

Sustainable Halton



Options for A Natural Heritage System in Halton

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Specialists in Sustainable Landscape Planning

Sustainable Halton

This is a draft final background report for the Sustainable Halton planning process. As the project continues and as we receive public feedback, there may be slight adjustments made to the content of this report.

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EXECUTIVE SUMMARY

CONTEXT AND OBJECTIVE

To guide Halton's response to Places to Grow, and create the Sustainable Halton Plan (SHP) a series of urban, rural and natural heritage studies are being undertaken. This report is the component of the SHP that addresses natural heritage. Consistent with the high priority that the Region has placed on the environment in the past, the SHP will take an "Environment First" approach. This means that the protection of the Region's natural heritage will be given a high priority in the development of a response to the provincial Places to Grow plan. The Terms of Reference for the Sustainable Halton Plan, Options for a Natural Heritage System in Halton, provides the following project objective:

"To articulate options for defining and identifying a Regional Natural Heritage System (NHS). While the final NHS options will be for Halton Region as a whole, the focus will be on the non-urbanized area outside of the Greenbelt and Niagara Escarpment Plan areas."

Following from this, the purpose of this report is to develop options for a NHS for the Region. The development of actual NHS options in mapped form is on-going and is being refined through consultation and further analysis. At the completion of the project, mapped options will be provided that illustrate NHS options for the Region. The "Primary Study Area" (PSA) is the area located between the designated Urban Areas in Halton and areas of the Provincial Greenbelt and Niagara Escarpment.

Natural Heritage Systems (NHS)

The NHS approach is a land use planning tool intended to mitigate the impacts and stresses associated with development. It involves establishing a system of protected areas that consists of large core areas connected by functional ecological linkages. The system of connected core areas protects significant features and functions, preserves and hopefully improves biodiversity, and accommodates the natural movement of plants and animals that is necessary for their long term viability. Thus NHSs seek to reverse the impacts of fragmentation caused by large scale development and provide sufficient habitat to support populations of native plants and animals in the very long term (greater than 100 years).

General Principles

The study presents several fundamental concepts relating the development of NHSs. These are articulated in a number of general principles that were applied during the development of NHS options for the Region. The general principles include:

1. Develop a Regional NHS connected with natural features outside the Region.
2. Refine existing linkages (e.g., Bronte Creek, 16 mile Creek) to ensure they are ecologically functional.
3. Identify linkages that connect natural features that would otherwise be lost to urban development.

4. Refine the shape and size of natural features, and/or connect existing natural features, such that i) the perimeter/area ratio is minimized, and ii) large patches are created that will sustain Halton's biological diversity.
5. Develop core areas for sustaining Halton's biological diversity that represent the main biophysical landscapes in Halton, *i.e.*, the Escarpment Lands and the Peel Plain.
6. Implement the principle of redundancy in the Regional NHS by providing alternate linkages among natural features
7. In recognition that the extent of future impacts cannot be predicted and that our understanding of natural systems is incomplete, take a precautionary approach in the design of the Regional NHS to minimize the risk of further reducing regional biodiversity and ecological function.
8. Build on the existing, established network of natural features in Halton that have been established through the Region's Greenlands policies, the Niagara Escarpment Plan and the provincial Greenbelt Plan, and the programs and policies of the three conservation authorities whose jurisdictions extend into Halton: Conservation Halton, Credit Valley Conservation and the Grand River Conservation Authority.

Options for a Regional Natural Heritage System

The development of NHS options for Halton Region is a consultative process involving Halton Region staff and an Environmental Cluster Working Group (ECWG) comprised of stakeholders from the area municipalities (Burlington, Oakville, Milton and Halton Hills), conservation authorities (Halton Conservation, Credit Valley Conservation, and Grand River Conservation Authority) and the Niagara Escarpment Commission to assemble data and review work undertaken in the development of NHS options. Ongoing consultations with the ECWG and the public will continue as NHS options are refined through future phases of SHP development.

The study first identified the existing, large-scale system of natural features and linkages that serves as a general framework within which Regional NHS options can be developed. The Niagara Escarpment lands, which transverse the Region from the south corner in Burlington to the north corner in Georgetown, were recognized as a main, inter-regional connection. Beyond Halton Region this natural corridor extends northward towards Tobermory and southward into New York State. There is also connection along the Oak Ridges Moraine which extends eastward to another regional scale corridor, the Frontenac Arch.

The Region is fortunate in that a large proportion of Halton includes the escarpment lands which tie Halton's natural areas into a extensive ecological system. This comprises a critical component of Halton's natural heritage. The study also recognizes that there are four major watercourses and valley systems that trend in an approximately east-west direction; they include Bronte Creek, Sixteen Mile Creek and the Credit River. There is also the Blue Springs Creek valley (within the Grand River watershed) which runs westerly from Acton. The natural areas associated with these valleylands provide a second layer of major linkages across the Region that tie into the Niagara Escarpment.

Regional NHS options were developed to utilize these linkages as an existing framework to connect regional natural features with the larger, inter-regional framework.

Three options for a Regional NHS have been proposed in draft form and are currently being refined:

- Option 1 NHS “Minimum Policy Standards”
- Option 2 NHS “Systems-Based Approach”
- Option 3 NHS “Enhanced Ecological Integrity”

A description of the three Options is provided below.

The first option, “Minimum Policy Standards”, was based solely on the existing Greenlands “A” and “B” identified in the Regional Official Plan (ROP), Candidate Significant Woodlands as defined in the ROP and the NHS defined as part of the Province’s Greenbelt Plan. It was developed to approximately illustrate the current situation with respect to the protection of natural features in the Region. However, in practical terms it goes beyond this by treating all areas designated as Greenlands and candidate Significant Woodlands as being completely protected, when in reality, existing policies do allow some development. Halton Region’s Greenlands are only partially system-based, having developed out of the features-based approach of the original ESA program. They pre-date the more recent NHS approach.

Options 2 and 3 both take a NHS approach. Option 2, the “Systems-Based Approach” builds on option 1 by increasing the size of some existing core areas and increasing the number of core areas to provide better representation of the two main biophysical landscapes in the Region, the Niagara Escarpment and the Peel Plain (the area below the escarpment). The resulting core areas should be large enough to provide habitat that will sustain Halton’s biological diversity. Most significantly, Option 2 increases the connectivity among natural features.

The third option, “Enhanced Ecological Integrity” is intended to reduce the risk of further species loss in the Region and provide additional confidence that Halton’s natural heritage could be sustained indefinitely. The third option builds on the Option 2 NHS largely by providing additional core areas on the Peel Plain and further enhancing the linkages among natural features. Most notably it proposes “regional centres of biodiversity”, which are large (>200 ha) core areas intended to provide the conditions necessary for the long term sustainability of regional biodiversity. Connectivity among core areas was improved primarily by adding alternative linkages. Option 3 NHS also addresses the need for mitigation of the impacts of major highways on connectivity by proposing wildlife crossing overpasses and underpasses at key locations.

The area of Halton Region and the Primary Study Area (PSA) that is included in each NHS Option				
NHS Options	Halton Region		Primary Study Area	
	Area (ha)	Proportion of Region	Area (ha)	Proportion of Primary Study Area
Total Area	97,284	100%	16,803	100%
Option 1	41,940	43%	4,128	25%
Option 2	43,800	45%	5,336	32%
Option 3	45,717	47%	5,659	34%

Note: Figures are preliminary and will be updated as analyses are refined; the PSA makes up 15% of Halton Region

A substantial proportion of the Region is incorporated in all three NHS Options, 43%, 45% and 47% respectively (see Table 1). This is largely a reflection of the substantial area encompassed by the NHS designated by the Province within the Greenbelt (the Greenbelt NHS) and the Niagara Escarpment Natural Areas designations. For example, of the 41,940 ha within Option 1, 23,358 ha (56%) is composed solely of the provincial Greenbelt NHS.

Nearly all of the Greenbelt NHS outside of existing Regional environmental designations is above the Niagara Escarpment, and from a Regional perspective, it includes an inadequate area of the Peel Plain to provide sufficient representation of that landscape. A relatively small proportion (approximately 8%) of PSA tableland natural areas on the Peel Plain is included within the Option 1 NHS. To remedy this deficiency the proposed Option 2 and 3 NHSs include larger core areas and more substantial linkages on the Peel Plain resulting in a larger proportion of the Peel Plain included in Options 2 and 3 (approximately 17% and 19% respectively).

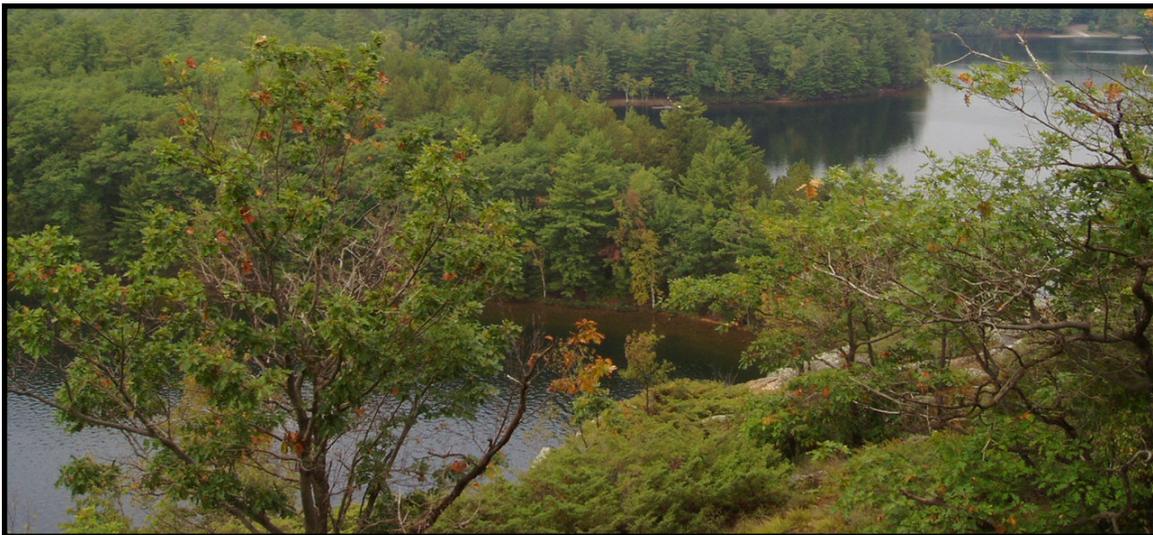
Summary of NHS Approaches

It is clear from Table 1 that Option 1 includes substantially less area of the PSA (25%), than either Option 2 or 3, which are relatively similar with 32% and 34% of the PSA respectively. This is a reflection of the approaches taken in the three options. Option 1 is rooted in a “features-based” approach (see Section 2.1 of main report). Although it has been refined substantially from the inception of natural feature protection embodied in the original ESA program, it does not adequately address issues of connectivity, size or shape for protected areas. The Option 1 approach is based on the protection of remnant features, whereas Options 2 and 3 include successional communities and agricultural lands intended for ecological restoration in order to identify sufficiently large core areas and functional ecological connections intended to achieve long term protection and enhancement of biodiversity and the ecological functions necessary for ecological integrity.

