

A Biodiversity Strategy for the Halton Regional Forests



2014 – 2024

Contents

1. Introduction	3
2. Understanding Biodiversity	3
2.1. What is Biodiversity?	3
2.2. Why is Biodiversity Important?	4
2.3. Threats to Biodiversity	5
3. Global, Federal and Provincial Biodiversity Strategies	6
3.1. United Nations Convention on Biological Diversity and Global Biodiversity Strategies	6
3.2. Canadian Biodiversity Strategy and Outcomes Framework.....	7
3.3. Ontario’s Biodiversity Strategy and Implementation Plan.....	8
4. Approach to Developing A Biodiversity Strategy for the Halton Regional Forests	10
4.1. Principles for Biodiversity.....	10
4.2. Vision for Biodiversity	11
4.3. Strategy Design.....	11
4.4. Existing Regional Programs and Activities Contributing to Biodiversity	13
4.5. Analysis of Existing Regional Programs Related to Biodiversity	16
5. Strategies to Achieve Biodiversity in the Halton Regional Forests	17
6. Alignment with Ontario’s Biodiversity Strategy Targets	22
7. Conclusion	22
References	23

1. Introduction

Halton Region introduced a Regional Natural Heritage System (RNHS) approach to biodiversity conservation through ROPA 38. The goal of the RNHS is to increase the certainty that the biological diversity (biodiversity) and ecological function within Halton will be preserved and enhanced for future generations. This important step reaffirms and strengthens Halton's commitment to biodiversity conservation and positions Halton Region as a leader in Natural Heritage System planning in the Greater Toronto and Hamilton Area.

As an owner of Regional Forests, the Region has an opportunity to lead by example in the preservation and enhancement of biological diversity for future generations. There are 14 Regional Forest Tracts which protect 665 ha of the most biologically sensitive lands in Halton's Natural Heritage System. The Forest tracts provide ecosystem services, encompass significant woodland and wetland habitats, and provide a home to wide array of plant and animals including a number of rare and endangered species. By managing land in a way that maintains and enhances biodiversity, Halton Region can contribute to local, provincial, national and international biodiversity conservation efforts and set an example of sound environmental stewardship for other municipalities and Halton residents to follow.

This document outlines a 10-year biodiversity strategy for the Halton Regional Forest lands. The Biodiversity Strategy for the Halton Regional Forests, in support of the Regional Natural Heritage System, is consistent with the Region's many initiatives to realize a more sustainable Halton by preserving a landscape that is rich, diverse, balanced, and productive for current and future generations.

The Citizens' Priorities: Halton Region's 2011-2014 Action Plan identified Defining and Preserving Natural Heritage as a priority. Key actions identified for this priority include the development and implementation of a program for maintaining and enhancing Halton's Natural Heritage System. The intent is that this Strategy will contribute to more comprehensive land stewardship by other landowners in the Regional Natural Heritage System. It is also the intent that the biodiversity principles contained in this Strategy will guide these landowners to pursue similar biodiversity conservation and enhancement activities.

2. Understanding Biodiversity

2.1. What is Biodiversity?

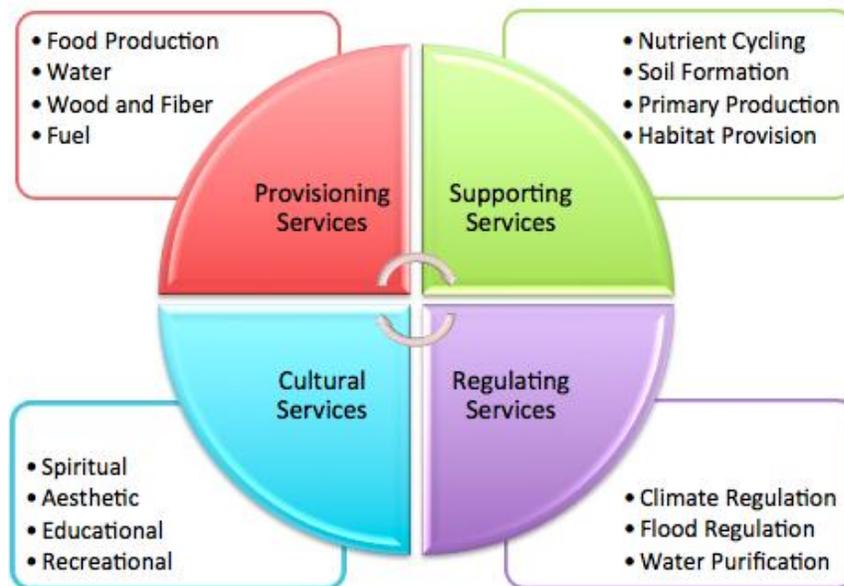
Simply put, biodiversity is life, or the variety of life on Earth. Biodiversity encompasses genes, species, ecosystems and the goods and services they provide. Technical definitions of biodiversity identify three levels of biodiversity: diversity within species (Genetic Diversity), diversity between species (Species Diversity), and diversity of ecosystems (Ecosystem Diversity). To help guide Halton Region's activities related to biodiversity, the following definition, adopted from the United Nations Convention on Biological Diversity (1992), the Canadian Biodiversity Strategy and Ontario's Biodiversity Strategy, 2011, is used in this Strategy:

Biodiversity is the variability among living organisms from all sources, including among others, 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

2.2. Why is Biodiversity Important?

Humans are entirely dependent on biodiversity for the necessities of life. For example our food, wood, fibre and even oil and natural gas are all products of biodiversity – commodities derived directly from living organisms past or present. Functioning ecosystems also provide essential services to humans, without which our continued existence would not be possible. These services include (but are not limited to) climate regulation, air and water purification, flood attenuation, pest and disease regulation, recreation, and improved human health and mental well-being. Goods and services provided by biodiversity are generally referred to as Ecosystem Goods and Services. Figure 1 provides an overview of the various Ecosystem Goods and Services provided by biodiversity. Halton Region has the capacity to maintain or increase the value of all ecosystem goods and services identified in Figure 1 by managing its land holdings to maintain and enhance biodiversity and ecological function.

