ACKNOWLEDGEMENTS

Many people and organizations have contributed to this project.

The Credit River Watershed and Region of Peel Natural Areas Inventory Project is a partnership between Credit Valley Conservation (CVC), Toronto and Region Conservation Authority (TRCA), the City of Brampton, the Region of Peel, the Halton-North Peel Naturalists' Club (HNPNC) and the South Peel Naturalists' Club (SPNC). This partnership has been special as each partner has contributed in its own unique way, and all contributions are important and are appreciated. This project would not have been possible without the support and guidance of these groups, including the executive members and staff that stand behind them.

Over the years of this project, the members of the NAI Management Committee have contributed their time, expertise and perspective. The Management Committee members are as follows.

NAI Management Committee Members	**Representing**
Sue Hayes	TRCA
Susan Jorgenson	City of Brampton
Joyce Lechasseur	SPNC
Bill McIlveen	HNPNC
Bob Morris	CVC
Don Morrison	SPNC
Audrey Oswald	SPNC
Scott Sampson	CVC
Janet Wong	Region of Peel

The NAI Technical Steering Committee members have provided much-appreciated insights, advice and expertise, especially in guiding this project through a thoughtful planning process. The Technical Steering Committee members are as follows, in addition to the Management Committee members.

NAI Technical Steering Committee Members	**Representing**
Kim Barrett	Conservation Halton
Mark Head	Region of Peel
Mark Heaton	Ontario Ministry of Natural Resources
Natalie Iwanycki	Royal Botanical Gardens
Eva Kliwer	City of Mississauga
Rod Krick	CVC
Leilani Lee-Yates	Region of Peel (until 2010)
Deanna Lindblad	Conservation Niagara
Peter Lyons	City of Mississauga (until 2009)
Liam Marray	CVC
Bob Noble	West Humber Naturalists Club
John Pisapio	Ontario Ministry of Natural Resources
Dave Taylor	Mississauga Gardens Council
Bree Wilson	Conservation Niagara
Brenda Van Ryswyk	Conservation Halton

Members of the Municipalities Group provided support and helpful insights from a municipal perspective. These members are as follows (in addition to some Management Committee members who participated in Municipalities Group meetings).

NAI Municipalities Group Members	**Representing**
Warren Harris	Town of Halton Hills
Susan Mentis	CVC
Mirella Palermo	City of Brampton
Marsha Paley	Town of Caledon (until 2009)
Jason Scott	Region of Halton (until 2008)
Mary Shields	Town of Erin EAC
Sally Stull	Town of Erin

Generous financial support was provided by the Ontario Trillium Foundation.

The Municipalities within the NAI study area have also provided financial support for the NAI. Major data sets were contributed by CVC, TRCA, Conservation Halton, the City of Mississauga and Bill McIlveen. Bill McIlveen generously compiled thousands of flora and fauna records for the study area from various sources as well as contributing thousands of his own records.

Dan Schuurman and Brian Morber of CVC's GIS Dept. produced all of the maps and figures for this report. Their contributions and patience in developing the format and their dedicated efforts to successfully meet mapping deadlines are greatly appreciated. Tyler Babony of CVC's Communications Dept. produced a variety of attractive potential layouts for the report cover and creatively refined the one that was selected.

Many volunteers have participated in data collection activities and have helped the NAI project accomplish public outreach deliverables. Outstanding among these are Lori Nero and Mark Cranford who gave hundreds of hours of their time and enthusiasm in helping with landowner contacts and winter raptor inventories. The NAI botanical consultant, Charles Cecile, and the NAI ornithological consultant, Bob Curry, both worked above and beyond their contracts out of enthusiasm for this project. All of you – thank you for your contributions.

Hundreds of landowners welcomed NAI biologists onto their properties. Much of the NAI field work was carried out on private land and would not have been possible without the interest and cooperation of landowners. Your welcome and your own accounts of flora and fauna on your properties are appreciated. You play a special role by caring for and protecting natural areas. It is hoped that this NAI project has been able to give something back to you, in return.

Dawn Renfrew,
Credit River Watershed and Region of Peel Natural Areas Inventory Project Coordinator
Credit Valley Conservation
2011

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PART A BACKGROUND

1. INTRODUCTION

A Natural Areas Inventory (NAI) is an inventory of the biological resources of a natural area – it documents the species and ecological features that are present in an area. Natural Areas Inventories are designed to provide biological and ecological information that can be used to establish baseline conditions on natural heritage features and functions present at varying geographic scales, including at a project site, for an area or over a municipality or a watershed. A NAI will enable municipalities and agencies to identify the significance and ecological sensitivities of natural features and areas in accordance with municipal and provincial policy, such as significant woodlands, wetlands, wildlife habitat, fish habitat, and the habitat for threatened and endangered species. Natural Areas Inventories are conducted using standardized inventory protocols (e.g. Ecological Land Classification for Southern Ontario, Forest Breeding Bird Monitoring, and Amphibian Call Counts) that are scientifically defensible. Therefore this inventory will ensure consistent data collection across the entire study area which will improve the utility of the data in environmental management programs, including the review of planning applications, environmental and/or ecological assessments and monitoring programs.

Ecological information for natural areas and features may not exist, be out-of-date or scattered in a variety of places including studies by various government agencies, development applications, and staff files. Many of the core resources for natural heritage information, such as Environmentally Significant Area reports, wetland evaluations and Forest Resource Inventories, were generated between the late 1970's to mid-1980's and are now out-of-date. More current data may be available from studies such as recent updates to wetland evaluations, subwatershed studies, and inventories conducted in relation to planning and development applications. Often, these studies have been carried out using a variety of inventory protocols. Some of the data may be useable, some may be incomplete and some may be lacking in quality. The variable quality of this data makes it very difficult to analyze in a manner that provides meaningful interpretation to accurately characterize the ecological landscape on a broader scale. This NAI sets out to address these deficiencies in biological knowledge of natural areas in the Credit River watershed and the Region of Peel.

Municipalities in other areas have also identified issues with the lack of adequate and good quality environmental data. In response to this, Natural Areas Inventories were undertaken in Haldimand-Norfolk, 1985; Hamilton – Wentworth, 1990 & 2001; Halton Region, 2003; and Niagara Region, 2006. Toronto and Region Conservation Authority (TRCA) and Credit Valley Conservation (CVC) have been conducting ongoing inventories of natural areas as part of their Natural Heritage Programs. The City of Mississauga developed a Natural Areas Survey (NAS) in 1995 and has maintained the NAS through annual surveys for the natural areas in each quadrant of the City on a four year rotation.

1.1. REPORT FORMAT - OVERVIEW

The Credit River Watershed and Region of Peel Natural Areas Inventory Report has three parts. Part A Background: describes the study area, physical and natural heritage context and methodology used to undertake fieldwork. Part B Site Summaries and References Cited: contains the site summaries for the natural areas covered, location maps of the natural areas summarized, and general concepts and terms to assist with reading site summaries. The site summaries contain the site-specific information collected for the natural areas inventoried. Also in Part B are general stewardship opportunities for landowners to consider. Appendix A contains descriptions of vegetation communities, listing plant species that are commonly encountered as community dominants, for each vegetation type found in the study area. Appendices B and C contain lists of all flora and fauna species (respectively) known to be present in natural areas of the NAI study area with the distribution of each species by Region/County given.

Site summaries presented here are designed to be self-contained, paginated according to site name. The report user may choose to order the summaries as desired. As well, site summaries produced in future NAI reports can also be inserted.

2. THE CREDIT RIVER WATERSHED AND REGION OF PEEL NATURAL AREAS INVENTORY PROJECT

The Region of Peel and the Credit River watershed are one of the fastest growing regions in Canada. Given the tremendous development pressures this area will be facing, it is essential that the existence and composition of natural areas in the region are known and their functions are understood. The Credit River Watershed and Region of Peel Natural Areas Inventory Project was initiated in 2007. The study area was defined to include the entire Credit River watershed and all of the Region of Peel, providing both watershed and municipal context for the data coverage.

The objective of the NAI project is to assemble existing information, identify basic data gaps and address the data gaps by documenting the existence and distribution of plant communities, and flora and fauna species in natural areas of the study area, that is accurate, up-to-date, easily accessible and in context. Ideally, inventory of all natural areas within the study area will be undertaken, although achieving this will take many years to complete due to the extensive area to cover. Information gathered by the NAI project can be used for land-use and natural heritage system planning, lands management, environmental monitoring, stewardship, restoration, and public education.

This NAI is a collaborative effort between Credit Valley Conservation (CVC), the Halton/North Peel Naturalist Club (HNPNC), the South Peel Naturalists' Club (SPNC), Toronto and Region Conservation Authority (TRCA), the Region of Peel and the City of Brampton. Credit Valley Conservation and the naturalist clubs jointly applied for, and received, a grant from the Ontario Trillium Foundation (OTF), which got the project started. All of the partners have made substantial contributions in various ways – providing financial support, providing data sets representing large inputs of field time, providing in kind contributions of facilities, expertise and manpower and providing assistance in meeting funding-related deliverables.

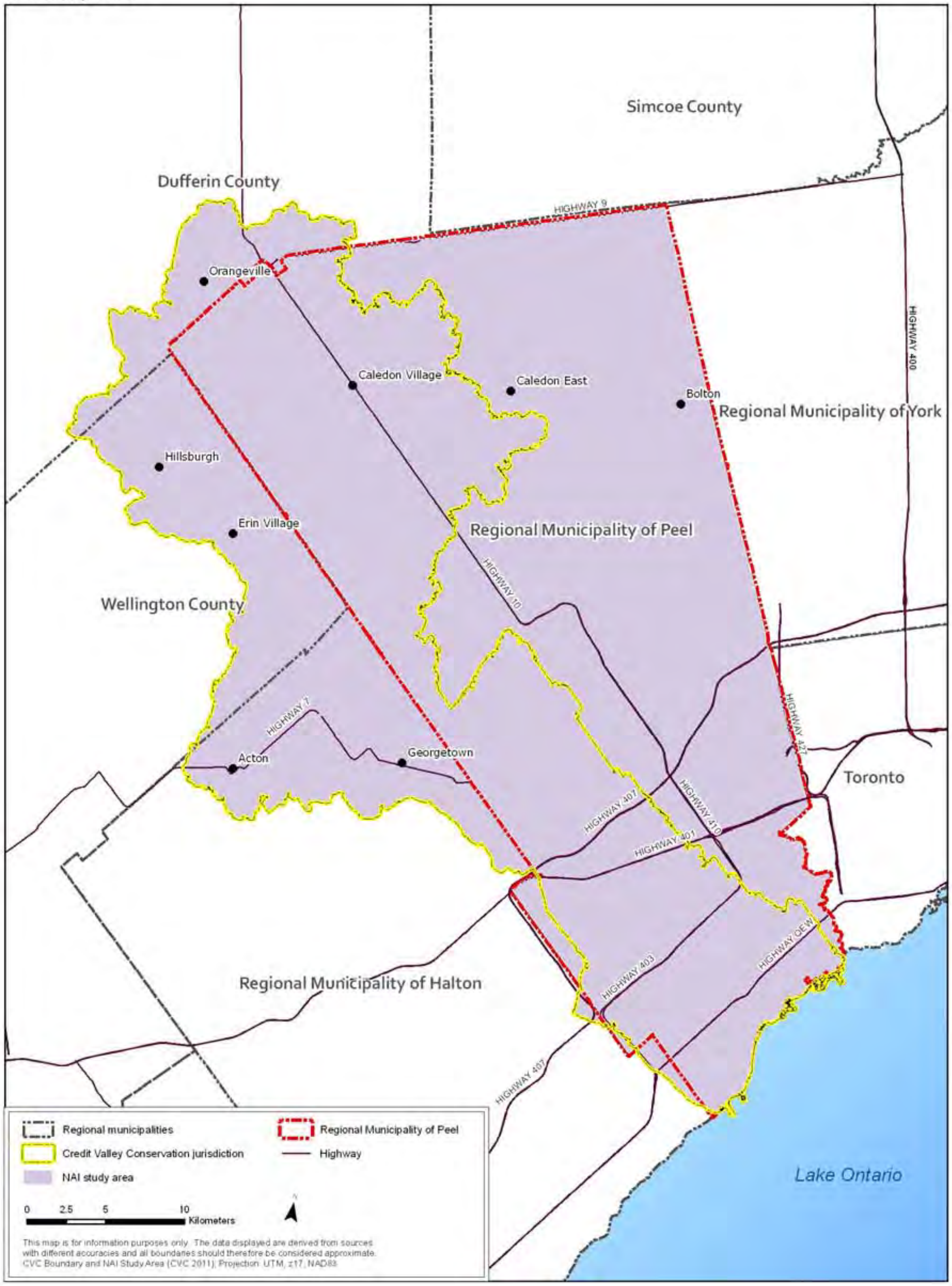
The NAI project is directed by a Management Committee consisting of representation from the project partners: CVC, TRCA, Region of Peel, City of Brampton, HNPNC and SPNC. The NAI Management Committee is responsible for all key decisions on NAI direction, staffing, financial matters and reporting.

