, and areas identified for natural cover regeneration/restoration which will improve connectivity and habitat. To achieve watershed targets, the Natural Heritage System shall be protected.

Ref	Fundamental Municipal Official Plan Policies
F10	Development in the Natural Heritage System is generally restricted to: fish and wildlife management; conservation; forestry; existing uses; flood or erosion control projects except stormwater management facilities. Public trail development may be permitted provided there will be no negative impact to the features or functions of the Natural Heritage System, to the satisfaction of the Municipality in consultation with the Conservation Authority.
F11	A connected natural system is vital to the health of the watershed. Regional and landscape corridors are part of the Natural Heritage System and identified on Schedule XX of this Plan. The Municipality is committed to supporting connectivity and continuity of wildlife corridors and ensuring that the function of these corridors will be preserved, enhanced and restored.
F12	Lands within 1 km of the Lake Ontario Shoreline are identified as an important ecological area providing natural heritage features and functions including: • coastal wetlands; • migratory stopover; • beach/bluff communities; • shoreline processes including dynamic beaches; • habitat for endangered, threatened, and/or special concern species; and • a regional wildlife movement corridor offering unique habitat and movement opportunities. New development within 1 km of the Lake Ontario Shoreline shall incorporate site design criteria which limits development impact on: migratory species; resident species; important natural heritage features and functions; and on wildlife movement corridors. Where development currently exists, the Municipality shall support education, restoration, rehabilitation and retrofit efforts to enhance natural features and functions.
F13	In areas identified as habitat of an endangered /threatened /species of concern, development shall only be permitted in accordance with the Endangered Species Act, 2007.

Transboundary Issues / Anthropogenic Influences	
F 14	The Oak Ridges Moraine, Lake Iroquois Beach and Lake Ontario Shoreline are important landscape features providing important wildlife corridors supporting east-west movement and connectivity with north-south movement corridors. All effort shall be made to maintain and/or restore continuous corridor function within and between these features. The Oak Ridges Moraine and the Lake Iroquois Beach are significant geological features having important groundwater functions and the Municipality shall make every effort to ensure groundwater recharge and discharge functions are protected, including limiting, or prohibiting where appropriate, the introduction and/or expansion of impervious surfaces.
F15	Development shall not result in any downstream impacts such as increased flood levels, stream erosion, or reduction in baseflow. Where every management measure has been taken and downstream impacts persist, alternative stormwater controls may be considered by the Municipality and the Conservation Authority.

Ref	Key Municipal Official Plan Policies
Water Resources	
K1	Generally, development within or adjacent to groundwater discharge areas shall not be permitted unless an Environmental Impact Study and/or Hydrogeological Impact Assessment demonstrating to the satisfaction of the Municipality in consultation with the Conservation Authority there will be no negative impact to the feature, function, and/or groundwater quality and quantity, and that groundwater discharge rates are maintained.
K2	If any groundwater and/or surface water feature is identified within or adjacent to a proposed development area, but is not shown on Schedule XX, the feature shall be delineated and an Environmental Impact Study and/or Hydrogeological Impact Assessment shall be conducted as a requirement of development to the satisfaction of the Municipality in consultation with the Conservation Authority.

Ref	Key Municipal Official Plan Policies
K3	The Municipality supports restoration of riparian areas and corridors to protect fish and aquatic resources. Development in riparian areas shall be restricted to: fish and wildlife management; conservation; forestry, existing uses, flood or erosion control projects with the exception of storm water management facilities. Public trail development may be permitted provided there will be no negative impact to aquatic habitat to the satisfaction of the Conservation Authority. Riparian areas shall be managed to achieve a naturalized vegetated condition.
K4	The Municipality supports natural stable stream channels and corridors that: allow for natural stream flow patterns; support diverse aquatic habitat; limit sediment loadings; and protect human life, property and infrastructure from risks associated with flooding, erosion and slope instability. Where in-stream work and/or stream realignment is proposed, the principles of natural channel design and use of biological engineering techniques and technologies, to the satisfaction of the Conservation Authority, shall be incorporated in the final design and construction.
Natural Heritage Resources	
K5	An Environmental Impact Study (EIS) prepared to the satisfaction of the Municipality and the Conservation Authority shall be required where a natural heritage feature is identified within or adjacent to a proposed development area, but beyond the limits of the Natural Heritage System. The EIS shall delineate the feature and function, determine the significance of the feature and function, assess its contribution to the ecological system including the Natural Heritage System, and evaluate whether it shall be protected or if mitigation can be provided to address any loss to the feature and/or function.
K6	Development adjacent to the Natural Heritage System may be permitted subject to submission of an Environmental Impact Study to the satisfaction of the Municipality in consultation with the Conservation Authority that demonstrates no negative impact to the feature/function and appropriate buffers between development and the Natural Heritage System are identified.

Ref	Key Municipal Official Plan Policies
K7	Where possible, new transportation and infrastructure projects shall avoid wildlife corridors, and/or demonstrate that there will be no barrier to wildlife crossing functions. Where every reasonable effort has been taken and wildlife barriers will result, adequate wildlife crossing provisions must be provided as part of the approval, to the satisfaction of the Municipality in consultation with the Conservation Authority. Improvements to existing infrastructure, including roads, shall incorporate measures to eliminate barriers to wildlife movement and include measures to accommodate enhanced wildlife movement.
K8	A minimum buffer of 10 m past the drip line of wooded areas shall be protected. Development in the buffer is restricted to; fish and wildlife management, conservation, forestry, existing uses and flood or erosion control projects with the exception of storm water management facilities. Public trail development may be permitted in the buffer provided it is demonstrated to the satisfaction of the Municipality, in consultation with the Conservation Authority that there will be no negative impact to the features and/or functions.
K9	A minimum 30m buffer shall be provided from provincially significant features within the Natural Heritage System, and a minimum 15m buffer shall be provided from all other wetlands in the Natural Heritage System. Development in the buffer is restricted to; fish and wildlife management, conservation, and flood or erosion control projects with the exception of storm water management facilities. Public trail development may be permitted provided it is demonstrated to the satisfaction of the Municipality in consultation with the Conservation Authority that there will be no negative impact to the features and/or functions.
K10	Invasive species and the spread of invasive species represent a significant threat to watershed health. The Municipality supports best management practices for controlling invasive species including: a) ensuring native or non-invasive species plantings are used on all publicly owned lands; b) ensuring vegetation plantings associated with development approvals use only native or non-invasive species plantings;' c) prior to development, site reconnaissance is undertaken to identify and delineate all on-site invasive species and a management/removal plan be prepared in consultation with the Conservation Authority; and implementing best management practices for control/removal and management of invasive species.

Transboundary Issues / Anthropogenic Influences	
K11	When opportunities for public ownership arise, all reasonable effort will be made to support the acquisition and/or conveyance of lands within the Natural Heritage System.
K12	New lot creation and intensification of development within the drainage basin of Chalk Lake shall be limited and subject to demonstration of no adverse impacts to the Lake through an Environmental Impact Study to the satisfaction of the Municipality in consultation with the Conservation Authority. Enhanced sewage treatment systems shall be required within the drainage basin of Chalk Lake where new development, intensification or significant renovations are approved. New development and/or redevelopment within the drainage basin of Chalk Lake shall be required to address phosphorus impacts and removal as part of the EIS. *(Note: this policy is specifically intended for the Township and Scugog and the Township of Uxbridge)*
K13	Prior to approval of intensification of proposed land uses, in addition to other municipal requirements, a thorough assessment shall be completed to ensure flooding conditions will not be exacerbated for upstream and/or downstream properties.
K14	Prior to approval of urban boundary expansions, in addition to other municipal growth requirements, a thorough assessment shall be completed to ensure flooding conditions will not be exacerbated for upstream and/or downstream properties.
K15	The Municipality supports effective, low impact management of stormwater run-off to protect the ecological health of the watershed and contribute to the protection of human life and property during storm events including incorporation of a best management treatment train approach with increased emphasis on lot level/source, Low Impact Development (LID) technologies and conveyance methods in addition to traditional end-of-pipe methods. Alternative stormwater management designs and practices should be explored for all new developments to minimize and attenuate runoff volumes, peak flow rates to pre-development levels and appropriate temperatures of stormwater discharge to streams. Stormwater management measures that meet multiple objectives (e.g. water quantity, water quality, erosion control, water temperature, infiltration etc.), and meet or exceed stormwater development standards set by the Municipality and CLOCA are expected.
K16	Stormwater management facilities are a vital component of municipal infrastructure requiring regular monitoring and management. The Municipality will adopt and maintain a Stormwater Performance Monitoring and Maintenance Plan that sets out a regular performance monitoring and maintenance plan ; a retrofit plan for existing facilities; the identification and prioritization of untreated areas for future stormwater management improvements and upgrades. To support this program, a municipal fund may be established to ensure dedicated funding is available to support the recommendations contained within the Stormwater Performance Monitoring and Maintenance Plan.

Voluntary Municipal Policies	
Water Resources	
V1	High Volume Recharge Areas (HVRAs) are identified on Schedule XX to this Plan. Removal or disruption to these areas will impact groundwater and surface water resources as well as those natural heritage features and habitat which rely upon groundwater inputs and surface water quality and quantity. Development within HVRAs may be permitted provided an hydrogeological impact assessment is conducted which demonstrates that development will result in no net loss to recharge functions attributed to the HVRA. A hydrogeological impact assessment shall: • identify recharge areas on-site and on adjacent lands; • identify the function and importance of the groundwater system for on-site and adjacent natural heritage features (wetlands, vegetation communities, aquatic habitat and fisheries), surface water quality and quantity, and groundwater discharge areas including seeps, springs, and baseflow contribution zones; • identify groundwater characteristics and linkages between the local groundwater system and surrounding groundwater system including: flow regime and connection to surface water features and functions; relationship to major and local aquifers; water table levels; aquifer vulnerability; ground and surface water quality; • identify existing and proposed local consumptive groundwater uses including location and use of wells within 1 km of the site; • characterize water demand using information attained through Permits to Take Water in a 5km radius of the site; • identify local geologic units, including soil substrates, and assess the role these units have in the hydrogeological system; • confirm water budget/balance that includes detailed water balance on a catchment area basis for existing and post-development conditions; • ensure that development will maintain or enhance pre-development groundwater recharge rates; • ensure that hydraulically connected features including groundwater discharge features are not adversely affected; • confirm that groundwater quality is not impacted; • confirm that impervious surfaces are minimized and measures to increase infiltration are incorporated in site design; and • ensure adaptive management, mitigation and monitoring strategies to ensure ground and surface water integrity. For minor development such as an addition to an existing structure, it shall be determined that the development will have no net loss on the recharge function of the HVRA.
V2	Development and site alternation will be setback from both sides of a watercourse in accordance with the flood or erosion hazard limit as defined by the MNR Technical Guides and shall include the erosion access allowance.

V3	Development impacts affecting stream temperature shall be mitigated through methods such as; providing adequate vegetated riparian buffers; limiting impervious surfaces; providing effective and efficient stormwater management techniques and facilities; and protecting groundwater discharge areas and baseflow to stream shall be encouraged and incorporated into site designs wherever possible.
V4	Infrastructure and transportation projects shall demonstrate that there will not be any impediment to stream flow, fish movement or aquatic habitat. Improvements to existing infrastructure, including roads, shall incorporate measures to eliminate any existing and/or future impediment to stream flow, fish movement or aquatic habitat. Where existing instream barriers exist, the Municipality and the Conservation Authority will work together to determine the best method of removal or preservation.
V5	New facilities where contaminants including fuel, pesticides, herbicides and road salt may be stored in large quantities and new Municipal snow storage facilities shall not be permitted within HVRAs. Exception may be permitted where it can be demonstrated that there will be no negative impact to groundwater quality. Opportunities to retrofit existing facilities, including municipal snow storage facilities, to minimize potential impacts, shall be encouraged. New Municipal snow storage facilities shall not be located within 30m of a waterbody, including wetlands. Exceptions may be permitted where water quality run-off is mitigated through buffers or treatment demonstrating there will be no negative impact to water quality in receiving streams and/or wetlands. The Municipality will consider undertaking improvements to existing municipal snow storage facilities located within 30m of a waterbody and/or wetland that will mitigate or eliminate untreated runoff to the waterbody/wetland.
V6	The Municipality supports the Region of Durham water conservation practices.
V7	While maintaining public safety, the Municipality will support minimizing road salt usage on public roads in the Natural Heritage System, and areas adjacent to waterbodies and wetlands. The Municipality supports site design of parking lots which reduces the need for salt application and encourages the study and use of alternative methods or technologies on public lands to reduce salt usage.

Natural Heritage Resources	
V8	An Environmental Impact Study (EIS), prepared to the satisfaction of the Municipality and the Conservation Authority shall be required to confirm the extent of the Natural Heritage System (NHS), boundaries of natural features within the NHS, determine the ecological function of these features including significance with respect to the Natural Heritage System, demonstrate no negative impact to the feature/function, and identify appropriate buffers between the development and the NHS.
V9	Where every possible alternative has been considered and no other option exists, development may be considered on lands within the Natural Heritage System(NHS) identified for natural cover regeneration/restoration provided it can be demonstrated through an Environmental Impact Study (EIS) prepared to the satisfaction of the Municipality and Conservation Authority that: • the area of additional lands to be added to the NHS will exceed the area of lands removed and the added lands will abut other portions of the NHS on the subject lands; and/or; • corridor connectivity will be enhanced/restored and protected.
V10	The Conservation Authority has a Level III agreement with the Department of Fisheries and Oceans Canada for the review and approval of proposals/projects where Section 35 of the Canada Fisheries Act is applicable. The Municipality supports the continued collaboration between the Conservation Authority and the Department of Fisheries and Oceans Canada in this regard.
V11	Where possible, greenspace areas on publicly owned lands will incorporate natural cover and be managed to achieve a naturalized vegetated condition.
V12	To protect natural features and functions and to limit potential damage to property and human life , the splitting or partitioning of natural areas and/or hazard lands through lot creation will not be permitted.
V13	The aquatic system includes fish and fish habitat, watercourses and waterbodies, riparian areas, and groundwater resources. The quality, quantity and health of these components influence the overall **health of the aquatic system.** The Municipality recognizes the aquatic system as an important ecological component of watershed health which shall be protected.
V14	Improvements to existing infrastructure located within the Natural Heritage System shall reduce, and where possible, eliminate impacts generated by existing infrastructure. Improvements to infrastructure through the use of appropriate technologies and mitigation measures as well as opportunities to remove or decommission existing infrastructure shall be investigated.

Transboundary Issues / Anthropogenic Influences	
V15	The quality of the air we breathe is an important factor in human health. Air quality also plays a role in ecological health. The impact of development on air quality shall be considered during review of development applications.
V16	The Municipality shall encourage efforts to adequately monitor air quality changes, trends and impacts that could impact human and ecological health.
V17	The Municipality shall support the Conservation Authority's efforts to document baseline indicator conditions and track future changes in conditions to assess impacts of climate change. If negative impacts are identified or predicted through this monitoring work adaptive management strategies will be created in coordination with the Conservation Authority where appropriate.
V18	The Municipality, in consultation with the Conservation Authority shall consider the need for adaptive stormwater management measures including alternative stormwater management facilities and designs to address anticipated increases in storm frequency and magnitude as a result of climate change.
V19	The Municipality supports the Conservation Authority's implementation of the requirements of Ontario Regulation 42/06 "Development, Interference with Wetlands and Alteration to Shorelines and Watercourses". In accordance with this regulation, development proposed within the regulated area requires permission from the Conservation Authority. Within the regulated area, the Conservation Authority shall be consulted for: development activities proposed adjacent or close to the shoreline of the Great Lakes and river system and inland lakes that may be affected by flooding, erosion, dynamic beaches; river or stream valleys; hazardous lands; lands in and adjacent to wetlands; and the straightening, changing, diversion or interference in any way with a watercourse.
V20	Municipal transportation plans shall support reducing the number of stream crossings and fragmentation of natural heritage features wherever possible.
V21	Diversion of water from an existing drainage catchment to another catchment is discouraged and every effort shall be made to maintain drainage patterns and watershed boundaries.
V22	All new infrastructure shall respect natural drainage patterns, and approval will require confirmation of appropriate minor/major systems, management of external drainage, and discharge to appropriate outlets.
V23	The Municipality will manage Watercourse Improvement Programs and respond to stream erosion where structures and services are at risk.

V24	Applications for development shall include an assessment of hydrologic impacts to demonstrate that peak flow rates will not exceed pre-development rates for the 1:2 year through 1:100 year design storm events and the Regional (Hurricane Hazel) Event. Where possible, appropriate mitigation measures may be considered by the Municipality and the Conservation Authority.
V25	Stormwater quality and quantity, and run-off will be controlled and treated to the satisfaction of the Municipality in consultation with the Conservation Authority. Pre-development runoff rates, flow paths, water quality and stream temperature shall be maintained. Where appropriate, the Municipality and the Conservation Authority may determine that stormwater quantity controls are not required, but in no case shall stormwater quality controls not be in place.
V26	Discharge of stormwater to a receiving watercourse must be outletted in a manner that does not adversely impact channel morphology, stream bank erosion or natural water temperature regimes of the receiving stream /feature. A geomorphological investigation shall be conducted to ensure that the impacts of stormwater discharge on streambank erosion are minimized.
V27	Road, transit and other infrastructure projects that include expansion of an existing service shall incorporate appropriate stormwater management for new and existing services/facilities.
V28	Stormwater management ponds which are entrenched within a watercourse will not be permitted and support will be provided to Conservation Authority efforts to remove these stormwater management ponds from the system.
V29	Where stormwater management facilities do not exist or provide limited water quality treatment, efforts will be made to retrofit all areas with approved stormwater management facilities using the most recent technologies and best management practices.
V30	Redevelopment and infill development shall provide measures to improve water quality and quantity controls, including where possible, treatment of run-off from existing adjacent development.
V31	The Municipality shall investigate opportunities to provide quantity control in areas identified to have undersized pipes/culverts that could impede water conveyance.
V32	Environmental Management Plans for major infrastructure at the detailed design stage shall be required to address details of mitigation measures during construction.
V33	Major recreation uses such as golf courses, ski facilities and other private/public recreational facilities shall adopt Best Management Practices for pesticides, herbicides, nutrient and water use including water conservation practices.
V34	A Subwatershed Plan shall be prepared prior to undertaking a Secondary Plan. The recommendations and policies contained within this Plan will provide guiding environmental and land use planning principles to be used in the development of the Secondary Plan. The Subwatershed Plan shall characterize existing subwatershed conditions, identify opportunities and constraints for development, assess impacts of development on the health of the subwatershed, and provide protective measures, restoration opportunities, mitigative methods and opportunities to manage impacts from development including cumulative development impacts. Specifically, the plan shall:

	• Identify, evaluate and model existing conditions including natural heritage features and functions, natural hazards, hydrogeology, fluvial geomorphology, hydrology and shall: - confirm the extent of the Natural Heritage System; - determine natural heritage features/functions beyond the subwatershed to identify connections with the larger watershed Natural Heritage System; - identify natural heritage features/functions within the subwatershed outside of the Natural Heritage System; - identify significant groundwater resources and prepare a hydrogeologic impact assessment; - confirm the extent of HVRAs and pre-development recharge rates; - conduct a water budget/balance to include detailed water balance on a catchment area basis for existing conditions; - delineate natural hazards; and - Prepare or update existing hydraulic and hydrology work including hydrological modeling for existing and future stormwater runoff including 2, 5, 10, 25, 100 and regional storm events, and prepare updated flood line mapping where required. • Conduct opportunities and constraints analysis to identify and address impacts of development on the Natural Heritage System, ground and surface water resources including: - how natural ecological systems and processes, including groundwater and surface water resources, will be maintained and improved; - identification of areas requiring additional buffers to protect the sensitivity of the feature/function; - preparation of a water budget/balance for post development conditions; - identification of opportunities to support infiltration and recharge at pre-development rates; - measure change in imperviousness, run-off, and prepare a stormwater management plan; - identify areas requiring further detailed study prior to site development; and - identify cumulative impacts to all the natural resources within, adjacent to, upstream and downstream of the study area as a result of the proposed development. Prepare a plan to ensure subwatershed health is not negatively impacted by the development, which can include protective measures, restoration opportunities and mitigation methods.
V35	The Municipality supports opportunities to reduce the amount of impervious surfaces, increase infiltration and implement design standards for all new development, redevelopment, including municipal facilities and lands, incorporating LIDs, green design standards, and other available techniques to support sustainable environmental design.
V36	At a minimum, as a condition of approval, all development will be required to apply, or maintain, a minimum application of 300mm of topsoil which can be amended with compost, during final site grading. It shall also be required that scarification of subsurface soils on all lands other than the building footprint be undertaken prior to final grading. Additional soil treatments shall be encouraged where appropriate to mitigate construction compaction impacts and support water infiltration and run-off retention.

V37	During construction, topsoil stripping shall be restricted until draft approval is obtained. At no time shall the entire site be stripped, rather removal of topsoil shall be phased to allow site stabilization and revegetation to occur as soon as possible. Appropriate erosion prevention and sediment controls shall be in place prior to topsoil stripping.
V38	Where it has been demonstrated to the satisfaction of the Municipality and Conservation Authority that the impact of development cannot be sufficiently addressed, and there is no other reasonable alternative to fully mitigate impacts, compensation may be considered in addition to mitigation efforts as a means of ensuring a net gain to the overall Natural Heritage System.
V39	Opportunities for public acquisition of lands along Highway 407 corridor shall be investigated as potential compensation for ecological losses incurred due to development, use, operation and maintenance of Highway 407.
V40	The potential of archaeological resources within 300m of a waterbody or stream shall be considered prior to development and the Province shall be contacted for guidance in this matter. *(Included as per Ministry of Culture request to recognize in Watershed Plans)*

7.0 Watershed Implementation Plan – Other Partners and Stakeholders

Protecting, restoring and enhancing watershed health requires the cooperation of all impacted stakeholders. Every person has an impact on the environmental, social and economic health of the watershed through their everyday lives and actions. This section of the Watershed Plan outlines the key ways in which our major stakeholder groups in addition to our municipal partners can work with us to achieve a healthy Lynde Creek Watershed.

7.1 Strategic Priorities for Stakeholder Enhancement of Watershed Health

Priorities for our other partners and stakeholders are provided in the context of CLOCA's Strategic Priorities over the next five years, the policies provided to municipalities for incorporation into Official Plan documents, and as a reflection of the Action Plans as discussed in **Section 5** of this Watershed Plan.

1. Active Engagement and Participation

Actively engaging and participating in the protection, restoration and enhancement of the watershed is crucial. Personal observations and insight add to the local knowledge base that can help create uniquely appropriate and creative solutions for local problems and opportunities. Restoration opportunities within the watershed largely occur on private lands, providing many diverse opportunities for stakeholders to directly and positively enhance watershed features and functions. Participation by residents, land owners, schools, community groups and the development community ensures that a holistic, appropriate, beneficial and tailored management approach can be achieved in the watershed. A fundamental active engagement principal is to encourage learning and participation in our young stakeholders. Children have an immense capacity to create changes when they develop an understanding of their connections, contributions and impacts on their environment.

2. Continuous Learning and Increasing Awareness

Watershed and resource management actions are constantly evolving as conditions, science and technology change. It is important for stakeholders to continue to learn new facts and lessons about the ecology of the watershed and how conditions are changing so they can be prepared to interpret and incorporate the information into their daily lives and activities. It is equally important to raise the awareness of stakeholders not yet engaged in beneficial watershed activities.

CLOCA offers many programs and opportunities to encourage and enhance learning for residents and students. Please see **Appendix E** for a list of programs offered, encouraged and participated in by CLOCA as well as contact information for future involvement or questions.

3. Information and Data Sharing

Data and information is the foundation for managing a watershed. By sharing available information, data and sources with CLOCA, stakeholders can make a very real contribution to watershed health. This information informs actions, planning and decision-making so that all environmental, social and economic factors are represented and considered during the planning and implementation stages of watershed management.

4. Partnering and Coordination of Resources

Community partners are a very important part of protecting, restoring and enhancing the ecological integrity of a watershed. Partners can offer the funding, volunteers and donations essential for completing many projects to enhance watershed health. Coordinating resources can also gain efficiencies, not only for CLOCA, but for schools, academic institutions, community groups and businesses to further their goals. CLOCA values each of our partners and is committed to working with all interested parties in cooperative efforts that protect, preserve and enhance the watershed

5. Responsible Land and Resource Stewardship Practices

A cornerstone of achieving a healthy watershed is the responsible use of land and resources. Every resident, land owner, business and guest in this watershed has an impact on its ecological features and functions. Through messaging this concept, positive changes will protect our watershed for generations to come. There are numerous opportunities to reflect this belief in daily life in the context of things like: lawn care and gardening practices; building techniques and technologies; water consumption rates and interactions; transportation alternatives; and consumption and disposal of goods. CLOCA offers education, support and resources for all stakeholders to practice responsible land and resource stewardship.

Devil's Den Pond in Heber Down Conservation Area – CLOCA Kids Fishing Day

7.2 How to Get Involved

Any stakeholder idea, suggestion or plan to help achieve watershed health will be considered and supported if possible. All stakeholders that would like to become involved or more involved in protecting the watershed should visit our website and/or contact or visit CLOCA's office and speak to reception for direction to the most appropriate person and department to investigate how we can work together. We very much look forward to working with our existing partners as well as any new stakeholders who would like to contribute to watershed health.