Figure 1: Ecosystem Services Provided by Biodiversity



Source: Millenium Ecosystem Assessment, 2005.

As noted in Ontario's Biodiversity Strategy (Ontario Biodiversity Council, 2011), Biodiversity is fundamental for human survival, as the goods and services ecosystems provide are the basis for human health. For example, breaking down and recycling wastes and providing clean air and water are supporting and regulating services that our health depends on. Our outdoor recreational areas, our food and medicines are examples of the cultural and provisioning services provided by biodiversity. Recent evidence also suggests that biodiversity may act as a buffer to protect humans from disease.

Changes in biodiversity can increase the risk of infectious disease in plants and animals, as well as humans. For example, when forests become fragmented into smaller patches, the diversity of forest-dwelling species decreases, allowing populations of White-footed Mouse, the most competent host for the bacteria that causes Lyme disease, to increase. This, in turn, can increase the risk of humans contracting Lyme disease. This buffering effect provided by biodiversity may also apply to other agents that can infect humans, such as the West Nile Virus.

Increasingly, research is showing that opportunities to explore and experience the natural world not only provide the physical health benefits of activity and exercise but also have psychological and developmental benefits. There are, for example, studies indicating faster recovery times from illness in patients with the ability to observe nature. Other studies link reduced violence and aggression with the increased availability of green space in urban settings. In a study in the United Kingdom, the restorative quality of city parks was shown to increase with greater diversity of plant and animal species. Pioneering work in the United States also shows that our contact with nature is fundamental to our development. This work suggests that children with opportunities to get outside and freely explore nature are less inclined to show attention disorders and depression and are more likely to be physically and emotionally healthy.

Aside from all the benefits biodiversity brings to our lives, it deserves to be recognized, appreciated and protected in its own right. Ontario's 30,000 known species live in inter-connected ecosystems that have evolved over thousands of years. It is our responsibility, as citizens of Ontario, to conserve the species and ecosystems that are found in our province, for their own sake, for our sake and for the enjoyment and benefit of future generations.

2.3. Threats to Biodiversity

Threats to Biodiversity come from natural phenomena and from human activities. Natural phenomena come primarily from geological or atmospheric activities (i.e. tidal waves, volcanos, tsunamis, earthquakes, tornados, etc.). We have little control over these threats. Direct human activities that disrupt and degrade Biodiversity, or create human induced natural phenomena are generally grouped into the six areas identified and described in Table 1.

Table 1: Threats to Biodiversity

Threat	Effect
Habitat Loss and Degradation	Reduces the amount of space available for plants and animals to carry out their life processes and reduces the quality of the habitat patches that remain.
Invasive Species	Invasive species compete with native species leading to population declines and possible extirpation
Population Growth	Population growth increases the intensity of other identified threats
Pollution	Variable affect depending on pollutant. Pollution generally alters the physical environment thus degrading habitat quality (e.g. acid rain, nutrient loading) or causes direct toxicity leading to population declines
Unsustainable Use	Unsustainable use of natural resources to population decline and possible extirpation
Climate Change	Causes changes in species composition within ecosystems due to variation in ability to disperse in response to changing climate or tolerate new climate conditions. This can lead to unpredictable changes to food chains and species interdependencies; changes in temperature regulated biological processes (e.g. breeding dates) possibly affecting species viability.

It is clear that the threats to biodiversity are broad. As a result, not all can be addressed through the biodiversity strategy for the Halton Regional Forests. The present strategy will primarily address threats related to habitat loss/degradation and invasive species.

3. Global, Federal and Provincial Biodiversity Strategies

3.1. United Nations Convention on Biological Diversity and Global Biodiversity Strategies

Formal global recognition of the importance of biodiversity to the economic and social wellbeing of humanity began with the United Nations Convention on Biological Diversity (CBD), an international legal instrument for the conservation and sustainable use of the Earth's biological diversity. The CBD has 3 main objectives:

- The conservation of biological diversity;
- The sustainable use of the components of biological diversity; and,
- The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

The CBD was opened for signature at the United Nations Conference on Environment and Development on June 5, 1992. Canada was the first industrialized country to sign and ratify the CBD, affixing its signature on June 11, 1992 and ratifying it on December 4 of the same year. The Convention came into force on December 29, 1993. There are currently 193 Parties to the CBD, 192 member states and the European Community. The CBD laid the groundwork for Canada's formal involvement in global biodiversity conservation.

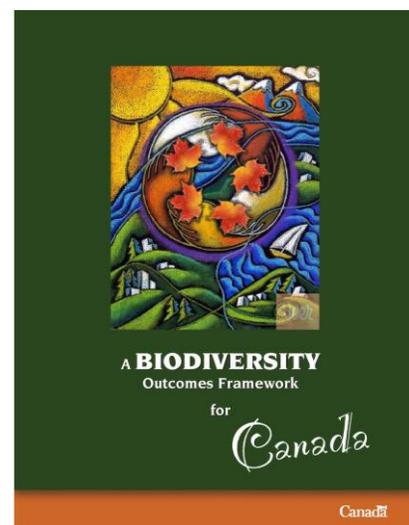
In 2010, the United Nations Conference of the Parties to the Convention on Biological Diversity agreed on a new Global Strategic Plan for Biodiversity 2011-2020 and on the establishment of the Aichi Biodiversity Targets. These targets can be found at <http://www.cbd.int/sp/targets>.

The year 2010 was declared as the International Year of Biological Diversity, and 2011-2020 is declared the United Nations Decade on Biological Diversity.