Of the two NHS-based options, Option 3 provides a much greater assurance that regional biodiversity and ecological function can be preserved in perpetuity. The creation of the large regional centres of biodiversity, the incorporation of alternative connections and the recommendation for substantial wildlife crossings at major barriers are all necessary to provide the present and future residents of Halton with representative examples of the Region’s natural heritage. The policy direction to support this is grounded in the Basic Position of the current OP, “*To maintain Halton as a desirable and identifiable place for this and future generations, certain landforms within*

Halton must be preserved permanently. This concept of Landform Permanence represents Halton's fundamental value in land use planning and will guide its decisions and actions on proposed land use changes accordingly. " (Halton Region Official Plan 2006, Part II, Basic Position, Section 26). In the context of this study, *Landform Permanence* manifests itself in a viable and robust NHS that protects a system of interconnected natural areas, sufficient to ensure the long term ecological integrity and protection of natural heritage for future generations.

In broad terms, the three options can be characterized by the two approaches: the features-based approach (Option 1) which would result in the protection of approximately 25% of the PSA, and ecosystem-based approaches (Options 2 and 3), which results in approximately 32 to 34% of the PSA being protected within a NHS.



I INTRODUCTION

A. PURPOSE OF THIS REPORT

As southern Ontario's population continues to increase government agencies need to prepare so that growth can be accommodated in an orderly, planned manner that maintains the quality of life, encourages healthy living and preserves our cultural and natural heritage. Recently, the province has issued a number of plans, the Greenbelt Plan and Places to Grow, that respectively protect a greenbelt within the Greater Golden Horseshoe Area (GGHA) and direct where growth will be accommodated. Places to Grow requires that the Region of Halton allow for approximately double the present population and employment opportunities by 2031. The *Places to Grow Act* (2005) requires municipalities to bring their Official Plans into conformity within three years.

Before Halton can amend their Official Plan, it is necessary to undertake a broad range of studies to ensure that wise planning decisions are made. To guide Halton's response to Places to Grow, and create the "Sustainable Halton Plan" (SHP) a series of urban, rural and natural heritage studies are being undertaken. This report is the component of the SHP that addresses natural heritage. Consistent with the high priority that the Region has placed on the environment in the past, the SHP will take an "Environment First" approach. This means that the protection of the Region's natural heritage will be given a high priority in the development of a response to the provincial Places to Grow plan. The Terms of Reference for the Sustainable Halton Plan, Options for a Natural Heritage System in Halton, provides the following project objective:

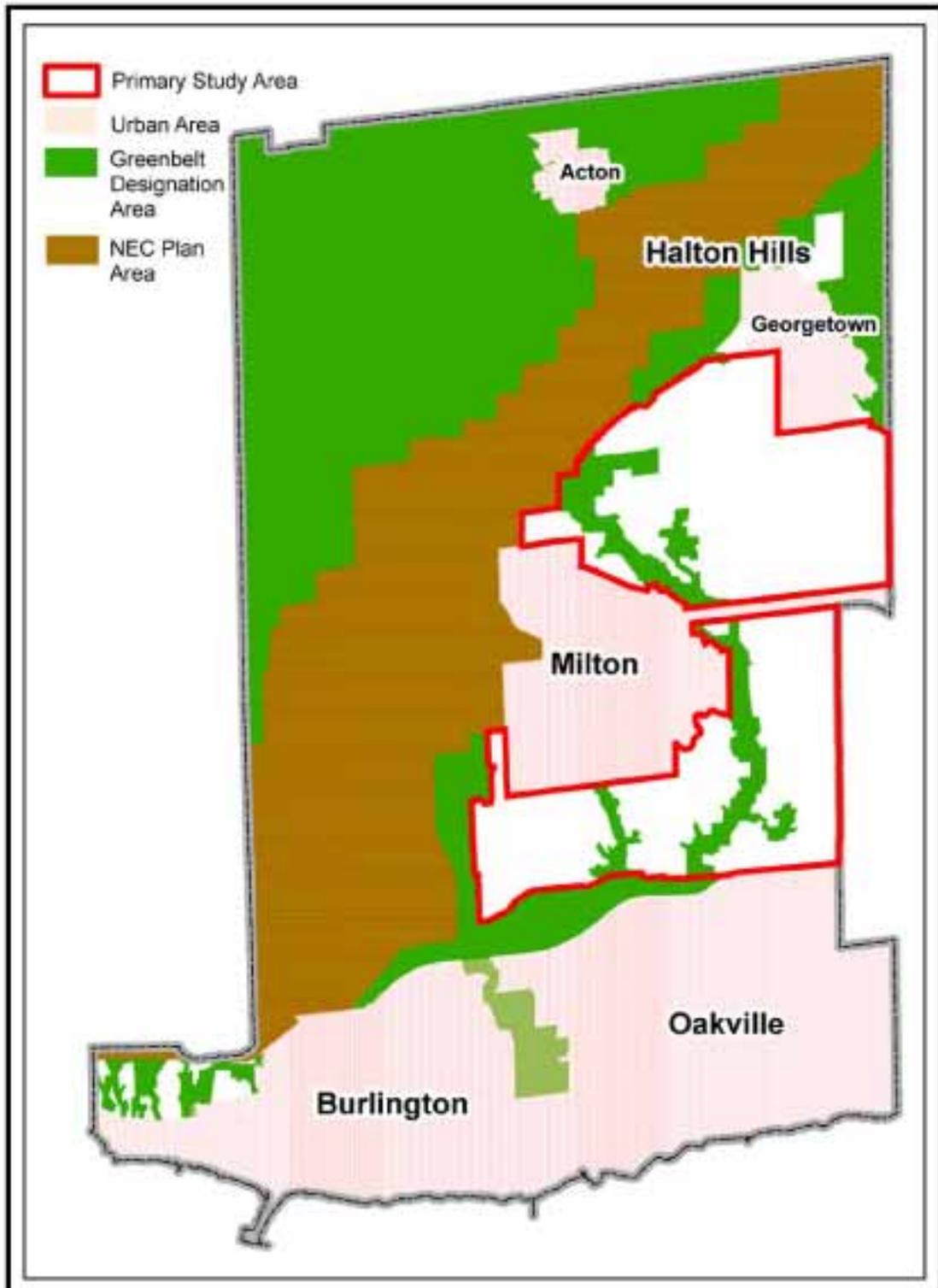
"To articulate options for defining and identifying a Regional Natural Heritage System (NHS). While the final NHS options will be for Halton Region as a whole, the focus will be on the non-urbanized area outside of the Greenbelt and Niagara Escarpment Plan areas."

Following from this, the purpose of this report is to develop options for a NHS for the Region. The development of actual NHS options in mapped form is on-going and is being refined through consultation and further analysis. At the completion of the project, mapped options will be provided that illustrate NHS options for the Region. The "Primary Study Area" (PSA) is the area located between the designated Urban Areas in Halton and areas of the Provincial Greenbelt and Niagara Escarpment (see Figure 1). The emphasis on the PSA reflects the overall purpose of the SHP, that being to find solutions to accommodating future growth. As the findings of this study are developed they will be integrated with other components of the SHP studies to articulate a comprehensive response to the Places to Grow plan.



Figure 1

Sustainable Halton Plan Primary Study Area



B. APPROACH TO DEVELOPING NATURAL HERITAGE SYSTEM OPTIONS

The development of NHS options for Halton Region is a consultative process involving Halton Region staff and an Environmental Cluster Working Group (ECWG) comprised of stakeholders from the area municipalities (Burlington, Oakville, Milton and Halton Hills), conservation authorities (Halton Conservation, Credit Valley Conservation, and Grand River Conservation Authority) and the Niagara Escarpment Commission to assemble data and review work undertaken in the development of NHS options. Ongoing consultations with the ECWG and the public will continue as NHS options are refined through future phases of SHP development.

The NHS options are based on existing information. To facilitate this a large digital dataset of maps, aerial photographs, and natural heritage information was assembled by Halton Region's staff and updated throughout this project with information provided by ECWG stakeholders. While NHS options are being developed for the entire Region, greater emphasis is being placed on the PSA due to the need to focus on areas of future growth in the Region, in response to Places To Grow. Consequently, in the PSA more detailed work on NHS options is being undertaken at a scale of 1:10,000, while work for the entire Region is being undertaken at a scale of 1:20,000. Rationale for the approach used to develop each of the three NHS options is articulated within goal statements, objectives and guidelines. These are being used to delineate and refine each option on maps. A detailed outline of the study approach is presented in Appendix A.



II RATIONALE FOR A REGIONAL NATURAL HERITAGE SYSTEM

In southern Ontario, land use changes have resulted in large-scale conversion of the pre-settlement landscape for agriculture and the more intensive land uses changes associated with urban and industrial development. The ongoing growth of urban areas in southern Ontario to accommodate the increasing population, especially within the Greater Toronto Area, is increasingly placing stress on the natural environment. The resulting fragmentation of the natural landscape creates an environment which generally supports relatively low biological diversity (biodiversity)¹. Over the long term, biodiversity continues to decline in small, unconnected natural areas, owing to the inability of many

¹ Biodiversity: The variety of life and its processes; it includes the variety of living organisms, the genetic differences among them, the communities and ecosystems in which they occur, and the ecological and evolutionary processes that keep them functioning, yet ever changing and adapting. (Noss and Cooperrider 1994)

species to maintain viable populations and to re-establish populations when they are extirpated through random natural events or due to stresses arising from adjacent agricultural, urban or industrial development.

The NHS approach is a land use planning tool intended to mitigate the impacts and



stresses associated with development. It involves establishing a system of protected areas that consists of large core areas connected by functional ecological linkages. The system of connected core areas protects significant features and functions, preserves and hopefully improves biodiversity, and accommodates the natural movement of plants and animals that is necessary for their long term viability. Thus NHS seek to reverse the impacts of fragmentation caused by large scale development and provide sufficient habitat to support populations of native plants and animals in the very long term (greater than 100 years).

Development of a NHS is the appropriate approach for the protection of natural heritage because it reinforces an understanding that individual areas and features have strong ecological ties to each other, as well as other physical attributes of the overall landscape. A NHS consists of connected ecological systems made up of natural features such as meadows, woodlands, wetlands, rivers and lakes.

A NHS approach places a strong emphasis on the maintenance of the ecological functions that sustain biodiversity, and is not just feature-based land use planning. With appropriate mechanisms for protection of the features and linkage aspects of natural heritage, biodiversity values can be protected in the long term. For example, a NHS will consider the protection of surface and groundwater elements required to sustain a wetland feature, and thus may extend protection limits beyond the boundaries of the wetland. Similarly, a NHS will seek to identify and preserve functional connections among natural features and areas to sustain the movement of flora and fauna that may be required as part of daily, seasonal, annual and/or long term movement patterns.

A. REVIEW OF NATURAL HERITAGE PROTECTION IN HALTON REGION

The protection of natural heritage features in Halton has progressed from a “features-based approach” to one that is more ecosystem-based. To a large degree, this progression in Halton parallels developments that have generally occurred in the scientific community and in the Province as a whole. Initially, land use planning focused almost entirely on meeting human needs (agricultural lands, resource extraction, urban lands, commercial lands, etc.) and the protection of natural heritage was largely ignored,

with the exception of hazard lands such as steep slopes and flood-prone lands. However, in the mid-1970s, protecting environmental features took on a greater importance and programs were developed that protected natural heritage features. These programs focused on the remnant features such as wetlands and woodlands. This has eventually evolved into a “systems approach” which recognizes the inter-relationships among environmental features, and the ecological functions performed by particular features. This evolution has resulted in a significant improvement in Halton’s ability to protect natural heritage.

