BRONTE CREEK
WATERSHED STUDY

Progreston Dam, Bronte Creek

Conservation Halton

March 2002

VISION STATEMENT

Our vision for the Bronte Creek is a healthy creek in a healthy watershed. A watershed that supports a rich diversity of plants and animals in extensive, interconnected forests, wetlands, meadows, valleys and Niagara Escarpment features within both the rural and urban landscape. Through sustainable human activities, carefully planned development and stewardship initiatives, there will be a place for nature, community, agriculture and recreation. Our citizens will be stewards protecting, enhancing and restoring the watershed for future generations.

Developed by the Bronte Creek Stakeholders

Acknowledgements

On behalf of the stakeholders, the members of the writing team would like to take this opportunity to thank the following people for their generous contributions to the production of the study:

George Atkins	Long time Bronte resident at "The Woodlands"
Rob Baker	University of Toronto
Victor Cairns	Fisheries and Oceans Canada
Murray Charlton	Environment Canada
Gary Cousins	County of Wellington
Peter Crockett	City of Hamilton
Geza Gaspardi	LGL Limited
Doug Geiling	Fisheries and Oceans Canada
Leo Gohier	Former Region of Hamilton-Wentworth
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Erling Holm	Royal Ontario Museum
Brenda Law	Puslinch Township
Alan Magi	City of Burlington
Bill Mann	Town of Milton
Brian McCarry	McMaster University
Suzanne McInnes	Region of Halton/Niagara Peninsula Conservation Authority
Mel Iovio	Town of Milton
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Bill Pearce	Former Region of Hamilton-Wentworth
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Al Thachuk	Ontario Ministry of the Environment
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Watershed Planning Staff	Conservation Halton
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Bronte Creek Stakeholders

The following people have given of their time, expertise and experience to provide the ideas and direction for this study.

Martin Bateson	Town of Milton
Dave Boddington	Bronte Creek Provincial Park
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Special Note of Thanks

The stakeholders and writing team wish to recognize the contribution of Ed Segsworth, who passed away during the course of the study. Ed, a Halton farmer, was always actively involved in the community representing the interests of farmers. He was past president of the Ontario Federation of Agriculture and the Halton Federation of Agriculture, and continued to represent the farming community through his involvement as a stakeholder on the Bronte Creek Watershed Study. He died on November 7, 2001.

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EXECUTIVE SUMMARY

Conservation Halton embarked on the Bronte Creek Watershed Study and Stewardship Project in 1999 and has now completed the final phase of the study. The watershed study was undertaken almost entirely in house with the expertise of Conservation Halton staff, and with the technical and financial assistance of the project partners. A Hydrology and Stream Morphology Study was contracted to Planning and Engineering Initiatives and the Region of Halton provided assistance for the hydrogeological component of the study through the services of their hydrogeologist. The Stewardship Project was undertaken through the Hamilton-Halton Watershed Stewardship Program with financial assistance from EcoAction. Conservation Halton Foundation assisted in the securement of these funds.

The study was undertaken in phases; background data collection (Phase1), completion of technical studies and field surveys to fill information gaps (Phase 2), and establishment of a stakeholders group to develop the watershed plan (Phase3).

Preparing the watershed plan involved a stakeholder and writing team developing the plan, public review of the plan through open houses, and the Conservation Authority and municipalities endorsing the plan.

The Stakeholders Committee represents a broad cross-section of individuals and interests who share a "stake" in the watershed. Stakeholders included representatives of municipalities, agencies, community groups, clubs, industry, and local residents. The stakeholders developed their "vision" for the watershed.

The Bronte Creek is the second largest watershed within the Halton jurisdiction and drains an area that is over 300 square kilometres in size. It is highly significant, from an environmental perspective, with large provincially significant headwater wetlands, forests, Niagara Escarpment features, major valley systems, and coldwater fish habitat supporting brook trout and migratory salmonids. The watershed extends across a number of municipal jurisdictions including portions of Region of Halton, City of Hamilton, County of Wellington, City of Burlington, Town of Milton, Town of Oakville and Puslinch Township (Figure 1).

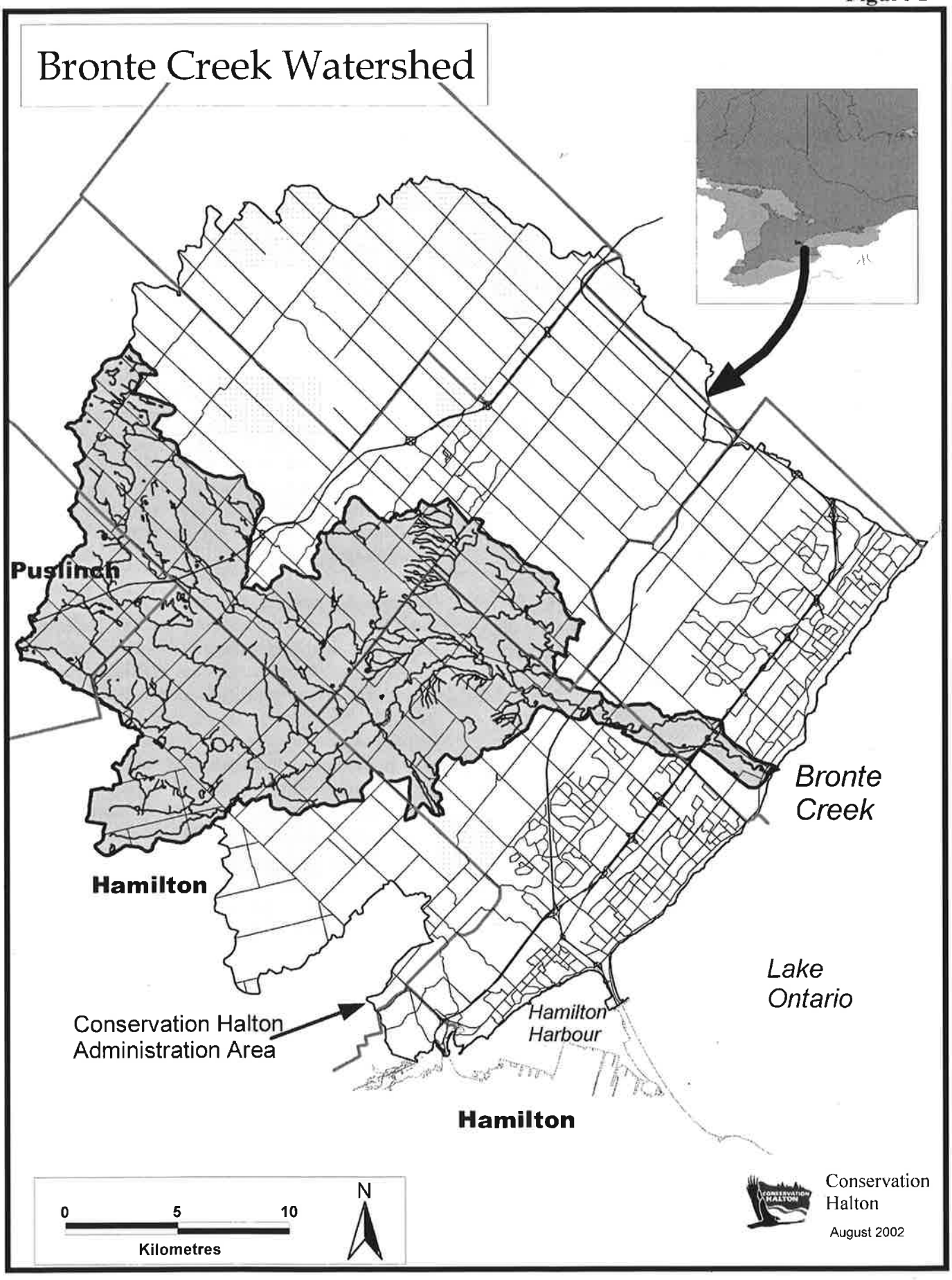
The majority of the watershed is rural and includes the communities of Moffat, Lowville, Kilbride, Cedar Springs, Carlisle, Freelton, Strabane, and Morriston. The residents of these communities and other rural properties are dependent on groundwater for their domestic water supply. Others rely on surface waters for irrigation, cattle watering and recreation (swimming and fishing). Often these uses are in conflict with each other and the aquatic habitat requirements.

Watershed strategies allow the community to care for the water resources, natural heritage, settlement and agriculture of the watershed through the Planning Process (Official Plans, Secondary Plans and Subwatershed Studies), projects on public lands and stewardship initiatives on private lands. Regeneration Plans for individual tributaries and strategies for implementing the watershed initiatives are presented and specify who will be responsible for the remedial actions. Conservation Halton will serve as the lead agency and request that the various municipalities and government agencies involved adopt the recommendations and implementation strategies as outlined.

The Bronte Creek Watershed Study consists of a summary document and seven technical appendices produced under separate cover.

The Bronte Creek Watershed Study provides a comprehensive strategy to support environmental stewardship, guide development, and recommend restoration strategies for the watershed.

Figure 1


Bronte Creek Watershed
Puslinch
Hamilton
Bronte Creek
Lake Ontario
Conservation Halton Administration Area
Hamilton Harbour
Hamilton
0
5
10
Kilometres
N
Conservation Halton
August 2002

INTRODUCTION

The Bronte Creek is a significant watershed at the western end of Lake Ontario. It extends across portions of the Region of Halton (City of Burlington, Town of Oakville, Town of Milton), the City of Hamilton (formerly Region of Hamilton-Wentworth) and Wellington County (Puslinch Township). It encompasses an area of approximately 312 square kilometres and is made up of ten subwatersheds (Figure 1).

The watershed has experienced limited development in its history. About 4% of the watershed is settled with the majority concentrated in the Town of Oakville around the creek mouth and in rural settlement areas. These smaller communities include: Moffat, Lowville, Kilbride, Cedar Springs, Carlisle, Freelton, Strabane and Morriston. Like most of the rural residences of the watershed, these communities rely on groundwater for potable water supplies. Farms are also dependant on groundwater for irrigation and livestock watering.

More urban expansion is starting to occur in the watershed, particularly as Milton expands to the west and Burlington grows northward. The scenic qualities of the watershed and its natural resources attract many visitors who come to hike, explore, fish and experience other recreational pastimes in the parks and conservation areas. The competing demands for the watershed resources are sometimes in conflict with each other and the requirements of the natural habitat. The need for a holistic understanding of the natural resources, community needs and their interdependence is essential, and has led to the development of the Bronte Creek Watershed Study.

The Bronte Creek Watershed Study provides a comprehensive strategy to support stewardship, guide development, and recommend restoration strategies. It supports Conservation Halton's corporate mission "to protect and enhance the natural environment from lake to escarpment for present and future generations" by providing "leadership in the wise use of natural resources" and helping "ensure a natural legacy for future generations." It is a vital component of Conservation Halton's Environmental Monitoring Program providing base-line data. The study is in keeping with the philosophy of the Ontario government's Smart Growth Strategy.

The plan was developed over the course of three years and involved background data collection, completion of technical studies and fieldwork, and the establishment of a Stakeholders Committee to develop a strategy to implement their "Vision" for the watershed.

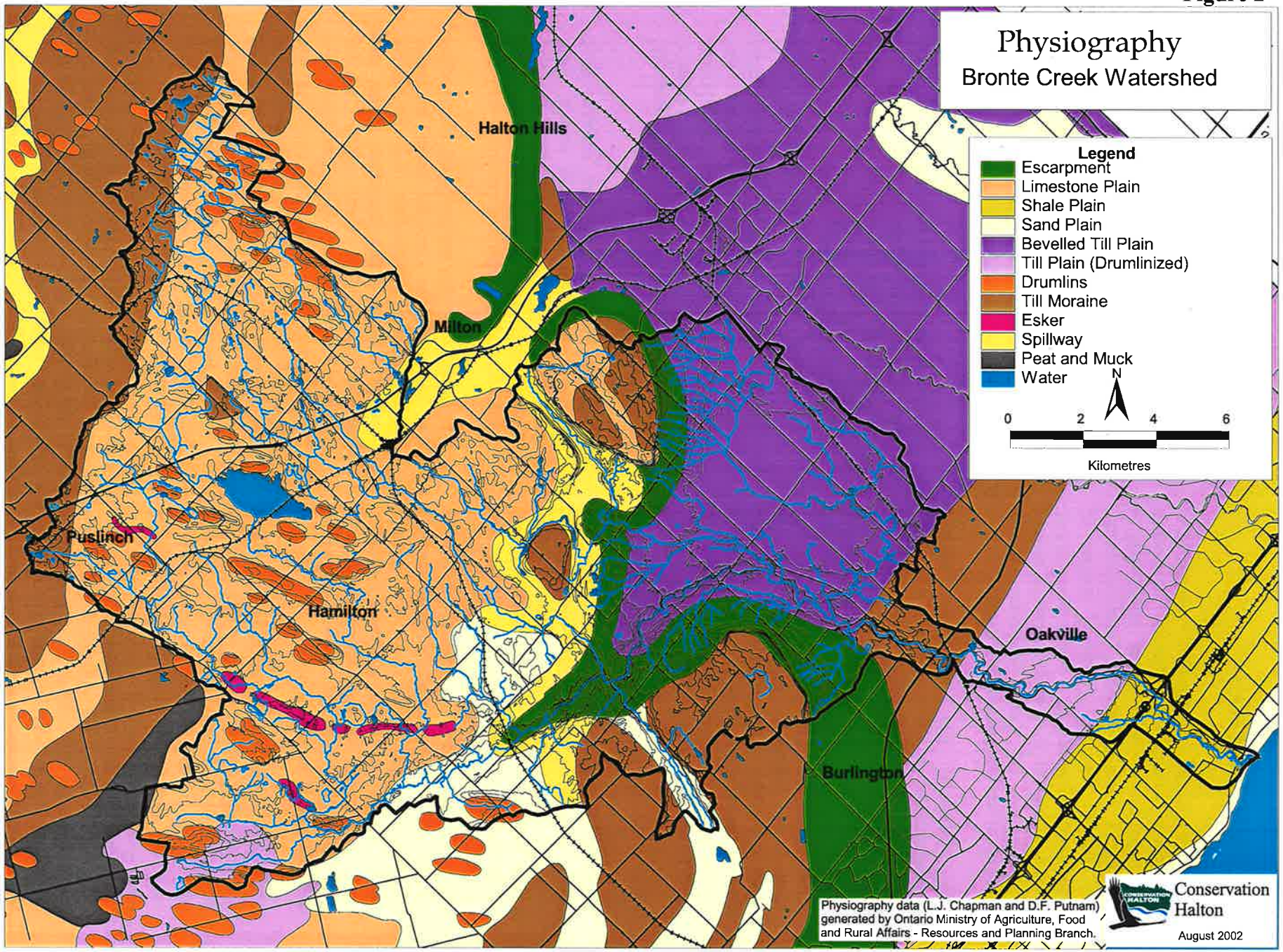
The Stakeholders Committee represents a broad cross-section of individuals and interests who share a "stake" in the watershed. Stakeholders included representatives of municipalities, agencies, community groups, clubs, industry, farmers and local residents.

Preparing the watershed plan involves three aspects. A stakeholder and writing team preparing the plan, public review of the plan through open houses, and the Conservation Authority and municipalities endorsing the plan.

Watershed strategies are proposed which allow the community to care for water resources, natural heritage, settlement and agriculture through Official Plans, Secondary Plans and Subwatershed Studies. Regeneration Plans for individual tributaries and strategies for implementing the watershed initiatives are presented and specify who will be responsible for the remedial actions. Conservation Halton will serve as the lead agency and request that the various municipalities and government agencies involved adopt the recommendations and implementation strategies as outlined.

The following report is a summary document and is not intended to provide comprehensive details of the conditions of the watershed. That level of detail is contained in the technical appendices accompanying this report. References are provided in the technical appendices with a complete list included in Appendix 1 – Annotated Bibliography of Reports, Papers and Publications.

Figure 2


Physiography
Bronte Creek Watershed
Halton Hills
Milton
Puslinch
Hamilton
Oakville
Burlington
Legend
Escarpment
Limestone Plain
Shale Plain
Sand Plain
Bevelled Till Plain
Till Plain (Drumlinized)
Drumlins
Till Moraine
Esker
Spillway
Peat and Muck
Water
N
0
2
4
6
Kilometres
Physiography data (L.J. Chapman and D.F. Putnam) generated by Ontario Ministry of Agriculture, Food and Rural Affairs - Resources and Planning Branch.
Conservation Halton
August 2002

HISTORICAL PERSPECTIVE

Climate

Climate is a major factor that determines the character of the watershed and its biota. The climate of the Bronte Creek watershed is primarily determined by its latitude, longitude and proximity to Lake Ontario. The centre of the watershed is about 43° 30´ parallel of north latitude and 79° 55´ meridian of west longitude. The creek empties into Lake Ontario at the Town of Oakville and extends approximately 37 kilometres inland.

The watershed contains three climatic regions: the Lake Erie Counties region, the South Slopes region and the Huron Slopes region. The Lake Erie Counties region is modified by Lake Ontario and consists of a narrow band at the mouth of the watershed. Most of the area is urbanized. The South Slopes region is found in the mid-portion of the watershed below the Niagara Escarpment. Land use in this region is predominantly agricultural. The Huron Slopes region is found above the Escarpment in the upper reaches of the watershed. The moderating influence of Lake Ontario is the most significant climatic influence in the lower reaches of the watershed while the Niagara Escarpment is the most significant influence in the upper reaches.

Climatic data from the watershed demonstrates the gradual decrease in mean annual temperature, length of the growing season and length of the frost-free period with increased distance from the lake. The mean annual temperature in the Lake Erie Counties region is 7.8° Celsius while it is 5.6° Celsius in the Huron Slopes region. Similarly the length of the growing season varies from 205 days to 200 days and length of the frost-free period from 155 days to 140 days.

The average annual precipitation in the watershed is approximately 762 mm falling at the rate of about 63 mm per month. About 150 mm falls as snow. Runoff is more variable than precipitation and amounts to between 20% and 50% of the precipitation with the average being about 35% or 280 mm. The incidence of runoff varies seasonally with as much as 75% of the runoff occurring from late February to late April and as little as 2% of the annual runoff occurring in July and August.

Physiography and Surficial Geology

The physiography and surficial geology of the Bronte Creek watershed (Figure 2) sets the stage for its features, natural resources and their interrelationships.

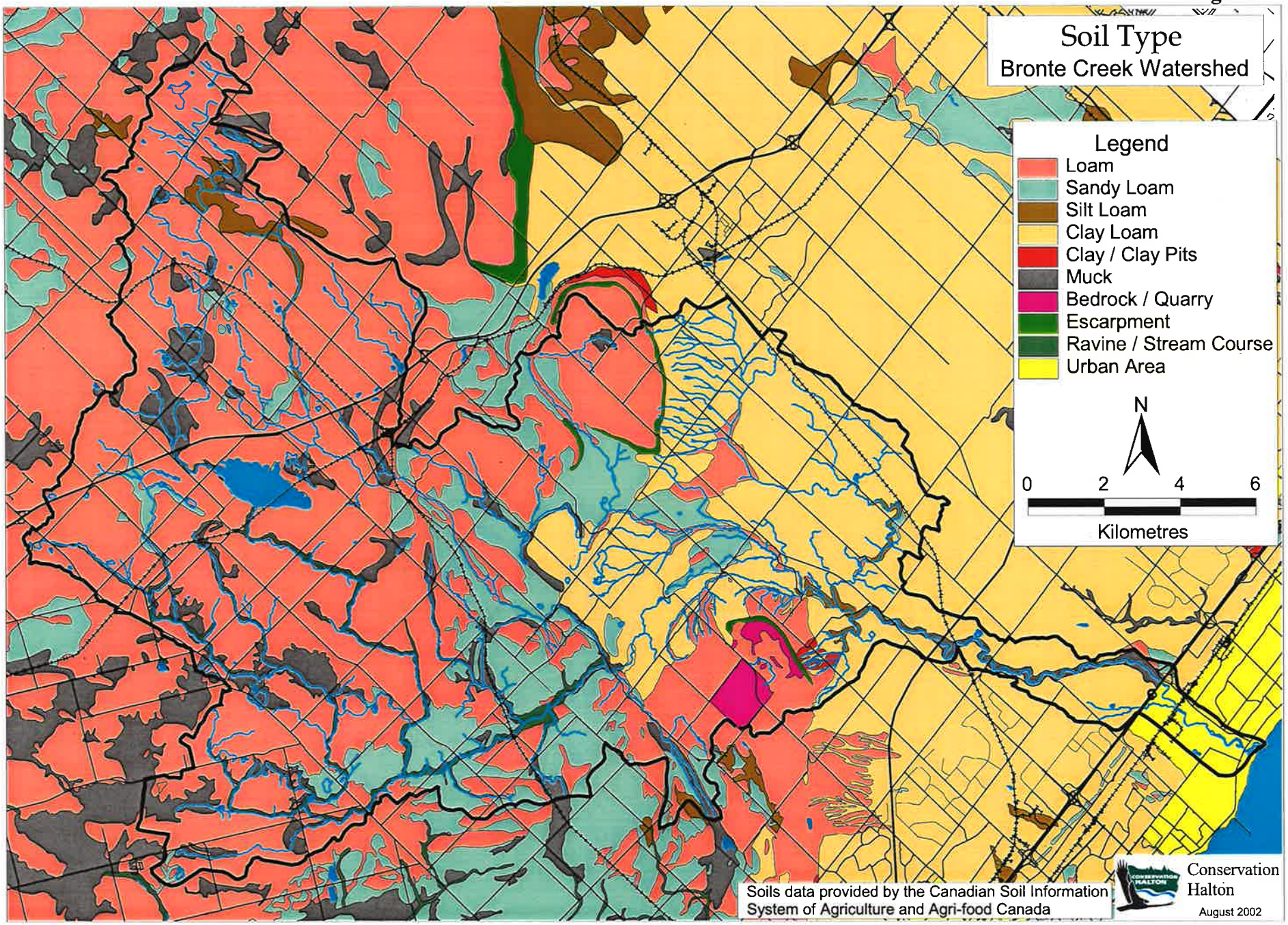
The Niagara Escarpment is the dominant physical feature of the watershed, dividing the watercourse into its upper and lower reaches. The Escarpment was formed from the differential erosion of sedimentary rocks. It was further shaped and partially buried by glacial, fluvial and post-glacial activity. The Escarpment displays some of the most prominent features of the watershed, including Rattlesnake Point, Mount Nemo, and the Nassagaweya Canyon.