3.2. Canadian Biodiversity Strategy and Outcomes Framework

Following Canada's ratification of the CBD in 1992, the federal, provincial and territorial governments collaborated on the production of the *Canadian Biodiversity Strategy*, published in 1995. The Strategy identified a vision of "a society that lives and develops as a part of nature, values the diversity of life, takes no more than can be replenished and leaves to future generations a nurturing and dynamic world, rich in its biodiversity." In 2006, the Canadian Councils of Resource Ministers developed a *Biodiversity Outcomes Framework* to focus conservation and restoration actions under the *Canadian Biodiversity Strategy*. In 2010, the first report under that framework, *Canadian Biodiversity: Ecosystem Status and Trends 2010*, was released. The report was the first assessment of Canada's biodiversity from an ecosystem perspective, and constitutes a partial assessment of Canada's progress toward the United Nations biodiversity target "to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth." Implementation of the *Canadian Biodiversity Strategy* is ongoing, and additional information about this initiative can be accessed at www.biodivcanada.ca.



3.3. Ontario's Biodiversity Strategy and Implementation Plan

In 2005, Ontario published a Biodiversity Strategy for the first time and simultaneously established the Ontario Biodiversity Council to help guide its implementation. The Ontario Biodiversity Council updated the Strategy in 2011 which can be accessed through <http://www.mnr.gov.on.ca/en/Business/Biodiversity>. The renewed Strategy establishes a guiding framework for conserving Ontario's biodiversity over the next decade, and supports both the *Canadian Biodiversity Strategy* and the CBD's *Global Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets*. The 2011 strategy is organized around four strategic directions:

- Improve Knowledge
- Engage People
- Reduce Threats
- Enhance Resilience

For each strategic direction, the strategy identifies Objectives, Outcomes, Key Actions, and Targets to guide implementation of the Strategy. Figure 2 provides an overview of the structure of the 2011 Strategy.

Ontario's Biodiversity Strategy, 2011 ultimately concludes that the protection and sustainable use of biodiversity is a shared responsibility for all Ontarians, not just government, and calls for various stakeholders, including municipalities, to develop implementation plans to adopt the vision and goals as outlined in the Strategy and identify specific actions to help achieve them.

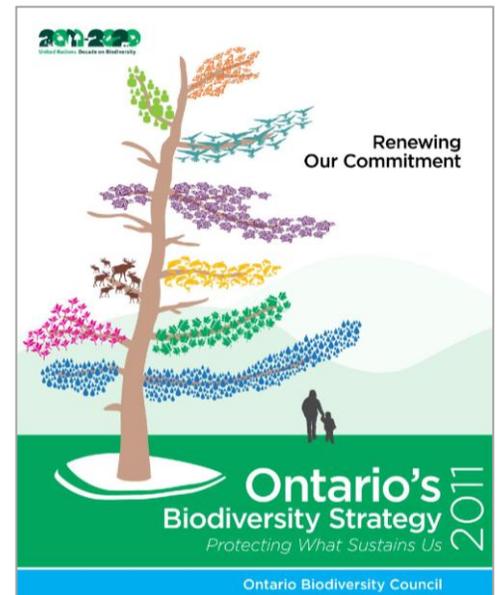
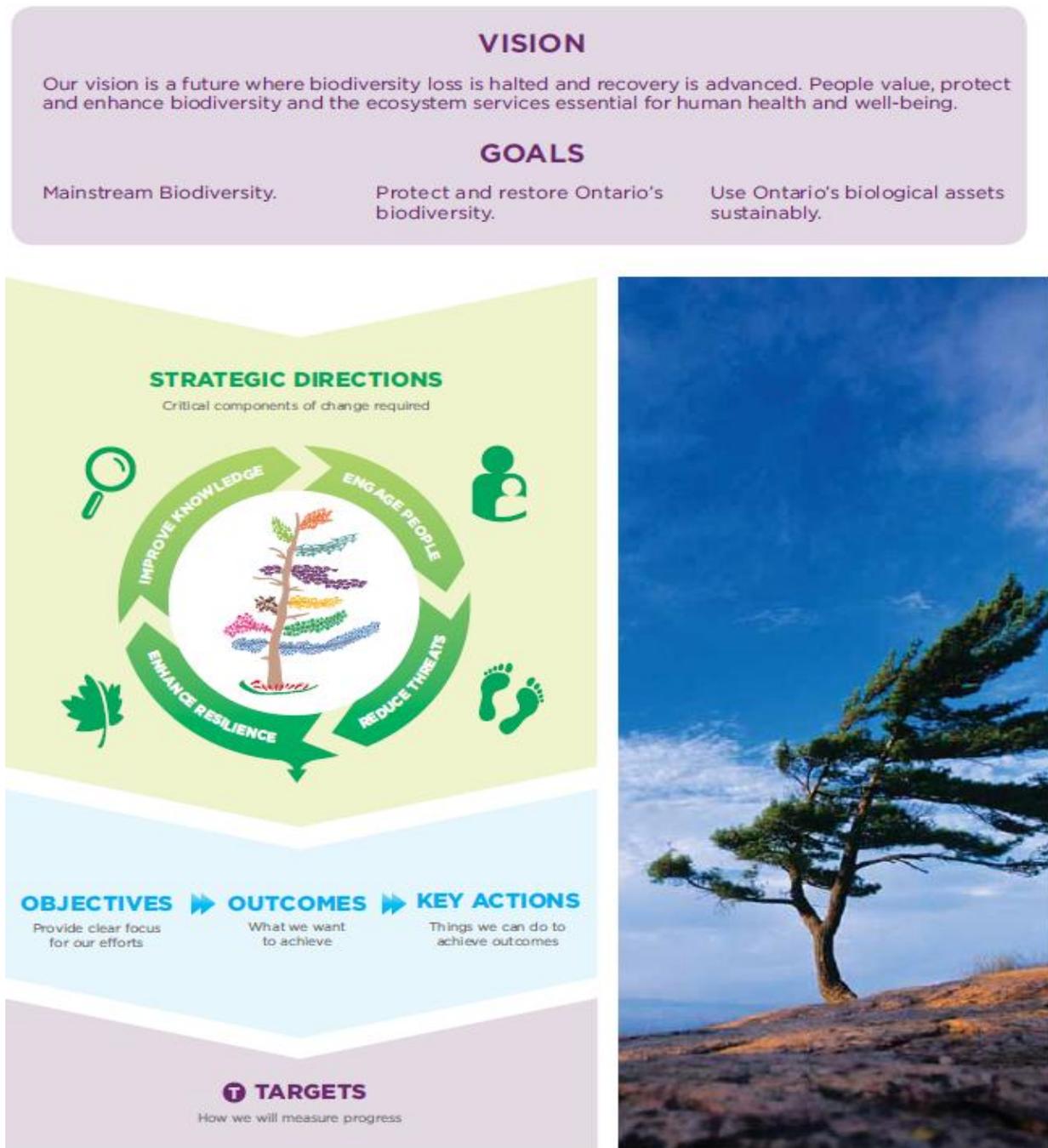