The NAI project received technical guidance from a NAI Technical Steering Committee, composed of individuals or representatives of groups with expertise in biological inventory (OMNR, Royal Botanical Gardens), groups with experience with NAI projects in other jurisdictions (City of Mississauga, Conservation Halton, Conservation Niagara), a planning perspective (CVC Planner-Ecologist) and representatives of groups to help deliver public participation and education objectives (Mississauga Gardens Council, West Humber Naturalists Club). The Technical Steering Committee provided advice on technical/scientific matters primarily biological, mapping, development of field protocols and facilitated the delivery of public education and participation deliverables associated the OTF grant. A Municipalities Group, composed of one representative from each of the lower tier municipalities that fall in the study area plus a representative from the Region of Peel and a representative from the Management Committee was also convened on occasion to inform the municipalities on the project and to obtain feedback on municipal needs and interests with respect to the NAI.

While initially supported as a four-year project with two field seasons, the NAI has evolved into a natural heritage program for CVC, and in 2011 completed its fourth field season. The NAI has also served to initiate the Brampton NAI (BNAI) project, which conducts additional field work and data compilation for the City of Brampton. The BNAI data set is fully integrated with the NAI data set.

Figure 1

NAI Study Area



This is the first report volume produced by the NAI project, providing summaries on NAI data for 100 natural areas across the study area. Additional site summaries will be published as ecological data is gathered. In addition to the production of these volumes, the NAI project has produced a web application with basic information on NAI areas (hosted on the Region of Peel website) and an internal database cataloging collected ecological data.

2.1. THE STUDY AREA

The study area for this NAI combines two elements: the jurisdiction of the Credit Valley Conservation Authority and the Region of Peel (Fig. 1).

Most of CVC's jurisdiction is comprised of the Credit River watershed but 13 small urban watersheds within Mississauga to the east and west of the Credit River that flow directly into Lake Ontario are also included (see the Hydrology section, later in this report, for more details). These small urban watersheds are also included in the NAI study area and their inclusion is implied throughout this report when general references are made to "the Credit River watershed". The Credit watershed covers approximately 1000 km^2 and is home to over 750,000 residents, inhabiting 11 municipalities (Fig. 2).

The Region of Peel covers 1254 km^2 and contains three municipalities (Fig. 2) with a total population of over 1.2 million. The majority of this population resides in the southern half of the region. Portions of 21 watersheds lie within the Region of Peel (Fig. 7).

Municipalities of the Study Area	Region or County
Township of Amaranth	County of Dufferin
Township of East Garafraxa	County of Dufferin
Town of Mono	County of Dufferin
Town of Orangeville	County of Dufferin
City of Brampton	Region of Peel
City of Mississauga	Region of Peel
Town of Caledon	Region of Peel
Town of Erin	County of Wellington
Town of Halton Hills	Halton Region
Town of Milton	Halton Region
Town of Oakville	Halton Region

Watersheds of the Region of Peel	% of Region of Peel	Conservation Authority Jurisdiction
Credit River	42%	Credit Valley Conservation
13 small Mississauga watersheds draining into Lake Ontario	5%	Credit Valley Conservation
Humber River	31%	Toronto and Region Conservation Authority
Etobicoke Creek	16%	Toronto and Region Conservation Authority
Mimico Creek	4%	Toronto and Region Conservation Authority
Nottawasaga River	0.9%	Nottawasaga Valley Conservation Authority

Holland River	0.8%	Lake Simcoe Region Conservation Authority
Joshua Creek & Sixteen Mile Creek	0.25%	Conservation Halton

The overall size of the NAI study area is 1607 km^2. The northern half of the study area is generally rural in nature and the southern half is urban. The area's population is concentrated in the southern, urban municipalities but the rural portion of the area does contain several smaller settlement areas. The study area contains three major physical features: the Oak Ridges Moraine, the Niagara Escarpment and the Lake Ontario shoreline.

3. PHYSICAL AND HISTORICAL CONTEXT

3.1. BEDROCK GEOLOGY

The Precambrian "basement" or Canadian Shield rocks of this area are granites and gneisses. During the Paleozoic era (505-408 million years ago), this area was covered by a sea. Marine sediments were deposited over the Canadian Shield rocks forming a thick layer of sedimentary bedrock: dolostones, limestones, sandstone, and shales. The oldest layer is the Georgian Bay Formation, composed of blue-grey shales with interbeds of siltstone, sandstone, limestone and dolostone. The soft red shales of the Queenston Formation were deposited next, over the older Georgian Bay Formation. Queenston Formation shales are predominantly red but also have narrow grey-green inter-bedded layers. Both the Georgian Bay and Queenston Formations are deep-water deposits. Later the sea became shallower and carbonate sedimentary rocks were deposited, first as the Amabel Formation and later as the Guelph Formation. These formations are of limestone and dolostone, much harder than the soft shale layers lying below them of the older formations (Fig. 3). The bedding plane of all of these formations is tilted from east to west, slightly higher in the east.

Over the next approximately 360 million years, weathering and erosion of the bedrock occurred. River valleys were carved into the bedrock, now filled by younger sediments and glacial deposits. The difference in hardness between the hard Amabel Formation dolostone and the soft Queenston shales below allowed differential erosion to create the Niagara Escarpment. The harder dolostone was more resistant to weathering and as the softer rock was eroded from beneath it, an escarpment face was formed. The weight of large overhanging blocks of dolostone would eventually collapse, maintaining a vertical escarpment face (Chapman and Putman, 1984; Credit Valley Conservation, 2007a; Davies and Holysh, 2007; Ontario Geological Survey, 2011).

More recently, glaciers covered southern Ontario and dramatically changed the landscape as they scraped and scoured the bedrock and deposited particulate debris, called till, ranging in size from boulders to fine sand and silt. The last glaciation occurred from 25,000 to 10,000 years ago. Water flowing within and off of the glacier formed glaciofluvial deposits: outwash plains, meltwater channels, kame moraines and eskers, all visible in the NAI study area. When glacial runoff was blocked and lakes were created, fine clays, silts and sands, called lacustrine deposits, were laid down (Chapman and Putman, 1984). Where arms of the glaciers met and where the edge of the glacial advance extended to, thick sand and gravel deposits formed hilly areas called moraines. Whaleback-shaped hills called drumlins formed during the advance of the glaciers and the axis of their orientation indicates the direction of movement of the glacier that deposited them. On occasion, large chunks of ice were left behind by the retreating glacier. When the ice chunk finally melted, kettle lakes were created in the depression that had been occupied by the ice.

In the NAI study area, exposed bedrock outcrops are limited to the Niagara Escarpment and along river valleys where the overlying overburden has been eroded away (Chapman and Putman, 1984;