Valleys formed from the erosive action of pre-glacial streams and glaciers heavily dissect the Escarpment face. These valleys act as conduits or pathways, channeling tributaries from above the Escarpment to the main branch of the Bronte Creek.

In the western reaches of the Bronte Creek watershed, resistant cap rock forms a gently rolling plateau. Thin veneers of coarse Halton Till cover portions of the limestone plain. A portion of the Galt Paris Moffat Moraine lies on the northwestern watershed divide. Closer to the Escarpment, the Waterdown Moraine system forms hummocky terrain, in a complex of sand, silt and gravel outwash deposits. Other glacial features, such as drumlins and eskers, occur throughout the headwaters.

Below the Escarpment, the bedrock is composed of more erodible shale. The soft red shale of the Queenston formation is well exposed in a broad plain running parallel to the Lake Ontario shoreline. Numerous valleys have been incised

Figure 3


Soil Type
Bronte Creek Watershed
Legend
Loam
Sandy Loam
Silt Loam
Clay Loam
Clay / Clay Pits
Muck
Bedrock / Quarry
Escarpment
Ravine / Stream Course
Urban Area
N
0
2
4
6
Kilometres
Soils data provided by the Canadian Soil Information System of Agriculture and Agri-food Canada
Conservation Halton
August 2002

into the bedrock by postglacial and fluvial erosion.

Thick spillway deposits of sand and gravel bury the shale closest to the Escarpment, forming part of an important aquifer system. To the east a thin veneer of clay-rich Halton Till covers a portion of the watershed, forming a bevelled, and occasionally, drumlinized till plain. Approximately twelve kilometres from the Lake Ontario shoreline, a narrow band of hummocky till, associated with the Trafalgar Moraine, forms a local watershed divide diverting the lower tributaries of the Bronte Creek into a single main channel. The lower reach of the creek is constrained within a deep, narrow shale bedrock valley that is up to 30 metres in depth and as little as 100 metres in width in some locations.

Soils

The soils of the Bronte Creek watershed are largely derived from glacial and glaciofluvial deposits that in turn have acquired their matrix from the local dolostone (limestone) and shale bedrock (Figure 3). The action of wind and water has reworked these deposits to produce local concentrations of silt, clay and muck. They can vary locally throughout the watershed with the effects of drainage, the presence of vegetation, and the time available for soil development.

The western portions of the watershed located above the Niagara Escarpment are dominated by loamy soils that are usually well drained and of coarse texture. Significant areas of muck soils occupy the low-lying areas, particularly between drumlins. These organic soils are poorly drained. Nearer the Escarpment, soil matrices become increasingly coarse from incorporated outwash sand and gravel. These often occupy former spillways of gravel overlain by sand. Below the Escarpment, clay loam soils are predominant. These soils are derived from silty clay tills and local outcrops of shale. The streambeds of the watershed are characterized by gravel and boulder beds accompanied by the accumulation of muck in local floodplains.

The Niagara Escarpment at Rattlesnake Point

Ecological And Cultural Heritage

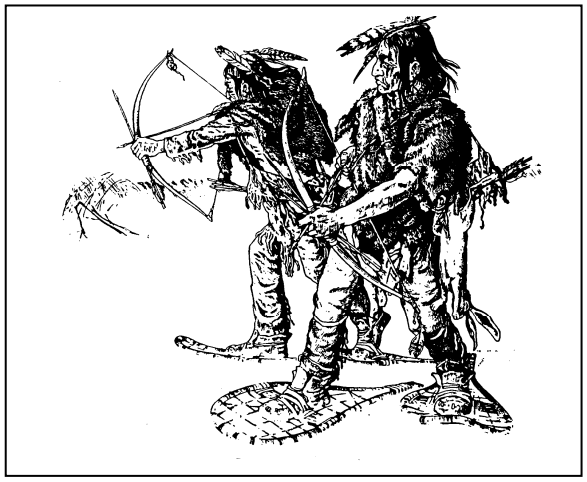
As the last glacier retreated some 11,000 BP, it left behind the Bronte Creek watershed as a barren, rubble-strewn landscape. The exposed cliffs of the Niagara Escarpment overlooked arctic-like tundra. Over the millennia, wind and water, time and nature reshaped the watershed. The landscape evolved from lichens and mosses to scrub and then taiga where mammoth and mastodon roamed. Eventually, black spruce replaced jack pine and caribou replaced muskox. Small, mobile bands of Archaic Indians hunted game in the spruce tundra and fished for char on inland lakes.

Centuries later, the indigenous people adopted the bow and arrow and ceramic technology. These hunter-gatherers moved about the now-forested watershed according to the seasons – from spring fishing at the mouth of the creek, to summer hunting grounds in the open meadows, to fall passenger-pigeon roosts, and on to the winter deer yards in headwater swamps. Trade routes linked the watershed to neighbouring territories. Unique flint points, stone pipes and clay pots were expressions of their culture. Around 1500 BP, the inhabitants of the watershed began experimenting with agriculture. Growing maize, gourds and squash, meant dependable food supplies and a more sedentary lifestyle. Permanent villages replaced temporary encampments.

The watershed of about 800 BP, contained species familiar to today's residents. Below the Escarpment, the Carolinian forest, with its black walnut and butternut would be found, while above was the mixed forest of the St. Lawrence lowlands. Pine and oak grew on the drier sites while cedar and hemlock occupied the swamps. The area teamed with game. There were sturgeon, trout and salmon in the creek. Untold numbers of birds congregated in the marshes. This environment of unmatched richness and diversity was later described in Jesuit diaries.

The human occupants of the watershed were Iroquoian-speaking First Nations. Theirs was a sophisticated social and political community where both men and women took prominent roles. They had entrenched religious beliefs and lived in permanent villages with long houses for up to 20 related families. Proficient farmers, they lived mostly on the crops they grew - the 'three sisters' (corn, beans and squash) as well as sunflowers for trade and tobacco for ceremonies. Hunting for elk, deer and bison, fishing for salmon and trout and foraging for nuts and berries supplemented their basic diet. The reconstructed village at Conservation Halton's Crawford Lake Conservation Area provides a glimpse of their culture.

The Woodland communities and the watershed ecology faced significant changes with the arrival of Europeans in the early part of the 17th century. At first, only a few French explorers passed through in their quest for routes to the west. Some missionaries visited the region to convert the aboriginals and French surveyors mapped the area, calling the Bronte Creek "Riviere de Gravois." Eventually the struggle



Woodland Hunters

between the British and the French destroyed the aboriginal culture. First, disease devastated the nations. Then, in wars over furs and territory, the remaining aboriginals were dispersed. By 1660, the watershed was largely devoid of human occupation. Eventually, the Mississaugas, an Algonkian nation, migrated into the region, drawn by the excellent hunting

and fishing. They called Bronte Creek the "Esquisink" or "Last Out Creek."

The American Revolution initiated a period of momentous change. Colonists who remained loyal to the crown were forced to flee to Canada. To compensate the Loyalists and forestall American incursions, the British began buying tracts of land from the Niagara River around the lake to the Humber River. In 1792, Lt. Governor Simcoe ordered the construction of a road to join York to Dundas. This opened the watershed to the outside world. By 1800, it was being surveyed and catalogued and all the land from Burlington Bay to the Humber River was purchased from the Mississaugas in 1805. Settlers slowly began taking up the lots, clearing the forests, building cabins and changing the face of the watershed.

Following the end of the War of 1812, the pace of change accelerated. Although hampered by the formidable terrain, extensive forests and interminable swamps, settlement advanced. Hardy pioneers like Charles Sovereign and John

Clearing the land

Belyea were drawn to the area by the promise of good land and unlimited opportunities. Licenses to cut timber were granted and mills established. Survival in the bush of Upper Canada was an ordeal of toil and struggle. Self-reliance, perseverance and resourcefulness were required to overcome the terrain, disease and isolation.

Gradually the watershed was settled. Pioneer families such as the Eatons and the Mounts cleared land in East Flamborough. In West Flamborough, communities like Strabane were established. In Nassageweya ("between two waters"), Darbyville, Haltonville and Moffat were founded. Even the Beverly Swamp, the "terror of travelers", was gradually penetrated. Where the creek dropped over the Escarpment, mills were built at Lowville and Progreston.

Settlement brought irrevocable changes to the watershed ecosystem. The loss of much of the forest meant changes to flows and altered temperature regimes in the creeks. Dams blocked the movement of fish and pollution from settlement and industry degraded water quality. Such changes meant the loss of flora and fauna. Species such as elk, bison, and marten, disappeared from the watershed forever.

By the time of Confederation, the watershed had changed so much that the early pioneers might not have recognized it. Over 50% of the forests had been cut down. Subsistence farming had given way to mixed farming. Wheat became the dominant cash crop and cattle and sheep were raised. The narrow tracks through the bush became roads. Wagons and carriages traveled the concessions that linked thriving communities. Frame houses replaced log cabins. General stores, blacksmith shops, and bakeries sprung up in hamlets like Cumminsville and Kilbride. Schools and churches were now relatively common.

Most watershed communities prospered during the later part of the nineteenth century. Bronte, for example, flourished, as wheat and pork, potash and lumber, butter and lard were shipped from the watershed to elsewhere in the region and around the world. Stone hooking – pulling up the soft shale from the shallow bottom along the shore of Lake Ontario for use as a building material - was a booming business. There was a lucrative commercial fishery.

By the time of World War I, over 70% of the original forest had been cut. Scattered remnants of the Carolinian forest only survived in valleys below the Escarpment. The stately pines and mighty oaks were gone from the upland sections and only vestiges of once dense cedars and hemlocks remained in headwater wetlands. There were other changes to the flora and fauna. Species such as bear and passenger pigeon were extinct, but introduced species like the European

hare and starling were becoming common. The sturgeon and Atlantic salmon were gone but carp and alewife now thrived.

An era of scientific invention and rapid mechanization changed the watershed in other ways. The telegraph, railways and a steadily improving regional road network all extended contact with the "outside world". The succession of simple wooden bridges at Tansley was finally replaced by a steel structure that took Dundas Street over 30 metres above the creek. In the 1930s, the Queen Elizabeth Way was completed through the lower watershed. At the same time, the Ontario Geographic Names Board changed the name of Twelve Mile Creek to Bronte Creek.

On the farms, steam and then gasoline-powered equipment replaced men and horses. Mixed farming was still common, but the lands near the lake became the "Garden of Canada", noted for the quality of the fruit grown and shipped around the world. In Lake Ontario and Bronte Creek, the commercial fishery was declining. The catches of perch and whitefish, cisco and herring were a fraction of what they once were. Stone hooking waned as watershed quarries became a more reliable source of stone. The milling industry was mostly gone.

The years following World War II brought many other changes. Rapid population growth and a demand for housing brought the biggest change to the watershed. Regional growth meant Bronte became part of Oakville, while Burlington expanded to annex Lowville and Kilbride. Suburban growth swallowed up many of the fruit farms and orchards below the Escarpment. As the role of farming declined, whole farms were converted to suburban development. The construction boom resulted in a need for stone, sand and gravel. More quarries were started to exploit the high quality dolostone of the Niagara Escarpment.

But growing public concern finally brought a halt to the long period of ecological decline. Threats to the environment, the loss of natural areas, pollution in the creeks, exploitation of the Niagara Escarpment all served to galvanize public opinion. In 1958, the Twelve Mile Creek Conservation Authority, later Conservation Halton, was established to mitigate the risks of flooding and protect valuable natural resources such as creeks, valleys, wetlands and escarpment features. The first major initiative was the acquisition of a prominent piece of the Escarpment at Mount Nemo to prevent a quarry expansion. This action led to the formation of a committee to evaluate the Escarpment at a Provincial level, ultimately resulting in the Niagara Escarpment Plan.

Family outing at Zimmerman

Important natural areas were protected as public conservation areas. Crawford Lake, with its rare meromictic lake, became an interpretive centre for local archaeology and aboriginal culture. Land was assembled from public and private sources to create Bronte Creek Provincial Park and the Bruce Trail. The extent of forest cover began to increase as marginal farmland was abandoned and regenerated. Environmental awareness led to the designation of parts of the watershed as Environmentally Sensitive or Significant Areas (ESAs) and Areas of Natural and Scientific Interest (ANSIs). Programs like Carolinian Canada were created to help protect the vestiges of that increasingly rare forest zone. The Beverly Swamp was designated as a Carolinian Canada Site.

The Bronte Creek Watershed Study presents the next opportunity for residents to have input in determining the future of their watershed. It is intended to help guide them in translating their vision for the watershed into strategies that will recognize and preserve the best of the natural and cultural heritage while allowing for continued growth, prosperity and opportunity for the future.

THE WATERSHED OF TODAY

CARING FOR WATER

Hydrology and Stream Morphology

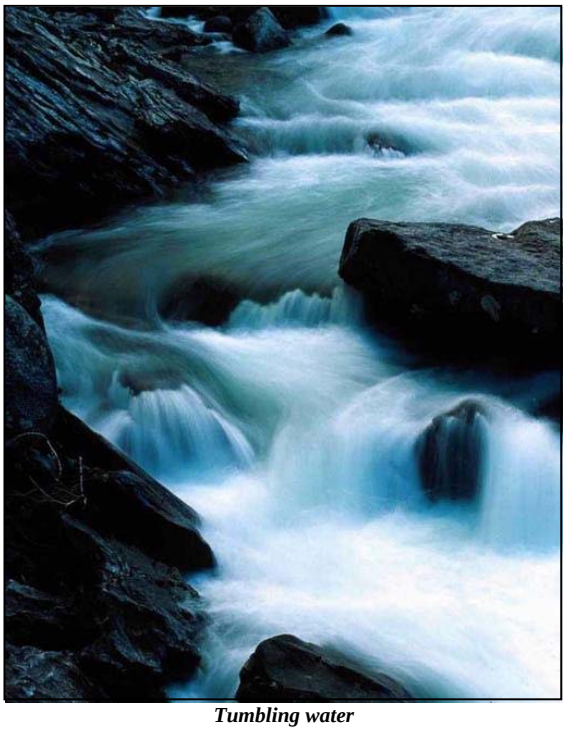
Hydrologic processes are central to many of the natural features and functions within the Bronte Creek watershed. An understanding of these processes is important to the protection of watershed resources. There are two primary factors that affect the hydrologic response of any watershed. These are the climate setting, including temperature which determines precipitation (i.e. rainfall and snow), and physiography (i.e. the physical characteristics of the watershed including topography, soil types, vegetation, land use and drainage area).

The Bronte Creek watershed traverses three primary physiographic areas, consisting of till moraine in the northern headwater areas, the Niagara Escarpment in the mid watershed region and the clay plain in the southern portions of the watershed. The headwater areas of Bronte Creek near Morriston contain a significant number of wetland areas that, along with the physiography and soil types, are the primary factors that determine the stream flow response. In addition, to these wetlands, there are a number of man-made ponds and reservoirs, including the Mountsberg Reservoir, that also affect streamflow.

The main branch is approximately 50 kilometres long and has an average slope of 0.005 metres/metre. The watershed is approximately 14 kilometres wide at its widest point and 1 kilometre wide at its narrowest near the mouth. The elevation of the watershed varies from approximately 75 metres A.S.L. (above sea level) at Lake Ontario to about 358 metres A.S.L. in the vicinity of Darbyville. The upper reaches of Bronte Creek traverse a relatively flat channel (average slope of less than 0.004 metres/metre) until it reaches the Niagara Escarpment, where slope increases to about 0.011 metres/metre. The lower section flows through a deep, narrow valley downstream to Lake Ontario with an average slope of approximately 0.005 metres/metre.

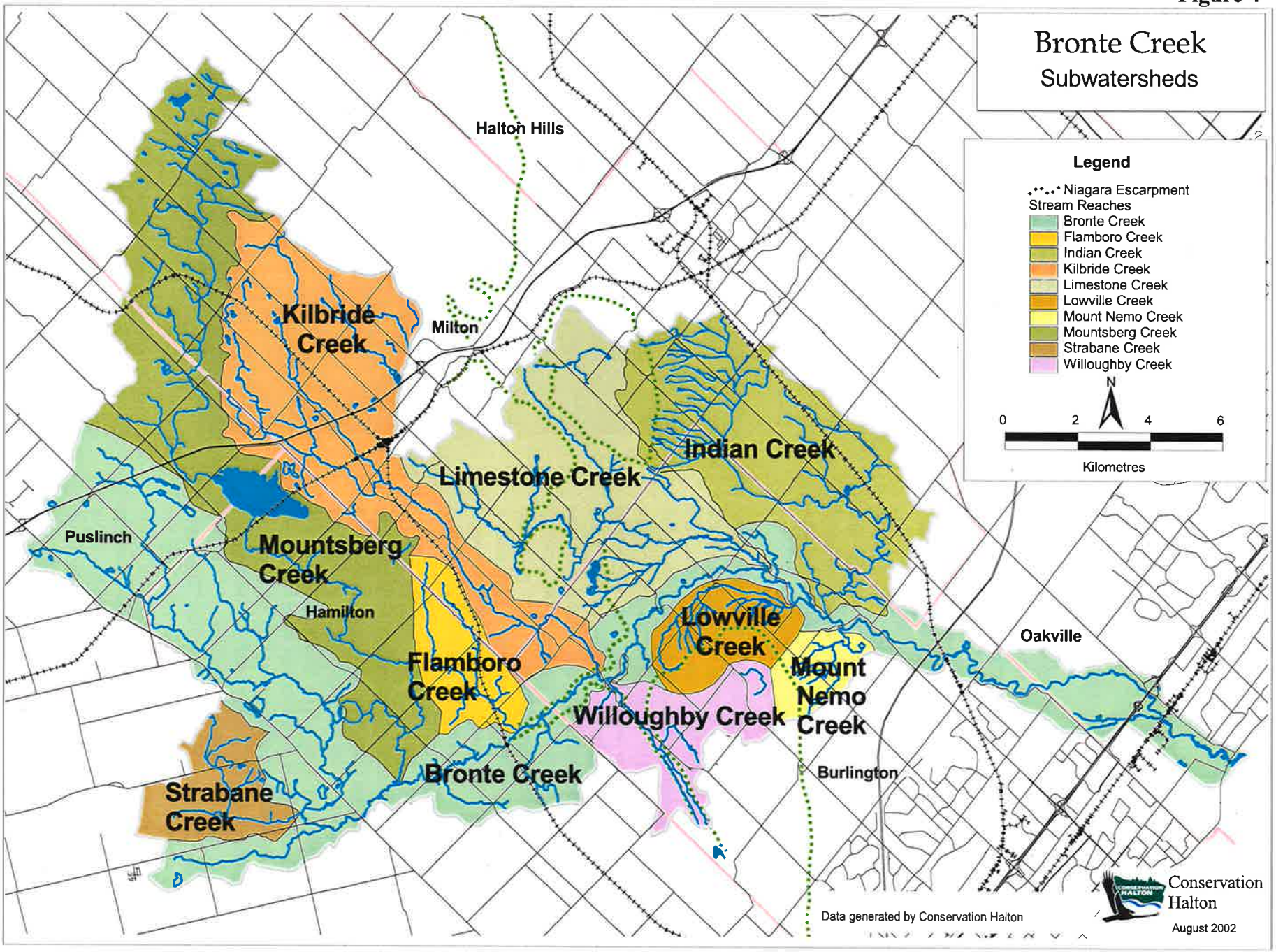
Ten primary subwatershed areas have been identified within the Bronte Creek (Figure 4). Each of these subwatersheds exhibits a unique streamflow response and stream form morphology due to the hydrologic cycle factors that dominate each subwatershed.

The physical characteristics of the stream reaches within each subwatershed are determined and influenced by fluvial processes. These fluvial processes are also linked to the hydrologic cycle, as well as other factors such as the nature and extent of vegetation, the type of substrate and topography within each stream system. Changes in land use, vegetative cover and/or to specific features (i.e. loss of wetlands or hardening of stream banks) may have a significant impact on the hydrologic processes



Tumbling water

Figure 4


Bronte Creek
Subwatersheds
Legend
Niagara Escarpment
Stream Reaches
Bronte Creek
Flamboro Creek
Indian Creek
Kilbride Creek
Limestone Creek
Lowville Creek
Mount Nemo Creek
Mountsberg Creek
Strabane Creek
Willoughby Creek
N
0
2
4
6
Kilometres
Halton Hills
Milton
Kilbride Creek
Limestone Creek
Indian Creek
Puslinch
Mountsberg Creek
Hamilton
Lowville Creek
Oakville
Flamboro Creek
Mount Nemo Creek
Willoughby Creek
Bronte Creek
Burlington
Strabane Creek
Data generated by Conservation Halton
Conservation Halton
August 2002

and in turn affect the receiving watercourses and adjacent lands.

The impact of such changes may include:

- increased runoff volumes (i.e. higher peak flow rates, longer duration of floods)
- lower baseflows (i.e. reduced infiltration reduces contributions to the streams from groundwater and movement of water through shallow soils which is known as interflow)
- changes in stream form and stability through erosion or aggradation (sedimentation) processes.

These changes can also adversely affect the aquatic habitats within the each stream reach. As part of the Bronte Creek Watershed Study a

Bronte Creek at Britannia Road

detailed technical study of the hydrology and stream morphology has been completed. This report (Appendix 5) makes several recommendations based on its characterization of the hydrologic cycle, and stream morphology factors within the Bronte Creek. For example, the study recommends that all water withdrawals be assessed for their impact on the system and that all water taking issues be examined.

The study also provides an analysis of the potential impacts to the hydrologic functions due to proposed land use changes within the watershed. It recommends that stormwater and land development control measures are required to ensure that new development does not increase existing levels of flood risk. It identifies the need to control flows from developed or developing areas to emulate both predevelopment peak flow rates and the rate of rise of storm flows. It recommends that detailed stormwater management plans be carried out.

The study also identifies the importance of maintaining headwater areas in a natural state to ensure an adequate source of natural sediment for the stream. Specific recommendations are also provided for stream rehabilitation, particularly in Indian Creek where there are opportunities to establish riparian buffers, restrict livestock access and undertake detailed rehabilitation works to mitigate the pressures of current and future development.

Finally the report recommends that existing channelization works be assessed as to their stability over the long term and that all artificially straightened reaches be rehabilitated using natural design techniques. The report sees a need for a full fluvial geomorphology and hydrological assessment prior to any future development, and that a continuing assessment of all the reaches detailed in the report should be undertaken at regular intervals.