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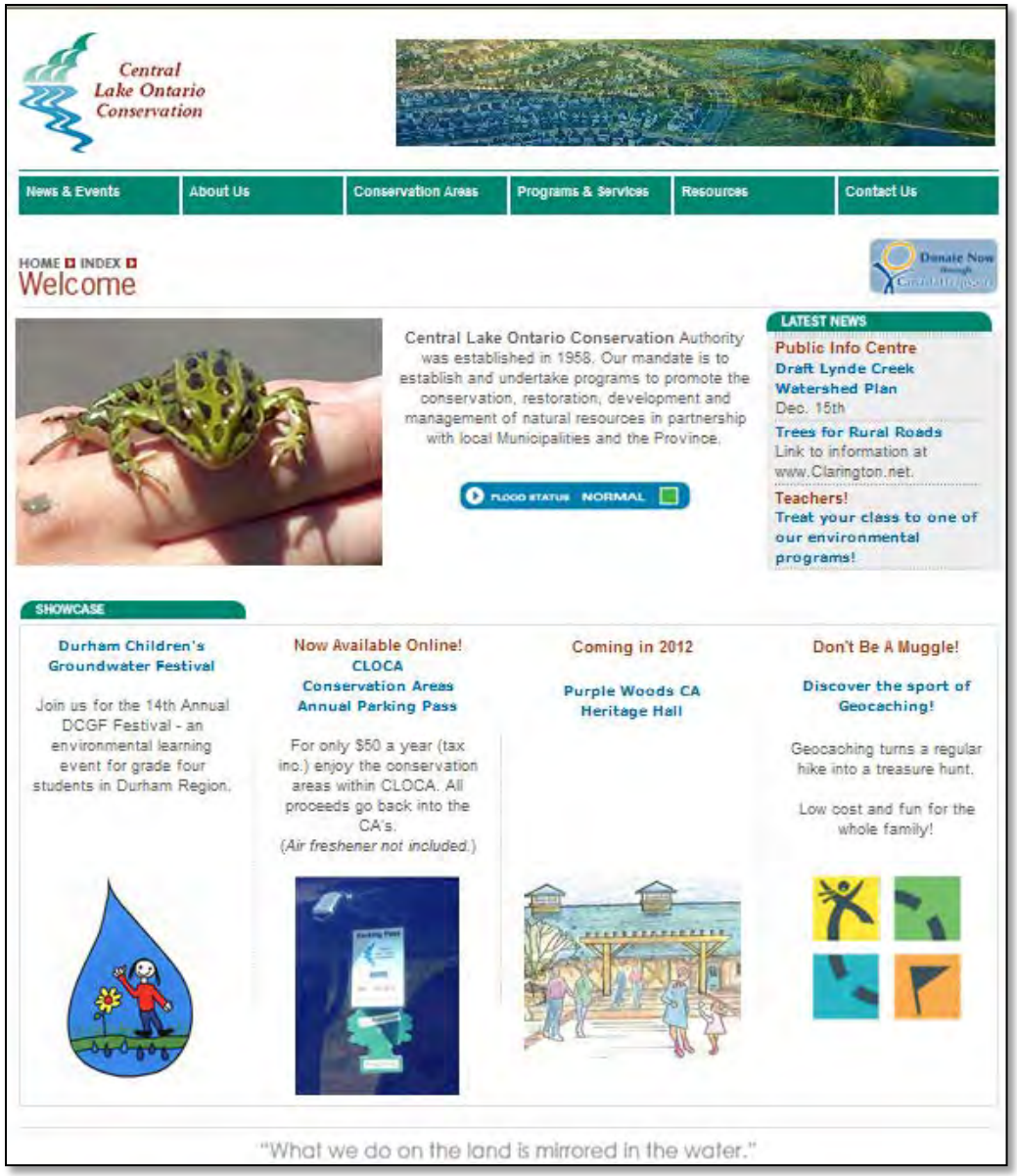
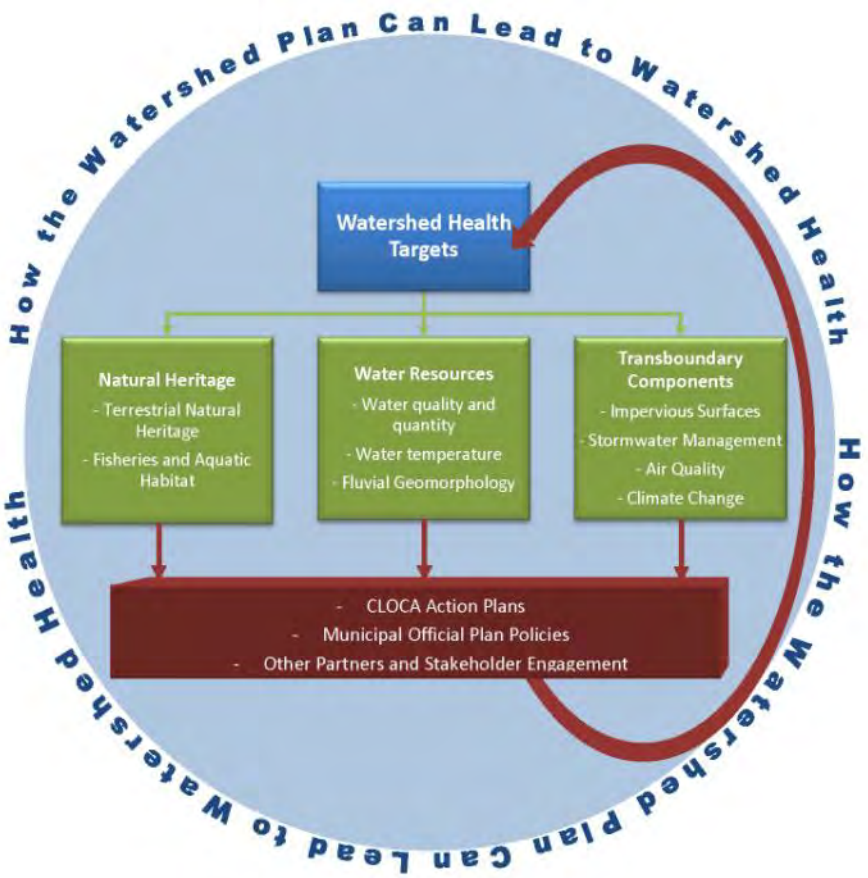


8.0 Monitoring and Evaluating Success

Watershed Plans are updated every five years from the date they are finalized to reflect the constantly changing conditions, pressures and trends in a watershed. It is important to be able to determine if the recommendations and Action Plans contained in this Watershed Plan have been effective so decisions are made moving forward on how to best continue protecting, restoring and enhancing the watershed. In order to do this, the following basic monitoring and evaluation structure has been developed. The Watershed Plan update, when developed, will refine this structure to ensure all aspects of the Implementation Plan are considered in order to effectively evaluate success.



8.1 Watershed Health Targets

To determine if watershed health is improving, it is important to monitor and report on each of the watershed targets outlined in the Existing Conditions Work. **Table 6** below outlines the watershed components that will continue to be monitored for change, as well as some quantitative indicators that contribute to the complete picture of watershed health.

TABLE 6: WATERSHED TARGET MONITORING

Objectives:	Indicators:	Existing Conditions:	Targets:	5 Year Review Conditions:	Explanation of Change:
WATER RESOURCES					
Protect and enhance public safety, private property and infrastructure from erosion and flooding	• Risk to public and private property	• Gauge network and models used to monitor and predict conditions in addition to multiple flood damage centers • Regional peak flows, flood elevations mapping, flood vulnerable areas • Reduced buffers and vegetative growth in natural channel corridors • Private manicured lawns reaching stream banks	• Protect private / public property and public safety.	•	•
Protect, restore and enhance groundwater recharge and discharge features	• High Volume Recharge Areas (HVRAs)	• Most significant areas are the Oak Ridges Moraine, Iroquois Beach (and isolated areas north of the beach)	• Maintain pre-development infiltration / recharge rates .	•	•
	• Discharge Areas	• Most prominent potential areas are along the southern fringe of the Oak Ridges Moraine and water courses	• Maintain average annual baseflow rates.	•	•
Protect, restore and enhance groundwater quality	• Groundwater Chemistry (metals, nutrients)	• 14 wells sampled bi-annually • High chloride concentrations in Heber Down Conservation Area and near Lake Ontario shoreline (potential road salt impact) • High nitrate levels in Macedonian Village (potential agricultural use impact)	• Meet Provincial Water Quality Standards. • Prevent future deterioration beyond recorded current / ambient background nutrient levels.	•	•
Ensure sustainable supply of groundwater for consumptive use and ensure surface water demand does not exceed surface water supply	• CLOSPA (Central Lake Ontario Source Protection Authority) Stress Assessment	• Quantity Recharge = 0.6765m^3/s • Quantity In = 0.2020 m^3/s • Quantity Supply = 0.8785m^3/s • Quantity Reserve = 0.0679 m^3/s • Quantity Demand = 0.0819 m^3/s • % Annual Consumption = 10.10% • Stress Level = Moderate • 7964 private groundwater well permits • Significant" surface water stress (i.e. more demand than supply) especially in summer • Annual streamflow has been decreasing since the 1998 • 11,554,667 L/day of surface water takings	• Reduce current Stress Assessment Level to "Low" vs. the current condition of "Moderate".	•	•
Protect natural baseflow	• Baseflow levels	• 140 stations measuring summer low flow data and modeled with MODFLOW	• Maintain long-term average and seasonal baseflow levels.	•	•
Protect and restore surface water quality to meet approved (current) standards	• Benthic invertebrate community	• 14 sites sampled, 7 considered impaired • 75% of urban sites are impaired • 83% of sites in natural areas are unimpaired • 50% of sites in agricultural areas are unimpaired (generally close to headwater areas)	• Improve all surface water benthic community quality ratings to un-impaired.	•	•
	• Biological Oxygen Demand (BOD)	• Rate rarely rose beyond 5 mg/L in the southern station • < 5 mg/L at Brooklin (northern) station	• Maximum BOD of 2mg/L.	•	•
	• Dissolved Oxygen (DO)	• All sites measured at 8-10mg/L	• Maintain DO requirements needed to support fisheries. ➢ 4 – 7mg/L in warm water streams. ➢ 5 – 8mg/L in cold water streams.	•	•
	• Chloride	• Increasing trend but well below the 150mg/L limit (higher in south of watershed and in winter months between Dec. and Mar.)	• <150mg/L and/or a decreasing trend.	•	•
	• Phosphorus	• Generally < 30ug/L	• <30ug/L for streams and <20ug/L for lakes and/or a decreasing trend.	•	•

Objectives:	Indicators:	Existing Conditions:	Targets:	5 Year Review Conditions:	Explanation of Change:
	• Nitrates (NO_3)	• Increasing trend	• <10mg/L and/or a decreasing trend.	•	•
	• Copper	• Decreasing trend (some exceedances of the 5ug/L limit were recorded in SWQ9 in Lynde Creek)	• 1-5ug/L depending on hardness and/or a decreasing trend.	•	•
	• Suspended Solids	• Not currently available	• Not currently available. *See Section 5 of this report for more detail on future work to set targets".*	•	•
Reduce / mitigate negative road salt impacts in sensitive areas	• Water Quality	• Increasing sodium trends in surface water quality • Shallow aquifer systems are susceptible to road salting	• Reduce / maintain historical / baseline water quality values indicative of salt impacts.	•	•
Protect / restore / reduce stream temperatures to support aquatic life	• Stream Temperature	• Cold/cool water thermal regimes	• Restore or maintain cold / cool water temperatures. • Restore and maintain seasonal temperature variations to natural fluctuations.	•	•
Protect, enhance and restore natural channel morphology and stability	• Rapid Geomorphic Assessment (RGA) and Rapid Stream Assessment (RSA)	• Livestock grazing and lack of riparian vegetation in the Taunton Road, Rossland Road and Regional Road 23 areas. • Stream instability downstream of the SWM pond south of the Brooklin community centre. • Stable conditions through the Lyndebrook Golf Course. • Private residential manicured lawns extending to creek bank in Winchester / Brooklin area.	• Achieve: ➢ Stability Index (SI) or <0.2 or "in regime" ➢ RSA health classification of excellent (40-50) or good (30-39)	•	•
NATURAL HERITAGE RESOURCES					
Protect, restore and enhance the ecological integrity of natural areas (including wetlands)	• Percent natural cover	• 29.16 % natural cover in watershed • 51,573,933 sq m total in NHS • 6,861,417 sq m is FNHS • 963,080 sq m of the TNHS is natural cover (so 14% of the TNHS is specified as natural cover)	• Achieve a minimum of 30% natural cover in the watershed.	•	•
	• Percent forest cover	• 16.78% forest cover	• Continual increases of watershed forest cover to achieve the long term target of 30% forest cover in the watershed.	•	•
	• Percent wetland cover	• 10% wetland habitat (1,347 hectares) • All subwatersheds have greater than 6% wetland habitat	• Increase existing wetland cover in headwater areas and no net loss of wetland cover in the watershed. • Achieve and maintain a minimum of 10% wetland cover in the watershed and greater than 6% wetland cover in each subwatershed.	•	•
	• Invasive species	• Highly invasive species present within the watershed	• Continual improvement in the mitigation of invasive species impacts. • Implement Invasive Species Management Strategy.	•	•
Protect, restore and enhance the ecological integrity of wildlife habitat (non-aquatic)	• Habitat diversity	• 20 ELC communities present	• No loss of Ecological Land Classification (ELC) system community types.	•	•
	• Habitat distribution	• Relatively even distribution of all habitat types in north half of watershed	• Maintain even distribution of natural and forest cover throughout the watershed.	•	•
	• Habitat quality	• Variety of habitat type shapes • There are no 200 ha forest patches • Majority of forest patches fragmented by roads and development	• Enhance habitat patches for better shape/area ratios. • At least one 200 ha forest patch that is a minimum of 500m wide.	•	•
	• Percent forest interior and deep forest Interior	• 1.19% forest interior • 0.23% deep forest interior	• Achieve and maintain greater than 10% interior forest in the watershed. • Achieve and maintain greater than 5% deep interior forest in the watershed.	•	•

Objectives:	Indicators:	Existing Conditions:	Targets:	5 Year Review Conditions:	Explanation of Change:
	• Corridor width	• Landscape corridors are generally between 50 m and 100 m wide (no corridors that exceed 100 m outside of the Oak Ridges Moraine, Lake Iroquois Beach and Lake Ontario Shoreline) • Maximum shoreline corridor width is approximately 2.3 km	• Achieve and maintain naturalized local corridors </=60m x 60 m wide or greater. • Achieve and maintain naturalized landscape corridors </=100m x 100 m wide or greater • Maintain and enhance 1 km of naturalized habitat along the Lake Ontario Shoreline where possible.	•	•
	• Terrestrial and wildlife Species at Risk	• Species at Risk present in watershed	• Support, in partnership, the protection, restoration and enhancement of the distribution of Species at Risk (SARs). • Support, in partnership, the identification, restoration and preservation of sensitive habitat as defined in species specific recovery strategies.	•	•
Protect, restore and enhance the ecological integrity of Coastal Wetlands	• Water quality	• Lynde Creek Marsh average (2002-2010) WQI is -1.75 (-3 to +3), which indicates a very degraded condition	• Achieve and maintain a Water Quality Index (WQI) of 9 to +1 (good condition) or higher.	•	•
	• Sediment quality	• Lynde Creek Marsh had an SQI score of 87.8 (/100) in 2002 and 90.8 (/100) in 2006, which indicate a Good condition	• Maintain a Sediment Quality Index (SQI) score of 87.8 or higher (excellent condition).	•	•
	• Submerged Aquatic Vegetation (SAV) Community	• Lynde Creek Marsh average (2002-2010) SAV IBI is 11.6 (out of 100), which indicates a Poor condition	• Achieve and maintain a Submerged Aquatic Vegetation (SAV) IBI of 40-60 (good condition) or higher.	•	•
	• Fish community	• Lynde Creek Marsh average (2002-2010) fish IBI is 47.8 (out of 100), which indicates a Good condition	• Maintain a Fish IBI of 47.8 or higher (good condition).	•	•
	• Bird community	• Lynde Creek Marsh average (2002-2009) bird IBI is 51.1 which indicates a ……	• Maintain a Bird IBI of 47.44 or higher (good condition).	•	•
	• Amphibian community	• Lynde Creek Marsh average (2002-2009) amphibian IBI is 23.9 which indicates a…..	• Achieve and maintain an Amphibian IBI of 40-60 (good condition) or higher.	•	•
	• Aquatic macroinvertebrate community	• Lynde Creek Marsh average (2002-2010) macroinvertebrate IBI is 35.8 (out of 100), which indicates a Fair condition	• Achieve and maintain a Macroinvertebrate IBI of 40-60 (good condition) or higher.	•	•
Protect, restore and enhance the health and diversity of native / naturalized fish / aquatic communities	• Diversity and distribution of fish communities	• Approximately 37 fish species, representing 12 families	• Continued presence and abundance of all native fishes. • Steady or increased abundance and distribution of Brook Trout.	•	•
	• Aquatic Species At Risk	• Redside Dace have been observed in northern reaches • Atlantic Salmon (extirpated and undergoing restoration attempts) • Eastern Pond Mussel in Lynde Shores	• Support, in partnership, the protection, restoration and enhancement of the distribution of Species at Risk (SAR). • Support MNR to achieve compliance with the Redside Dace Ontario Recovery Strategy, MNR, 2009 and the 2011 MNR Habitat regulation. • Provide support to responsible authorities to apply habitat regulation for Eastern Pond Mussel. • Support, in partnership, the identification, restoration and preservation of sensitive habitat as defined in species specific recovery strategies.	•	•
	• Invasive / non-native species (not applicable to naturalized species)	• Abundance and presence of all invasives / non-native species (with the probable presence of ammocoetes) • Serious threat of dispersal of Rudd, Tubernose European Ruffe and Round Goby from Lake Ontario	• Absence and/or decline in abundance and distribution of invasive / non-native species. • Implement Invasive Species Management Strategy.	•	•
Protect, restore and enhance fish / aquatic habitat and riparian habitat	• Stream barriers	• 6 known barriers ➢ Ashton Berm (not passable) ➢ McIntosh Berm (not passable)	• Remove in-stream barriers where appropriate in priority sequence. • Protection of the ability of Salmonids as well as native	•	•

Objectives:	Indicators:	Existing Conditions:	Targets:	5 Year Review Conditions:	Explanation of Change:
		➢ Muirhead Berm (undetermined if passable) ➢ Highway 7 Culvert (not passable) ➢ Collins Pond (salmonids pass seasonally) ➢ Bryant Sideline Culvert (not passable)	non-jumping fish from Lake Ontario to spawn upstream in the watershed.		
	• Percent riparian habitat per stream length	• Total stream length is 326km with 34% or 112km of the Lynde having treed riparian habitat **Existing Riparian Cover by Subwatershed:** ➢ Ashburn: 10.93 km (29%) ➢ Herber Down: 38.81 km (34%) ➢ Kinsale: 26.04 km (38%) ➢ Lynde Main: 22.82 km (34%) ➢ Myrtle Station: 13.33 km (35%)	• Increase quality and range of fish habitat to achieve 75% riparian stream target with a 30m vegetated buffer on either side of the stream. • Achieve Subwatershed Riparian Cover Targets of: ➢ Ashburn: 17.73 km ➢ Heber Down: 46.43 km ➢ Kinsale: 25.64 km ➢ Lynde Main: 26.84 km ➢ Myrtle Station: 15.48 km	•	•
TRANSBOUNDARY ISSUES / ANTHROPOGENIC INFLUENCES					
Limit impervious land cover in watershed	• Percent imperviousness	• 9.2% imperviousness over full watershed • Urban areas predominate from Columbus Rd. south to Lake Ontario • Paved roadway surfaces represents the majority of the remaining impervious areas • ***Note for future conditions:*** *Highway 407 extension and 407-401 west link will significantly increase impervious surface coverage*	• < 10% on ORM and Greenbelt Lands. • <28.35% in existing urban areas. • Increase the use of Low Impact Development (LID) / green technologies for future development and retrofits to existing development where applicable.	•	•
	• Connected imperviousness	• Not currently available	• TBD *See Section 5 of this report for more detail on future work to set targets".*	•	•
Protect human life and property	• Flood Damage Centres	• Older parts of Brooklin and Whitby do not have stormwater management facilities / treatment	• Limit flood damages and prevent further flood damage centres.	•	•
	• New infrastructure	• N/A	• All new infrastructure to have no impediment to natural overland / surface water flows.	•	•
Protect and maintain existing watershed / subwatershed catchment boundaries	• Drainage patterns	• On-going monitoring	• Maintain existing watershed boundaries and drainage patterns. • New infrastructure to mitigate potential impacts & risk to human life/property from increased surface flows.	•	•
Maintain pre-development peak flow rates from stormwater runoff	• Peak flow rates	**Location** / **Flow (cms)** At mouth 937.69 At Hwy 401 743.20 At Hwy 2 739.25 Rossland Rd W 325.13 Rossland Rd E 404.76 Hwy 7 Main 279.04	• Peak flow rates on receiving streams must not exceed corresponding pre-development rates for the 1:2-year through 1:100-year design storm events and the Regional Event (Hurricane Hazel) *Note: exceptions include areas in proximity to Lake Ontario or where Master Plans exist and state otherwise.*	•	•
Protect Ecological Health	• Existing infrastructure	• 22 stormwater management ponds and 10 known Oil Grit Separators	• Improve existing stormwater management facilities to reduce adverse ecological impacts of development.	•	•
	• New infrastructure	• N/A	• New stormwater management facilities to mitigate all impacts to water quality including stream temperature.	•	•
Effective and efficient performance of Stormwater Management	• Existing and new facilities	• N/A	• Achieve enhanced Level 1 requirements. • Reduce thermal impacts.	•	•

Objectives:	Indicators:	Existing Conditions:	Targets:	5 Year Review Conditions:	Explanation of Change:
Facilities			• Achieve intended designed flow control. • Reduce the number of structures impacted by flooding. • Reduce the number of flooding complaints.		
Sustain healthy levels of air quality for human health	• Ground level ozone	• Increasing trend at Oshawa AQI station (ID# 45026)	• Reduction in average annual Ozone levels. • Monitoring of Nitrogen Oxides and Volatile Organic Compounds.	•	•
Sustain healthy levels of air quality for ecological health	• Lichens	No conditions are currently monitored	TBD See Section 5 of this report for more detail on future work to set targets".		
Protect, restore and enhance existing natural conditions to mitigate negative climate change impacts	• Precipitation	• 890 mm/yr (observed)	• N/A *Monitoring and climate change observations to be recorded to assist in future assessment of impacts and included in an adaptive management strategy. See "CLOCA Action Plans" section of this report for more detail on future work to set targets".*	•	•
	• Surface Run-off	• 183 mm/yr (simulated in Water Budget)			
	• Evapotranspiration	• 391 mm/yr (simulated in Water Budget)			
	• Infiltration	• 143 mm/yr (simulated in Water Budget)			
	• Air temperature	• Environment Canada historical data to be used in 5 year review.			
QUALITATIVE COMPONENTS OF WATERSHED HEALTH					
Protect, Enhance and Restore the Lynde Creek Watershed to a be a Resilient Ecosystem with Ecological Integrity	• Enhancement of watershed health based on a systems approach	• Generally healthy watershed due to large areas protected by provincial policy and minimal development in northern half of watershed. Impaired systems in southern developed areas.	• Increase in the majority of watershed component targets.		
Implementation, Acceptance and Support of the Watershed Plan	• Incorporation of recommended Official Plan policies, endorsement and support by municipalities	• Municipal and Regional Official Plans have existing environmental policies but they are not designed to protect, restore and enhance ecosystem health on a watershed basis as is recommended through the Watershed Plan.	• Incorporation of Watershed Plan policy recommendations into all appropriate Official Plans.		
Long-Term and Sustainable Funding	• Increased commitment for long-term funding	• Long-term sustainable funding is currently provided for core business programs of development review, protection of people and property from flooding, support for land acquisitions and basic levels of monitoring.	• Increase in sustainable, long-term funding for priority protection, restoration and enhancement programs.		
Consistent and Long-Term Monitoring	• Increased ability to dedicate resources to long-term monitoring plans and objectives	• Monitoring currently depends on short-term funding and resources.	• Increase in long-term monitoring commitments for priority watershed components.		
Engaging Stakeholders through Stewardship and Education	• Increased engagement, participation, cooperation, education and communication with stakeholders	• Existing stewardship work is minimal due to funding and resource limitations. School education programs are fairly comprehensive but funding is a limitation. Communication and engagement efforts are minimal due to resource limitations.	• Dramatic increases in stewardship and education efforts with private stakeholders. • Development of a Communication and Marketing Plan to guide Watershed Plan implementation. • Increase in partnerships and cooperative efforts.		
Filling Data Gaps	• Improvement in existing data gathering, management and sharing processes	• Internal CLOCA data gaps and management limitations exist as well as numerous opportunities to coordinate data acquisition, use and management with external partners.	• Demonstrable filling of identified data gaps.		
Land Acquisition	• Continued increase in the acquisition of lands	• Current program is successful in continuing to acquire priority lands.	• Continued acquisition of priority lands for long-term protection, restoration and enhancement.		