Figure 2

Municipalities of the NAI Study Area

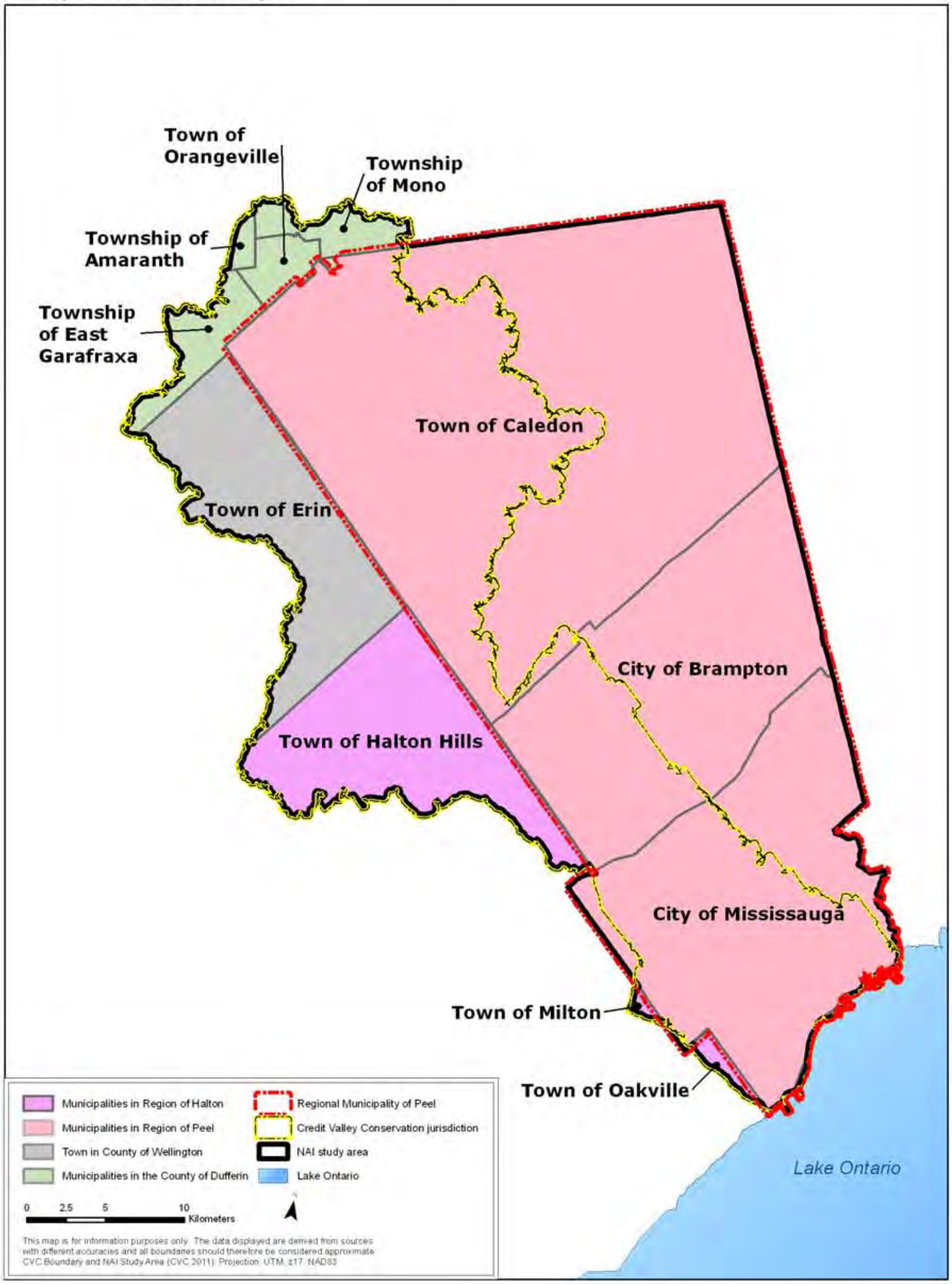
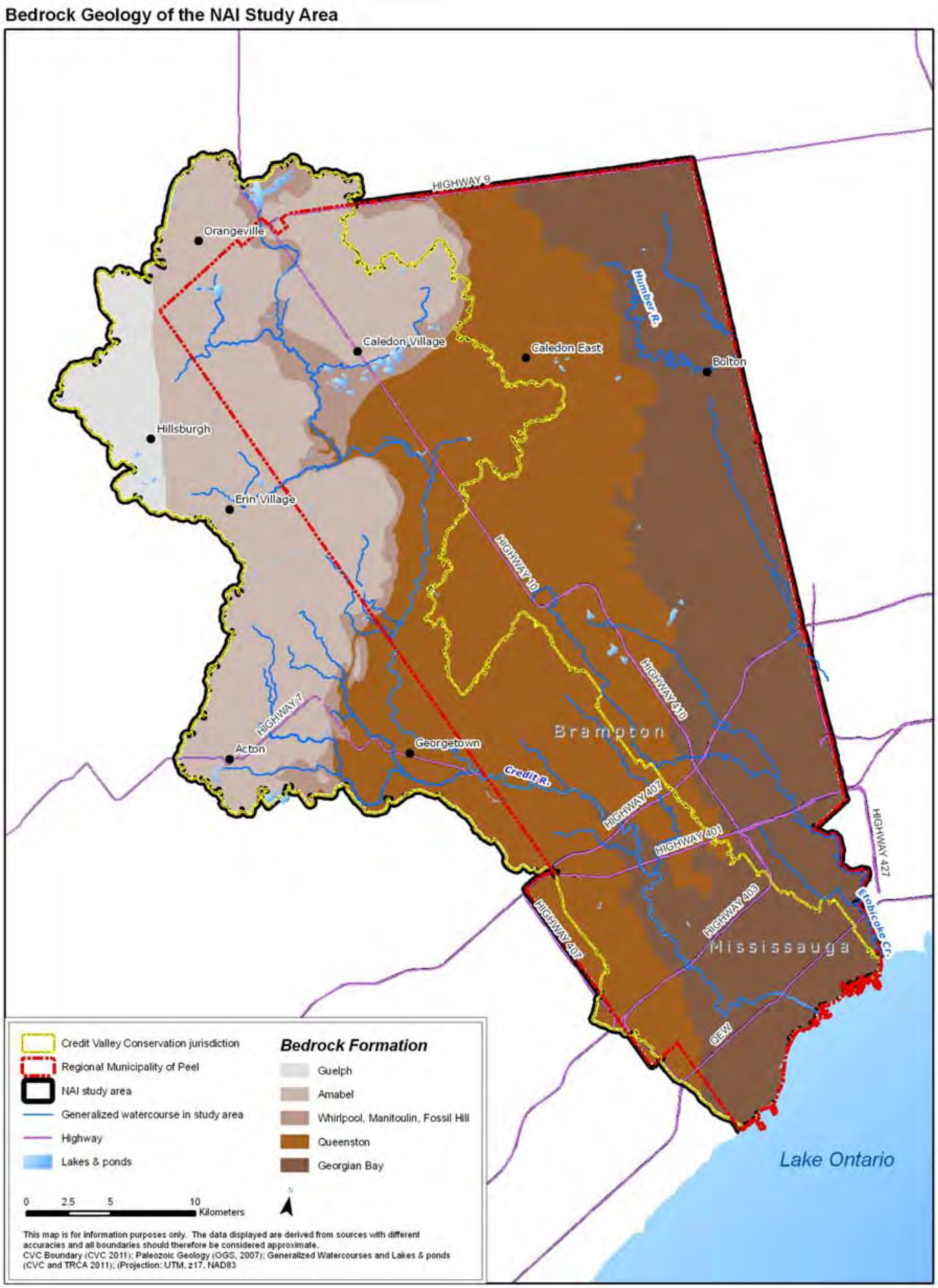


Figure 3


Bedrock Geology of the NAI Study Area
HIGHWAY 9
Orangeville
Caledon Village
Caledon East
Humber R.
Bolton
Hillsburgh
Erin Village
HIGHWAY 10
HIGHWAY 410
HIGHWAY 7
Acton
Georgetown
Brampton
Credit R.
HIGHWAY 407
HIGHWAY 401
HIGHWAY 427
HIGHWAY 403
Etobicoke Cr.
HIGHWAY 407
Mississauga
QEW
Lake Ontario
Credit Valley Conservation jurisdiction
Regional Municipality of Peel
NAI study area
Generalized watercourse in study area
Highway
Lakes & ponds
Bedrock Formation
Guelph
Amabel
Whirlpool, Manitoulin, Fossil Hill
Queenston
Georgian Bay
0 2.5 5 10 Kilometers
N
This map is for information purposes only. The data displayed are derived from sources with different accuracies and all boundaries should therefore be considered approximate.
CVC Boundary (CVC 2011); Paleozoic Geology (OGS, 2007); Generalized Watercourses and Lakes & ponds (CVC and TRCA 2011); (Projection: UTM, z17, NAD83

Credit Valley Conservation, 2007a, b). Over the rest of the study area, glacial deposits cover the bedrock.

It is this history of glaciation and the bedrock geology that have largely shaped the current physiography of the NAI study area. Some later erosion and alluvial deposits have occurred in river valleys and organic deposits have formed more recently.

3.2. PHYSIOGRAPHY (SURFICIAL GEOLOGY)

The physiography of a landscape dictates elevation, drainage patterns, soil texture and chemistry, and thus influences hydrology, as well as local climate and the movement and accumulation of materials across the landscape (Lee *et al*., 1998). Through these mechanisms, physiography influences ecological patterns of the landscape. Physiographic regions have been identified in southern Ontario (Chapman and Putnam, 1984) and the NAI study area falls mainly into eight physiographic regions as outlined below (Credit Valley Conservation, 2007b; Toronto and Region Conservation Authority, 2002, 2008; Fig 4)

3.2.1. Dundalk Till Plain: This physiographic region occurs in what is commonly referred to as the "the roof of Ontario". It is a plain that slopes to the basins of Georgian Bay, Lake Huron and Lake Ontario. The plain is gently rolling with low topographic relief and many shallow, poorly-draining depressions containing wetlands. Some low drumlins are present with long axes oriented northwest-southeast. Glacial overburden deposits are shallow in this area. Soils here are primarily silty loams with imperfect drainage. Only a small part of the NAI study area occurs in this physiographic region.

3.2.2. Hillsburgh Sandhills (Orangeville Moraine): The Hillsburgh Sandhills physiographic region is found in the northwestern portion of the study area and consists of coarse-grained sediments. It is an area of high relief with thick deposits of glacial outwash (sandy materials) overlying glacial tills and bedrock. In higher regions, well-drained terrestrial communities (e.g. forests) are found, while lower areas yield wetlands (e.g. swamps) (Chapman and Putman, 1984; Credit Valley Conservation, 2007b).

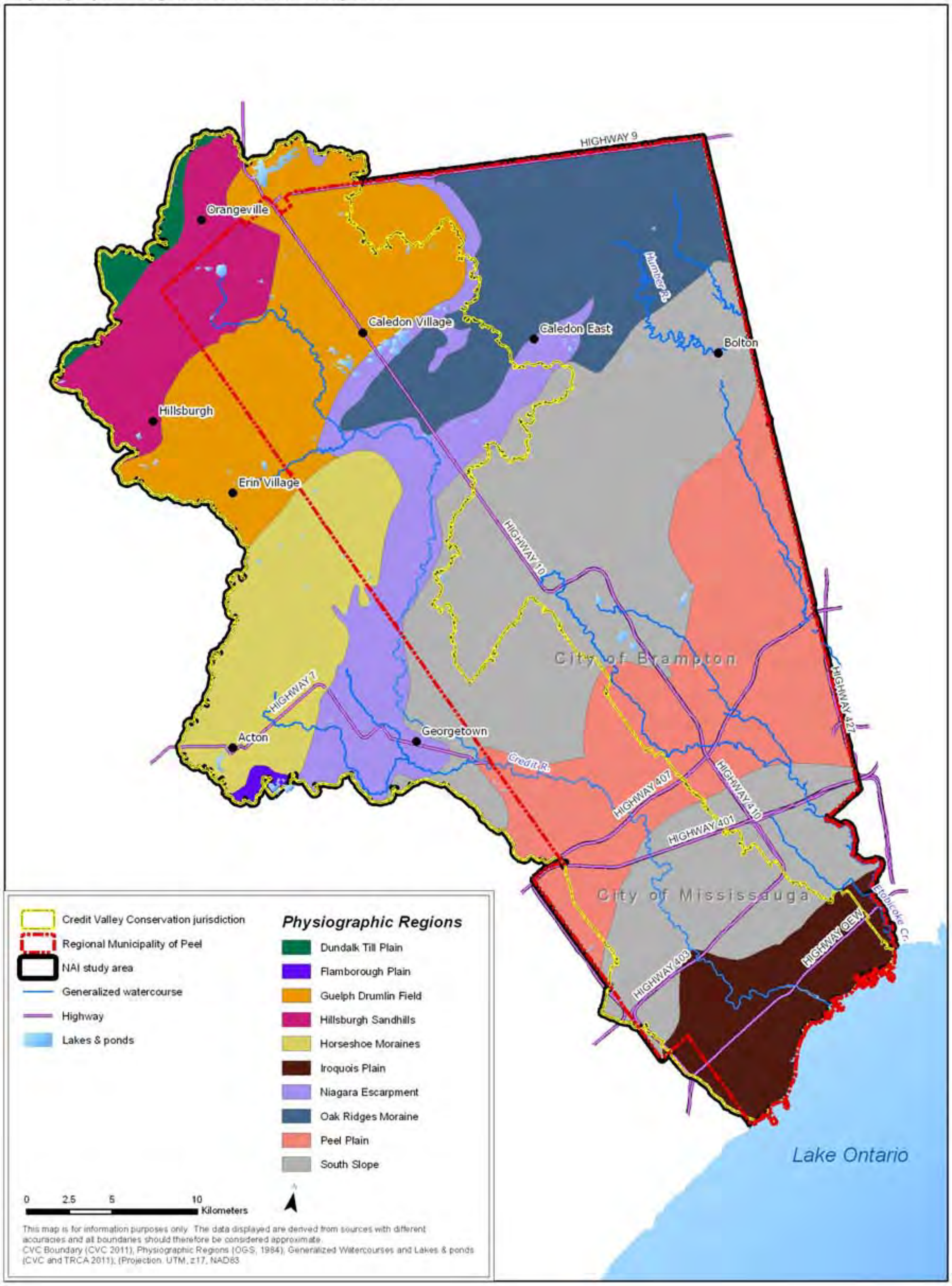
3.2.3. Guelph Drumlin Field: This is a region of low, rolling, streamlined drumlins located between the Hillsburgh Sandhills to the west and the Horseshoe Moraines to the southeast. The drumlins are separated from one other by interconnected meltwater channels, which in some instances have formed valleys. The drumlin till is loamy and calcareous and the valleys often have sand and gravel terraces along their edges; the low-lying area is comprised of mostly fluvial materials and is often swampy (Chapman and Putman, 1984; Credit Valley Conservation, 2007b).