Protection of Halton’s environment began in 1976 when Halton Regional council approved the formation of an Environmental and Ecological Advisory Committee (EEAC). The following year, the Royal Botanical Gardens, under the guidance of Dr. Peter Rice, undertook a survey of the Region of Halton to identify areas with environmental significance. The results of this survey were documented in Halton’s Environmentally Sensitive Area Study (ESA) completed in 1978. Simultaneously, a hydrogeological study of Halton’s ESAs was also undertaken by Ecologistics Ltd. and Conestogo Rovers and this was completed in 1977. Thirty-seven of the original thirty-eight ESAs identified (one was destroyed before it was protected through policy) were incorporated into Halton’s 1980 Regional Official Plan (ROP).

The first review of the 1980 ROP commenced in 1986 with an evaluation of the effectiveness of the 1980 policies. This was followed by several years of consultation with the public and agencies which culminated in the preparation of the B4 report in 1991. The B4 report presented Regional Council’s vision for Halton in the long term, and proposed changes to the 1980 ROP to move toward that vision. The B4 report noted that the 1980 ROP treated the environment in a “... *rather fragmented manner*”. This observation was consistent with the widespread changes going on in the manner in which natural heritage protection was being viewed. In response, the B4 report recommended the adoption of a Greenlands System to encompass all natural areas including, “... *parts of the Niagara Escarpment, the ESA’s, streams, valley lands, wetlands, groundwater recharge areas, woodlots, forests, parks and other open space*”. The initial proposal of having “environmental reserves” and “Greenlands Linkages” was eventually refined to create Greenlands “A” and “B” categories, but the essential concept to take a more systems-based approach and to recognize the protection of natural heritage has to be done holistically, was incorporated into the updated ROP.

As part of the ROP review undertaken in the early 1990s, the Region retained the consulting firm of Geomatics International to undertake a review of the criteria for identifying ESAs, including the development of a set of objectives for the ESA program and an evaluation of the effectiveness of the ESA guidelines, in order to make recommendations that would strengthen the ESA program. This review was at least partially motivated by the observation that while only one ESA had been lost to development, and another seriously impacted, there were “peripheral” impacts to many ESAs, referring to the incremental reduction of ESA areas resulting from minor concessions to development around their edges. While any one peripheral impact was probably not significant, the cumulative impact of ongoing changes was thought to be significant. The update studies recommended a number of changes to the ESA criteria, as well as other changes to the ESA program. The 1995 update study also recommended the addition and deletion of ESAs, based on a re-examination of all existing ESAs using the revised criteria, and the evaluation of several new candidate ESAs (Geomatics International 1995).

In 2002 further updates to the ESA program were undertaken (Mirek Sharp & Associates 2002) in preparation for the most recent review and update, Regional Official Plan Amendment 25 (ROPA 25). These updates included developing guidelines to standardize the determination of ESA boundaries, and resolving, to the extent possible, boundary differences among ESA, wetland and ANSI programs. Some further, but minor revisions to the ESA criteria and supporting explanations were provided and all ESAs, as well as some additional candidate ESAs, were re-evaluated using the revised criteria. The main outcome of the 2002 Update study was the production of Background Report #7 which provided direction for ROPA 25. Subsequently, the information from these various updates was consolidated the information into one report, the “Halton Region Environmentally Sensitive Areas Consolidation Report”.

The recent review and update of the ROP has further refined the approach to protecting natural heritage in Halton Region. ROPA 25 demonstrates an ongoing intent by the Region to strengthen the adoption of a systems approach to environmental protection. Section 115 states: “*A systems approach may be undertaken in identifying and protecting the Greenlands System within a Secondary Plan area...*”, suggesting environmental protection may go beyond the existing Greenlands policies.

Notwithstanding the improvements in natural heritage protection in Halton, the overall approach is still rooted in the original ESA program which seeks to protect the remnant natural features in the Region. Current approaches to natural heritage protection focus on protecting biodiversity and ecological function within a system of connected core areas, usually referred to as a NHS. This approach emphasizes the need to create cores that are sufficient in number and size to protect biodiversity and allow ecological functions to persist in the long term, and to provide connections that are ecologically functional and that will facilitate the movement and migration of vegetation and wildlife indefinitely. The NHS approach inevitably builds on remnant features such as wetland, woodland and valley systems, but it also increases their size, improves their shape and connects them such that long term conservation of biodiversity and ecological function is more likely to be achieved. The evolution to the current NHS approach to natural heritage protection is reflected in the 2005 Provincial Policy Statement (see Section 2.2). Thus the creation of a NHS for Halton is the next logical step in the evolution of the protection of the Region’s natural heritage.

B. ASSESSMENT OF REGIONAL OFFICIAL PLAN POLICIES

The current Greenlands System in the ROP (2006) protects a variety of natural heritage features within the following four categories, Escarpment Natural Area, Greenlands A, Greenlands B and Regional Waterfront Parks and each category has a different set of protection policies. One of the founding principles of a NHS is the protection of ecological linkages between natural heritage features in order to provide natural corridors that accommodate the short and long term movement patterns of plants and animals. The ROP (2006) includes references to the concept of ecological linkage in the Greenlands System goal which refers to: “*an interconnected system of natural areas and open space*” and in the Greenlands A and B objectives which include: “*to contribute to a continuous natural open space system*”. In addition, policies related to ESAs which are included in Greenlands B, include as an objective, “*To preserve the ecological integrity, including inter-connections, within and between natural ecosystems*”.

The inclusion of ecological linkages has not been one of the primary objectives in the identification of natural heritage features which make up the Greenlands System; except for ESAs. We note that of the 48 ESAs identified, 14 do fulfill the criteria of “*Areas that provide functional links among two or more adjacent natural systems*” (Region of Halton 2005). Generally, the Greenlands System as shown in Map 1 of the ROP (2006) consists of natural heritage features some of which have good ecological linkage but many have poor or no ecological linkage. Further, there is no objective for the Greenlands System aimed at protecting regional or landscape-level ecological linkages that would ensure the protection of ecological linkage throughout and beyond the Region of Halton.

Section 115 of the ROP (2006) provides the opportunity to identify and protect a Greenlands System within a Secondary Plan by using criteria other than those currently used in the ROP. It indicates that a “*systems approach*” must be undertaken, and this could result in greater ecological linkage among natural heritage features identified. The Greenlands System identified by this approach replaces the Greenlands System as identified in the ROP (2006) once approved. Application of Section 115 may lead therefore to greater connection among natural heritage features for approved Greenlands Systems within Secondary Plans. Section 115 will not, however, address the need for the protection of regional or landscape-level ecological linkages, nor does it provide for the development of a Region-wide NHS.

A review of natural heritage protection in Halton (see Section 2.1 above) concluded by suggesting the next logical step in the evolution of natural heritage protection in Halton is the development of a Regional NHS. Taking a NHS approach is consistent with the Provincial Policy Statement (2005). Policy 2.1.2 indicates, “*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.” (PPS 2005, underlined words are defined in the PPS). This is further supported by the Natural Heritage Reference Manual (MNR 1999). This Manual (MNR 1999) was prepared to provide technical information on issues relating to the application of natural heritage policies in the PPS. It specifically refers to the older 1997 PPS, but is currently being updated to reflect the 2005 PPS, as well as recent advances in conservation science. The Manual (MNR 1999) notes that a NHS approach is a useful method for implementing the PPS because it addresses the ecological ties that exist between individual areas and features and other physical features and areas in the landscape. The MNR is also currently developing a comprehensive method for the identification of a NHS over broad areas of the province.*

III DEVELOPING A NATURAL HERITAGE SYSTEM FOR HALTON REGION

A. CHARACTER OF THE PRE-EUROPEAN LANDSCAPE IN ONTARIO

In developing a NHS intended to protect the diversity of native plants and animals and the plant communities that support them, it is useful to consider the natural environments that characterized the Region of Halton prior to European settlement. If the Greenlands System is to achieve the protection of native biodiversity, it must include some of the features and functions that characterized the environment present in the past, because it

was these conditions that supported the rich and diverse species and ecosystem diversity that existed in pre-settlement times. This vision is not intended to represent the intended end point of the NHS. It is not possible, and perhaps not even desirable, to turn the clock back and try to re-create a pre-settlement landscape. However, it is important to have a sense of what the former landscape was like, and thus provide a perspective for the proposed NHS Options

The Character of Ontario's Pre-European Landscape



Woodland was the prevalent vegetation cover in eastern North America prior to European settlement (Braun 1950), covering approximately 90% of southern Ontario (Riley 1999). The woodlands were largely continuous across the landscape, with only small openings from natural disturbances such as fallen canopy trees, small areas of blowdown, and occasional understory fires. These pre-settlement woodlands were structurally diverse with “supercanopy” older growth trees, (mostly white pine) that pierced and rose above the more continuous, shade-tolerant canopy. Beneath the main canopy there was a sub-canopy of trees, as well as tall and short shrubs, forbs and grasses and ground layers of mosses, liverworts and low herbs. The lofty canopies created cathedral-like spaces beneath them. An idea of what it would be like to walk in such woodlands is provided by an early traveller:



“The grand forests present a more striking appearance than anything else to the eye of one just arrived from the Old World. No one entered their shadows or tread their long-drawn vistas of tall grey stems, spanned by over-arching roof of dark leaves, without the idea of a vast cathedral involuntarily rising in the mind. Like ruined columns, huge prostrate trunks lie strewn around, some but newly fallen, others moss-grown and verdant, with creeping plants; while many show only a dark line of decayed vegetable mould, the last and rapidly disappearing vestige of their former stateliness.” (King. 1866., as cited in Larson et al. 1999)

Of interest in this quote, is the observation of the various states of decay of fallen deadwood, some acting as host trees to mosses and other woodland plants, some almost fully decayed and noticeable only as a “dark line of decayed vegetable mould”. These are characteristics of what we now recognize as “old growth” woodlands, and are a necessary structural feature for capturing the biodiversity of native woodlands.

Not only were the woodlands expansive, but they were older and, therefore, contained much bigger trees. David Douglas, traveling through Ontario in the 1820s, wrote:

“... on the banks of the Detroit River, from Amherstburgh [sic] to the junction of the Thames with the St. Clair in Upper Canada, and on the opposite banks, in Michigan Territory, on a deep alluvial rich black soil, these trees [referring to white oak (Quercus alba)] frequently measure from 20 to 25 feet in circumference [approximately 195 to 240 cm in diameter] at 8 feet from the ground, and are from 80 to 100 feet high [24 to 30 metres]” (Douglas 1914 as cited by Fox and Soper 1954).

Similarly,

“One tulip tree near Kingsville yielded six thousand board feet of lumber. Chestnut trees have also been known to equal this... A giant walnut in Metcalf township locally know as ‘King of the Forest’ measured thirty-six feet in circumference [approximately 350 cm] one foot above the roots with very little loss of size in the first twenty feet.” (Ontario Lands and Forests 1963, as reported in Larson et al. 1999)



These pre-settlement woodlands supported a very different fauna from the small woodland patches that characterize much of the current landscape in southern Ontario. Top predators such as wolf and cougar were present and black bear were common throughout southern Ontario. Lady Simcoe wrote in her diary, “Near the [Don] river we saw the track of wolves, and the head and hooves of a deer” (Robertson 1911, pg. 213)

It is important to note that the Region was not 100% woodland prior to settlement. There were also scattered patches of open prairie and savannah-like ecosystems scattered across southern Ontario, reaching at least as far as the Rice Lake Plains near Peterborough. There is evidence that the extreme southwest corner of Halton supported savannah and/or prairie communities, thus the source of the name “Plains Road”, reflecting the fact there were open plains in that part of the Region.

