RES.#A306/06 - TERRESTRIAL NATURAL HERITAGE SYSTEM STRATEGY

Approval of the strategy document.

Moved by: Bill Fisch
Seconded by: Gerri Lynn O'Connor

THAT the Terrestrial Natural Heritage System Strategy (herein 'the Strategy') be approved in principle;

THAT staff publish the Strategy and provide it to member municipalities, stakeholder watershed councils and task forces, the Greater Toronto Home Builders Association-Urban Development Institute (GTHBA-UDI), the Aggregate Producers Association of Ontario, contributing private foundations, the Ministry of Natural Resources (MNR), the Ministry of Municipal Affairs and Housing (MMAH), the Ministry of Public Infrastructure Renewal (MPIR), Canadian Wildlife Service, local universities and colleges, Conservation Ontario, the South Central Ontario Conservation Authorities (SCOCA) Natural Heritage Discussion Group, and participating or interested non-governmental organizations, citizens and professionals;

THAT staff make council presentations, and conduct workshops or information sessions, to inform municipal staff and stakeholders about the terrestrial natural heritage tools and science to assist them in planning for growth;

THAT staff be directed to promote the use of the science and tools in the Strategy to local and regional municipalities to assist them in developing a system to achieve local natural heritage protection and restoration goals in their official plans and to provide support as requested in its interpretation and application in development review/official plans and site specific plans;

THAT staff be directed to work with local and regional municipalities and the province to re-evaluate the natural heritage system requirements in the urban expansion lands, known as the "white belt area", as part of an integrated planning process being undertaken to meet the requirements put forth by the province in Places to Grow, and report back to the Authority in approximately 6 months on progress towards successful integration of these potentially conflicting objectives of growth planning;

THAT staff use the tools and science in the Strategy to inform environmental assessment and plan input and review activities to encourage a terrestrial natural heritage system (TNHS) that will result in long term protection and enhancement of biodiversity, giving each municipality time to develop and define their own system;

THAT staff use the Strategy for Toronto and Region Conservation Authority (TRCA) activities including watershed planning, land securement, land stewardship, conservation land planning, restoration planning and education;

AND FURTHER THAT staff monitor and report on progress toward achieving the targetted natural heritage system, and continue research and monitoring to provide leadership in advancing the science in sustainable ecosystem management for regional biodiversity.

CARRIED

Reference this Strategy as follows: Toronto and Region Conservation Authority (TRCA). 2007. Terrestrial Natural Heritage System Strategy.

PREFACE

"The Toronto of my childhood was a banquet of choices for a boy with an interest in nature. I mean different habitats with different sets of creatures in different seasons. I mean a variety of ecosystems for my buddies and me to choose from. In the 1940's and '50's the term ecosystem was unheard of, at least by us. I was privileged to be living in the old Belt Line Ravine, a tributary of the Don River. At the bottom of our garden was a natural stream with minnows, tadpoles and even a painted turtle. In the big backyards "across the tracks" grew giant willows with a groundcover of spring flowers, trilliums, hepaticas, bloodroot and many others. There were wild grape tangles where catbirds nested. The whole valley was an essential migration route for birds. We boys could take public transportation; reach the waterfront, Toronto Island, the Humber Valley with its marshes and wooded slopes, High Park, Grenadier Pond. On our bikes we went north to the rolling pastures and scrubby meadows, up Bathurst Street.

Now, of course, things have changed. The Belt Line Creek is a storm sewer, much of the waterfront is inaccessible, blocked by industry or condominiums, marshes have been dredged or drained and the fields and pastures covered by suburbia. The choices and variety are greatly reduced, not just for the public young and old, but more importantly for Torontonians of other species. Most of their worlds have disappeared.

We can count our blessings that our predecessors had the foresight to set aside places like Toronto Island and High Park as well as a patchwork of parks here and there throughout the metro area. Some areas have even been restored. The bottom of Leslie Street was worth a visit as a young birder in the '50's, but the creation of the man-made natural area of Leslie Spit is a great improvement.

David Brower, the famous American environmentalist, said: "What the world needs is CPR, not cardio-pulmonary resuscitation (which it also does need), but conservation, preservation and restoration". This is why I am so excited by the TNHSS. Nature dealt our community a rich and varied handful of possibilities. We have spent decades destroying possibilities, but there are still plenty left to work with. However, we need a cohesive plan, not just a patchwork. We need much more variety, including wetlands, corridors and other places designed for our neighbours of other species. Variety is not only the spice of life, it is life. As E.O. Wilson says, biodiversity is the creation. There will be costs, but nature is not a free lunch. There is no free lunch. We can pay now or pay later, but as in most things, if we pay later it will cost much more. I for one think it is well worth it and so will the generations that follow us.

Robert Bateman

ACKNOWLEDGEMENTS

The Terrestrial Natural Heritage System Strategy is the result of numerous years in the development of a new approach to defining a terrestrial natural heritage system and in the involvement of multiple participants in its review and testing. Consultation with stakeholders began in the late 1990s with technical meetings to discuss the premise behind the new approach (as described in Chapters one and two) and the various methodologies (as detailed in Appendices B, D and E). Stakeholders including municipal staff, watershed councils, academics, environmental consultants and biologists were invited. They contributed significant support in the form of accolades, constructive criticism and recommendations. Feedback was also received at conferences and larger, external meetings. Throughout its development the approach was applied in various projects, both internal and external, and we are thankful for the opportunity to assist and participate in those projects and, in that process, to improve the methodologies' relevance to real situations.

Toronto and Region Conservation wishes to thank its many partners, including the Etobicoke-Mimico Watershed Task Force, Humber Wateshed Alliance, Don Watershed Regeneration Council, Rouge Watershed Task Force, Duffins and Carruthers Creek Watershed Task Forces, and the South Central Ontario Conservation Authority (SCOCA) Natural Heritage Discussion Group. Support in the form of funding, advice and sharing the vision came from J.P. Bickell Foundation, Richard Ivey Foundation, McLaughlin Foundation, Schad Foundation, Salamander Foundation, Unilever Canada, City of Toronto, Region of Durham, Region of Peel, Region of York, Toronto Region Remedial Action Plan (RAP) and Environment Canada.

Toronto and Region Conservation wishes to thank the following individuals (listed alphabetically) Dawn Bazely, Graham Bryan, Brian Craig, Natalie Helferty, Brian Henshaw, Tom Hilditch, Steve Hounsell, Charles Kinsley, Dale Leadbeater, Kathy Lindsay, Brian McHaddie, Gray Merriam, Mike Puddister, Bridget Stutchbury and Cathy Plosz, for their on-going involvement and contribution in the development of the science, and in the communication and application of this approach.

EXECUTIVE SUMMARY

The Terrestrial Natural Heritage System Strategy (TNHSS) was developed between 2001 and 2006 by the Toronto and Region Conservation Authority (TRCA) and was approved in principle by the TRCA Board in 2007. It provides extensive data, scientific models, mapping and guidance for TRCA staff, TRCA's partner municipalities and community groups for achieving natural heritage protection objectives.

The need for a TNHSS originated from observations by TRCA and others that showed an alarming reduction in vegetation communities and species populations, and their distribution within TRCA's area of jurisdiction. This change was occurring simultaneously with urban expansion despite best efforts at protection. The reduction in forests, wetlands, meadows and their species was also accompanied by an increase in flooding and erosion, and in conflicting recreational uses in protected areas. Changes in land use were being approved site by site without understanding how, cumulatively, they were impacting the region's natural system and environmental health. Toronto and Region Conservation initiated The Living City® Strategic Plan in 1999 with the goal to engage agencies, industries and communities in collaborating for the sustainability of all life within TRCA's nine river watersheds and Lake Ontario waterfront. The TNHSS provides an important vehicle for achieving the greenspace and biodiversity objective of The Living City® Strategic Plan.

Toronto and Region Conservation would redefine its approach to biodiversity conservation to better reflect the role of ecosystems in the landscape. One important premise was that the distribution and quantity of natural cover and species is intricately linked to water, air quality and climate regulation, quality of life, and sustainability for citizens of The Living City® region. Conservation efforts should, therefore, not focus solely on the conventional protection of rare species or special natural areas. Toronto and Region Conservation collected a large database of flora and fauna species and land cover from across the region. From that database, a computer model (landscape analysis model) was developed to evaluate the existing condition and to predict the response of the region's biodiversity to urbanization should it proceed following the current practices in natural system protection. From a known 1111 species, 693 were predicted to either disappear from the region or be severely restricted in their distribution. This dramatic loss would be accompanied by further impacts on water quality, flooding, erosion and visitor crowding within the natural system. It was concluded that in order to meet the objectives of The Living City® Strategy Plan – to protect biodiversity and its ancillary benefits in the face of urbanization – more natural cover would be needed in the region than exists today.

A second model was developed to assist in designing an expanded target natural system. The model selected the areas of highest value to the region's natural system based on a variety of criteria, both ecological and planning. The result was a target system that includes much of the existing forests, wetlands and meadows (adding up to 25 per cent of the region) plus additional areas to be restored. This target system was evaluated using the landscape analysis model. It was determined that at least

30 per cent of the region should be natural cover in order to sustain the existing distribution and populations of species of concern. That target system would also help to sustain the environmental and social benefits of the existing system.

The TNHSS was developed and finalized in consultation with stakeholders including municipalities, National Government Organization's (NGO), provincial and federal governments, community groups, academics and the development industry. The data, mapping and models are now available to stakeholders to assist them in decisions around land planning, management, stewardship and securement. The target terrestrial natural system was used and refined at the watershed scale in the development of watershed plans. The target system within the growth plan area is subject to further analysis and refinement to integrate with other community planning objectives as part of growth planning exercises. Applications and refinements will also occur through the more detailed planning at the secondary, subdivision and site plan scales. The target system within the rural areas will be refined at the detailed scale with landowners in stewardship initiatives. Thus, guided by the TNHSS, decisions at smaller scales will be made in consideration of the sustainability of the region.

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APPENDICES – TECHNICAL

All appendices are contained on DVD located in the back of this strategy document

A. Benefits of a Sustainable Terrestrial Natural System
B. Vegetation Community and Species Ranking and Scoring Method
C. Data Collection Methodology
D. Setting Terrestrial Natural System Targets
E. Evaluating and Designing Terrestrial Natural Systems

APPENDICES – PLANNING

All appendices are contained on DVD located in the back of this strategy document

F. Model Policies
G. Natural Heritage Restoration Plan Guidelines
H. Natural Heritage Compensation Plan Requirements
I. Environmental Impact Study Guidelines

J. Glossary

CHAPTER

1

1.0 INTRODUCTION

The Terrestrial Natural Heritage System Strategy (TNHSS) is a significant undertaking toward achieving the Toronto and Region Conservation Authority's (TRCA) objective for Regional Biodiversity: to protect and restore a regional system of natural areas that provide habitat for plant and animal species; improve air quality; contribute to water management, liveable environments and neighbourhoods; and provide opportunities for enjoyment of nature.

Analysis of our natural heritage information determined that 'business as usual' has not resulted in the protection of ecological function and biodiversity, especially in the developing lands of our jurisdiction. Toronto and Region Conservation has documented a significant decrease in the abundance and diversity of species (flora and fauna) within the nine watersheds of our jurisdiction. As well, the distribution of many of these species has been restricted to the very northern parts of our watersheds. Therefore, it was time to develop a new approach.

The Strategy represents six years of consultation with many stakeholders, including our municipal partners, other conservation authorities, academia, ecological specialists and the provincial government to develop and document the science and modeling tools that allow us to identify the potential effects of changing land use on existing cover and its habitat value. It also shows us how existing habitat function can be improved with the addition of lands that have the potential to become natural cover. It is the first time that we have been able to model the effects of changing land use on existing habitats and determine what it will take to protect and enhance habitats for the future. As our communities continue to grow, it is important to plan comprehensively for a sustainable natural heritage system for the region.

The regional terrestrial natural heritage system defined in the Strategy is designed to protect and improve biodiversity by increasing the quality and amount of forest and wetland habitats by building upon the existing terrestrial system and optimizing the opportunities for native species diversity. It uses ecologically-based analytical tools to identify lands that have the greatest potential

to contribute to improvements in size, shape and connectivity resulting in a target terrestrial natural heritage system. The Strategy incorporates the current thinking on terrestrial natural heritage protection and restoration as well as comprehensive data on the terrestrial natural heritage assets of TRCA's jurisdiction.

The result is a targeted terrestrial natural heritage system *model* that distributes natural cover throughout our jurisdiction, includes areas of all levels of quality and recognizes provincial interests as well as those of regional and local importance.

The system, as defined in the Strategy, is based on a modeling exercise using 2002 base information (the only information that was available for the entire jurisdiction). Therefore, while it can be used to inform TRCA activities from restoration to plan review, the potential of lands to contribute to the system must be assessed along with site-specific, recent information to make informed decisions about the potential of a piece of land to contribute to the system.

It is our intent that the science and tools developed are offered to TRCA's watershed municipalities to assist them in defining a natural heritage system as required by the province for their official plans. Because it is a model and not based on the most current landuse information, it must be refined for specific municipal use and supported by a policy framework that allows for site specific assessment and modification where appropriate.

Toronto and Region Conservation recognizes the considerable challenges facing municipalities to accommodate the growth expected for this region. To this end, TRCA is committed to working with our municipal partners to use the tools developed for the Strategy to assist them in re-evaluating and refining the system to meet their goals for sustainable community building. This includes identifying a natural heritage system that encompasses areas of provincial interest as per the Provincial Policy Statement (MMAH 2005), key natural heritage features as defined by the Oak Ridges Moraine Conservation Plan (ORMCP 2001) and Greenbelt Plan (MMAH 2005b), watercourses and their

Indian Pipe, one of 1111 plant and animal species known in the region; Species, whose habitats perform ecosystem functions such as purifying air and water, indicate ecosystem health

floodplains, provision of nature-based recreational amenities, climate change mitigation and the management of urban drainage. This is best accomplished through interdisciplinary planning. Toronto and Region Conservation is willing to assist municipalities in optimizing and integrating natural heritage planning into growth planning scenarios for the growth planning areas within the rural-agricultural areas (referred to as the "white belt") as well as for planned and existing built-up areas.

In summary, the Strategy was developed at the regional scale with a single focus—terrestrial biodiversity. The proposed target system for the TRCA jurisdiction will need to be integrated with other ecosystem elements (e.g., Climate change mitigation, hydrology) and refined using site-specific information and various community design requirements.

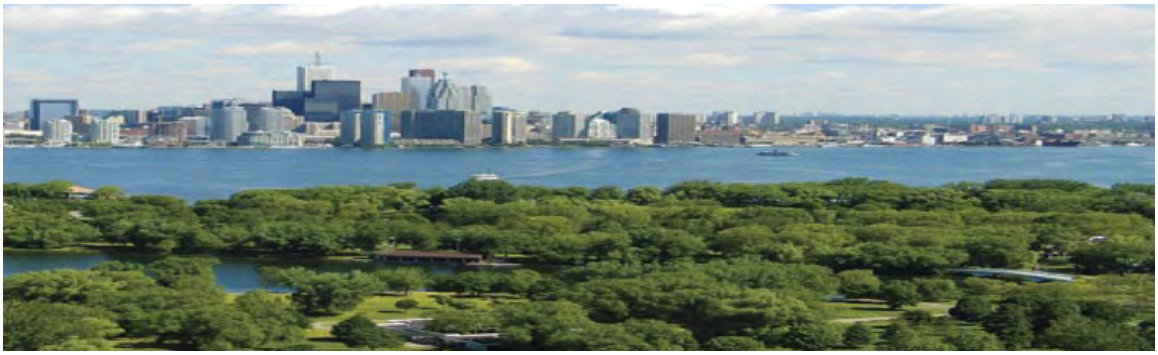
This chapter details the rationale and history of the TNHSS, including the link between wild species and people. The chapters that follow lay out the vision, report on existing conditions, and present the target system and how to achieve it.