3.2.4. Horseshoe Moraines (Paris and Singhampton Moraines): This physiographic region consists of a broad belt of north-south trending moraines (of sand and salt tills) lying west of the Niagara Escarpment, between Orangeville and Acton (Chapman and Putman, 1984). Soils of this physiographic region are coarse-grained and more permeable than in other parts of the study area, allowing for significant recharge (infiltration) of water to underground aquifers (Credit Valley Conservation, 2007b).

3.2.5. Flamborough Plain: This physiographic region consists of a level plain of shallow glacial deposits overlying limestone bedrock. The flat topography produces numerous shallow wetland pockets. Some scattered low drumlins are present with long axes oriented east-west. Soils in this physiographic region are shallow with an exception being on the drumlins that have somewhat deeper soils (and making them attractive for agriculture). Only a very small part of the NAI study area occurs on the Flamborough Plain.

Figure 4

Physiographic Regions of the NAI Study Area



<u>3.2.6. Niagara Escarpment</u>: The Niagara Escarpment is the most distinctive physiographic feature in the NAI study area. The community interest to strike a balance between preservation, development and enjoyment of the landscape associated with the Niagara Escarpment led to its declaration as a World Biosphere Reserve by the United Nations Educational, Scientific and Cultural Organization (UNESCO). This physiographic region forms a north-south trending strip along the escarpment, which is a major topographic break in the bedrock (between the carbonate Amabel Formation to the west and the soft sediments of the Queenston Formation to the east). Vertical cliffs and frequent bedrock exposures exist along the Niagara Escarpment south of Forks of the Credit but glacial deposits (primarily the Oak Ridges Moraine) generally bury the escarpment bedrock north of Forks of the Credit. Areas of exposed bedrock, cliffs, caves, crevices, talus slopes and thin soils are not suitable for many types of plants; however the escarpment geology does provide habitat for specialized species that cannot survive elsewhere. Bedrock and fine-grained till such as that found in this physiographic region typically do not conduct water easily. Groundwater is only plentiful when the porous Amabel Formation underlies the shallow glacial till (Credit Valley Conservation, 2008), and in these areas, large wetlands exist (Credit Valley Conservation, 2007b; Credit Valley Conservation 2007c). Forests are possible in areas where adequate soils exist (Credit Valley Conservation, 2007b).

<u>3.2.7. Oak Ridges Moraine</u>: This physiographic region consists of an extensive interlobate moraine (i.e. a moraine formed from the deposits of multiple lobes of a glacier) that extends from the Niagara Escarpment east to the Trent River (just west of Belleville). Most of this physiographic region is characterized by hummocky hills of fine grained sand and gravel, allowing infiltration of water to underground aquifers and the slow release of water into rivers flowing to Lake Ontario. The Oak Ridges Moraine plays a crucial role in maintaining the quality and quantity of drinking water. The moraine itself, however, lacks many streams, as the water drains vertically through the sand and gravel, moving laterally only when it reaches less pervious beds and reappearing as springs along the slopes of the moraine. Small kettle wetlands exist in depressions between hills, made by the melting of glacial ice blocks. Much of the original vegetation of this physiographic region was a mixed forest of pine and hardwoods (Sugar Maple, *Acer saccharum* ssp. *saccharum*; American Beech, *Fagus grandifolia*; Red Oak, *Quercus rubra*; and White Oak, *Quercus alba*). However, many trees, especially Eastern White Pine (*Pinus strobus*) were heavily harvested in the past and few large trees remain today (Chapman and Putman, 1984; Credit Valley Conservation, 2007b, 2010a; Toronto and Region Conservation Authority, 2008).

<u>3.2.8. South Slope</u>: This physiographic region extends from the base of the Niagara Escarpment to the Iroquois Plain physiographic region and encompasses portions of the Palgrave and Cheltenham Moraines and part of the Trafalgar Moraine. In the NAI study area the South Slope region is bisected by the Peel Plain physiographic region. The South Slope is characterized by low-lying, fine-grained, undulating ground moraine and knolls. The till is part of the Halton Till layer which created fertile soils, once supporting rich upland forests. In areas of groundwater discharge, cedar swamps and meadow marshes were present (Chapman and Putman, 1984; Credit Valley Conservation, 2007b; Toronto and Region Conservation Authority, 2008). However, this area is highly valued for agriculture and is also becoming increasingly urbanized. It has been greatly altered by agricultural and urban land use practices (in similar ways to the Peel Plain, see below). The soils have low permeability and groundwater infiltration is limited. Localized pockets of sand and gravel exist amongst the moraines (e.g. in Brampton and Georgetown) serving as areas of groundwater infiltration that feed local lakes and streams (Credit Valley Conservation, 2007b).

<u>3.2.9. Peel Plain</u>: An area of dense clay soils were deposited when glacial melt-water ponded on top of the low permeability Halton Till plain (underlain by shale and some limestone). This area of almost-flat topography forms the Peel Plain physiographic region (Chapman and Putman, 1984; Credit Valley Conservation, 2007b). Historically, parts of the Peel Plain were poorly-drained and other parts were well-drained. Well-drained areas had high-quality hardwood forests (e.g. Sugar Maple, American Beech, White Oak, Hickories, *Carya* spp.; American Basswood, *Tilia americana*) and some White Pine. Poorly-drained areas had forests of American Elm (*Ulmus americana*), White

Ash (*Fraxinus americana*) and White Cedar (*Thuja occidentalis*) as well as wetlands (Chapman and Putman, 1984; Toronto and Region Conservation Authority, 2002). Today, this physiographic region has been greatly altered by deforestation and wetland drainage to support agricultural and urban land uses. The extensive human use of this area has, in some places, actually changed the topography of the landscape, through earth displacement and filling, and watercourse alteration (re-alignment and engineering).

3.2.10. Iroquois Plain: This physiographic region is an area of gentle slope, from the shoreline of Lake Ontario, back about 3-5 km. This plain is the remnant shoreline of glacial Lake Iroquois. The plain was smoothed over time by wave action and lacustrine deposits. Now this physiographic region is composed of a thin veneer of glacio-lacustrine sand and silty sand. These sandy soils once supported forests, savannahs and prairies, populated by species of the Carolinian Ecoregion at close to their northern extent. In the NAI study area, all of the Iroquois Plain is urban.

3.3. SOILS

Soils are produced by the decomposition of mineral parent material and organic material. They are heavily influenced by the composition of the bedrock parent material, topography, climate and environmental conditions where they occur (Hoffman and Richards, 1953). Soils in the study area are closely influenced by the glacial history of the area and glacial deposits that remain.

In general, over the NAI study area, sandy loams and loams are the predominant soils above the Niagara Escarpment in the area with moraines and drumlins (Fig. 5). These soils are coarse-grained and tend to drain well, although there are also many small pockets of poorly draining soils associated with wetlands in moraine depressions and kettles (Fig. 6). A band of sandy loam soils also occur along the old Lake Iroquois shoreline. Soils below the Niagara Escarpment are mainly clay and clay loams. These fine-grained soils drain less well to poorly. The river valleys tend to have variable soils more closely associated with recent erosional processes and less related to the glacial deposits of the area.

3.4. HYDROLOGY

Watersheds are areas of land whose waters drain into one river, lake, or other body of water. Watershed boundaries are determined by the elevation and natural contours of the landscape. There are several major watersheds that fall partly or fully within the NAI study area: the watersheds of the Credit River, the Humber River, Etobicoke Creek and Mimico Creek (Fig. 7). As mentioned in an earlier section (The Study Area), there are also several minor watersheds of creeks within the NAI study area that flow directly into Lake Ontario, and small portions of headwater tributaries of the Nottawasaga River and Holland River in the northeast corner of the study area.

The drainage area of the Credit River watershed is approximately 1,000 square kilometers and the entire watershed is included in the NAI study area. The main branch of the Credit, originating north of Orangeville and flowing southerly to its mouth in Lake Ontario at Port Credit, Mississauga, is over 90 kilometers in length (Credit Valley Conservation, 2007b; Fig. 8). The Credit River has approximately 1500 km of tributaries. Credit Valley Conservation recognizes 15 major named tributaries of the Credit River (as subwatersheds). The Humber River drains an area of 912 km^2 of which approximately 350 km^2 lies in the study area. Its main course is over 100 km in length from the top of the Niagara Escarpment near Mono Mills to the shore of Lake Ontario at the western outskirts of Toronto. Most of the upper reaches of the main branch of the Humber River as well as the upper half of the West Branch of the Humber River fall within the study area. Toronto and Region Conservation Authority recognize 13 major named tributaries of the Humber River (some are outside this study area). Etobicoke Creek and Mimico Creek both originate on the south slope of the Oak Ridges Moraine near Caledon and flow southeast to their mouths at Lake Ontario. Mimico Creek has a total length of just over 32km and drains 77 km^2. Only the upper half of Mimico Creek's watershed is