The picture of the pre-settlement woodland with its multi-layers and giant canopy trees provides a worthwhile perspective when identifying a NHS in Halton Region (and elsewhere). The woodlands present within natural areas today which we perceive to be mature ecosystems with “interior woodland”, do not fulfill the same ecological roles or provide the high biodiversity which existed in the undisturbed, old-growth woodlands that dominated southern Ontario just 200 years ago. Our current perception that areas of southern Ontario are “well-wooded” because they have 30% or more woodland cover is misguided, because it does not reflect the continuous natural woodland cover of the original landscape. When viewed from this perspective, all of the remaining natural areas within southern Ontario are important to some extent.



B. NATURAL HERITAGE SYSTEM CONCEPTS

i. Influence of Surrounding Landscape Matrix

The protection of a NHS is an approach to preserving biodiversity and ecological function within developed landscapes. The area surrounding the NHS, which is referred to as the “landscape matrix”, has an impact on remnant natural systems, and will therefore influence the design of a NHS. The landscape matrix may support a variety of other land uses which have varied impacts on natural features. Generally speaking, agricultural landscapes impose fewer impacts on the natural environment than urban development and are, therefore, more compatible with a NHS in most cases. The other land uses which form the landscape matrix may be supportive or detrimental to the objectives of biodiversity protection and maintenance of ecological function, depending on their compatibility with natural systems.

An agricultural landscape matrix can be supportive of a NHS particularly when Best Management Practices (BMPs) and/or an Environmental Farm Plan (EFP) are implemented. With appropriate management, supportive aspects may include the more natural distribution of surface water, minimized impacts to infiltration and ground water, and better opportunities for the movement, migration and dispersal of plants and animals within the landscape. The movement of flora and fauna through an agricultural landscape may utilize agricultural fields, hedgerows and/or protected linkages and riparian corridors.



However, agricultural land uses can also result in significant negative impacts to a NHS. For example there are direct impacts when wetlands and woodlands are removed to facilitate agricultural land use or when livestock are permitted to trample, feed and defecate in natural areas. There is also the potential for numerous indirect impacts such as alteration of the natural water balance due to installation of tile drains; reduced infiltration and increased runoff caused by soil compaction; depletion of surface and groundwater resources from irrigation and the creation of drainage ditches; and a reduction in air and water quality due to agricultural fertilizer and pesticide inputs, and erosion.

Areas where the landscape matrix includes aggregate extraction are generally seen as potentially the most detrimental to a NHS. This is due to the direct impacts associated with aggregate extraction that result in the complete removal of native vegetation cover and soil, the significant alteration of natural topography, reduction of surface and ground water quality and impacts to hydrological cycle of surface and groundwater flows. These changes may have indirect impacts on wetlands, woodlands and other natural features as well as other indirect impacts due to noise,



dust, light and vibration. Nonetheless, the environment has a tremendous capacity to recover from impacts, and with an increasing knowledge of restoration ecology, areas of aggregate extraction may in some cases be supportive to a NHS through the strategic staging of extraction and the timing, intensity and type of rehabilitation following extraction.

Urban areas consist of residential, commercial and industrial land uses and the supporting infrastructure of roads and highways, these types of land uses create landscape matrix that is significantly less supportive of a NHS than an agricultural matrix. Urban land use impacts include the creation of impervious surfaces (roads, parking areas, roof tops, compacted lawns, *etc.*) that alter timing, quantity and quality of surface and ground water flows. Urban lands are far less hospitable (or permeable) for wildlife movement than agricultural landscapes. For example, roads, buildings, and fences, *etc.* constitute substantial barriers to the movement of plants and animals and offer little habitat to support and conceal wildlife as it attempts to move among remnant natural features and in the case of roads animals may be killed by vehicles while crossing.

Urban lands also result in many indirect impacts to protected areas within a NHS such as the introduction of non-native plants and animals, pets that harass and kill native wildlife, soil compaction and erosion from trampling, motorized recreational vehicles and mountain bikes, dumping of refuse and garden waste, noise, light, contamination of surface water, *etc.* The provision of significant buffers and functional ecological linkages are critical to mitigating the impacts associated with the more intensive impacts of urban land uses.



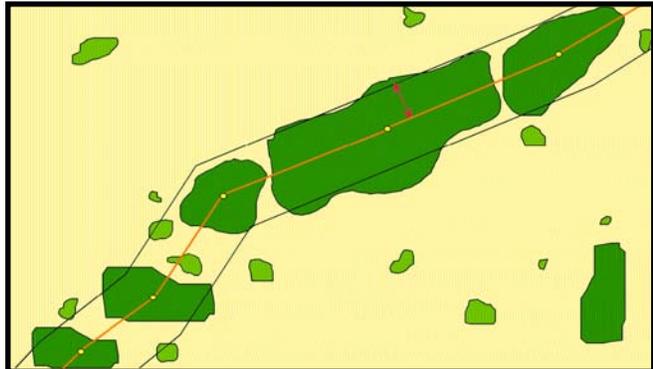
Within areas of urban land use a well-managed NHS protection program can provide a tremendous opportunity for the public to learn more about natural heritage and the impacts of human activities on natural areas, and to become involved in stewardship to ensure ongoing protection of a NHS. Involvement of the local community in stewardship initiatives contributes to community pride and elevates the importance of natural systems in the community. This in turn assists in the overall protection of natural heritage. Trails within a NHS may be used for passive recreation and commuting, thereby increasing public health through exercise and reducing the impact of motorized transportation. A NHS within an urban environment can increase natural heritage appreciation by providing outdoor educational opportunities for local schools and through the placement of educational signage along trails. Hands-on stewardship of a NHS may also be encouraged as schools and community groups become involved in programs to restore

degraded areas through clean-up programs, invasive species removal, and native species planting programs, *etc.*

In conclusion, the landscape matrix is an important consideration in the development of a NHS. Where a NHS is anticipated within an urban area, it will likely need to be more robust with respect to the size of core areas, buffers against remnant features and connecting habitat, and its protection may be enhanced through active management that includes the community stewardship programs. Within an agricultural landscape a NHS still needs to provide substantial core areas and functional ecological connections consisting of natural habitat in order to accommodate species intolerant of agricultural landscapes, if native biodiversity is to be protected and enhanced, and protection of the NHS will be enhanced through implementation of BMPs and implementation of an EFP.

ii. Functional Linkages

The NHS approach to natural heritage protection is based on recognition of the many substantial and critical interactions that occur within natural, healthy ecological landscapes. These interactions are complex and occur at a variety of spatial (geographic) and temporal scales. For example, on a daily basis animals may move between protected areas that offer cover and protection from predators and areas where they forage; seasonally aquatic insects may emerge from a wetland and forage in upland habitat where they may also perform an important pollination function for plants; tree frogs and some salamanders move annually from breeding ponds to upland over-wintering sites; and, over the long term the movement and dispersal of organisms results in the exchange of genetic material among populations, thereby contributing to the genetic health, adaptation and evolution of species. A fundamental objective of a NHS is to provide functional ecological linkages that maintain the natural interactions of plants and animals that occur within the landscape at the spatial and temporal scales required to protect native biodiversity.



The aspects essential to consider in creating successful ecological linkage are the width and length of linkage corridors, the habitat quality within linkage corridors, the redundancy of linkages and the creation of habitat nodes along linkage corridors. Generally the habitat must be of high quality and suitable for the species intended to move through a linkage. This is what is meant by a linkage being “functional”. As the length of the corridor increases the width must also increase. It may be important to provide habitat nodes along the linkages to provide refuge for wildlife moving through a corridor, thereby providing an area where wildlife can forage and rest in a more protected habitat before completing their movement through a corridor. For species that may take more than one generation to move between major habitat cores, the corridor must be of sufficient size and quality to support overlapping populations along the length of the linkage. Redundancy of linkages increases the probability of wildlife finding and utilizing linkages for movement within the landscape. Redundancy also mitigates against future changes (*e.g.*, climate change) that may destroy or compromise one ecological connection.

iii. Core Areas

The ability to protect the full range of native species diversity increases as the size of core areas increases, and as their shape becomes more regular (circular or square). Core areas that fall below certain size thresholds are incapable of providing suitable habitat for a large number of species that require large areas of habitat. These are frequently referred to as “area-sensitive” species (the term “interior forest” species is also used). This is largely attributed to the environmental conditions that are present along the edges of cores (“edge effects”) that create light levels, soil and air moisture levels, ambient wind and temperature that are significantly different from conditions that characterize the “core interior”. Edge effects have been shown to penetrate 100 to 300+ metres into a forest patch or meadow. Thus to obtain one hectare of “interior conditions” buffered by the minimum 100 edge, requires a square patch size of nine hectares (a perfectly round patch would be slightly smaller at around 8 ha in size to provide 1 ha of interior conditions with a 100 m buffer). One hectare is too small an area of interior habitat to support the many area-demanding species common to southern Ontario. Nor does it begin to provide representation of our natural heritage, considering the historic landscape of near continuous forest cover that characterized the vegetation prior to European colonization (see Section 3.1). Moreover, many species require a range of habitat conditions (wetlands, forests, thickets, *etc.*) in which to survive, thus requiring cores containing a mosaic of habitats. Lastly, long term sustainability requires a landscape capable of supporting many populations of individuals to allow for normal ecological events of extinction and re-colonization, to facilitate evolution and speciation, to allow for response to widespread impacts such as climate change, and to support species near the top of the food chain that require extensive prey bases.

A recent study by Environment Canada (2004) examined the ability of various patch sizes to provide habitat for native species. The report suggests patch sizes to sustain various animal groups for a variety of ecosystems, two examples are provided below.

Treed Swamp Wetland:

- areas 100 to 400 ha in size provide habitat for all forest-dependent bird species though many populations may be small and will therefore rely on other areas of similar size to ensure long term viability;
- areas > 1000 ha in size provide habitat for some forest-dependent mammals but most will still be absent; and
- areas > 10,000 ha are considered fully functional ecosystems, however, these areas may still be of inadequate size for some large mammals such as gray wolf or bobcat

Upland Forest:

- areas 50 to 75 ha in size will support some area-demanding bird species;
- areas 100 ha in size will support approximately 60 percent of area-demanding species; and
- areas > 200 ha in size support approximately 80 percent of area-demanding species.

It is apparent that a NHS must include some core areas of considerable size, much larger than have generally been protected in most urban and agricultural landscapes of southern Ontario. In many cases there are no individual remnant natural areas that meet the size requirements outlined above, especially on the well-developed Peel Plain



that stretches west from Toronto, and includes that area of Halton below the escarpment lands. As such, a NHS must establish large core areas where none are currently present, preferably by combining several existing natural features located in close proximity, combined with the long term ecological restoration of the intervening lands to a natural state. Similar to linkages, redundancy of large core

areas is also important to the protection of biodiversity.