The Living City Vision

Since 2000, TRCA has reviewed its challenges and accomplishments and positioned itself to be more effective in the 21st century. Based on the knowledge that, by 2030, 61% of the world's population will be living in cities (United Nations Population Fund, 1999), TRCA agrees with the assertion of the United Nations that the future of the planet will be determined in rapidly expanding city/regions. The quest for sustainable development has always been, and will continue to be, at the forefront of TRCA's work—reconnecting human and natural environmental objectives by working in partnership with the community. Toronto and Region Conservation works from the perspective that natural processes contribute to the physical form of cities and neighbourhoods and that the development of urban areas influences and affects the health and ecological integrity of natural systems—that cities are part of, not separate from, nature.

In 2003, TRCA put forth its vision for a new kind of community, "The Living City" (TRCA 2005),

"...where human settlement can flourish forever as part of nature's beauty and diversity."



The southern edge of the Living City Region - downtown Toronto and the Toronto Islands

Biological systems need to be protected and restored with consideration for the design of human systems. Increasing the liveability of the Toronto region by conserving freshwater and biological resources for future generations is our imperative and our commitment. The TNHSS is a key means to achieving the objectives of The Living City and sustainable communities:

- **Healthy Rivers and Shorelines**: to restore the integrity and health of the region's rivers and waters from the headwaters in the Oak Ridges moraine, throughout each of the nine watersheds in TRCA's jurisdiction, to the Toronto region waterfront on Lake Ontario
- **Regional Biodiversity**: to protect and restore a regional system of natural areas that provide habitat for plants and animal species, improve air quality and provide opportunities for the enjoyment of nature and recreation
- **Sustainable Communities**: to facilitate broad community understanding, dialogue and action toward integrated approaches to sustainable living and city building that improve the quality of life for residents, businesses and nature
- **Business Excellence:** to pursue continuous improvement in the development and delivery of all programs through creative partnerships, diverse funding sources and careful auditing of outcomes and effectiveness.

Legislative Mandate

The legislative mandate for developing the TNHSS comes from the Conservation Authorities Act. Section 20 (1) of the Conservation Authorities Act specifies that the objects of an authority are to:

> *"establish and undertake...a program designed to further the conservation, restoration, development and management of natural resources other than gas, oil, coal and minerals."*

For the purpose of accomplishing its objects, Section 21 (1) of the Act assigns to conservation authorities numerous powers, including 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."*

Thus, this Terrestrial Natural Heritage System Strategy is the result of a six-year study of the TRCA's terrestrial natural heritage resources and recommends a program to conserve and restore terrestrial natural resources.

One of the key vehicles for implementation of a natural heritage system is the Planning Act. Section 2 (a) of the Planning Act requires that planning approval authorities have regard to matters of provincial interest including, "the protection of ecological systems, including natural areas, features and functions", as well as Natural Hazards for which Conservation Authorities have delegated commenting authority on behalf of the province. The provincial interest in natural heritage is further specified in Section 2.1 of the Provincial Policy Statement (PPS)

(MMAH, 2005a), which sets out protection requirements for identified natural heritage features and areas. Even more directly related to the terrestrial natural system is Section 2.1.2 of the PPS, which states that:

> *"The diversity and connectivity of natural features in an area, and the long-term ecological function and biodiversity of natural heritage systems, should be maintained, restored or, where possible, improved, recognizing linkages between and among natural heritage features and areas, surface water features and ground water features."*

The Toronto and Region Conservation holds Memoranda of Understanding with several of its municipal partners to provide technical advice on environmental matters relating to planning applications and development proposals requiring approval under the Planning Act.

1.1 DEFINING THE TERRESTRIAL NATURAL SYSTEM

Natural Heritage System

The Province of Ontario, through the PPS, defines the natural heritage system as a system of natural heritage features and areas, 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 (MMAH, 2005a).

The ***terrestrial*** *natural heritage system* is composed of two major components—*terrestrial natural cover* (features) and *natural processes* (functions)—and all of the linkages between features and functions.

Terrestrial Natural Cover (the Features)

Toronto and Region Conservation defines terrestrial natural cover as all land cover that is

- Forest (coniferous, deciduous and treed swamp)
- Wetland (marsh, meadow marsh, thicket swamp, bog and fen)
- Meadow (including sand barren, savannah and tallgrass prairie)
- Coastal habitat (including beach, dune, and bluff).

Toronto and Region Conservation's definition includes natural communities that have been altered from the original state and are considered "cultural" or "anthropogenic" natural communities, for example, plantations and old fields, but not manicured lawns. Although these are distinct vegetation types, the definition of natural cover acknowledges the benefits of physical linkages in the landscape among all of these features.

Natural Processes (the Functions)

The terrestrial natural system definition encompasses the natural processes associated with terrestrial natural cover and the linkages between features and functions:

- The organization of flora and fauna species into natural communities
- The interactions and relationships between these natural communities
- The cycling of water, air and nutrients
- The response to environmental change (to climate change, for example).

The influence of these processes extends beyond the limits of the terrestrial natural cover itself and to aquatic systems and agricultural and urban lands, exhibiting further the important linkages between components and processes across the landscape as a whole.

1.2 PEOPLE AND THE TERRESTRIAL NATURAL SYSTEM

Ecosystem Services

Natural processes that help "sustain and fulfill human life" are considered ecosystem "services" (ecology.org, 2005). Terrestrial natural systems perform ecosystem services on which we depend to live and which are economically and ecologically impossible to duplicate. As illustrated in Figure 1, there are many characteristics of a healthy terrestrial natural system:

- It regulates the hydrologic cycle by capturing, storing and cleaning the water we drink and swim in
- It reduces peak flows and flooding from storm events
- It promotes healthy fish and aquatic communities
- It contributes to cleansing pollutants from the air we breathe and producing oxygen
- It regulates climate
- It provides active and passive recreational opportunities
- It promotes a sense of place from identifying with the unique character that natural areas bring to a city
- It promotes healthier lifestyles resulting from clean air and water and access to open spaces with natural aesthetics.

Appendix A expands on these links.

This Strategy was developed to protect and restore species and vegetation communities that comprise the terrestrial natural system, but its implementation will depend on the general recognition of its positive impact on human wellbeing at the local and regional scales.

The key is to understand the link between species and human quality of life. All species tell something about our shared environment. Studies show that lichens, which feed on nitrogen from the air, are generally absent from areas where air pollution is high but very diverse as air quality

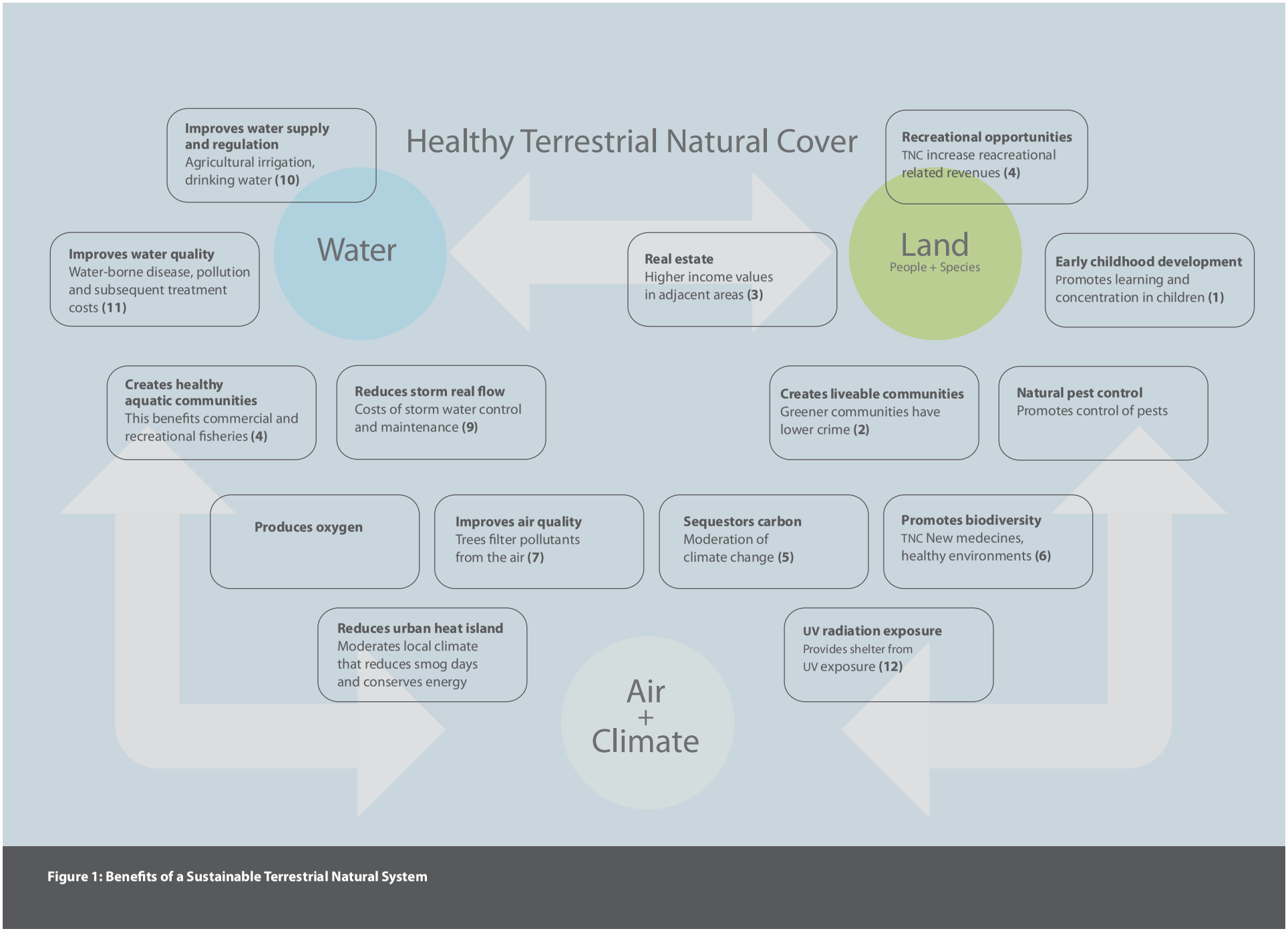


Figure 1: Benefits of a Sustainable Terrestrial Natural System

improves (Government of Canada, 2006; USDA 2006). In the city, a spread of red trilliums blooms at the base of sugar maples before the leafing tree canopy shades them. In the suburbs, in the only sizeable wetland in a kilometer stretch, leopard frog tadpoles await the next storm to bring new water to their shrinking pool. In the countryside, every summer, black-throated green warblers raise families in a vast, mature eastern hemlock forest. Brook trout live in cool streams within that forest and hikers pass by on weekend daytrips.

Likely neither trillium, tadpole, trout nor warbler thinks of its habitat as a protector of discharge areas, reducer of flood damage, regulator of ambient temperatures or provider of outdoor experiences for people. But to planners and scientists with a mandate to protect species, air, water, soil, property, and to provide public safety and wellbeing, a natural system can provide an opportunity to reach across disciplines for efficient, sustainable solutions. One important theme of the TNHSS is that the distribution of species and their habitats is the foundation for a green infrastructure for healthy communities.

The new Bloorview Kids Rehab center was intentionally built to "draw on the natural beauty and restorative nature of the neighbouring ravine" at Bayview and Eglinton, Toronto (Bloorview Kids Rehab website). Research shows that viewing and accessing nature promotes healing (Ulrich, 1984; Wells 2000).

Bloorview Kids Rehab Centre

The natural system is a fundamental component to achieving a high quality of life. Ecosystem services are needed particularly in urban and urbanizing areas where, ironically, natural systems are under the greatest pressure. Robust natural systems are better able to perform ecosystem services but human population growth puts additional stresses on the natural system. In urbanizing city/regions like the Toronto region, a more robust terrestrial natural system will be that much more valuable in the future.

Environmental Economics

Standard economic measures such as the Gross National Product (GNP) are misleading in that they ignore non-market values of ecosystem services but include ecosystem depletion as a contribution to prosperity (GPI Atlantic, 2005; Mosquin *et al.* 1995).

It is difficult to determine a monetary value for species and ecosystem services because social values are not easily quantified; it is difficult to agree on the precise value of air, water, soil and species (Wikipedia 2006). But the concept of environmental economics values natural systems

more comprehensively than conventional economics (Costanza *et al.* 1997). Mosquin *et al.* (1995) estimated the value of nature as a biological resource for Canadians to be a minimum of $70 billion annually; they estimated the cost of conservation to be $2.9 billion.

At the regional scale, in a case study in Ontario's Grand River, Ducks Unlimited Canada and the Nature Conservancy of Canada calculated the net value for local natural areas to be approximately $200 per hectare per year for selected services (Olewiler, 2004). A study of 27 water suppliers showed that "***the treatment and chemical costs [of providing water] decreased approximately 20 per cent for every 10 per cent increase in forest cover in the source area (up to 60 per cent forest cover)***" (Ernst *et al.* 2004). In New York, the adoption of a forest protection strategy will be seven times cheaper than building and operating a treatment plant (World Bank/World Wildlife Fund Alliance 2004). Studies in the United States have illustrated the relationship between forest and the sale price of residential properties, including a six per cent increase in value in one study, and 3.5 to 4.5 per cent in another (Wolf, 2001). These are just a few of the findings from this emerging field of study. Environmental economics can assist in determining the value of implementing the TNHSS, in

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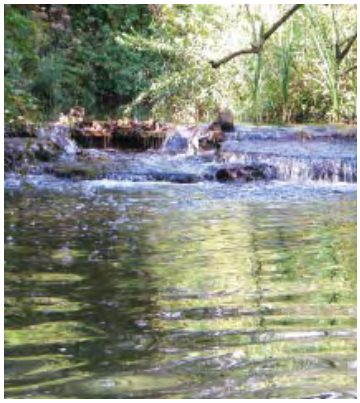

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Glen Major trail, Duffins Watershed; Bruce Creek, in the Rouge River; New England Aster.

essence, the extrinsic value of protecting species. In the end, the TNHSS target system may not be valued for resource extraction (lumber, etc.), but more likely for its ecosystem services contributing to the liveability of growing communities; for maintaining the appeal for tourism (Toronto the Green); and for its contributions to climate change mitigation and for savings in health care and infrastructure costs (including remediation works to protect public life and property from flooding). These are not resources that can be purchased from elsewhere in Ontario; they are the natural capital that can only be generated from within the boundary of this region, from our local natural system.

Putting it all Together

A terrestrial natural system is the most important means of achieving the "Regional Biodiversity" objective of the Living City. But when looking at ecosystem services and environmental economic perspectives, it becomes evident how terrestrial natural cover is also a very significant contributor

to achieving the Living City "Healthy Rivers and Shorelines" and "Sustainable Communities" objectives. The terrestrial biodiversity focus of the TNHSS on species, vegetation communities and natural processes, is considered fundamentally inseparable from overall ecological, social and economic wellbeing. Species, which are used in the Strategy as indicators of ecosystem health, are complicit "partners" in the Living City endeavour.