Recommendations to Care for Hydrology and Stream Morphology

1. Develop storm water management plans to control flows from developed areas so they emulate both predevelopment peak flow rates and the rate of rise of storm flows
2. Maintain headwater areas in a natural state
3. Promote channel morphologies that are in balance with the natural tendencies of the reach
4. Use natural channel designs to rehabilitate stream reaches
5. Conduct fluvial geomorphology and hydrological assessment prior to future development
6. Assess water withdrawals and study water taking issues

Surface Water Quality

Surface water quality was assessed as part of the Bronte Creek Watershed Study. Historical data from all sources were reviewed and a limited sampling program was undertaken from 1999 to 2001 to help quantify water quality throughout the watershed.

Ministry of Environment (MOE) objectives for the protection of the fresh water aquatic environment are used for most water quality parameters. In the case of bacteria, the MOE objective for recreational use is applied. By meeting these, all other objectives, except the most stringent relating to drinking water, are met. Where applicable, federal guidelines are also considered.

Results of historical data, related studies, and the Bronte Creek Water Quality Monitoring Program (BCWQMP) indicate that while most water quality parameters measured meet MOE objectives, several are a source of concern. Based on all available data, total phosphorus and bacteria concentrations are often elevated throughout the watershed. While not toxic by itself, elevated phosphorus levels can lead to degradation of the aquatic environment. Bacteria can pose a health hazard for recreational use.

High concentrations of phosphorus can result in excessive plant/algae growth and ultimately, in eutrophication and oxygen depletion. There is a close relationship between phosphorus and erosion. Areas with increased levels of erosion usually have increased suspended sediments and phosphorus concentrations. Elevated levels of sediments can adversely affect fish habitat.

High bacteria concentrations can adversely affect human and animal health, and have a negative impact on agricultural produce. It is believed that runoff from land, the major source of sediments, phosphorus and bacteria, has increased in the watershed due primarily to urban development and various land use practices. A lack of riparian buffer strips along many reaches of the creek, compounds the problem.

Based on the MOE Provincial Water Quality Monitoring Network (PWQMN) data, over 51% of total phosphorus concentrations sampled exceed the desired level of less than 0.03 mg/l. Maximum individual readings are as high as 5.2 mg/l in Limestone Creek at Derry Road and almost 2.0 mg/l at Zimmerman and Highway 2. The average concentration in Indian Creek is approximately 0.05 mg/l and the average concentration at Highway 2 is approximately 0.04 mg/l. The high concentrations recorded in Indian Creek are thought to be due to erosion, agricultural activities and livestock access. Trend analysis indicates a slight but steady decline in concentrations over time.

Concentrations monitored during the BCWQMP were consistent with those of historical records and other studies. The mean concentration throughout the watershed is about 0.04 mg/l. The highest concentrations monitored are found in Strabane Creek, Limestone Creek and Indian Creek.

Sampling Limestone Creek

High concentrations of *E. coli* and other fecal coliform bacteria are found throughout the watershed. Concentrations monitored since 1964 have consistently exceeded provincial objectives (100 *Ec.*/100ml) and federal guidelines (200 *Ec.*/100ml) for recreational use.

Maximum concentrations of more than 16,000 *Ec*/100ml have been recorded. Unpublished trend analysis data indicates little change in bacterial concentrations over time. A limited number of bacteria samples were taken as part of the BCWQMP.

Bronte Creek tributary

Concentrations monitored during the BCWQMP were consistent with those of historical records. Surface runoff from urban centres, livestock operations, and a lack of riparian buffers are thought to contribute to the elevated bacteria concentrations.

Concentrations of metals are normally found to meet provincial objectives. However, aluminum, iron and zinc concentrations sometime exceed MOE objectives at several points in the watershed. Elevated concentrations of these metals appear to be naturally occurring, due to soil and substrate types, and are not thought to pose a threat to the aquatic environment.

No sampling for pesticides or Polycyclic Aromatic Hydrocarbons (PAH) was conducted.

The results of historical data and the Bronte Creek Water Quality Monitoring Program provide a general picture of water quality that is consistent with other sections of the Bronte Creek Watershed Study and other water quality studies conducted in the watershed.

Buffer strips, conservation tillage, modified land management practices, upgrades to private sewage treatment systems, stormwater Best Management Practices and public education can all be used to reduce the potential for and mitigate the impact of pollutants in the watershed.

Recommendations to Care for Surface Water

1. Reduce mean levels of Total Phosphorus.
2. Reduce mean levels of *E. coli*.
3. Reduce sedimentation from channel erosion, urban construction sites and agricultural runoff.
4. Maintain and enhance riparian cover by stream plantings and watercourse buffer strips.
5. Promote channel morphologies that are in balance with the natural tendency of a particular reach.
6. Restrict livestock access to the creek.
7. Continue to monitor surface water quality throughout the watershed.

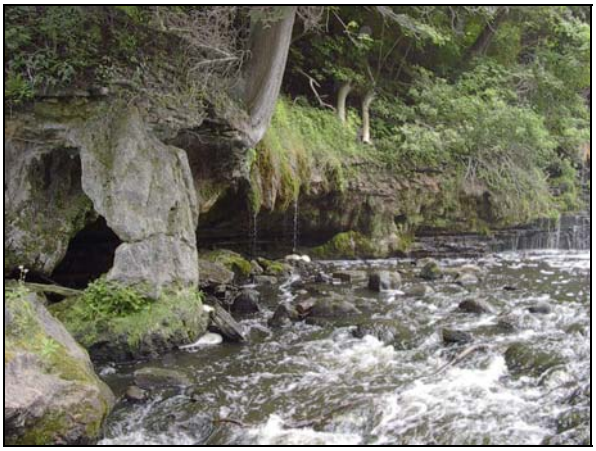
Groundwater

Groundwater is an extremely important natural resource to the Bronte Creek watershed. Much of the groundwater of the watershed moves south under pressure towards the regional discharge point, Lake Ontario. The groundwater system contributes a significant portion of the baseflow to the numerous creeks in the watershed. In addition, more than 25% of the total watershed population relies on groundwater as its primary source of drinking water.

The impacts of human activities on groundwater in the watershed and the sustainability of water removal remains, for the most part, unclear. Without adequate protection and analysis of aquifers and recharge and discharge areas in the watershed, there is the potential for contamination of groundwater resources.

Aquifer Geology

The geology of the watershed is comprised of a series of layers of slightly dipping sedimentary bedrock consisting of the Cataract Group, Queenston, Amabel, and Guelph Formations.



Groundwater seepage near Progreston

Multiple glaciations and meltwater erosion have exposed these bedrock formations and carved significant bedrock valley systems into their surface. The Niagara Escarpment stands where these dipping strata remain exposed. Overlaying the eroded bedrock surface is a complex mix of glacial tills, eskers, spillways, drumlins and moraines deposited about 11,000 years ago.

Groundwater is obtained from aquifers in both the sedimentary bedrock and overlying glacial sediments in the Bronte Creek watershed. Ideally, the quantity of water pumped from wells tapping an aquifer should not exceed its natural ability to recharge itself from rainfall and other sources. The quantity and quality of water available in these aquifers varies considerably across the watershed, governed by the hydraulic properties of geologic units.

Groundwater Distribution

Above the Niagara Escarpment, most wells penetrate into the Amabel Formation to obtain water. This formation has a relatively high permeability and yields high volumes of potable water. Below the Escarpment, wells drilled into the Amabel Formation yield lower, but acceptable volumes of water. The Queenston Formation is the only other significant bedrock aquifer in the Bronte Creek watershed. Wells drilled into the shales of this unit provide adequate volumes for household use, but quality is often poor.

Deep bedrock valleys filled with coarse sands and gravels intersect the Escarpment and the Amabel Formation. Groundwater discharge from bedrock into the highly permeable sediments filling these buried valley systems is significant enough to be used as a source of drinking water for a portion of the Town of Milton's urban area. One of the largest glacial bedrock valleys in the watershed is located south of Kilbride and extends from Progreston to Lowville and down through Bronte Provincial Park into Lake Ontario. Other buried valley systems such as the Nassagaweya Canyon link up and contribute groundwater to this channel.

Moraines, eskers and outwash areas elsewhere in the watershed can act as local aquifers and recharge and discharge areas. Local deposits of permeable coarse-grained sands and gravels found in the form of lenses and channels, can

Escarpment wetland

provide quantities of groundwater suitable for household use both above and below the Escarpment. Not all glacial materials in the watershed are acceptable aquifers; widespread clay rich tills with low permeability do not yield adequate quantities of water for many uses.

Groundwater Contribution to Creeks

Above the Escarpment, the relatively small tributaries of the Bronte Creek are generally shallow, slow moving and rarely incised into the bedrock surface. Despite this, groundwater contributes significant flow to these tributaries, providing coldwater habitat to sustain viable fish populations in the creeks even during periods of drought. The creeks serve as localized groundwater discharge areas in a vast area of poor drainage dominated by extensive wetlands. Much of the area above the escarpment functions as a recharge area.

At the Escarpment edge, the Amabel Formation contributes significant volumes of water into the small tributaries of the Bronte Creek that originate as springs at the toe of the Escarpment.

Below the Escarpment, the Bronte Creek forms a major topographic low carved deeply into glacial sediments and bedrock. While significant groundwater does move from bedrock and glacial sediments into the main channels of the creek (i.e., below Progreston Dam), the significance of these contributions to baseflow is less than that of area above the Escarpment. In some tributaries (i.e., Indian Creek), bedrock contributions to baseflow combined with overland flow is insufficient to maintain permanent flow year round. However, locally permeable glacial sediments in the stream bed act as a sink and reclaim flows previously released to the surface by a bedrock aquifer.

Potential Groundwater Contamination

Large areas of the watershed are highly susceptible to groundwater contamination. The

Tapping the aquifer

area above the Escarpment is hydrogeologically more sensitive than areas below. The thin veneer of sediments overlying the very permeable Amabel Formation and a high water table make the Escarpment vulnerable to contamination. Contaminants that do enter the system would move rapidly into the main aquifer of the Amabel Formation.

Below the Escarpment, the Halton Till acts as a low permeability shield that helps protect potentially vulnerable areas. Areas of exposed sand and gravel and the Queenston Formation do exist, but these are much smaller in extent than above the Escarpment.

Permits to Take Water

The Ministry of Environment lists approximately 26 licensed water-taking permits for the Bronte Creek watershed. The permit use by category is as follows:

Agriculture	4	(15%)
Commercial	1	(4%)
Industrial	1	(4%)
Municipal Water Supply	6	(23%)
Other	7	(27%)
Recreational	7	(27%)
Total	26	(100%)

It is unknown how many landowners actually pump water from the watershed or how much water is used annually. Some permits listed by the MOE have expired and appear to have not been renewed. Water-taking permits are not required for amounts under 50 cubic metres per day (50,000 litres per day) and some landowners may simply not be aware that a permit is required. More significantly, even when permits are issued, there is no strategy in place to coordinate the volume and timing of water-taking to ensure that the minimum base flow for the protection of the aquatic environment is maintained.

Recommendations to Care for Groundwater

1. Protect areas of recharge and discharge
2. Enhance the duration and volume of base flows to support the aquatic environment
3. Continue comprehensive monitoring for water quantity and quality
4. Undertake a water allocation strategy to ensure that future supplies of groundwater are adequate for the natural environment and human needs
5. Assemble the necessary information to produce a comprehensive water budget
6. Examine the effect that quarries have on groundwater capture and explore the potential to augment base flows following quarry closures
7. Prohibit development in areas with hydrogeologic sensitivity

CARING FOR NATURE

Natural Heritage

The natural heritage features within the Bronte Creek watershed have evolved over the past 14,000 years in response to the prevailing climate and parent soil material left behind in the wake of glacial retreat. From 8,000 years BP until the early 1800s, mixed and deciduous forests dominated the landscape. Larger mammals requiring large tracts of forest cover such as black bear, marten, fisher, wolverine, timber wolf, lynx, elk and eastern cougar were present within the watershed.

As the influx of settlers swelled in the early 1800s, forest clearing associated with agriculture grew as did the need for saw mills and grist mills. By 1920, forest cover had declined to less than 10% within the Bronte Creek watershed. Loss of forest habitat combined with over-harvest led to the extirpation of at least eight species of mammals which inhabited the watershed prior to European settlement. Massassauga and timber rattlesnakes were also extirpated during this period. The passenger pigeon was rendered extinct.

Over the past eighty years, significant regeneration of natural areas has occurred within the Bronte Creek watershed. Its wetlands, woodlands, special habitats and corridor linkages form a relatively intact, functional natural heritage system that is rare, if not unparalleled, within the context of the Greater Toronto Area.

Wetlands

Nine provincially significant wetland complexes are found within the Bronte Creek watershed. All nine complexes are associated with the Niagara Escarpment and the Flamborough Plain physiographic features and form the headwaters of Bronte Creek and several of its tributaries.

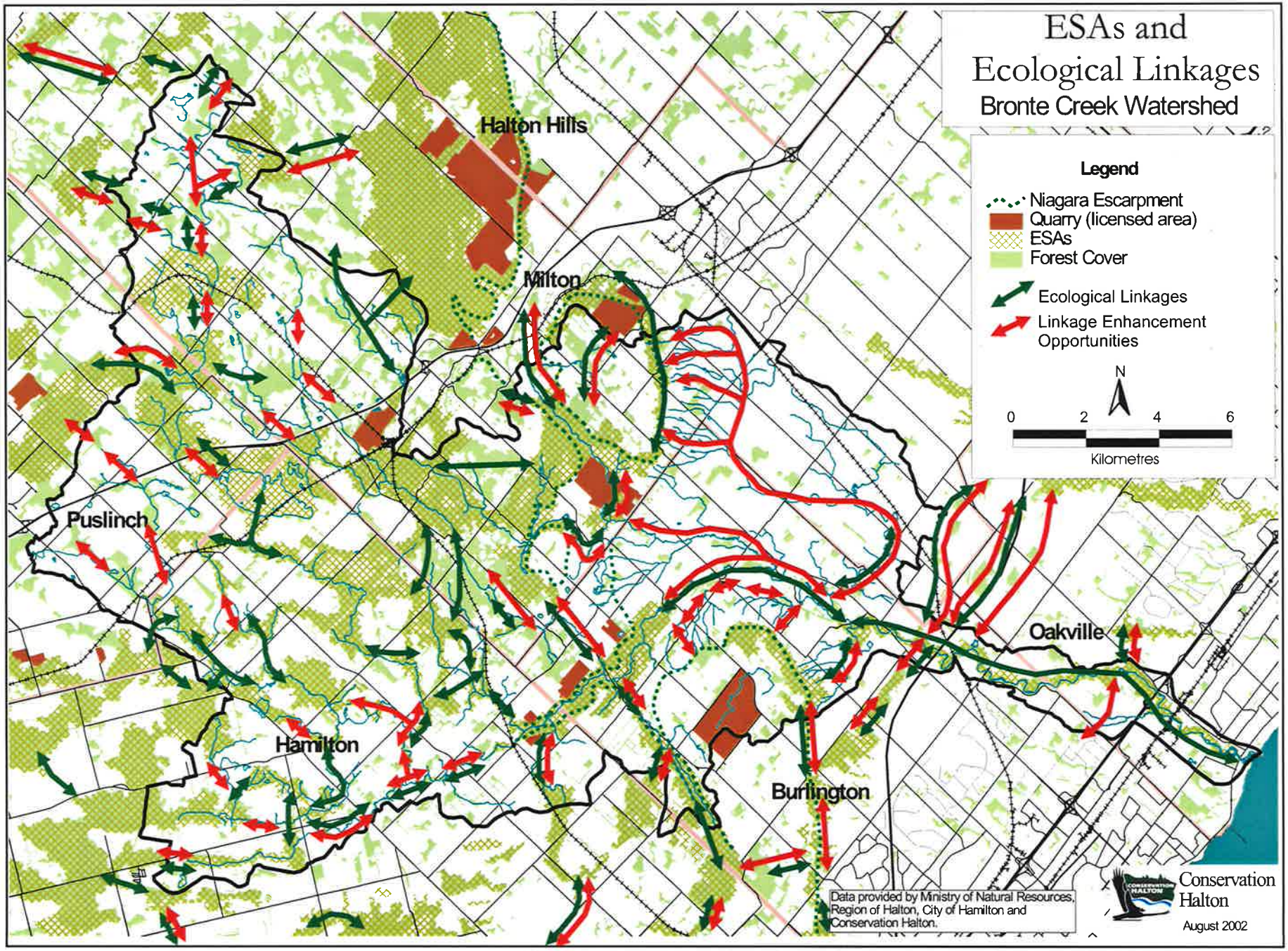
The headwater wetlands within the watershed provide a range of habitat types that support rare plants and significant wildlife species. They act as recharge and storage areas that contribute to water quality, instream flow stability and coldwater fish habitat. Most of these wetland complexes are characterized by extensive swamp forest cover interspersed with shrub thickets and beaver meadow marshes. Large tracts of forest cover (deciduous, mixed and coniferous swamp forest types) provide suitable habitat for a number of area-sensitive bird species and wetland specialists. A diverse array of herpetofauna and mammals also utilize wetland habitats. Conifer swamps in the northern portion of the watershed provide overwintering habitat for white-tailed deer.

Beverly Swamp

Mountsberg Reservoir, constructed in 1967, provides a large expanse of shallow, open marsh habitat that is unique within the watershed. This marsh has been designated as a provincially significant waterfowl staging area and a regionally significant waterfowl breeding area. It also acts as a significant migratory stopover area and supports a vibrant warmwater fish community.

Bronte Marsh is located just upstream of Bronte Harbour. Although not considered provincially significant, this remnant coastal wetland provides staging and breeding habitat for wetland bird species, and important spawning and nursery habitat for warmwater fish species from Bronte Creek and Lake Ontario.

Figure 5


ESAs and
Ecological Linkages
Bronte Creek Watershed
Legend
Niagara Escarpment
Quarry (licensed area)
ESAs
Forest Cover
Ecological Linkages
Linkage Enhancement Opportunities
N
0
2
4
6
Kilometres
Halton Hills
Milton
Puslinch
Hamilton
Burlington
Oakville
Data provided by Ministry of Natural Resources, Region of Halton, City of Hamilton and Conservation Halton.
Conservation Halton
August 2002

Forests

The extent of forest cover reached its lowest point in the 1920s. Since then, forest cover has regenerated and now covers approximately 29% of the watershed. Secondary and successional forests are developing in former areas of marginal farmland along the Escarpment and above the Escarpment on the Flamborough Plain. Below the Niagara Escarpment, forest cover is limited with interior forest habitat restricted to Bronte Creek valley within Bronte Creek Provincial Park and a handful of isolated woodlots within the Indian Creek subwatershed. However, above the Escarpment, forest cover and interior forest habitat is significantly greater in extent with deep interior forest habitat (forest core areas greater than 300 m from the forest edge) also present.

Bronte Watershed forest

Large tracts of intact forest cover within the Bronte Creek watershed provide interior forest habitat for a number of sensitive neotropical migrant bird species such as ovenbird, wood thrush, veery, black-throated green warbler and scarlet tanager. Forest interior habitat supports other taxa that require large tracts of forests for reproduction, foraging and shelter. Weak flying butterflies such as the West Virginia white are dependent on sheltered interior woodland habitats. Herpetofauna such as Jefferson salamander, wood frog, yellow spotted salamander and wood turtle are strongly associated with interior forest habitat. Similarly, mammals such as flying squirrel, porcupine and bobcat require large forest tracts to carry out their life cycles.

Special Habitats

The geographical position of the Bronte Creek watershed, combined with its physiography, create conditions suitable for the establishment of special habitats which are rare from a national, provincial and regional perspective. The moderating effects of Lake Ontario, combined with the presence of dry valley rims and south-facing slopes along Bronte Creek valley downstream of Zimmerman, provide warm, dry microclimates suitable for a variety of Carolinian and prairie-savanna species which are at the northern limit of their range in Ontario. In contrast, the cool coniferous swamps in the northern portion of the watershed provide habitat for vegetation species which are near the southern end of their distribution. The Niagara Escarpment provides a set of special habitats (rim/talus/cliff face forests, crevice caves) that are rare at a provincial, national and global level.

Natural Corridors and Linkages

Natural corridors provide important habitat connections within watersheds and provide linkages to adjacent watersheds (Figure 5). Bronte Creek and its tributaries provide important corridor functions which link the provincially significant wetland units/complexes above the Niagara Escarpment. The Bronte Creek valley provides a relatively unfragmented conduit from Lake Ontario to the Escarpment that is utilized by migratory birds during seasonal migrations. Extensive forest cover along the slopes and adjacent tablelands of the Niagara Escarpment form part of a large mega-corridor that extends from Niagara Falls to Tobermory. The Niagara Escarpment is linked to the Oak Ridge Moraine near Caledon and through other habitat corridors to the Long Point Biosphere Reserve along the shore of Lake Erie forming part of a provincial corridor network.

Designated Natural Areas

A number of the natural features within the Bronte Creek watershed have been designated as

Table 1. Natural Areas and Associated Designations

Site	Environmentally Sensitive/ Siginificant Area[1]	Life Science ANSI[2]	Earth Science ANSI[2]	Prov. Significant Wetland	Carolinian Canada Site	World Biosphere Reserve
Beverly Swamp	HW23	P		*	*	
Bronte Creek Ravine/ Lowville-Bronte Creek Escarpment Valley	HW36/H9	P, P				*
Bronte Creek Valley	H10	P,R				*
Brookville Drumlin Field	H43	R		*		
Brookville Swamp	H22	R		*		
Calcium Pits	H19	P,R	P	*		*
Carlisle North Forests	HW38			*		
Crawford Lake/Rattlesnake Point Escarpment Woods	H18	P	P	*		*
Exhumed Silurian Reef			R			
Flamboro Centre Swamp	HW44			*		
Freelton Esker-Wetland Complex	HW30		P	*		
Guelph Junction Woods	H20			*		*
Halton Till			P			
Lake Medad and Medad Valley	HW49/H7	P	R	*		*
Mill Creek Wetland				*		
Moffat Swamp/Moffat Marsh/Fish Hatchery Swamp	H21/W7,8	P	P	*		
Mount Nemo Escarpment Woods	H8	P	P			*
Mountsberg East Wetlands	HW36			*		
Mountsberg Wildlife Area	HW29/W6	R		*		
Paris, Galt and Moffat Moraines			P			
Progreston North Swamp	HW40					
Puslinch Southeast Wetland	HW27			*		
Strabane North Wetlands	HW31			*		
Strabane Southwest Drumlin Field	HW26			*		
Aberyfoyle Woods	W9					
Hilton Falls Complex	H25	P				*
Milton Heights	H 17					*

1. HW Region of Hamilton-Wentworth ESAs
   H Region of Halton ESAs
   W Wellington County ESAs
2. P Provincially Significant ANSI
   R Regionally Significant ANSI

Bronte Creek Provincial Park

significant natural areas through international, federal, provincial and regional planning policy (Table 1). There are portions of the Niagara Escarpment Biosphere Reserve, one Carolinian Canada site (Beverly Swamp), Provincially Significant Wetlands (PSW), Areas of Natural and Scientific Interest (ANSI) and Environmentally Sensitive/Significant Areas (ESA) that are located within the watershed.