C. GUIDING PRINCIPLES FOR A NHS FOR HALTON REGION

While each option for the NHS has its own set of guidelines, the concepts presented in Sections 3.1 and 3.2 provide guiding principles that apply to all options as follows:

Overall Guiding Principles

1. Develop a Regional NHS connected with natural features outside the Region.
2. Refine existing linkages (e.g., Bronte Creek, Sixteen Mile Creek) to ensure they are ecologically functional.
3. Identify linkages that connect natural features that would otherwise be separated by urban development.
4. Refine the shape and size of natural features, and/or connect existing natural features, such that i) the perimeter/area ratio is minimized, and ii) large patches are created that will sustain Halton's biological diversity.
5. Develop core areas for sustaining Halton's biological diversity that represent the main biophysical landscapes in Halton, *i.e.*, the Escarpment Lands and the Peel Plain.
6. Implement the principle of redundancy in the Regional NHS by providing alternate linkages among natural features
7. In recognition that the extent of future impacts cannot be predicted and that our understanding of natural systems is incomplete, take a precautionary approach in the design of the Regional NHS to minimize the risk of further reducing regional biodiversity and ecological function.

8. Build on the existing, established network of natural features in Halton that have been established through the Region's Greenlands policies, the Niagara Escarpment Plan and the provincial Greenbelt Plan, and the programs and policies of the three conservation authorities whose jurisdictions extend into Halton: Conservation Halton, Credit Valley Conservation and the Grand River Conservation Authority.

IV ALTERNATIVE NATURAL HERITAGE SYSTEMS FOR HALTON

A. REGIONAL FRAMEWORK FOR THE NHS OPTIONS

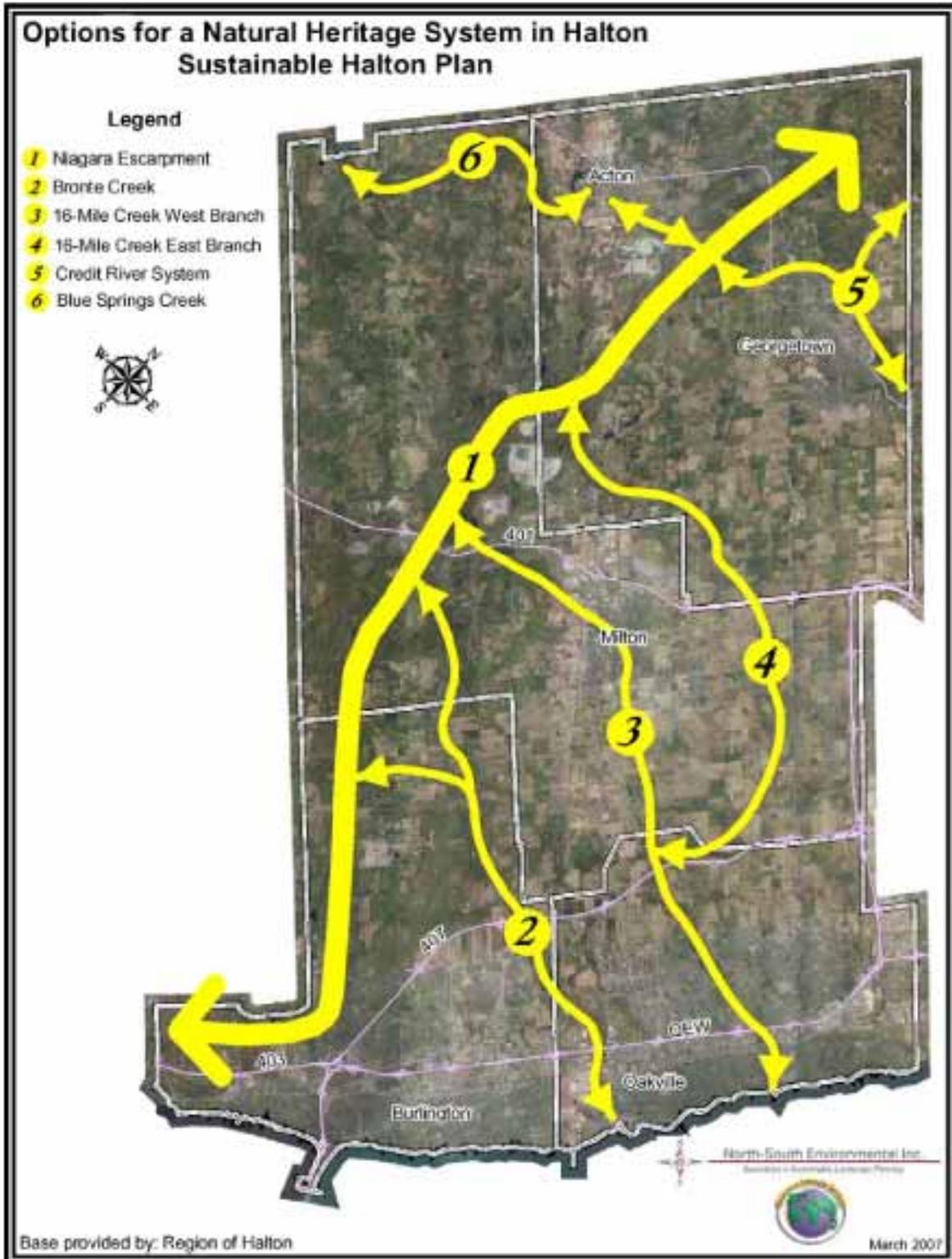
Prior to looking at individual NHS options, it is necessary to look at the Region from an overall, landscape perspective, to identify a framework around which the NHS options can be designed. Thus the existing, large-scale system of natural features and linkages that serves as a general framework within which Regional NHS options was identified (see Figure 2).

The Niagara Escarpment lands, which transverse the Region from the south corner in Burlington to the north corner in Georgetown, were recognized as a main, inter-regional connection. Beyond Halton Region this natural corridor extends north to Tobermory and south into New York State, with connections to the Oak Ridges Moraine and subsequently further eastward to the Frontenac Arch. The Niagara Escarpment has been recognized as a World Biosphere Reserve and is a major, provincial-level natural heritage feature. The Region is fortunate in that a large proportion of Halton includes escarpment lands as they include substantial natural areas and serve to tie Halton into a very extensive ecological system. This comprises a critical component of Halton's natural heritage.

There are also four major watercourses and valley systems that trend in an approximately east-west direction and include Bronte Creek, Sixteen Mile Creek and the Credit River. There is also the Blue Springs Creek valley (within the Grand River watershed) which runs westerly from Acton. The natural areas associated with these valleylands provide a second layer of major linkages across the Region that tie into the Niagara Escarpment (see Figure 2). Regional NHS options were developed to utilize these linkages as an existing framework to connect regional natural features with the larger, inter-regional framework.

Figure 2

Major Regional Ecological Linkages in Halton



B. OVERALL FRAMEWORK FOR THE NHS OPTIONS

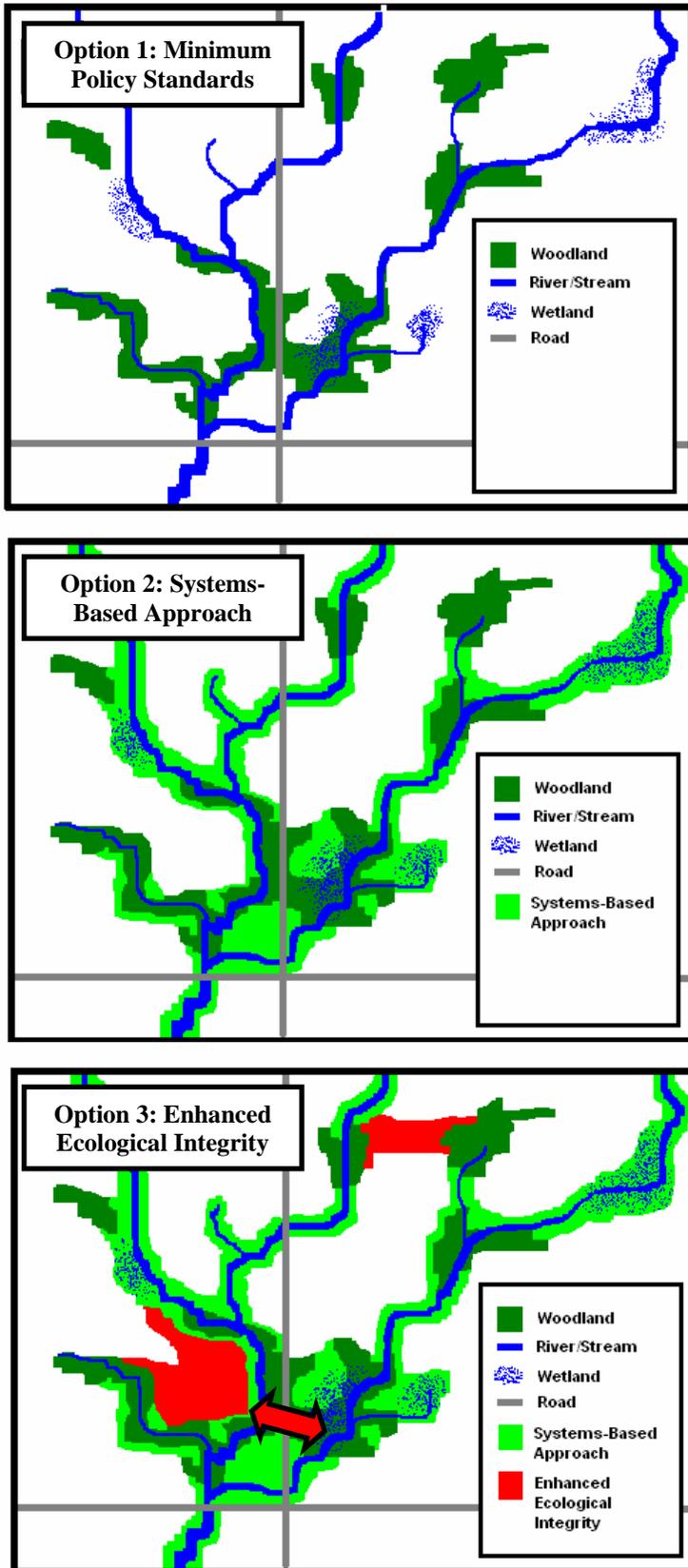
Three options for a Regional NHS have been proposed:

- Option 1 NHS “Minimum Policy Standards”
- Option 2 NHS “Systems-Based Approach”
- Option 3 NHS “Enhanced Ecological Integrity”

Each option achieves a different level of protection for natural heritage features. Figure 4 provides diagrams that conceptually illustrate how areas could be included within an NHS starting with Option 1 and then adding additional areas under Options 2 and 3. Option 1 primarily protects existing natural heritage features with limited regard to protection within a systems framework. An Option 1 NHS would include remnant habitat patches of woodland and wetland that may be small in size and fragmented with poor or no ecological connections among them. The ecological connections that do exist will primarily be based upon undeveloped, remnant natural areas along streams and rivers that may be discontinuous and which generally are not of sufficient width or quality to provide functional ecological linkage.

The Option 2 NHS builds on the remnant natural features that form the Option 1 NHS by increasing the size of core areas, including the intervening lands between clusters of natural areas, increasing the width of connections among natural features and providing new connections where needed. Option 3 more fully addresses the need to preserve and restore ecological integrity, and thus preserve Halton’s natural heritage. It further enhances the NHS by creating large regional core protected areas and by creating an additional, ecological functional connections among natural features. Option 3 may also include the design of wildlife crossings over or under roads intended to facilitate the movement of plants and animals within the landscape.