8.2 CLOCA Action Plans

Twenty three Action Plans (APs) have been described in Section 5 of this Watershed Plan. These APs are the result of recommendations made by CLOCA staff for achieving the watershed component targets set out in **Table 6**, which in turn support the broader watershed health targets (30% natural cover, 10% wetland cover etc.). For each AP, the following questions are to be answered and scored according to the provided scale. Scores over 5 indicate a "successful" AP that should then be evaluated to determine if future enhancements to watershed health would result from the continuation of the AP. APs having scores of 3-5 will be evaluated to determine where improvements are necessary or could have been made, and to establish positive outcomes. Any AP scoring less than 3 will be considered "unsuccessful". "Lessons Learned" from the development and implementation of each AP will be communicated in the Watershed Plan update to help inform decisions regarding future or continued APs. Connections between successful APs and specific watershed targets outlined in **Table 6** above will be identified to help further assess future work to enhance watershed health. Action Plans that were not completed as anticipated will undergo a qualitative assessment to determine if they merit continuation in the next 5 years of implementation.

Question	Score		
1. Was the Action Plan Completed?	Yes = 2	Partially = 1	No = 0
2. Was the Action Plan supported through implementation?	Yes = 2	Partially = 1	No = 0
3. Has the Action Plan satisfied / contributed to the achievement of its strategic priorities?	Yes = 2	Partially = 1	No = 0
4. Has the Action Plan resulted in any gains to watershed health?	Yes = 2	Partially = 1	No = 0
5. Has the Action Plan resulted in any negative impacts to watershed health?	Yes = -2	Partially = -1	No = 0
	Total Score:		

8.3 Recommended Municipal Official Plan Policies

A series of Municipal Official Plan policies were recommended as part of the implementation plan of this Watershed Plan. For each policy, the following considerations will be assessed to determine if the policy is successful as recommended or if modifications to existing policies or additional policies are needed to support watershed health from a municipal perspective.

1. Was the policy incorporated into Official Plans?
2. Was the policy incorporated in other municipal procedures, programs or policies?
3. What type of feedback was received regarding this policy?
4. What would enhance this policy's ability to support watershed health?
5. What, if anything, is preventing this policy from effectively supporting watershed health?
6. Are modifications to the policy necessary to increase its effectiveness?
7. Does this policy require a supplemental / additional policy for incorporation into Official Plans, programs, procedures, or policies to increase effectiveness?

Municipalities will be consulted to seek feedback on the implementation of the Watershed Plan over the five years as well as for requesting advice and recommendations for future watershed management activities and planning.

8.4 Other Stakeholder Engagement

A qualitative assessment of the engagement of other stakeholders in the watershed will take place to determine if the approach recommended in this Watershed Plan and the resulting recommendations from applicable Action Plans is effective for engaging stakeholders. The following questions need to be asked in the context of the work undertaken during the five years of implementation time to determine the most effective means of continuing to engage stakeholders.

1. Has there been an increase in active engagement and participation in the watershed? What worked well, what did not work as anticipated?
2. Is there evidence of continuous learning by and with stakeholders in the watershed? What programs offered the best opportunities for continuous learning?
3. Has there been effective information and data sharing by and with stakeholders in the watershed? What lessons have been learned that will support the continued sharing of data and information?
4. Has there been an increase in partnering with stakeholders and in the coordination of resources to help achieve watershed health? What good examples can be used to highlight effective partnerships? What examples illustrate lessons learned that will be avoided in future endeavors?
5. Has there been evidence of responsible land and resource stewardship practices in the watershed? What examples can be provided to illustrate how stakeholders have continued or increased responsible stewardship initiatives?

9.0 Key Messages Moving Forward

The Lynde Creek Watershed has many unique features that need to be protected for future generations to enjoy. The Oak Ridges Moraine, Chalk Lake and the Lake Ontario are just three examples of the unique attributes of this watershed that not only support a variety of ecosystems, but also enhance the quality of life for residents of the watershed. All stakeholders in the Lynde Creek Watershed have the opportunity to experience these and other great natural areas. This Watershed Plan is a key step in ensuring that future residents and visitors will have this same opportunity.

9.1 Everyone has a role in watershed health

Watershed planning is about more than knowing where our trees, animals and fish are. It is about how guidance, based on the ecological features and functions of an area, can be provided for decision-makers so that a healthy watershed remains a priority as an area grows and develops. The majority of this Watershed's Implementation Plan focuses on what CLOCA will do over the next 5 years to lead the charge towards a healthier and more ecologically resilient watershed, as well as how municipalities can endorse, support and enforce watershed policies. That does not mean that other stakeholders don't have an extremely important role to play in improving watershed health. As you have read, there is a lot of restoration and enhancement work to be done that will help us achieve our targets. The fact is that most of these opportunities are on private land, which means that we need urban and rural residents, land owners, farmers, the development community and businesses to join with us to voluntarily get some substantial on-the-ground work done in the watershed. CLOCA prides itself on its strong customer service approach and aims to work collaboratively with various partners.

As noted above, one stakeholder group that needs to be highlighted is school children. This stakeholder group has enormous potential to achieve and maintain watershed health if they are engaged early and consistently. The recycling program is an example of how educating children is a very effective way to affect change in daily life. It is a fundamental shift in the habits of an entire generation that throwing aluminum cans in the garbage is unthinkable. The possibilities for positive behavioural changes impacting the watershed are endless, ranging from lawn care procedures, to water conservation, to energy consumption, transportation choices and everything in between.

9.2 Implementation = Action = Success

This Plan is a guiding document that has been developed and written to be consistently and repeatedly used by all stakeholders for activities that impact the watershed. The focus has been placed on the user for implementation of recommendations and strategies that will achieve watershed health. Much work needs to be done to achieve the watershed targets. It is not enough to simply identify where we need and want to go for watershed health, rather, we have to systematically take action on each of the priorities in order to realize the benefits that a healthy and resilient watershed will provide for the health, well being and prosperity of its residents.

Some of the identified watershed targets will be harder to achieve than others simply based on how much degradation has occurred to each watershed component to date. However, all targets can be achieved through effective and efficient cooperation between stakeholders to make the protection, restoration and enhancement of this watershed a priority.

9.3 This Watershed Plan Can Affect Change

Not only is watershed planning generally accepted as the best way to keep our resources healthy, it is a legal requirement through the Oak Ridges Moraine Conservation Plan and recommended in many other federal and provincial guiding documents.

This Plan is intended to be the authoritative guidance document for watershed planning to be used by decision makers, residents, land owners, farmers, community groups and the development community to work together to achieve the ultimate goal of a healthy, resilient watershed in the context of our changing landscapes.

This plan can affect change through the enforcement of watershed recommendations at the municipal level; protection, restoration and enhancement work; stewardship, education and awareness activities in the community; and participation in the process of achieving watershed targets by the development community through innovative design and conformity to policy. This Watershed Plan can lead all efforts to achieve and maintain a healthy watershed.

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APPENDIX A: LEGISLATIVE / POLICY CONTEXT AND COMPLIANCE

LEGISLATIVE FRAMEWORK

In the last few years, enactment of new provincial legislation and policies including the Oak Ridges Moraine Conservation Act and Oak Ridges Moraine Conservation Plan (ORMCP); the Greenbelt Plan and Act, the 2005 Provincial Policy Statement (PPS), the Clean Water Act; and other source water protection initiatives, have placed a greater emphasis on the need for watershed plans. In fact, the ORMCP requires watershed plans to be completed for all watersheds within the Moraine. The Lynde Creek watershed is the first Watershed Plan in CLOCA's jurisdiction that satisfies the requirements of the ORMCP. In addition to the now legislated requirement for a Watershed Plan, there has been increasing recognition of the importance of maintaining, restoring and improving natural heritage systems within a provincial, watershed and municipal level policy context. The following describes each applicable legislation, policy or implementation tool as well as provides a conformity table illustrating the specific requirements met through the development of this plan.

LEGISLATIVE CONTEXT OF WATERSHED PLANS

Oak Ridges Moraine Conservation Plan (2002)

Watershed plans

24. (1) Every upper-tier municipality and single-tier municipality shall, on or before April 22, 2003, begin preparing a watershed plan, in accordance with subsection (3), for every watershed whose streams originate within the municipality's area of jurisdiction.

(2) The objectives and requirements of each watershed plan shall be incorporated into the municipality's official plan.

Greenbelt Plan (2005)

Water Resource System Policies

The following Water Resource System policies apply throughout the Protected Countryside:

2. Watersheds are the most meaningful scale for hydrological planning, and municipalities together with conservation authorities should ensure that watershed plans are completed and used to guide planning and development decisions within the Protected Countryside.
3. Cross-jurisdictional and cross-watershed impacts need to be considered in the development of watershed plans. The development of watershed plans and watershed management approaches in the Protected Countryside should be integrated with watershed planning and management in the NEP and the ORMCP areas and beyond the Greenbelt.

External Connections

To support the connections between the Greenbelt's Natural System and the local, regional and broader scale natural heritage systems of southern Ontario, the federal government, municipalities, conservation authorities, other agencies and stakeholders should:

3. Undertake watershed based planning, which integrates supporting ecological systems with those systems contained in this Plan.

Planning Act, Section 2(a)

The Minister, the council of a municipality, a local board, a planning board and the Municipal Board, in carrying out their responsibilities under this Act, shall have regard to, among other matters, matters of provincial interest such as the protection of ecological systems, including natural areas, features and functions.

Provincial Policy Statement (PPS) and Natural Heritage Reference Manuals

The PPS identifies the need for long term protection of natural features and their functions. Natural heritage systems that link natural heritage features and hydrological features across the landscape are to be maintained, improved and/or restored. Key sections of the PPS pertaining to Natural Heritage Systems are:

2.1.1 Natural features and areas shall be protected for the long term.

2.1.2 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 linkages between and among natural heritage features and areas, surface water features and ground water features.

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

a) using the watershed and the ecologically meaningful scale for planning;
b) minimizing potential negative impacts, including cross-jurisdictional and cross-watershed impacts;
c) identifying surface water features, ground water features, hydrologic functions and natural heritage features and areas which are necessary for the ecological and hydrological integrity of the watershed.

Section 4.6 of the PPS recognizes that the policies of the PPS represent minimum standards. Planning authorities and decision-makers can go beyond these standards as long as they do not conflict with any other policy in the PPS. The Natural Heritage Reference manual provides technical guidance for implementing the natural heritage policies of the PPS. Section 3.0 of the manual is specifically dedicated to NHS identification and planning while the remainder of the manual provides technical guidance on various NHS components.

The Conservation Authorities (CA) Act

Described in Section 21(1), CAs have the power to study and investigate the watershed and to determine a program whereby the natural resources of the watershed may be conserved, restored, developed and managed. The identification and mapping of the Natural Heritage System in the Lynde Creek watershed and the characterization of the watershed's water resources with the analytical work and watershed management recommendations provided in the Lynde Creek Watershed Management Plan identifies and sets out what is needed to ensure the watershed resources can be managed in a sustainable manner.

In addition, CAs have the power to prohibit any development that, in their opinion, affect the conservation of land. Section 28(1)(c) prohibiting, regulating or requiring the permission of the authority for development if, in the opinion of the Authority, the control of flooding, erosion, dynamic beaches or pollution or the conservation of land may be affected by the development.

Other applicable sections of the Act include:

Objects

20. (1) The objects of an authority are to establish and undertake, in the area over which it has jurisdiction, a program designed to further the conservation, restoration, development and management of natural resources other than gas, oil, coal and minerals.

Powers of authorities

21. (1) For the purposes of accomplishing its objects, an authority has power,

(a) to study and investigate the watershed and to determine a program whereby the natural resources of the watershed may be conserved, restored, developed and managed

Ontario Water Resources Act (2007)

Under the Water Taking and Transfer Regulation (O. Reg. 387/04) Permits to Take Water (PTTW) are issued by the Ministry of Environment. In accordance with the regulation, the Director issuing a PTTW shall consider a suite of environmental issues to the extent that information is available, and relevant to the application. These considerations include:

- the natural variability of water flow or water levels,
- minimum stream flow,
- habitat that depends on water flow or water levels, and
- water balance and sustainable aquifer yield.

While specific reference to watershed plans and associated technical reports is not made in the Regulation, such documents provide information and guidance regarding the considerations noted above.

Clean Water Act (2006)

Assessment reports

15. (1) The source protection committee for a source protection area shall prepare an assessment report for the source protection area in accordance with the regulations, the rules and the terms of reference. 2006, c. 22, s. 15 (1).

Contents

(2) An assessment report shall, in accordance with the regulations, the rules and the terms of reference,

(a) identify all the watersheds in the source protection area;

(b) characterize the quality and quantity of water in each watershed identified under clause (a);

(c) set out a water budget for each watershed identified under clause (a) that,

(i) identifies the different ways that water enters and leaves the watershed and quantifies the amount of water that enters or leaves in each way,

(ii) describes the groundwater and surface water flows in the watershed,

(iii) quantifies the existing and anticipated amounts of water taken from the watershed that require a permit under section 34 of the *Ontario Water Resources Act*,

(iv) quantifies the existing and anticipated amounts of water taken from the watershed that do not require a permit under section 34 of the *Ontario Water Resources Act*, and

(v) having regard to the information referred to in subclauses (i) to (iv), describes any existing or anticipated water shortages in the watershed

Official Plans (OPs)

Official Plans are prepared under Part III of the Planning Act and must have regard to the directions set out in the PPS. Development that does not conform to an OP cannot be carried out. OPs are the main formal mechanism for implementing Watershed Plans. Incorporation of the Watershed Plan, principles and recommendations (including monitoring and implementation) in OPs solidifies municipal commitment to achieving watershed health. The identification and designation of protected land is demonstrated in the schedules that are included in OPs. An OP can also specify required studies and conditions that have to be met where a development proposal may affect natural heritage features. The inclusion of natural heritage systems in municipal and regional OPs is essential for ensuring that natural areas receive the ongoing protection required for them to function over the long term. CLOCA has identified planning policies within this watershed plan, based on recommendations designed to achieve ecological health, that are designed for incorporation into Regional and local municipal OPs.

Zoning By-Laws

Zoning by-laws regulate the use of land and will direct the type and form of development permitted on land. While Conservation Authorities can advise and make recommendations through policy review, it is up to the discretion of the Municipality to pass by-laws.

Site Plan Control Areas

Through Section 41 of the Planning Act, a Municipality can specify areas in its OP where development is subject to site plan control. In these designated areas, a proponent must provide plans showing the location of all buildings and structures. The Municipality when conducting it's review may grant conditions of approval to be fulfilled prior to, during and after development. Conservation Authorities will advise the Municipality with respect to conditions of

development which will protect sensitive natural areas and natural resources.

Topics as Required by the ORMCP Technical Paper #9 - Watershed Plans

A series of technical papers were released as part of the ORMCP that provide specific guidance for undertaking components of the Plan. Technical Paper #9 provides guidance to assist municipalities in preparing watershed plans. In this case, CLOCA is preparing the Lynde Creek Watershed Plan, as it is common for Conservation Authorities to use in-house expertise to develop these plans for use by and with municipal partners.

#1: Identification of Key Natural Heritage Features

Key Natural Heritage features were identified in the Existing Conditions Report finalized June 2008 as well as form the basis for the Natural Heritage System developed for the Watershed Plan.

#2: Significant Wildlife Habitat

Significant Wildlife Habitat has been identified in detail in the Existing Conditions Report, specifically in Chapter 17 – Terrestrial Natural Heritage and Chapter 18 – Wetlands. Significant Wildlife Habitat is further identified and included in the Natural Heritage System as a component of the Functional Natural Heritage System through the inclusion of core habitat areas and corridors. The components include:

- Size, shape, juxtaposition, representation, multiple function and Species at Risk (SAR) considerations for the habitat patch;
- Regional, landscape and local corridors;
- Riparian corridors, SAR riparian corridors, wetlands and woodlands >/= 0.5 ha; and
- Provincially Significant Wetlands (PSWs) and Area of Natural and Scientific Interest (ANSIs).

#3: Supporting Connectivity

The Natural Heritage System was developed as a connected system for the watershed. Key existing corridors and habitats were identified and manual edits were made to the modeled system to ensure appropriate connectivity throughout the watershed.

#4: Landform Conservation

There are three key landforms in the Lynde Creek Watershed: the Oak Ridges Moraine, the Lake Iroquois Beach and the Lake Ontario Shoreline. These landforms have been identified in mapping and policy recommendations for protection.

#5: Identification and protection of Vegetation Protection Zones for ANSI

ANSIs have been included as part of the Functional Natural Heritage System, meaning they form a core component of the overall Natural Heritage System and as such are identified through mapping and protected through policy.

#6: Identification of significant portions of habitat for Endangered, Rare or Threatened Species

The ability of a habitat patch to support Species at Risk (SARs) as identified by the Committee on the Status of Wildlife in Canada (COSEWIC) and the Committee on the Status of Species at Risk in Ontario (COSSARA) has been considered in the identification of Core Habitat Areas and Corridors in the Natural Heritage System.

In 2008, the Endangered Species Act, 2007 was enacted. This Act places responsibility for identification of specific habitat requirements with the Province. CLOCA will continue to work with the MNR in the protection of Endangered, Threatened and Special Concern Species.

#7: Identification and protection of Significant Woodlots

All woodlots >/= 0.5 ha have been identified as part of the Natural Heritage System of the watershed and protected through policy. Also, the policies recognize and support the preparation of technical studies which further delineate features and confirm the ecological function of these features.

#8: Preparation of Natural Heritage Evaluations for all key natural heritage features

Through the development of the Natural Heritage System a Landscape Analysis Model (LAM) was used to evaluate the quality of natural heritage features in the watershed based on:

- Distance from urban areas;
- Proximity to natural areas;
- Distance from roads;
- Interior forest;
- Proximity of a wetland to a forest;
- Proximity of a forest to a wetland; and
- Proximity to a water feature (within Ontario Regulation 42/06).

Through this modeling process, key natural heritage features were evaluated to determine the quantity and quality of the feature as well as the value of the feature as part of the larger Natural Heritage System. Also, the policies recognize and support the preparation of technical studies which further delineate features and confirm the ecological function of these features.

#9: Preparation of a Watershed Plan

The Watershed Plan has been prepared in accordance with all provincial requirements and guidelines and in consultation with area municipalities and watershed stakeholders.

#10: Water Budget

A Water Budget was prepared for the CLOCA jurisdiction by Earth*fx* Incorporated entitled *Water Budget Modelling for the Oak Ridges Moraine Conservation Plan in the Central Lake Ontario Conservation Authority Area* finalized in March 2011. This work was used in the evaluation of management scenarios as discussed in Section 3 of this Watershed Plan. Also, the policies recognize and support the preparation of technical studies which further delineate features and confirm the ecological function of these features.

#11: Water Conservation Plans

The Region of Durham undertakes water conservation initiatives and as such, key recommendations for anthropogenic use have not been offered in this Watershed Plan. Water as it relates to ecological functions and need has been assessed through the Water Budget work and imperviousness modeling. Principles of water

conservation are woven through the recommendations of this Watershed Plan.

#12: Hydrological Evaluations for hydrologically sensitive features

The Water Budget work conducted by Earth*fx* includes the identification of all water features in the CLOCA jurisdiction and notes key hydrological indicators, including the identification of sensitive areas, features and functions.

#13: Subwatershed impervious surfaces

An Impervious Surfaces model was developed and used as part of the management option evaluations (Scenario Analysis) in the Watershed Plan. The model identifies existing impervious surfaces and was used to predict the impact of various management scenarios during the evaluation of impervious cover in the watershed.

#14: Wellhead Protection - site management and contingency plans

100% of the municipal drinking supply for the Lynde Creek Watershed comes from Lake Ontario. As such, wellhead protection site management and contingency planning was not required from this watershed. However, the Intake Protection Zones (IPZs) in Lake Ontario were considered for water quality targets and recommendations in the Watershed Plan.

#15: Recreation and Vegetation Management Plans

Recreation plans are addressed by local municipalities. CLOCA has a history of working with municipalities to review and comment upon plans in association with plan review responsibilities. As such, no recreation-specific recommendations are made in this Watershed Plan but CLOCA will continue to provide advice and support where requested to municipalities. Vegetation management planning has been considered through the inclusion of policies on riparian buffers, the Natural Heritage System and policy recommendations encouraging the naturalization of Greenspace lands.

#16: Sewage and Water System plans

Sewage and water system plans have not been included specifically as part of this Watershed Plan. The Regional Municipality of Durham and local Municipalities address these issues in their policy and management plans. The Watershed Plan aims to reinforce their work and recommendations by providing a plan to achieve healthy watershed conditions that support efficient and effective sewage and water systems.

#17: Stormwater Management Plans

The Watershed Plan addresses stormwater management plans through the Action Plans and municipal policy recommendations for water quantity and quality control. The Action Plans will support further investigation into underperforming areas of the watershed and provide remediation / retrofit recommendations to municipal responsible authorities. Several of the policy recommendations included in the Watershed Plan specifically address stormwater quality, quantity, control and maintenance issues.

CONFORMITY TABLE

Legislation	Sub-section	Requirement	Conforms? √ or X
ORMCP	24(1)	Every upper-tier municipality and single-tier municipality shall, on or before April 22, 2003, begin preparing a watershed plan, in accordance with subsection 24.(3), for every watershed whose streams originate within the municipality's area of jurisdiction.	✓
ORMCP	24(2)	The objectives and requirements of each watershed plan shall be incorporated into the municipality's official plan.	✓
ORMCP	24(3)	A watershed plan shall include, as a minimum, a) a water budget and conservation plan as set out in section 25; b) land and water use and management strategies; c) a framework for implementation, which may include more detailed implementation plans for smaller geographic areas, such as subwatershed plans, or for specific subject matter, such as environmental management plans; d) an environmental monitoring plan; e) provisions requiring the use of environmental management practices and programs, such as programs to prevent pollution, reduce the use of pesticides and manage the use of road salt; and f) criteria for evaluating the protection of water quality and quantity, hydrological features and hydrological functions.	✓ **Note:** Durham Region is responsible for the Water Conservation Plan.
ORMCP	25(1)	Every upper-tier municipality and single-tier municipality shall, on or before April 22, 2003, begin preparing a water budget and conservation plan, in accordance with subsection 25.(2), for every watershed whose streams originate within the municipality's area of jurisdiction.	✓
ORMCP	25(2)	A water budget and conservation plan shall, as a minimum, a) quantify the components of the water balance equation, including precipitation, evapotranspiration, groundwater inflow and outflow, surface water outflow, change in storage, water withdrawals and water returns; b) characterize groundwater and surface water flow systems by means of modelling; c) identify, (i) targets to meet the water needs of the affected ecosystems, (ii) the availability, quantity and quality of water sources, and (iii) goals for public education and for water conservation;	✓
ORMCP	25(2)	(a) provide for monitoring of the water budget and water conservation plan for effectiveness.	✓

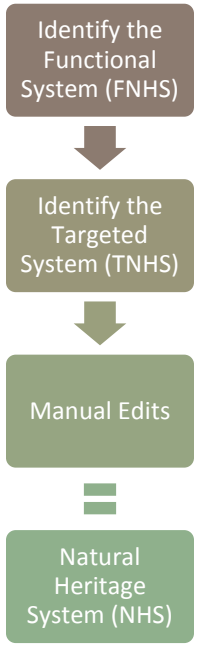
Legislation	Sub-section	Requirement	Conforms? √ or x
ORMCP	27(1)	Except with respect to land in Settlement Areas, all development and site alteration with respect to land in a subwatershed are prohibited if they would cause the total percentage of the area of the subwatershed that has impervious surfaces to exceed, (a) 10 per cent; or (b) any lower percentage specified in the applicable watershed plan.	✓
Greenbelt Plan (GBP)	3.2.3	(2) Watersheds are the most meaningful scale for hydrogeological planning and municipalities together with conservation authorities should ensure that these watershed plans are completed and used to guide planning and development decisions within the protected countryside. (3) Cross-jurisdictional and cross-watershed impacts need to be considered in the development of watershed plans. The development of watershed plans and management approaches in the protected countryside should be integrated with watershed planning and management in the NEP and ORMCP areas and beyond the (Greenbelt). (4) Municipalities shall, in accordance with provincial direction related to the protection of source water, protect vulnerable surface and groundwater areas, such as wellhead protection areas, from development that may adversely affect the quality and quantity of the ground and surface waters.	✓
GBP	3.25	For areas surrounding watersheds within CLOCA jurisdiction and the local, regional and broader scale natural heritage systems of southern Ontario, such as lake Ontario shoreline, including its remaining coastal wetlands, the Great Lakes Coast, Lake Simcoe, the Kawartha Highlands, the Carolinian zone and the Algonquin to Adirondack corridor, the federal government, municipalities, conservation authorities, other agencies and stakeholders should: (a) Consider how activities and land use change both within and abutting the CLOCA watersheds (including the Greenbelt and Oakridges Moraine) relate to the areas of external connections identified in this Plan (b) Promote and undertake appropriate planning and design to ensure that external connections are maintained and or enhanced and; (c) Undertake watershed based planning, which integrates supporting ecological systems with those systems contained in the Plan. The river valleys that run through existing or approved urban areas and connect the Greenbelt to inland lakes and the Great Lakes are a key component of the long-term health of the Natural System. In recognition of the function of the urban river valleys, municipalities and conservation authorities should: (a) Integrate watershed planning and management approaches for lands both within and beyond the Greenbelt.	✓