Implementation of natural areas management guidelines and strategies will increase the extent and function of significant habitats and corridors within the Bronte Creek watershed. This will result in the development of a robust natural heritage system, which will support a full complement of flora and fauna adapted to the suite of available physical and climatic conditions endemic to the area.

Recommendations to Care for Nature

1. Wetland Enhancement
   - protect extent of existing wetlands
   - increase areal extent of wetlands
   - improve quality of wetlands
2. Forest Enhancement
   - protect extent of existing forests
   - increase areal extent of forests with emphasis on increasing extent of interior forest habitat
   - maintain and enhance biodiversity
3. Special Habitats
   - protect Carolinian forests
   - manage and protect prairie/savanna and extensive grassland habitats
   - protect Escarpment features through appropriate regulation of recreational activities in Escarpment parks
4. Corridors and Linkages
   - protect/enhance existing linkages
   - restore degraded linkages
   - identify specific corridor and linkage strategies as part of subwatershed studies

Aquatic Habitat

Prior to the War of 1812, Atlantic salmon and brook trout were plentiful within Bronte Creek and its tributaries. The fisheries resources of Bronte Creek were considered a mainstay for the Mississauga First Nation. However, as the influx of settlers swelled in the early 1800s, degradation of habitat associated with dam construction and deforestation, combined with over-harvesting of fish, resulted in the decline of fisheries within Bronte Creek. By the end of the 1800s, the Atlantic salmon had been extirpated from the Lake Ontario watershed and brook trout had been pushed back to the relatively pristine headwaters of the Bronte Creek watershed.

Since the 1920s, significant regeneration of forest cover within the watershed has coincided with regeneration of aquatic habitat. To assess the existing status of aquatic habitat within the Bronte Creek watershed, a comprehensive study of fish and benthic communities, instream temperature and associated water quality was undertaken as part of the watershed study. In general, there was broad agreement between the various parameters.

Local and regional physiography is intricately linked to the hydrology and hydrogeology of the watershed. Physiography is also the driving force which has dictated vegetation and land use patterns. Instream temperature surveys illustrate the influence of physiography within the watershed.

Coldwater habitat capable of supporting salmonids (brook trout, brown trout and rainbow trout) is typically associated with stream systems flowing through the well-vegetated, coarser-grained physiographic features along, or lying above, the Niagara Escarpment (Bronte Creek upstream of Lowville, Limestone Creek, Willoughby Creek, Kilbride Creek, Flamboro Creek, Mountsberg Creek and Strabane Creek). These systems are characterized by abundant groundwater inputs that provide a strong baseflow which moderates extremes in stream flow and water temperature (Figure 6).

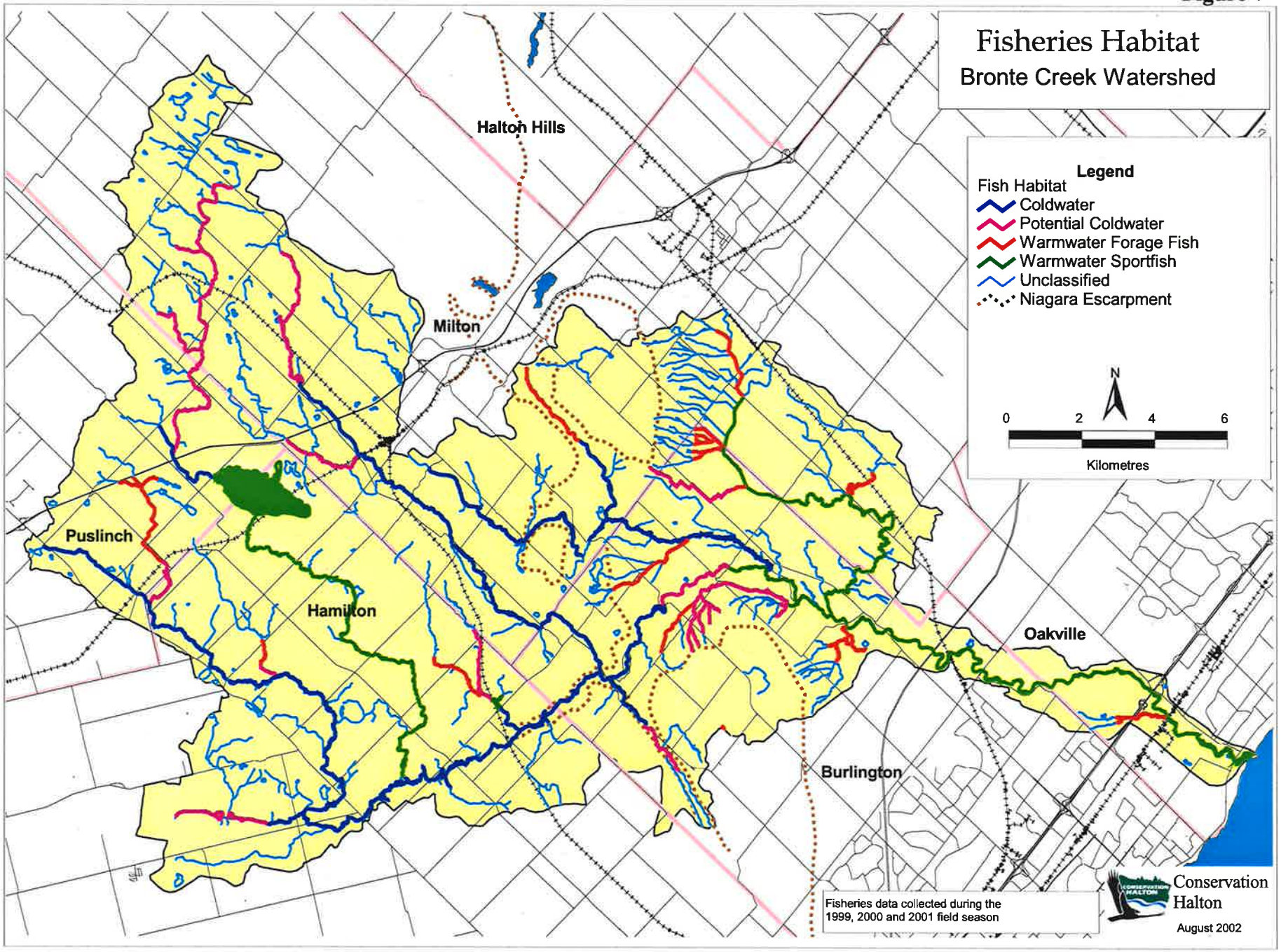
Warmwater habitat conditions are generally associated with stream systems flowing through the sparsely vegetated, finer-textured till plain features located below the Escarpment (lower Bronte Creek, Indian Creek, Lowville Creek, Mount Nemo Creek). These systems are dominated by “flashy” surface runoff rather than steady groundwater discharge. Tributaries which flow through the fine till plains may become intermittent during the summer months.

Two vulnerable fish species, redside dace and silver shiner, are present within the Bronte Creek watershed. Redside dace formerly inhabited Mountsberg Creek and Bronte Creek (upstream of Progreston), however, their distribution is now quite restricted, likely as a result of changes to the fish community associated with construction of the Mountsberg Reservoir (1967). Silver shiner are common in the lower reaches of Bronte Creek. This species is restricted to a handful of watersheds in southwestern Ontario and is a “Carolinian species” which is at the northern edge of its range in Canada.

Stream Monitoring

Bronte Creek is known as one of the highest producers of lamprey larvae, proportional to its size, in the Great Lakes. This naturalized parasite preys on a variety of fish species and has been identified as a key factor in past declines of native fish stocks in the Great Lakes. Lampricide treatments have been carried out at three year intervals on Bronte Creek and Limestone Creek since 1971. The Fisheries and

Figure 6


Fisheries Habitat
Bronte Creek Watershed
Legend
Fish Habitat
Coldwater
Potential Coldwater
Warmwater Forage Fish
Warmwater Sportfish
Unclassified
Niagara Escarpment
N
0
2
4
6
Kilometres
Halton Hills
Milton
Puslinch
Hamilton
Oakville
Burlington
Fisheries data collected during the
1999, 2000 and 2001 field season
Conservation
Halton
August 2002

Oceans Canada is currently proposing the construction of a low-head barrier at the QEW to eliminate or reduce the need for future lampricide treatments within the watershed. This barrier would include a fishway to allow the unimpeded migration of other fish species within Bronte Creek.

Within the context of the Greater Toronto Area, the Bronte Creek watershed is blessed with significant aquatic habitat resources. However, the full potential of these resources is constrained by the presence of dams/on-line ponds and patchiness of riparian cover.

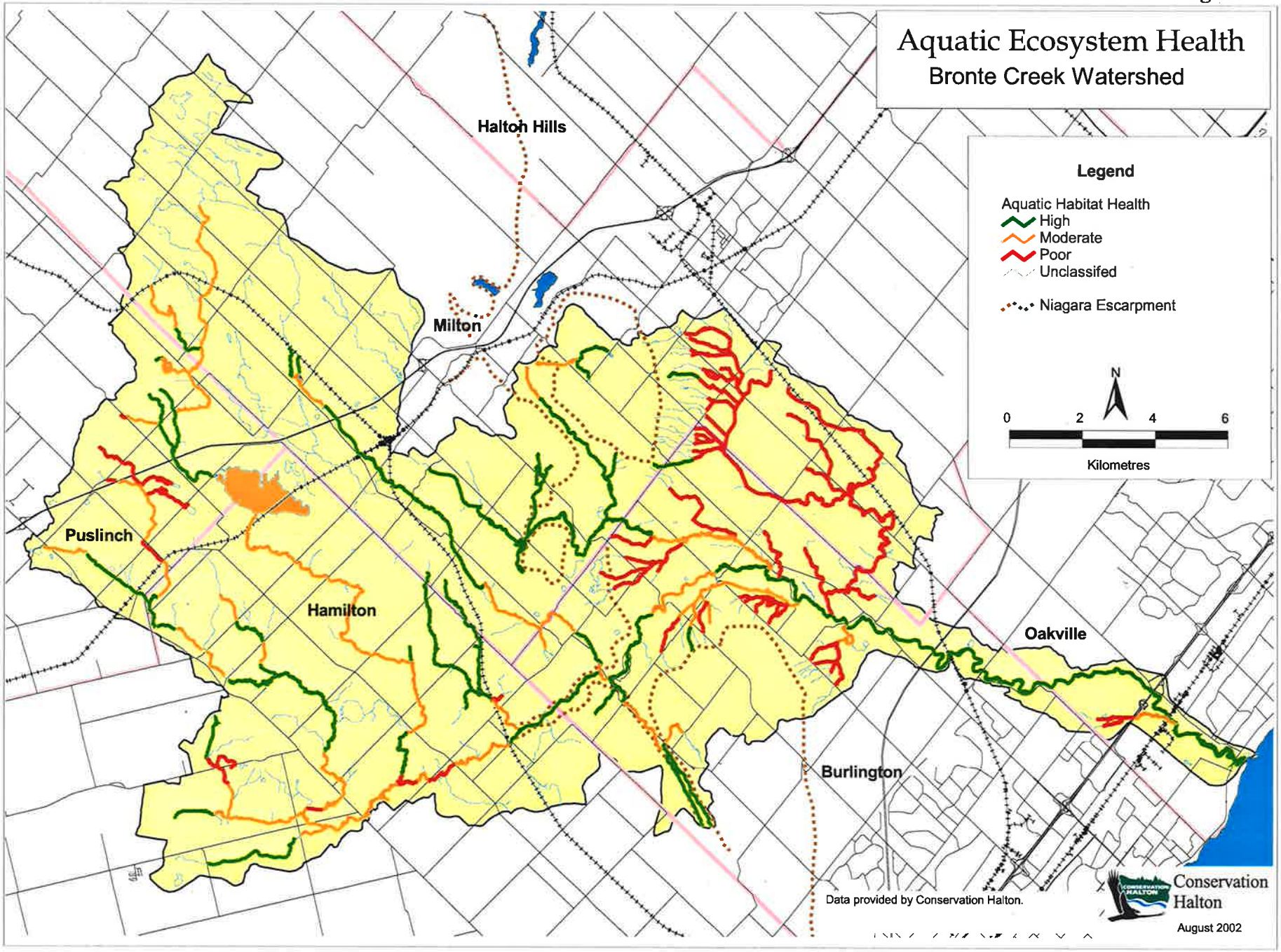
On-line ponds result in downstream thermal impacts, interfere with sediment/bedload movement and may inhibit fish passage. These features can provide habitat opportunities for non-indigenous fish species to the detriment of the native stream fish community. Sparse riparian vegetated cover reduces stream shading, bank stability, food inputs, instream cover and wildlife linkages while increasing nutrient and sediment loading.

The degradation of aquatic habitat associated with on-line ponds and lack of riparian vegetation, combined with livestock access and channel alterations is best observed within the Indian Creek subwatershed. As a result of impacts associated with these activities, Indian Creek is the most degraded system within the Bronte Creek watershed. Benthic and water quality sampling indicates that water quality is impaired and is characterized by elevated nutrient levels, moderate to high temperatures and low levels of dissolved oxygen.

Regeneration of aquatic habitat through stewardship activities (i.e. removal/retrofitting on-line ponds, increasing riparian habitat, naturalization of altered channel reaches, and fencing livestock) on private and public lands provides an opportunity to further enhance aquatic resources within the watershed.

Benthic Sampling

Figure 7


Aquatic Ecosystem Health
Bronte Creek Watershed
Halton Hills
Milton
Puslinch
Hamilton
Oakville
Burlington
Legend
Aquatic Habitat Health
High
Moderate
Poor
Unclassifed
Niagara Escarpment
N
0
2
4
6
Kilometres
Data provided by Conservation Halton.
Conservation Halton
August 2002

Aquatic Ecosystem Health

An assessment of aquatic ecosystem health was undertaken for the Bronte Creek watershed based on an examination of water quality, fisheries, benthic invertebrates, temperature, habitat alteration, and riparian cover (Figure 7). Stream reaches are described as having high, moderate or poor aquatic ecosystem health as per the criteria shown in Table 2. It should be noted that stream reaches generally fall into one of the three categories (high, moderate, poor), however, all parameters, described in Table 2, may not necessarily apply to each reach. Some reaches are unclassified as a result of insufficient information.

Table 2. Aquatic Ecosystem Health

Parameter	High Aquatic Ecosystem Health	Moderate Aquatic Ecosystem Health	Poor Aquatic Ecosystem Health
Water Quality	Most parameters regularly meet PWQO*	Some parameters occasionally do not meet PWQO	Several parameters regularly do not meet PWQO
Benthic Community	Unimpaired	Moderate impairment	Impaired
Fish Community	Expected community based on stream order and physiography	Moderate diversity, absence of expected species, presence of some non-indigenous species	Expected community not present (i.e. poor diversity, expected species absent, non-indigenous species abundant)
Instream Temperature Regime	Appropriate based on stream order and physiography	Marginal based on stream order and physiography (i.e. marginal coldwater habitat on Flamborough Plain)	Inappropriate based on stream order and physiography (i.e. warmwater habitat on Flamborough Plain)
Instream Habitat	Natural channel	Some alteration of aquatic habitat	Altered channel (i.e. on-line ponds, dredging, livestock/ farm animal access, barriers to fish passage, urbanization)
Riparian Cover	Well buffered	Patchy/sporadic buffering	Absent/sparse buffering

*Provincial Water Quality Objectives

Recommendations to Care for Aquatic Habitat

1. Compile an inventory of all on-line ponds within the watershed. This information can then be compared to instream temperature and fish community data to identify priorities for retro-fit/removal.
2. Promote riparian buffers along watercourses to enhance shading, bank stability, instream habitat, food inputs, sediment/nutrient removal and terrestrial wildlife linkages.
3. Restrict farm animal access to watercourses to facilitate regeneration of riparian buffers, stabilization of stream banks and nutrient reduction.
4. Renaturalize altered channel reaches.
5. Improve instream temperature regimes by removing or relocating on-line ponds and structures.

CARING FOR COMMUNITY

Urban and Rural Development

The Bronte Creek watershed is predominantly rural in character and will remain so for the foreseeable future. Urban expansion in Milton, Burlington and Hamilton is beginning to advance into the watershed. In Halton the areas of development are primarily in the Town of Milton and, to a lesser degree, the City of Burlington. In the City of Hamilton development in the Bronte watershed will be mainly centred around rural settlements such as Carlisle and Freelton. Rural subdivisions have also been built around Morriston in Wellington County.

The first phase of residential development in Milton is located entirely within the Sixteen Mile Creek watershed. However, the second and third phases lie partially within the Sixteen Mile Creek watershed and extend to the west into the Indian Creek Subwatershed of the Bronte Creek. The development is bounded to the west by Tremaine Road and to the south by Britannia Road.

A Secondary Plan and Subwatershed Study has been recently initiated for the Sherwood Survey (Phase 2). The Bronte Creek Watershed Study will provide direction and background for the more detailed Indian Creek Subwatershed Study. Tremendous opportunities exist for the rehabilitation of Indian Creek as part of the development. The establishment of stormwater management facilities and naturalized creek blocks with appropriate stream morphology and enhanced riparian buffers will greatly improve the quality of Indian Creek.

CN has proposed an Intermodal Facility in the rural area of Milton south of Britannia Road between Tremaine Road and 1st Line. This facility, if developed, would allow for the transfer of shipping containers from train to truck. The large area needed for the site would be impervious and stormwater management would be required to ensure the downstream creek system is not impacted by the proposed change in land use.

Some recent urban development has occurred in Burlington associated with the Orchard Community. It is located on tablelands to the west of Bronte Creek. The watershed is very narrow through its lower reaches and, therefore, only a small portion of this development lies within its boundaries. The Halton Urban Structure Plan also identifies a limited area of urban expansion within North Oakville to the east of the creek, south of Highway 407.

The Bronte Creek watershed is fully developed through Oakville with the exception of the lands associated with Bronte Creek Provincial Park. The thriving community of Bronte is located at the mouth of the creek. Its nautical heritage as a protected port at the creek mouth, gives the community its vibrant character.

Orchard Community Development

Portions of the watershed lie within the newly amalgamated City of Hamilton where there has been rural subdivision development associated with communities such as Carlisle, as well as along Highway 6. While the existing Official Plan for the former Town of Flamborough remains in effect, preliminary studies that will form the basis of a new Official Plan for the City of Hamilton are currently being initiated. When completed the new Official Plan will guide development in the Hamilton portion of the watershed. Adequate supplies and protection of groundwater resources appear to be major issues associated with development in these settlements.

Approximately 64% of the watershed is in agriculture or rural residential land use. Settlement areas within the rural area include Moffat, Lowville Kilbride, Cedar Springs, Carlisle, Freelton, Strabane, and Morriston. These areas rely on groundwater for their domestic water supply, and private septic systems.

Flooding in Lowville

Forested areas cover 29% of the watershed and are generally restricted to areas of rocky/shallow soils, swamp and escarpment slopes considered unsuitable for agricultural use. A number of these natural areas are contained within Conservation Halton's Conservation Areas, including Mount Nemo, Rattlesnake Point, Crawford Lake, and Mountsberg.

Other watershed development includes aggregate extraction operations for limestone, shale, sand and gravel. Opportunities for restoration of these sites as they are nearing completion will enhance linkages and reestablish natural habitat.

Golf courses are another form of development that occur within the watershed and place demands on the Bronte Creek. Irrigation must be carefully designed to ensure that it does not pose a threat to downstream aquatic ecosystems and riparian rights. Pesticides and fertilizers must be used judiciously, and reduced whenever or wherever possible to minimize impacts on the natural environment. The maintenance of riparian buffers, wetlands, terrestrial features and linkages also remains critical.

Continued development is a certainty but the challenge will be met through careful planning, enlightened land management and dedicated community involvement. In this way, the natural fabric and biological diversity of the watershed can be preserved, protected and enhanced for future generations. This concept has not only been embraced by Conservation Halton as part of its Strategic Plan but also by the Province as part of its Smart Growth strategy to manage growth in Ontario. Smart Growth has the potential vision and means to achieve sustainable communities while protecting the natural environment.

Flood Damage Centres

The hydrology and hydraulics studies of the Bronte Creek watershed have been undertaken to identify areas susceptible to flooding during extreme events such as the 100-year storm or Hurricane Hazel storm.

Historical urban and rural development in the floodplain has the potential to result in property damage or risk to life during major storm events. Mapping, developed as part of the Flood Damage Reduction Program, has identified 134 structures within the regional storm floodplain. Approximately 60% of these buildings are located in the following "flood damage centres":

- Sidrabene Camp (25 camp buildings)
- No. 4 Sideroad (4 dwellings)
- Lowville (13 structures)
- Cedar Springs (21 structures)
- Carlisle (26 structures)
- Highway 6 and Carlisle Road (6 structures)
- Highway 6 and Concession 10 (11 structures)

The remainder are individual structures scattered through the watershed.

Flooding is exacerbated in some areas by undersized culverts that restrict creek flow and cause temporary ponding of floodwaters. This backwater effect often results in local flooding of properties adjacent to tributaries or in areas of wide shallow floodplains.

Like many creeks, the watershed's tributaries are subject to seasonal flooding and ice jams that can temporarily dam spring runoff. When these ice dams burst, widespread flooding can occur immediately downstream. As illustrated (above), ice-jam related floods have previously occurred in Lowville and Carlisle. In addition, heavy down-

Escarpment view

pour events produced during intense summer storms can generate flash floods that result in localized flooding, particularly on low-lying properties that adjoin tributaries.

Future development in flood susceptible areas is prohibited to protect life and property as per the Provincial Policy Statement, the Conservation Authorities Act and Conservation Halton's Fill, Construction and Alteration to Watercourse Regulations and policies.

Conservation Halton is currently undertaking a major initiative to refine its flood forecasting program. The intent is to improve the effectiveness of the program so that predictions can be made as to the timing and extent of flooding on individual properties and the anticipated impact on structures throughout the watershed but particularly at the flood damage centres.