Figure 3 Conceptual diagrams illustration Natural Heritage System Options



C. OPTION 1: MINIMUM POLICY STANDARDS

The ROP (2006) protects natural heritage features through the policies of the Greenlands System. The goal, objectives and criteria listed below are taken from the ROP (2006).

i. Goal

The goal of the Greenlands System is to maintain as a permanent landform an interconnected system of natural areas and open space that will preserve areas of significant ecological value while providing, where appropriate, some opportunities for recreation.

ii. Objectives

Escarpment Natural Area

- To maintain the most natural Escarpment features, stream valleys, wetlands and related significant natural areas and associated cultural heritage features.
- To encourage compatible recreation, conservation and educational activities.
- To maintain and enhance the landscape quality of Escarpment features.

Greenlands A

- To define hazard lands for the protection of life and property.
- To protect or enhance the diversity of fauna and flora, ecosystems, plant communities, and significant landforms of Halton.
- To maintain or enhance the water quality and natural flow regulation of rivers, streams and wetlands within Halton.
- To provide opportunities, where appropriate, for passive outdoor recreational activities.
- To contribute to a continuous natural open space system to provide visual separation of communities and to provide continuous corridors between ecosystems.
- To protect significant scenic and heritage resources.
- To protect or enhance significant habitats of endangered and threatened species.
- To achieve no loss of function or area of Provincially Significant Wetlands.
- To protect or enhance fish and wildlife habitats.
- To protect and enhance the Halton waterfront as a major resource that is part of the Provincially significant Lake Ontario and Burlington Bay shoreline.

Greenlands B

- To protect or enhance the diversity of fauna and flora, ecosystems, plant communities, and significant landforms of Halton.
- To maintain or enhance the water quality and natural flow regulation of rivers, streams and wetlands within Halton.
- To provide, where appropriate, some opportunities for outdoor recreation.
- To contribute to a continuous natural open space system to provide visual separation of communities and to provide continuous corridors between ecosystems.
- To protect significant scenic and heritage resources.
- To protect or enhance fish and wildlife habitats.

Regional Waterfront Parks

- To maximize public accessibility to the Halton waterfront by increasing the amount of well distributed public open space.
- To provide a variety of recreational, cultural and tourism opportunities along the Halton waterfront.

iii. Guidelines for Developing NHS

Escarpment Natural Areas meet one or more of the following criteria:

- Escarpment slopes and related landforms associated with the underlying bedrock which are in a relatively natural state;
- Where they abut the Escarpment, woodlands extending 300 metres (1,000 feet) back from the brow of the Escarpment slope;
- The most significant Areas of Natural and Scientific Interest (Life Science); and
- The most significant stream valleys and wetlands associated with the Escarpment.

Greenlands A meet one or more of the following criteria:

- Areas included in the Regulatory Flood Plains, as determined and mapped by the appropriate Conservation Authority, and refined from time to time;
- Lake Ontario and Burlington Bay shoreline outside Regional Waterfront Parks;
- Provincially Significant Wetlands, as determined by the Ministry of Natural Resources, and refined from time to time; or

- Significant portions of the habitat of endangered and threatened species, as determined by the Ministry of Natural Resources, and refined from time to time;

Greenlands B meet one or more of the following criteria:

- Environmentally Sensitive Areas (ESA) outside of Escarpment Natural Area or Greenlands A;
- Public Open Space as identified in The Parkway Belt West Plan;
- Regionally Significant Wetlands, as determined by the Ministry of Natural Resources, and refined from time to time;
- Provincially and Regionally Significant Areas of Natural and Scientific Interest (both Life Science and Earth Science);
- Candidate Significant Woodlands, as identified under Sections 132(4) and 132(5);
- Carolinian Canada sites;
- Halton Regional Forests; or
- Environmental Protection Areas identified in the North Aldershot Inter-Agency Review Final Report (May 1994), with precise boundaries to be established through an Environmental Impact Assessment (EIA).

Regional Waterfront Parks meet one or more of the following criteria:

- Burlington Beach,
- Burloak Park, or
- Bronte Harbour.

iv. Description of Option 1

The first option, “Minimum Policy Standards”, was based solely on the existing Greenlands “A” and “B” from the Regional Official Plan (2006) (ROP), candidate significant woodlands² as defined in the ROP and the NHS defined as part of the Province’s Greenbelt Plan. It was developed to approximately illustrate the current situation with respect to the protection of natural features in the Region. However, it actually goes beyond this by treating all areas designated as Greenlands and candidate significant woodlands being completely protected, when in reality, existing policies do allow some development in them. Halton Region’s Greenlands are partially system-based, having developed out of the features-based approach of the original ESA program. They pre-date the more recent NHS approach.

² Candidate significant woodlands were determined using the definition in the ROP and applying it to a map of woodlands provided by the Region.

D. OPTION 2: SYSTEMS-BASED APPROACH

i. Goal

To preserve and improve the biological diversity and ecological function of the Region of Halton for future generations, through the creation of a Natural Heritage System consisting of cores and linkages of sufficient size and connectedness to provide long-term ecological integrity.

ii. Objectives

The objectives for Option 2 are directed at developing a NHS that utilizes and builds on the existing protected features identified in Option 1. As a result, with very few exceptions, the features identified in Option 1 are incorporated into Option 2. The objectives for Option 2 are:

- Maintain and create the conditions that will result in landscape-level ecological functions;
- Create functional ecological connections at inter-regional, inter-watershed and local scales;
- Provide habitat that will support biodiversity of the Region of Halton in perpetuity;
- Protect river systems and valleylands to permit, ongoing, natural, dynamic hydro-geomorphic processes that are essential to sustain the evolving complex of abiotic and biotic features and functions;
- Maintain and create major core areas large enough to support populations of area-sensitive species;

iii. Guidelines For Developing NHS

- 1. Greenlands A and B:** NHS includes everything that is in Greenlands A and B except for some portions of earth science ANSIs without life science natural heritage features and some Greenland areas that are small in size and isolated from other natural features or Greenland areas which are developed.
- 2. Greenbelt NHS:** It is assumed the NHS from the Greenbelt Plan should remain within Halton's NHS. If necessary, exceptions will be identified and rationalized.
- 3. Floodlines:** All lands that fall within floodlines are included. This may require some future refinement where the accuracy of some watercourses is unknown. It is also possible to consider protection of the hydrological function, which in some cases may permit the re-alignment of some streams to facilitate good planning. The location of buffers and linkages associated with minor watercourses may change, while the intent of protection is maintained.
- 4. Agricultural lands:** The NHS includes land that is currently in agricultural usage. It is anticipated that agricultural land uses will be maintained within these NHS areas and where possible good stewardship would be encouraged such as through BMPs

and the development of EFP. Should agricultural land use be discontinued, these lands would be incorporated into the NHS as natural habitat.

5. **Enhanced core areas:** In some cases large core areas have been created that include proposed restoration areas intended to achieve minimum threshold sizes and/or improved shape for core areas. The area of a natural feature may be the single most important factor in maintaining long term ecological integrity and for maintaining biological diversity. There is literature that provides guidance on the biodiversity that can be maintained in various areas of different habitat in southern Ontario. Where the size of certain existing habitats are just below these thresholds, areas suitable for restoration are identified to increase the size to attain these threshold areas, and to restore shapes that maximize their integrity (*i.e.* avoid linear or highly irregular shapes). Desired minimum sizes used are as follows:
 - woodlands: 20 ha
 - wetlands: 10 ha (marsh/thicket); 20 ha (swamp)
 - open habitat: 15 ha
6. **Buffers:** The NHS includes internal buffers around some natural heritage features as follows:
 - woodlands: 30 metres
 - wetlands: 30 metres
 - open habitat: no buffer
7. **Watercourses:** Watercourses without floodlines, for which substantial ecological linkage was not considered necessary have the following buffers:
 - cold-water and cool-water watercourses: 30 metres both sides
 - warm-water watercourses: 15 metres both sides
 - “unknown” watercourses: 15 metres both sides
8. **Ecological Connectivity:** Ecological linkages were considered at two levels *regional* and *local*. *Regional* corridors ensure continuous linkage across the landscape, and as such they are wider in order to facilitate the long term movement of all plant and animals, in the very long term. *Local* corridors connect isolated natural heritage features to the larger NHS. While they are narrower they are intended to accommodate the short and long term movement requirements of plant and animals over shorter distances. Linkage corridors were based on the following guidelines:
 - regional linkage: 300 to 400 m width
 - local linkage: 60 to 100 m width

iv. Description of Option 2

The second option, “Systems-Based Approach”, seeks to take a NHS approach. It builds on option 1 by increasing the size of some existing core areas and increasing the number of core areas to provide better representation of the two main biophysical landscapes in the Region, the Niagara Escarpment and the Peel Plain (the area below the escarpment). The resulting core areas should be large enough to provide habitat that will sustain Halton’s biological diversity. Most significantly, the second option increases the connectivity among natural features.

E. OPTION 3: ENHANCED ECOLOGICAL INTEGRITY

i. Goal

To provide a high degree of confidence that the biological diversity and ecological function of the Region of Halton will be preserved and enhanced for future generations, through the creation of a Natural Heritage System consisting of substantial core areas connected by multiple linkages, thus enhancing long-term integrity.

ii. Objectives

Option 3 builds on the system approach taken for Option 2, thus, like Option 2, it incorporates all but a very few of the areas that are identified in Option 1. It also takes a system-based approach like Option 2, but enhances the long term ecological integrity of the NHS. Thus the objectives for Option 3 are similar to those in Option 2.

- Maintain and create the conditions that will result in landscape-level ecological functions;
- Create functional ecological connections at inter-regional, inter-watershed and local scales, and enhance their long term function by providing additional connections among features, thus adding an increased measure of redundancy to the NHS;
- Provide sufficient representative habitat that will not only support the biodiversity of the Region of Halton in perpetuity but will also facilitate the restoration of habitat necessary to increase biodiversity of the Region;
- Protect river systems and valleylands to permit, ongoing, natural, dynamic hydro-geomorphic processes that are essential to sustain the evolving complex of abiotic and biotic features and functions; and
- Restore connectivity where major highways represent major barriers to wildlife movement, thus enhancing the overall connectivity of the NHS.

iii. Guidelines For Developing NHS

- 1. Utilize the Option 2 NHS as a starting point:** As noted above, Option 3 builds on Option 2, thus all the guidelines used for developing Option 2 represent minimums with respect to defining core areas and connections.