Figure 2: Structure of Ontario's Biodiversity Strategy, 2011



Source: Ontario Biodiversity Council, 2011

4. Approach to Developing A Biodiversity Strategy for the Halton Regional Forests

4.1. Principles for Biodiversity

This strategy is guided by the following principles which are adapted from Ontario's Biodiversity Strategy:

Ecological Principles

Applying key ecological concepts is important in protecting biodiversity.

- All species, including humans, are connected and dependent on one another for their mutual survival.
- Large, contiguous natural areas withstand impacts better than smaller areas with similar habitat characteristics.
- Habitat connectivity is essential to maintaining ecological functions, ecological interactions and viability of species populations for the long term.
- The integrity and resiliency of natural systems are critical to human and environmental security.

Societal Principles

Biodiversity is critical to human civilization.

- Biodiversity has intrinsic societal, cultural and economic value.
- Human health and well-being are inextricably linked to and depend on biodiversity.
- Everyone is responsible for the stewardship of our ecological, environmental, and hydrological resources.
- Biodiversity assets in our land, air, and water environments are valuable for present and future generations.

Management Principles

Conservation and sustainable use of natural resources are key to maintaining biodiversity.

- Ecosystem approaches for the integrated management of land, water and living resources are needed.

- The precautionary approach for maintaining biodiversity is prudent and more cost-effective, and less risky than recovery and restoration.
- Long-term monitoring of ecosystem health and function are necessary given the complex and dynamic nature of ecosystems and changing climate patterns.
- Co-operation and sharing of information, knowledge, and expertise on biodiversity will guide and inform community building.
- Public awareness and education are integral to the protection and enhancement of biodiversity.

4.2. Vision for Biodiversity

The vision for this strategy is that Halton Region, through its management of the Halton Regional Forests, will be a leader in enhancing, maintaining, and promoting biodiversity in Ontario, set an example of sound environmental stewardship for other landowners in the Region to follow, and contribute to achieving many of the targets identified in Ontario's Biodiversity Strategy.

4.3 Strategy Design

The Biodiversity Strategy for the Halton Regional Forests is consistent with the structure of Ontario's Biodiversity Strategy. This will ensure that Halton's efforts complement the goals and objectives established as priorities at provincial, national and global scales. This approach will also provide opportunities to align communications activities with the provincial strategy and thereby leverage these efforts and achieve consistent messaging.

Development of the Strategy employed the following strategy design considerations:

- *Lead the way in preserving and enhancing biodiversity in the Halton Regional Forests by demonstrating good land stewardship for other landowners within the Regional Natural Heritage System to follow.*

The overall success of the Region's Natural Heritage System in preserving and enhancing biodiversity over the long-term depends in part on decisions made by the individuals who own lands within the system. The Region promotes the Regional Natural Heritage System and encourages other Halton landowners to participate in its identification, protection and enhancement by setting an example of responsible land stewardship for other landowners within the system to follow.

- *Build on existing Regional efforts to maintain and enhance biodiversity by recognizing and integrating existing Regional programs and implementing new programs to fill gaps.*

This will ensure an integrated approach that avoids duplication of effort by the Region and others and recognizes and promotes important efforts already underway.

- *Focus on readily implementable activities contributing directly to biodiversity maintenance and enhancement in the Halton Regional Forests and/ or furthers our knowledge of best management practices.*

Ontario's Biodiversity Strategy recognizes pollution, climate change and population growth as major threats to biodiversity. Although this connection is clear, the Biodiversity Strategy for the Halton Regional Forests is not the most effective mechanism to address these threats (although it may contribute indirectly through increased carbon sequestration on restored lands as an example). Furthermore, the Region and other agencies have other programs that are better positioned to address these threats. This Strategy will focus on action oriented initiatives that result in measurable gains in biodiversity or improve our understanding of how to most effectively maintain and enhance biodiversity, rather than activities that are less tangibly connected to biodiversity maintenance and enhancement.

- *Recognize that different management approaches are needed to reflect existing ecological conditions and constraints.*

The ecological condition of the Regional forest tracts range from pristine or near pristine natural ecosystems (e.g. Regional Forest Tracts above the escarpment) located within a natural or rural landscape matrix. It is important to recognize that the existing ecological condition of a given property is the primary factor that influences opportunities to manage it for biodiversity maintenance and enhancement. For example, the Britton Regional Forest Tract (166 ha) is a diverse natural area comprised entirely of forests and wetlands which support a diverse array of plant and animal species, including rare species and species at risk (SAR). Because it is already so diverse, there is limited opportunity to increase (enhance, restore) biodiversity on this property. The primary management objectives for this property would be directed at maintaining ecosystem resiliency by reducing threats such as invasive species proliferation or informal trail creation, or advanced silvicultural treatments to ensure forest structure remains suitable for the diversity of birds present.

- *Focus first on maintaining and enhancing biodiversity resources where they currently exist and second on implementing opportunities to restore and enhance biodiversity as appropriate.*

Halton's existing natural heritage features and functions represent the reservoir of local biodiversity that we have inherited from previous generations. This reservoir of biodiversity contains unique ecological communities, species and genetic variation that may be impossible to truly restore once it is lost. Therefore, the primary focus of the strategy is on maintaining these resources, and the secondary focus is on augmenting them through restoration activities.