Recommendations to Care for Development

1. Reduce and/or mitigate the impacts of urban development
2. Protect wellhead areas
3. Reduce the impact of transportation systems on the natural features of the watershed
4. Reduce the threat of flooding, thereby reducing the potential for loss of life and property damage
5. Reduce/mitigate the impacts of public use of natural areas
6. Reduce /mitigate the impacts of quarries and golf courses
7. Complete Subwatershed Studies, Storm Water Management Plans and Sediment and Erosion Control Plans prior to development

Agriculture

The prosperity of the Bronte Creek watershed has always been linked to agriculture. Aboriginals were farming in the watershed long before Europeans arrived. After the American Revolution, the Loyalists were compensated with land in exchange for clearing the bush, building a cabin and harvesting crops. As the population grew, early subsistence farming gave way to cash cropping. By the early twentieth century mechanization and an improved transportation network changed the face of agriculture. Mixed farming and market gardening were now prevalent. But the urban development following World War II meant the loss of farms and orchards below the QEW in Oakville. The inevitable creep of rural residential development in the last 25 years has meant further fragmentation to this once dynamic fabric of the watershed.

Today, approximately 64% of the watershed is devoted to agriculture. Field crops (i.e., corn, grain and mixed systems) occupy 34% of the watershed and livestock-related farming (i.e., hay and pasture) occupy another 21%. Market gardens, nurseries and orchards use less than 5% of the available land.

Current trends in watershed farming include a growing number of horse farms, particularly in the upper reaches of the watershed. The south-facing slopes below the Escarpment have seen an increase in the number of berry farms. Another trend has been the amount of farm acreage being purchased for development speculation by absentee landowners. This activity makes available large tracts of land for rent or lease to local farmers for cash cropping. However, it tends to distort local agricultural land values and makes it more difficult to undertake stewardship initiatives.

With increasing pressure for development, farmers have a growing number of concerns over their future. They include:

- Concern for the continued loss of prime agricultural land to urban sprawl and other development, along with the impact this process has on land values and the future viability of the local farm community;
- The availability of good quality water in sufficient quantities to support agricultural needs, community demands, as well as the natural environment;
- A desire to preserve a clean, healthy rural environment.

The Bronte Creek Water Quality Report (Appendix 4) found elevated levels of total phosphorus, suspended sediments and bacteria in the creek. Since phosphorus attaches itself to soil particles, agricultural practices allowing eroded soil to enter a stream can be a source of both suspended sediments and phosphorus. Buffer strips can address this problem. In rural areas, bacterial contamination can be associated with malfunctioning septic tile beds, inadequate manure handling and livestock access to streams. These contaminants not only affect water quality, but also impact the productivity of agricultural operations. Sediments clog pumps and irrigation systems. Bacteria can affect the health of livestock and can be passed on to consumers of irrigated vegetables. Many watershed farmers have been diligent in completing and implementing Environmental Farm Plans to reduce contaminants from agricultural activities and improve water quality in the creek.

Recommendations to Care for Agriculture

1. Preserve and protect farm land from development
2. Maintain a healthy, productive agricultural community
3. Reduce the transport of excess nutrients and bacteria to watershed streams
4. Reduce and or mitigate the impacts of intense livestock opperations
5. Promote the use of agricultural Best Management Practices

Stewardship

Many of the regeneration actions identified in the Bronte Creek Watershed Study depend on the willingness of private landowners to make a commitment to undertake stewardship projects on their own lands. Their involvement and cooperation are essential to successfully achieve the stakeholder's vision for the watershed.

Stewardship activities on private lands have been promoted through several stewardship initiatives. The Hamilton Halton Watershed Stewardship Program is one. The goal of the Watershed Stewardship project is to encourage stewardship practices through landowner contact, by providing assistance and advice for restoration projects and encouraging landowners to enter into stewardship agreements.

Courtcliffe Park

Since 1994, the Hamilton-Halton Watershed Stewardship Program has shared information with over 4000 rural and urban landowners on the effect that land use activities have on the watershed. Recently the focus of the Stewardship Program has shifted to include Bronte Creek.

To date approximately 765 landowners have been contacted in the watershed. Most of these landowners either own part of a significant natural area or have a watercourse flowing through their property. Sixty-eight landowners within the Bronte Creek watershed have made a commitment to act as stewards of natural areas and stewardship agreements now cover more than 805 hectares or 2.6% of the watershed. Thirty-one kilometres of stream length, 62 hectares of riparian habitat and approximately 380 hectares of significant natural areas are now protected under agreement.

Since 2000, some 10 landowners have either implemented or are interested in conducting restoration activities on their properties. Community groups and school children have participated in the restoration and enhancement of many natural features. An attractive sign signifying a commitment to stewardship can be seen on the gateposts of participating landowners.

Another vital component of stewardship restoration is the dedicated work of local fishing clubs such as the Izaac Walton Fly Fishers' Club and the Credit River Anglers Association. These organizations and their volunteer members have worked with private landowners to restore stream reaches and stabilize creek banks with riparian plantings. Other projects have improved stream morphology using natural design and/or bioengineering techniques. In addition the members have helped to protect stocks by regularly monitoring fish communities and conducting spawning surveys.

The Courtcliffe Park Steering Committee, a group of watershed volunteers, is overseeing a major restoration project at Courtcliffe Park, located at the confluence of Mountsberg Creek and Bronte Creek. The restoration activities centre around restoring the natural stream morphology and riparian revegetation in the former trailer park. Other stewardship programs that promote restoration activities in the watershed include the Halton-Peel and Hamilton-Wentworth Stewardship Councils.

Recommendations For Stewardship

1. Continue to promote the goals of the Hamilton Halton Watershed Stewardship Program
2. Encourage the efforts of private citizens and groups in their stewardship activities

Stakeholder tour of the watershed

Stakeholders Meeting

THE VISION FOR TOMORROW

Vision Statement

The following vision was developed by the Bronte Creek Stakeholders. It is based on an understanding of the watershed resources and community needs of today and provides direction for their protection in the future. The vision formed the basis for the regeneration actions and implementation strategies presented in the Watershed Study.

Our vision for the Bronte Creek is a healthy creek in a healthy watershed. A watershed that supports a rich diversity of plants and animals in extensive, interconnected forests, wetlands, meadows, valleys and Niagara Escarpment features within both the rural and urban landscape. Through sustainable human activities, carefully planned development and stewardship initiatives, there will be a place for nature, community, agriculture and recreation. Our citizens will be stewards protecting, enhancing and restoring the watershed for future generations.

Guiding Principles

- **Create A Community-based Plan**

"Community-based planning" seeks to have those who have the most at stake, "stakeholders", working together towards a common vision. All aspects of the watershed, water, nature, community and agriculture, are dependent on the health of the Bronte Creek and its watershed. The interrelationships between each must be taken into consideration to ensure that they are not in conflict and ideally able to successfully co-exist. The flowing water network affects and is affected by land uses that represent the visions of both individuals and the community. Planning for the watershed is, therefore, a shared responsibility.

- **Know and Value Our Heritage**

The Bronte Creek watershed is a dynamic feature. It has been a resource to various communities of people for almost 10,000 years. By knowing the past cultural and ecological heritage, it provides an important perspective for the future. A future held in trust for the next generation.

- **Have a Vision for the Future**

The community of people within the watershed share a common vision for the future. The vision includes a commitment to sustain water resources, natural features, and community interests.

Stream rehabilitation

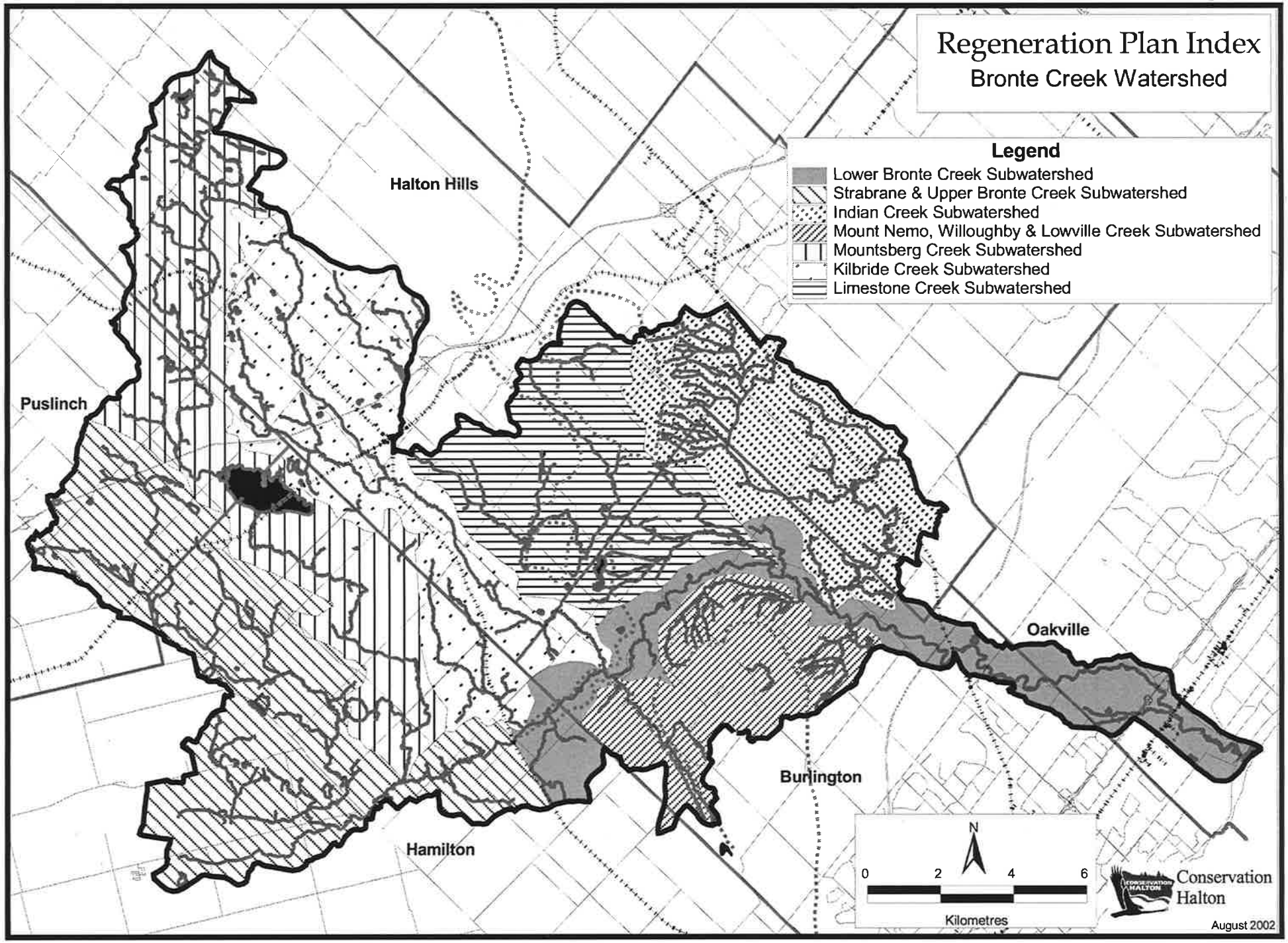
- **Take Responsibility**

The watershed study defines targets and makes recommendations to implement the vision for the watershed. It also identifies strategies and those responsible for implementing these actions.

- **Regenerate What is Degraded**

Opportunities to enhance and regenerate the watershed and its natural heritage have been identified. Issues that need solutions for agriculture and community development to prosper are essential, as well as creating opportunities for the public to enjoy and sustain a linked system of open space.

Figure 8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Mount Nemo, Willoughby & Lowville Creek Subwatershed
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Puslinch
Oakville
Burlington
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Kilometres
Conservation Halton
August 2002

REGENERATION PLANS

Introduction

The Bronte Creek watershed stakeholders examined the watershed and have produced recommendations on how sections of the watershed could be sustained or enhanced. In order to make the recommendations more manageable and easier to implement, the watershed was divided into seven subwatersheds of similar size, topography, land use, environmental issues and stresses, including:

- Lower Bronte Creek
- Strabane and Upper Bronte Creeks
- Indian Creek
- Mount Nemo, Willoughby and Lowville Creeks
- Mountsberg Creek
- Kilbride and Flamboro Creek
- Limestone Creek

The stakeholder committee identified specific opportunities to preserve, sustain, regenerate and enhance portions of the watershed within each area. Based on these opportunities, regeneration plans containing general recommendations for each area were formulated. The opportunities were divided into three types: **stewardship opportunities** to be implemented on private properties; **project opportunities** to be implemented on public lands; and areas requiring additional **special studies** before specific strategies can be formulated. The general recommendations were applied to all seven areas. The opportunities identified in these regeneration plans are not the only occasions where preservation and regeneration activities can occur. The committee focused on the most obvious and manageable situations as a starting point. It is intended that as the plan is reviewed and revisited, other opportunities will be identified and implemented over time.

The regeneration plan for each area is presented in three parts; a general description, together with the challenges and opportunities for that area; a chart detailing the regeneration actions needed for each opportunity; and a map identifying and illustrating the challenges and opportunities.

Each map focuses on the specific areas detailing the major landscape components and road network. Each regeneration approach is located and identified:

the circles highlight stewardship opportunities on private property;

the rectangles highlight project opportunities on public lands; and

the triangles highlight sites in need of further special studies.

The regeneration actions are identified and illustrated by a unique symbol within the regeneration approach. The relative priority of each regeneration action is indicated by a colour code:

- **red** indicating a high priority requiring considerable modification to regenerate the site;
- **yellow** indicating a moderate priority requiring some modification to enhance the site;
- **green** indicating a low priority requiring protection to sustain the features and functions of the site, and
- **clear** indicating not applicable to that site

Abbreviations

ESA – Environmentally Sensitive/Significant Area
ANSI – Area of Natural and Scientific Interest
P – Provincially Significant
R – Regionally Significant
PW – Provincially Significant Wetland
LW – Locally Significant Wetland
LS – Life Science
ES – Earth Science

Regeneration Actions Applicable to the Entire Watershed

On-Line Ponds

On-line ponds are a significant issue throughout the watershed. They may be associated with industry, agriculture, golf courses, recreation and private uses for practical, aesthetic and recreational purposes. On-line ponds have many effects on water quality and aquatic wildlife. They disrupt natural sediment transport that in turn affects downstream erosion and stream morphology. They also produce habitats that would not normally be associated with streams that allow for the displacement of native fish species such as brook trout and redside dace with those species that are more suited for lentic (lake-like) conditions such as sunfish and northern pike. Ponds provide the necessary conditions for excessive algae and bacterial growth. They can also affect water quality by increasing water temperatures which is an important determinant of aquatic wildlife and fish (especially trout species). Dams associated with on-line ponds prevent fish passage. In some cases the on-line ponds may infringe on riparian water rights if downstream flows are prevented.

A study of the cumulative and individual impacts of on-line ponds should be undertaken to inventory the location of all on-line ponds and dams to develop a priority list for potential removal and alteration of these structures. The study should encompass the effects of these ponds on base flows and water quality. Stewardship efforts should focus on relocating, and retrofitting existing on-line ponds to minimize the impacts on water quality and fisheries habitat without compromising individual riparian rights (i.e. agricultural irrigation ponds).

Riparian Habitat, Wetlands, Forest Cover, Linkages and Corridors

The lack of riparian stream buffers is also a large issue affecting many parts of the watershed. Riparian buffer vegetation influences river systems in numerous ways. The majority of shade in the river is supplied by riparian vegetation. Shade acts to maintain low water temperatures, allowing many native plants and animals to survive. Buffers decrease the amount of available light preventing excessive and nuisance algae growth. If natural vegetation is cleared for development, agricultural or aesthetic reasons, water temperatures and light will increase and greatly disturb the natural ecosystem. Buffer strips prevent streambank erosion and stream siltation, which in turn benefit stream health and property maintenance costs. Buffers affect nutrient transport, sediment filtration, and provide vital food sources for aquatic animals. Stewardship opportunities to increase riparian cover along watercourses should be identified and developed with all landowners. Residents mowing riparian habitats or extending their maintenance activities on to adjacent public lands should be discouraged. In developing areas the width of riparian buffers should be established through subwatershed or other planning studies.

Wetlands are an integral part of the Bronte Creek landscape. These wetlands support a myriad of functions including moderating flow regimes, runoff storage, enhancing watercourse baseflows and water quality, and supporting a rich diversity of flora and fauna. Opportunities exist to protect, improve and increase the extent and function of wetlands within the watershed. Restoration opportunities through stewardship should be assessed on a site-by site basis with consideration given to present and future wetland functions.

Forest cover within the watershed approaches the Great Lakes Areas of Concern (AOC) target of 30%. However there is a significant disparity in forest cover between the lands above and below the Niagara Escarpment. The overall amount of large forest patches, interior forest cover and deep interior forest cover within the watershed do not meet the AOC targets. Reforestation to promote the establishment of compact forest blocks with significant interior forest habitat should be a primary focus of stewardship and reforestation initiatives.

Natural corridors and linkages have been fragmented by land use activities within the watershed. A significant opportunity exists to create wildlife links and ecological corridors throughout the watershed. Restoration of wetlands, riparian corridors, and reforestation will reconnect natural core areas, facilitating the movement and reproductive interchange between populations of plant and animal species.

Fisheries Management Plan

An updated detailed fisheries management plan is required for the watershed. The plan should address current recreational angling issues in the middle and lower reaches of Bronte Creek including fisheries partitioning. Fisheries management issues associated with the introduction of non-indigenous species are significant within Mountsberg Creek and the upper reaches of Bronte Creek. Sea Lamprey control remains a high priority downstream of the escarpment.

Development and Protection of Natural Areas

Substantial development is proposed within portions of the watershed. All future development should take into consideration the protection, maintenance and enhancement of natural features. The following guidelines should be implemented related to development: undertake subwatershed studies prior to secondary plans; continue to mitigate the impacts of stormwater management through stormwater management plans using best management practices; continue to enforce the Conservation Authority Fill, Construction and Alteration to Watercourse regulations; enact and enforce municipal topsoil preservation, site alteration and tree cutting bylaws; update municipal ESA studies regularly; continue to require the preparation of Environmental Impact Assessments for proposed developments within and adjacent to significant natural areas through the Provincial Policy Statement and regional/ municipal Official Plans. Protection of natural areas can also be accomplished through dedication or acquisition for Public Open Space; voluntary stewardship protection agreements; tax incentives through conservation land tax programs; promotion of stewardship projects within the watershed; demonstration projects on public lands; and implementation of long-term monitoring to assess changes in watershed health.

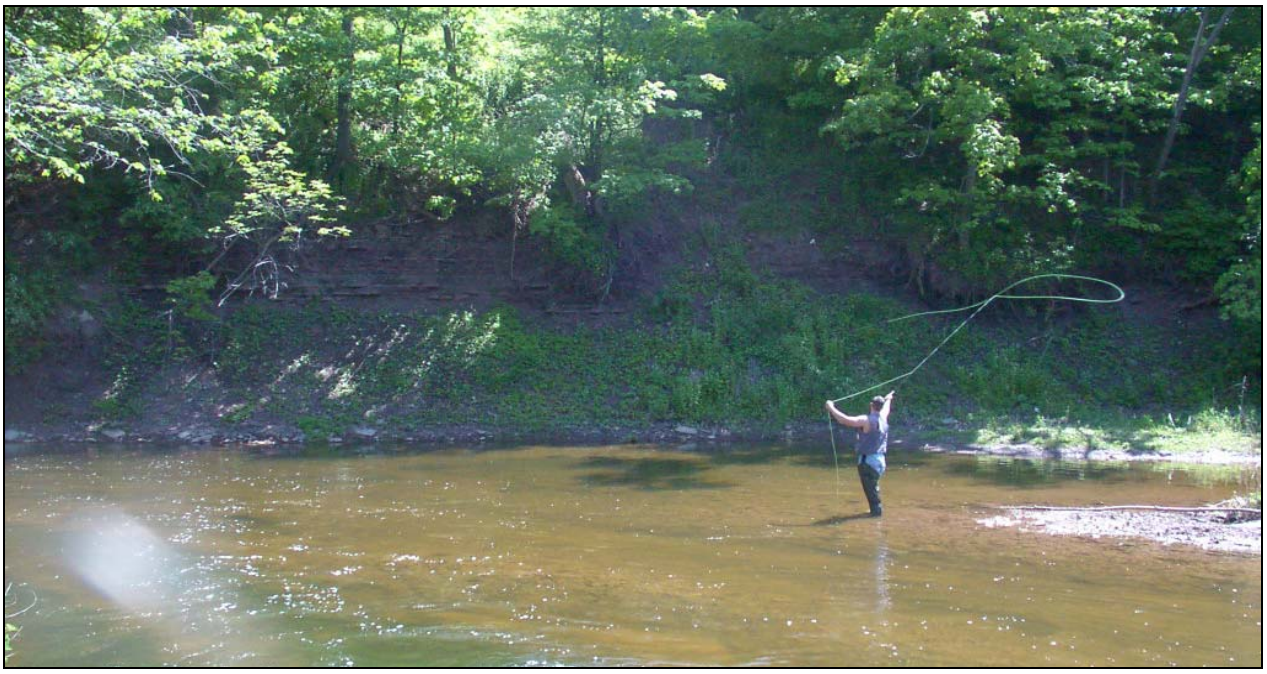
Maintaining a Balance Between Public Access and Protecting Sensitive Natural Areas

The population of the near-urban areas associated with Bronte Creek is expected to increase substantially in the next twenty-five years. Accompanying this large-scale population growth will be an increased demand for the use of natural areas including those in the Bronte Creek watershed. Impacts to natural communities have already been demonstrated in some natural areas including sensitive escarpment rim communities such as the old growth cedars in areas like Rattlesnake Point and Mount Nemo Conservation Areas. Impacts have also resulted from mountain biking, spelunking, rock climbing and hiking activities. Future park master planning should consider the protection of these natural areas while maintaining the balance between public access and protecting the sensitive natural areas.

Water Quality, Water Allocation and Water Budgets

Surface water and groundwater quality and quantity should be protected and enhanced where possible. The identification of pollution sources, mitigation of erosion, and protection of recharge and discharge areas should be implemented. Wellhead capping, updating of the Permit to Take Water database, and aquifer mapping is also recommended. Revisions and updates to this permitting process should also be addressed. A comprehensive water allocation strategy should be undertaken to determine current water usage to provide the basis for future water taking and conservation efforts. This strategy will also provide input into a water budget survey.