Photography © 2008 Toronto and Region Conservation

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Every species fills a niche: the Black-crowned night heron feeds at night on the Lake Ontario shoreline; the Maidenhair Fern lives in rich, mature forests.

1.3 THE TORONTO REGION AT A GLANCE

Toronto and Region Conservation's jurisdiction, as defined for this Strategy, includes the City of Toronto, parts of the three Regional Municipalities of York, Peel and Durham, and the small area of Counties of Simcoe and Dufferin within the TRCA area of jurisdiction. It consists of the nine watersheds, from Etobicoke Creek in the west to Carruthers Creek in the east, that drain from the Oak Ridges Moraine and Peel Plains into the north-western shores of Lake Ontario, and includes the waterfront between these rivers. This jurisdiction takes in the most urbanized core of the City of Toronto and surrounding suburbs of the three regional municipalities, yet almost half of the area remains rural and agricultural.

Ecological Character

The Toronto region lies in an ecological zone of transition between two forest regions, the Great Lakes-St. Lawrence forest to the north, and the Carolinian forest to the south. Terrestrial natural cover is mainly deciduous and mixed forest, interspersed with smaller tracts of wetland, native meadow and Great Lakes coastal habitats. Prior to European settlement and the clearing of forests for agriculture, forest is estimated to have covered approximately 90 per cent of southern Ontario, including the TRCA's watersheds. It has been said that a squirrel could have travelled through the treetops from the locations of present-day Windsor to Ottawa without ever having touched the ground!

Photography © 2008 S. Hayes, Toronto and Region Conservation

A misty Charles Sauriol Reserve, Don Watershed

Today the remnant terrestrial natural system throughout the TRCA jurisdiction is largely confined to the deeply-incised valley systems of the urban landscape or to the rural and agricultural landscapes of the upper portions of the watersheds. Besides the Oak Ridges Moraine and a small portion of the Niagara Escarpment, there are many remnant natural places that shape the character of the TRCA jurisdiction:

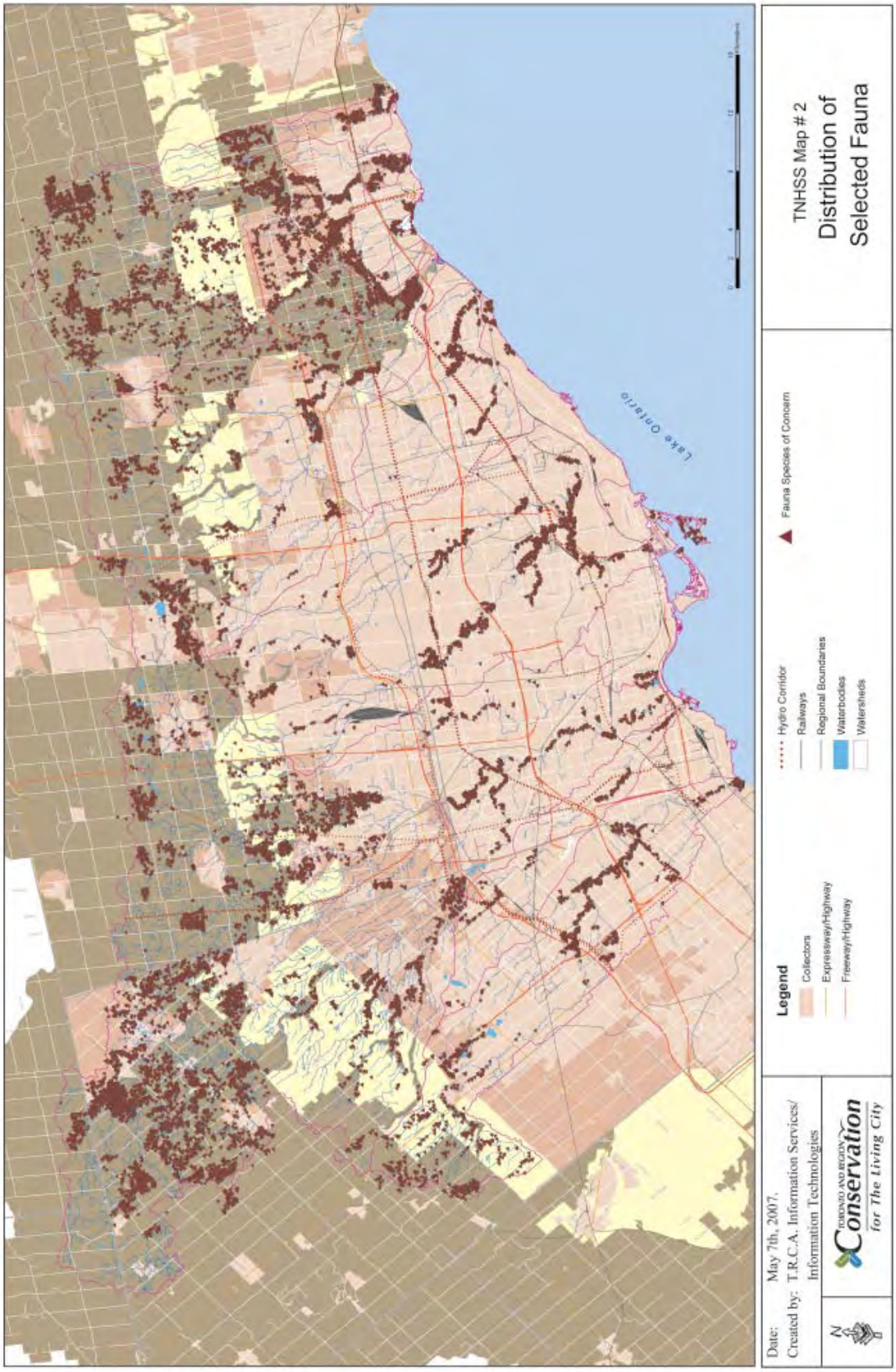
- The nine rivers and their tributaries, much of whose valleylands function as vital green corridors within the urbanized area
- Rouge Park, the second largest urban natural heritage park in North America.
- The shoreline of post-glacial Lake Iroquois, a major rise in elevation that extends from west to east across the Region inland from Lake Ontario
- Scarborough Bluffs, Toronto Islands, and other Lake Ontario beaches and bluffs
- Forests and wetlands that are large and intact enough to support species and communities characteristic of the region before European settlement, some of which are now rare or endangered
- Tallgrass prairie and oak savannah communities, now rare in North America, such as those in High Park in the City of Toronto.

Land Use

For the purpose of better reflecting the TRCA jurisdiction's land use diversity, this Strategy divides the region into four terrestrial natural heritage planning areas (consistent with the Province's Growth Plan delineations in 2006). Each area has its own combination of geophysical, land use, and policy characteristics. Shown on Map 1, from north to south the four areas are

- The *Greenbelt Area* (including the Oak Ridges Moraine and Niagara Escarpment), mainly natural or agricultural in character, with that character protected by provincial legislation
- The *Agricultural and Rural Area*, mainly agricultural lands south of the Moraine and Greenbelt, and outside of lands currently designated for urban development—this is where the next wave of growth will occur
- The *Designated Greenfield Area*, consisting of mainly agricultural lands that are within designated urban or settlement areas, and are currently being developed or are committed to development, including settlement areas of the Oak Ridges Moraine

Map 2: Known Distribution of Fauna Species of Concern in the TRCA Jurisdiction.



- The , incorporating the built out areas of the City of Toronto and the surrounding suburban communities of York, Peel and Durham, including the urbanized areas of the Oak Ridges Moraine and Niagara Escarpment.

Human Population and Biodiversity

The Toronto and Region Conservation area of jurisdiction is approximately 2500 km^2 (250,000 hectares) and is home to some 3.5 million people (2003), up from 1.2 million in 1951. It is one of the fastest growing city/regions in North America. Historical Ontario Ministry of Natural Resources (OMNR) records, settler reports and other sources have also shown that an estimated 119 species, including elk, bobcat, wood turtle, Calypso Orchid and Indian Paintbrush, are no longer found in the region. This happened in two ways:

1. The direct loss of natural cover to urbanization
2. The indirect degradation of the remaining natural cover though changes in the hydrology (water quantity and quality), soil compaction and recreational use.

Changes in biodiversity may also be the result of climate change.

Photography © 2008 Mark Peck, Royal Ontario Museum

Photography © 2008 K. Purves, Toronto and Region Conservation

Red-headed Woodpeckers are at the edge of their range and were likely always uncommon in this region. In contrast, Broad-leaved Spring Beauty are less common now than they were historically in response to dramatic changes in the landscape.

Despite the increase in awareness of conservation issues in the TRCA jurisdiction, there continues to be incremental losses of habitat while the quality of remaining habitat continues to decline. Biological inventory work undertaken by TRCA over the last decade has highlighted an abrupt interruption in the southern distribution of many species and vegetation communities in the TRCA jurisdiction.

Map 2 shows the result of fauna surveys conducted evenly across the region, demonstrating the unbalanced distribution of occurrences (points) especially between the built-up planning area and the other three areas. Of the 1111 native flora and fauna species found in the TRCA jurisdiction, currently 693 are not found within the urbanized portions, illustrating the impact that urbanization

has had on the region's biodiversity. All 693 are currently on TRCA's list of species of conservation concern (Species of Concern) (see Appendix B on Vegetation Community and Species Ranking and Scoring). As urbanization expands within the watersheds, it is expected that this trend of gradual species extirpation will continue unless a different approach is taken.

1.4 NATURAL HERITAGE IN ONTARIO- ADAPTING TO AN EVOLVING FRAMEWORK

Conservation, as it was

Conservation approaches of the 1970s and 1980s failed to adequately conserve the ecological integrity and biodiversity of natural systems because they traditionally focussed on setting aside the most significant and often rarest areas as parks or reserves. This "islands of green" approach had the unintended effect of allowing species to become threatened or rare before they were considered significant, leading to perpetual crisis management.

Through the 1980s and 1990s, the TRCA led the identification of Environmentally Significant Areas (ESAs) based on criteria specific to the TRCA jurisdiction (MTRCA 1993), and these, by and large, have been identified for some measure of protection in municipal official plans. The province also designed the cores-and-corridors approach to protecting natural heritage systems in Ontario (Riley and Mohr 1994), which identified special features and connecting corridors as the system to be protected. This early systems approach culminated in a 1995 provincial requirement, now expressed through the *Provincial Policy Statement* under the *Planning Act*, that a specified list of significant natural heritage features should be protected in all planning documents and through the development approvals process.

The fundamental flaw of these traditional approaches is that they generally focus on protecting the existing features and systems rather than envisioning the system that would be required in the long-term for sustainable species populations and ecosystem services. The features are often protected in isolation of other natural cover and surrounded by an increased urban cover. Site-by-site decisions are made without being able to assess the cumulative implications at multiple scales. This results in the gradual degradation of those features and the decline of common species at all scales.

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Photography © 2008 R. Hasner, Toronto and Region Conservation

Land planning must take place at both the site and landscape scales.

Systems Approach - Planning at Multiple Scales

The legislative and policy framework that supports natural heritage protection in the province has evolved over the years to reflect changes in the Ontario landscape. Toronto and Region Conservation's approach and this Strategy were developed in parallel to this "evolving framework". In its early development, TRCA pioneered this approach to protect biodiversity at the regional scale. But today there is a growing recognition by biologists, environmentalists and planners that conservation needs to occur at both the site and regional scales together.

The provincial trend toward regional planning is obvious. Through its Natural Spaces Program, the province is developing and testing an approach for identifying landscape-scale natural heritage systems for southern Ontario. The Ontario Biodiversity Strategy was finalized in 2005 (OMNR, 2005)) in response to a recommendation in 2002 by the Environmental Commissioner of Ontario to address rapid declines in biodiversity in the province (Environmental Commissioner of Ontario, 2003). The 2005 Provincial Policy Statement recognizes that "[natural heritage] systems can include lands that have been restored and areas with the potential to be restored to a natural state" (MMAH 2005a). This recognition of the *potential* of lands to contribute to achieving conservation objectives is fundamental in Southern Ontario where landscapes support limited existing natural cover. In the Greater Toronto Area, the province has increased its emphasis on regional planning with the Oak Ridges Moraine Conservation Plan that identifies for protection a natural heritage system of cores and corridors across the entire Moraine, the Greenbelt Plan that protects rural character and the Growth Plan that establishes growth objectives, across the Greater Golden Horseshoe. These shifts by the province from managing at the site scale to now setting a regional context for protecting natural systems and managing growth and development locally are important steps to promoting sustainability.

Regional-scale planning for protecting natural heritage has become more widely accepted and has been incorporated into the official plans of municipalities in the TRCA jurisdiction as a Natural Heritage System (City of Toronto), a Greenlands System (Regions of Peel, York) or a Natural Heritage Areas layer (Region of Durham), with similar systems being incorporated into local municipal official plans, and in watershed and subwatershed plans. Municipalities have supported the TRCA in improving its systems thinking from protecting environmentally significant sites and linked greenlands to modeling sustainable natural system scenarios as target systems.

Setting Targets

The concept of striving for a given minimum amount of natural cover to achieve specific conservation objectives is also widely accepted. The Great Lakes Remedial Action Plan work coordinated by Environment Canada (Environment Canada, 2004) has suggested that to achieve and maintain healthy watersheds, at least 30% of a watershed should be in forest cover and 10% of the watershed should be wetlands.

The Oak Ridges Moraine Conservation Plan (MMAH 2002) recommends that municipalities assess the desirability of achieving a minimum 30% of a subwatershed in self-sustaining vegetative cover. The official plan of the Region of York sets a target of achieving a minimum 25 per cent forest cover up from the existing 22.5 per cent (The Regional Municipality of York, 2005 a and b). Background

discussion papers for the review and update of the Region of Durham official plan recommended 30% forest cover for the Region. Support for similar percentage cover targets have been found in the scientific literature for some time now (Andren, 1994; Fahrig 2002; Freemark 1988; Lee *et al.* 2002; Villard *et al.* 1999).

Toronto and Region Conservation's Approach

Toronto and Region Conservation developed its own approach. First, it formulated a rationale for protecting Species of Concern regionally that would facilitate target setting, then it used predictive modeling of future land cover changes (natural, agricultural and urban) to determine sustainable regional-scale targets for natural cover and species in the region (see Appendix D, *Setting Terrestrial Natural System Targets*).

The province, through the PPS, sets the standards for conservation at a coarse provincial scale, and allows and encourages municipalities to go beyond this standard to reflect the needs for conservation at the local scale. The TNHSS, backed by an extensive inventory of local data and local expertise in conservation, is TRCA's version of the finer level of detail needed in order to be effective in conservation at both the regional and site planning scales.

CHAPTER

2

2.0 THE STRATEGY: A VISION FOR A SUSTAINABLE REGION

2.1 THE TERRESTRIAL NATURAL HERITAGE SYSTEM: VISION, GOAL AND OBJECTIVES

- The TNHSS is designed to maintain and, where possible, restore species populations, vegetation communities and natural processes (ecosystem services) and thus enhance the quality of life for Toronto region residents by identifying a land base necessary for a sustainable terrestrial natural system across the TRCA jurisdiction.

Vision

Toronto and Region Conservation's vision for the terrestrial natural system is

> *"A sustainable system that is accessible to and valued by the region's residents as the foundation for the health and ecological integrity of the Toronto region, making it "The Living City".*

This vision looks forward:

- For a generation, to 2031 (as per Provincial Growth Plan), when the commitments necessary to protect and restore the targeted land base for terrestrial natural heritage will be made in policies, land securement agreements and stewardship
- For a century, to 2100, when our natural heritage will be restored to the target system through forest, wetland and meadow regeneration
- To the centuries beyond, which will have their own ways of expressing and protecting this vision while maintaining and enhancing its essential principles.