Legislation	Sub-section	Requirement	Conforms? √ or x
GBP	Definitions	A watershed plan is a plan used for managing human activities and natural resources in an area defined by watershed boundaries. Watershed plans shall include, but are not limited to, the following components: a) A water budget and conservation plan; b) Land and water use and management strategies; c) A framework for implementation; d) An environmental monitoring plan; e) Requirements for the use of environmental management practices and programs; f) Criteria for evaluating the protection of water quality and quantity, and key hydrologic features and functions; and g) Targets on a watershed or sub-watershed basis for the protection and restoration of riparian areas and the establishment of natural self-sustaining vegetation.	✓
Provincial Policy Statement (PPS)	1.2.1	A coordinated, integrated and comprehensive approach should be used when dealing with planning matters within municipalities, or which cross lower, single and/or upper-tier municipal boundaries, including: d) ecosystem, shoreline and watershed related issues;	✓
PPS	2.2.1	Planning authorities shall protect, improve or restore the quality and quantity of water by: a) using the watershed as the ecologically meaningful scale for planning; b) minimizing potential negative impacts, including cross-jurisdictional and cross-watershed impacts; c) identifying surface water features, ground water features, hydrologic functions and natural heritage features and areas which are necessary for the ecological and hydrological integrity of the watershed;	✓
Places to Grow, Growth Plan	3.2.5	(7) Municipalities, in conjunction with conservation authorities are encouraged to prepare watershed plans and to use such plans to guide development decisions and water and waste water servicing decisions.	✓
Regional OP	2.1.1	To ensure the preservation, conservation and enhancement of the Region's natural environment for its valuable ecological functions and for the enjoyment of the Region's residents.	✓
Regional OP	2.1.4	To undertake planning functions based on the understanding that there is a relationship between the natural and built environments and the principle of preserving resources and protecting the natural environment for future generations.	✓
Regional OP	2.2.1	In the planning and development of the Region, the natural environment which includes areas designated as ORM, waterfronts and major open space areas as well as the Greenbelt NHS and key natural heritage and hydrologic features shall be given paramount consideration in light of their ecological functions and scientific educational and health values.	✓
Regional OP	2.2.3	Woodlands, wetlands and peat bogs shall be protected and managed to provide environmental, recreational and economic benefits to the Region.	✓

Legislation	Sub-section	Requirement	Conforms? √ or x
Regional OP	2.3.18	The Region will, in cooperation with the area municipalities, conservation authorities and other agencies having jurisdiction, participate in managing the woodlands in the Region by: f) establishing an overall woodland cover target of a minimum of 30% or Durham's total land area. Recognizing that not all areas of the Region will be covered by woodlands, watershed plans will be utilized to assest in establishing woodland targets for a watershed or smaller geographical area that is in keeping with the Regional target. To assist in implementation, watershed plans may also identify the most suitable areas that should be targeted for enhanced woodland coverage, avoiding prime agricultural lands. The use of indigenous tree species to achieve these targets is encouraged.	✓
Regional OP	2.3.19	e) ensure that, for lands located on the Oak Ridges Moraine and the lands within the Protected countryside of the Greenbelt Plan, stormwater management and watershed plans and their components, meet the requirements of the Oak Ridges Moraine Conservation Plan and the Greenbelt Plan respectively.	✓
Regional OP	2.3.2	The development of a connected and functional natural system comprised of the Greenlands System and additional linkages and corridors as identified in area municipal official plans is encouraged.	✓
Regional OP	2.3.32	High aquifer vulnerability areas shall be detailed in area municipal official plans. The location and boundaries of high aquifer vulnerability areas shall be refined through the preparation of studies such as watershed plans.	✓
Regional OP	2.3.5 h)	Regional Council shall, in conjunction with the Provincial Government and the area municipalities, examine the ways and means to maintain wildlife habitats.	✓
Regional OP	2.3.8	The preparation and implementation of watershed plans is supported as an effective planning tool in the protection of the Region's natural resources.	✓
Regional OP	2.3.11	The Region, in co-operation with the conservation authorities, shall, where necessary, ensure that the appropriate policies to implement individual watershed plans are incorporated into the Regional and area municipal official plans.	✓
Regional OP	2.3.14	…The location and extent of key natural heritage and/or hydrologic features may be further confirmed through appropriate studies such as a watershed plan.	✓
Regional OP	2.3.20	Regional Council shall cooperate with the Provincial Government and the conservation authorities to promote the effective use and conservation of surface and groundwater resources and to protect against adverse cumulative impacts of development on water quality and quantity.	✓
Regional OP	2.3.29	Areas of high aquifer vulnerability are shown on Schedule 'B'…..Additional areas may be identified through future studies such as source water protection plans or watershed studies.	✓

Legislation	Sub-section	Requirement	Conforms? √ or x
Regional OP	2.3.46 a)	Regional Council shall promote tree planting for the purposes of improving air quality, health and reducing energy use through shading and sheltering.	✓
Regional OP	2.3.46 c)	Regional Council shall recognize the potential implications of climate change and will continue to investigate and implement mitigation measures where appropriate.	✓
Regional OP	2.3.48	The region's involvement in potential land securement opportunities for conservation purposes shall focus on the following areas and considerations: A) key natural heritage and hydrologic features and hazard lands B) establishment of a regional trail network C) damaged or degraded areas D) nature and immediacy of threats to an area E) proximity of area to existing property in public ownership F) the overall cost of purchase and long term management of an area G) any other consideration identified through a Council approved Land Securement Strategy.	✓
Regional OP	10B.2.12	Regional Council shall, in consultation with area municipalities and the conservation Authorities, prepare and endorse watershed plans, including water budgets and conservation plans, to satisfy the requirements of the Oak Ridges Moraine Conservation Plan for every watershed having streams originating on the Moraine. Watershed plans shall provide knowledge of the terrestrial natural heritage and groundwater and surface water systems and recommend how land and water resources are to be protected and enhanced in response to changing land uses as a guide to planning decisions. Appropriate objectives and requirements of the watershed plans shall be incorporated into this Official Plan by amendment. Area municipalities shall incorporate, by amendment, appropriate objectives and requirements of the watershed plans into their Official Plans.	✓
Regional OP	Definitions	Watershed Plan: means a plan used for managing human activities and natural resources in an areas defined by watershed boundaries. Watershed plans shall include, but are not limited to, the following components: a) A water budget and conservation plan; b) Land and water use and management strategies; c) A framework for implementation; d) An environmental monitoring plan; e) Requirements for the use of environmental management practices and programs; f) Criteria for evaluating the protection of water quality and quantity, and key hydrologic features and functions; and g) Targets on a watershed or sub-watershed basis for the protection and restoration of riparian areas and the establishment of natural self-sustaining vegetation.	✓

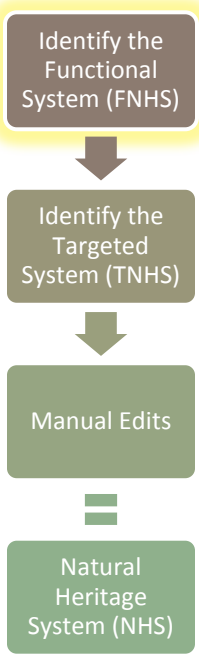
APPENDIX B: DEVELOPING CLOCA'S NATURAL HERITAGE SYSTEM – A METHODOLOGY



Executive Summary of CLOCA's 2011 METHODOLOGY DOCUMENT

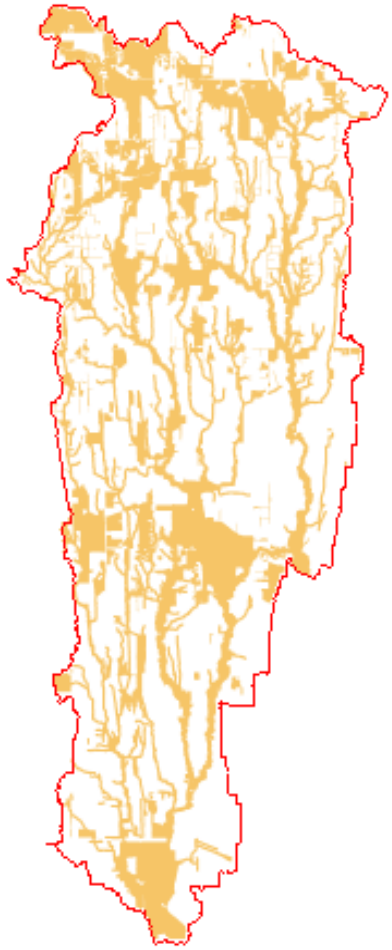
The development of a Natural Heritage System (NHS) for managing natural resources has become a widespread tool used by Conservation Authorities and planning authorities. A NHS provides a scientifically defensible tool to manage watershed resources in accordance with the Conservation Authorities Act. A NHS can also be used by Municipalities to update municipal environmental policies and inform development of municipal NHS and identification of significant features. The NHS CLOCA developed offers a connected system consistent with the direction of other provincial land use plans including the ORMCP and Greenbelt Plan and can be used as support in the implementation of the Natural Heritage section of the Provincial Policy Statement (PPS). It also can be used for refinement of the Greenbelt NHS used in the Durham Region Official Plan. CLOCA's NHS represents a healthy, self-sustaining, connected system that supports: a diversity of native terrestrial, wetland and aquatic species, communities and habitats; natural healthy fish and riparian habitats; and a natural and healthy watershed hydrological cycle. It is a connected system consisting of PSWs, provincially significant ANSIs, important aquatic habitat, riparian corridors, core habitat areas and terrestrial corridors, woodlands *>/= 0.5ha,* wetlands >/= 0.5ha, and areas identified for natural cover regeneration/restoration which will improve connectivity and habitat. This approach of identifying a Natural Heritage System that includes existing features as well as regeneration/restoration lands is widely supported by provincial authorities and extensively referred to in the *Natural Heritage Reference Manual for Natural Heritage Policies of the Provincial Policy Statement, 2005 Second Edition*. CLOCA has identified a Natural Heritage System that if protected, can achieve the minimum watershed health targets as set out in the Watershed Plan and provincial and federal policies. CLOCA began the process of developing a Natural Heritage System for our jurisdiction in 2006 following the release of the Toronto and Region Conservation Authority's (TRCA's) methodology for the development of their Targeted Terrestrial Natural Heritage System (TTNH). Since that time, CLOCA has dedicated many resources to developing a Natural Heritage System (NHS) for our jurisdiction that is built on TRCA's scientific foundation methodology and customized to best reflect the conditions and management capacities of CLOCA. The NHS methodology document was finalized in 2010 and updated to reflect minor terminology changes in 2011 (i.e. the term Ultimate Natural Heritage System was modified to Natural Heritage System). This methodology was used to develop the NHSs for the four major watersheds within CLOCA from 2007 to 2010, and is being used to support the planning review process undertaken by CLOCA staff on behalf of area municipalities. The development of the NHS allows CLOCA to better manage the natural features and functions of our watersheds based on a systems management approach.

Identification of the Functional Natural Heritage System (FNHS)



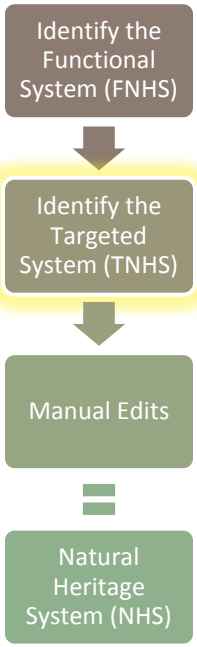
The Functional Natural Heritage System (FNHS) is a series of shapefile overlays, as developed in ArcGIS, of valued natural system components that include PSWs, ANSIs, core habitat and corridors, riparian corridors and wetlands and woodlots >/=0.5ha. Many of these components have been derived from CLOCA's Ecological Land Classification (ELC) mapping, a provincial standard in classifying and mapping natural communities, developed by the Ministry of Natural Resources (MNR) in 1998. CLOCA's ELC mapping has been completed to the Community Series level of detail, which is defined as the smallest ecological unit of mapping (0.5 ha) that can be interpreted from aerial photography at a scale of 1:10 000. For the purposes of ELC mapping and subsequently the development of a Natural Heritage System, polygons under 0.5 ha were not been mapped unless they have been groundtruthed and have been included as a rare community type.

Essentially, the FNHS is a mapped representation of the existing features of the watershed (both terrestrial and aquatic) plus a 30m buffer along each side of streams (also referred to as core corridors and/or riparian buffers). It is important to note that the 30m buffers represented on either side of streams may not exist today in a natural state but have been included as part of the FNHS because they are necessary to connect the existing features into a system.



The example image represents the Functional Natural Heritage System (FNHS) in the Lynde Creek Watershed (i.e. existing terrestrial and aquatic features plus 30m stream buffers as connecting corridors).

Defining the Targeted Natural Heritage System (TNHS)



An analysis of the existing conditions versus the watershed targets identified that in order to reach targets of 30% natural cover, 10% wetland cover and 75% riparian cover it was necessary to identify lands for protection, restoration and enhancement. The NHS system model identified targeted lands through the application of the Landscape Analysis Model (LAM). This model provided the opportunity to determine the parameters for the most desirable characteristics of the system and run various modelling tests to assess the changes in target lands based on various target thresholds.

The LAM first analyzed habitat patches using a GIS vector-based approach and were scored through a weighted average and ranked according to their size, shape and matrix of influence. Patch scores were ranked from L1 (best quality) to L5 (poorest quality). It was determined that the target threshold for running the model would represent a scenario where the majority of existing habitat patches moved from L3 (fair quality) to L2 (good quality). Quality of patches increases as the size, shape and matrix influences of a patch increases with the addition of land. It is important to note that additional / target lands are not chosen based on their ELC classification but are rather selected to improve the quality of adjacent features within the system (so their value is cumulative to the system, not based on the additional patch itself). Essentially, the model assesses the quality of the existing conditions of the system and then strategically adds lands where additional land mass improves the existing patches, size, shape or matrix of influence enough to increase the quality of that patch to a fair, good or excellent quality rating. Through this exercise, the model targeted lands that would improve the quality of an existing feature to benefit the system as a whole. The model was "run" or "scenario tested" until that threshold of the majority of patches reaching a score of 3 or greater was achieved. The lands the model added to the system became the baseline targeted lands for restoration / regeneration in the Natural Heritage System or the Targeted Natural Heritage System.

The darkened areas on the example image above represent the Targeted Natural Heritage System (TNHS) in the Lynde Creek Watershed (i.e. the areas of land identified for restoration / regeneration to add value to the NHS as a whole).

Manual Edits to the System

Following the identification of the FNHS and the TNHS CLOCA Natural Heritage staff, using their experience in the watershed and on-the ground knowledge, made manual edits to the systems where appropriate. Edits included removal of:

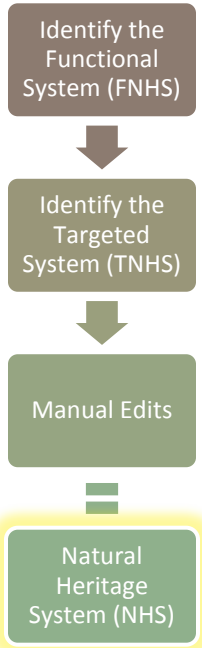
- small disconnected hedgerows within the FNHS;
- isolated “islands" of forest cover/naturalized space that cannot reasonably be connected to the system, but would be protected through policy;
- target area extensions of existing natural cover creating a highly irregular shape (ideal forest shape is circular, so “fingers” would be removed where appropriate);
- target areas identified by the model within existing urban areas that are unlikely to be achieved; and
- features that no longer exist on the landscape as 2008 ortho-photos were used for the exercise.

Also, manual additions were made to:

- connect areas intuitively within the ORM or Greenbelt Policy Areas;
- fill in gaps where they exist without constraints to enhance features;
- create better shape : area ratios of a feature (i.e. filling in edges of irregularly shaped features); and
- adding CLOCA properties to recognize the long-term protection and inclusion of these lands into the NHS.

Identify the Natural Heritage System

The NHS is a connected system which supports a healthy, ecologically functioning and sustainable watershed for the long term. It encompasses a connected assembly of features and functions, including significant features as identified in the PPS. The value of the NHS is cumulative based on lands that enhance the functions of existing features. The NHS includes existing natural features and future restoration/regeneration areas and when realized will meet ecological targets set out through science and policy, including the healthy watershed targets identified for this watershed.



The NHS is a guide for protecting minimum ecological standards in the watershed and every effort should be made to protect, enhance and restore it through policy, stewardship, education and other available tools.

DECEMBER 2011 CLOCA METHODOLOGY DOCUMENT

OVERVIEW

The Natural Heritage System (NHS) for the watersheds within the Central Lake Ontario Conservation Authority (CLOCA) jurisdiction has been developed in three parts. The first part is referred to as the Functional Natural Heritage System (FNHS) is a series of shapefile overlays, as developed in ArcGIS, of valued natural system components. Those components are described in detail in Part 1. Many of these components have been derived from CLOCA's Ecological Land Classification (ELC) mapping, a provincial standard in classifying and mapping natural communities, developed by the Ministry of Natural Resources (MNR) in 1997. CLOCA's ELC mapping has been completed to the Community Series level of detail, which is defined as the smallest ecological unit of mapping (0.5 ha) that can be interpreted from aerial photography at a scale of 1:10 000. For the purposes of ELC mapping and subsequently the development of a Natural Heritage System, polygons under 0.5 ha have not been mapped unless they have been ground-truthed and have been included as a rare community type (i.e. Old Growth Forest, Fen). Occasional gaps within the corridors that do not represent existing natural heritage features, are necessary to connect habitat patches, which are required to support and maintain a connected natural system.

The second part in developing the Natural Heritage System is determining where additional natural cover should occur adjacent to the FNHS, in order to achieve watershed health targets. CLOCA adapted the Targeted Terrestrial Natural Heritage System (TTNHS) as developed by the Toronto Region Conservation Authority (TRCA), to reflect local conditions for CLOCA watersheds. The methodology for the TTNHS is appended and includes the methodology for Landscape Analysis Model (LAM) which evaluates habitat patches based on their size, shape, and proximity to other natural features. The information presented from the LAM, forms the basis of the TTNHS. In addition to generating a TTNHS for the CLOCA jurisdiction, additional manual edits are considered (Part 3); edits include the removal of small stand alone features with little functional value (i.e. small hedgerows). These edits can be assisted by Greenbelt and Recharge/Discharge mapping. The final product of this exercise is the NHS.

Part 1: FNHS components

Core Habitat Areas & Corridors:

Core Habitat Areas

Although virtually all vegetated areas provide some habitat for wildlife, there are some habitats that can be considered "core" because they are able to provide for a large suite of wildlife or support sensitive wildlife species. Deciding which habitats should be considered core habitats is a somewhat subjective exercise depending on the species being considered, but for the purposes of defining a FNHS, the designation of core habitat areas has been made using the following criteria:

- **Size** being the physical size of the habitat being measured. Larger sized habitats are preferable to smaller sized habitats.
- **Shape** refers to the geometric shape of the habitat being measured. Compact habitat patches (e.g. square or circular)

are preferable to linear (e.g. rectangular) patches as they have fewer edges.

- **Juxtaposition** being the position of the habitat on the landscape relative to other features such as settled areas or natural areas. Natural areas adjacent to other natural areas are preferred over natural areas adjacent to urban development.
- **Representation** is the range of a specific habitat type in the watershed. A high diversity of well-distributed habitat types is preferable.
- **Multiple Function** is the ability of a habitat to provide more than one function for local wildlife communities.
- **Species at Risk** refers to the ability of a habitat patch to support species at risk as identified by the Committee on the Status of Wildlife in Canada (COSEWIC) and the Committee on the Status of Species at Risk in Ontario (COSSARO).

Habitat size and shape are important factors for any habitat, however in forests, size and shape are particularly important because they determine the amount of forest interior (100 m from forest edge) and deep forest interior (200 m from forest edge) that may be present. Forest interior is a prerequisite for many breeding birds as it provides increased protection from wind, light, nest parasitism and predation.

As human development approaches and in some cases surrounds wildlife habitats, the effects of noise, light, disturbance from recreation or pets, and other stressors are increased. Consequently, species that are sensitive to disturbance are less likely to occupy these habitats even if they meet their needs for food or cover, and the result is a loss in overall biodiversity. Habitat size, shape and juxtaposition were evaluated using the LAM.

Representation and multiple function have been assessed using ELC. Because wildlife have varying needs, and some have very specific needs, a wide variety of habitats must exist within a watershed to support biodiversity. Representation is not limited to broad habitats such as forests and wetlands; it includes types of forests as well as types of wetlands.

The evaluation of habitats for species at risk within the CLOCA jurisdiction is done using information from the Natural Heritage Information Centre (NHIC), from data collected through field work, external documents, or Environmental Impact Studies, and from data reported to the Authority by the public.

Corridors

Animals are not stationary. Species have a tendency to move between habitats to fulfill dietary or lifecycle needs, seek refuge, and escape predation, so connectivity between habitat patches is important for maintaining wildlife populations. At a broader scale, connectivity enables animal migration, which is integral to maintaining genetic diversity and facilitating the repopulation of habitats after local extinction events.

Because corridors serve a number of functions and operate at varying scales, they can be categorized in the following manner:

Type	Description
Regional Corridors	These are major movement corridors which connect a number of watersheds at a large landscape scale. Regional corridors are often comprised of upland areas since they exist across watershed divides and they are connected via large habitat patches. Examples of Regional Corridors include the Oak Ridges Moraine and Lake Iroquois Shoreline.
Landscape Corridors	These are major movement routes within the watersheds that connect core areas and/or are robust enough to be sustainable as habitat units themselves. They typically follow linear features such as creeks and valleys, and can be composed of a series of independent habitats that allow wildlife to "hopscotch" across the landscape. Landscape corridors should be at least 100 metres in width. (Environment Canada, 2004)
Local Corridors	These are minor movement routes within the watershed that help to connect habitat patches into a continuous series. They are often associated with creek valleys and typically function at a sub-watershed scale. They function with landscape corridors to connect the smaller habitats to the larger ones. Local corridors are 60 metres in width.

Riparian Corridors

In order to protect/enhance the thermal regime of the watercourses in the CLOCA jurisdiction a minimum 30-metre buffer from the wetted width of either side of a watercourse is required. Watercourses can be permanent, intermittent and ephemeral. The 30-metre buffer requirement is well documented in and supports the goals, objectives and recommendations of the Central Lake Ontario Fisheries Management Plan.

Species At Risk (SAR) Riparian Corridors

SAR riparian corridors are required to protect the reaches of watercourses that provide habitat for the provincially endangered Redside dace. Currently within the CLOCA jurisdiction Redside dace occurs only in reaches of the Lynde Creek Watershed, however ongoing watershed monitoring occurs across the jurisdiction for this species. In keeping with the recovery strategy in development for Redside dace, a buffer of the meander belt plus 30-metres on either side of the wetted width of the watercourse is required. Buffers are applied to reaches of permanent and intermittent watercourses where habitat for Redside dace occurs or has been known to occur historically.

Wetlands >/= 0.5 ha

Existing wetlands in CLOCA watersheds occasionally fall short of the 10%/watershed target suggested in Environment Canada's "How Much Habitat is Enough?" AOC Guidelines of 10%/watershed. The guidelines also recommend restoration of wetland habitat to mirror historical percentages. As such, it has been determined that all wetlands are valued and should be considered in the development of the FNHS. Since ELC at the Community Series level of detail identifies 0.5 ha polygons as the smallest units mappable, 0.5 ha is the smallest wetland considered for incorporation into the FNHS.

Woodlands >/= 0.5 ha

Existing woodlands in CLOCA watersheds generally fall short of targets suggested in Environment Canada's "How Much Habitat is Enough?" AOC Guidelines of 30%/watershed. As such, it has been determined that all woodlands are valued and should be considered in the development of the FNHS. Since ELC at the Community Series level of detail identifies 0.5 ha polygons as the smallest units mappable, 0.5 ha is the smallest woodland considered for incorporation into the FNHS.

Provincially Significant Wetlands (PSWs)

PSWs have been designated by the Ministry of Natural Resources and are protected features under provincial policies including the Provincial Policy Statement, The Oak Ridges Moranine Conservation Plan and the Greenbelt Plan. While already protected by policy, PSWs are also important biological features and therefore warrant inclusion into the FNHS mapping.

Areas of Natural and Scientific Interest (ANSIs)

ANSIs have been designated by the Ministry of Natural Resources and are protected features under provincial policies including the Provincial Policy Statement, The Oak Ridges Moranine Conservation Plan and the Greenbelt Plan. While already protected by policy, ANSIs are also important biological and physiographical features and therefore warrant inclusion into the FNHS mapping.

Part 2: NHS components

Methodology for Developing a Targeted Terrestrial Natural Heritage System

Introduction

Following an extensive literature review, CLOCA adopted the Toronto and Region Conservation Authority's Targeted Terrestrial Natural Heritage Approach (2005) in early. It was felt that this approach would suit our own needs within the CLOCA jurisdiction. The premise of the TTNHS development comes from amendments to the Planning Act in 1996 and the then drafted Comprehensive Set of Provincial Policy Statements that were introduced by the Federal Government, which placed more onus on the municipalities for land-using planning. Specifically, the onus was placed on municipalities to define significant natural heritage feature and functions. Conservation Authorities have long played an active role in providing natural heritage advice to municipalities with regard to natural heritage, so developing a tool that would assist municipal partners, seemed like a logical next step.

The rapid urban expansion in the Greater Toronto Area (GTA) has led to continuous incremental loss of natural cover and species. Despite good intentions, land use policies that focus on protecting only the most significant of habitats ultimately contribute to the overall loss in biodiversity and ecosystem function. In a landscape that quite likely supported over 90% forest cover prior to settlement, current mapping shows that only 20% remains. This represents a substantial loss.

CLOCA's approach for the development of a TTNHS was the adoption of the work already undertaken by TRCA which is appended in this document for reference. Minor changes were made to the TRCA methods as are reflected in this document for adaptation to the CLOCA jurisdiction. The approach used in defining the TTNHS is broken down into three components:

1. evaluation of current habitat patch characteristics using landscape metrics;
2. determining the targeted condition for the landscape;
3. identifying protection and restoration opportunities to reach the predetermined target condition for the watersheds within the CLOCA jurisdiction.