Figure 5

Soil Types of the NAI Study Area

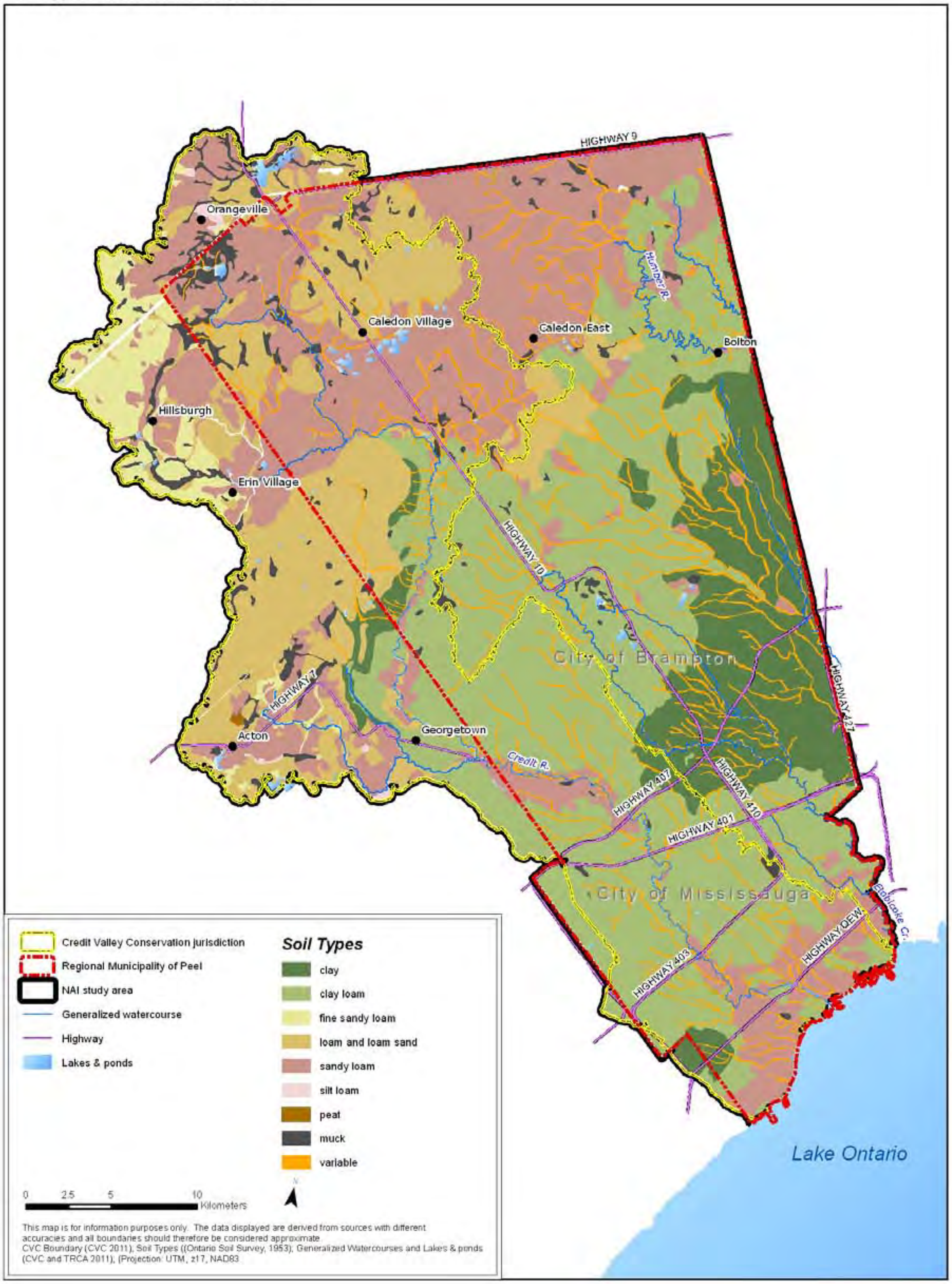


Figure 6

Soil Drainage of the NAI Study Area

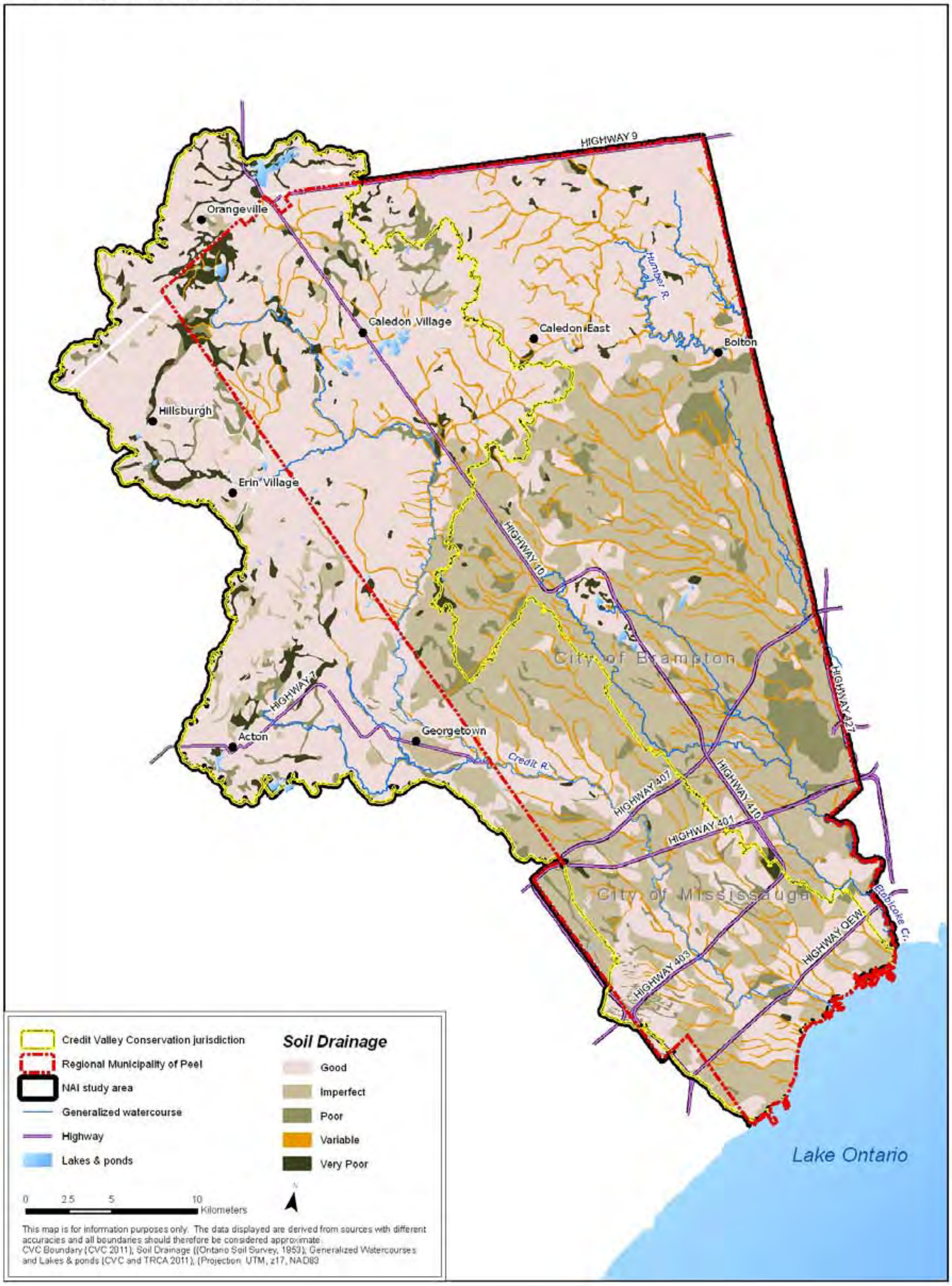


Figure 7

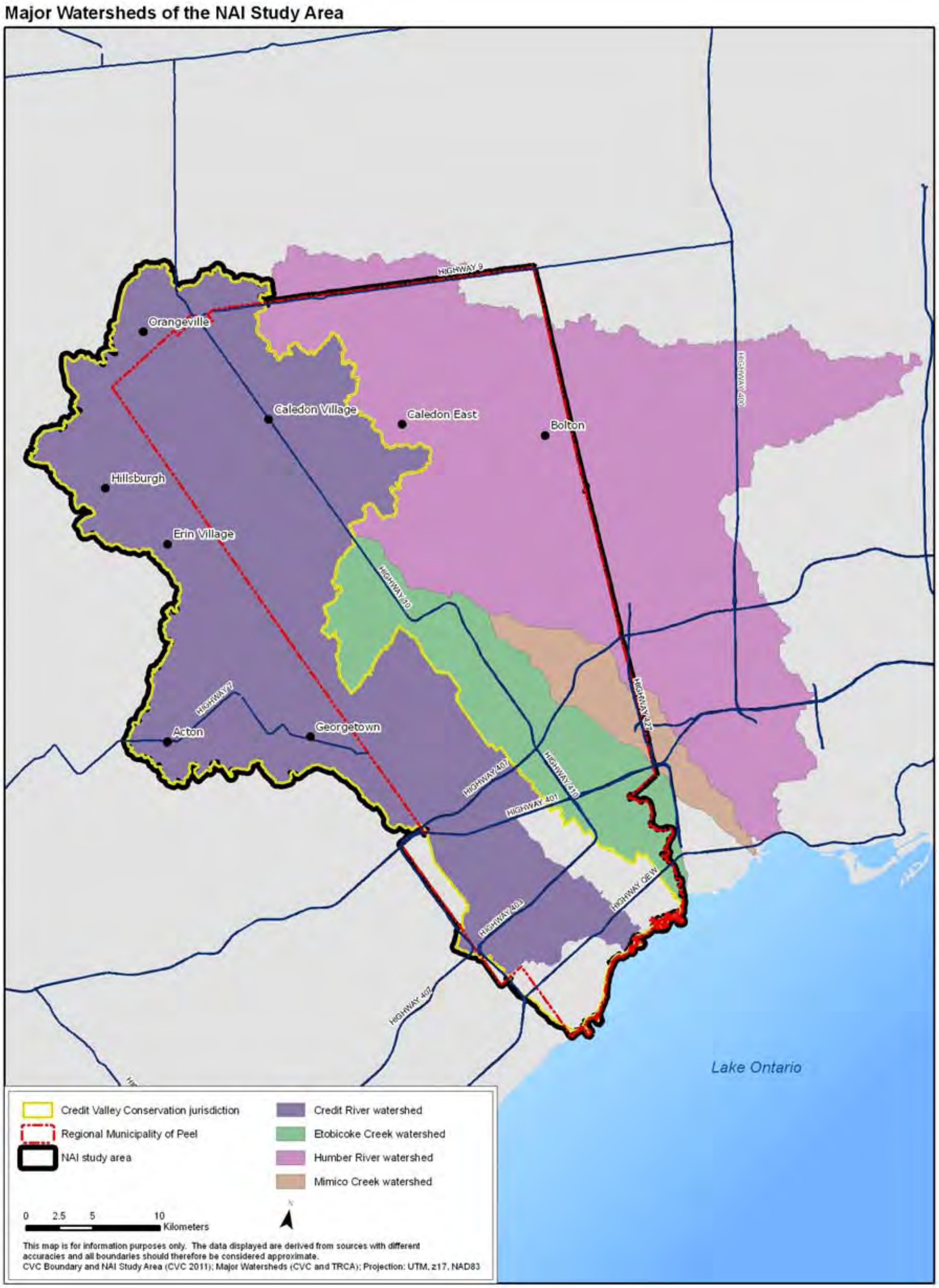
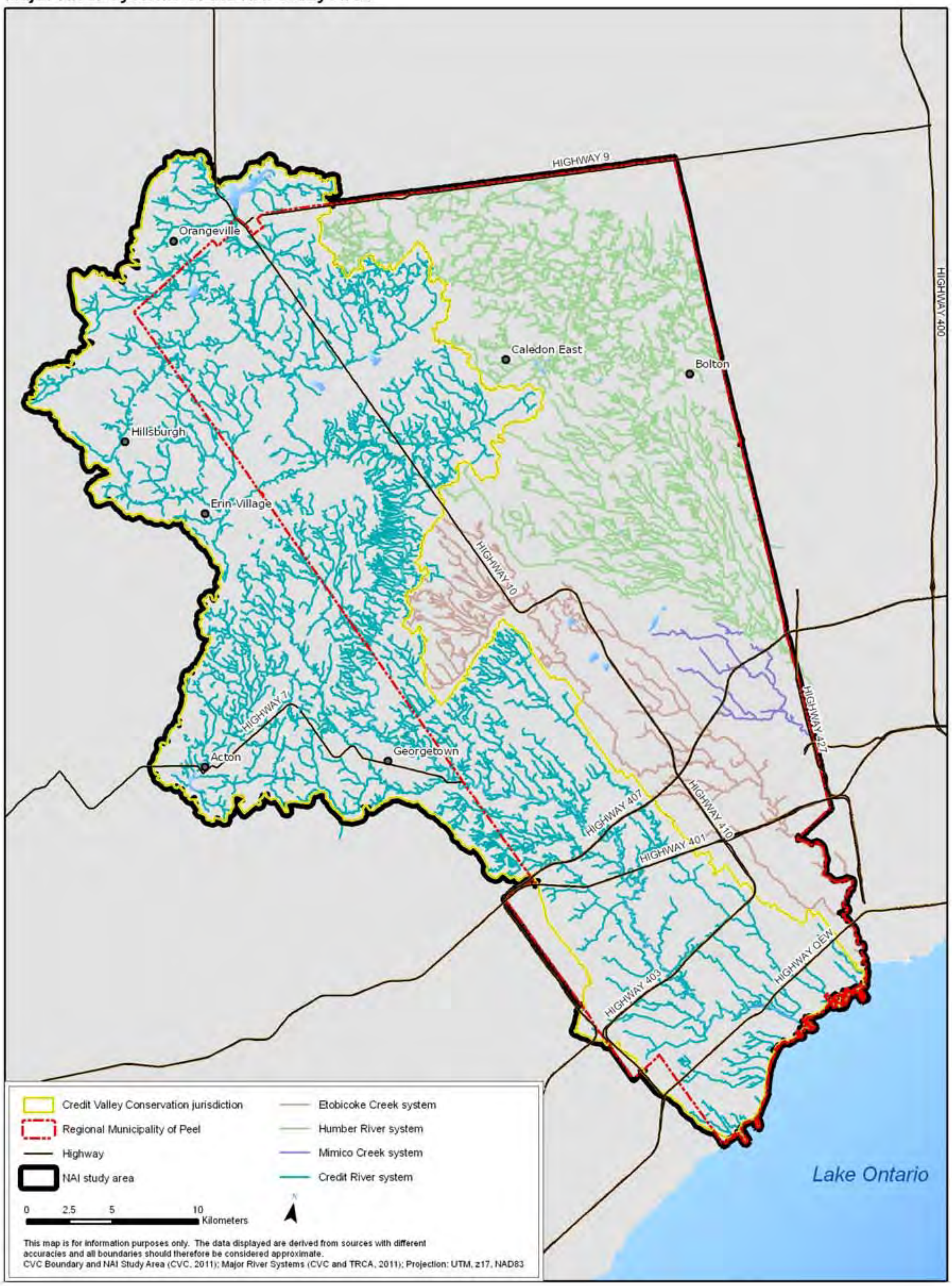