Goal

> *To work with all stakeholders to identify and protect a land base comprised of "existing" and "potential" natural cover and to fully secure and restore a target terrestrial natural system by 2100 that will both protect and restore native biodiversity.*

Objectives

Toronto and Region Conservation's objectives for the TRCA jurisdiction terrestrial natural system are to

- Increase the quality, distribution and quantity of natural cover to promote and sustain natural processes across the region
- Establish conditions that will allow terrestrial natural communities and native species to evolve and flourish throughout the region as development and intensification continues
- Contribute to the social and environmental well being of the TRCA jurisdiction through integration of the TNHSS into other natural heritage and sustainability initiatives.

The TNHSS achieves these objectives in two ways:

- By using a systems approach, evaluating the quality, distribution and quantity of the terrestrial natural cover in the landscape as a single functional unit, rather than as separate natural areas
- By determining targets for the quality, distribution and quantity of terrestrial natural cover needed in the landscape in order to promote biodiversity and a sustainable city region.

2.2 PRINCIPLES OF LANDSCAPE ECOLOGY

For many years, scientists, planners, and citizens worldwide have been working toward sustainability, in part through the protection and restoration of ecosystems at various scales. From the accumulated experience and knowledge, science-based principles have been widely accepted in the design of terrestrial natural heritage systems (Noss and Harris 1986; Poser *et al.* 1993; Forman 1995; Lee *et al.*. 2002). The following principles of landscape ecology provided guidance in the development of the TRCA approach. They are also the principles adopted by the South Central Ontario Conservation Authorities' (SCOCA) Natural Heritage Discussion Group to assist in the standardization of methodologies for natural heritage protection and restoration across watershed boundaries (see Section 5.2.3).

Biodiversity

The purpose of designing a terrestrial natural system is to achieve diversity, abundance, viability of native species populations, natural communities and natural processes at multiple scales.

Scale

A terrestrial natural system can be designed for an area as small as a neighbourhood or as large as a continent. Compatibility between scales is important.

Systems Approach

Protecting terrestrial natural heritage requires a comprehensive approach that includes ecosystem structure, form, and function and species populations across the whole landscape.

Precautionary Principle

Ecological systems and processes are complex and uncertain. It is usually easier and less costly to prevent environmental damage than to repair it.

Size

Larger habitat patches are better for promoting native species diversity because they provide more niches and resources, more micro-climatic conditions, more vegetation age classes and community types, and larger populations of species. This diversity and space allows for better response to weather fluctuations, better reproductive success and better genetic vigour (more individuals to contribute to reproduction).

Shape

In developed or fragmented landscapes, habitat patches that are more compact and consolidated have the least amount of edge, and are therefore less vulnerable to adverse external effects.

Matrix Influence (Surrounding Land Use)

Matrix influence is a very important factor in planning at multiple scales, especially in urban areas. Every habitat patch has a relationship, either positive or negative, with its surrounding land uses, its "matrix". Each habitat patch has its own unique ratio of urban, agricultural and natural cover in its matrix. Generally, a habitat patch whose matrix is predominantly urban undergoes more adverse effects than one whose matrix is predominantly agricultural, and a habitat patch will benefit most from a predominantly natural matrix. Thus the ratio of urban, agricultural and natural cover in a habitat patch's matrix will influence its condition.

There are many negative impacts from development adjacent to protected natural areas:

- **Water:** changes in the hydrology (quantity of water); water pollution from storm water runoff and spills
- **Soil:** soil compaction from construction and trail use; high inputs of nutrients from agricultural and urban lands
- **Human presence:** recreational pressures (areas "loved to death"), trampling of vegetation, disturbance of fauna, collection of plants and animals
- **Invasives:** competition by alien plants, predation on low-nesting birds by pets and urban-adapted fauna (raccoons, etc.)
- **Ambient conditions:** light pollution, chronic excessive noise.

Quantitative evidence of changes in bird communities, including loss of sensitive species due to housing developments, was shown in a study in Waterloo, Ontario (Friesen *et al.* 1995).

Distribution

The more balanced the spatial distribution of natural cover is across a region, the greater the opportunities for species to find what they require, from local resources for reproduction to regional

resources for migration. Distribution of natural cover across physiographic regions provides diversity of soil types, climate and topography and thus opportunities for a diversity of flora and fauna species and vegetation communities.

Connectivity

The more connected (through direct linkage or proximity) habitat patches are to each other, the more effectively natural processes operate across the whole landscape, improving opportunities to support viable species populations. All of the system principles listed here leads to connectivity in the landscape, each in its own way. For example, increasing the size of a forest patch increases the amount of contiguous habitat available to an individual. The matrix also plays a role in connectivity and species dispersal. For example, agricultural lands allow relatively safe, uninterrupted passage for many species (woodland frogs, for example) from forests to wetland where they breed. Urban lands tend to restrict such movements and cause isolation among habitat patches.

Quantity

The higher the percentage of natural cover in any area, the greater the potential for optimizing overall patch size, shape, matrix influence, distribution and connectivity, and therefore biodiversity.

2.3 FROM PRINCIPLES TO APPROACH

The distribution of species played a significant role in the formulation of the TNHSS vision and targets. The Species of Concern, in particular, were used as a surrogate measure of ecosystem function and sustainability. In the late 1990s, the 693 Species of Concern were designated to raise awareness of species loss in the landscape. The message was: 254 plant and animal species were already considered rare in 1982 (MTRCA 1982) and, from trends in landscape change, we can foresee approximately 450 species potentially becoming rare over time. Having achieved that awareness, Species of Concern have since become more like "indicator species", plants and animals to be protected and restored because their abundance is considered synonymous with overall ecosystem function.

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"The conservation message we tried to express through species at risk, we should have been conveying through common species"

Bob Johnson, Curator, Reptiles and Amphibians, Toronto Zoo

The target system's land base provides the space needed for plant and animal species to assemble and evolve as natural communities. Mature forest, left, and Spotted Salamander, right.

The target system, rather than protecting land just for rare species and existing terrestrial natural cover, provides a land base necessary for Species of Concern and other species to recover and to assemble into resilient, evolving natural communities that perform ecosystem services over the long-term.

For more information on Species of Concern designation and their use in target setting and monitoring, see Appendices B and D.

To assist in quantifying the TNHSS objectives, the principles of landscape ecology were distilled into three indicators: the quality, distribution and quantity of terrestrial natural cover, and targets were set for each with the purpose of sustaining and improving the diversity, distribution and richness of Species of Concern in the TRCA jurisdiction.

CHAPTER

3

3.0 THE EXISTING TERRESTRIAL NATURAL SYSTEM

3.1 EVALUATING THE EXISTING SYSTEM

The quality, distribution and quantity of natural cover in the region were evaluated using a combination of methods:

- Digital mapping of urban, agricultural and natural land cover from 2002 aerial photography (the most current available mapping at the time offering complete coverage of the TRCA jurisdiction)
- Species abundance and distribution from an intensive field inventory of plant and animal species in the region, including the 693 TRCA Species of Concern (from 1996 to 2005).

Details are found in Appendix C, Data Collection Methodology.

The TNHSS objectives were expanded upon (and explained below) to provide preliminary targets for quality, distribution and quantity, against which to evaluate the existing system (see Appendix D, "Setting Terrestrial Natural System Targets").

3.2 QUALITY INDICATOR

The Quality Indicator is the terrestrial natural cover or system quality as determined through remote-sensing. Three factors of quality were used: size, shape and matrix influence (from surrounding lands).

3.2.1 METHOD

The size, shape and matrix influence of each patch was calculated and scored to provide a quality score for each patch (with a potential of 15 points), and the scores were calibrated into ranks based

on their potential to support species. Each patch then received one of five ranks for quality, from "very poor", "poor", "fair", "good" to "excellent". For more details on this Landscape Analysis Model, see "Evaluating and Designing Terrestrial Natural Heritage Systems" (Appendix E).

Based on the landscape analysis model, a few species (such as eastern wood pewee) can live in "poor" quality patches. However, most Species of Concern (such as scarlet tanager) require at least "fair" quality; some (such as black-throated green warbler) require at least "good" quality; a few (such as black-throated blue warbler) require patches of "excellent" quality. This suggests that if the system supported a full range of quality (up to 15 points) but emphasized "good" quality (11-12 points), then most Species of Concern (and associated ecosystem benefits) would be protected throughout the system. (Note: the predictive model accounts for changes in land cover, not the potential influences from future drastic changes in climate, human population densities, etc.)

3.2.2 RESULTS

Map 1 shows the existing terrestrial natural system along with urban and agricultural land cover corresponding to the four land use planning areas described in Section 1.3. Overall, the existing system, as evaluated on Map 3, ranges from "very poor" to "excellent" but is characterized by "fair" quality in that most hectares of terrestrial natural cover across the TRCA jurisdiction contribute to patches of "fair" quality (the mean patch quality score is 10). This range of quality and the emphasis of hectares in the "fair" quality rank can be seen in the bar graph on Map 3. The results for the quality of the regional system are discussed below in terms of overall patch size, shape and matrix influence; each factor is examined individually and together as interdependent factors. The following explains how terrestrial natural cover looks and functions very differently between the more northern rural and the more southern urban areas in terms of species diversity and abundance, as well as patch size, shape and matrix.

Matrix Influence: Higher scores are awarded to patches whose matrix is predominantly natural, medium scores for a predominantly rural-agricultural matrix, and lower scores for a predominantly urban matrix. Most Species of Concern tend to occur in rural areas with the highest natural cover, partly because each patch receives a relatively positive influence from the natural and agricultural matrix. Where sensitive species do occur in the urbanized landscape, they tend to be found only where patches are large enough, or where enough natural cover exists in the matrix to offset the negative matrix influence of urbanization. However, in such cases, these species are typically represented by very low populations.

Size: Patches receive higher scores for size if they measure 50 hectares or more, medium scores for 50-10 hectares, and lower scores for less than 10 hectares. The habitat patches found in the TRCA jurisdiction average about 3 hectares. However, these small patches actually represent only a small amount of the total area (hectares) of natural cover in the region. Most of the hectares are found in patches of 50 hectares or more. Unfortunately there are few of the larger patches. Individually the large patches may be high-functioning but their small numbers and limited distribution limits their influence on the region.

Shape: Higher scores for shape are awarded to compact patches such as circles and squares; lower scores are given to longer, narrower and more convoluted patches. Toronto and Region Conservation's jurisdiction is characterized by long, narrow patches within linear valley corridors and by larger, bulky patches mostly in the headwaters. The latter have a lower ratio of edge to total area and are less affected by a convoluted edge than are smaller, linear patches. The grid network of roads that defines a straight edge in many patches and the farming practice of maintaining square or rectangular forest lots improve the shape scores in the system, although roads diminish the size and connectivity of patches.

3.3 DISTRIBUTION INDICATOR

This indicator examined the distribution of terrestrial natural cover across the region (using remote-sensed mapping), in particular the distribution of "good" patch quality regionally.

3.3.1 METHOD

Having established the overall patch quality within the system, the next step is to determine how well this quality is distributed regionally across the four land use planning areas. First, distribution was calculated as the percentage of terrestrial natural cover in each planning area, assessing all terrestrial natural cover equally without considering patch quality. However, distribution of species, including Species of Concern, depends on the quality of that natural cover across the region. Therefore, the relative proportion of the five quality ranks within each planning area (the relative proportion of "very poor", "poor", "fair", "good" and "excellent") was also calculated as a measure of "distribution of quality". It is important to examine the results of both calculations together to assess distribution. For more details, see "Evaluating and Designing Terrestrial Natural Heritage Systems" (Appendix E).

In order for plant and animal species to assemble into diverse natural communities and for species to disperse locally or migrate, natural cover would need to be distributed across all physiographic regions. To support Species of Concern, in particular, throughout the region, "good" quality natural cover should characterize the majority of terrestrial natural cover in each planning area.

3.3.2 RESULTS

As shown on Map 3, the distribution of the existing terrestrial natural cover, in particular the "good" quality cover (scoring 11-12), is skewed toward the north and, to some extent, the east. The results described below by planning area essentially depict the north-south distribution of natural cover. The hundreds of species and vegetation communities implicated in these results could not all be discussed. However, where possible, a few species were selected to illustrate what the models summarize.

By Planning Area

Although the Greenbelt Area (including the Oak Ridges Moraine) accounts for only 31 per cent of the jurisdiction's total area (Table 1), 44 per cent of the jurisdiction's natural cover is found here. Habitat patches tend to be of "good" quality (mean patch score of 11) (Figure 2 and Map 3), being larger and surrounded by other habitat patches or by a predominantly agricultural matrix. A few patches of "excellent" quality are also found to the northeast. It is in the Greenbelt Area that vegetation communities and species are most diverse and abundant. For example, Species of Concern such as Starflower and Black-throated Green Warbler are generally not found in other areas largely because patches are too small.

The Agricultural Rural area and the Designated Greenfield area contain 12 and 37 per cent natural cover, respectively, and patch quality in both tends to be "fair" (mean patch score of 9) (Figure 2). In all three of these non-urban planning areas mentioned so far, Species of Concern such as Wood Thrush (a low-nesting forest bird), Northern Leopard Frog, White Trillium and Blue Flag Iris are relatively well represented, as are their respective natural communities and associated ecosystem services. Such species do not need the larger patches as long as the matrix remains rural-natural. Most development in the next few years will tend to occur in the Designated Greenfield area and, therefore, to prevent the loss of these and other Species of Concern, increasing patch size will be important in order to partially compensate for the shift to an urban matrix. The next wave of growth is being planned for the Agricultural Rural area.

At the opposite end of the spectrum is the more urbanized planning area of the south, the Built-up area (Map 3). Thirteen per cent of this area is terrestrial natural cover and its quality is more characteristically "poor" (mean patch score of 8) (Figure 2). Fewer species occur this far south. For example, the four species listed above are found only occasionally, generally where "fair" quality patches occur. Species found in all four planning areas including the Built-up area, include Green Frog, Gray Catbird, Screech Owl, Red Oak and Bloodroot, species that can adapt to smaller patches exposed to a predominantly urban matrix.