- *Make the strategy accountable and adaptive to changing priorities by establishing targets, regularly measuring progress towards those targets, and revising the strategy as necessary to remain on track.*

Regional staff will work on the development of targets and reporting mechanisms to ensure the strategies are appropriate. Staff will confer with experts in conservation biology to ensure relevance and the pursuit of best practices, in concert with the Forest Management Plan.

- *Utilize the Regional Forest Advisory Committee and Ecological and Environmental Advisory Committee in the review and refinement of the strategy.*

These citizen advisory groups have expertise and interest in biodiversity conservation and can provide guidance.

4.4. Existing Regional Programs and Activities Contributing to Biodiversity

Table 2 provides a summary of existing Regional programs, studies, and communications materials that contribute directly or indirectly to biodiversity maintenance and enhancement in Halton Region. The list should be considered a 'living document' as there may be other items identified in the future that could be added.

Table 2: Existing Regional Programs, Studies, and Communications Materials Related to Biodiversity

Type	Name	Department	Description
Monitoring Program	Forest Health Monitoring Program (Williams & Associates, annual reporting)	Legislative and Planning Services - Planning Services	<ul style="list-style-type: none"> • An annual report that documents potential threats to the health of the Regional Forest posed by various forest pests, diseases and invasive species. • Covers Regional Forest lands as well as other Regionally-owned forested lands. • In accordance with recommendations of the Halton Regional Forest Management Plan, the Regional Forester has implemented an annual Forest Health Monitoring Program that, among other things, documents potential threats to biodiversity in Regional Forest lands posed by forest pests/diseases and invasive species and recommends management actions to address. • This report will be used to guide more strategic management of non-native, invasive plant species in the Regional Forest lands.
	Niagara Escarpment ONE Monitoring Plot Network	External (NEC) – future partnership with LPS –Planning Services for expanded monitoring	<ul style="list-style-type: none"> • A network of permanent ecological monitoring plots located along the Niagara Escarpment, designed to monitor changes in forest biodiversity, health and dynamics of forest ecosystems located within the Niagara Escarpment Plan Area. • One of the five plots located in Halton Region is located within the Robertson Forest Tract. • Halton Region and the NEC are partnering to establish additional monitoring plots in Halton's Cox Forest Tract in 2014. This new plot will be used to assess the impacts of quarrying, timber harvest and recreational uses such as mountain biking on the biodiversity and health of Halton's forest ecosystems.
	Neyagawa Boulevard wildlife passage monitoring project	Public Works - Transportation Planning	<ul style="list-style-type: none"> • A project administered independently by Halton's Transportation Planning group to monitor and photograph wildlife passage under a Regional Road which bisects the North Oakville NHS. • This project will provide useful information to inform wildlife passage design for future transportation projects
Characterization Report	Halton Region Environmentally Sensitive Areas Consolidation Report (North-South Environmental 2005)	Consultant report commissioned by Planning Services	<ul style="list-style-type: none"> • A Report that documents ecological conditions in Halton's ESAs, some of which overlap with the Halton Regional Forest Tracts. • Information contained in this Report may assist staff to determine management objectives for Forest Tracts within ESAs.
	Halton Natural Areas Inventory (2006)	External report prepared by Conservation Halton in partnership with the Halton Peel partially funded by Halton Region	<ul style="list-style-type: none"> • A Report that documents ecological conditions in Halton's natural areas generally, including some Regional Forest Tracts. • Information contained in this Report may assist staff to determine management objectives for Regional Forest Tracts.
	Profile of the Halton Forests (Gartner Lee 2002)	Legislative and Planning Services - Planning Services	<ul style="list-style-type: none"> • A Report that documents the baseline condition of biodiversity in the Halton Regional Forest lands
Communications - Print	Halton's Regional Forests information brochure	Legislative and Planning Services - Planning Services	<ul style="list-style-type: none"> • A brochure that summarizes biodiversity resources of the Halton Regional Forest lands
	Halton's Natural Environment brochure	Legislative and Planning Services - Planning Services in partnership with the EEAC	<ul style="list-style-type: none"> • A brochure that summarizes history, uniqueness, protection and stewardship of Halton's natural environment
	Owls for Climate Change book series	Halton Region Health Department	<ul style="list-style-type: none"> • A series of 3 children's books developed by Halton's Health department. • The publications were designed to inspire earth-friendly living at an early age. • The books are not directly applicable to this Strategy, but may be appropriate to include in communications initiative related to biodiversity in general.