The base premise for the TTNHS is that in the heavily fragmented landscape of the GTA, more natural cover is required to improve ecological function and integrity, and that, based on historical conditions and the tendency of natural succession, most of that cover should be forest.

There are four stages in developing the terrestrial natural heritage system and they are as follows:

1. determine existing conditions (landscape analysis)
2. determine what condition is needed in the landscape (target setting process)
3. develop a scenario that achieves the targets (systems design – provided by TRCA)
4. evaluate the resulting scenario to determine if targets are met (landscape analysis)

Methodology

Study Area Definition

The study area is defined by the watershed boundaries of the Central Lake Ontario Conservation Authority's jurisdiction. For the purposes of defining a Targeted Terrestrial Natural Heritage System, and recognizing target percentage of 30% forest cover as defined by the AOC guidelines (Environment Canada, Ontario Ministry of Natural Resources and Ontario Ministry of Environment 1998, 2004) A scenario approach was used. GIS scenarios were modeled using the LAM and addressing where the largest shift in L3 quality habitat patches to L2 quality patches. Ironically this shift happened at approximately 30%.

The Methodology document is comprised of two parts: (1) The Natural Heritage Methodology for developing the Landscape Analysis Model (LAM) which was used to develop the (2) Targeted Terrestrial Natural Heritage System. Both methodologies closely reflect the TRCA approach with minor modifications.

Part 2.1: Developing a Landscape Analysis Model (LAM)

Data Preparation

In a region of rapid land use change, landscape-level analyses must be based on the most recent information possible. The CLOCA landscape analysis was derived from 2008 orthogonally rectified aerial photography. Discreet polygons were digitized at a scale of generally 1:3000. Natural communities were classified according to ELC at the Community Series level of detail and other land uses

including Agriculture and Urban were defined using land cover classification criteria developed by CLOCA. All polygons were digitized onscreen utilizing Arcview software.

Habitat and Land use Definition

An important step in defining and mapping habitat patches for a terrestrial natural heritage strategy is to specify the different types of habitat to be used in the landscape analysis. The major habitat types considered for the CLOCA analysis are forest (including successional areas), wetland, meadow and beach/bluff. The Community Series level of detail in which CLOCA bases much of its natural heritage work on, needed to be nested upward into more general categories.

Table 1: Nested ELC

Forest	Wetland	Meadow	Beach/Bluff
Coniferous forest	Open fen	Open tallgrass prairie	Open beach/bar
Mixed forest	Shrub fen	Tallgrass savannah	Shrub beach/bar
Deciduous forest	Treed fen	Tallgrass woodland	Treed beach/bar
Cultural plantation	Open bog	Cultural meadow	Open bluff
Cultural thicket	Shrub bog	Inactive aggregate	Shrub bluff
Cultural savannah	Treed bog		Treed bluff
Cultural woodland	Meadow marsh		Open cliff
Coniferous swamp	Shallow marsh		Shrub cliff
Mixed swamp	Submerged shallow aquatic		Treed cliff
Deciduous swamp	Mixed shallow aquatic		
	Floating-leaved shallow aquatic Thicket swamp		
	Open Water Aquatic		

Polygon borders are generally defined by obvious changes in the type of habitat or land use. Roads, railways, wide trails and obvious breaks in canopy closure (at a scale of 1:3000) are considered as a break in habitat patches. Areas covered by roads, railways and trails are considered as "urban" land use as per the definition in Table 2. An exercise was completed to distinguish natural open water areas from man-made ponds, so that Open Water Aquatic (OAO) ELC units could be included as they are most often associated with wetland features. It was necessary to include these OAO features in the LAM so that they wouldn't be targeted for restoration in the TTNHS.

Table 2: Summary of the habitat type and land use patch definitions used to delineate polygons.

Habitat Type/Land use	Community Types Considered
Forest	FOC, FOM, FOD, CUP, CUT, CUS, CUW, SWC, SWM, SWD
Wetland	FEO, FES, FET, BOO, BOS, BOT, MAM,

	MAS, SAS, SAM, SAF, SWT, OAO
Meadow	TPO, TPS, TPW, CUM, Inactive aggregate
Beach/Bluff	BBO, BBS, BBT, BLO, BLS, BLT, CLO, CLS, CLT
Agriculture	Croplands, orchards and pastures
Built Form (Urban)	These areas are considered any part of the landscape that has been modified primarily for human use other than agriculture or natural ELC communities. This designation includes, residential, commercial, industrial, road and manicured areas such as cemeteries, golf courses and parkland.
Natural Water Feature	Lakes and OAO

LANDSCAPE ANALYSIS MODEL (LAM): PATCH ANALYSIS AND SCORING METHODOLOGY

The landscape-level patch analysis applies several criteria and measures that are relevant to the inherent qualities of individual habitat patches and their position in relation to each other and to current surrounding landuses. Measuring attributes of habitat patches and their interrelationships is the basis of landscape analysis.

Once the major habitat and landuse types have been digitized, the analysis is undertaken using a vector-based approach in ARCView GIS (Figure 1) with the Spatial Analyst addition. Habitat patches can be scored and ranked according to their respective qualities.

There are **three measures** used to quantitatively score individual habitat patches in the LAM. These are: **size**, **shape** and **matrix influence** and they are discussed in detail below.

Size

This is the most basic of polygon measures. For biodiversity and maintenance of ecosystem integrity, large habitat patches are preferred over small ones because they (Forman, 1995; Bennett, 1999):

1. support larger populations of species, thus promoting their viability;
2. have the capacity to support area-sensitive and forest interior species;
3. are better buffered from negative external influences;
4. likely feature a greater diversity of habitat types which increases biodiversity;
5. are more resilient to external influences;
6. have a greater capacity to maintain and promote a variety of natural ecological processes.

Size is a straight-forward measure of the number of hectares occupied by a habitat patch. Patches that straddle the boundary of the study area are assessed for the entire size of the patch, not just the portion of the patch which falls within the study area. In the case of the CLOCA jurisdiction, a 3 km buffer was added to each habitat patch to be inclusive of all patches that straddle the watershed boundary.

In a landscape where forest is the dominant ecosystem type, under natural conditions, wetlands typically cover less area than forest

(both individually and combined). Small wetlands are also likely to have more wildlife value than a forest of equal size and may also provide greater ecosystem functions per unit area. Therefore it makes sense to score wetlands on a scale that gives higher points for smaller patch ranges than forests. Given their rarity in the landscape, Beach/Bluff habitats are treated similarly to wetland habitat in this regard. Scores are assigned to the patch size classes for each habitat type (Table 3).

Shape

Patch shape is a measure of its exposure to external influences, including the negative edge effects resulting from habitat fragmentation. Theoretically, the more convoluted the polygon, the larger its edge, the higher its exposure to these influences will be (Forman, 1995).

Shape is scored as a patch's perimeter (edge to area ratio – P/A). To compensate for the increase in perimeter with increasing size, a corrected shape calculation is used (TRCA, 2005)

$$(28.2) \times (P) / (A)^{1/2}$$

A perfect circle (the best possible shape for reduction of edge to area) would be P/A = 100. As in the case for the size measure, patches that extend outside of the study boundary are measured in their entirety, not just the portion that falls within the study area. The scores assigned to the patch shape classes are listed in Table 3.

Matrix influence

Matrix influence is a measure of the positive or negative influence that a patch is subject to based on its surroundings. Land uses, especially urbanization, adjacent to a patch can exert pressure or impacts that can have a profound effect on its biodiversity (Lindedmayer and Franklin, 2002). Conversely, a patch can have a synergistic and beneficial relationship with other natural cover in its surrounding area and to a lesser degree, with agricultural lands. In other words, a patch's score for "matrix influence" reflects the degree to which the surrounding land cover and land uses threaten or contribute to its biological integrity and diversity.

The CLOCA TTNHS measures the character of the matrix within a 3 km radius from the outside edge of each habitat patch. The 3 km radius of influence extends beyond the limit of the study area in most cases. This distance was chosen because:

- it is considered to be a more than reasonable foraging circuit for predatory species associated with edge effects, such as raccoons, foxes, feral cats and cowbirds;
- it is a distance within most genetic exchange and species dispersal can be expected from most flora and fauna species;
- it is a distance that could be considered reasonable by people to regularly visit a natural area for recreation purposes, by walking, cycling or driving;
- it is at a distance that is inclusive of all large habitat patches within CLOCA

(See Austen et al., 2001; Austen and Bradstreet, 1996; Hames et al., 2001; Norris & Stutchbury, 2001; Haddad 2000; Askins et al., 1987; Robbins et al., 1989)

In scoring for matrix influence, land cover types are calculated as a percentage of the total area within 3 km from the edge of each

habitat patch. For the purposes of this calculation, there are three categories of land cover: natural, agricultural and urban. Each type of land cover receives a base value of 1, 0 or -1 on the gradient of influence. Natural cover surrounding a patch is considered to have a positive influence and therefore receives a value of "1". Included in this category are patches of the major habitat types (forest, meadows, wetlands, beach/bluff) as well as natural open water communities in the form of lakes, rivers and ponds. Agricultural lands can have a negative impact such as pesticide runoff, but they also allow for movement of species between patches and across the landscape, in particular for amphibian movement between forests and wetlands. As a result agricultural lands score "0". Urban land uses do not provide a connectivity function for many species. In fact, due to pollution, refuse increased recreational pressures, the presence of domestic animals and invasive species, urban areas in general can be considered harmful to natural habitats. Urban areas receive a base point of "-1"

The percent of each of the land cover types is measured within the 3 km matrix and each is multiplied by the base point value. From a biodiversity conservation perspective, the perfect patch surroundings would be 100% natural (e.g. wetland within and extensive forest patch, measuring at least 3 km out from the wetland edge) and would receive the highest possible matrix score of 100. The lowest possible score of -100 would come from a natural habitat patch immersed within an expanse of developed urban land.

Table 3: Scoring for size, shape and matrix influence of habitat patches

Score	Size (ha) Forests and Meadows	Size (ha) Wetlands and Beach/Bluff	Shape (P/A)	Matrix
1	> 0	< 1	>= 500	-100 to -60
2	>= 2	>= 1	>= 300	< -20
3	>= 10	>= 3	>= 200	-20 to 20
4	>= 50	>= 10	>= 125	> 20
5	>= 250	>= 20	>= 100	60 - 100

Total Score

Total score is calculated through a weighted average of the scores for size, shape and matrix influence. This total score is used as a surrogate for the 'quality' of a habitat patch. Of the three scored criteria, size is the single most important patch attribute. Large patches are more likely to maintain their functional integrity and negative edge effects (related to shape and matrix influence) tend to have less influence on large habitat patches that generally support more interior habitat. The most important characteristic of a habitat patch for biodiversity is its size (Kilgour, 2003), which relates to the amount of space required for species to find resources and remain in viable populations. The second factor is matrix influence. Shape is also a factor in determining the quality of a habitat patch, but to a lesser degree. As a result, when adding size, shape and matrix influence together for a total landscape score, the size criteria is given an additional weighting on a sliding scale from small to large patches. Thus for a small habitat patch, each landscape criterion

(size, shape, matrix influence) may have relatively equal weighting and the size score may be weighted more than shape and matrix influence for a larger patch. Forest, meadow and beach/bluff habitats are treated separately from wetlands as previously explained.

Note: a multiplier of 3 is used in the calculation of Total Score. For example, a forest patch with the following scores:

size=5, shape=3 and matrix=4

With the assumption that the patch is 250 ha (see tables 3 and 4), the following equation would be used to calculate total score:

5(50%)*3 +3(25%)*3 + 4(25%)*3 = 13.25

Table 4: Weighting system for total score in forest, meadow and beach/bluff habitats

Size (ha)	% Size	% Shape	% matrix
> 0	40	30	30
>= 10	45	27.5	27.5
>= 250	50	25	25
>= 500	55	22.5	22.5
>= 1000	65	17.5	17.5
>= 2000	75	12.5	12.5

Table 5: Weighting system for total score in wetland habitats

Size (ha)	% Size	% Shape	% Matrix
>= 1	33.3	33.3	33.3
>=3	40	30	30
>=10	45	27.5	27.5
>=20	50	25	25

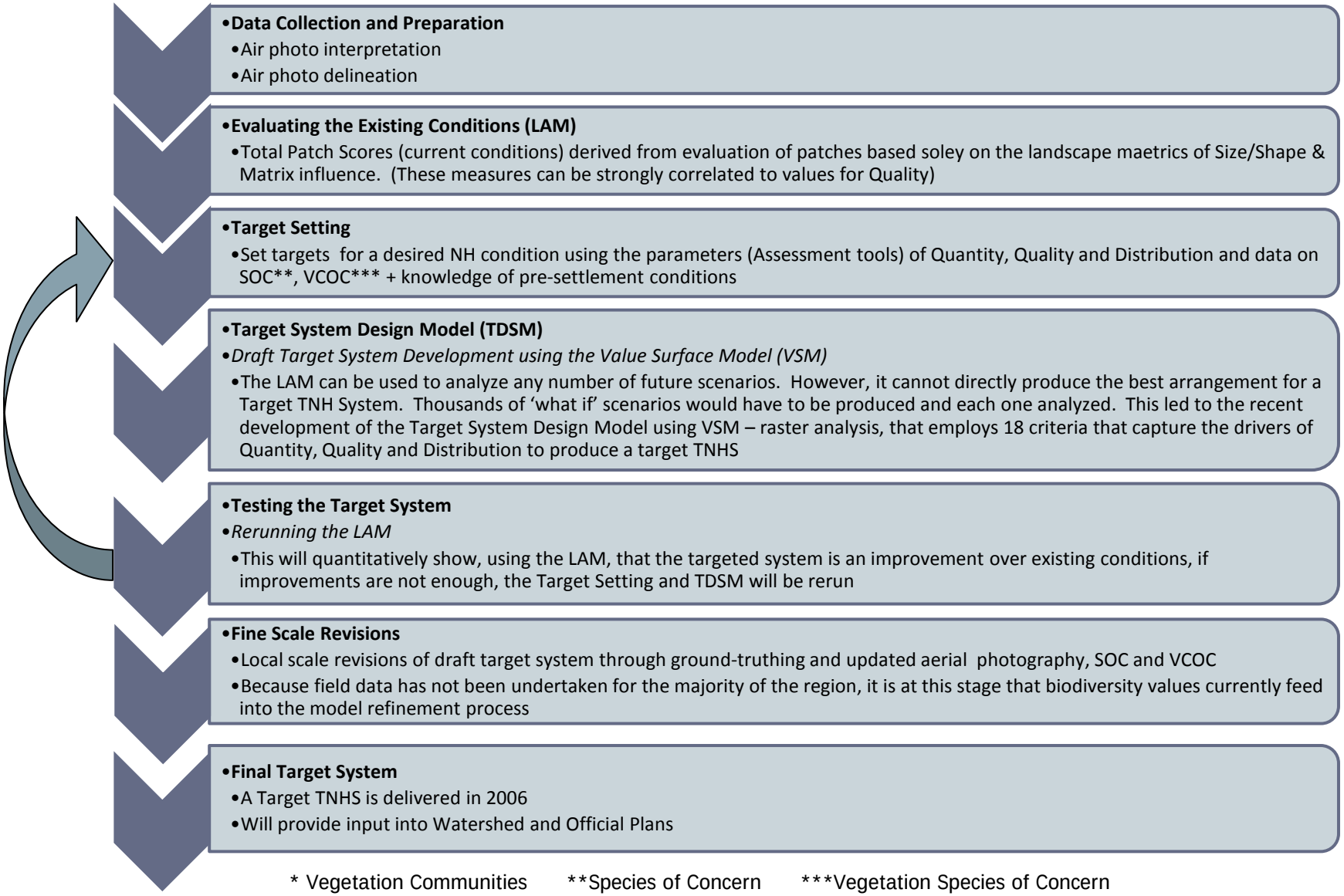
Each of the total weighted scores for landscape are then translated into individual patch ranks (Local Ranks) based on the range of possible total scores from 0-15 points. L1 is the highest local rank and L5 the lowest (see Table 6)

Table 6: Habitat patch total score ranking system (size, shape and matrix influence)

Score	Rank	Patch Colour	'Quality' Condition
13-15	L1	Dark Green	Excellent
11-12	L2	Light Green	Good
9-10	L3	Orange	Fair
6-8	L4	Beige	Poor
0-5	L5	Brown	Very Poor

Part 2.2: Developing a Target System

Figure 1: How the Target Terrestrial Natural Heritage System is Developed



* Vegetation Communities **Species of Concern ***Vegetation Species of Concern

Target Setting

When evaluated according to the methodology described previously, the average quality of the habitat patches in the CLOCA jurisdiction is used to input into the overall target system. Modeling of the trends in land use changes show that even if the same quantity of natural cover was retained through the land use planning process, a degradation of overall quality would result. In order to prevent impacts on biodiversity and ecosystem services and redress some of the past decisions on the landscape the methodology further evolves from landscape analysis into target setting.

Contextualizing the Targeted System

Since European settlement, the bulk of changes to natural cover in the landscape have been the following:

- Quantity – the amount of natural cover
- Quality – the average size and shape of individual patches and the land use matrix that surrounds them
- Distribution – the allocation of natural cover across the landscape

These are the three parameters used to assess and compare past, present and predicted conditions and to set targets. The process of setting targets for a desired terrestrial natural heritage system in the CLOCA jurisdiction requires an understanding of:

1. Historical changes in the landscape and the gradual gains and losses in natural cover over time;
2. Likely future gains and losses based on history and trends;
3. Constraints and opportunities that resulted from past decisions and
4. Potential for the future, including the gains that are desired and the losses that are acceptable.

Targeted Terrestrial Natural Heritage System

The TTNHS is one configuration of natural cover that would achieve the targets set for quality, quantity and distribution across the landscape. Although a vision for the future and a tool for land use planning, this TTNHS is influenced by past trends and decisions. The target of 30% forest cover is based on AOC guidelines (Environment Canada, Ontario Ministry of Natural Resources and Ontario Ministry of Environment 1998, 2004) The rationale for determining desirable gains and acceptable losses in natural cover and for targeting a TNH system in 'good condition' is as follows:

That the condition be above the threshold of crisis management (which is fair condition or patches ranking L3 or better as determined by the LAM);

1. To increase overall species biodiversity across the landscape (Kilgor, 2003);
2. To be locally self-reliant for recreational opportunities and some natural resources;
3. To support air and water management and climate regulation through natural means;
4. To boost aesthetic value for cities/communities and
5. To accommodate the principles of smart growth

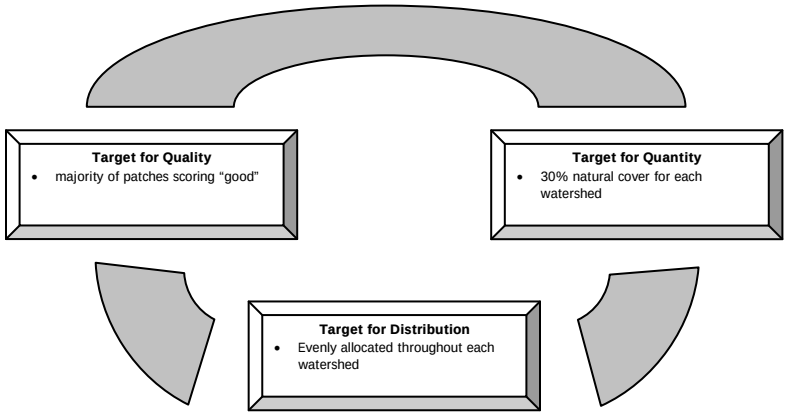
The Target Setting Process

Determining the desirable condition of the TTNHS is done by setting natural cover targets for each of quality, distribution and quantity and then in an iterative manner, use quantity targets to determine the best possible balance between all three targets (Figure 2).

Figure 2: Iterative target setting process

CLOCA has determined the following for the target setting process:

- The majority of the habitat patches are scoring "good"
- The target for distribution is evenly allocated
- The target for quantity is 30% natural cover in each watershed



Quality

Definition: the quality target is such that on average, patches are of a high enough quality to provide natural system functions that will support the defined species and communities of conservation concern.

Target: The average quality condition of natural cover across the CLOCA jurisdiction that would be needed to support species of conservation concern would be higher functioning, at a "good" or L2 ranking, as determined by landscape analysis (Kilgor, 2003)

Rationale: The quality target is determined through scenario development using the landscape analysis model. Achieving the target will improve system quality sufficiently to offset impacts from further urban growth and intensification. The target expectantly falls short of pre-settlement quality which will be unattainable in some urban watersheds in any case, but it far exceeds the quality likely to result if current approaches continue.

Distribution

Definition: The distribution target describes ideal spatial arrangement of natural cover throughout the landscape. Distribution is measured qualitatively by examining the configuration of natural cover across the landscape.

Target: An improvement (i.e. more even distribution of natural cover) and/or maintenance of current status quo. An even distribution of natural cover in the CLOCA jurisdiction is unachievable.

Rationale: Past land use changes have made dramatic changes to the distribution natural cover. Natural cover distribution will continue to be weighted to the northern undeveloped areas of the watersheds. Ideally, natural cover would be distributed evenly throughout the landscape; however, natural cover must be clumped in order to achieve patches of sufficient size to function at high levels. In addition, clumping habitat in some areas means that other areas will have little or no habitat.

As the second step in the iterative target setting process, setting distribution targets requires a balance between clumping natural cover for quality purposes and distributing natural cover (and the ecosystem services associated with natural cover) evenly throughout the landscape. It is recognized that an even distribution target may not be achievable in a landscape with constraints due to existing development patterns.

Quantity

Definition: The amount of natural cover in the landscape

Target: The amount of natural cover necessary to achieve the desired quality and distribution of natural cover in the study area at 30% natural cover.

Rationale: The amount of natural cover in the landscape is determined by the amount of cover needed to achieve quality and distribution targets. This is instead of the more common, but reverse way of thinking, where a quantity target is determined and quality and distribution targets are simply the result of that decision. It has been determined that in order to achieve good quality and distribution across the CLOCA jurisdiction, that a target of 30% natural cover is applied across CLOCA's jurisdiction.

Target System Design Model

Once the targets have been determined based on present conditions and on the trends of landscape responses to past land use decisions, the next task is to design a TTNHS that achieves the targets.

Not necessarily all existing natural cover will be included in the targeted system (i.e. very small and isolated existing patches, hedgerows,etc.), conversely land will be selected for restoration that currently does not support natural features. This is an important concept of the target system design process as it is aimed at working with existing land development patterns with the goal to promote viable populations of regional species of concern and improved biodiversity.

Value Surface Approach

The landscape analysis gives an assessment of the quality of existing conditions and this can be compared to the targets set for quality and distribution. But when it comes to reconfiguring or increasing the natural cover, the landscape analysis methodology cannot automatically determine the best location for restoration or protection of natural cover. A different technology, based on raster GIS is used to show the protection and restoration values of the entire landscape.

Expansion of the System

Defining the TTNHS involves dividing the entire landscape into a grid of cells or "pixels". In this case the pixels are 10 x10 m in size. This

provides a high level of detail and ensures that small habitat patches, particularly wetlands are well represented.

Each of the pixels is assigned a number of criteria. These criteria were developed to closely match the objectives of the targets and to benefit from current protection mechanisms and policies. Therefore both Landscape and Social/Political criteria were selected (Table 7). Refer to the Appendix (Table i) for the scoring system used for each criteria layer.

These criteria layers are overlain and the sum of the scores for each cell for each criterion provides a range of cell values across the landscape that increase in value as values for protection or restoration increase. Several assumptions were built into this process that limit where restoration and protection can take place based on prior experiences within the CLOCA jurisdiction (see Table 8). It must be noted that these assumptions in no way diminish the importance of the areas affected and CLOCA will assess the importance of these areas on a site by site basis through the development review process and through Conservation Area management programs, where applicable.

Table 7: Input Layers for Target System

Landscape Criteria	Social/Political Criteria
Total Quality Score (LAM) *	Provincially Significant Wetlands (PSW)
Distance From Urban Areas	Areas or Natural and Scientific Interest (ANSI)
Proximity to Natural Areas	Environmentally Sensitive Areas (ESA)
Distance From Roads	Generic Regulation Areas
Interior Forest	CLOCA Properties
Proximity of a Forest to a Wetland	Area
Proximity of a Wetland to a Forest	Greenbelt Plan Area
Proximity to a Water body	
Distribution *	

Note:

1. Existing natural cover included in the analysis includes Forest and Wetland cover only.
2. A description of each layer and why it was selected is available in the Appendix
3. *Landscape analysis polygons converted to pixel, thus giving a score to pixels falling within existing habitat boundaries only.

Table 8: Assumptions built into the value system analysis process

Assumption #1	For existing urban areas: i) Expansion of the existing TTNHS cannot occur into an already developed area. ii) All existing habitat identified within the urban boundary are included in the final system, regardless of scores.
Assumption #2	For urbanizing areas: For urbanizing areas (areas where planning has occurred, but development of the area may or may not be completed): i) Expansion of the system cannot occur into areas slated for future development under an approved official plan or secondary plan regardless of the pixels individual scores. ii) The only habitat that will remain in urbanizing areas will be associated with areas that have existing protection policies (i.e. PSW, ANSI, ESA, EP, CLOCA Property and floodplain). There may be

	opportunity to build upon existing remaining habitats through the site specific plan review process.
Assumption #3	Only existing forest and wetland patches were used in the raster analysis. Old field meadow habitat was assumed to be as easy to restore as agricultural fields.