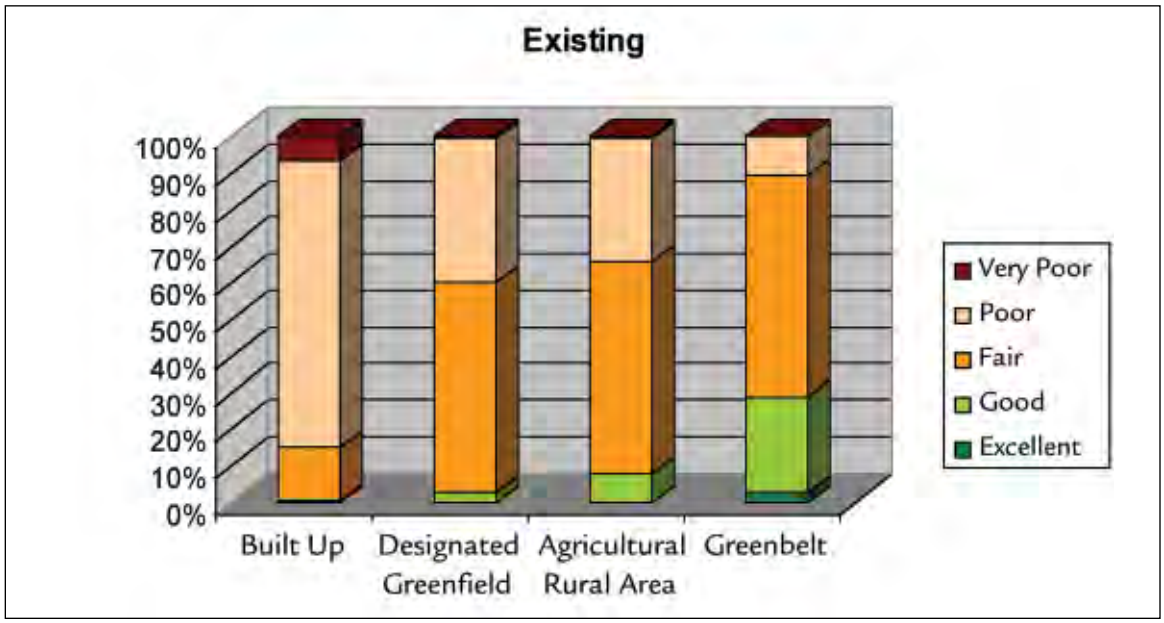
The Wood Thrush (left) is an exceptional songster and sensitive species of forests. The species occasionally attempts to breed in the Built-up Area (Wood Thrush nestlings, right).

A gradient of quality is to be expected in any region in Southern Ontario and "poor" quality patches are part of the natural system mosaic in the TRCA jurisdiction, performing local ecological and social functions. Habitat patches benefit from other natural areas in proximity; even "poor" quality patches can contribute to a more positive matrix influence on other habitat patches.

Table 1: Existing Natural Cover (2002) by Planning Area in the TRCA Jurisdiction (region)

TNH PLANNING AREA	AREA		NATURAL COVER (Forest, wetland, meadow and coastal)	
	hectares	% of region	hectares	% of planning area
Greenbelt	78 008	31%	34 596	44%
Agricultural and Rural	23 298	9%	2 824	12%
Designated Greenfield	28 527	11%	10 694	37%
Built-up	119 393	48%	15 231	13%
Total, Region	249 225	100%	63 345	25%

Figure 2: Quality of Existing Natural Cover by Planning Area



3.4 QUANTITY INDICATOR

The Quantity Indicator is the amount of natural cover in the region, determined using remote-sensed mapping.

3.4.1 METHOD

The quantity of terrestrial natural cover is measured as a proportion (or per cent) of the total land surface area of the region.

Toronto and Region Conservation's jurisdiction is a finite area. Converting lands from agricultural to urban uses changes the matrix, making it necessary to increase the natural cover if the existing quality is to be maintained or improved. Therefore the quantity necessary to achieve the targeted "good" quality and more balanced distribution will depend on the character of the region in the long term (the ratio of natural, agricultural and urban land cover). Preliminary modeling and literature research were used to determine that at least 30 per cent of the TRCA jurisdiction land surface should be natural cover in order to distribute "good" quality natural cover throughout the region and sustain populations of Species of Concern for the long-term.

3.4.2 RESULTS

In 2002, the quantity of terrestrial natural cover in the TRCA region is approximately 63,349 hectares, or nearly 25 per cent of the total land surface, which includes 23,615 hectares or 9 per cent cultural meadow (Table 2). The desired regional distribution of terrestrial natural cover with an emphasis on "good" quality is not met by the existing terrestrial natural system that covers 25 per cent of the TRCA jurisdiction.

Table 2: Existing Natural Cover (2002) by Habitat Category in the TRCA Jurisdiction (region)

HABITAT	HECTARES	% OF REGION
Forest	33,851	14
Meadow	23,615	9
Successional	3,150	1
Wetland	2,572	1
Beach/Bluff	162	(0.07) <1
Total	63,349	25

3.5 SUMMARY OF EXISTING CONDITIONS

While the quality, distribution and quantity of existing terrestrial natural cover in the TRCA jurisdiction are better than in some rural parts of Ontario (e.g. Essex County has only about four per cent forest cover in a mainly agricultural matrix), they are below what is required for a sustainable terrestrial natural system envisioned for this Living City region. The existing terrestrial

natural system in the TRCA jurisdiction ranges in quality from "very poor" to "excellent" and is dominated by patches of "fair" quality. In the southern half of the TRCA jurisdiction, most of the patches are in "poor" quality. This means that planning areas that are found within the southern portion of the TRCA jurisdiction are markedly dependent on the quantity and quality of natural cover in adjacent planning areas for ecosystem services and biodiversity. However, even this northern natural cover is currently on the threshold, close to the "poor" quality, where an increase in urban matrix would cause many species to disappear (Kilgour 2003).

Today the existing system is dominated by "fair" quality patches and does not meet the objectives set out in this Strategy; further decline in quality and biodiversity is anticipated in light of projected urbanization. Therefore, this Strategy provides a scenario of terrestrial natural cover to assist the TRCA, municipalities and other stakeholders who will improve the long-term health and sustainability of the terrestrial natural system:

1. Quality: a better configuration of the system to promote larger habitat patches with more compact shapes and a better placement relative to agricultural and urban land cover, moving the system from "fair" to "good" quality (mean scores of 10 improving up to between 11 and 12)
2. Distribution: a more even distribution of "good" quality natural cover across the TRCA jurisdiction
3. Quantity: an increase in natural cover from 25 per cent (including meadows) to at least 30 per cent (largely forest and wetland), to increase the natural matrix and achieve the desired quality and distribution of natural cover.

CHAPTER

4

4.0 THE TARGET TERRESTRIAL NATURAL SYSTEM

4.1 DESIGNING AND EVALUATING MODELED SCENARIOS - METHODOLOGY

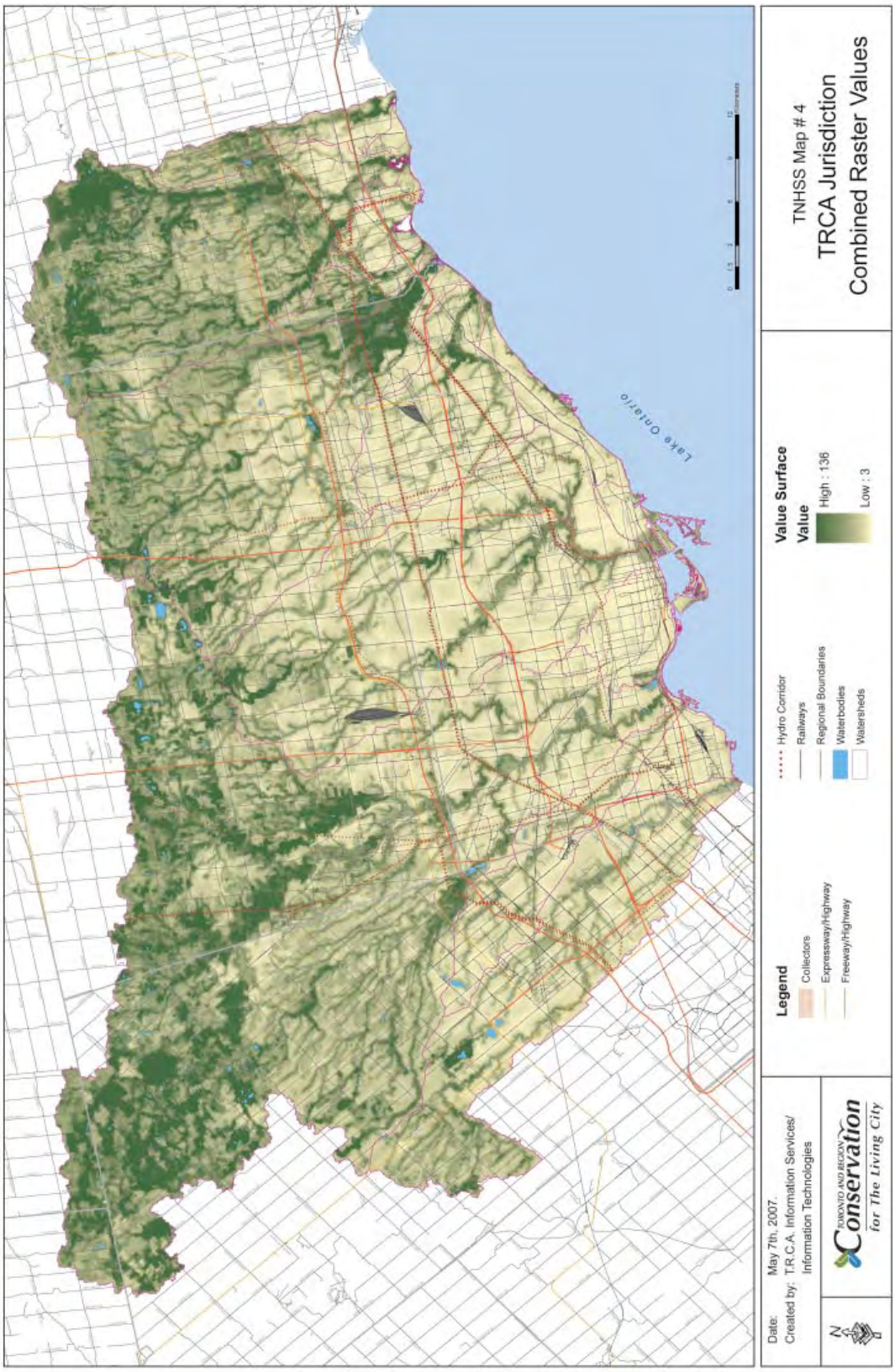
Having evaluated the existing system in Chapter 3 and determined that it did not meet the objectives, the next step was to design a more robust terrestrial natural system. A System Design Model was used to develop a scenario that would achieve the quality and distribution targets on as little land as possible, recognizing the competing land interests.

The first step was to map the projected, long-range urban growth so that the target system scenario could be evaluated in the context of future changes in the matrix. Then the entire TRCA jurisdiction surface area was divided into very small units (10 x 10 meter cells). Each small square was assigned value for its potential to contribute to the terrestrial natural heritage system, according to various ecological criteria (distance from natural or urban areas, etc.) and planning criteria (protection designations, TRCA ownership, etc.).

For more details, see Evaluating and Designing Terrestrial Natural Heritage Systems, Appendix E. Map 4 shows the region's entire surface evaluated; the more criteria are fulfilled, the darker the shade of green. This was used to determine where to best protect and expand existing cover to make up the target system.

The highest scoring cells (the darker greens in Map 4) were selected as a target system scenario, beginning with the highest scoring cells adding up to 30 per cent of the TRCA jurisdiction. That target system scenario was then evaluated for quality using the landscape analysis model (the same methods as described in Chapter 3). If quality and distribution objectives were met, then the cells selected would comprise the quantity (the land base) required for the target terrestrial natural system (for more details, see Evaluating and Designing Terrestrial Natural Heritage Systems, Appendix E).

Map 4: Toronto and Region Conservation Jurisdiction Surface Evaluated for Potential toward Target System.



The scenario of terrestrial natural cover selected as the target terrestrial natural system for the TRCA jurisdiction is presented on Map 5, showing existing cover in dark green and potential cover in lighter green. This expanded system is shown again on Map 6, evaluated for quality, and is described in the following section.

4.2 RESULTS

The target system quality still ranges from "very poor" to "excellent" but is improved overall, from being dominated by "fair" patches in the existing system to "good" patches in the target system (mean patch quality score improved from 10 up to 11), as shown in the bar graph on Map 6. The improved regional quality resulted from improving individual patch size, shape and, to some degree, matrix (an increase in natural matrix) throughout the system.

The distribution of terrestrial natural cover in the target system, especially ranked as "good" quality, is still very much skewed to the north, generally within the Greenbelt Area (Map 6), largely because of the limited ability to increase natural cover in existing urbanized areas. "Good" quality habitat does not characterize every planning area as was the distribution objective (those results are described below by planning area).

From a quantity perspective, the target system covers approximately 74,000 hectares, or approximately 30 per cent of the total land surface area of the TRCA jurisdiction. This is the quantity necessary to achieve a target system that is dominated by "good" quality patches and to achieve the best distribution possible given existing constraints. Some existing natural cover, mostly as small and isolated patches, was excluded from the system in favour of potential natural cover abutting larger, connected existing natural cover. According to predictions from the landscape analysis model, existing native species populations, vegetation communities and natural processes will be maintained throughout the system in the future if the quality target is reached.

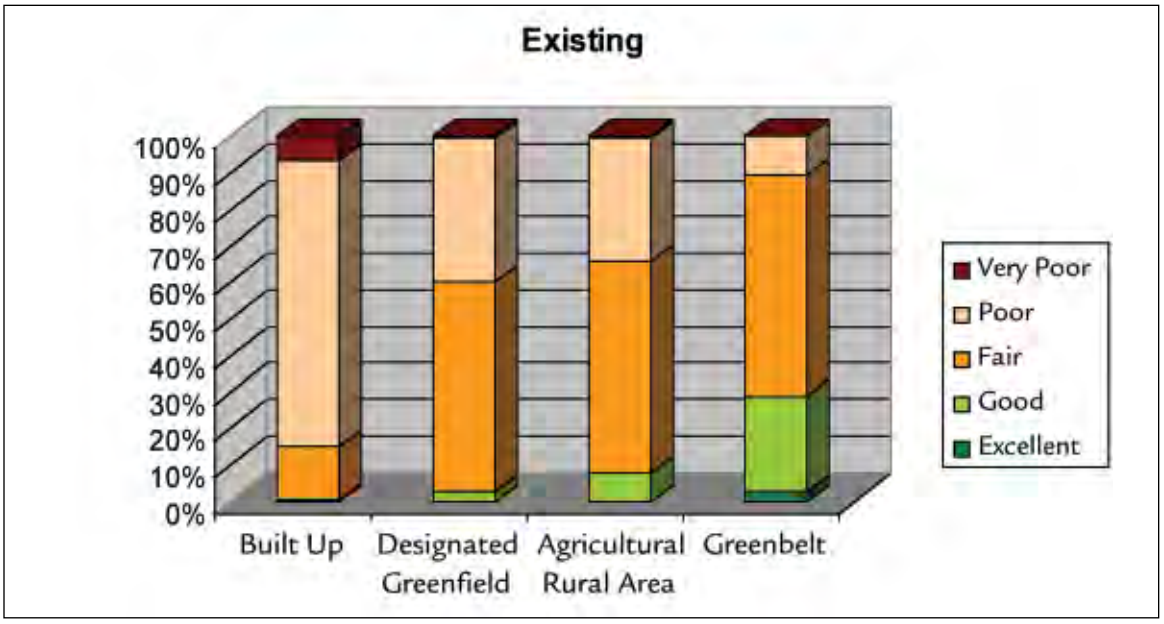
By Planning Area

Two planning areas, the Built-up and Designated Greenfield areas, show a decrease in quantity of terrestrial natural cover (Table 4). The Built-up area's loss from 13 to 10 per cent is mostly from the exclusion of existing habitat patches that either were isolated from the rest of the system and did not fulfil enough criteria to be captured at the regional scale or were linear meadows abutting 400-series highways. However, the importance of these areas for water management and other functions is being explored at the watershed scale and through site-specific opportunities. Figure 3 shows that with the target system, the quality of terrestrial natural cover would remain dominated by "poor" patches in the Built up area but that a slight increase in "fair" and "good" quality patches would also be seen.