Type	Name	Department	Description
Communications - Web	Regional Forests web pages (Regional Forests, Forest Updates, Forest Tract Maps, Forest Use By-Law, Regional Forests Background Information)	Legislative and Planning Services - Planning Services	<ul style="list-style-type: none"> • A website discussing the Regional Forests and related programs and activities • This website is maintained and updated by Regional Forester. • Information contained on the website is primarily related to forestry management activities and recreational use. • An opportunity may exist to integrate and build the awareness and education component of this Strategy on the website.
	Agriculture and Environment web pages (Environment blurb, Environmentally Sensitive Areas page)	Legislative and Planning Services - Planning Services	<ul style="list-style-type: none"> • A static web page with a small blurb about the Region's Natural Environment with a separate page dedicated to describing Halton's Environmentally Sensitive Areas, with a link to the related technical report. • An opportunity may exist to integrate and build the awareness and education component of this Strategy on the website.
	Jeff's Home	Legislative and Planning Services - Planning Services, Halton Regional Museum	<ul style="list-style-type: none"> • An interactive website that allows users to explore the biodiversity of the Niagara Escarpment. • Though not directly applicable to this Strategy, this website may be appropriate to include in communications initiative related to biodiversity in general. • Interactive mapping could be updated to include an educational component about the Regional Forest lands.
Management Plan	Halton Regional Forest Management Plan and addenda (Gartner Lee and others, 2005 and 2006)	Legislative and Planning Services - Planning Services	<ul style="list-style-type: none"> • A management plan that outlines objectives and actions for management of the Halton Regional Forest Tracts, covering a period of 20 years (2005-2024) • The management plan includes biodiversity conservation concepts and considerations, including managed succession of conifer plantations, invasive species management, forestry restrictions in highest quality habitats, trail decommissioning, etc. • This plan is actively implemented by the Regional Forester. • Explore opportunities to expand on and accelerate implementation of biodiversity related components of the plan where possible (e.g. enhanced invasive species management)
	Forest Management Plans for Public Works properties (e.g. Princess Anne Woodlot, Southeast Wastewater Treatment Plant)	Public Works with input from Legislative and Planning Services - Planning Services	<ul style="list-style-type: none"> • A management plan that outlines objectives and actions for management of specific Public Works properties that support woodlands. • Plans could continue to be implemented where they exist. Where not yet in place, explore opportunities to develop similar management plans.
Action Plan	Corporate Sustainability Action Plan	Legislative and Planning Services - Planning Services	<ul style="list-style-type: none"> • A program to increase sustainability of Halton Region's operations. • This Program includes actions to identify where tree coverage needs to be restored or augmented at all Regional facilities and reforest Region-owned open fields that are not currently in agricultural production. • This work has been initiated by the Regional forester. Opportunities could be explored to build on and expand the scope of this work to include non-tree planting restoration activities that contribute to biodiversity conservation and enhancement.
Citizens Advisory Committees	Ecological and Environmental Advisory Committee (EEAC)	Legislative and Planning Services - Planning Services (Citizens Advisory Committee administered by LPS)	<ul style="list-style-type: none"> • This Advisory Committee advises and assists Staff on implementation, review and monitoring policies of the Regional Plan in keeping with the desire for a high quality natural environment. • Opportunity to involve this citizens group in ongoing review and implementation of the strategy could be explored.
	Regional Forest Stewardship Advisory Committee (RFSAC)	Planning Services (Citizens Advisory Committee administered by LPS)	<ul style="list-style-type: none"> • This Advisory Committee advises and assists staff in reporting to Council on the implementation of the Halton Regional Forest Management Plan. • Opportunity to involve this citizens group in ongoing review and implementation of the strategy could be explored.

4.5. Analysis of Existing Regional Programs Related to Biodiversity

Prior to devising strategies related to biodiversity maintenance and enhancement, a SWOT (Strengths, Weaknesses, Opportunities, and Threats) Analysis of Regional programs was conducted. The following bullet points highlight the findings:

Strengths

- The Region's most important land holdings (from a biodiversity perspective) are the Regional Forest lands. The Halton Regional Forest Management Plan and Addenda provide a sound approach for managing these lands to maintain and enhance their biodiversity, and this plan is being actively implemented by the Regional Forester.
- Forested lands on Regionally-owned properties outside of the Regional Forest lands are generally well recognized for their ecological value and in some cases are managed according to property-specific woodland management plans.
- Existing monitoring programs, particularly the annual Forest Health Monitoring program, provides valuable current data regarding emerging threats to the biodiversity of the Halton Regional Forests.
- Halton's Transportation Planning group is actively funding biodiversity related research on Regional road projects.

Weaknesses

- Opportunities to maintain and enhance biodiversity other than through tree planting have generally not been explored.
- The ecological research value of the Regional Forest lands could be better used and advanced for educational and Regional purposes.
- Efforts to control invasive species are not strategic and this may limit success in controlling these species. This could contribute to reduced native biodiversity in the Halton Regional Forests in the future.
- Regional communications activities related to biodiversity are limited in scope. There is limited public engagement on biodiversity matters.

Opportunities

- Manage invasive species strategically.
- Expand scope of restoration/enhancement activities to include more than just planting of common tree and shrub species.
- Encourage ecological research activities in the Halton Regional Forests that contribute to improving our understanding of the impact associated with a variety of uses, and best practices for maintaining and enhancing biodiversity.
- Explore the opportunity of forest certification of the Regional Forest lands, through a formal certification scheme.
- Engage the public in the enjoyment, maintenance and enhancement of biodiversity in the Halton Regional Forests.

Threats

- Lack of staff resources for implementation.
- Lack of or change in political support for such an initiative.
- Continual pressure from recreational use and forest operations leading to introduction of invasive plants.
- Global trade and the introduction of non-native pathogens introduction and establishment.
- Climate change and myriad unknown changes as a result of climate impacts.

5. Strategies to Achieve Biodiversity in the Halton Regional Forests

Table 3 identifies a number of strategies to achieve biodiversity in the Halton Regional Forests together with accompanying actions, a brief justification for strategy selection, the specific threats addressed by both strategies and actions, alignment with Ontario's Biodiversity Strategy framework's "Strategic Directions", and the anticipated timeline for implementation.