A Different Approach

Rather than selecting high value existing areas to be protected, this approach examines the full range of values and selects those areas needed for reaching targets for quality and distribution. This means that some areas where there is no existing cover, but high potential for restoration, may score higher than some areas with existing cover.

The model is focused on forest restoration because forest was the dominant historical cover in the region and the natural tendency of succession over most of the landscape is toward a forest community. However, because it is preferable to maintain a landscape mosaic that also includes a diversity of communities and associated species, site conditions and the potential to support specific community types must be investigated before any restoration work is considered. Conversely, site level investigations are also required before any existing habitat is removed.

The methodology described above automatically and uniformly depicts the range of restoration and protection opportunities and/or priorities across the entire surface area of the CLOCA jurisdiction. The next step is to select the appropriate pixels that together as a system fulfill the quantity, quality and distribution targets most efficiently.

Results – Mapping the TTNHS

The next stage in the process of developing a TTNHS is to decide where to draw the line around the TTNHS. Because the goal is to improve the quality and distribution of the natural cover in the landscape to allow for viable populations of regional species of concern, the boundary is driven by a target for quality (size, shape and matrix influence) and distribution of natural cover; however, the model does not need a percent cover as an initial input. CLOCA has applied the 30% target based on the work presented in the Great Lakes Remedial Action Plan. That indicates that areas falling into this area of concern should target for a minimum of 30% forest cover in all watersheds. (Environment Canada, Ontario Ministry of Natural Resources and Ontario Ministry of Environment 1998, 2004). This percentage of cover is further supported in the scientific literature (see Andren, 1994; Fahrig 1997, 1999, 2001, 2002; Lee et al. 2002b; Villard et al. 1999). Therefore the line is initially drawn around the 30% highest scoring pixels and included within the target system.

To direct the mapping of the TTNHS three components – the target setting process, system design and landscape analysis – come together for mapping the TTNHS. This process begins with the target setting process that sets quality, distribution and quantity targets, then uses the system design model (GIS) to automatically select the best locations for restoration and protection, then evaluates the results for quality and distribution and finally revisits the targets to determine if the targets have been achieved. The final result of setting the best possible targets for quality, distribution and quantity in a real landscape is described below.

Quality

As earlier described, the first consideration of the process is the quality of the system, which is targeted to be of 'good' quality (11-12 range for 'total score' in the LAM) so that on average, patches are of a high enough quality to provide natural system functions that will support viable populations of regional species of concern (Kilgor, 2003). As described above, an amount of natural cover is needed as an initial input to the process and 30% natural cover is chosen as the input. When analyzed for quality, it was determined that the average patch quality is within the targeted range. Had the quality been below the target, then a new scenario using more than 30% would have been created.

Distribution

The next consideration in the target setting process is distribution. Due to obvious constraints in expanding the TNHS is the southern, primarily urban portion of the landscape, distribution of natural cover in the TNHS is concentrated in the northern areas of the individual CLOCA watersheds. This is assessed through the visual inspection of the configuration of natural cover and by overlaying a grid over both the existing system and the resulting target system map and calculating the differences in percent cover per grid.

Quantity

The quantity target is the result of striving for a desired quality and distribution, as opposed to driving the process. The minimum target for quantity is roughly 30% across the CLOCA jurisdiction. This amount of natural cover achieves targets for quality (movement of L3 patches to L2 patches) and due to real constraints in the urban areas, increasing the amount of cover beyond this amount will not lead to improvements in distribution as determined by the methodologies presented here. Improved science and detailed planning studies at a local scale may result in refinements to this target.

Part 3– Manual Edits

Once the TTNHS is completed and layered on the FNHS, the manual edit process is initiated. In order to complete a connected NHS scenario, some clean-up or manual edits must be done. This non-automated process is undertaken by experienced Natural Heritage staff in a group setting.

A large map of the watershed in question is produced with the FNHS and the TTNHS overlain. This paper map is used to manually track the changes made, both deletions and additions to target area. Further, two GIS projects were developed to track the edits. The first project documents all the target areas removed and the second documents all target areas added. Through the manual edit process, ideally removals should be nearly equal to additions to keep overall target consistent with the model. Once the rough edits are made to the project, they are forwarded to GIS for clean-up and recalculation.

In addition to the final tweaking of the FNHS and TTNHS, a CLOCA properties map is overlain to ensure that all CLOCA owned lands are protected through the NHS. These lands are fully protected from future development and are part of the NHS. CLOCA is committed to the protection of public lands.

The edits themselves consist of the following:

Removals:

- Many of the small unconnected hedgerows within the FNHS,
- Stand alone "islands" that cannot be reasonably connected to the system, although, still protected through policy,
- Target area extensions of existing natural cover that make for highly irregular shape and
- Excess Target area within the developable areas that is unlikely to be achieved.

Additions:

- Connecting areas intuitively within the ORM or Greenbelt Plan areas,
- Filling in existing gaps "donut holes" where they exist without constraints,
- To create better shape to area ratios and
- Connecting headwater areas where they exist in close proximity without constraints
- Addition of CLOCA properties mapping

Once the final GIS calculations are attained, a map of the NHS is produced.

NEXT STEPS

CLOCA is committed to working with its partners and stakeholders to fine-tune and determine the ideal Natural Heritage System for the area, making use of existing opportunities and ongoing efforts to protect natural system functions. This includes ensuring:

- That the municipal official plans and policies are keeping with the intent of the protection of the NHS and its components.
- That all known patches that support populations of endangered and threatened and species of special concern are included in the NHS.
- That all patches that received high size and shape scores (L1-L3) are captured as part of the system.
- That all known opportunities to achieve the targets in existing urban and urbanizing areas are not lost.
- That the requirements of the ORM Conservation Plan (MMAH, 2002), and the Greenbelt Plan (MMAH, 2005) are met.

Implementation of the NHS

The goal is to have the NHS principles, landscape targets and the mapped system reflected in municipal/regional official plans and policies of CLOCA and its partners. The targets will be used as a tool in watershed plans and may help to guide acquisition programs in some cases. It will further focus public restoration efforts to where they can be most effective and potentially guide private land stewardship initiatives. Rather than becoming a fixed line on a map, the NHS will be flexible to allow for regional targets to be met at the site level even as land use change proposals are introduced.

Acknowledgements

CLOCA thanks Toronto and Region Conservation Authority for the work that went into the development of the TTNHS and for taking the time to meet with staff and share their product.

APPENDIX

Natural Cover

Area of land occupied by naturally and culturally occurring vegetation that is not characterized as agriculture or urban land uses. It could be dominated by native and non-native vegetation and does not include manicured areas such as parkland. Existing natural cover consists of lands that are existing forest (including thicket), wetland, meadow and beach/bluff patches as defined by ELC. Potential natural cover are lands that are currently void of existing natural cover, but are needed to achieve CLOCA's targets for the development of the TTNHS.

Forest

Forest is a term frequently used, but seldom defined. For the CLOCA system, forest is defined as a "natural habitat dominated by trees" established by means of either self perpetuation or by active reforestation. The First Approximation of the Ecological Land Classification (ELC) System (Lee, et al., 1998) considers forest habitat to be terrestrial vegetation community with at least 60% tree cover. The ELC system distinguishes between "cultural" plantations and natural deciduous, coniferous or mixed forest and suggests a minimum forest patch or polygon size of 0.5 ha, based on 1:10 000 aerial photos. For the landscape analysis, minimum forest patch size has been set at 0.5 ha, although smaller patches may be mapped because digital aerial photography allows for further refinement at a larger scale.

A natural forest typically features several layers, including the canopy, understory and herbaceous layer as well as dead standing trees and fallen woody debris. By this definition, treed lawns, cemeteries, backyards, etc., do not have forest structure and are therefore not considered as a functioning forest, despite providing a variety of ecological and environmental benefits. By contrast, plantations which usually display basic forest structure are not natural forest, although they still provide some forest functions. Depending on how they are managed, their composition and structure can improve over time, especially when native tree or herbaceous species regenerate under the planted canopy and start to form an understorey. Where they are adjacent to forests, plantations contribute to the increase of the total forest area and the amount of interior habitat.

For the landscape analysis of forest habitat patches, forest plantations, successional growth, the three major forest types defined in the ELC system (coniferous, deciduous and mixed) and swamp forests have been combined and treated as forest polygons. Including successional growth in the forest category for the evaluation, means that polygons with less than 60% tree cover are also included (i.e. savannah, woodland or successional lands end up being considered forest). Tree-dominated swamps are mapped and evaluated as forest, rather than wetland, in part, because they are difficult to discern through aerial photo interpretation and because they provide many wildlife values associated with forest (e.g. forest interior conditions). When considering total landscape area covered by habitat type, successional growth patches are considered as a separate category, as it is important to know the difference between what is already forest and what will become forest if left alone.

Wetland

Wetlands include shallow marsh, meadow marsh, shallow aquatic systems, swamps, bogs and fens. Aquatic and wetland sites where water is known to be 2 m or less in depth are considered to be marsh or shallow water, according to the MNR wetland and ELC definitions. Where water depth is thought to be deeper than 2 m or unknown, only the perimeter marsh vegetation is mapped as wetland and the remaining area, if large enough is classified as open water. Meadow marsh is often indistinguishable from ordinary meadow on aerial photographs and cannot always be accurately mapped as wetland unless a wet meadow is known to exist there. Swamp communities are dominated either by shrubs or trees. Thicket swamps are easier to discern than treed swamps when remotely sensed and are usually mapped as wetland polygons.

No limit was set on the size of a wetland for it to be mapped, since they often naturally occur as small pockets in the landscape. If a wetland habitat is discernable at a scale of 1:3000, it is mapped.

Meadow

"Meadow" generally refers to old field habitat, fallow field, pasture or open areas that are mowed occasionally, such as highway and transmission corridors. Native tallgrass prairie, open sand barren and sometimes meadow marsh are also considered as "meadow" in the landscape analysis because these are difficult to distinguish from old field through air photo interpretation. Old fields are considered to have high restoration potential for native vegetation communities.

As with forest, the minimum size for meadow to be included and mapped as habitat was set at 0.5 ha, although again, smaller patches may warrant inclusion and be mapped due to some of the unique habitats that fall under meadow category.

Beach/Bluff

This category includes natural barren coastal habitats that do not correspond to any of the other major habitat type categories. It includes natural beach, coastal dunes and bluffs.

No limit was set on the size of beach/bluff communities to be mapped, since they often naturally occur as small features in the landscape. If a beach/bluff is discernable at a scale of 1:3000, it is mapped.

Agriculture

Agricultural lands include croplands, fruit tree plantations (orchards) and pastures. Agricultural lands are considered to have potential for forest restoration (recognizing that the constraints analysis may indicate that much of this area is not available).

Urban

For the purpose of the landscape evaluation "urban" areas are considered to be any part of the landscape that has been modified for a human use other than agriculture. This includes residential, commercial and industrial land. It also includes manicured areas such as cemeteries, golf courses and parklands because the intensity of management and use of these areas is considered to have many potential negative impacts on nearby natural areas. In some cases,

manicured parks within the urban areas may be analyzed as having restoration/naturalization potential.

Table i): Targeted Terrestrial Natural Heritage System – Value Surface Criteria

Criteria LANDSCAPE CRITERIA	Rationale	Value Range (distance in m)		Potential to expand Quantity of Natural Cover
Patch Quality – Total Scores (LAM)	This criterion makes use of the quality or total scores assigned to every patch in the jurisdiction (the weighted addition of the individual patch scores for size, shape and matrix influence). Total scores are translated from the raw vector score (scored on a scale of 1-15) to a raw raster shape score (on a scale of 1-10). This criterion assumes that the higher the total score is for a particular habitat patch, the more valuable it is for the target system. The maximum value of 10 points is associated with the highest total score values	Raw Score 0-1.5 1.5-3 3-4.5 4.5-6 6-7.5 7.5-9 9-10.5 10.5-12 12-13.5 13.5-15	Total Score 1 2 3 4 5 6 7 8 9 10	No Addresses existing conditions only. Will protect existing patches with higher shape total (size, shape and matrix influence scores).
Distance from urban areas	This criterion is related to “matrix influence” in that it assumes that the further away a natural area is from an existing urban area, the better. The maximum value of 10 points is associated with distances of 2 km or more, this number being the distance considered in the landscape measure for matrix influence, which in turn was based on a rough estimate of how far certain	Distance (m) 0-10 11-30	Score 1 2	Yes Shows preference for areas that are far from urbanization targeting the more rural areas for an increase in natural cover; if cover is increased in the areas, matrix influence will be improved in

	negative impacts (i.e. urban faunal predators, human visitors and their pets) can move in a landscape, the benefits of having additional natural cover within 2 km of an existing patch for biodiversity and how far most visitors are likely to go in order to use a local natural area on a frequent basis, e.g. daily.	31-60 61-120 121-200 201-300 301-500 501-1000 1001-2000 2000+	3 4 5 6 7 8 9 10	areas where new habitat is added and the biodiversity will benefit from this as well. Distribution of habitat will be influenced in a negative way, pulling more natural cover to the north and away from urban fringe.
Proximity to natural areas	This measures the proximity of natural habitat patches, up to a distance of 3 km. Like the former layer, this is also essentially a matrix measure, although this one assumes that nearby natural areas are beneficial to a habitat patch. The ways in which they can be beneficial are numerous, including support of a breeding pair or a population because of close access to additional resources, provision of pollination services and seed sources, etc. (Austen et al., 2001; Norris & Stutchbury, 2001; Askins et. al., 1987; Robbins et. al., 1989). Natural areas within the study area which are very close to each other (0 to 10 m) score the maximum of 10 while areas more than 2 km away from each other receive a score of 1	Distance 0-10 11-30 31-60 61-120 121-200 201-300 301-500 501-1000 1001-2000 2001+	Score 10 9 8 7 6 5 4 3 2 1	Yes Shows preference for areas that are in close proximity to or connected to other natural patches; this criterion will mainly serve at improving the matrix influence of a patch, and potentially the size, shape and connectivity of patches may also be improved. This criterion will also affect the distribution of natural cover by encouraging more habitat to be built up in areas where existing natural cover is high, in the northern, more rural areas.
Distance from roads	Roads area negative influence on terrestrial natural heritage. As a result of pollutant run-off, noise, etc., as well as acting as barriers to the movement of many species for example, those	Distance 0-100	Score 1	Yes Values areas far from roads; will improve the distribution of natural cover CLOCA jurisdiction

	which refuse to cross open areas due to the threat of exposure due to desiccation, predation, etc. (Fahrig et al.,1995). All roads outside of the urban fringe are used for this criterion (roads within the urban matrix are considered to have the same negative influence as the urban area itself). Areas that are 1 km or more away from a road receive a score of 10 for this layer.	101-200 201-300 301-400 401-500 501-600 601-700 701-800 801-900 901+	2 3 4 5 6 7 8 9 10	due to the grid network of roads. The shape of habitat patches will also be improved through rounding out or squaring of patches farther from network of roads.
Interior Forest	Core habitats or interior forest habitat (defined as areas greater than 100 m from the forest edge) are important, as many species will find difficulties in areas that are near the edge, due to the effects listed above. For this reason, existing interior forest is highly valued and it is given a score of 10 points. Also, all forest 100 m moving back out from the interior forest boundary is given maximum points. The reason for this is because interior forest would not exist if the surrounding 100 m "buffer" of forest is not maintained. This will promote better patch shapes (for patches with interior forest) by not valuing linear convolutions or appendages that do not contribute to interior forest on larger patches.	Distance from edge 100+ Distance back out from 100 m forest interior line 100-0	Score 10 Score 10	No Addresses existing interior forest only. Will protect existing cover only.
Proximity of a wetland to a forest	This layer takes into consideration the need for species to have close proximity of wetlands to forests to provide summer, spring and winter habitat. Wetland habitat that is in close proximity to	Distance 0-10	Score 10	No Addresses existing forest and wetland cover only.

	forest habitat is a given a maximum score of 10 points. The value breakdown goes from immediate adjacency (given a maximum score of 10) to a distance greater than 2 km (score of 0). This distance of 2 km is both the distance used for the matrix influence and the approximate width of concession blocks, where roads break connectivity for these species. Species requiring or benefiting from the close proximity of wetlands and forests include: amphibians such as spring peepers, wood frogs, gray treefrogs, eastern newts, spotted and blue spotted salamanders; reptiles such as garter and ribbon snakes; birds such as wood ducks, hooded mergansers, broad-winged hawks, barred owls, screech owls, Acadian flycatchers, Eastern phoebes, and mourning warblers; mammals such as beavers raccoons, white-tailed deer and eastern chipmunks.	10.1-30 30.1-60 60.1-120 120.1-200 200.1-300 300.1-500 500.1-1000 1000.1-2000 2000.1+	9 8 7 6 5 4 3 2 1	Will protect existing cover only
Proximity of a forest to a wetland	This layer is the inverse of the previous, valuing forest immediately adjacent to wetlands (and out 10 m) with a maximum score of 10. The value breakdown is the same as the above layer. (Gibbs, 1998a, 1998b; Pope et al., 2000; Lamoureux et al., 1999; Guerry and Hunter, 2002; Lehtinen et al., 1999).	Distance 0-10 10.1-30 30.1-60 60.1-120 120.1-200 200.1-300 300.1-500 500.1-1000 1000.1-2000 2000.1+	Score 10 9 8 7 6 5 4 3 2 1	No Addresses existing forest and wetland cover only. Will protect existing cover only.
Proximity to a water feature (within	There is value to being in proximity to a water feature (watercourse, water body). Water bodies include lakes and	Distance to Feature	Score	Yes

Ontario regulation 42/06)	ponds of all sizes and any open water or wetland system, not including swamp forests (see below). Some positive influences of riparian or water features on terrestrial systems are; nutrient exchange, source of drinking water, breeding areas and the connectivity function provided by valleys and the influence extends beyond the riparian areas and onto tablelands. The nature of this influence changes within this area but at the scale we are working at, it is difficult to be more precise and tease out the different positive influences of riparian on terrestrial. Therefore, all areas that were determined to be within or in proximity to water features were given maximum points. Proximity to a water feature was based on distance to those lands regulated by CLOCA under Ontario Regulation 42/06.	Within limit 0-30 10 >30-200 10 9-1 (even breaks) 0 >=200	Values areas within generic regulation limit and 30 m beyond. Will affect natural cover distribution in a negative way due to the greater abundance of watercourses in the headwater areas to the north in the CLOCA jurisdiction. This criterion will also improve matrix influence, patch size and connectivity around watercourses.
SOCICIAL/POLITICAL CRITERIA			
PSWs & LSWs	This layer addresses the opportunities where expansion of the TNHS can and might be possible due to the presence of a PSW or LSW. A PSW provides some means of protection to the landscape due to current provincial policies and this 'protection' currently extends beyond the PSW feature out to 120 m. According to the Natural Heritage Reference Manual for Section 2.1.3 of the PPS, development applications within a PSW will not be allowed. Development applications on adjacent lands of a PSW must demonstrate that there will be no negative impact on the feature or its function. LSWs can be afforded protection through local planning authorities.	Distance Score Within feature 10 0-120 8 120+ 0	Yes Awards protection for existing PSWs and shows preference for lands within 120 m of the feature to build up on existing cover. Matrix influence in the vicinity of PSWs will be improved.
ANSI	This layer addresses the opportunities where expansion of the existing TNHS might be possible due to the presence of an ANSI. An ANSI provides some means of protection to the landscape due to current policies. Development and site alteration within an ANSI is not permitted unless it can be demonstrated that there will be no negative impact on the feature and its function. For this criteria, all ANSIs (Provincial, Regional and Candidate are considered)	Distance Score Within feature 10 0-10 8 10+ 0	Yes Awards protection for existing ANSIs and shows preference for lands within 10 m of the feature to build up upon existing cover. Many of the ANSIs within the CLOCA jurisdiction are also PSWs. Size, shape and matrix influence in the vicinity of ANSIs will be improved.

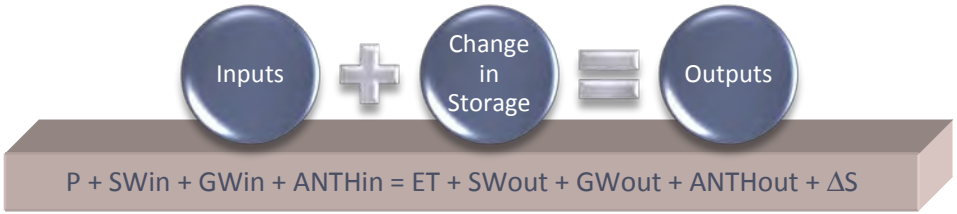
ESA	This layer addresses the opportunities where expansion of the existing TNHS can and might be possible due to the presence of an ESA. An ESA provides some means of protection to the landscape due to current local policies. Development applications within and ESA must demonstrate through and EIS that there will be no negative impact on the feature or its function.	Distance Within feature 0-10 10+	Score 10 8 0	Yes Awards protection for existing ESAs and shows preference for lands within 10 m of the feature to build up on existing cover. Size, shape and matrix influence in the vicinity of ESAs will be improved.
Generic Regulation Areas	This layer addresses opportunities where expansion of the existing TNHS might be possible due to the influence that CLOCA has in this area.	Distance Within Reg. Limit Outside Reg. limit	Score 10 0	Yes Shows a preference for areas within 10 m of the CLOCA Regulation line to build up on existing cover. Size of patches and matrix influence in the vicinity will be improved. In some cases shape will be affected in a negative way because of long linear valley systems (unfavourable shape).
CLOCA property	This layer addresses the opportunities where expansion of the existing TNHS is possible due to public ownership and the CA mandate to manage its lands according to Natural Heritage principles.	Distance Within feature Outside feature	Score 10 0	Yes Shows preference for CLOCA owned lands to build upon existing cover. Size, shape and matrix influence in the vicinity of CLOCA owned property will be improved.
ORM	This layer addresses the opportunities where expansion of the existing THNS is possible due to the ORMCP	Designation Core Corridor Countryside area	Score 10 9 5	Yes Shows a preference for lands classified as Core and Corridor areas in the ORMCP to build upon existing cover. This criterion will affect distribution in a negative way due to geographical location of the ORM in the CLOCA jurisdiction. Size, shape and matrix influence on and in the vicinity of the ORM will be improved.
Greenbelt	This layer addresses the opportunities where expansion of the existing TNHS might be possible due to the influence of the Greenbelt Plan in areas outside of the ORMCP.	Designation Within plan area (outside of ORMCP)	Score 5	Yes Shows a preference for lands within the greenbelt designation, to build upon existing cover. Size, shape and matrix influence within the Greenbelt area may be improved.

APPENDIX C: WATER COMPONENTS OF THE WATERSHED PLAN

WATER BUDGET

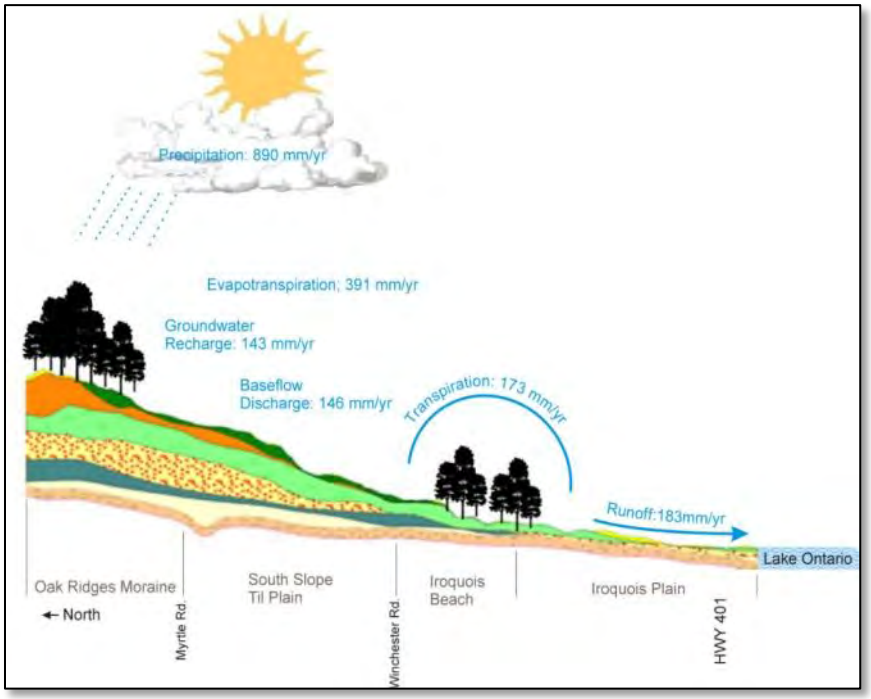
A water budget quantifies the major components of the hydrologic cycle and estimates the amount of water and where the water is within the watershed. It determines the water inputs, outputs and changes in storage. **Figure 1** demonstrates that the general water budget may be expressed as an equation with water inputs to the watershed equaling water outputs plus the change in water storage (as per the Ministry of Environment's Technical Paper #9 of the Oak Ridges Moraine Conservation Plan).

Figure 1: Water Budget Equation



Where: *P = precipitation, SWin = surface water flow in, GWin = groundwater flow in, ANTHin = anthropogenic or human inputs such as waste discharges, ET = evaporation and transpiration, SWout = surface water flow out, GWout = groundwater flow out ANTHout = anthropogenic or human removals or abstractions, ΔS = change in storage (surface water, soil moisture, groundwater). Source: (OMOE, 2005b)*

The natural system is extremely complex and the interaction, contribution and importance of water resources within this system have been modeled using the best available information and modeling technology available. The Water Budget has identified High Volume Recharge Areas (HVRAs) and verifies the need to maintain the function of these areas. The Watershed Plan will include recommendations to ensure pre-development recharge rates are maintained where appropriate. The Water Budget work also contributes significantly to the review of Permit To Take Water (PTTW) applications and identifies areas where private well use may be susceptible to supply or stress.