In the Designated Greenfield area, the results show a loss of terrestrial natural cover from 37 to 34 per cent of the planning area (a loss of approximately 900 hectares). The increase in the proportion of "fair" and "good" patch quality and reduction in "poor" quality patches, as shown in Figure 3, is due to the system design model's tendency to eliminate small, isolated habitat patches and linear extensions that would normally lower patch quality scores.

The other two planning areas show net increases in terrestrial natural cover quantity. Table 4 shows that the quantity of Terrestrial natural cover in the Agricultural and Rural Area increases from 12 to 14 per cent and from 44 to 63 per cent in the Greenbelt Area. The dominant patch quality in the Agricultural and Rural Area remains virtually the same, "fair" (Figure 3), but a slight increase in both "fair" and "good" quality can be observed. The dominant quality in the Greenbelt area improves from "fair" up to "good", with some increases in "excellent" patches (Figure 3).

Figure 3: Quality of Existing and Targeted Natural Cover, by Planning Area



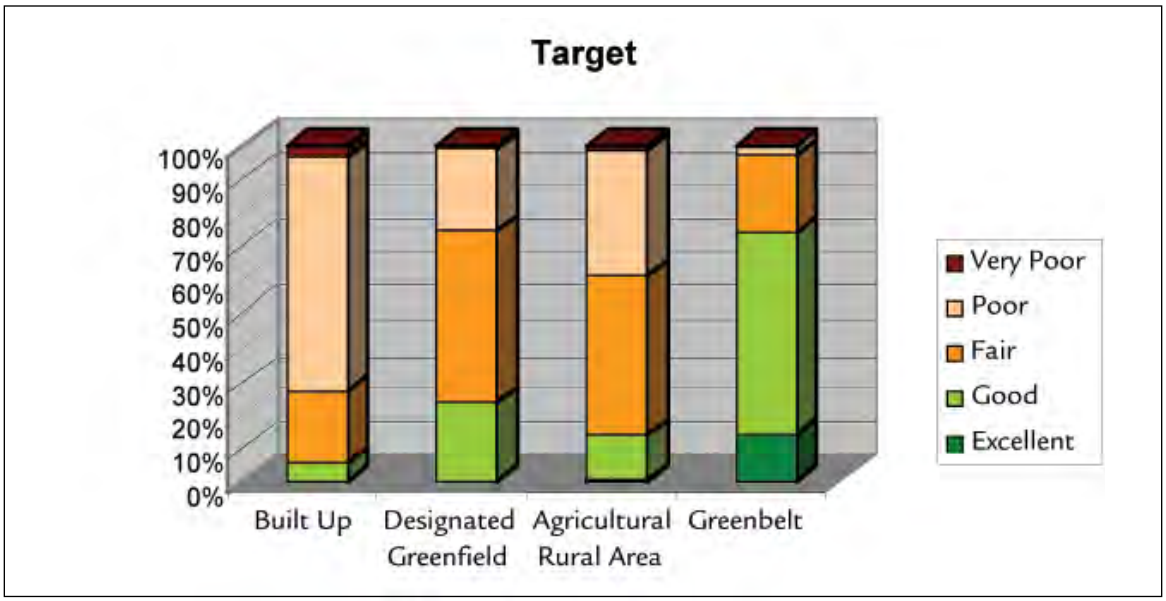


Table 3: Existing (2002) and Target Natural Cover by Planning Area

PLANNING AREA	EXISTING NATURAL COVER		TARGETED NATURAL COVER	
	Hectares	% of area	Hectares	% of area
Greenbelt	34,596	44	48,935	63
Agricultural and Rural Area	2,824	12	3,212	14
Designated Greenfield	10,694	37	9,792	34
Built-up	15,231	13	12,039	10
Total, Region	63,345	25	73,977	30

4.3 SUMMARY OF TARGETS

In summary, the greatest gains to regional biodiversity will be expected to follow from changes to the existing system:

- An increase regionally in terrestrial natural cover quality, from "fair to good" (mean patch quality scores from 10 to 11), and quantity, from 25 to 30 per cent
- Increases to terrestrial natural cover quantity and quality in the Greenbelt Area
- Increases in terrestrial natural cover quantity in the Agricultural and Rural Area
- Increases in terrestrial natural cover quality in the Designated Greenfield Area
- The protection of much of the existing terrestrial natural cover in the Built-up Area.

The targets reflect the best possible achievement and a most effective use of land (more compact patches with better shape), considering constraints and opportunities at the regional scale. All hectares of terrestrial natural cover in the modeled target system depicted on Map 5 cumulatively play a role in the region's condition and represent a substantial step toward building a Living City region.

CHAPTER

5

5.0 IMPLEMENTATION: ACHIEVING THE TARGET SYSTEM

The target system was determined for the TRCA region spanning multiple watersheds, municipalities and regions, each with its own challenges in terms of policy and physical constraints, as well as availability of up-to-date data layers. The target system in this Strategy is conceptual and will have to be refined and evaluated at the watershed and local scales. Watershed Plans provide an important medium for promoting the terrestrial target system as part of an integrated natural heritage system. It is anticipated that the final natural heritage system will be implemented in a variety of ways, including municipal growth planning.

5.1 CONSTRAINTS, OPPORTUNITIES AND EXPECTATIONS FOR IMPLEMENTATION

The Toronto region is one of the fastest-growing city regions in North America. While urban development poses challenges to natural heritage protection, expansion and restoration, some opportunities present themselves (through the planning process, for example) for advancing the TNHSS objectives. Each of the four Planning Areas introduced in Chapter 1 has its own set of specific issues and opportunities, and each presents a different expectation for how a target system could be achieved cumulatively over time with stakeholders.

Built-up Area

This planning area has a great potential for the terrestrial natural system to have a direct positive influence on the day to day life of a large number of people and to contribute to the quality of life of communities in the TRCA jurisdiction. In this area, there is little room to expand the terrestrial natural system because the vast majority of lands are intensely developed. Lands in public ownership are in high demand for recreation, which often competes directly with natural heritage

protection. Therefore, it is expected that implementation will rely more on impact management than system expansion. In general, in the Built-up area we are looking at four spheres of action:

- System expansion: relatively small expansions throughout but some areas, by their larger size, have potential to be restored to support species that have been lost from the urban areas. For example, Downsview Park, brownfields and idle lands were included in the TNHSS because they were not already developed and could potentially be restored to natural cover. Other restoration opportunities that are not yet identified (to be found potentially in backyards, parks, golf courses and cemeteries) may present themselves through more detailed refinements of the target system at watershed and site planning scales.
- Development setbacks: buffers and setback requirements should be identified for redevelopment sites in order to reduce pressure on the system's edge. Over time, the implications of major redevelopment and intensification on the terrestrial natural system will need to be determined and evaluated.
- System management: restoration/recovery planting will be the first activity. Constructed or created habitat structures, such as nesting structures, hibernacula, wetlands and or buffer plantings can enhance the function of natural cover. As well, active management of terrestrial natural cover will be necessary to maintain quality, in particular, the control of non-native invasive species and reintroduction of native species where possible.
- Matrix management: compensating for the lack of opportunity to increase patch size by managing the matrix influence, e.g., reduce the negative effects of urban uses on adjacent natural areas through public education and public and private land stewardship.

Designated Greenfield Area

The Greenfield area is designated for urban development, with proposed land use changes in various stages of approval. There may be opportunities to incorporate the target system into urban design but these may be limited. Given the status of existing official plans or other planning documents (e.g., approved secondary plans) containing natural heritage elements, implementation of the target system will be largely through voluntary means, negotiated agreements to address opportunities or acquisition.

It is expected that restoration of lands identified as "potential" natural cover in the target system will be addressed through development limit setting. Management may also include habitat structures, buffer plantings, and managing invasive species, as well as public education and public lands stewardship.

Agricultural and Rural Area

The Agricultural and Rural planning area has been identified as a future growth area in the Provincial Growth Plan but remains zoned rural and agricultural in Municipal Official Plans and as such currently supports rural-agricultural land uses. At this time, the target system may be

implemented through land securement and stewardship programs but, as these lands are expected to be designated for urban expansion, the development planning process will become the primary means of achieving the target system.



Cropland, pastures and fallow fields can provide important dispersal areas for amphibians and breeding habitat for open country fauna, such as the American Kestrel.

The final terrestrial natural heritage system for these lands will be determined in collaboration with municipalities as they embark on growth planning exercises that will update or redefine the natural heritage system, along with the other aspects of community building. It is our intent that the tools and science of this strategy will be provided to municipalities to form the basis for natural heritage system definition. Given that the target system in the Strategy is modelled and based on 2002 base information, it will be necessary to customize the target system, both with more recent information but also to reflect the various community design requirements to balance the multiple objectives the municipalities need to consider.

In this planning area, the target system falls largely along riparian (stream) systems, increasing riparian cover and connections, both up and downstream, with local adjacent forest patches. Once secured or protected, the land base identified as "potential" natural cover will need to be restored to natural cover. It is expected that proportionately less "matrix management" will be required where the matrix remains rural.

Greenbelt Area

Most existing terrestrial natural cover in this area is well protected, and land use change to urban is restricted by three of North America's leading-edge conservation plans (Niagara Escarpment Plan, Oak Ridges Moraine Conservation Plan, and The Greenbelt Plan). This planning area is where the majority of the target system is located. With the existing critical mass of forest cover in the Greenbelt area, a focus on achieving increasing amounts of interior forest habitat (by improving patch size and shape) will be key to increasing biodiversity and enhancing the ecological integrity of the regional terrestrial natural system. The continuance of agricultural uses is a prominent objective of the Greenbelt Plan. Since an agricultural matrix poses less impact on natural cover and is partly beneficial to biodiversity, these two land uses are relatively complementary.

In contrast to the other three areas, where land use planning will be key, voluntary landowner stewardship and land securement approaches will provide the primary means to achieve the target system. Funding incentives and partnerships through existing organizations such as the Oak Ridges Moraine and Greenbelt Foundations will encourage participation in these programs. Again, restoration of "potential" natural cover areas will be the primary restoration emphasis.

5.2 IMPLEMENTATION ACTIONS AND METHODS

The sections that follow describe the implementation actions and methods:

- communicate and build support for the Strategy
- identify, secure and restore the target system land base
- monitor the target system.

5.2.1 COMMUNICATION (BUILDING SUPPORT)

The development of the Strategy was built on partnerships that will continue to be important as implementation moves forward. TRCA draws on numerous ongoing and successful working relationships that have developed over many decades, ranging from working with the public on shared conservation goals to cost-sharing agreements with municipalities and other Conservation Authorities. New directions will also be necessary to optimize the success of implementation.

The tools and science of the TNHSS will be promoted not only through the active participation in the work detailed in the next sub-sections but support will also be built through general public education and awareness activities:

- The Living City Campaign will provide a corporate vehicle for raising the profile of the target system.
- Workshops on the TNHSS and its use may be held for various industry groups such as municipalities, corporations, environmental consultants and not-for-profit organizations.
- Toronto and Region Conservation will improve its partnerships and working relationships with universities and colleges by better sharing our data, information and experience in ecology, conservation and land use planning. By providing practical research opportunities for students, their understanding of the TNHSS should assist in promoting a change in conservation practice.

Toronto and Region Conservation is one of Canada's largest providers of outdoor and experiential education. Toronto and Region Conservation developed a *Systems Thinking Curriculum for Learning in the Living City* to engage people in learning about sustainability and The Living City and encourage "systems thinking" (emphasizing the multiple benefits of healthy watersheds) and long-term

thinking. The TNHSS approach is an important element of this curriculum. At this time, the Systems Thinking Curriculum is delivered mainly to elementary and secondary school students at TRCA field centers and through TRCA public programs. Toronto and Region Conservation will continue to integrate the TNHSS into existing TRCA environmental education programs and develop new programs that promote and build on the TNHSS.

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The Long-eared Owl (left) and Monarch Butterfly (larvae on Milkweed, right) are two of over two hundred fauna species that participate in ecosystem cycles as they migrate through this region twice a year.

5.2.2 PROVINCIAL AND MUNICIPAL POLICY, GROWTH PLANNING AND REGULATORY TOOLS

Flexibility in Implementation

The regional targets reflect the objectives and broad intentions of TRCA and provide guidance (a master plan) for local decision making rather than strict prescriptions. The targets could be implemented in numerous ways at the local scale, and the target system represents only one potential scenario. The target system was developed using remotely-sensed information at the regional scale based on 2002 data that is expected to require updating and refinement at the local scale. Additional local level information and design options will be used to refine the natural system line with municipalities and will assist in decision making at the local level. The target system will also be revised at the watershed scale to provide more detail in the mapping and to integrate the terrestrial layers with additional environmental parameters including aquatic ecosystem and water management.

Provincial Planning

Toronto and Region Conservation has been and will continue to actively participate in the development or review of provincial, regional, and municipal policies and plans that influence growth, settlement, transportation, and the environment in the TRCA jurisdiction. Toronto and

Region Conservation will seek to advance this Strategy and its natural heritage vision through many strategies and plans:

- Provincial policy statements and planning applications under the *Planning Act*, the *Oak Ridges Moraine Conservation Plan*, *Niagara Escarpment Plan, Greenbelt Plan*, development plans under the *Ontario Planning and Development Act* and projects under the *Environmental Assessment Act*
- Regional growth management strategies such as the sub-area plans for the Greater Golden Horseshoe and the associated Natural Spaces program
- Source water protection planning process under the Clean Waters Act
- Provincial transportation strategies and plans

Toronto and Region Conservation will assist in and benefit from any new initiatives, data and research from the province and local municipalities as they emerge. The tools and databases developed for the TNHSS can be utilized to confirm and complement the work of the province and municipalities.

Municipal Planning

As the region's municipalities undertake growth management studies and review their urban boundaries, the Strategy will help municipalities assess their strategic directions and the ecological implications of growth. When it comes to development planning for local areas or neighbourhoods, the Strategy will also encourage integrating natural heritage protection and restoration at the conceptual stage (i.e., secondary plans) and the services planning stage (master environmental servicing plans, generally required by TRCA as part of development approval), before landowners submit their individual subdivision applications.

The TNHSS provides municipalities and the development industry with a consistent approach to conservation for local development planning. It is the intent that the target system will be offered to municipalities to form the base for defining or refining their natural systems in their official plans and/or secondary plans, Master Environmental Servicing Plans (MESP), individual planning applications, as well as environmental assessments, regional and local municipal greening strategies, natural heritage plans and recreation master plans, and plans for new and expanded transportation, infrastructure, and utility corridors.
Toronto and Region Conservation will provide support and technical expertise in the interpretation of data and use of the tools and science in the TNHSS. Regulatory tools such as Site Alteration and Tree-cutting by-laws exist today and will lend support for the initial protection of existing cover and, in time, protection of the expanded system. Other tools and incentives available to maximize the gains to be made through the development review process may also be developed (e.g. density bonusing, density transfers and land swaps).

To assist municipalities with implementation of a policy framework to support a terrestrial natural heritage system, Toronto and Region Conservation has developed nine model planning

policies. A synopsis of these model policies follows below and the detailed policies can be found in Appendix F.

Policy 1: Defines and maps the target system for protection and restoration
Policy 2: Prohibits new development and site alteration in existing natural cover
Policy 3: Conditions and restrictions on development and site alteration in potential natural cover
Policy 4: Permitted land use and development in existing and potential natural cover
Policy 5: Development setbacks from existing natural cover
Policy 6: Refining or changing target system boundaries
Policy 7: Significant features which cannot be removed from the target system
Policy 8: Removals from or additions to the target system - "net gains"
Policy 9: Modification for transportation, infrastructure and utilities

Toronto and Region Conservation believes that the target system map and model policies (Figure 1) can be smoothly integrated into official plans, especially those that have been recently adopted or reviewed and fully conform to the *Provincial Policy Statement* and *Oak Ridges Moraine Conservation Plan*. In many municipalities, most of the lands identified as existing cover within the terrestrial natural heritage system are already subject to one or more official plan designations that protect natural heritage features, "greenland" systems, and other lands identified as environmentally sensitive.