Major Watersheds of the NAI Study Area
Orangeville
Caledon Village
Caledon East
Bolton
Hillsburgh
Erin Village
Acton
Georgetown
HIGHWAY 9
HIGHWAY 400
HIGHWAY 10
HIGHWAY 7
HIGHWAY 427
HIGHWAY 407
HIGHWAY 410
HIGHWAY 401
HIGHWAY 403
HIGHWAY QEW
HIGHWAY 407
Lake Ontario
Credit Valley Conservation jurisdiction
Regional Municipality of Peel
NAI study area
Credit River watershed
Etobicoke Creek watershed
Humber River watershed
Mimico Creek watershed
0 2.5 5 10
Kilometers
This map is for information purposes only. The data displayed are derived from sources with different accuracies and all boundaries should therefore be considered approximate.
CVC Boundary and NAI Study Area (CVC 2011); Major Watersheds (CVC and TRCA); Projection: UTM, z17, NAD83

Figure 8

Major River Systems of the NAI Study Area



included in the NAI study area. Etobicoke Creek's watershed is 211 km^2 in size and is situated between Mimico Creek and the Credit River (Toronto and Region Conservation Authority, 2002, 2008). Almost all of the Etobicoke Creek watershed lies within the NAI study area with only a small part of the east side of the lower creek basin outside the Region of Peel. The lower reaches of Etobicoke Creek form the municipal boundary between the City of Mississauga and the City of Toronto.

In addition to the four major watersheds described above, there are small portions of other watersheds or small creek basins that are also included in the study area. The study area includes the small watersheds of Applewood Creek, Avonhead Creek, Birchwood Creek, Cawthra Creek, Clearview Creek, Cooksville Creek, Lakeside Creek, Lornewood Creek, Moore Creek, Serson Creek, Sheridan Creek, Tecumseh Creek, Turtle Creek, all of which drain directly into Lake Ontario, to the east or west of the Credit River. The northeast corner of the study area contains small portions of the headwaters of the Nottawasaga River and Holland River. The southwest edge of the study area includes small parts of the watersheds of Joshua Creek and Sixteen Mile Creek.

Precipitation falling in areas with highly permeable soils (e.g. sand, gravel) will infiltrate to the water table and flow within the groundwater system at a greater rate than precipitation falling on soils with low permeability (e.g. silt, clay). Groundwater flows both laterally and vertically depending on soil and rock permeability and the presence of boundaries (i.e. streams, lakes) which can either add or remove water from the groundwater system (Credit Valley Conservation, 2007b).

The regional groundwater flow system is controlled primarily by topographic relief, and the ability of the subsurface geologic material to transmit water. Highest groundwater levels are in the northwest, declining towards the Escarpment, except where influenced by buried bedrock valleys, such as along the West Credit and main branch of the Credit River above Forks of the Credit. In areas where rivers or streams intersect the water table, groundwater will discharge into the stream or river and contribute baseflow to the surface water feature (Credit Valley Conservation, 2007b). For example, 65% of the Credit River's flow comes from groundwater (Credit Valley Conservation, 2010a). Groundwater is also important for improving water quality, and supporting seeps which often have a high diversity of plant communities and species (Credit Valley Conservation, 2007a, b). In addition to maintaining river flow rates during periods of low or no precipitation, groundwater also helps to keep temperatures of streams low, supporting cold and cool-water aquatic communities. During the winter months, when groundwater is warmer than (frozen) surface water, the presence of groundwater flows provides important wildlife habitat.

There are two regionally significant groundwater aquifers within the Credit River Watershed: the Guelph/Amabel Formation found west of the Niagara Escarpment and buried bedrock valleys (filled with coarse-grained glacial overburden deposits) found throughout the study area (Credit Valley Conservation, 2007b). Some of these buried valleys are known to contain large volumes of groundwater, including aquifers in both Halton and Peel Regions (Credit Valley Conservation, 2007b), that municipalities tap to supply municipal water. The Oak Ridges Aquifer Complex (shallowest), Thorncliffe Aquifer Complex and Scarborough Aquifer Complex (deepest) are other regionally important groundwater sources in the east part of the study area.

3.5. HUMAN HISTORY

After the last glaciers retreated about 10,000 years ago, this area would have become habitable, and archaeological evidence has been collected of aboriginal hunting camps and villages along the Credit River and Humber River valleys that date from approximately 8000 B.C (City of Brampton, 2011).

Early inhabitants included people of the Iroquois First Nations and the Mississauga First Nation. By the mid-1600's, Europeans began visiting the area and had initiated trade with the First Nations by the 1720's. For example, the Credit River is so-named because trade goods were provided to the

First Nations at the mouth of the Credit River “on credit” in exchange for furs that would be delivered later (Heritage Mississauga, 2009). Between 1805 and 1820, the Mississaugas signed land treaties with the British Crown and the area became available for European settlement (*ibid*).

In addition to European settlers, some of the settlers to this area were United Empire Loyalists who had remained loyal to the British Crown during the American Revolution. After the Revolution they immigrated to this area and were given land grants (Mackenzie, 2008). Steady settlement occurred throughout the early 1800’s. Land clearing for agriculture and to support logging were major activities. Many wetlands were filled in to accommodate alternative land uses and certain wildlife species were extirpated from the area due to human persecution (e.g. Wolves, Massasauga Rattlesnakes; Bull, 1938, Mulvany *et al*., 1885). Stone quarrying for building materials was also a significant land use in some parts of the study area.

During the 1900’s, increased industrial development put strain on the natural environment and resulted in impacts such as sewage problems, industrial waste from saw and grist mills entering waterways, and sedimentation from sand and gravel extraction operations. Atlantic Salmon (*Salmo salar*), once extremely abundant, were extirpated from the area around the 1890’s (Credit Valley Conservation, Undated).

Throughout the 1900’s, the population of the study area grew. A large portion of the study area is located within the Greater Toronto Area (GTA). The population of the GTA tripled between 1951 and 2001 and is the largest urban concentration of people within Canada, with over five million inhabitants (Credit Valley Conservation, 2004). The population of the GTA is expected to swell to eight million by 2031 (Ontario Ministry for Public Infrastructure and Renewal, 2006)

Urban development creates extensive areas of impermeable surfaces (e.g. roads, roofs and pavement) that will adversely affect water quantity and quality. Development can lead to an outright loss of natural areas with consequent biodiversity decreases, fragmentation and isolation of remaining natural patches, an increase in surface water flows and a contamination of groundwater supplies, and a decrease in quality and diversity of aquatic communities. Larger urban populations put increased pressure on those natural resources and areas that remain. More recently though, public awareness and understanding of natural processes, ecological issues and environmental benefits and services has been gradually increasing. Municipalities, the public, institutions, agencies and businesses are increasingly interested and engaged in the stewardship of natural areas and in the restoration of degraded areas.