Table 3: Biodiversity Strategies for the Halton Regional Forests

Biodiversity Strategy	Action	Overview and Approach	Justification	Threat(s) addressed	Alignment with Ontario's Biodiversity Strategy	Implementation Timeframe	
						2014-2019	2019-2024
1. Implement strategic control of priority invasive species in Regional Forest Tracts.	<ul style="list-style-type: none"> Implement annual control of priority invasive species populations identified in the FHMP using contractors (licensed pesticide applicators). 	<ul style="list-style-type: none"> Maintain narrow focus on most problematic species (from biodiversity perspective not human) and most sensitive areas. Integrate quantitative monitoring of treatment success into FHMP. Explore opportunities to partner with Conservation Authority partners in controlling invasive species in the Halton Regional Forests. 	<p>Invasive species are recognized as one of the most significant threats to biodiversity in Ontario. Populations of priority invasive species have been identified at low levels in the Regional Forest Tracts and have the potential to spread and negatively impact biodiversity of these areas. Control of invasive species will become more difficult and expensive as populations expand over time, and therefore early and consistent management of these populations is preferred. Current management of these species is not consistent due to limited staff and financial resources.</p>	<ul style="list-style-type: none"> Invasive Species 	<ul style="list-style-type: none"> Reduce Threats 	√	√
2. Expand the scope of restoration/enhancement activities beyond tree and shrub planting.	<ul style="list-style-type: none"> Prioritize opportunities to implement biodiversity maintenance and enhancement projects on Regional Forest lands. 	<ul style="list-style-type: none"> Biodiversity maintenance and enhancement projects may include (but not be limited to) the following: <ul style="list-style-type: none"> Enhancement of forest bird habitats in Regional forests through silvicultural treatments Restoration of specialized species at risk habitats (e.g. chimney swift chimneys, aquatic habitat buffer plantings, etc.) Restoration of stream/aquatic habitat to improve water quality, temperature and flow dynamics. 	<p>Habitat loss/degradation is recognized as the greatest threat to biodiversity in Ontario. Regional habitat restoration initiatives currently focus exclusively on tree planting. While tree planting and forest establishment are important objectives and should remain a primary component of the Region's efforts, restoration should attempt to maintain and enhance a variety of habitats in order to maximize resultant benefits to Halton's biodiversity.</p> <p>Finally, expanding the scope of restoration opportunities will increase potential funding sources that may be exploited to get projects implemented.</p>	<ul style="list-style-type: none"> Habitat Loss and Degradation 	<ul style="list-style-type: none"> Enhance Resilience 	√	
	<ul style="list-style-type: none"> Obtain historical vegetation mapping to assist in identifying and guiding appropriate restoration activities. 	<ul style="list-style-type: none"> Halton Region will engage researchers at the University of Toronto's Faculty of Forestry to map and model historical vegetation cover (including non-forest ecosystems) in the Region based on land surveyor records and other digital mapping such as topographical information, climate, and soils data. 				√	
	<ul style="list-style-type: none"> Implement specific projects as opportunities arise 	<ul style="list-style-type: none"> Opportunities to implement specific projects may include working with developers to implement Endangered Species Act compensation in the Halton Regional Forests where this is required by ESA 2007 rules and regulations, making use of external funding opportunities such as the Species At Risk Stewardship Fund, or using funds from the Regional Forest budget. 				√	√
3. Implement programs to	<ul style="list-style-type: none"> Partner with the NEC to establish long term forest 	<ul style="list-style-type: none"> Staff from the NEC and Halton Region will collaborate to establish the new long-term monitoring plots, collect data, and 	<p>To better understand how ecosystems change and respond to human</p>	<ul style="list-style-type: none"> Habitat Loss and Degradation (by 	<ul style="list-style-type: none"> Improve Knowledge 	√	√

Biodiversity Strategy	Action	Overview and Approach	Justification	Threat(s) addressed	Alignment with Ontario's Biodiversity Strategy	Implementation Timeframe	
						2014-2019	2019-2024
monitor the biodiversity of Regional Forest Tracts.	biodiversity and health monitoring plots in Halton's Cox Tract and expand the scope to include monitoring of forest bird activity.	generate monitoring reports that document findings.	activities, it is important to monitor their composition and structure over time. The Regional Forest lands provide accessible and secure locations for establishing long term biodiversity monitoring plots.	providing information that can be used in adaptive management)			
	<ul style="list-style-type: none"> Establish long-term monitoring of wetlands within the Halton Regional Forests as an indicator of overall health of biodiversity. 	<ul style="list-style-type: none"> Parameters monitored at each station may include hydrology, vegetation, amphibians and birds. Locations will be selected to provide representative coverage of the RNHS and different types of wetlands to the extent feasible within the Halton Regional Forests. 	The NEC ONE Monitoring Program has been in operation since 1996 and provides high quality data about the biodiversity, health and dynamics of forest ecosystems along the Niagara Escarpment. The existing ONE monitoring plot in Halton Region is located in a relatively undisturbed portion of the Robertson forest tract that has limited human influence. By establishing new monitoring plots in the Cox forest tract, which is subject to human influences from forestry operations, quarrying and recreational use, it will be possible to better understand how these activities affect the health of the forest. This information will help inform future management decisions within of the Regional Forest Tracts.			√	√
	<ul style="list-style-type: none"> Explore additional opportunities to partner with others to monitor the impact of the above noted activities.. 	<ul style="list-style-type: none"> Staff will use this strategy as a vehicle to continue exploring opportunities to partner with others in monitoring the biodiversity of the Halton Regional Forests. 	Wetlands are among the most biologically productive and diverse ecosystems in Halton and provide particularly valuable ecological services such as flood attenuation, water filtration and vital habitat for fish and wildlife. They are also particularly sensitive to changes in precipitation and ground water, and monitoring them will assist us in understanding how climate change and other factors impact their capacity to perform these important functions.			√	
4. Promote Regional Forest Tracts as	<ul style="list-style-type: none"> Work with universities to conduct ecological research 	<ul style="list-style-type: none"> Provide research opportunities to address ecological issues encountered by Halton Region's Planning Department and 	There are currently gaps in our understanding of how to best maintain	<ul style="list-style-type: none"> Habitat Loss and Degradation (by 	<ul style="list-style-type: none"> Improve Knowledge, 	√	√