Compensation – Ecosystem Credits

Compensation is an option when the target system land base cannot be secured through the normal suite of planning tools. Compensation, for example, mitigation banking, allows a landowner to compensate for losses to the target system by providing funds toward the implementation of the target system. Ecosystem credits may be purchased from official off-site restoration areas where comparable or better ecological functions could be achieved. Toronto and Region Conservation will always advocate first for the protection, securement and stewardship of the target system as identified on Map 5, or modified through other processes (e.g., official plans, watershed plans) but ecosystem credits, which have been used in other regions (South Florida Water Management District, 2004; California Department of Fish and Game, 2005) offer a creative alternative for achieving the system where flexibility may be required. Criteria for compensation will be developed as part of TRCA's ongoing Terrestrial Natural Heritage Program and will be used to determine appropriate situations and processes for the use of compensation credits.

5.2.3 WATERSHED PLANNING

The TNHSS target system (Map 5) covers all nine watersheds, Frenchman's Bay and the Lake Ontario Waterfront across the TRCA jurisdiction. In the development of watershed plans the TRCA integrates data on natural features, natural processes and human use components (Figure 4) from which it develops scenarios of land cover and management options, and then evaluates

them to identify multiple benefits. There are many current processes and components of the watershed plans:

- Terrestrial natural systems (as defined in Chapter 1)
- Surface water quantity and quality (including surface water budget, hydrology, flooding, stream morphology, base flow, water taking, pollutant loading from construction, rural and urban runoff, and wastewater discharges)
- Groundwater quantity and quality (including recharge, discharge, water taking, and contaminants)
- Aquatic species and communities (including fish and benthic invertebrates, and instream and riparian habitats)
- Cultural heritage (including archaeological and built heritage)
- Recreational use (including trails and other passive use opportunities).

Future watershed modeling may consider additional processes and components, such as air quality (areas for carbon sequestration), climate change regulation, agricultural and areas for agrotourism, and so forth.

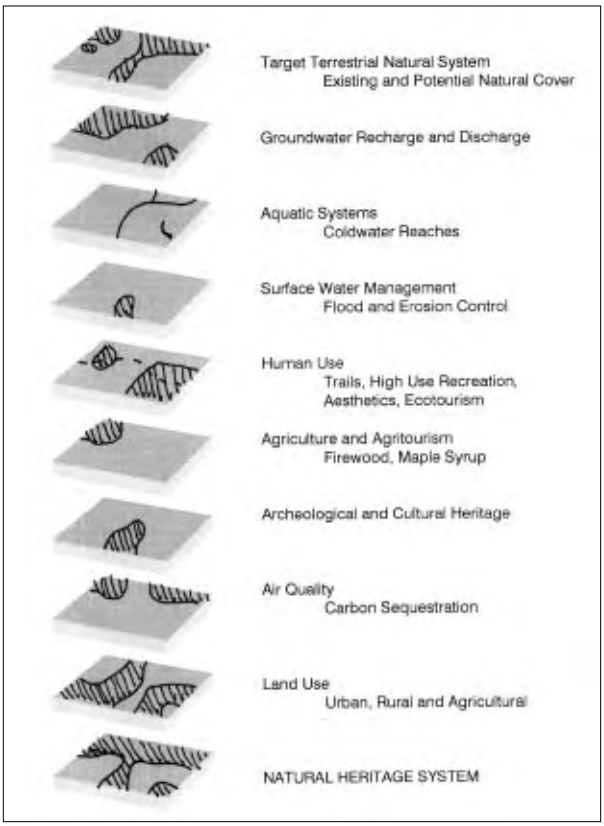

Figure 4: Integrating Component Values to Identify a System

Conventional science tended to separate these components into individual disciplines of research ("silos") but recent science has returned to a more holistic ecology. Thus integrated watershed planning involves understanding each ecosystem component individually and then as integrated with other components in a complex system. The TNHSS represents the individual terrestrial component in integrated watershed planning. TRCA has developed a "watershed response model" (which is a series of models, e.g., hydrologic, aquatic community, etc.) to predict how this complex ecosystem will respond to changes in a watershed.

Figure 5 shows how changes in land cover, land uses and climate that affect one component may have a cascading effect on all other components of the system. Thus, the model can estimate the benefits of terrestrial natural cover

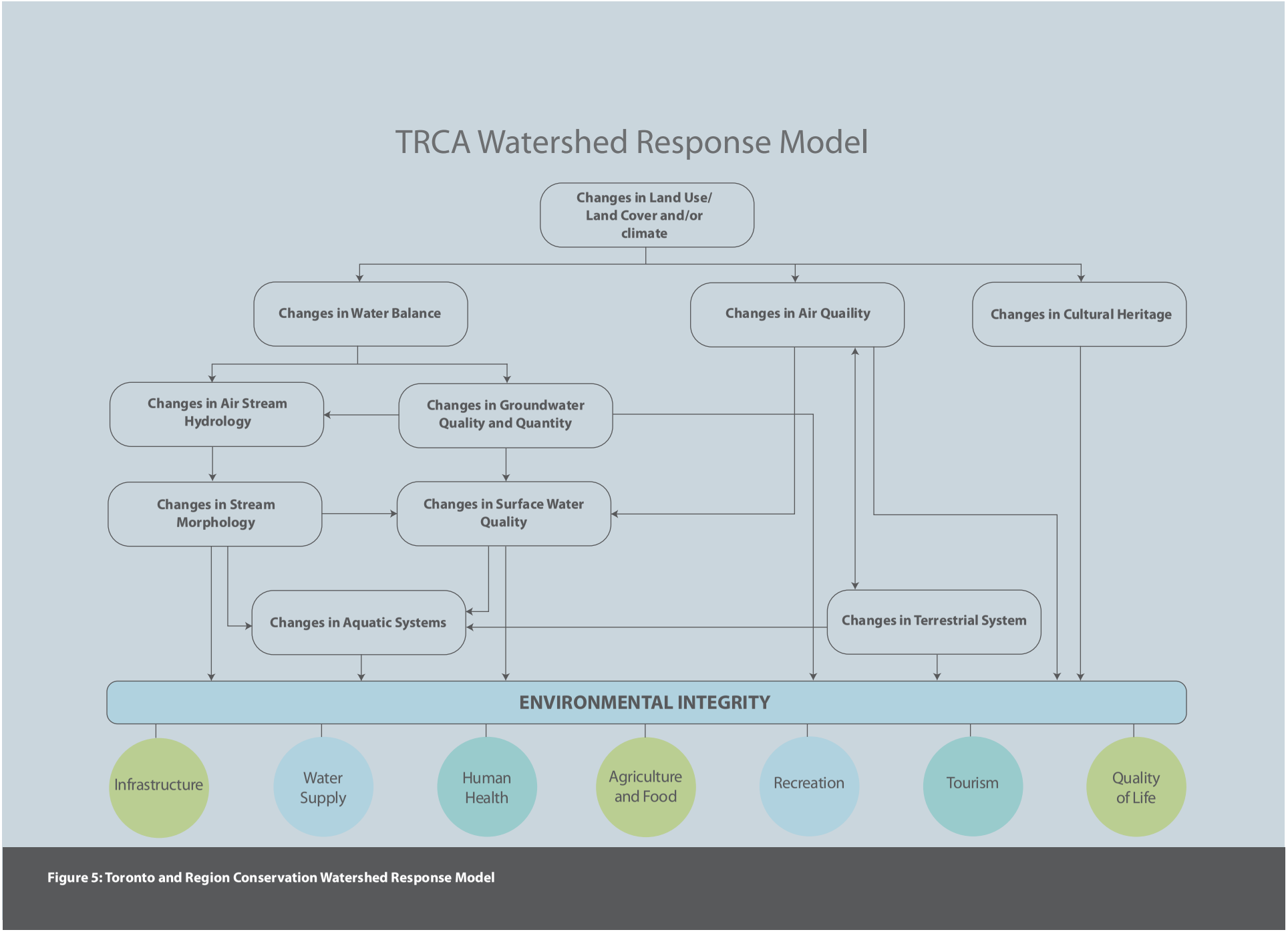

Figure 5: Toronto and Region Conservation Watershed Response Model

for other components. For example, an increase in terrestrial natural cover can change groundwater levels and stream base flow, which in turn can affect aquatic community composition in some stream reaches. The technical studies supporting the Duffins and Carruthers Creeks Watershed Plans predicted that the target terrestrial natural system would result in reductions to peak (flood) flows of up to 25 per cent for the 100-year storm (TRCA 2003).

The watershed response model allows TRCA to evaluate land use scenarios based on a range of environmental and social indicators and to recommend a preferred scenario based on set objectives. The watershed response model is used to estimate the multiple benefits of implementing the terrestrial target system. At the same time, the watershed response model will also occasionally identify where the terrestrial target system should be expanded to include areas that are needed for hydrological or aquatic ecosystem functions.

As they are developed, the province's new requirements for drinking water source protection planning will be integrated into the watershed response model. The model policies in Appendix F offer an example of how the protection of the target system may be addressed through watershed policies in watershed plans. The TNHSS will also assist in fulfilling the objectives of the federal government's Remedial Action Plan/Great Lakes Sustainability Fund programs to restore the impaired uses and "de-list" watersheds within the TRCA jurisdiction Area of Concern.

Neighbouring Conservation Authorities

Toronto and Region Conservation works closely with other Conservation Authorities through the South Central Ontario Conservation Authorities (SCOCA) Natural Heritage Discussion Group to share approaches to conservation planning. Toronto and Region Conservation has also supported the development of natural heritage discussion groups among Conservation Authorities in other regions, as well as a province-wide Conservation Authority natural heritage network. Through these networks, the approaches and methods described in this Strategy are being articulated, adapted and applied widely. For example, the landscape ecology principles described in Chapter 2 (Section 2.2) were also adopted by SCOCA. The goal is to have consistent and compatible approaches to terrestrial natural heritage system identification, protection and management.

5.2.4 LAND ACQUISITION AND SECUREMENT

Toronto and Region Conservation's Greenlands Acquisition Project for 2006 – 2010 guides TRCA's land acquisition and securement activities and will therefore provide the main vehicle for acquiring and securing priority portions of the target system land base. There are many potential actions:

- Identify acquisition objectives specific to each TNHSS planning area to meet the localized demands, e.g., emphasizing urgency in developing areas, opportunities in built-up areas and highest ecological function in Greenbelt
- Continue to encourage TRCA's member municipalities to support the Greenlands Acquisition Project, both politically and financially, not only within their own boundaries but across the whole region

- Encourage municipalities and other organizations undertaking their own securement programs to work closely with TRCA to establish priorities, maximize the effectiveness of all efforts and ensure consistency in approaches
- Where applicants own lands within the target system, TRCA, as part of its plan review under the Planning Act, will recommend that applicants convey their target system lands to the appropriate public agency and have those lands protected through appropriate land use designations
- Administer the securement of lands through compensation banking and ecosystem credits.

5.2.5 PUBLIC LAND MANAGEMENT

Much of the public lands in the TRCA jurisdiction are owned by TRCA, local and regional municipalities, and the federal government. Management and active restoration are the main activities that could take place within the target system boundary on these public lands:

- Complete management plans for all TRCA-owned lands within the target system
- Undertake natural heritage restoration plans for TRCA lands that are potential natural cover, in accordance with the Natural Heritage Restoration Plan requirements found in Appendix G
- As the target system lands are secured, continue to explore partnership opportunities to manage and care for the lands, to ensure the long term protection and benefits of the ecological functions that the lands provide
- Work with municipalities that manage TRCA-owned lands within the terrestrial natural heritage system, to improve the management in accordance with this Strategy
- In new development projects, limit future recreational uses in the target system to only those low-intensity activities such as those noted in the land use model polices (Appendix F), specifically Policy 4(g)
- Toronto and Region Conservation will develop best practice guidelines for environmental management plans in areas with intensive recreational activities or municipal services, for example, in the appropriate relocation of activities outside the target system.
- Other public authorities owning lands in the target system, especially lands in the Agricultural and Rural and Greenbelt Areas, will be encouraged to prepare similar plans.
- Toronto and Region Conservation will provide guides for good stewardship to tenants on its lands within the terrestrial natural heritage system.
- Formulate recovery plans or strategies for ecosystems, for example, for suites of fauna and flora species and vegetation communities
- Toronto and Region Conservation will promote the achievement of the target system when undertaking environmental farm plans for its lands currently in agricultural uses.
- Develop management plans or strategies to address restoration challenges, such as invasive species, soil degradation, climate change, etc.
- Work with appropriate agencies and stakeholders to develop an environmental response committee and protocol to anticipate and effectively manage potential future biological (i.e. invasive species) and non-biological threats (i.e. natural disasters) to the terrestrial natural heritage system

- Continue to provide opportunities for appropriate passive recreation within the target system
- Plan for the proper management of public lands potentially secured through compensation banking or ecosystem credits.

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The target system land base encompasses high functioning natural communities, such as Black Spruce Swamp (left), as well as lands that will need restoration to a more natural condition (right, a restored Cattail Marsh).

5.2.6 PRIVATE LAND STEWARDSHIP

The TNHSS may be implemented in part through voluntary stewardship in all planning areas. Toronto and Region Conservation currently assists landowners both technically and, where possible, financially in habitat restoration. Toronto and Region Conservation will enhance its existing stewardship programs with incentives and education in order to encourage private landowners to take action in the implementation of the TNHSS. Toronto and Region Conservation will support the continuation of agriculture, recognizing the benefits and complement of agricultural uses to the natural system regionally. However, the target system map will also help locate areas on private lands that, if protected, would assist in realizing the goals of local landowners, the TNHSS, Watershed Plans and The Living City initiative. To that end, TRCA will

- Integrate the target system into current private land stewardship programs and develop new stewardship programs that further protect and restore the target system
- Continue to promote collaborative community stewardship programs that are linked to a subwatershed or neighbourhood, and to educate residents about the importance of their part of the target system to the region as a whole
- Develop incremental targets for restoration of the target system's "potential cover" and identify priority areas and key landowners
- Approach landowners for participation and, using the TNHSS, continue to encourage residents to voluntarily naturalize any available portions of their properties, including backyards within the Built-up Area

- Continue to approach businesses to jointly develop stewardship plans for portions of their private properties
- Encourage private owners undertaking naturalization and other restoration initiatives to adopt elements of the Natural Heritage Restoration Plan requirements Appendix G
- Toronto and Region Conservation will continue to work with all of its partners, including the Oak Ridges Moraine Stewardship Partners Alliance and neighbouring Conservation Authorities, to coordinate stewardship activities across the Moraine and the TRCA jurisdiction.
- In cooperation with its partners, TRCA will investigate the development of seminars and guidelines for realtors, developers, and residents on how to live and work in the region in a manner that is more sustainable.
- Formulate recovery plans or strategies for species and vegetation communities or ecosystems
- Develop management plans to address restoration challenges, such as invasive species, soil degradation, climate change, etc.
- Toronto and Region Conservation will not only work with existing partners, but will seek to develop new partnerships to achieve the goals of the TNHSS.