- 2. Restore Connectivity over Major Highways:** It was recognized that major highways such as Highways 401, 403, and 407, Dundas Street, and Highway 7, represent major barriers to wildlife. In response, several areas where NHS connections are interrupted by major highways were identified as priorities for creating wildlife overpass or underpass crossings.
- 3. Development of Regional Centres for Biodiversity:** Although Option 2 creates some sizable core areas, long term biodiversity protection is most likely to be achieved through establishing several very large (e.g., >200ha) core areas that provide greater confidence in creating the conditions necessary to support native plant and communities and wildlife populations indefinitely. Moreover, such cores need to represent the two major landscape types with Halton, i.e. the lands above and below the Niagara Escarpment. To achieve this, the size and proximity of habitat patches identified in Option 2 are examined to identify the most efficient opportunities to combine patches and create regional centres for biodiversity protection.
- 4. Enhancement of Connectivity:** One of the principles used in the design of nature reserves addresses the need to provide alternative connections among habitat patches. This introduces a measure of redundancy into the NHS. This is seen as necessary in order to increase the opportunity for the long term movement and migration of wildlife and vegetation in response to large scale change (e.g. climate change), and to mitigate against a future disaster that may eliminate one or more connections. It may best be thought of as a “safety factor”, much in the same way an engineer will incorporate a safety factor into a bridge design, to mitigate against conditions that could not be foreseen or predicted during design. It provides a greater level of confidence that the goal and objectives of the NHS can be met.

iv. Description of Option 3

The third option, “Enhanced Ecological Integrity” further reduces the risk of species loss and provides additional confidence that Halton’s natural heritage could be sustained in the long term. The third option builds on the Option 2 NHS by providing additional core areas on the Peel Plain, larger core areas to represent “regional centres of biodiversity” and further refining the linkages among natural features. Option 3 NHS also incorporates the need for mitigation of the impacts of major highways by enhancing ecological linkage through the development of wildlife crossing overpasses and underpasses.

V DISCUSSION OF OPTIONS

A. COMPARISON OF ALTERNATIVE OPTIONS

A description of the three preliminary Options is provided below and is summarized in Table 1. It must be realized that the refinement of the three options is ongoing and that the figures provided below are based on the current draft NHS options. These figures are expected to change in the future as the refinements are made, but not substantially.

The area of Halton Region and the Primary Study Area (PSA) that is included in each NHS Option				
NHS Options	Halton Region		Primary Study Area	
	Area (ha)	Proportion of Region	Area (ha)	Proportion of Primary Study Area
Total Area	97,284	100%	16,803	100%
Option 1	41,940	43%	4,128	25%
Option 2	43,800	45%	5,336	32%
Option 3	45,717	47%	5,659	34%

Note: Figures are preliminary and will be updated as analyses are refined; see Figure 1 for location of PSA; the PSA makes up 15% of Halton Region

A substantial proportion of the Region is incorporated in all three NHS Options, 43%, 45% and 47% respectively (see Table 1). This is largely a reflection of the substantial area encompassed by the NHS designated by the Province within the Greenbelt (the Greenbelt NHS) and the Niagara Escarpment Natural Areas designations. For example, of the 41,940 ha within Option 1, 23,358 ha (56%) is composed solely of the provincial Greenbelt NHS.

Nearly all of the Greenbelt NHS outside of existing Regional environmental designations is above the Niagara Escarpment, and from a Regional perspective, it includes an inadequate area of the Peel Plain to provide sufficient representation of that landscape. A relatively small proportion (approximately 8%) of PSA tableland natural areas on the Peel Plain is included within the Option 1 NHS. To remedy this deficiency the proposed Option 2 and 3 NHSs include larger core areas and more substantial linkages on the Peel Plain resulting in a larger proportion of the Peel Plain included in Options 2 and 3 (approximately 17% and 19% respectively).

B. SUMMARY OF NHS APPROACHES

It is clear from Table 1 that Option 1 includes substantially less area of the PSA (25%), than either Option 2 or 3, which are relatively similar with 32% and 34% of the PSA respectively. This is a reflection of the approaches taken in the three options. Option 1 is rooted in a “features-based” approach (see Section 2.1). Although it has been refined substantially from the inception of natural feature protection embodied in the original ESA program, it does not adequately address issues of connectivity, size or shape for protected areas. The Option 1 approach is based on the protection of remnant features, whereas Options 2 and 3 include successional communities and agricultural lands intended for ecological restoration in order to identify sufficiently large core areas and functional ecological connections intended to achieve long term protection and enhancement of biodiversity and the ecological functions necessary for ecological integrity.

Of the two NHS-based options, Option 3 provides a much greater assurance that regional biodiversity and ecological function can be preserved in perpetuity. The creation of the large regional centres of biodiversity, the incorporation of alternative connections and the recommendation for substantial wildlife crossings at major barriers are all necessary to provide the present and future residents of Halton with representative examples of the Region’s natural heritage. The policy direction to support this is grounded in the Basic Position of the current OP, “*To maintain Halton as a desirable and identifiable place for this and future generations, certain landforms within*

Halton must be preserved permanently. This concept of Landform Permanence represents Halton's fundamental value in land use planning and will guide its decisions and actions on proposed land use changes accordingly. " (Halton Region Official Plan 2006, Part II, Basic Position, sec 26). In the context of this study, *Landform Permanence* manifests itself in a viable and robust NHS that protects a system of interconnected natural areas, sufficient to ensure the long term ecological integrity and protection of natural heritage for future generations.

In broad terms, the three options can be characterized by the two approaches: the features-based approach (Option 1) which would result in the protection of approximately 25% of the PSA, and ecosystem-based approaches (Options 2 and 3), which results in approximately 32 to 34% of the PSA being protected within a NHS.



LITERATURE CITED AND REFERENCES

- Aurora District Ministry of Natural Resources. 2005. Seaton Lands/Duffins-Rouge Agricultural Preserve Natural Heritage System, City of Pickering. p. 8.
- Bennett, A.F. 1999. Linkages in the Landscape: The Role of Corridors and Connectivity in Wildlife Conservation. IUCN, The World Conservation Union. pp. 204.
- Dillon Consulting Limited. 2003. City of Pickering Growth Management Study. Phase 1: Environmental Systems Analysis Report and Phase 1 Summary. Prepared for the City of Pickering. p. 38-39.
- Dillon Consulting Limited, Sorenson Gravely Lowes Planning Associates Inc., Joseph Bogdan Associates Inc., and Enid Slack Consulting Inc. 2004. City of Pickering Growth Management Study. Phase 2: Preferred Growth Management Concept and Structure Plan. Prepared for the City of Pickering. Figure 19.
- Gartner Lee. 1996. Development of a Natural Heritage System for the County of Simcoe. Prepared for the County of Simcoe. pp. 57.
- Geomatics International Inc. 1995. Evaluation of Environmentally Sensitive Area Program in Halton R.M. (phases 1 and 2). 1990-1993. Prepared for The Regional Municipality of Halton.
- Geomatics International Inc. 1998. Richmond Hill Corridor Study: Final Draft Report. Prepared for the Planning and Development Department, the Town of Richmond Hill. pp. 159.
- Gore & Storrie Limited. 1993. Town of Markham Natural Features Study: Phase 2 Implementation Plan. p. A1-11.
- Noss, R.F. 1992. The Wildlands Project: Land Conservation Strategy. Wild Earth. Michigan: Cenozoice Society Inc. p. 10-22.
- Noss, R.F. 1993. Ecology of Greenways: Design and Function of Linear Conservation Areas. Wildlife Corridors. Minneapolis: University of Minnesota Press. p. 43-68.
- Noss, R.F. and A.Y. Cooperrider. 1994. Saving Nature's Legacy: Protecting and Restoring Biodiversity. Washington: Island Press. pp. 416.
- Peterson, Brad. 1994. Natural Heritage Action Plan: Background and Analysis. Orillia: Couchiching Conservancy. p. 41.
- Rouge Park. 2000. Rouge North Management Plan: A Strategy to Guide the Realization of the Rouge Park from Steeles Avenue to the Oak Ridges Moraine. p. 4-7.
- Rouge Park. 2001. Rouge North Management Plan: A Strategy to Guide the Realization of the Rouge Park from Steeles Avenue to the Oak Ridges Moraine. p. 4-18.
- Schollen and Company Inc and Terra Geographical Studies. 2002. Rouge North Implementation Manual. Draft Issue. p. 12, 30.

APPENDIX A

SHP NATURAL HERITAGE SYSTEM OPTIONS STUDY APPROACH

Appendix A: SHP Natural Heritage system Options Study Approach

Sustainable Halton Plan Studies

The Sustainable Halton Plan (SHP) is comprised of a number of studies intended to guide Halton's response to Places to Grow. Study series and reports include the following:

Urban Series

- Land Supply Analysis
- Regional Land Analysis
- Explaining Density
- Effect of Demographic Change
- Density Choices
- Towards An Intensification Strategy for Halton Region
- Health Facilities Planning
- Urban Structure: Potential for Long-Term Growth Areas
- Housing Directions
- Air Quality, Human Health and the Built Environment
- Physical Activity and the Built Environment
- Human Services
- Transportation Infrastructure
- Water and Wastewater Infrastructure
- Waste Management Facilities
- Energy Demand and Supply
- Climate Change

Natural Heritage Series

- Options for a Natural Heritage System in Halton

Rural Series

- An Agricultural/Countryside Vision
- Community Food Security
- Aggregate Resources Strategy
- Archaeological Resources

Options for a Natural Heritage System in Halton

Options for a Natural Heritage System in Halton is the component of the SHP that addresses natural heritage. Consistent with the high priority that the Region of Halton has placed on the environment in the past, the SHP will take an "Environment First" approach. This means that the protection of the Region's natural heritage will be given a high priority in the development of a response to the provincial Places to Grow plan.

The Terms of Reference for the SHP *Options for a Natural Heritage System in Halton*, provides the following project objective:

“To articulate options for defining and identifying a Regional Natural Heritage System (NHS). While the final NHS options will be for Halton Region as a whole, the focus will be on the non-urbanized area outside of the Greenbelt and Niagara Escarpment Plan areas.”

Following from this, the purpose of this report is to develop options for a NHS for the Region. The development of actual NHS options in mapped form is on-going and is being refined through consultation and further analysis. At the completion of the project, mapped options will be provided that illustrate NHS options for the Region. The “Primary Study Area” (PSA) is the area located between the designated Urban Areas in Halton and areas of the Provincial Greenbelt and Niagara Escarpment (see Figure 1). The emphasis on the PSA reflects the overall purpose of the SHP, that being to find solutions to accommodating future growth. The findings of this study will need to be integrated with other components of the SHP to articulate a comprehensive response to the Places to Growth plan.

Study Team Organization

North-South Environmental Inc. (NSE) was retained in the fall of 2006 to prepare the natural heritage component of the SHP. The lead firm on the project is Meridian Planning. Although NSE reports through Meridian Planning, we have worked directly and closely with the regional planning staff in the development of NHS Options. Progress and findings were presented to the Environmental Cluster Working Group (ECWG) at a number of meetings throughout the project. The ECWG is comprised of agency stakeholders that have responsibility for various aspects of land use planning within the Region. This includes representatives from:

- regional departments;
- the Towns of Burlington, Halton Hills, Milton and Oakville;
- Conservation Halton;
- Credit Valley Conservation;
- Grand River Conservation Authority; and
- Niagara Escarpment Commission

A complete description of the study team framework will be provided in the project report being prepared by Meridian Planning.

Refining Terms of Reference and Work Plan

The first task in the project was to review the Terms of Reference, and develop and refine a work program. Several draft Work Plans were reviewed and commented on by the Environmental Cluster Working Group. One concern that was voiced at the outset was the very aggressive time schedule for completing projects. This was eventually

extended as the project progressed. The final Work Program reflects comments provided through the review by the Working Groups.