Biodiversity Strategy	Action	Overview and Approach	Justification	Threat(s) addressed	Alignment with Ontario's Biodiversity Strategy	Implementation Timeframe		
						2014-2019	2019-2024	
Living Laboratories.	in Regional Forest Tracts.	use as a testing ground for ecological inquiry.	and enhance the biological resources of Halton Region in the face of ongoing pressure from human uses including recreation, forestry, quarrying and development. Halton's Regional Forest Tracts provide an excellent field lab for applied ecological research that may help fill these knowledge gaps. Findings from such research, if appropriately designed and implemented, may provide evidence that can help inform and defend future land use planning decisions.	providing information that can be used in adaptive management)	Engage People			
	<ul style="list-style-type: none"> Undertake staff driven research activities focussed on informing mitigation/restoration best practices as time and budget allow. 	<ul style="list-style-type: none"> Regional staff expand current research efforts in the areas of Jefferson's Salamander pond creation, BMC Oak Regeneration, American Chestnut planting, as time and resources permit. 				√	√	
5. Engage the public in enjoying, characterizing and enhancing biodiversity resources in the Regional Forest tracts.	<ul style="list-style-type: none"> Promote citizen participation in existing ecological inventory and monitoring programs within Regional Forest Tracts. 	<ul style="list-style-type: none"> Promote participation in select programs such as eBird, the Ontario Nature Herpetofaunal Atlas app, etc. as part of Regional communications initiatives. This may include posting links to relevant programs on relevant Regional web pages or presenting about these opportunities at relevant events. 	Interested members of the public have the capacity to make significant contributions to our understanding of the Region's biodiversity resources, and can also contribute to maintaining and enhancing biodiversity through participation in volunteer events. A number of existing programs administered by others are increasingly being utilized by ecologists and others to inform decision making and impact assessment. By promoting awareness and participation in such programs, Halton Region can increase the availability of information used to make important planning and land management decisions with minimal cost and effort.	<ul style="list-style-type: none"> Habitat Loss and Degradation (by engaging people in conservation) 	<ul style="list-style-type: none"> Improve Knowledge, Engage People 	√	√	
	<ul style="list-style-type: none"> Create and promote self-guided interpretive walks for select Regional Forest tracts using smartphone technology such as QR code readers and/or 'Everytrail' tours. 	<ul style="list-style-type: none"> Existing free smartphone apps provide platforms for dissemination of educational content that can provide powerful and immersive educational experiences and help users understand the importance of biodiversity and the Region's efforts to protect it. This mode of information delivery requires no or minimal installation of signage in sensitive natural areas. Regional staff will develop content and deploy QR code signage in consultation with Citizen Advisory Committees. 				√		
	<ul style="list-style-type: none"> Work with our Conservation Authority partners to undertake a "BioBlitz" event(s) within Regional Forest Tracts. 	<ul style="list-style-type: none"> Encroachment, dumping and unauthorized trail creation (among other things) have the potential to negatively impact biodiversity in the Halton Regional Forests, particularly those adjacent to residential areas. 					√	
	<ul style="list-style-type: none"> Create online education tools such as Google Earth tours of biodiversity in the Regional forests. 	<ul style="list-style-type: none"> Google earth and other online tools are available that provide engaging educational platforms that can be used to provide an introduction to Halton's biodiversity. These tools are ultimately intended to encourage citizens and tourists to engage in experiencing Halton's biodiversity in person. 				Promoting participation in these programs may also help engage younger, tech savvy citizens in understanding and contributing to biodiversity conservation in their community, and in this way help connect them with the health benefits afforded by spending time in nature.	√	
	<ul style="list-style-type: none"> Collaborate with museum staff to engage school groups in understanding and enhancing biodiversity. 	<ul style="list-style-type: none"> Museum staff are already engaging and educating school groups on a range of topics related to biodiversity. 					√	√

Biodiversity Strategy	Action	Overview and Approach	Justification	Threat(s) addressed	Alignment with Ontario's Biodiversity Strategy	Implementation Timeframe	
						2014-2019	2019-2024
6. Engage in public awareness and educational activities to promote biodiversity.	<ul style="list-style-type: none"> Develop opportunities to promote awareness of this initiative 	<ul style="list-style-type: none"> Work with Corporate Communications to incorporate content on biodiversity with other Regional initiatives and awareness programs and to develop a multi-modal strategy including a website and social media for doing so. 	Public awareness and education are key to maintaining and enhancing biodiversity resources of the Halton Regional Forests for the benefit of our citizens, today and in the future.	Habitat Loss and Degradation (by engaging people in conservation)	<ul style="list-style-type: none"> Engage People 	√	
7. Continue to implement good forestry practices harvests in Regional Forest Tracts in accordance with the Forest Management Plan	<ul style="list-style-type: none"> Continue to implement good forestry practices harvests in Regional Forest lands in accordance with the Forest Management Plan 	<ul style="list-style-type: none"> Ongoing implementation of the Forest Management Plan will continue to make progress towards achieving biodiversity goals and objectives outlined in that plan. 	The primary objective of the existing Forest Management Plan is to conserve and enhance biodiversity within the Regional Forest Tracts. Continued implementation of the plan will ensure continued progress towards this goal.	Habitat Loss and Degradation (by restricting harvest and recreation to least sensitive areas), Invasive species, unsustainable use.	<ul style="list-style-type: none"> Enhance Resilience 	√	√

6. Alignment with Ontario's Biodiversity Strategy Targets

It is anticipated that the Region's Biodiversity Strategy will contribute to achieving at least 7 of the 15 targets identified in Ontario's Biodiversity Strategy, including:

- By 2015, 50% of Ontarians understand biodiversity and its role in maintaining their health and well-being.
- By 2015, the number of Ontarians who participate in biodiversity conservation activities is increased by 25%.
- By 2015, all sectors have initiated the development of implementation plans in support of Ontario's Biodiversity Strategy, and by 2020 those plans are implemented.
- By 2020, all relevant policies and programs integrate biodiversity values.
- By 2015, strategic plans are in place to reduce the threats posed to biodiversity by invasive species.
- By 2015, the status of species and ecosystems of conservation concern in Ontario is improved.
- By 2015, natural heritage system plans and biodiversity conservation strategies are developed and implemented at the municipal and landscape levels.

7. Conclusion

The Biodiversity Strategy represents the Region's commitment to a more sustainable Halton in general, and to the environment and ecology in particular. Halton's new program in ecology also demonstrates the Region's commitment to protecting and enhancing Halton's Natural Heritage System. This Strategy is intended to contribute to a more comprehensive program targeting long-term maintenance and enhancement of biodiversity in Halton's Natural Heritage System through responsible land stewardship with many partners including the public, non-governmental organizations, and other government agencies. Two implementation timelines have been established. While the majority of strategies will commence in the first five-year term most will continue to 2024, coinciding with the horizon date (2025) of the Halton Regional Forest Management Plan. The Biodiversity Strategy and associated actions contained in this document will assist in realisation of both Halton's biodiversity vision and contribute to efforts in the Province.

References

Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

Ontario Biodiversity Council. 2011. Ontario's Biodiversity Strategy, 2011: Renewing Our Commitment to Protecting What Sustains Us. Ontario Biodiversity Council, Peterborough, ON.