George Atkins leading a tour of "The Woodlands"



Fly fishing in Lower Bronte Creek

Lower Bronte Creek: Regeneration Plan (Figure 9)

Subwatershed: Lower Bronte Creek (Lake Ontario to Progreston)

Municipalities

- City of Hamilton
- Region of Halton - Town of Oakville, City of Burlington, Town of Milton

Settlement Areas

- Bronte, Burlington, Cedar Springs Community, Lowville, Oakville, Progreston, Zimmerman

Subwatershed Area & Gradient

• Estuary to Lowville	18.3 km^2	0.5%
• Lowville to Progreston	13.7 km^2	1.0%
• **Total Area**	**22.0 km^2**	

Physiological Features

- Peel Plain - clay silt, low recharge/discharge capability
- Trafalgar Moraine - clay till with boulders, recharge/discharge capability currently being studied
- South Slope - clay silt, low recharge/discharge capability
- Iroquois Plain - shale plain and sand plain low recharge/discharge capability
- Niagara Escarpment and Spillway - sand and gravel deposits, high recharge/discharge capability

Significant Natural Features

- Bronte Creek Ravine/Lowville-Bronte Creek Escarpment Valley (ESA) includes Bronte Creek Escarpment Valley (P LS ANSI), Cedar Springs Swamp (LW), Lowville-Bronte Creek Valley (P LS ANSI)
- Bronte Creek Valley (ESA) includes Bronte Creek Provincial Park Nature Reserve Zone (P LS ANSI), Zimmerman Valley (R LS ANSI), Bronte Marsh (LW)
- Flamboro Centre Swamp (ESA)
- Halton Till (P ES ANSI)

Significant Forest Cover

- Bronte Creek Ravine/ Lowville-Bronte Creek Escarpment Valley (ESA)
- Bronte Creek Valley (ESA)
- Flamboro Centre Swamp (ESA)

Description

The lower portion of Bronte Creek includes the main branch of Bronte Creek from Progreston Falls downstream to Bronte Harbour. Bronte Creek plunges over the Niagara escarpment at Progreston and flows through a geologically significant re-entrant valley that extends downstream to Lowville. With the exception of the Cedar Springs Community, the valley is characterized by mature, native vegetation communities. This moderate-to-high gradient reach is fed by groundwater inputs that emanate along the valley walls, providing suitable habitat for resident brown trout. Downstream of Lowville, Bronte Creek flows within a defined valley feature to Lake Ontario. Adjacent lands represent a mosaic of agricultural land use and natural areas to the Queen Elizabeth Way. South of the Queen Elizabeth Way, the watershed is predominantly urbanized. Downstream of the Rebecca Street bridge, Bronte Creek enters the Bronte Marsh wetland (estuary marsh) that extends downstream to Bronte Harbour. The marsh provides significant habitat for a myriad of wetland wildlife, is an important staging area for migratory fish species and provides important spawning and nursery habitat for several Lake Ontario fish species. Bronte Creek is an important migratory corridor for lake-run salmonids such as rainbow trout and chinook salmon. Summer instream temperatures below Lowville are generally too high to support significant salmonid production in the lower reaches, but temperatures above Lowville are indicative of coolwater to marginal warmwater-coolwater habitat. Three significant barriers to fish passage within this area include the Lowville Dam, Dakota Mills Dam and Progreston Dam. Benthic sampling indicated that water quality within the lower reaches is generally unimpaired to slightly impaired. Generally, nutrient concentrations and other water quality parameters including aluminum, iron and *Eschericha coli* concentration exceed provincial objectives.

Lower Bronte Creek: Regeneration Actions (Figure 9)

The Lower Bronte Creek Regeneration Plan identifies:

- six reaches with specific stewardship recommendations;
- six site regeneration opportunities on public lands; and
- three areas in need of special study.

Stewardship Opportunities

Progreston Dam
A hydroelectric generating facility currently operates at Progreston Falls. It is important to ensure that appropriate flows are maintained in the creek during its operation. Ongoing monitoring of compliance should be maintained. The appropriate provincial and federal agencies should investigate issues dealing with water taking and fish habitat protection.

Cedar Springs Community
The reach that flows through the historical Cedar Springs Community is an excellent example of potential stewardship opportunities. The reestablishment and naturalization of riparian buffer habitat and the continued upgrade of existing septic systems will aid in improving water quality.

Guelph Line to No. 2 Sideroad
This reach offers an opportunity to improve water quality, fish habitat, decrease thermal impacts and control sedimentation by maintaining and enhancing riparian buffers.

Camp Sidrabene
Camp Sidrabene presents an excellent potential for a community based stewardship effort. The site contains the confluence of Indian Creek with the main branch of the Bronte Creek. Currently, the main branch dam represents a partial barrier to fish habitat. The removal or the retrofitting of the existing dam structure would allow fish passage and enhanced/unrestricted flows. Enhancing the riparian buffer habitat would help improve water quality.

Canada Brick
The Canada Brick shale pit offers the opportunity to rehabilitate and naturalize the disturbed site prior to and after decommissioning. Opportunities to enhance the site include: enhancing the riparian buffer areas, relocating the current snow disposal location to protect the valley from erosion, and establishing linkages to the Orchard Community Trail.

Petro Canada Park
Stewardship actions to enhance riparian buffers would aid in improving fish habitat, improve thermal regime and control sedimentation and erosion in the park. The site represents an opportunity to provide interpretation while protecting and enhancing the natural features in the park.

Project Opportunities

Lowville Park
Lowville Park is a site along the main branch of Bronte Creek just downstream of the upper limit of trout and salmon migration. Rainbow trout and Chinook Salmon can be seen spawning in the stream in early spring and in the fall. The park offers an excellent opportunity for interpretation and signage to describe fisheries and restoration initiatives. Riparian plantings and an increased buffer zone would improve fish habitat and water quality.

Zimmerman Park
Zimmerman Park offers the opportunity to enhance riparian buffers to augment water quality. Enhancing the trail system will provide increased public access to the site and an excellent chance to provide interpretation.

Orchard Community Trail
The Orchard Community Trail is a wonderful example of a community-based project that can provide access and interpretation while protecting natural features. Opportunities along the trail include: controlling access by motor

vehicles to prevent further site degradation, compaction and trampling, potential for cleaning up existing construction debris, preventing further dumping into the ravine, establishing a trail system connected to the Bronte Creek Provincial Park. The trail should be setback from the valley rim with an enhanced buffer zone.

Bronte Creek Provincial Park
Bronte Creek Provincial Park is endowed with an ecologically significant river valley. This near-urban park is designated as a provincially significant life science resource and contains many natural features that should be protected and enhanced. For example, management of the rare prairie and grasslands habitat associated with the hydro corridors in the park would protect the site from degradation. Adverse impacts to sensitive plant communities from recreational use should be minimized and a study undertaken to assess the potential impact. Future development should not be allowed to enter the Creek valley and the storm run-off from development and roads surrounding the valley should be mitigated with the appropriate stormwater management.

Sea Lamprey Barrier
Bronte Creek is one of the highest producers of parasitic sea lamprey larvae in Lake Ontario. There is an environmental assessment being undertaken to assess the proposed installation of a low-head sea lamprey barrier. It is important that the barrier ensure non-lamprey fish passage during operation.

Oakville Heritage Trail
The proposed trail system should offer public access to natural areas, while minimizing the impact and disturbance to natural areas. There is an opportunity to include interpretation of both the natural and cultural heritage of the area. A formalized trail system should also connect the lower Bronte Creek with Bronte Creek Provincial Park.

Special Studies

Bronte Marsh
Bronte Marsh is an estuary marsh that extends downstream to Bronte Harbour. The marsh provides excellent habitat for a variety of wetland wildlife, and provides a staging area for migratory fish species. Opportunities to be examined include; a spring fish community survey to determine utilization, enhancing the buffer habitat surrounding the marsh, enhancing the existing fish and wildlife habitat to improve the functionality of the wetland, enhancing the interpretation of the wetland feature, and investigating the control of water levels to allow for skating.

Fisheries Management Plan
A comprehensive Fisheries Management Plan is recommended for the entire watershed to address current recreational angling issues and fishing pressure in Bronte Creek. Fisheries management issues associated with the introduction of non-indigenous species are significant within Mountsberg Creek and the upper reaches of Bronte Creek. The study should incorporate and examine the implications of fish partitioning of brown trout and rainbow trout with dam removal and retrofitting.

Stakeholders tour "The Woodlands" in Lower Bronte Creek

Table 3. Lower Bronte Creek (Estuary to Progreston) Subwatershed Regeneration Actions

STEWARDSHIP OPPORTUNITIES				
		Buffer Strips and Reforestation	**Stream Morphology, Fish /Wildlife**	**Water Quality and Water Quantity**
	Progreston Dam			• Hydroelectric generating facility operates at the Progreston Dam • Important to ensure that flows are maintained in creek during its operation and that appropriate provincial/federal agencies deal with the issue of water taking and fish habitat protection
	Cedar Springs Community	• Enhance riparian habitat	• Improve fish habitat through reestablishment of riparian buffers	• Continue to upgrade septic systems to ensure water quality not being affected
	Guelph Line to No. 2 Sideroad	• Enhance riparian habitat	• Improve fish habitat through reestablishment of riparian buffers	• Improve thermal regime and control sedimentation through riparian plantings
	Camp Sidrabene	• Sustain/improve riparian habitats	• Modify stream morphology • Examine removal of dam or retrofitting structure to remove partial barrier to fish movement	
	Canada Brick	• Rehabilitate/ naturalize the shale pits following decommissioning • Improve buffering • Change disposal location of snow to protect valley • Establish linkages to Orchard Community trail		
	Petro Canada Park	• Enhance riparian buffers	• Improve fish habitat through reestablishment of riparian buffers	• Improve thermal regime and control sedimentation through riparian plantings
PROJECT OPPORTUNITIES				
		Buffer Strips and Reforestation	**Stream Morphology, Fish /Wildlife**	**Water Quality and Water Quantity**
	Lowville Park	• Improve riparian habitat and naturalize areas through planting native tree and shrub species • Opportunities to describe fisheries and restoration initiatives through interpretive signage	• Improve fish habitat through reestablishment of riparian buffers	• Improve thermal regime and control sedimentation through riparian plantings
	Zimmerman Park	• Enhance riparian buffers • Opportunities for trails		• Enhance water quality by controlling sedimentation
	Orchard Community Trail	• Improve buffering along the valley rim through native plantings • Clean up construction debris & control dumping into ravine • Establish trails, setback from valley rim, with connections to Bronte Creek Provincial Park • Control access by motorized vehicles		
	Bronte Creek Provincial Park	• protection/management of prairie/grasslands • protection of ESA/ANSI		
	Sea Lamprey Barrier	• Environmental Assessment being undertaken to assess the proposed installation of a sea lamprey barrier • Sustain existing buffers and forested valley feature	• Ensure fish passage during operation of barrier	
	Oakville Heritage Trail	• Examine trail options to minimize disturbance to natural areas • Formalize trail to connect lower Bronte Creek with Bronte Creek Provincial Park • Opportunities to interpret natural and cultural heritage to the public		
SPECIAL STUDY				
		Buffer Strips and Reforestation	**Stream Morphology, Fish /Wildlife**	**Water Quality and Water Quantity**
	Bronte Marsh	• Examine opportunities to enhance buffering around the marsh and aquatic communities • Opportunities for interpretation of wetland feature	• Examine enhancement opportunities to improve fish and wildlife habitat and improve the functioning of the wetland • Examine improvements for water level regulation to allow for skating	
	Bronte Creek Provincial Park	• Undertake a sustainability study to ensure balance between public use and natural area protection (sensitive plant communities, prairie, grasslands)		
	Fisheries Management Plan		• Undertake a Fisheries Management Plan throughout the Bronte Creek watershed • Study should examine the implications of fish partitioning (brown and rainbow trout) and dam removal/retrofitting	

Figure 9

Bronte Creek Regeneration Plan

Lower Bronte Creek Subwatershed

Regeneration Approach:

- Stewardship Opportunity
- Project Opportunity
- Special Study

Regeneration Actions:

- Buffer
- Reforestation
- Aquatic Habitat
- Access and Interpretation
- Stream Morphology
- Water Quality
- Water Quantity

Regeneration Priority:

- High (modify)
- Moderate (enhance)
- Low (sustain)
- Not Applicable

Legend

- Municipal Boundary
- Hydro Corridor
- Niagara Escarpment
- Public Lands
- ESAs
- Quarries (Licensed Area)
- Provincially Significant Wetlands
- Locally Significant Wetlands
- Forest Cover
- Lower Bronte Creek Watershed
- Flood Damage Centre

N

0 1000 2000

Metres

Guelph Line to No. 2 Sideroad

Camp Sidrabane

Zimmerman Park

Orchard Community Trail System

Sea Lamprey Barrier

Petro Canada Park

Fisheries Management Plan

Progreston

Lowville Park

Canada Brick

Cedar Springs Community

Bronte Creek Provincial Park

Oakville Heritage Trails

Bronte Marsh

Bronte Creek Watershed Study

Tremaine Rd

Walkers Line

Derry Rd

Guelph Line

Britannia Rd

Lowville

Millborough Line

CPR

CNR

No. 2 Sideroad

401

Bronte Rd

Oakville

Burlington

Lake Ontario

Due to differences in mapping data accuracy, all boundaries are approximate

Conservation Halton

August 2002

Upper Bronte Creek and Strabane Creek: Regeneration Plan (Figure 10)

Subwatershed: Upper Bronte Creek

Municipalities

- City of Hamilton
- Wellington County - Township of Puslinch

Settlement Areas

- Carlisle, Freelton, Morriston, Progreston, Strabane

Subwatershed Area & Gradient

- Upstream of Progreston 52.0 km^2 0.3%

Physiological Features

- Niagara Escarpment and Spillway - sand and gravel deposits, high recharge/discharge capability
- Galt and Moffat Moraines - sand and gravel deposits, high recharge/discharge capability
- Flamborough Plain - limestone plain overlain by boulder, sand and gravel till, medium recharge/discharge capability
- Norfolk Sand Plain - sand and silt, high recharge/discharge capability
- Till Plain (drumlinized)

Significant Natural Features

- Mountsberg East Wetlands (ESA) includes Beverly Swamp Wetland Complex (PW), Lower Mountsberg Creek Complex (PW)
- Bronte Creek Ravine/ Lowville-Bronte Creek Escarpment Valley (ESA)
- Beverly Swamp (ESA) includes Beverly Swamp Wetland Complex (PW), Beverly Swamp (P LS ANSI)
- Strabane North Wetlands (ESA) includes Beverly Swamp Wetland Complex (PW)
- Flamboro Centre Swamp (ESA) includes Flamborough Wetland Complex (PW)
- Strabane Southwest Drumlin Field (ESA) includes Beverly Swamp Wetland Complex (PW)
- Freelton Esker-Wetland Complex (ESA) includes Beverly Swamp Wetland Complex (PW), Freelton Esker (P ES ANSI)
- Puslinch Southeast Wetland (ESA) includes Beverly Swamp Wetland Complex (PW)
- Mill Creek Wetland (PW)
- Carlisle Wetland Complex (LW)
- East Morriston Swamp (LW)
- Morriston Marsh (LW)

Significant Forest Cover

- Mountsberg East Wetlands (ESA)
- Bronte Creek Ravine/ Lowville-Bronte Creek Escarpment Valley (ESA)
- Beverly Swamp (ESA)
- Strabane North Wetlands (ESA)
- Flamboro Centre Swamp (ESA)
- Strabane Southwest Drumlin Field (ESA)
- Freelton Esker-Wetland Complex (ESA)
- Puslinch Southeast Wetland (ESA)

Description

The headwaters of Bronte Creek meander through a series of wetlands associated with the Beverly Swamp Complex from Morriston downstream to Carlisle. Downstream of Carlisle, the creek is primarily associated with agricultural lands but also includes Courtcliffe Park and the Carlisle Conservation Area. Generally, the stream gradient is relatively low, and groundwater inputs provide suitable habitat for resident brook trout upstream of Strabane. Summer instream temperatures through this reach are indicative of warmwater, coolwater and coldwater habitat. On-line ponds, sections of sparse riparian vegetation and channel modifications (Courtcliffe Park and Carlisle Conservation Area) contribute to instream warming whereas groundwater discharge contributes to areas associated with cooler water temperatures. The federally and provincially vulnerable redside dace inhabit a portion

Description (Upper Bronte Creek Continued)

of this reach upstream of Carlisle; however, their range appears to have contracted considerably since the early 1970's. The downstream portions of the east tributary continue to support redside dace. Riparian cover along some reaches is patchy with small areas of wooded swamp separated by areas of intensive agricultural activity. Biological and chemical water quality parameters generally indicate non-impairment to moderate impairment. Significant agricultural impacts are evident in the upstream reaches of the northeast tributary.

Subwatershed: Strabane Creek

Municipalities

- City of Hamilton

Settlement Areas

- Strabane
- Freelton

Subwatershed Area & Gradient

• Strabane Creek	11.1 km^2	0.4%

Physiological Features

- Flamborough Plain - limestone plain overlain by boulder, sand and gravel till, medium recharge/discharge capability
- Till Plain (drumlinized)

Significant Natural Features

- Beverly Swamp (ESA) includes Beverly Swamp Wetland Complex (PW)
- Strabane North Wetlands (ESA) includes Beverly Swamp Wetland Complex (PW)

Significant Forest Cover

- Beverly Swamp (ESA)
- Strabane North Wetlands (ESA)

Description

The headwaters of Strabane Creek arise within the Beverly Swamp complex on the Flamborough Plain. With the exception of the hamlet of Strabane, land use within the subwatershed is characterized as rural and agricultural. Downstream of Brock Road to the Bronte Creek confluence, Strabane Creek supports a relatively diverse coolwater fish community with brook trout in the deeper pools. Summer instream temperatures are generally indicative of coolwater/warmwater habitat. Water quality monitoring indicated moderate impairment, with the concentrations of some metals and nutrients exceeding objectives.

Strabane Creek

Upper Bronte Creek & Strabane Creek: Regeneration Actions (Figure 10)

The Strabane and Upper Bronte Creek Regeneration Plan identifies:

- ten reaches with specific stewardship recommendations; and
- two site regeneration opportunities on public lands.

Stewardship Opportunities

Northeast Tributary upstream of Leslie Road
This reach has been ditched and channelized. There is an opportunity to improve the stream morphology by using natural channel design techniques. Livestock and farm animal access to the creek should also be controlled and restricted. Regeneration efforts should focus on improving the stream meander pattern, reestablishing riparian buffer habitats and limiting cattle access to the creek to improve water quality and fish habitat.

Northeast Tributary between Leslie Road and 14th Concession East
This reach of the creek is largely associated with agricultural and rural land use. Significant agricultural impacts including channelization and cattle access are evident in the upstream reaches. This area also represents a site of groundwater discharge that should be protected. There is an excellent opportunity to improve the buffers of the creek, thus improving the thermal regime, water quality, and fish habitat. Cattle fencing to limit livestock access would also result in immediate water quality enhancements. An examination of stream morphology improvements should also be undertaken to the extent practical.

East Tributary
The downstream portion of the East Tributary supports a community of the provincially and nationally vulnerable redside dace species. This reach of the creek could be improved by reestablishing riparian habitat to aid in shading and buffering the creek. On-line ponds also impact the instream water temperatures in the creek. Stewardship efforts should be made to contact landowners to minimize these adverse impacts. Reforestation and the creation of a corridor in this area would aid in connecting portions of the Mountsberg East Wetlands ESA and the Puslinch Southeast Swamp ESA.

Four Seasons Nature Park
The Four Seasons Nature Park offers the chance to enhance and restore wetlands through a community-based effort. The site includes portions of the Freelton Esker Wetland Complex ESA and the Beverly Swamp Provincially Significant Wetland Complex. The site is also located within a flood damage centre, where there is a risk to life and property. Stewardship efforts should be directed towards upgrading existing septic systems to protect and enhance water quality. Recent encroachments into the wetland have resulting in wetland filling. Further wetland filling is restricted and efforts should be made to further restore and enhance the wetlands.

Freelton Esker Wetland Complex ESA
The Freelton Esker Wetland Complex ESA encompasses portions of the provincially significant Beverly Swamp Wetland Complex. The wetlands feed into a reach of Bronte Creek which supports a coldwater fisheries. The site contains the highly significant West Virginia White Butterfly species and is an importing nesting habitat for great blue herons. Efforts should be made to sustain, enhance and protect existing wetland habitat and also to protect the great blue heron henory. Further reforestation would also aid in increasing interior forest habitat.

11th Concession East to Highway 6
The reach found between 11th Concession East to Highway 6 is susceptible to flooding during the spring during seasonally high flows. Improvements to the culvert under Hwy 6 should be implemented to reduce flooding during regional storm conditions. Improvements and enhancements to riparian habitat in this stretch is also recommended.

Reach West of Highway 6
The reach of Bronte Creek located west of Highway 6 includes the village of Strabane, which lies in a flood damage centre that is a potential risk to life and property in flood conditions. Stewardship opportunities exist to enhance riparian habitats to improve water quality and fish habitat. The water quality effects of a large scale farming operation's on-line pond should also be investigated.

West Tributary
Riparian cover downstream of Brock Road in the West Tributary is sparse. Riparian plantings would reduce thermal impact and improve water quality in this reach. Reforestation would increase wetland and forest cover, reduce forest fragmentation, and provide connections between the Strabane North Wetlands ESA and the Strabane Southwest Drumlin Field ESA and from Bronte Creek to adjacent watersheds.

Morriston to Leslie Road
Downstream of this reach represents an excellent and productive site for resident brook trout. The site also represents a significant groundwater discharge area that should be protected. The reach of Bronte Creek between Morriston and Leslie Road is an ideal site for enhancing riparian habitat to shade and buffer the creek. Connections and corridors between the Morriston Marsh, East Morriston Swamp and Beverly Swamp would also be enhanced.

Strabane Tributary
The Strabane Tributary supports a diverse coolwater fish community downstream of Brock Road to the Bronte Creek confluence. However the stretch downstream and in the vicinity of Hwy 97 offers ample opportunities to; enhance and protect riparian buffer habitat, protect and enhance the Beverly Swamp, reforest and increase wetland and forest cover to reduce forest fragmentation, and retrofit on-line ponds to improve downstream water quality.

Project Opportunities

Carlisle Conservation Area
Historical channel alterations through the Carlisle Conservation Area have created lake-like conditions that have resulted in significant instream warming. The site offers a singular opportunity to improve stream and water quality by returning the system to its original state. Restoration efforts should focus on improving stream morphology by reducing the width of the dredged channel and reestablishing riparian habitat to improve water quality. This project provides an opportunity for public education through interpretive signage to describe the natural heritage of the site.