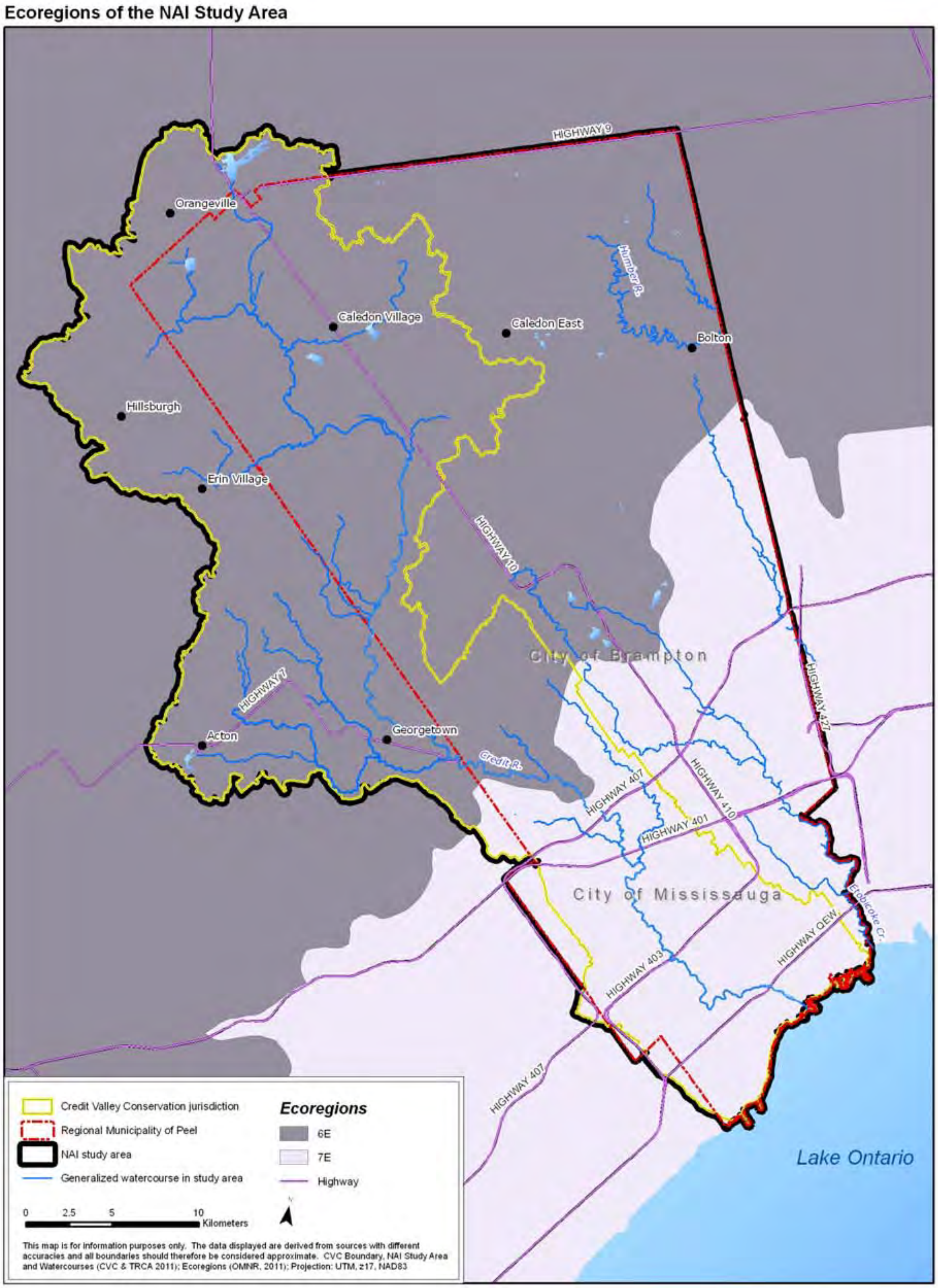
4. NATURAL HERITAGE CONTEXT

4.1 ECOREGIONS

The Ontario Ministry of Natural Resources has defined broad “ecoregions” in Ontario, characterized by climate, forest ecosystems and wildlife species (Watkins, 2006). The NAI study area includes two ecoregions: the Lake Erie-Lake Ontario Ecoregion 7E (more familiarly known as the Carolinian Forest Region) and the Lake Simcoe-Rideau Ecoregion 6E (Fig. 9).

The Carolinian Forest Ecoregion (Lake Erie-Lake Ontario Ecoregion) occurs in the southern portion of southern Ontario (Lee *et al*., 1998). The predominantly limestone bedrock is deeply buried by tills and sediments in this ecoregion and the topography is relatively flat. The Carolinian Forest Ecoregion coincides with the Deciduous Forest Region, representing the northernmost extension of the deciduous forests typical of the eastern and southeastern United States. Many tree and shrub species of the Deciduous Forest Region have their northern range limits in the Carolinian Forest Ecoregion, such as Tulip Tree (*Liriodendron tulipifera*), Black Gum (*Nyssa sylvatica*), Sassafras (*Sassafras variifolium*), Flowering Dogwood (*Cornus florida*), several species of Hickory and several Oak species. This ecoregion covers less than 1% of Canada's land mass but is home to more than 25% of Canada's population (of approximately 34 million) and over 90% of Ontario’s 13 million

Figure 9


Ecoregions of the NAI Study Area
HIGHWAY 9
Orangeville
Caledon Village
Caledon East
Humber R.
Bolton
Hillsburgh
Erin Village
HIGHWAY 10
City of Brampton
HIGHWAY 7
Acton
Georgetown
Credit R.
HIGHWAY 427
HIGHWAY 407
HIGHWAY 410
HIGHWAY 401
City of Mississauga
Etobicoke Cr.
HIGHWAY QEW
HIGHWAY 403
HIGHWAY 407
Lake Ontario
Credit Valley Conservation jurisdiction
Regional Municipality of Peel
NAI study area
Generalized watercourse in study area
Ecoregions
6E
7E
Highway
0 2.5 5 10 Kilometers
This map is for information purposes only. The data displayed are derived from sources with different accuracies and all boundaries should therefore be considered approximate. CVC Boundary, NAI Study Area and Watercourses (CVC & TRCA 2011); Ecoregions (OMNR, 2011); Projection: UTM, z17, NAD83

residents. This ecoregion has the highest proportion of development in Ontario. The resultant high level of natural habitat loss and limited extent of this ecoregion (in Ontario and in Canada) means that many species characteristic of this ecoregion are rare and may be at risk.

The Lake Simcoe-Rideau Ecoregion occurs south of the Precambrian shield, in the northern portion of southern Ontario (Lee *et al*., 1998). In the study area, the bedrock is buried by glacial deposits. The topography is relatively flat, except near the Niagara Escarpment. This ecoregion occupies the southern part of the Great Lakes-St. Lawrence Forest Region (the forest region extends north onto the Precambrian shield). This forest region is characterized by a variety of forest types (deciduous, coniferous, mixed) with a mixture of northern and southern species, as species composition transitions between the deciduous forests to the south and the coniferous (boreal) forests to the north. In the Lake Simcoe-Rideau Ecoregion, the forests tend to have a greater proportion of southern species than the same forest region does in the ecoregion to the north.

In the NAI study area, the transition between Ecoregions 6E and 7E occurs in the area of Brampton and southern Halton Hills.

4.2. THE STATE OF NATURAL HERITAGE AND ENVIRONMENTAL FEATURES

Natural areas face numerous threats in Ontario, including those in the NAI study area. Since European settlement a large portion of the forests have been cleared and wetlands drained. Urbanization of agricultural areas has caused even further fragmentation of natural areas, making them more susceptible to damage by invasive species, pests and disease. The loss and degradation of habitat has resulted in a loss of species and a decline in biodiversity. The effects of land clearing and urbanization have altered the quality and quantity of ground and surface waters. With increasing urbanization humans are becoming more heavily dependent on the remaining natural areas for the provision of ecosystem goods and services (Credit Valley Conservation, 2011). Non-native species alter existing species compositions and can crowd out native species. Climate change can increase environmental stress by increased storms, drought, and lower water levels.

4.2.1. Land Use Changes: Since European settlement, the landscape across southern Ontario has undergone dramatic change, including the NAI study area. Lands previously covered by continuous forests, swamps and marshes were cleared for agriculture and wood products by early settlers. It is estimated that about 90% of southern Ontario's land base was forested prior to European settlement (Larson *et al*., 1999). In the NAI study area, approximately 21% forest cover remains (Regional Municipality of Peel, 2008). The majority of this occurs above the Niagara Escarpment (42% forest cover). Rural areas below the escarpment (south Caledon) have only 11% forest cover remaining and urban areas (Brampton and Mississauga) have 7% forest remaining (Regional Municipality of Peel, 2008), a pattern that illustrates the northward advancement of urbanization from where it was initiated near the Lake Ontario shoreline. This pattern also reflects the high value of gently sloping lands with good soils below the escarpment for agriculture. Countering this trend (but not out-weighing it) is the more recent phenomenon of the return of marginal agricultural lands to natural cover. This is particularly noticeable above the escarpment where old fields are being allowed to undergo succession, eventually back to treed communities.

Wetland loss due to changing land use is an issue in the study area, as it is throughout southern Ontario. In southern Ontario, 76% of large (>10ha) wetlands have been lost following European settlement, primarily through early conversion of land for agriculture and more recently due to urban development. In addition to loss of wetland habitat and associated species, and thus decreases in overall biodiversity of the area, there is consequent loss in the ecological functions that wetlands provide. Wetlands play important roles in slowing runoff and reducing the potential for flooding, purifying water of nutrients and other pollutants, reducing sediment loads in water, providing nursery habitat for aquatic wildlife and nesting and foraging habitat for terrestrial wildlife.

<u>4.2.2. Habitat Fragmentation</u>: Habitat fragmentation has increased with more recent urbanization (Credit Valley Conservation, 2011). Roads can result in fragmented and isolated plant and wildlife populations. Natural areas that are fragmented by non-natural land are less resilient because species and genetic diversity are harder to maintain over time (Forman, 1995). Natural areas which are already under stress from fragmentation and degradation will be more susceptible to stresses caused in the future by climate change.

<u>4.2.3. Water Quality and Quantity</u>: Loss of natural vegetation cover has had a negative affect on water quality and quantity. The reduction of streamside vegetation and increased impervious (paved) cover associated with urbanization has caused an increase in runoff and sediment loading in watercourses (Credit Valley Conservation, 2007b). Hydrological regimes have been affected by land clearing and urbanization resulting in changes in groundwater levels and inputs to river and stream baseflow levels (Credit Valley Conservation, 2011). Land clearing and urbanization often cause streams and rivers in urban areas to experience rapid increases in runoff during storm events, elevated concentrations of nutrients and contaminants, altered channel morphology and/or realignment of watercourses, increased stream temperatures, depletion of dissolved oxygen, reduced biodiversity and an increase of tolerant species, and reduced nutrient uptake.

<u>4.2.4. Invasive Species</u>: Over time, many non-native species have been introduced to the area both intentionally and accidentally. While some of these non-native species are relatively benign, others can invade communities aggressively and negatively affect terrestrial, wetland and aquatic communities. It is thus important to mark the distinction between non-native and invasive species – not all non-native species are invasive, but all invasive species are non-native (Pysek *et al*., 2004).

To varying degrees, invasive species take over habitats, outcompeting and displacing native species. The more problematic invasive species are able to invade and dominate multiple habitat types. Some invasive species release chemical compounds that inhibit the germination and/or growth of native seeds and seedlings and thus simplify species diversity and ecosystems. (Complexity adds robustness to ecosystems.) Invasive species are considered one of the top five threats to biodiversity in the province of Ontario (Ontario Ministry of Natural Resources, 2005).

Invasive species established in the NAI study area include European Buckthorn (*Rhamnus cathartica*) in forests, Purple Loosestrife (*Lythrum salicaria*) in wetlands and Common Carp (*Cyprinus carpio*) in rivers and waterways. Invasive forest pests and diseases include the Emerald Ash Borer (*Agrilus planipennis*); a beetle accidentally introduced from Asia causing mortality in all Ash (*Fraxinus* spp*.*) tree species; Beech Scale (*Cryptococcus fagisuga*), an exotic insect which renders American Beech (*Fagus grandifolia*) trees susceptible to infection by the non-native *Nectria coccinea* var. *faginata* fungus leading to lethal Beech Bark Disease (Hodge *et al.,* 2008); Dutch Elm Disease, a lethal disease of Elm trees caused by a non-native fungus *Ophiostoma novo-ulmi* which is spread by the native Elm Bark Beetle (*Hylurgopinus rufipes*) and the non-native European Elm Bark Beetle (*Scolytus multistriatus*) (*ibid*). Butternut Canker is a lethal disease of Butternut (*Juglans cinerea*) trees caused by the non-native fungus *Sirococcus clavigignenti-juglandacearum* (Hodge *et al*. 2008). It has caused widespread death and decline of Butternut trees through their range.