Using the best information available at the time of the Water Budget report, the following key conclusions are applicable to the Lynde Creek Watershed:

- Increased runoff appears to be the most significant consequence of development (in particular decreased stability and health of stream corridors);
- Unless water is somehow introduced into the groundwater reservoirs, aquifer levels will be reduced due to development;
- The recharge function of High Volume Recharge Areas (HVRAs) should be maintained everywhere;
- Preservation of the Natural Heritage System (NHS), maintenance of the recharge function of HVRAs, and stormwater management practices offer the most beneficial solutions for mitigating runoff impacts, providing benefits to water recharge, providing for more habitat, aiding water quality, improving aquatic habitat, and managing sediment supply and channel form; and
- The CLOCA jurisdiction would appear to benefit from increase precipitation and temperature from a water supply standpoint due to climate change predictions.

Water Conservation Plan

Water conservation planning contributes to a sustainable and healthy watershed by recognizing water as a valuable, finite resource to be utilized efficiently, wisely and cost-effectively to sustain a high quality of social, environmental, and economic well being, for the present and the future (MOE, Technical Paper #11, June 2005, page 2).

The development and implementation of water conservation plans and strategies for consumptive use falls under the purview of the Regional Municipality of Durham. The Water Budget work described above provides the science behind how the water systems work so that water supply, flow and capacity issues are addressed. This information is also vitally important for understanding capacity within the system for municipal water usage and supply as the Region operates and maintains the municipal water system and approves new private wells. As a companion to the Water Budget, the water conservation program from the Region is aimed at residents and businesses providing education, water conservation techniques and water conserving programs (like the low flush toilet program). The Region also promotes conscientious water use (turn off the tap when brushing teeth), tips for reducing lawn and garden watering, will advise when water levels are low (summer) and implement rotating schedule for lawn and garden watering, even banning it on occasion.

The watershed plan will offer recommendations for water conservation measures to meet ecosystem needs, including groundwater recharge, baseflow and wetland preservation. The combined work of the Water Budget and the Region's Water Conservation principles satisfies the requirements of the ORMCP.

Source Water Protection

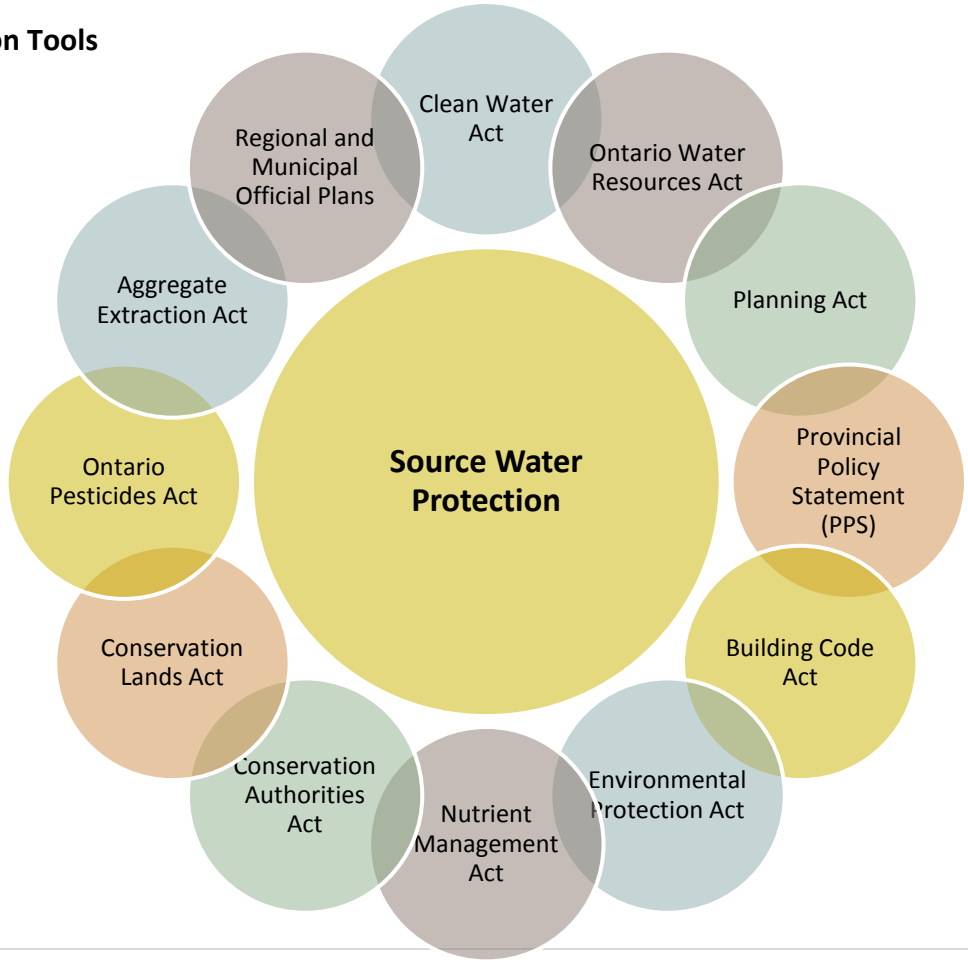
The core legislation for protecting source water is found in The Clean Water Act (CWA). The intent of this legislation is to protect existing and future sources of drinking water. One of the most important parts of the CWA is that it requires source protection committees to develop science-based assessment reports and Source Protection Plans (SPPs) at the local level. CLOCA is part of the CTC (Central Lake Ontario Conservation Authority, Toronto and Region Conservation Authority,

Credit Valley Conservation Authority) Region assigned by the Province as part of the provincial Source Water Protection Plan Program.

A SPP is being developed for the CTC following approval of the assessment report outlining the existing state of our drinking water resources and the identification of threats to its health. The SPP will identify a suite of policies which will protect municipal drinking water sources from existing and future threats. Under the Clean Water Act, local municipalities must ensure their Official Plans conform to the policies of the SPP.

Figure 2 illustrates the applicable legislative and land-use planning tools available to protect drinking water in the CLOCA jurisdiction and each tool will be considered and applied in the SPP and reflected in the Watershed Plan where applicable.

Figure 2: Source Water Protection Tools



APPENDIX D: METHODOLOGY FOR IMPERVIOUSNESS ANALYSIS MODELING

Introduction:

The Region of Durham will continue to experience a rapidly changing landscape through significant increases in population and employment, construction of major infrastructure such as the 407 East Extension, and a recent Regional Official Plan Amendment (ROPA #128) to accommodate designated growth centres of Pickering, Whitby, Ajax, and Oshawa, as per the Growth Plan. With this changing landscape, there will also be a significant increase in imperviousness which, if not wisely managed, can impact the watershed through increased runoff, channel erosion, downstream flooding, stream quality impairment, loss of infiltration and groundwater recharge, and loss of fish and wildlife habitat.

There are a number of studies which indicate that a healthy watershed should not exceed a maximum limit of 10% imperviousness, in order to preserve the health of aquatic ecosystems, water quality and quantity (EC, 2004; MOE, 2007). In addition, the Oak Ridges Moraine Conservation Plan (ORMCP) has provisions for limiting the watershed's imperviousness on the Moraine to 10%. The ORMCP also states (Section 27. (3) that:

'….the approval authority shall consider the importance of,

Ensuring that natural vegetation is maintained, and where possible improved or restored; and

Keeping to a minimum impervious surfaces and their impact on water quality and quantity'

In 2009, Central Lake Ontario Conservation (CLOCA) developed a Geographic Information Systems (GIS) based model to determine the amount of imperviousness based on current and future land cover scenarios of the four major watershed systems that originate from the Oak Ridges Moraine. These watersheds include: Lynde Creek, Oshawa Creek, Black/Harmony/Farewell Creeks, and Bowmanville/Soper Creek.

Future land cover scenarios have been developed to incorporate build-out scenarios using municipal Official Plan and Secondary Plan land use designations, ROPA #128 land use designations, potential whitebelt development, and the approved 407 East Extension route. In addition to the land cover scenarios, watershed management alternatives have also been considered to model the watershed's response to the protection of an Ultimate Natural Heritage System (CLOCA, 2010) and protection of the function of High Volume Recharge Areas (Earthfx, 2008).

The results of the model will help to determine each scenario's capability of meeting the Oak Ridges Moraine Conservation Plan (ORMCP) and watershed imperviousness targets, and will provide the impervious land cover base for the water budget scenario modeling required under ORMCP Technical Paper #10 Water Budgets (MOE, 2007). Additional statistical queries have been conducted to assess

how each scenario compares to the Environment Canada guidelines for natural heritage watershed targets (EC, 2004).

Purpose:

To determine the current and future amount of imperviousness in the ORMCP areas, and assess whether the maximum limit of 10% impervious cover is exceeded.

To provide the land cover classes and impervious values on a watershed and subwatershed basis, for model input information for water budget modeling (Earthfx, 2010).

To provide the land cover classes on a watershed and subwatershed basis for each scenario, in order to assess the amount of natural cover achieved for each scenario and how this amount compares to the natural heritage watershed targets.

Methodology:

The following 8 land cover scenarios were developed, as shown in Table . The steps required to develop these scenarios are outlined below.

Table 1: Current and Future Land Cover Scenarios for Impervious Analysis

Scenario	Name	Description	Rationale
1	Existing Conditions (2008)	Watershed condition that existed in 2008	Baseline for comparison
2a	Full OP Build-out	Future conditions of full development of approved municipal OPs and ROPA #128	Evaluate impact of full OP build-out
2b	Full OP Build-out + UNHS	Scenario 2a + protection of UNHS	Evaluate impact of UNHS
2c	Full OP Build-out + UNHS + HVRA	Scenario 2b + protection of HVRA function	Evaluate impact of UNHS + HVRA
3a	Full OP and Whitebelt Build-out	Scenario 2a + full whitebelt development	Evaluate impact of full OP build-out and whitebelt build-out
3b	Full OP and Whitebelt Build-out + UNHS	Scenario 3a + protection of UNHS	Evaluate impact of UNHS
3c	Full OP and Whitebelt Build-out + UNHS + HVRA	Scenario 3b + protection of HVRA function	Evaluate impact of UNHS + HVRA
3d	Full OP and Whitebelt Build-out – under Climate Change	Scenario 3a under Climate Change conditions	Evaluate impact of climate change

Development of Existing Conditions Land cover Scenario:

Step 1: GIS-based method to calculate existing impervious area

Calculating the level of existing imperviousness within each Oak Ridges Moraine (ORM) watershed was carried out using three main steps:

- reclassification of the Ecological Land Classifications (ELC) categories
- a literature review of land use designation and the associated impervious values; and
- a spatial analysis of imperviousness within the ORM watersheds.

The Oak Ridges Moraine Conservation Plan (ORMCP) technical guidance document #13 (MOE, 2007) recommends three GIS-based methods for calculating the impervious areas within a watershed including random sampling, digitizing and land classification. The method that CLOCA chose to use was a variation of digitizing because it was felt that this method was reliable and required data that was already complete and available. The methodology used to determine the impervious areas is described below.

Impervious surfaces are directly related to land use and thus to obtain values describing this characteristic, the land cover for the area must be known. CLOCA has developed an extensive inventory of the Ecological Land Classification (ELC) and land cover for the watershed. This ELC/land cover data was derived from 2008 colour orthophotos and the ELC categories used were derived from the *Ecological Land Classification for Southern Ontario* (Lee et al. 1998). It is this data set that was used to determine the impervious area for the study area.

A literature review of land use designations and typical impervious values was conducted. Sources such as the Ministry of Transportation Drainage Manual (MTO, 1982) and Visual Otthymo Manual (Greenland, 2002) provide a range of average parameters that are typically used in hydrology applications, but in order to apply the typical values a reclassification of the ELC/land cover values was necessary. The values from the ELC and land cover dataset were assigned a more general classification, referred to as the Hydrology land cover (HydroLU). The ELC/land cover categories that were assigned to the Hydrology land cover categories are shown in Table 2. Table 3 details the compiled values for imperviousness for each land cover classification and associated Hydrology Land cover (HydroLU) coding used by CLOCA.

Table 2: Imperviousness and ELC/land cover classifications.

Hydrology Land Cover	GIS Classification	
	CLOCA Land Cover	ELC
Crop & Improved	Agricultural Facility Crop Field Nursery	
Pasture & Unimproved	Pasture Transportation Greenspace Treed Field (Orchard)	Cultural Meadow Cultural Savannah Cultural Thicket
Urban Residential	Urban Residential	
Rural Residential	Rural Residential	
Industrial & Commercial	Commercial Industrial Institutional Building	

Hydrology Land Cover	GIS Classification	
	CLOCA Land Cover	ELC
Lakes and Wetlands	Stormwater Pond Water Feature	Open Fen Meadow Marsh Shallow Marsh Open Aquatic Submerged shallow aquatic Floating-leaved shallow aquatic Deciduous Swamp Coniferous Swamp Mixed Swamp Thicket Swamp
Woodlot & Forest		Cultural Plantation Cultural Woodland Coniferous Forest Deciduous Forest Mixed Forest
Manicured Green space	Athletic field Golf facility Institutional green space Park Ski hill	
Landfill and Aggregate	Aggregate Landfill	
Transportation & Utility	Transportation Corridor Utility Corridor Utility Transfer Station	

Table 3: Hydrology landcover, HydroLU codes and impervious values

Hydrology Land Cover	HydroLU Codes	Impervious Value
Crop/Improved	CI	0
Pasture/Unimproved	PU	0
Urban Residential	UR	0.45
Rural Residential	RR	0.2
Industrial/Commercial	IC	0.85
Lake/Wetland	LW	0
Woodlot/Forest	WF	0
Manicured Greenspace	MG	0
Landfill/Aggregate	LA	0.5
Transportation/Utility	TU	0.5

Development of Future Land cover Scenarios

Step 2: - Dataset Acquisition and Consolidation

In order to begin building each of the future land cover scenarios, the datasets required for the modeling analysis were identified and obtained, as shown in Table 4.

This data represents the most accurate information available at the time of the analysis. Due to the number of different data sources, a GIS based exercise was performed to ensure that all planning boundaries were matched at the edges.

Table 4: Datasets for Impervious Modeling Analysis

Source	Data
Ministry of Affairs and Housing	Oak Ridges Moraine Boundary
	Greenbelt Boundary
Ministry of Natural Resources	Provincially Significant Wetlands
	Areas of Natural and Scientific Interest
Regional Municipality of Durham	Regional Official Plan Amendment #128
Local Municipalities	Local Official Plans and Secondary Plans
Ministry of Transportation	Highway 407 'Technically Approved Route'
CLOCA	Watershed/Subwatershed Boundaries
	Ecological Land Classification
	Land Cover Classification
	Ultimate Natural Heritage System (CLOCA, 2010)
	High Volume Recharge Area (Earthfx, 2008)
	Floodplain polygon
	Highway 407 buffered polygon

Step 3: Standardization of land use designations within Municipal and Regional Official Plans (OP)

Within the urban boundary, each Municipal and Regional Official Plan land use designation was re-assigned into a HydroLU category, in order to provide a consistent, comparable land cover base and associated impervious values throughout all local jurisdictions (Table 5, Table 6, and Table 7)

Where there was more accurate data available, those data sources were used to supplement the Official Plan (OP) data to depict future build-out scenarios. For example, the approved 407 East Extension Technical route was used in place of the OP transportation designation for the 407 Extension . As well, the HydroLU land cover classification was used to depict existing development outside the urban boundary in place of the general agriculture land use designations.

The OP land use designations that would function to preserve the existing land uses were coded using the existing conditions HydroLU codes. These included the following designations: Open Space and Recreation, Environmental Protection, Greenspace, Community Park, and Waterfront Greenway.

Municipal official plan data for the Town of Whitby was not available in a useable format, at the time of this analysis. As the majority of Whitby is already developed, the existing conditions Hydro LU codes were used to supplement as a base layer and gaps were filled in by applying land use designations from the West Whitby Secondary Plan and Regional Official Plan Amendment #128 (ROPA #128).

Table 5: Converted HydroLU codes for Clarington Official Plan

Hydrology Land Cover	HydroLU Codes	Municipal OP Designation (Clarington)	Impervious Value
Urban Residential	UR	Urban Residential, Future Urban Residential, Special Study Area 5 & 6	0.45
Rural Residential	RR	Country Residential, Hamlet Residential	0.2
Industrial/ Commercial	IC	Business Park, Courtice West Shopping District, General Industrial, Highway Commercial, Light Industrial, Prestige Employment, Town Centre,	0.85
Landfill/ Aggregate	LA	Aggregate Extraction	0.5
Transportation/Utility	TU	Utility	0.5
	Use existing conditions Hydrology land cover classification	Environmental Protection, Greenspace, Community Park, Waterfront Greenway	

Table 6: Converted HydroLU codes for Oshawa Official Plan

Hydrology Land Cover	HydroLU Codes	Municipal OP Designation (Oshawa)	Impervious Value
Urban Residential	UR	Residential	0.45
Rural Residential	RR	Hamlet, Rural Residential	0.2
Industrial/Commercial	IC	Airport, Commercial, Deferred by Regional Council, Industrial, Institutional, Special Study Area, Special Waterfront Area, Community Use	0.85
Landfill/Aggregate	LA	Aggregate Extraction	0.5
Transportation/Utility	TU	Utilities	0.5
	Use existing conditions Hydrology land cover classification	Open Space and Recreation	

Table 7: Converted HydroLU codes for ROPA #128

Hydrology Land Cover	HydroLU Codes	ROPA #128 Designation	Impervious Value
Urban Residential	UR	Living Area	0.45
Industrial /Commercial	IC	Employment Area	0.85
	Use existing conditions Hydrology land cover classification	Major Open Space	

Step 4: Identify scenario data layers, order of supercedence and assumptions

For each land cover scenario, the contributing data layers were identified and the supercedence of these layers was conceptualized as shown in Table 8 Future land cover scenarios are progressive and were built upon the preceding scenario. Assumptions were made for the impervious treatment of policy areas, protected areas (mapped features protected by the Provincial Policy Statement and UNHS), HVRA, and whitebelt build-out scenarios, as shown in Table 9.

Table 8: Data layers for current and future land cover scenarios

Scenario Type	Scenario 1 Existing Conditions (2008)	Scenario 2a Future full OP Build-out (including ROPA #128)	Scenario 2b Future full OP Build-out with Protected UNHS	Scenario 2c Future full OP Build-out with Protected UNHS and Protected HVRA	Scenario 3a Future full OP Build-out with Whitebelt Build-out	Scenario 3b Future full OP Build-out with Whitebelt Build-out and Protected UNHS	Scenario 3c Future full OP Build-out with Whitebelt Build-out, Protected UNHS, and Protected HVRA	Scenario 3d Future full OP Build-out with Whitebelt Build-out and Climate Change
Main data Layers (in order of super-cedence from top (highest) to bottom (lowest))	Existing Hydro LU codes (based on 2008 ELC/land cover classification)	Hwy 407	Hwy 407	Hwy 407	Hwy 407	Hwy 407	Hwy 407	Hwy 407
		Select Municipal OP land use designations outside urban boundary	Select Municipal OP land use designations outside urban boundary	Select Municipal OP land use designations outside urban boundary	Select Municipal OP land use designations outside urban boundary	Select Municipal OP land use designations outside urban boundary	Select Municipal OP land use designations outside urban boundary	Select Municipal OP land use designations outside urban boundary
		Greenbelt	Greenbelt	Greenbelt	Greenbelt	Greenbelt	Greenbelt	Greenbelt
		ORM	ORM	ORM	ORM	ORM	ORM	ORM
		Provincially Protected Features	Provincially Protected Features	Provincially Protected Features	Provincially Protected Features	Provincially Protected Features	Provincially Protected Features	Provincially Protected Features
		ROPA #128 land use designations	UNHS	UNHS	ROPA #128 land use designations	UNHS	UNHS	ROPA #128 land use designations
		Municipal OP land use designations within the current urban boundary	ROPA #128 land use designations	HVRAs	Municipal OP land use designations within the current urban boundary	ROPA #128 land use designations	HVRAs	Municipal OP land use designations within the current urban boundary
			Municipal OP Land Use designations within the current urban boundary	ROPA #128 land use designations	1 Km 407 buffer within whitebelt lands beyond future urban boundary (Ind/Comm use)	Municipal OP Land Use designations within the current urban boundary	ROPA #128 land use designations	1 Km 407 buffer within whitebelt lands beyond future urban boundary (Industrial/Commercial)

Scenario Type	Scenario 1 Existing Conditions (2008)	Scenario 2a Future full OP Build-out (including ROPA #128)	Scenario 2b Future full OP Build-out with Protected UNHS	Scenario 2c Future full OP Build-out with Protected UNHS and Protected HVRA	Scenario 3a Future full OP Build-out with Whitebelt Build-out	Scenario 3b Future full OP Build-out with Whitebelt Build-out and Protected UNHS	Scenario 3c Future full OP Build-out with Whitebelt Build-out, Protected UNHS, and Protected HVRA	Scenario 3d Future full OP Build-out with Whitebelt Build-out and Climate Change
				Municipal OP Land Use designations within the current urban boundary	Whitebelt lands beyond 1 km 407 buffer (Urban Residential)	1 Km 407 buffer within whitebelt lands beyond future urban boundary (Industrial/Commercial)	Municipal OP Land Use designations within the current urban boundary	Whitebelt lands beyond 1 km 407 buffer (Urban Residential)
						Whitebelt lands beyond 1 km 407 buffer (Urban Residential)	1 Km 407 buffer within whitebelt lands beyond future urban boundary (Industrial/Commercial)	
							Whitebelt lands beyond 1km 407 buffer (UrbanResidential)	

Table 9: Data Layer Assumptions

Basic Assumption for Scenario Analyses

- The 407 layer supersedes all (a transportation/utility impervious code of 0.5 is applied). 407 layer is based on the preferred technical route as per the approved Environmental Assessment.
- Existing land use conditions correspond to 2008 or later Hydrology-Land Use (HydroLU) codes (as determined by orthrophoto land cover analysis)
- Select Municipal OP designations outside the urban boundary (including Hamlet residential, rural residential, country residential, aggregate, industrial) are assumed to be approved development areas to be fully built out (see converted HydroLU codes). Only applied in Black/Harmony/Farewell, Bowmanville/Soper, and Oshawa where OP data was available in digital format.
- Municipal OP land use designations were used in the following watersheds: Black/Harmony/Farewell Creek, Bowmanville/Soper, and Oshawa Creek. Municipal OP data for the Lynde Creek watershed was not available in a useable format at the time of this analysis. As the majority of the Lynde Creek watershed is already developed, the existing conditions Hydro LU codes were used to supplement as a base layer and gaps were filled in by applying land use designations from the West Whitby Secondary Plan and ROPA #128 land-use.

- No new development will occur in the UNHS polygons. (2008 HydroLU codes and corresponding impervious code is applied, except where superseding layer applies)
- Water balance will be maintained to pre-development levels in HVRAs (2008 HydroLU codes and corresponding impervious code is applied, except where superseding layer applies). HVRAs are based on 1.15 times above average watershed based threshold recharge rates.
- No new development will occur in the Greenbelt areas (2008 HydroLU codes and corresponding impervious code is applied, except where superseding layer applies)
- No new development will occur in the ORM areas (2008 HydroLU codes and corresponding impervious code is applied, except where superseding layer applies). ORM layer is based on the ORM Conservation Plan planning boundary.
- No new development will occur in provincially protected features which include Regulation floodplain, PSW, ANSIs, and watercourses (2008 HydroLU code applies, except where superseding layer applies)
- New urban boundaries, land uses for new additional lands & land use conversions in ROPA #128 supersede municipal OP land use map (employment lands will have industrial/commercial (IC) impervious code of 0.85, living areas will have urban residential (UR) impervious code of 0.45). Only these amended portions of the plan have been applied.
- Within remaining whitebelt lands (i.e. not designated under ROPA #128, Greenbelt Plan, ORMCP), a 1 km buffer surrounding Hwy 407 will be treated as industrial land cover (impervious code of 0.85 is applied), and the whitebelt lands beyond the 407 buffer will be treated as urban residential land cover (impervious code =0.45 applied).
    - ROPA #128 – Regional Official Plan Amendment #128
    - Hydro LU - Hydrology-Land cover codes
    - ORM - Oak Ridges Moraine Planning Area

Step 5: Build impervious analysis model using ArcGIS ModelBuilder

Using the data compiled and identified in Steps 1-4, the imperviousness analysis was broken down into 3 steps using an ArcGIS tool called ModelBuilder. Detailed GIS script and commands were used to build the model. An example of impervious calculation is attached as Appendix A.

Step 5a: Data acquisition from multiple locations within CLOCA's GIS servers, and placed into a geodatabase. Data was clipped to the CLOCA jurisdictional boundary during the importation process. Attributes, that can describe conditions or give meaning to specific records, are added to the policy areas that are used later on in the analysis. For future land cover scenarios, several additional processes are run in this step, including the merging and attributing of the Official Plan data, as well as the creation of the 'Protected Areas' which included mapped features protected under the Provincial Policy Statement and UNHS, and the addition of the high volume recharge area (HVRA) layer.

Step 5b: Create the whitebelt area shapefile

This area is attributed in the same way the other policy areas were in the previous step. For future land cover scenarios, the Ecological Land Classification (ELC)/Land cover layer is also modified with the Official Plan data and 407 buffer in this step according to a list of superseding assumptions (Table 8and Table 9).