Courtcliffe Park
Courtcliffe Park is located at the confluence of the Bronte Creek with Mountsberg Creek. Extensive channel alterations in Courtcliffe Park have created conditions that resulted in degraded water quality. An excellent community-driven restoration initiative is on-going. Restoration efforts are underway to remove the on-line ponds and restore the natural meander pattern of the watercourse. Other opportunities at the site include the enhancement of riparian habitat along the watercourse, enhancement and reforestation of portions of the forest community, and public education through interpretive signage. Undertaking an archaeological study is necessary prior to restoration work proceeding.

Stakeholders tour Courtcliffe Park

Table 4. Strabane & Upper Bronte Creek (Morriston to Progreston) Subwatersheds Regeneration Actions

STEWARDSHIP OPPORTUNITIES				
		Buffer Strips and Reforestation	**Stream Morphology, Fish /Wildlife**	**Water Quality and Water Quantity**
	Northeast Tributary upstream of Leslie Road	• Reestablish riparian habitat to shade and buffer creek	• Examine opportunities to improve stream morphology where the channel has been straightened using natural channel design techniques	• Encourage farmers to restrict livestock/farm animal access to creek to reduce erosion and nutrient enrichment
	Northeast Tributary between Leslie Road and 14th Concession East	• Reestablish riparian habitat to shade and buffer creek	• Improve fish habitat through reestablishment of riparian buffers • Examine opportunities to improve stream morphology where the channel has been straightened using natural channel design techniques	• Protect areas of groundwater discharge • Improve thermal regime through reestablishment of riparian buffers
	East Tributary	• Reestablish riparian habitat to shade and buffer creek		
	Four Seasons Nature Park	• Restrict further wetland filling • Enhance and restore wetlands		• Flood damage centre risk to life and property • Upgrade septic systems/communal septic system to protect water quality
	Freelton Esker Wetland Complex ESA	• Protect and sustain wetland habitat	• Protect great blue heronry	
	11th Concession East to Highway 6	• Enhance existing riparian habitat		• Improvements to culvert under Hwy #6 to reduce flooding during regional storm conditions
	Loop west of Highway 6	• Enhance existing riparian habitat	• Improve fish habitat through reestablishment of riparian buffers	• Flood damage centre risk to life and property • Investigate the effect of intense farming operation/lagoon on water quality
	West Tributary	• Protection and rehabilitate riparian habitat • Examine opportunities for reforestation to increase wetland and forest cover infill gaps in forest to reduce fragmentation	• Improve fish habitat through reestablishment of riparian buffers	
	Morriston to Leslie Road	• Reestablish riparian habitat to shade and buffer creek		
	Strabane Tributary	• Encourage protection and rehabilitation of riparian cover • Protect and enhance Beverly Swamp • Opportunities for reforestation to increase wetland and forest cover, infill gaps in forest to reduce fragmentation	• Improve fish habitat through reestablishment of riparian buffers	• Retrofit on–line pond to improve downstream water quality
Project Opportunities				
		Buffer Strips and Reforestation	Stream Morphology, Fish /Wildlife	Water Quality and Water Quantity
	Carlisle Conservation Area	• Provide public education through interpretive signage to describe the natural heritage of the site • Reestablish riparian habitat to shade and buffer creek	• Improve stream morphology, reduce channel width of previously dredged channels • Improve fish habitat	
	Courtcliffe Park	• Protect and rehabilitate riparian habitat around ponds and along watercourse • Enhance forest community • Provide public education through interpretive signage to describe the restoration efforts and natural heritage • Undertake archaeology study prior to restoration work	• Improve coolwater fishery habitat and structure • Improve stream morphology as per the recommendations of the Courtcliffe Park Stream Morphology Study (removal of additional channels, reinstate meanders) • Protect and enhance existing fish and wildlife habitat	• Remove on-line ponds to improve base flow and temperature • Improve thermal regime through reestablishment of riparian buffers

Figure 10

Bronte Creek Regeneration Plan

Strabane and Upper Bronte Creek Subwatersheds

Regeneration Approach:

- Stewardship Opportunity
- Project Opportunity
- Special Study

Regeneration Actions:

- Buffer
- Reforestation
- Aquatic Habitat
- Access and Interpretation
- Stream Morphology
- Water Quality
- Water Quantity

Regeneration Priority:

- High (modify)
- Moderate (enhance)
- Low (sustain)
- Not Applicable

NE Tributary, Upstream of Leslie Road

NE Tributary, Leslie St to 14th Concession

East Tributary

Four Seasons Nature Park

Courtcliffe Park

11th Concession to Hwy 6

Carlisle CA

Morriston to Leslie St

Freelton Esker - Wetland Complex

Strabane Tributary / Beverly Swamp

Loop West of Hwy 6

West Tributary

Bronte Creek Watershed Study

Upper Bronte

Strabane

Legend

- Municipal Boundary
- Hydro Corridor
- Niagara Escarpment
- Public Lands
- ESAs
- Quarries (Licensed Area)
- Provincially Significant Wetlands
- Locally Significant Wetlands
- Forest Cover
- Watershed Area
- Flood Damage Centre

N

0 500 1000 1500 2000

Metres

Due to differences in mapping data accuracy, all boundaries are approximate.

Conservation Halton

August 2002

Indian Creek: Regeneration Plan (Figure 11)

Subwatershed: Indian Creek		
Municipalities		
• Region of Halton - Town of Milton, City of Burlington		
Settlement Areas		
• Milton		
Subwatershed Area & Gradient		
• Indian Creek	39.9 km^2	0.3%
Physiological Features		
• Peel Plain - clay silt, low recharge/discharge capability		
• Till Moraine (small northern portion of subwatershed)		
• Niagara Escarpment and Spillway - sand and gravel deposits, high recharge/discharge capability		
Significant Natural Features		
• Crawford Lake/Rattlesnake Point Escarpment Woods (ESA) includes Lowville Re-entrant Valley Central (P ES ANSI)		
• Britannia Road Marsh (LW)		
Significant Forest Cover		
• Crawford Lake/Rattlesnake Point Escarpment Woods (ESA)		
Description		
The headwaters of Indian Creek arise from a number of small tributaries along the face of the Niagara escarpment. On-line ponds intercept the creek near its source. Landuse within the subwatershed is predominantly agricultural. As a result, vegetation cover within the subwatershed is sparse and fields extend to the stream banks. Although historically characterized as permanently flowing, recent droughts 1998, 1999 and 2001 have resulted in intermittent flow conditions through the middle and lower reaches during the summer months. A substantial portion of the subwatershed is included in Phases 2 and 3 of the Milton Urban Expansion area. The fish community is characterized by a warmwater community. On-line ponds and lack of riparian vegetation contribute to instream warming. Water quality is generally poor throughout the subwatershed, and nutrient, metals and bacterial levels often exceed provincial objectives. Indian Creek has the poorest water quality of any subwatershed in the Bronte Creek watershed.		

Indian Creek: Regeneration Actions (Figure 11)

The Indian Creek Regeneration Plan identifies:

- five reaches with specific stewardship recommendations;
- two site regeneration opportunities on public lands; and
- three areas in need of special study.

Stewardship Opportunities

Escarpment Tributaries North of Derry Road, Derry Road to Britannia Road, Britannia Road to Tremaine Road, Tremaine Road to Bronte Confluence

Landuse in the subwatershed is predominantly agricultural, and thus the stewardship efforts should focus on the agricultural communities. These tributaries offer many opportunities including; enhancing riparian buffers, enhancing forest areas to increase linkages and interior forest habitat, improving stream morphology using natural channel design, restricting livestock access to the creek to reduce erosion and enrichment, removing and retrofitting on-line ponds to improve baseflows.

Camp Sidrabene

Camp Sidrabene presents excellent potential for a community-based stewardship effort. The site contains the confluence of Indian Creek with the main branch of the Bronte Creek. Currently, the Indian Creek dam represents a partial barrier to fish movement. The removal or retrofitting of the dam would allow fish passage and enhanced/

unrestricted flows. Enhancing the riparian buffer habitat would improve water quality. Stream morphology could also be modified using natural channel designs.

Project Opportunities

Milton Phase 2 and 3 Urban Expansion Area
Milton Phase 2 and 3 Urban Expansion is slated to occur in the upstream reaches of Indian Creek. Development will provide an excellent opportunity to enhance aquatic habitat through the dedication of the creek blocks to a public agency which can form the basis for an extensive riparian corridor adjacent to the watercourse. Opportunities exist to increase forest habitat, corridors and linkages, reestablish riparian habitat, create a trail system along the creek blocks, and improve water quality. Stormwater management is necessary to control flooding, minimize erosion, sustain base flows and protect downstream morphology.

Special Studies

Ponds/Water Taking Issues
On-line ponds are a significant issue in the Indian Creek subwatershed and throughout the entire Bronte Creek watershed. A study of the cumulative and individual impacts of pondsshould be undertaken. This should include an inventory of the location of all on-line ponds and dams to develop a priority list for potential removal and alteration of these structures. The study should also encompass the effects of theseponds on base flows and water quality. A comprehensive water allocation strategy should be undertaken to determine the current water usage and determine the basis for future water taking and conservation efforts.

CN Intermodal (Proposed)
Should the proposed CN Intermodal facility proceed, opportunities to improve and enhance existing conditions along the watercourse should be examined. This study should encompass the following: increase the existing riparian habitat to improve water quality and thermal regime, enhance and protect forest habitats to increase corridors and linkages, improve stream morphology where stream is or will be altered, remove or retrofit on-line ponds, ensure there is no impact on flood plain storage or flood conveyance, implement stormwater management for quality and quantity, and match the pre- and post-development rising limbs on the flow hydrographs to minimize erosion and protect downstream stream morphology.

Tremaine Road Straightening (Proposed)
A study should be implemented focusing on the straightening of Tremaine Road. The study should encompass the protection and establishment of riparian buffers, the potential to increase corridors and linkages, and improving stream morphology using natural channel design.

On-line Pond

Table 5. Indian Creek Subwatershed Regeneration Actions

STEWARDSHIP OPPORTUNITIES				
		Buffer Strips and Reforestation	**Stream Morphology, Fish /Wildlife**	**Water Quality and Water Quantity**
	Escarpment Tributaries North of Derry Road	• Enhance and rehabilitate riparian cover • Enhance forest areas to increase linkages and interior forest habitat. • Reestablish linkages connecting creeks to escarpment.	• Improve stream morphology where the channel has been altered using natural channel design techniques • Improve fish habitat through reestablishment of riparian buffers • Remove or retrofit on-line ponds to improve base flows	• Limit further water-taking until a comprehensive water allocation strategy is completed • Improve thermal regime, and control sedimentation and nutrient loading through riparian buffers
	Derry Road to Britannia Road	• Reestablish riparian habitat • Enhance linkages between forest blocks and creek • Reestablish linkages between forest blocks • Maintain/enhance Britannia Road Marsh	• Examine opportunities to improve stream morphology where the channel has been altered using natural channel design techniques • Improve fish habitat through reestablishment of riparian buffers	• Improve thermal regime, and control sedimentation and nutrient loading through riparian buffers
	Britannia Road to Tremaine Road	• Reestablish riparian habitat • Enhance linkages between forest blocks and creek	• Rehabilitate areas prone to erosion • Improve fish habitat through reestablishment of riparian buffers	• Encourage farmers to restrict livestock/farm animal access to creek to reduce erosion and nutrient enrichment
	Tremaine Road to Bronte Confluence	• Enhance existing riparian habitat • Enhance linkages between forest blocks and creek • Reestablish linkages between forest blocks	• Examine opportunities to improve stream morphology where the channel has been altered using natural channel design techniques • Improve fish habitat through reestablishment of riparian buffers	• Improve thermal regime, and control sedimentation and nutrient loading through riparian buffers
	Camp Sidrabene	• Sustain/improve riparian habitat	• Modify stream morphology • Examine removal of dam or retrofitting structure to remove partial barrier to fish movement	
PROJECT OPPORTUNITIES				
		Buffer Strips and Reforestation	**Stream Morphology, Fish /Wildlife**	**Water Quality and Water Quantity**
	Milton Phase 2 Urban Expansion Area	• Reestablish riparian habitat • Increase forest habitat • Increase corridors and linkages • Create trail system along creek blocks	• As part of the urban expansion, all tributaries proposed to be maintained be protected in a creek block in public ownership • Improve stream morphology where the channel has been or will be altered • Improve fish habitat through reestablishment of riparian buffers	• Improve thermal regime through riparian buffers • Implement storm water management for both quality and quantity (flooding and erosion) • Match pre- and post-development rising limbs on the flow hydrograph to minimize erosion and protect downstream stream morphology
	Milton Phase 3 Urban Expansion Area	• Reestablish riparian habitat • Increase forest habitat • Increase corridors and linkages • Create trail system along creek blocks	• As part of the urban expansion, all tributaries proposed to be maintained be protected in a creek block in public ownership • Improve stream morphology where the channel has been or will be altered using natural channel design techniques • Improve fish habitat through reestablishment of riparian buffers	• Improve thermal regime through riparian buffers • Implement storm water management for both quality and quantity (flooding and erosion) • Match pre- and post-development rising limbs on the flow hydrograph to minimize erosion and protect downstream stream morphology
SPECIAL STUDY				
		Buffer Strips and Reforestation	**Stream Morphology, Fish /Wildlife**	**Water Quality and Water Quantity**
	Ponds/Water Taking		• Undertake a pond study to determine the effects of headwater ponds on base flows, identify opportunities to retrofit or decommission existing ponds	• Undertake a comprehensive water allocation strategy to determine current water usage and use as a basis for future watertaking/conservation

	CN Intermodal (Proposed)	• Undertake study to achieve the following as part of the proposed development:
		  • Increase riparian habitat
		  • Enhance and protect forest habitat
		  • Increase corridors and linkages
		  • Reestablish linkages between forest blocks
			• Undertake study to achieve the following as part of the proposed development:
			  • Improve stream morphology where channel has been altered or may be altered using natural channel design techniques
			  • Improve fish habitat through reestablishment of riparian buffers
			  • Investigate removal/retrofit of on-line pond to improve fish movement/passage
			  • Ensure no impact on flood plain storage or conveyance
				• Undertake study to achieve the following as part of the proposed development:
				  • Improve thermal regime through riparian buffers
				  • Implement storm water management for both quality and quantity to address large impervious area
				  • Match pre- and post-development rising limbs on the flow hydrograph to minimize erosion and protect downstream stream morphology

	Tremaine Road Straightening	• Undertake study to achieve the following as part of the proposed development:
		  • Protect and reestablish riparian habitat
		  • Increase riparian habitat
		  • Increase corridors and linkages
			• Undertake study to achieve the following as part of the proposed development:
			  • Improve fish habitat through reestablishment of riparian buffers
			  • Maintain of improve stream morphology using natural channel design techniques
				• Undertake study to achieve the following as part of the proposed development:
				  • Improve thermal regime through riparian buffers

Figure 11

Bronte Creek Regeneration Plan
Indian Creek Subwatershed

Regeneration Approach:

- Stewardship Opportunity
- Project Opportunity
- Special Study

Regeneration Actions:

- Buffer
- Reforestation
- Aquatic Habitat
- Access and Interpretation
- Stream Morphology
- Water Quality
- Water Quantity

Regeneration Priority:

- High (modify)
- Moderate (enhance)
- Low (sustain)
- Not Applicable

Escarpment Tributaries

Milton Urban Expansion Area - Phase 2

Milton Urban Expansion Area - Phase 3

Tremaine Road Reconstruction

CN Rail Intermodal Facility

Ponds / Water Taking

Derry Rd to Britannia Rd

Britannia Rd to Tremaine Rd

Tremaine Rd to Bronte Confluence

Camp Sidrabane

Milton

Oakville

Burlington

Steeles Avenue

Derry Rd

Bronte Rd

Britannia Rd

Tremaine Rd

Bell School Line

Walkers Line

Lower Base Line Rd

Bronte Creek Watershed Study

Legend

- Municipal Boundary
- Hydro Corridor
- Niagara Escarpment
- Public Lands
- ESAs
- Quarries (Licensed Area)
- Provincially Significant Wetlands
- Locally Significant Wetlands
- Forest Cover
- Indian Creek Watershed

N

0 500 1000 1500 2000

Metres

Due to differences in mapping data accuracy, all boundaries are approximate.

Conservation Halton

August 2002

Mount Nemo Creek, Willoughby Creek & Lowville Creek: Regeneration Plan (Figure 12)

Subwatershed: Mount Nemo

Municipalities

- Region of Halton - City of Burlington

Subwatershed Area & Gradient

- Mount Nemo Creek 6.4 km^2 2.3%

Physiological Features

- Waterdown Moraine - stoney till, silty clay, low to medium recharge/discharge capability
- Niagara Escarpment and Spillway - sand and gravel deposits, high recharge/discharge capability

Significant Natural Features

- Bronte Creek Valley (ESA)
- Mount Nemo Escarpment Woods (ESA) includes Mount Nemo (P ES ANSI), Mount Nemo Escarpment (P LS ANSI), contains portion of Mount Nemo wetland complex (LW)

Significant Forest Cover

- Bronte Creek Valley (ESA)
- Mount Nemo Escarpment Woods (ESA)

Description

The headwaters of Mount Nemo Creek emanate from the base of the Niagara Escarpment at Mount Nemo. The subwatershed is characterized by intermittent flow conditions that reflect a lack of groundwater discharge and the presence of warmwater habitat conditions. On-line ponds and the lack of riparian vegetation in the upper portion of the watershed contribute to instream warming. Mount Nemo Creek supports an assemblage of tolerant warmwater forage fish species. Benthic sampling indicates that water quality in Mount Nemo Creek is moderately to substantially impaired and the watercourse is characterized by elevated nutrient levels, moderate to high temperatures, and low levels of dissolved oxygen.

Subwatershed: Willoughby Creek

Municipalities

- Region of Halton - City of Burlington

Settlement Areas

- Cedar Springs Community

Subwatershed Area & Gradient

- Willoughby Creek 7.0 km^2 1.2%

Physiological Features

- Waterdown Moraine - stoney till, silty clay, low to medium recharge/discharge capability
- Niagara Escarpment and Spillway - sand and gravel deposits, high recharge/discharge capability
- Norfolk Sand Plain- sand and silt, high recharge/discharge capability

Significant Natural Features

- Lake Medad and Medad Valley (ESA) includes Lake Medad and Spillway channel (R ES ANSI), Lake Medad Valley Swamp (PW), Medad Valley (P LS ANSI)
- Bronte Creek Ravine/ Lowville-Bronte Creek Escarpment Valley (ESA)
- Colling Rd. Marsh (LW)
- Lake Medad Valley Swamp (PW)
- Mount Nemo Wetland Complex (LW)
- Lake Medad and Medad Valley (ESA)
- Bronte Creek Ravine/ Lowville-Bronte Creek Escarpment Valley (ESA)

Description (Willoughby Creek Continued)

Willoughby Creek represents an area of extensive groundwater discharge, particularly through the Medad Valley and the Bronte Creek Escarpment Valley. Groundwater discharge and significant forest cover characterize the headwater area downstream to Colling Road. The east branch formerly originated on the lands currently owned and licensed by Nelson Aggregates, but now existing flows are maintained by quarry pumping operations which discharge to Colling Road immediately north of the Burlington Springs Golf and Country Club. Much of the watershed remains in a naturalized state, though barriers to fish passage and thermal impacts associated with numerous on-line ponds detract from water quality. A large dam structure is located on Willoughby Creek approximately 100 metres upstream of its confluence with Bronte Creek. Summer instream temperatures in Willoughby Creek are generally indicative of coolwater habitat though the sections of more marginal coolwater habitat are associated with a number of on-line ponds along Cedar Springs Road. Benthic sampling indicates that the water quality at the Britannia Road crossing is slightly impaired with elevated nutrients, low to moderate temperatures and moderate levels of dissolved oxygen. *E. coli* levels often exceed provincial objectives, particularly during rainfall events.

Subwatershed: Lowville Creek

Municipalities

- Region of Halton - City of Burlington

Subwatershed Area & Gradient

- Lowville Creek 7.0 km^2 1.2%

Physiological Features

- Peel Plain - clay silt, low recharge/discharge capability
- Waterdown Moraine - stoney till, silty clay, low to medium recharge/discharge capability
- Niagara Escarpment and Spillway - sand and gravel deposits, high recharge/discharge capability

Significant Natural Features

- Mount Nemo Escarpment Woods (ESA) includes Mount Nemo (P ES ANSI), Mount Nemo Escarpment (P LS ANSI)

Significant Forest Cover

- Mount Nemo Escarpment Woods (ESA)

Description

The headwaters of Lowville Creek originate from the escarpment slopes. These tributaries flow through an area of rural/agricultural land use and the Indian Wells Golf Course coalescing upstream (west) of Walkers Line. Most of the tributaries are intermittent, though one spring fed tributary that flows through the Lowville Golf Course supports permanent flow. Changes to the flow regime have led to intermittent flow conditions in its main branch downstream to Bronte Creek. Forest cover dissipates downstream of Walker's Line as the watercourse enters the Peel Plain. Summer instream temperatures in Lowville Creek are indicative of coolwater and warmwater habitat. Coolwater habitat extends downstream to Walkers Line with warmwater habitat present in the downstream reaches. Benthic sampling indicates that water quality near Lowville Creek's confluence with Bronte Creek is slightly impaired with elevated nutrients and moderate oxygen levels.

Mount Nemo Creek, Willoughby Creek & Lowville Creek: Regeneration Actions (Figure 12)

The Mount Nemo, Willoughby and Lowville Creek Regeneration Plan identifies:

- twelve reaches with specific stewardship recommendations;
- two site regeneration opportunities on public lands; and
- two opportunities for special studies.

Stewardship Opportunities

Burlington Springs, Indian Wells and Lowville Golf Courses
These golf courses offer an opportunity for naturalization efforts to coincide with public recreation. Stewardship efforts should focus on encouraging Audubon certification for the golf course, and minimizing the impacts of the golf course on the natural environment by optimizing pesticide and fertilizer use, retrofitting on-line ponds and managing water taking in a sustainable manner to provide sufficient downstream flows to maintain aquatic life and protect downstream riparian rights.

Ponds along Cedar Springs Road
Landowners with on-line ponds along Cedar Springs Road should be contacted to discuss the potential options to minimize and eliminate the adverse effects associated with the ponds. Removal or retrofitting of the ponds, the reduction and elimination of pesticide and fertilizer use for cosmetic purposes, and the reestablishment of buffer habitats by plantings and not mowing lawns adjacent to the ponds would improve and protect the existing coldwater fisheries downstream. Removal of ponds would also result in the decrease of fecal coliforms associated with geese in the ponds. Improving riparian habitat would enhance fish and wildlife linkages between Medad Valley and the main Bronte Creek. Protection of groundwater discharge areas should be implemented. Removal of the ponds would enhance the degraded coolwater habitat and provide more suitable brook trout habitat.