<u>4.2.5. Climate Change</u>: Climate change is occurring and has caused visible local environmental effects. Temperature changes affect species ranges allowing more southern species to become established farther north. Species that cannot tolerate warmer temperatures must be free to move northward in order to avoid local extinctions. Thus wildlife movement corridors and linked natural areas across the landscape will become increasingly important as terrestrial and aquatic ecosystems are disrupted and/or are modified as a result of climate change. New relationships between species and habitat must be established. Drought is another anticipated effect of climate change. Drought tolerance may become a more important factor in shaping vegetation communities. Stress due to drought may also decrease resistance of species to disease. Drought can also lower water levels which can affect surface water and groundwater availability, changing the type and distribution of wetlands. Lower water levels in streams and rivers may affect fish habitat and spawning success.

Warmer winters are linked to increased insect pest population levels when temperatures do not drop low enough to kill them off. Warmer winter and drought during the winter also affect the amount of ice cover and the amount of snow pack, reducing the insulating capacity of ice and snow and possibly affecting wildlife behaviour over winter. Intense storms increase the risk of flooding events and erosion of stream banks and shorelines, threatening infrastructure such as dams and bridges over waterways and impacting water quality. Storms may damage trees and other vegetation along riverine systems and the lakefront.

4.2.6. Loss of Biodiversity: Loss of biodiversity is a major threat to ecosystem stability and resilience. Habitat loss, degradation of habitat quality (e.g. due to fragmentation and reduction in size of natural patches, pollution, etc.), competition with invasive species, losses to diseases particularly non-native pathogens, climate change effects and other factors all contribute to decreases in biodiversity. Maintenance of linkages between areas of natural habitat and provision for wildlife movement corridors can help to guard against biodiversity loss by allowing for re-population if local extinctions occur. Biodiversity gives strength to ecosystems as more niches are filled and greater complexity allows for more connections in food webs and support for more ecosystem services.

4.3. NATURAL HERITAGE AND ENVIRONMENTAL MANAGEMENT

Governing bodies and the public are becoming more aware of the environmental costs of urbanization and population growth. They are showing increasing concern for the environment, increasing interest in preserving and conserving the natural features that remain, and in mitigating and restoring what has been damaged. These interests and concerns are reflected in legislated and planning efforts.

4.3.1. Provincial Policy Statement (PPS): The PPS provides direction on all matters of provincial interest related to land use planning and development (Ontario Ministry of Municipal Affairs and Housing, 2005a). Among other things, the PPS directs municipalities to protect natural features and areas over the long term, with a focus on natural heritage systems planning that will preserve ecological function, biodiversity and linkages between features. The PPS identifies outright protection of significant features from the impacts of development (significant habitat of endangered and threatened species, significant wetlands, significant coastal wetlands) and requires demonstration of no negative impacts on the natural features or their ecological functions (significant woodlands south and east of the Canadian Shield, significant valleylands south and east of the Canadian Shield, significant wildlife habitat and significant areas of natural and scientific interest).

4.3.2. Niagara Escarpment Plan (NEP): The Niagara Escarpment Plan was established to provide protection to the unique ecological and geological features of the escarpment. As the Niagara Escarpment extends through a variety of Ontario landscapes, the NEP designates seven landuse categories, ranging from natural areas, to intensive urban development and mineral extraction areas. The Escarpment Natural Area designation gives the greatest protection to natural features, followed by the Escarpment Protection Area designation. The Escarpment Rural designation buffers the protected natural areas from the mineral extraction, major and minor urban and recreational designations.

4.3.3. Oak Ridges Moraine Conservation Plan (ORMCP): The Oak Ridges Moraine Conservation Plan was created to guide land use and resource management on the Oak Ridges Moraine, an area of unique environmental, geological and hydrological features that are essential to the well-being of south-central Ontario. The ORMCP recognizes four landuse designations of which the Natural Core Areas and Linkage Areas are most protective of natural features, and are buffered by Countryside Areas from Settlement Areas.

4.3.4. Greenbelt Plan: The Greenbelt Plan includes the protection afforded by the NEP, the ORMCP and the Parkway Belt West Plan and extends protection to additional lands identified as Protected

Countryside. In the Protected Countryside, natural areas are part of the Natural Heritage System that together with a Water Resource System provides a continuous and permanent landbase necessary to support ecological integrity.

4.3.5. Natural Heritage Systems: A watershed natural heritage system has been defined by TRCA and is also being developed by CVC to identify, protect and enhance natural features in the watersheds of the NAI study area. The TRCA *Terrestrial Natural Heritage System Strategy* was developed between 2001 and 2006 and was approved in principle by the TRCA Board in 2007 (Toronto and Region Conservation Authority, 2007a). The Credit Valley Watershed Natural Heritage System is being defined through a four-phase study process. It is currently described in the document *Towards a Natural Heritage System for the Credit River Watershed Phases 1 & 2: Watershed Characterization and Landscape Scale Analysis,* Final Technical Report (Credit Valley Conservation, 2011).

These natural heritage systems are identified and designed at the watershed scale. It is intended that municipal planning authorities can use the watershed natural heritage systems and conservation authority strategies to identify regional and local natural heritage systems, and to review existing natural heritage system policies and strategies in municipal planning documents to enhance the protection of natural heritage features and functions over the long term (Credit Valley Conservation, 2011; Toronto and Region Conservation Authority, 2007a). These watershed natural heritage system srategies have been developed to address the natural heritage policies of the PPS 2005 and conform to provincial plans including the Niagara Escarpment Plan (Niagara Escarpment Commission, 2005, revised 2010), Oak Ridges Moraine Conservation Plan (Ontario Ministry of Municipal Affairs and Housing, 2002), Greenbelt Plan (Ontario Ministry of Municipal Affairs and Housing, 2005b) and the Growth Plan for the Greater Golden Horseshoe (Ontario Ministry for Public Infrastructure and Renewal 2006) (Credit Valley Conservation, 2011; Toronto and Region Conservation Authority, 2007a).

The PPS defines the natural heritage system as: a system of natural heritage features and areas, linked by natural corridors which are necessary to maintain biological and geological diversity, natural functions, viable populations of native species and ecosystems. These systems can include lands that have been restored and areas with the potential to be restored to a natural state. The *Natural Heritage Reference Manual for Natural Heritage Policies of the Provincial Policy Statement, 2005* (Ontario Ministry of Natural Resources, 2010a), and the previous 1999 edition were created to provide technical guidance to implement the natural heritage policies of the PPS. The guidelines of this manual represent the minimum standard required and planning authorities such as municipalities may choose to go beyond these standards (*ibid*). By implementing natural heritage systems throughout the coverage area the negative affects of past and present urban development will be minimized.

The NAI project contributes to the goal of identifying and refining the natural heritage features throughout the study area.

4.3.6. Region of Peel Greenlands System: The Region of Peel Official Plan (Regional Municipality of Peel, 2008) includes a Greenlands System designed to provide protection for the natural environment (Regional Municipality of Peel, 2008). It consists of Core Areas, Natural Areas and Corridors (NAC) and Potential Natural Areas and Corridors (PNAC). Core Areas are given the highest level of protection to provide uninterrupted natural systems and maximum biodiversity. These areas are protected and are functionally supported, connected and/or buffered by NAC and PNAC areas (*ibid*). The Peel Greenlands System includes Areas of Natural and Scientific Interest (ANSI), Environmentally Significant Areas (ESA), Escarpment Natural Areas and Escarpment Protection Areas identified in the *Niagara Escarpment Plan*, fish and wildlife habitat, endangered and threatened species habitat, wetlands, woodlands, valley and stream corridors, shorelines, natural lakes, natural corridors, groundwater recharge and discharge areas, open space portions of the Parkway Belt West Plan 1978 and other natural features and functional areas (Regional Municipality of Peel, 2008).

4.3.7. Provincially Significant Wetlands (PSW): The Ontario Ministry of Natural Resources has a program to evaluate the significance of wetlands based on a variety of physical, biological and social criteria (Ontario Wetland Evaluation System, 3rd edition). Wetlands may be evaluated individually or as complexes that have related hydrology and that function as a whole. The result of evaluations is the determination that a wetland, or wetland complex, is provincially significant or not. In the past, regional or local significance was determined by the wetland evaluation scores; however this is no longer the case. The significance of other evaluated and/or identified wetlands within municipalities is the responsibility of the regional and/or area municipalities.

The NAI study area includes provincially significant wetlands as well as other wetlands that are not provincially significant. Some wetlands are unevaluated. Development and site alteration are not permitted within PSWs in accordance with the PPS. Policies for protection, development and site alteration and mitigation/compensation for other wetlands are provided in provincial plans, municipal official plans, as well as the conservation authority regulations and policies.

4.3.8. Areas of Natural and Scientific Interest (ANSI): The PPS defines ANSIs as: "areas of land and water containing natural landscapes of features that have been identified as having life science or earth science values related to protection, scientific study or education." Earth science ANSIs contain significant geological features. Life science ANSIs are evaluated on an MNR Ecoregion scale and contain the best natural heritage features and landscapes outside of provincial parks and reserves. Life science ANSIs are selected based on quality and representation of the province's natural heritage. Both Life Science and Earth Science ANSIs are evaluated and identified as provincially or regionally significant.

The NAI coverage area contains both life science and an earth science ANSI's.

4.3.9. Environmentally Significant Areas (ESA): Environmentally Significant Areas (sometimes referred to as Environmentally Sensitive Areas) are identified areas that contain natural features or ecological functions that are significant at a regional scale and are recognized in order to provide protection to them. ESA areas may often coincide at least in part with ANSI boundaries. Conservation Authorities are responsible for identifying ESAs according to a set of criteria. The NAI study area contains ESA's, with those in the Credit River watershed identified by Credit Valley Conservation and those in the watersheds of Etobicoke Creek, Mimico Creek and the Humber River identified by the Toronto and Region Conservation Authority.

4.3.10. Significant Wildlife Habitat (Region of Peel): Significant wildlife habitat is a key natural feature identified for protection under the PPS. Documents such as OMNR's Significant Wildlife Habitat Technical Guide (Ontario Ministry of Natural Resources, 2000) provides technical information on the identification, description and prioritization of significant wildlife habitat. Municipalities were tasked with carrying out the details of putting the PPS directive into effect. Toward this end, the Region of Peel and the Town of Caledon jointly commissioned an analysis of the criteria and thresholds for identifying significant wildlife habitat in their respective jurisdictions (North-South Environmental Inc. *et al.*, 2009) and will consider this analysis when their respective Official Plans are updated. A variety of criteria have been identified that fall into four groupings: seasonal concentration areas, rare vegetation communities or specialized habitat for wildlife, habitats for Species of Conservation Concern and animal movement corridors. Thresholds for determination of significance for many of the criteria have been identified. For some criteria any occurrence is significant and for other criteria too little data exists currently to establish significance thresholds.