Step 5c: Combine all policy areas, watershed boundaries and ELC data layer to run analysis.

If/Else and Case statements were used to read through the table and apply additional attributes needed to create the statistical report. For example in a Visual Basic for Applications (VBA) Case statement, the code reads through a field called Hydro LU and assigns an impervious factor, which is essentially a percentage of area in a particular land classification that is impervious. For future land cover scenarios, the data has been attributed as in Scenario 1, the same If/Else and Case scripts were used to produce the final statistical report.

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Appendix A

Example of impervious calculations generated from ModelBuilder analysis.

Pivot tables were used to calculate the model data into an impervious percentage. These tables are created for each scenario to show statistics for total area of each Hydro_LU, broken down by Policy and by subwatershed, impervious area found within each Policy, broken down by subwatershed, and impervious percent found within each Policy, broken down by subwatershed.

In this sample table, the watershed is broken down into subwatershed, policy area, & HydroLU code (aggregated ELC codes) with the total area in each category being shown.

Each HydroLU code has an impervious value (as shown on the maps. i.e. 0 for CI, 0.85 for IC etc.)

A similar table was generated, containing <u>impervious</u> area. Each value in the table represents the original value multiplied by the corresponding impervious value (i.e. 100 ha of CI * 0.0 becomes 0 ha of impervious land).

The information from these two tables is used to calculate the imperviousness.

Impervious % = ((value in impervious table) / (corresponding value in the original table)) x 100%

For example, Current Impervious %:

Original table (hectares)

		Greenbelt		Green belt Total	White Belt		White Belt Total	Grand Total
		CI	IC		CI	IC		
Ashburn	Ashburn Total	300	400	700	3000	3000	6000	6700

Impervious Table (hectares)

		Greenbelt		Green belt Total	White Belt		White Belt Total	Grand Total
		CI (0.0)	IC (0.85)		CI (0.0)	IC (0.85)		
Ashburn	Ashburn Total	0	340	340	0	3400	3400	3740

Output Imperviousness % Table

		Greenbelt	White Belt	Total
Ashburn	Ashburn Total	48.6%		55.8%

For the entire Ashburn sub-watershed, impervious % = (3740 ha / 6700 ha) * 100% = 55.8%

For the total Ashburn Greenbelt, impervious % = (340 ha / 700 ha) * 100% = 48.6%

APPENDIX E: CLOCA PROGRAMS AND SERVICES

WATERSHED PLANNING

- Preparation of Watershed Plans creating the framework for the protection, restoration and enhancement of healthy ecosystems.
- Analysis of data collected through the ongoing monitoring of aquatic, terrestrial, wildlife and water resources.
- Assessment and prediction of impacts of future land use changes in the watershed, cumulatively and on individual natural resources.
- Guidance for future watershed activities ensuring natural resources are protected, sustained and/or enhanced.
- Establishment of existing natural heritage conditions from which to measure change and identify ecological trends.
- Provides input and recommendations to municipal partners and stakeholders regarding the quality, quantity, protection, maintenance and restoration of terrestrial and aquatic resources in support of defensible environmental policies and sustainable growth objectives.

RESOURCE INVENTORY/ENVIRONMENTAL MONITORING

- Conducts annual integrated monitoring programs of aquatic, terrestrial, wildlife, coastal wetland and water resources using standard protocols.
- Prepares annual reports for each of the above monitoring programs.
- Uses the results of the monitoring program, analyzes and evaluates ecological trends and resource changes, identifying impacts and opportunities for improvements to our natural resources and their functions.
- Makes sound, science-based management decisions regarding natural resources.
- Gains an understanding of current conditions, identifies ecological trends and provides a good basis from which to measure the effectiveness of implemented resource management plans, watershed plan recommendations and stewardship activities.
- Provides scientifically based information and analysis from which informed land use decisions can be made, contributing to the Authority's Municipal Plan Input and Review responsibilities and the Department of Fisheries and Oceans federal requirements for the protection and maintenance of aquatic habitat.
- Provides information required for watershed health reporting at a provincial level.
- Identifies stewardship opportunities and provides recommendations for on the ground projects and their implementation.
- Contributes defensible information to various Municipal Programs, including emergency management and risk analysis, drinking and recreational (fishing, swimming) water quality, education and tourism (sport fishing, boating, trails) in support of sustainable living and growth objectives across the Region.

Resource Management, Protection and Conservation

- Ensures long term protection of our natural resources including woodlands, wetlands, valleylands, surface and ground water quality and quantity, and aquatic and wildlife habitat.
- Protects significant natural areas from the impacts of land use changes within the watershed.
- Promotes the creation of a connected, diverse, sustainable natural heritage system.
- Provides advice to our partners and carries out and/or supports habitat restoration/ enhancement/ management projects within our watershed including tree planting, wetland and stream restoration and improve land management practices.
- Protects, sustains and improves our natural resource capital, ensuring a healthy and functioning watershed for the enjoyment of future generations.
- Minimizes the impact of existing and changing land uses on natural resources, ensuring biodiversity and achievement of standard watershed function targets. For example, adequate riparian buffers reduce bank erosion, filter surface water and nutrients before entering the stream, provide habitat, cover and movement corridors for wildlife, and regulate stream temperature for cold and warm water fisheries.
- Advance the science and understanding of the importance of our natural resources to further the management, protection and conservation of our watershed resources.

Municipal Plan Input and Review

- Provides land use planning input and review.
- Assists our partner municipalities by providing comments on municipal capital works, policy documents and planning applications related to the protection, conservation and enhancement of natural heritage/hydrologic features and systems, and floodplain and stormwater management.
- Reduces the risk to life and property from natural hazards such as flooding and unstable slopes.
- Conducts fish habitat review on behalf of DFO
- Promotes wise use of land and water resources for future generations.
- Screen for habitat of endangered, threatened, and species at risk.
- Ensures land use policy documents such as Official Plans and Secondary Plans contain effective policies for the protection of natural features and their functions.
- Ensures that development applications will not have a negative impact on natural features or their functions.

Ontario Regulation 42/06

- Implements, enforces and administers O.Reg. 42/06, Regulation of Development, Interference with Wetlands and Alteration to Shorelines and Watercourses which protects the public and property from flood and erosion hazards.
- Prohibits, restricts, regulates or gives permission for certain activities in and adjacent to watercourses, valleylands, wetlands, shorelines and other hazardous lands.
- Ensures that development will not have an adverse affect on the control of flooding, erosion, dynamic beaches or the pollution or conservation of land.

Flood Forecasting, Warning and Water Monitoring

- Provides a flood forecasting and warning program, including emergency procedures.
- Reduces the potential for injury, loss of life and property damage resulting from flooding.
- Provides continuous water level monitoring of watercourses, rain gauging, computerized flood forecasting, monitoring of snow conditions and potential runoff problems within the watershed.
- Provides key information to support low flow, water budget and climate change analysis for various internal and external programs.

Floodplain Mapping

- Develops hydrologic and hydraulic models and prepares floodplain mapping on a watershed basis.
- Discerns the location and extent of risk associated with flooding.
- Provides valuable information for plan review, regulation and flood warning.

Groundwater Resources

- Prepares watershed characterization (including groundwater/ surface water analysis) and conduct water budget studies in support of Central Lake Ontario Conservation Programs.
- Prepares Source Water Protection Assessment Reports for Central Lake Ontario Conservation, per legislated requirements as part of the Credit Valley, Toronto Region & Central Lake Ont. (CTC) Source Protection Region
- Manages hydrologic and source water related databases.
- Provides understanding and management of groundwater resources for enhanced environmental discussions on Conservation Authority programs and contributes to regional and provincial groundwater research and programs.
- Review and comment on applications for consumptive water usage (PTTW).

Private & Public Land Stewardship

- Undertakes programs to promote natural heritage and water resource stewardship throughout the watershed.
- Provides technical advisory services and financial grants to assist landowners and community groups undertaking habitat restoration or enhancement projects, including proper maintenance of private wells.
- Identifies potential stewardship projects and sites.
- Encourages landowners to maintain, restore and protect existing natural features and consider the ecological health of natural systems in their land use activities.

Conservation Areas Planning & Management

- Provides management and planning to the many different landscapes and natural resources found within our Conservation Areas. This ensures their significance is not diminished, while still providing opportunities for public use where appropriate.
- Manages Areas based upon the sensitivity of the ecosystem, with some Areas being actively managed and some Areas not.
- Maintained trails and facilities are available in some Conservation Areas for public use and enjoyment

- Management of capital investment and long term planning to ensure continued response to user needs.
- Provide vital long term monitoring and information gathering areas needed to assess change and trends for Watershed monitoring programs.
- Provides long term protection of the watershed's significant natural areas.
- Provides opportunities for the public to enjoy recreational and environmental experiences.

Corporate Services

- Undertakes all aspects of coordinating corporate financial duties, budget, audits, managing human resources, development of effective policies and administration frameworks to support CA projects and programs.
- Provides a suite of information management, GIS mapping and database management services in support of internal and external projects and programs which involve CA staff.

Environmental Education

- Provides curriculum based education and information about watershed conservation and the environment.
- Provides hands-on experiential learning opportunities.
- Creates awareness of the value of environmental protection and stewardship of our watershed.
- Establishes an environmental ethic in future generations.

Public Information

- Provides information on programs and services.
- Hosts public outreach events providing variety of experiences celebrating our natural resources.
- Provides tours, brochures, fact sheets and publications.
- Creates awareness of watershed resources.
- Ensures Conservation Authority programs and services are understood.

Volunteer Services

- Provides a variety of volunteer opportunities.
- Establishes a stewardship ethic within our community
- Provides in kind resources to assist with the delivery of programs and projects.

Over 6,000 students participate annually in CLOCA's "In Our Watershed" Education Programs

GLOSSARY OF TERMS

Adjacent Lands: Lands contiguous to a specific natural heritage feature or area where it is likely that development or site alteration would have a negative impact on the feature or area. The extent of the adjacent lands may be recommended by the Province or based on municipal approaches which achieve the same objectives.

Agricultural Uses: The growing of crops, including nursery and horticultural crops; raising livestock; raising of other animals for food, fur or fibre, including poultry and fish; aquaculture; apiaries; agro-forestry; maple syrup production; and associated on-farm buildings and structures, including accommodation for full-time farm labour when the size and nature of the operation requires additional employment.

Anthropogenic: Created by a human or by human influence.

Aquatic Habitat: An area that provides the physical and/or chemical features needed to sustain aquatic life which can include, but shall not be limited to, flow, temperature, quality and/or nutrients. Areas required for various life stages which aquatic species depend upon directly or indirectly (feeding, reproduction, rearing, migration routes, riparian zones) are considered necessary habitat.

Aquifer: An underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt or clay).

Bank Full Width: The point on each bank from which width is measured - usually indicated by a definite change in vegetation and sediment texture.

Benthic: Bottom dwelling organisms that spend all or part of their life cycle in water and are used as indicators of environmental conditions.

Best Management Practices (BMPs): Methods, facilities and structures which are designed to protect or improve the environment and natural features and functions from the effects of development or interference.

Biodiversity: the variability among living organisms from all sources, including inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems.

Bioengineering: A natural engineering technique for bank stabilization that incorporates the use of native plants together with natural materials (logs, live stakes, live brush bundles, etc.) to increase slope stability.

Bodies of Water/Waterbody: A body of water which may or may not flow such as a lake, pond, wetland, watercourse but does not include a pool or puddle.

Buffers: An area or band of permanent vegetation, preferably consisting of native species, located adjacent to a natural heritage feature, surface water feature, HVRA and/or the Natural Heritage System, and usually bordering lands that are subject to development or site alteration and creating a physical separation that will discourage encroachment. The purpose of the buffer is to protect the feature and its function(s) by mitigating the impacts of the proposed land use and allowing an area for edge phenomena to continue. A buffer may also provide an area for a recreational trail. The vegetation within a buffer can be managed (e.g., trimmed, cut, thinned, but not cultivated) providing that the integrity of the buffer and the feature/function it is protecting is not negatively impacted

Confined River or Stream System: A watercourse located within a valley corridor, either with or without a floodplain, and is confined by valley walls. The watercourse may be located at the toe of the valley slope, in close

proximity to the toe of the valley slope (less than 15 m) or removed from the toe of the valley slope (more than 15 m). The watercourse can contain perennial, intermittent or ephemeral flows and may range in channel configuration, from seepage and natural springs to detectable channels.

Connectivity: The degree to which key natural heritage features or key hydrologic features are connected to one another by links such as plant and animal movement corridors, hydrologic and nutrient cycling, genetic transfer, and energy flow through food webs.

Conservation of Land: The protection, management, or restoration of lands within the watershed ecosystem for the purpose of maintaining or enhancing the natural features and hydrologic and ecological functions within the watershed.

Cumulative Effects / Impacts: The combined effects of all activities in an area over time and the incremental effects associated with individual projects in an area over time.

Demand Stress Level: The level of stress a groundwater system is under due to demand for the groundwater resources.

Development (1) as defined by the Provincial Policy Statement: Means the creation of a new lot, a change in land use, or the construction of buildings or structures, requiring approval under the Planning Act, but does not include:

- activities that create or maintain infrastructure authorized under an environmental assessment process;
- works subject to the Drainage Act.

Development (2) as defined by the Conservation Authorities Act:

- the construction, reconstruction, erection or placing of a building or structure of any kind;
- any change to a building or structure that would have the effect of altering the use or potential use of the building or structure, increasing the size of the building or structure or increasing the number of dwelling units in the building or structure;
- site grading; or
- the temporary or permanent placing, dumping or removal of material, originating on the site or elsewhere.

Note: The PPS definition of development is used generally within the Watershed Plan. Where "Development" is used in the context of where CA regulations apply, the Authority will be implementing the definition of development in accordance with the CA regulation as noted above.

Drainage Area: The area that contributes runoff to a point.

Ecological / Ecosystem Goods and Services: Consumable products provided by ecosystems, such as food, fuel or building materials. Most ecosystem goods are traded in the marketplace and have explicit prices. Ecosystem Services are non-material benefits provided to humans by nature's ecosystems, such as replenishing and protecting water supplies or providing recreational opportunities. Most ecosystem services do not have markets to be traded in and, therefore, do not have explicit prices assigned to them.

Ecological Function: The natural processes, products or services that living and non-living environments provide or perform within or between species, ecosystems and landscapes. These may include biological, physical and socio-economic interactions.

Ecological Integrity: Means the condition of ecosystems in which,

a) the structure, composition and function of the ecosystems are unimpaired by stresses from human activity,
b) natural ecological processes are intact and self-sustaining,
c) the ecosystems evolve naturally, and
d) includes hydrological integrity.

Ecosystem: Systems of plants, animals and micro-organisms together with non-living components of their environment, related ecological processes and humans.

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Endangered Species (federal): A wildlife species that is facing imminent extirpation or extinction, listed in Schedule 1 of the Species at Risk Act as updated and amended from time to time, by order in council.

Endangered Species (provincial): A species that is classified by COSSARO (Committee on the Status of Species at Risk) as "endangered species" living in the wild in Ontario but is facing imminent extinction or extirpation.

Enhance: To improve, augment, intensify or increase in quality, value, or functionality.

Environmental Impact Study: A report prepared to address the potential impacts of development or interference on natural features and ecological functions.

Erosion Hazard: The loss of land, due to human or natural processes, that poses a threat to life and property. The erosion hazard limit associated with confined river and stream systems is determined using considerations that include an allowance for toe erosion, an allowance for slope stability, and an allowance for access. The erosion hazard limit associated with unconfined river and stream systems is determined using considerations that include the flooding hazard limit or the meander belt width, whichever is greater, plus an allowance for access.

Fill: Includes earth, sand, gravel, rubble, rubbish, garbage, or any other matter whether similar to or different from any of the aforementioned materials, whether originating on the site or elsewhere, used or capable of being used to raise, lower, or in any way effect the existing grade (does not include herbaceous or woody plant material).

Fish Habitat: Spawning grounds and nursery, rearing, food supply, and migration areas on which fish depend directly or indirectly in order to carry out their life processes. Also includes the necessary physical and/or chemical features needed to sustain aquatic life which can include, but shall not be limited to, flow, temperature, quality and/or nutrients.

Flood Damage Centre: An area consisting of residential, commercial and institutional development that is adjacent to a creek and prone to flooding that threatens the safety, welfare of people, and damage to public and/or private property.

Flooding Hazard: The limits of an area of inundation under a flood resulting from the rainfall experienced during the Regional Storm (Hurricane Hazel event) or the 100-year flood, whichever is greater.

Floodplain: The area, usually low lands, adjoining a river, stream or small inland lake system, which has been or may be subject to flooding hazards.

Frequent Flooding: A site that is subject to the 1:25 year flood event or a more frequent flood event.

Hazardous Lands (1) as defined by the Conservation Authorities Act: Means land that could be unsafe for development because of naturally-occurring processes associated with flooding, erosion, dynamic beaches, or unstable soil or bedrock.

Hazardous Lands (2) as defined by the Provincial Policy Statement: Means property or lands that could be unsafe for development due to naturally occurring processes. Along the shorelines of the Great Lakes - St. Lawrence River System, this means the land, including that covered by water, between the international boundary, where applicable, and the furthest landward limit of the flooding hazard, erosion hazard or dynamic beach hazard limits. Along the shorelines of large inland lakes, this means the land, including that covered by water, between a defined offshore distance or depth and the furthest landward limit of the flooding hazard, erosion hazard or dynamic beach hazard limits. Along river, stream and small inland lake systems, this means the land, including that covered by water, to the furthest landward limit of the flooding hazard or erosion hazard limits.

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Note: The PPS definition of hazardous lands is used generally within the Watershed Plan. Where "Hazardous Lands" is used in the context of where CA regulations apply, the Authority will be implementing the definition of hazardous lands in accordance with the CA regulation as noted above.

Headwater Drainage Feature: Means ill-defined, non-permanently flowing drainage features that may offer permanent, seasonal or contributing fish habitat providing important sources of food, sediment, water, nutrients and organic matter to downstream reaches

Hydrologic Function: The functions of the hydrologic cycle that include the occurrence, circulation, distribution and chemical and physical properties of water on the surface of the land, in the soil and underlying rocks, and in the atmosphere, and water's interaction with the environment including its relation to living things.

Hydrologic Study: A report prepared to characterize the hydrologic functions of a wetland or other natural feature and to address the potential impacts of development and interference on the wetland or natural feature.

Indicators: scientific variables that help to simplify large amounts of complex information. They are a guide used to determine if environmental quality or health is good or bad.

Infrastructure: Means physical structures (facilities or corridors) that form the foundation for development or resource use and may include: sewage and water systems, sewage treatment systems, waste management systems, electric power generation and transmission including renewable energy systems, communications/telecommunications, transit and transportation corridors and facilities, oil and gas pipelines and associated facilities, but does not include "community infrastructure" or trails.

Impervious: Any surface that is not 100% pervious including all paved surfaces, building footprints, and areas compacted by equipment during construction activity.

Integrated Treatment Train Approach: Refers to a planned sequence of methods of controlling stormwater and keeping its impact to a minimum by techniques including, but not limited to:

- source controls, such as green roofs;
- lot-level controls such as rain gardens;
- conveyance controls such as grassed swales; and
- end-of-pipe controls such as wet ponds at the final discharge stage.

Invasive Species: Species of plants, animals, and micro-organisms introduced by human action outside their natural past or present distribution whose introduction or spread threatens the environment, economy, or society.

Meander Belt: The area of land in which a watercourse channel moves or is likely to move over a period of time.

Mitigate: To prevent, modify, or alleviate impacts (negative) on the natural environment. Mitigation also includes any action intended to enhance beneficial effects.

Natural Cover: Consists of lands that are existing forest (coniferous forest, mixed forest, deciduous forest, cultural plantation, cultural thicket, cultural savannah, cultural woodland, coniferous swamp, mixed swamp, deciduous swamp), wetland (open fen, shrub fen, treed fen, open bog, shrub bog, treed bog, meadow marsh, shallow marsh, submerged shallow aquatic, mixed shallow aquatic, floating-leaved shallow aquatic, thicket swamp, open water aquatic), meadow and beach/bluff patches (open tallgrass prairie, tallgrass savannah, tallgrass woodland, cultural meadow, inactive aggregate, open beach/bar, shrub beach/bar, treed beach/bar, open bluff, shrub bluff, treed bluff, open cliff, shrub cliff, treed cliff) as defined by the Ecological Land Classification system.

Natural Heritage Features: Features and areas including all wetlands, significant woodlands, significant valleylands, aquatic habitat, fish habitat,

watercourses and bodies of water, significant habitat of endangered and threatened species, significant wildlife habitat, and significant areas of natural and scientific interest, which are important for their environmental and social values as a legacy of the natural landscapes of an area; part of an ecologically functional corridor or linkage between natural areas; or, any other features or areas that are considered ecologically important in terms of contributing to the quality and diversity of an identifiable geographic area or natural heritage system.

Natural Heritage System (specific to this Watershed Plan): A healthy connected system comprising existing natural heritage features and areas, corridors, and those areas identified for natural cover regeneration which improve connections and habitat patches necessary to achieve and maintain minimum targets of ecological integrity.

Note: In the Phase 1 and Phase 2 Watershed Plan work, the Natural Heritage System was referred to as the Ultimate Natural Heritage System.

Negative Impacts:

a) Degradation to the quality and quantity of water, sensitive surface water features and sensitive ground water features, and their related hydrologic functions;
b) in regard to fish habitat, the harmful alteration, disruption or destruction of fish habitat; and
c) for other natural heritage features and areas, degradation that threatens the health and integrity of the natural feature or ecological function for which an area is identified.

No Net Loss: Balancing the loss of natural cover due to development, to be achieved through preservation, restoration, mitigation and compensation efforts. The overall percentage of natural cover, including, but not limited to forests and wetlands, will remain constant or increase over time.

Precautionary Principle / Approach: an approach to protect the environment that where there are threats of serious or irreversible damage, scientific uncertainty shall not be used to postpone measures to prevent environmental degradation.

Regulated Area: Those areas within the jurisdiction of the CLOCA defined in Ontario Regulation 42/06 Development, Interference with Wetlands and Alteration to Shorelines and Watercourses.

Restore: The re-establishment or rehabilitation of a former or degraded system or feature with the goal of returning natural functions and characteristics that have been partially or completely lost or damaged.

Riparian Area: The transitional area between land and a waterbody which is permanently vegetated, preferably consisting of native species to provide run-off retention, sediment and erosion controls, water temperature regulation, maintain or improve water quality, support fish life processes and protect fish habitat. The vegetation can be managed (e.g., trimmed, cut, thinned, but not cultivated) provided that the integrity of the riparian area and the waterbody is not negatively impacted

Riparian Vegetation: The plant communities in the riparian area, often characterized by hydrophilic plants.

Special Concern Species: A species that is classified by COSSARO (Committee on the Status of Species at Risk) as a "special concern species" if it lives in the wild in Ontario, is not endangered or threatened, but may become threatened or endangered.

Stakeholder: A person, group, or organization that has direct or indirect stake in the natural resources of the watershed, watershed planning or Watershed Plans.

Surface Water Feature: Refers to water-related features on the earth's surface, including watercourses, bodies of water, wetlands, headwater

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drainage features seepage areas, discharge areas, springs, and associated riparian lands that can be defined by their soil moisture, soil type, vegetation or topographic characteristics.

Thermal Impact: The impairment of water quality through temperature increase or decrease. Changes in temperature can also effect species composition of plants, insects and fish in a water body.

Threatened Species: A species that is classified by COSSARO (Committee on the Status of Species at Risk) as "threatened species" living in the wild in Ontario which is not endangered but is likely to become endangered.

Toe of Valley Slope: The base of an inclined surface of a hill.

Ultimate Natural Heritage System: see Natural Heritage System.

Unconfined River or Stream System: A watercourse not located within a valley corridor with discernible slopes, but within relatively flat to gently rolling plains and is not confined by valley walls. The watercourse can contain perennial, intermittent or ephemeral flows and may range in channel configuration, from seepage and natural springs to detectable channels.

Valley or Valleyland: Land that has depressional features associated with a river or stream, whether or not it contains a watercourse.

Water Budget: Quantifies the major components of the hydrologic cycle and estimates the amount of water and where the water is within the watershed. It determines the water inputs, outputs and changes in storage.

Watercourse: An identifiable depression in the ground in which a flow of water regularly occurs. A watercourse also includes a municipal drain.

Watershed: An area that is drained by a river and its tributaries.

Wetland: Means land that:

a) is seasonally or permanently covered by shallow water or has a water table close to or at its surface;
b) directly contributes to the hydrological function of a watershed through connection with a surface watercourse;
c) has hydric soils, the formation of which has been caused by the presence of abundant water; and
d) has vegetation dominated by hydrophytic plants or water tolerant plants, the dominance of which has been favoured by the presence of abundant water;

but does not include periodically soaked or wet land that is used for agricultural purposes and no longer exhibits a wetland characteristic referred to in clause (c) or (d).

Wildlife habitat: Areas where plants, animals and other organisms live, and find adequate amounts of food, water, shelter and space needed to sustain their populations. Specific wildlife habitats of concern may include areas where species concentrate at a vulnerable point in their annual or life cycle; and areas which are important to migratory or non-migratory species.

Woodlands: Treed areas that provide environmental and economic benefits to both the private landowner and the general public, such as wildlife habitat, erosion prevention, hydrological and nutrient cycling, and provision of clean air and the long-term storage of carbon. Woodlands include treed areas, woodlots or forested areas and vary in their level of significance at the local, regional and provincial levels.

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