Individual landowners influence ecosystem health at the site scale and together can determine the regional system health (left, high quality forest); Over half of the findings of Bullfrog in the TRCA jurisdiction were on private lands.

5.2.7 MONITORING AND RESEARCH

The progress in the implementation of the TNHSS will be measured in two ways:

1. By tracking the *actions* taken to protect and restore the land base
2. By monitoring the results of these actions and the resulting *state* of the terrestrial natural system.

Watershed Report Cards and the regional State of the Terrestrial Ecosystem Report that summarize actions taken and the state of the terrestrial natural system will be important vehicles for maintaining stakeholder interest in achieving the TNHSS and Living City objectives. Results will inform decision-making and the development of incremental targets for achieving the target system as well as provide direction for data collection, data management and reporting protocols and methods being used as part of the Regional Monitoring Network (a multi-agency, multi-disciplinary network of participants in watershed monitoring). There are many specific monitoring and research directions:

- Developing a monitoring framework or guidelines for monitoring "action and success" in achieving Strategy objectives
- Conducting regular monitoring and reporting on the condition of the regional terrestrial natural heritage system
- Engaging in research of the effect of change at the regional and site scales on the interaction between the natural system and other land uses
- Monitoring the evolving science to formulate measures for additional indicators of the ecological integrity of terrestrial natural heritage systems
- Using the watershed plan process to refine the target system and to continue to develop a comprehensive approach to natural heritage management through integration with aquatic and hydrologic systems
- Continuing refinements of the TRCA approach to conservation to address contemporary environmental issues
- Refining the approach's methods and calibrate models through a periodic review of science and success
- Monitoring, for compatibility, the evolution of programs for natural heritage management being developed by other organizations, and be open to change as new ideas emerge
- Using the TNHSS science to develop or improve best management practices for human activities and development within or adjacent to the terrestrial natural system
- Continuing to seek partnerships with universities and colleges to share TRCA data and expertise with academic researchers.

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Botanical study and staff training day, Oak Ridges Moraine peatland; Great Lakes dynamic sand beach, Lake Ontario shoreline; Wild Ginger flower.

5.3 SUCCESS STORIES ON THE WAY TO THE FUTURE

The following are some of the many examples of how this Strategy's methods, results, and recommendations have already been applied to improving terrestrial natural heritage conditions in the TRCA jurisdiction.

City of Toronto Official Plan

Staff of the City of Toronto and TRCA completed a Natural Heritage Study for the City (City of Toronto 2002) using the TRCA approach. It included a complete inventory of natural heritage features, as well as future land use scenarios predicting ecological improvements through natural heritage protection and restoration. The City adapted the natural heritage system from the Study and included it as an overlay in the new Official Plan.

Rouge Park North Implementation Guidelines

The methods in this document were used to assist in the refinement of the Implementation Guidelines for the Rouge Park North boundary delineation (Rouge Park 2001). The land necessary to achieve the desired ecological condition was built into the ecological criteria that will be used to define the park boundary. The Town of Markham has adopted an Official Plan Amendment to recognize the Rouge Park North and the boundary delineation process outlined in the implementation guidelines.

Duffins and Carruthers Creeks Watershed Plan

This watershed plan (TRCA 2003) benefited from, and further advanced, state-of-the-art watershed planning methods. An innovative aspect of this plan was the degree to which the findings of each technical study component were integrated and interpreted from the perspective of the other components. A watershed response model (see TNHSS Section 5.2.3) guided the evaluation of three land use scenarios including no change, further development in accordance with local official plan policies, and further development but with enhanced natural cover. A net gain philosophy was critical in determining the location and amount of natural cover included in the enhanced natural cover scenario.

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Earl Bales Park spring wildflowers; Red Eft (young Eastern Newt): small steps toward big outcomes.

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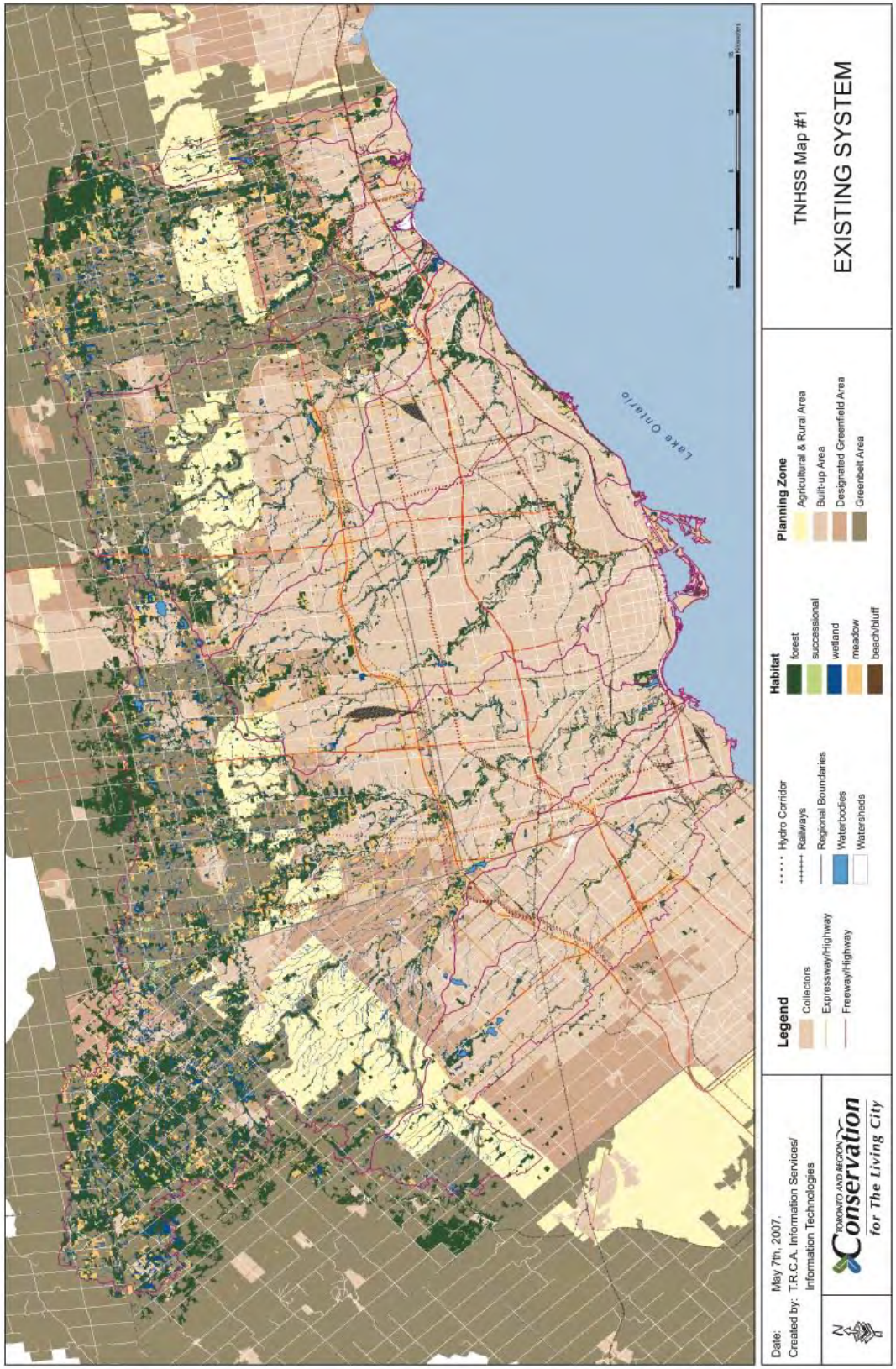
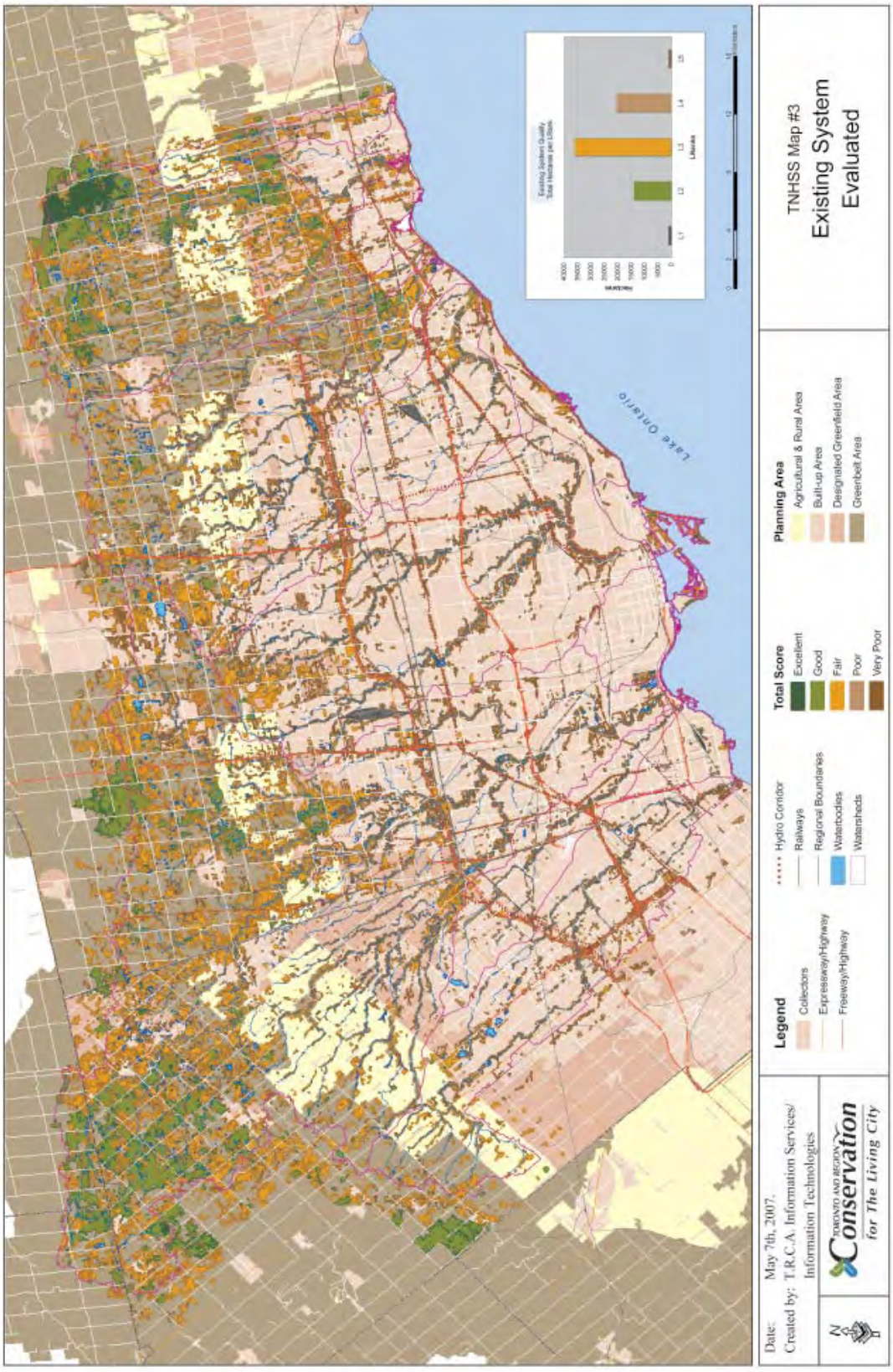
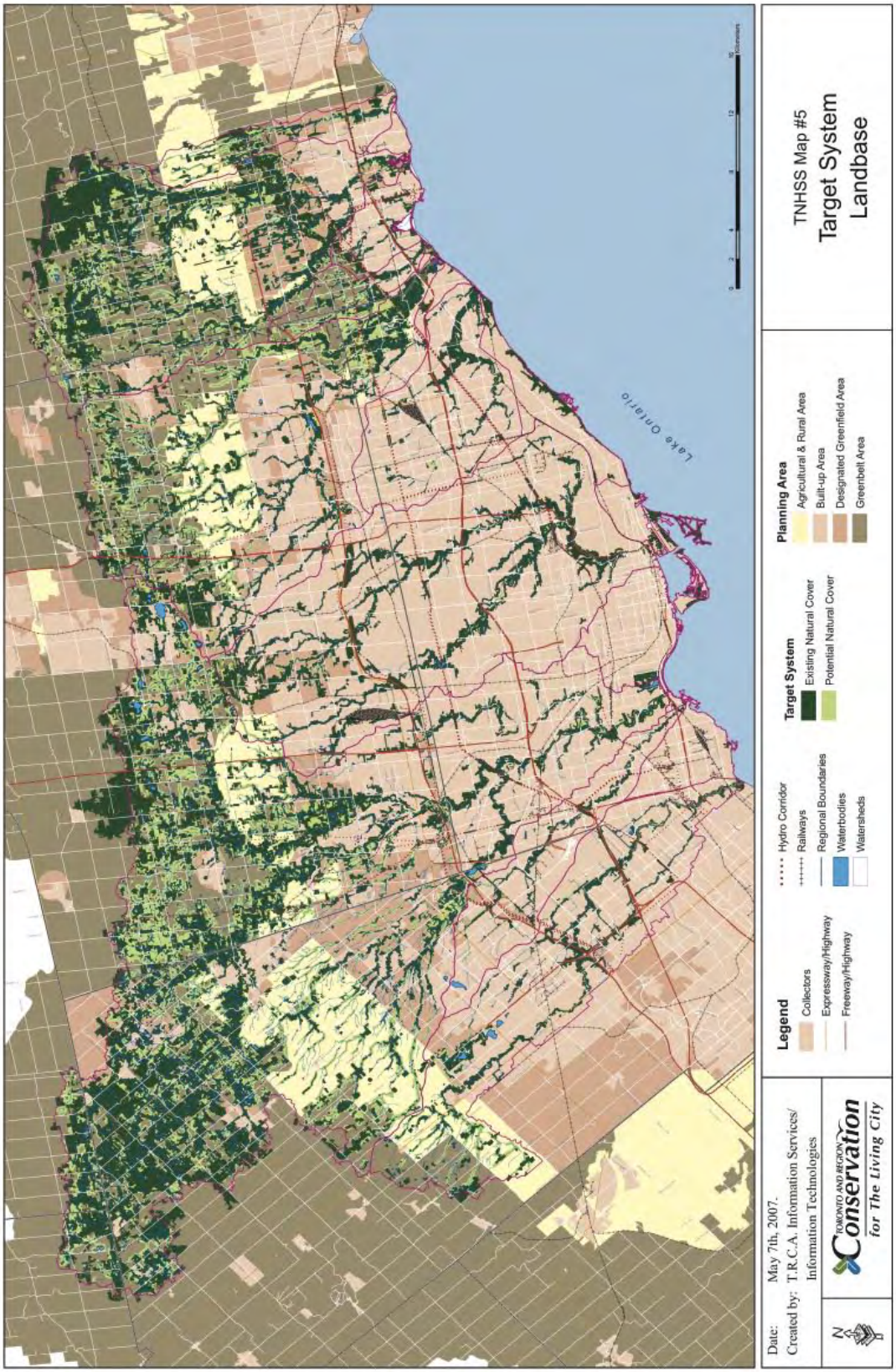
Map 1: Existing Terrestrial Natural System in the TRCA Jurisdiction (2002)



Map 3: Existing Terrestrial Natural System in the TRCA Jurisdiction (2002) – Evaluated



Map 5: Target Terrestrial Natural System in the TRCA Jurisdiction



Map 6: Target Terrestrial Natural System in the TRCA Jurisdiction – Evaluated