Data Acquisition and Background Information

Halton has developed an extensive digital library of various datasets that are desirable in the development of a NHS. This included digital layers of:

- ortho-rectified aerial photographs (May 2005);
- topographic contours;
- watercourses, classified as cold, cool or warmwater, or status unknown;
- Environmentally Sensitive Areas (ESAs);
- Areas of Natural and Scientific Interest (ANSIs);
- regional forests;
- wetlands, including identification of those which were evaluated, those known to be provincially significant and others with unknown status;
- location of threatened or endangered species (a 100 m generalized polygon location);
- Ecological Land Classification (ELC) polygons at Community, Ecosite and Vegetation Type levels;
- Niagara Escarpment Natural Areas and Protection Areas;
- Greenbelt boundaries;
- Greenbelt NHS boundaries;
- Carolinian Canada sites;
- North Aldershot Environmental Protection Areas;
- regional waterfront parks;
- floodlines (updated lines were requested from the relevant conservation authority);
- woodlands; and
- protected areas with Milton Secondary planning areas.

All but a few of these data layers were used to assist in the determination of NHS options. The woodlands layer was used to develop a draft candidate significant woodlands layer by applying the size and proximity to watercourse criteria for significant

woodlands provided in the Regional Official Plan (2006). The age criterion was not used owing to the lack of reliable data to apply it.

In addition to these data, some planning reports were also reviewed for background information including:

- Regional Official Plan (2006): review the foundation for environmental protection in Halton (the Basic Position), as well as policies that pertain directly to NHS, Greenlands, ESAs, etc.
- Halton Region Environmentally Sensitive Areas (Halton Region and North-South Environmental Inc. 2005): review certain criteria for identifying ESAs;
- Niagara Escarpment Plan;
- Greenbelt Plan;
- Official Plans for the Towns of Burlington, Halton Hills, Milton and Oakville;
- Bronte Creek Subwatershed study;
- Silver Creek Subwatershed study;
- Nature Counts report (2006); and
- Places to Grow (2005).

Study Areas, Scale and Mapping Process

Given that the emphasis of the SHP is to guide future growth in the Region, the focus of the environmental studies was on the PSA. This can be approximately described as comprising the lands north of Highway 407, extending to Georgetown, and from the Niagara Escarpment east to the Regional boundary, but excluding the urbanized area of the Town of Milton and the area within the Greenbelt Plan. This area is referred to as the PSA in this study (see Figure 1 in main report).

Notwithstanding this emphasis on the PSA, it was decided that the proposed NHS options should be developed for the entire Region. It was recognized that opportunities to add natural heritage features and linkages over and above those areas captured by current and past planning policies (*e.g.*, ESAs, ANSIs, wetlands, floodplains, NEP areas, *etc.*) are very limited within the area outside of the PSA, since most of it is urbanized (or approved for development), however, there are still some areas where increased ecological function and biodiversity protection may be achieved. Also, it was recognized that there was insufficient time and budget to undertake as thorough review of background information for the entire Region as it was for the smaller PSA.

It was agreed that there would be greater effort and detail used in the development of NHS options for the PSA, thus two scales of investigation were established. Within the PSA, the NHS is being developed using maps at a scale of 1:10 000, with the intent of producing presentation maps at 1:30 000. At the Regional scale, working maps are

being produced at a scale of 1:20 000, and presentation was at 1:40 000. The 1:40 000 scale presentation map allows the entire Region to be represented on one map.

All digital mapping services are being undertaken by the GIS services within Planning and Transportation Services, Planning and Public Works Department of the Region of Halton (Halton P&TS). Halton P&TS provided ortho-rectified aerial photograph bases (orthophotos) of the entire Region at the working scales noted above. The digital information listed in the Data Acquisition and Background Information section above was then plotted onto the orthophotos bases as requested by the NSE study team. These were over-laid with clear film and various NHS alternatives were hand drawn on the film, using the underlying information to apply the principles for developing the NHS options. The limits of ESAs, ANSIs, floodlines, the Greenbelt NHS, etc. could be seen through the clear film overlay and used to locate lines that delineated the limits of each NHS option. The films were then provided back to Halton P&TS where the NHS options were digitized through a process of scanning and hand digitizing. Hard copy check maps were then provided back to NSE for review and refinement.

Once initial refinement of Options 1, 2 and 3 was complete, they were over-laid to determine where differences occurred. Some differences could be attributed to minor inaccuracies associated with the hand drawing done on the clear film overlays. Although these minor differences were inconsequential given the overall intent of the project, they were corrected by defaulting to the most accurate boundary information available for existing features (e.g., the Region's ESA boundaries are relatively accurate and when the intent was to follow one of these boundaries in either option, the NHS boundary was made to confirm to the ESA limits). In some cases in Options 2 and 3, a deliberate decision was made to not use the ESA boundary, for example when the intent was to build on an existing feature, or to combine existing features to attain a certain size core area. These options are now being further refined through consultations and evaluation of more detailed planning information.

A set of draft maps was produced for input to the SHP workshops held on December 14, 2006. These were again produced as overlays to enable them to be superimposed on other bases as input to the development of various planning scenarios. Some basic descriptive statistics were also generated by Halton P&TS that provided the area covered by the three NHS options and the components (ESAs, candidate significant woodlands, Greenlands, etc.) that were included in them.

Defining the NHS Options

Prior to developing the options for a Regional NHS, two initial tasks were undertaken: 1) articulate a set of general principles that would apply to all options, and 2) develop a rationale for each option consisting of a goal, objectives and guidelines for delineating each option.

The general principles are ecological and are derived from some basic ecological concepts that are relevant to preserving biodiversity in a developing landscape (see Section 3.2 of the main report). The guiding principles used in the development of NHS options are discussed and presented in section 3.3 of the main report.

It was felt that a rationale for each option was needed to i) guide its intent, ii) ensure that distinct options were developed, and iii) ensure that there was consistency in the

delineation of each option. Consideration was given to using strict criteria for guiding the delineation of each option, however it was decided that this approach would be too limiting and that there was need for flexibility to apply sound ecological judgement. For example, it would be difficult to draft algorithms that would determine when there was benefit to combine two existing woodlands, refining the boundaries of patches to maximize the ration of area to circumference, create a large (>100 ha) core area, *etc.* Also, the extensive experience of the NSE study team with Halton natural areas and professional ecological judgement were deemed to be important contributions to the development of options that might be lost if strict criteria were used. Instead of criteria, a set of guidelines for the development of each option was assembled. These flowed from the goal and objectives.

As described in the Study Areas, Scale and Mapping Process above, the NHS options were delineated on clear film, overlaid on base maps containing the background information layers. For each option, the guidelines were applied, going over the study areas (*i.e.*, the PSA or the entire Region) in detail to improve the shape, size and connectivity among habitat patches (woodlands, wetlands, *etc.*), bearing in mind the overall principles described in section 3.3 of the main report and the overall NHS framework described in section 4.1 of the main report. It should be noted that there was no preconceived target of what proportion of the landscape should be included in each of the options. The process was driven by ecological considerations and application of the principles.

Consultations undertaken as part of NHS development

It was recognized from the outset that the involvement of experts with expertise in NHS and knowledge of Halton Region would greatly benefit the development of the NHS options.

Technical Workshop

To facilitate as much involvement as possible given the timelines of the project, a small workshop comprising biologists from the three conservation authorities and the Region's environmental planner was held at the NSE office. Basemaps of the Region and PSA were used to develop some of the basic principles and directions for the NHS options. Most importantly, there was extensive discussion on the requirements for a NHS that would preserve biological diversity in the long term, and how that could translate to cores and connections in mapped form. This workshop provided the starting point for the development of the three options.

During the development of the options NSE staff met a second time with conservation authority staff, first with Credit Valley Conservation (Scott Sampson and Chris Hibbard) and then with Conservation Halton staff (Brenda Axon) and the Grand River Conservation Authority (Chris Powell). The purpose of these meetings was to specifically clarify NHS options throughout the Region and get feedback based on detailed knowledge in certain locations.

A third round of consultations was conducted with each of the three conservation authorities in meetings that included a variety of technical staff from each conservation authority. While these meetings focused on each authorities watershed they also

provided extremely useful input to the over approach to development of the NHS options.

Steering Committee Meetings

As noted elsewhere in this report, there were several meetings with Environment Cluster Working Group. These meetings generally consisted of a verbal progress report, supported by handouts where appropriate, that explained the current status of the development of NHS options. The ECWG then provided feedback that was incorporated into the development of options. This feedback sometimes included new information that may be useful (especially with respect to recent development not evident on the orthophotos and recently approved development applications). The meetings and the information presented are summarized below:

Meeting 1 Sept 7 th	Introduce SHP project directions
Meeting 2 Sept 12 th	Discuss available data and data needs for project
Meeting 3 Sept 27 th	Review and comment on revised draft terms of reference
Meeting 4 Oct 26 th	Introduce draft goals, objectives and criteria for NHS options
Meeting 5 Nov 16 th	Review and comment on first draft goals and objectives for NHS options
Meeting 6 Nov 27 th	Review and comment on preliminary map illustration NHS options
Meeting 7 Nov 30 th	Presentation of overall findings

Review with Municipalities and Niagara Escarpment Commission

Lastly, following several refinements of the NHS options, NSE staff met individually with staff from the Towns of Burlington, Halton Hills, Milton and Burlington, and the NEC to review the NHS options within each of their respective jurisdictions. These meetings provided input that will lead to a refinement of the NHS options, similar to the meetings with the conservation authorities, these meetings provided extremely useful input to the over approach to development of the NHS options throughout the Region.

Limitations of Natural Heritage System Study

There are a number of limitations to the study that need to be considered. These were not considered an impediment to the overall goal of the SHP, but need to be identified so that future use of the NHS options can be appropriately evaluated.

Where possible, use of the data was supplemented with the personal knowledge of the study team and experts that were consulted, but ultimately NHS boundaries will have to be confirmed in the field as part of a Master Environmental Study Report (MESP), watershed or sub-watershed plan, block plan or secondary plan process.

Based on Secondary Source Information

There was no field component to this study. Although the NSE study team is very knowledgeable of Halton Region, and there was input from the staff of the three conservation authorities who also have extensive knowledge of their watersheds, there is still some information which represents an approximation. For example, the woodlands layer which was used to identify candidate significant woodlands likely needs to be ground-truthed to establish the exact extent and condition of woodlands. Likewise, there are some watercourses from the digital watercourse layer which are not reflected

in the orthophoto base and may represent older aerial photograph interpretation, or which may be drainage swales that flow only occasionally and do not have distinct channel.

Incomplete Knowledge of Approved Development Plans and other Initiatives

The current extent of development as depicted on the 2005 aerial photographs is out of date and does not reflect approved plans and initiatives. Where possible, the NHS options were refined as this information became apparent (*e.g.*, recent OMB decisions in Glen Williams), however there are likely other approved plans which we are unaware of. The NHS options are not intended to impinge upon or result in modification to any approved development plans.

Limitations to Accuracy of NHS Limits

The scales at which the NHS options were developed is not conducive to the establishment of limits of development required to create plans of subdivision. Additional work, undertaken as part of the normal planning process, will be required to establish precise boundaries.

Focus on Ecological Considerations

This study developed options for a Regional NHS based mainly on ecological considerations (some allowances were made for approved and future developments where they were known). There are other components of the SHP (*e.g.*, sustainable agriculture, sound urban planning, aggregate resources, infrastructure requirements, *etc.*), that need to be considered, thus the NHS options will likely need to be refined in the future. Future refinement should be done with input from ecologists to ensure the intent and functions of individual components of the NHS options are not lost.