Cedar Springs Community On-Line Pond
The Cedar Springs Community on-line pond has historical value within the community. The current dam partitions the rainbow trout and brown trout communities from the native brook trout populations. The opportunity for a community-based project should focus on removal or retrofitting of the on-line pond, increasing and enhancing riparian cover and identifying sources and control measures of bacterial contamination.

Mount Nemo Scout Camp
The Mount Nemo Scout Camp should continue to be used to promote environmental awareness and stewardship through the Scouts and Board of Education Programs. Reforestation on the property should be further encouraged to enhance interior forest habitat.

Mount Nemo Creek, Mount Nemo Headwater Ponds, Lowville Creek Tributaries and Lowville Creek West Tributary
Restoration efforts should focus on encouraging riparian buffers and eliminating mowing along the watercourses to improve water quality. Linkages between the Niagara Escarpment, Bronte Creek and Nelson Escarpment Woods should be enhanced by reforestation. Landowners should be encouraged to remove or retrofit on-line ponds to improve water quality. At one location a horse manure pile should be relocated or the runoff from the pile contained to protect and improve water quality along the Lowville Creek West Tributary. Monitoring of summer baseflows and instream temperatures should be conducted in Lowville Creek to determine the feasibility of reintroducing resident trout species.

Intensive Livestock Operation
Efforts should be taken to investigate the effects of an intensive livestock operation with its related manure lagoon on water quality in the Mount Nemo Tributary.

Mount Nemo ANSI/ESA
The ANSI/ESA is a prominent natural feature along the Niagara Escarpment which contains significant biological and natural features which require protection such as the old growth cedar communities. Efforts should be made to reforest fields adjacent to the ESA to enhance interior forest habitat and encourage dedication of the ANSI and ESA to a public agency

Project Opportunities

Conservation Halton Administration Office
Ongoing efforts at the Conservation Halton Administration Office have focused on naturalizing the surrounding area by native prairie and tree plantings. Conservation Halton should continue to maintain the project and use the site as a demonstration project to interpret the benefits of restoration and reduction of lawn mowing to the public.

Mount Nemo Conservation Area
The conservation area is under the administration of Conservation Halton and encompasses wonderfully diverse and unique communities. Efforts should be directed to reforestation of the fields adjacent to the ESA to enhance interior forest habitat and to the continued protection of the old growth forest.

Special Studies

Mount Nemo Conservation Area
Due to the proximity of this Conservation Area to urban areas, the site is increasing in public use. As a result, a balance must be struck between public use of the natural areas and the protection of the natural resources. A sustainability study should be undertaken to further investigate the effects of trail usage and rock climbing on cliff edge and old growth cliff forests. The delicate cliff communities are susceptible to damage and their protection should be made a priority within the park master planning process.

Nelson Quarry
A review should be undertaken to investigate the dewatering and pumping regime of the quarry to Willoughby Creek. With the imminent closure and decommissioning of the quarry, a examination of the rehabilitation plans should be conducted to identify long term rehabilitation efforts, focusing on the reestablishment of terrestrial habitats and linkages.

Mount Nemo Conservation Area

Table 6. Mount Nemo, Willoughby and Lowville Creek Subwatersheds Regeneration Actions

STEWARDSHIP OPPORTUNITIES				
		Buffer Strips and Reforestation	**Stream Morphology, Fish /Wildlife**	**Water Quality and Water Quantity**
	Burlington Springs Golf Course		• Encourage Audubon certification or equivalent	• Optimize pesticide/fertilizer use to protect water quality • Manage water taking in a sustainable manner to provide sufficient downstream flows to sustain aquatic life as well as provide a water supply for the golf course
	Cedar Springs Road Ponds	• Reestablish riparian buffers around ponds and along watercourse • Discourage mowing adjacent to the ponds	• Work with landowners to encourage taking ponds off line to improve fish habitat • Strengthen fish and wildlife linkages from Medad valley to main Bronte Creek	• Improve thermal regime by removal of on-line ponds and shading of watercourse • Investigate bacterial input to watercourse (geese) • Protect points of groundwater discharge • Encourage reduction /elimination of pesticide and fertilizer use for cosmetic purposes
	Cedar Springs Community On-line Pond	• Encourage riparian buffers and reduction in mowing along watercourse upstream of pond	• Dam provides fish partitioning between brown and rainbow trout and native brook trout populations • Improvements to fish habitat • Retrofit on-line pond to improve thermal regime	• Improve thermal regime by removal of on-line pond and shading of watercourse • Identify sources of bacteria /and examine ways to control
	Mount Nemo Scout Camp	• Encourage continued reforestation of property to enhance interior forest habitat	• Continue to promote environmental awareness and stewardship through the Scouts and Board of Education programs	
	Mount Nemo Creek	• Strengthen linkages between Niagara Escarpment, Bronte Creek and Nelson Escarpment Woods through reforestation and riparian buffers		• Improve thermal regime and control sedimentation through riparian buffers
	Mount Nemo Headwater Ponds			• Encourage landowners to remove on-line ponds to improve base flow and temperature
	Intensive Livestock Operation			• Investigate the effect of intensive livestock operation/ lagoon on water quality in Mount Nemo tributary
	Mount Nemo ANSI/ESA	• Encourage reforestation of fields adjacent to ESA/ANSI to enhance interior forest habitat • Encourage dedication of the ANSI/ESA to a public agency		
	Indian Wells Golf Course		• Encourage Audubon certification or equivalent • Investigate opportunities for taking ponds off-line	• Optimize irrigation, fertilizer, and pesticide use to minimize impact on Lowville Creek
	Lowville Golf Course		• Encourage Audubon certification or equivalent	• Optimize irrigation, fertilizer, and pesticide use to minimize impact on Lowville Creek • Sustain and enhance base flows to downstream tributary to protect riparian rights and aquatic habitat
	Lowville Creek Tributaries	• Encourage riparian buffers and reduction in mowing along watercourses		• Improve thermal regime and control sedimentation through riparian buffers
	West Tributary	• Reestablish riparian buffers		• Encourage landowner to relocate horse manure pile or contain runoff to protect/improve water quality
PROJECT OPPORTUNITIES				
		Buffer Strips and Reforestation	**Stream Morphology, Fish /Wildlife**	**Water Quality and Water Quantity**
	Conservation Halton Administration Office	• Continue to maintain naturalization project surrounding the administration office • Use as demonstration project to interpret the benefits of restoration and reduction in lawn mowing to the public		
	Mount Nemo Conservation Area	• Reforestation of fields adjacent to ESA/ANSI to enhance interior forest habitat • Continued protection of old growth forest		
SPECIAL STUDY				
		Buffer Strips and Reforestation	**Stream Morphology, Fish /Wildlife**	**Water Quality and Water Quantity**
	Mount Nemo Conservation Area	• Undertake a sustainability study to ensure balance between public use and natural area protection (trail usage/cliff edge, rock climbing/old growth cliff forest)		
	Nelson Quarry	• long term rehabilitation of terrestrial linkages		• review the dewatering and pumping regime of the quarry focusing on discharge to Willoughby Creek • review of quarry closure and rehabilitation plans to determine potential effects on the Willoughby Creek and identify opportunities to improve water quality, base flows, and terrestrial linkages

Figure 12

Bronte Creek Regeneration Plan

Mt Nemo, Willoughby and Lowville Creek Subwatersheds

Regeneration Approach:

- Stewardship Opportunity
- Project Opportunity
- Special Study

Regeneration Actions:

- Buffer
- Reforestation
- Aquatic Habitat
- Access and Interpretation
- Stream Morphology
- Water Quality
- Water Quantity

Regeneration Priority:

- High (modify)
- Moderate (enhance)
- Low (sustain)
- Not Applicable

Lowville Creek Tributary

Indian Wells Golf Course

Scout Camp

Intensive Livestock Operation

Mt Nemo CA

Lowville Golf Course

West Tributary

Cedar Springs Pond

Cedar Springs Rd Ponds

Conservation Halton Administration Office

Burlington Springs Golf Course

Nelson Quarry

Mt Nemo ANSI/ESA

Headwater Ponds

Mt Nemo Creek

Britannia Road

Walkers Line

Blind Line

Guelph Line

Cedar Springs Road

Burlington

401

Bronte Creek Watershed Study

Lowville

Mt Nemo

Willoughby

Legend

- Municipal Boundary
- Hydro Corridor
- Niagara Escarpment
- Public Lands
- ESAs
- Quarries (Licensed Area)
- Provincially Significant Wetlands
- Locally Significant Wetlands
- Forest Cover
- Area of Watersheds

N

0 500 1000 1500 2000

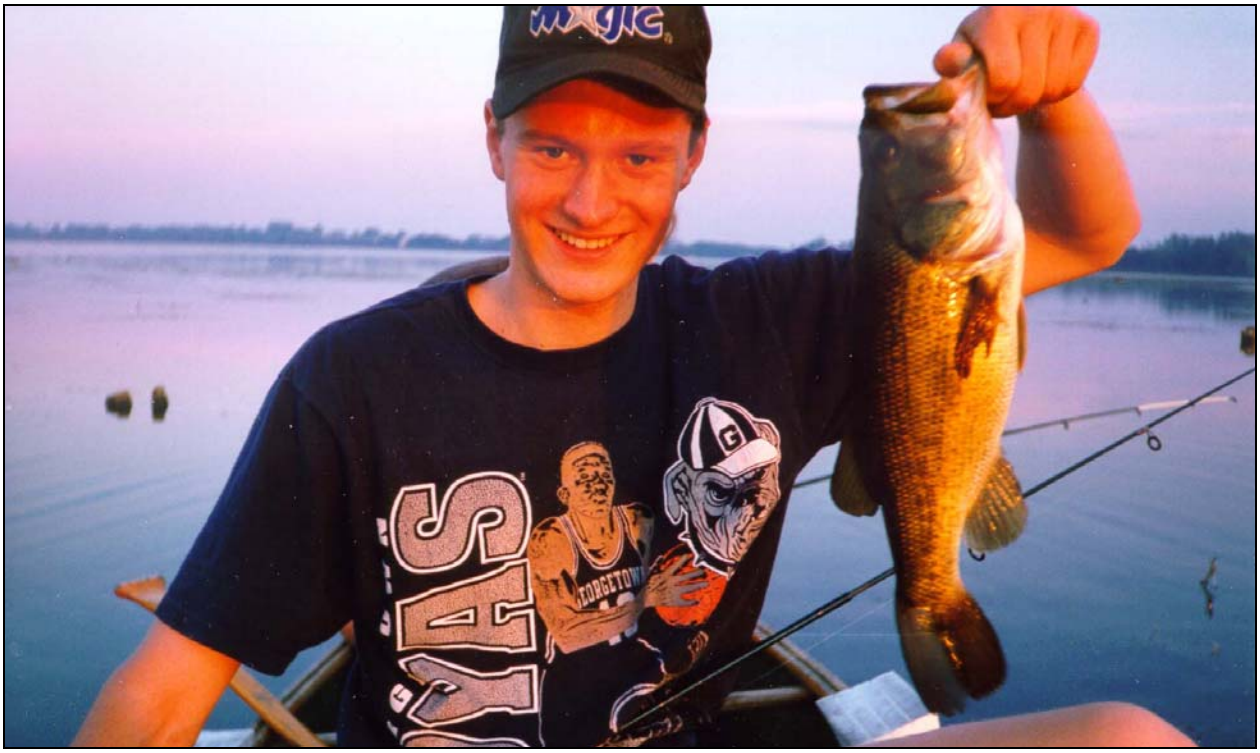
Metres

Due to differences in mapping data accuracy, all boundaries are approximate.

Conservation Halton

August 2002

Mountsberg Creek at Courtcliffe Park



Largemouth Bass caught in Mountsberg Reservoir

Mountsberg Creek : Regeneration Plan (Figure 13)

Subwatershed: Mountsberg Creek

Municipalities

- City of Hamilton
- Region of Halton - Town of Milton
- Wellington County - Township of Puslinch

Settlement Areas

- Brookville, Carlisle, Darbyville, Moffat

Subwatershed Area & Gradient

- Mountsberg Creek 46.7 km^2 0.3%

Physiological Features

- Flamborough Plain- limestone plain overlain by boulder, sand and gravel till, medium recharge/discharge capability
- Galt and Moffat Moraines- bands of hummocky terrain and gravel/sand outwash deposits, high recharge/discharge capability

Significant Natural Features

- Carlisle North Forests (ESA) includes North Carlisle Swamp Wetland (LW), Lower Mountsberg Creek Complex (PW)
- Freelton Esker-Wetland Complex (ESA)
- Puslinch Southeast Wetland (ESA)
- Aberfoyle Woods (ESA)
- Mountsberg East Wetlands (ESA) includes Lower Mountsberg Creek Complex (PW)
- Mountsberg Wildlife Area (ESA) includes Mountsberg Reservoir Marsh (PW), Mountsberg Wildlife Centre R LS ANSI, Lower Mountsberg Creek Complex (PW)
- Moffat Swamp/Moffat Marsh/Fish Hatchery Swamp (ESA) includes Badenoch-Moffat Wetland Complex (PW)
- Brookville Drumlin Field (ESA) includes Brookville Swamp (R LS ANSI)
- Brookville Swamp (ESA) includes Brookville Swamp (R LS ANSI)
- Exhumed Silurian Reef (R ES ANSI)
- Paris, Galt and Moffat Moraines (P ES ANSI)
- Mill Creek Wetland (PW)

Significant Forest Cover

- Carlisle North Forests (ESA)
- Freelton Esker-Wetland Complex (ESA)
- Puslinch Southeast Wetland (ESA)
- Aberfoyle Woods (ESA)
- Mountsberg East Wetlands (ESA)
- Mountsberg Wildlife Area (ESA)
- Moffat Swamp/Moffat Marsh/Fish Hatchery Swamp (ESA)
- Brookville Drumlin Field (ESA)
- Brookville Swamp (ESA)
- North east portion of subwatershed

Description

The headwaters of Mountsberg Creek arise within the provincially significant Badenoch-Moffat Swamp complex/ESA on the Flamborough Plain. Land use is predominately rural and agricultural. Upstream of the Mountsberg Reservoir, summer instream temperatures are indicative of a mix of marginal coolwater/warmwater temperatures from the headwaters downstream to Moffat. Flows in this reach may become intermittent during periods of drought. West of Moffat, five tributaries enter the main branch which contribute permanent baseflow and, where unimpeded by on-line ponds, coldwater discharge to Mountsberg Creek. These coolwater and coldwater

Description (Mountsberg Creek Continued)

habitats support brook trout and a variety of forage fish species. Northern pike have colonized significant portions of the watercourse and tributaries upstream of the reservoir and appear to be using the marsh wetlands as spawning areas. Benthic sampling indicated that water above the reservoir is slightly to moderately impaired. Mesotrophic conditions, moderate oxygenation and moderate temperatures characterize much of the reach. Significant thermal impacts are associated with discharge from the Mountsberg Reservoir. Warmwater habitat conditions generally extend downstream of the Mountsberg Reservoir to the Bronte Creek confluence. Small, isolated populations of brown trout and, possibly, brook trout persist in this reach; however, the fish community is dominated by centrarchids and forage fish. Northern pike have also been observed in this reach. Benthic sampling indicates that water quality below the reservoir is slightly impaired. Mesotrophic conditions, moderate to high dissolved oxygen levels and low to moderate temperatures characterize the watercourse.

Mountsberg Creek: Regeneration Actions (Figure 13)

The Mountsberg Creek Regeneration Plan identifies:

- six reaches with specific stewardship recommendations;
- two site regeneration opportunities on public lands; and
- two opportunities for special study.

Stewardship Opportunities,

Mountsberg Creek Headwaters, Upstream of Moffat Swamp, Calfass Road and Town Line Area, and the Carlisle Area

Stewardship efforts in these areas should focus on enhancing riparian habitats along the watercourses to improve fish habitat and water quality. Opportunities also exist to improve stream morphology using natural channel design where the channel has been altered in the Mountsberg Creek headwaters. On-line ponds should also be taken offline or retrofitted to minimize the effects on the creek.

Rainbow Ranch

The current site houses several commercial fishing ponds and has been associated with downstream water quality impacts. However, the site has been considered as a potential site for an expanded water bottling operation, which would require landuse policy changes requiring a water taking permit and an environmental impact assessment to support the application. This presents an opportunity to improve the water quality and downstream baseflow by removing or retrofitting the on-line ponds.

Moffat Badenoch Wetland Complex

The Moffat Badenoch Wetland Complex consists of large contiguous forested areas that provide important habitat for interior forest bird species and other wildlife. These wetlands help in maintaining water quality and may contribute significant groundwater discharge. Stewardship efforts should focus on the protection and enhancement of this provincially significant wetland. The site should be enhanced through reforestation. Land acquisition and dedication to public agencies should be encouraged.

Project Opportunities

Mountsberg Reservoir and Wetland

The Mountsberg East Wetland and the Mountsberg Wildlife Area encompass a large area of provincially significant wetlands. The wetlands are important for groundwater recharge and assist in maintaining water quality. The reservoir, though artificial, is recognized as a provincially significant waterfowl staging area and a significant stopover for migrating shorebirds and passerines. Efforts should be made to protect, maintain and enhance the existing wetland, shorebird, waterfowl, osprey and fish habitats. Efforts should continue to promote environmental awareness and stewardship at Mountsberg through education programs and interpretive signage. It is further suggested that riparian habitat should be improved on the lands surrounding the reservoir and at the reservoir outlet to help alleviate thermal effects and help maintain water quality.

Courtcliffe Park
Courtcliffe Park is located at the confluence of the Bronte Creek with Mountsberg Creek. Extensive channel alterations in Courtcliffe Park have created conditions that resulted in degraded water quality. An excellent community-driven restoration initiative is on-going. Restoration efforts are underway to remove the on-line ponds and restore the natural meander pattern of the watercourse using natural channel design techniques. Other opportunities at the site include the enhancement of riparian habitat along the watercourse, enhancement and reforestation of portions of the forest community, and public education through interpretive signage. An archaeological study is necessary prior to stream restoration.

Special Studies

Mountsberg Reservoir and Wetland
Significant thermal impacts are associated with the Mountsberg Reservoir. Warmwater habitat conditions extend downstream of the Mountsberg Reservoir to the Bronte Creek confluence. A study should be undertaken to examine the opportunities to reduce these thermal impacts. Furthermore, a watershed-wide fisheries management plan, that includes a northern pike management strategy, should be implemented to reduce upstream and downstream impacts on the native fish community. This plan should also incorporate fishing enforcement and education.

Graevette Springs/Water Bottling
A special study should be conducted to determine the capacity for water taking at the site and its effect on aquatic habitat. A model for water taking should be developed to determine base flows and other hydrogeological information. The on-going water quality monitoring should continue.

Mountsberg Reservoir

Table 7. Mountsberg Creek Subwatershed Regeneration Actions

STEWARDSHIP OPPORTUNITIES				
		Buffer Strips and Reforestation	**Stream Morphology, Fish /Wildlife**	**Water Quality and Water Quantity**
	Mountsberg Creek Headwaters	• Enhance riparian habitat along watercourse	• Examine opportunities to improve stream morphology where the channel has been altered using natural channel design techniques.	
	Upstream of Moffat Swamp	• Enhance riparian habitat along watercourse	• Improve fish habitat through reestablishment of riparian buffers	
	Rainbow Ranch		• If a change in the landuse is proposed, work with landowner to encourage retrofitting or taking ponds off-line to improve downstream fish habitat	• Improve thermal regime and nutrient input by removal of on-line ponds and shading of watercourses • Protect points of groundwater discharge • Potential site for water bottling may require landuse policy change, Permit to Take Water and a study in support of application
	Moffat Badenoch Wetland Complex	• Protection and enhancement of Provincially Significant Wetland through reforestation • Encourage dedication/acquisition of the Provincially Significant Wetland to a public agency		
	Calfass Road and Town Line Area	• Enhance riparian habitat along watercourse	• Improve fish habitat through reestablishment of riparian buffers	
	Carlisle Area	• Enhance riparian habitat along watercourse	• Improve fish habitat through reestablishment of riparian buffers	
PROJECT OPPORTUNITIES				
		Buffer Strips and Reforestation	**Stream Morphology, Fish /Wildlife**	**Water Quality and Water Quantity**
	Mountsberg Reservoir and Wetland	• Protect and maintain existing wetland habitat • Restore riparian habitat near outlet • Continue to promote environmental awareness and stewardship through interpretive programs and signage	• Protect and enhance existing shorebird, waterfowl, osprey and fish habitat	• Improve thermal regime through reestablishment of riparian buffers
	Courtcliffe Park	• Protect and rehabilitate riparian habitat around ponds and along watercourse • Enhance forest community • Provide public education through interpretive signage to describe the restoration efforts and natural heritage • Undertake archaeology study prior to restoration work	• Improve coolwater fish habitat and structure • Improve stream morphology as per the recommendations of the Courtcliffe Park Stream Morphology Study (removal of additional channels, reinstate meanders) • Protect and enhance existing fish and wildlife habitat	• Remove on-line ponds to improve base flow and temperature • Improve thermal regime through reestablishment of riparian buffers
SPECIAL STUDY				
		Buffer Strips and Reforestation	**Stream Morphology, Fish /Wildlife**	**Water Quality and Water Quantity**
	Mountsberg Reservoir and Wetland		• Develop a fisheries management plan which examines pike management, fishing enforcement and public education (multilingual), etc.	• Undertake a study to examine opportunities to reduce thermal impacts downstream of reservoir
	Graevette Springs/Water bottling		• Determine effects on aquatic habitat	• Undertake a study to determine the capacity for water taking • Determine base flows, hydrogeological information • Develop model for water taking • Continue on-going water quality monitoring

Figure 13

Bronte Creek Regeneration Plan
Mountsberg Creek Subwatershed

Regeneration Approach:

- Stewardship Opportunity
- Project Opportunity
- Special Study

Regeneration Actions:

- Buffer
- Stream Morphology
- Reforestation
- Water Quality
- Aquatic Habitat
- Water Quantity
- Access and Interpretation

Regeneration Priority:

- High (modify)
- Moderate (enhance)
- Low (sustain)
- Not Applicable

Mountsberg Creek Headwaters

Upstream of Moffat Swamp

Graevette Springs

Rainbow Ranch

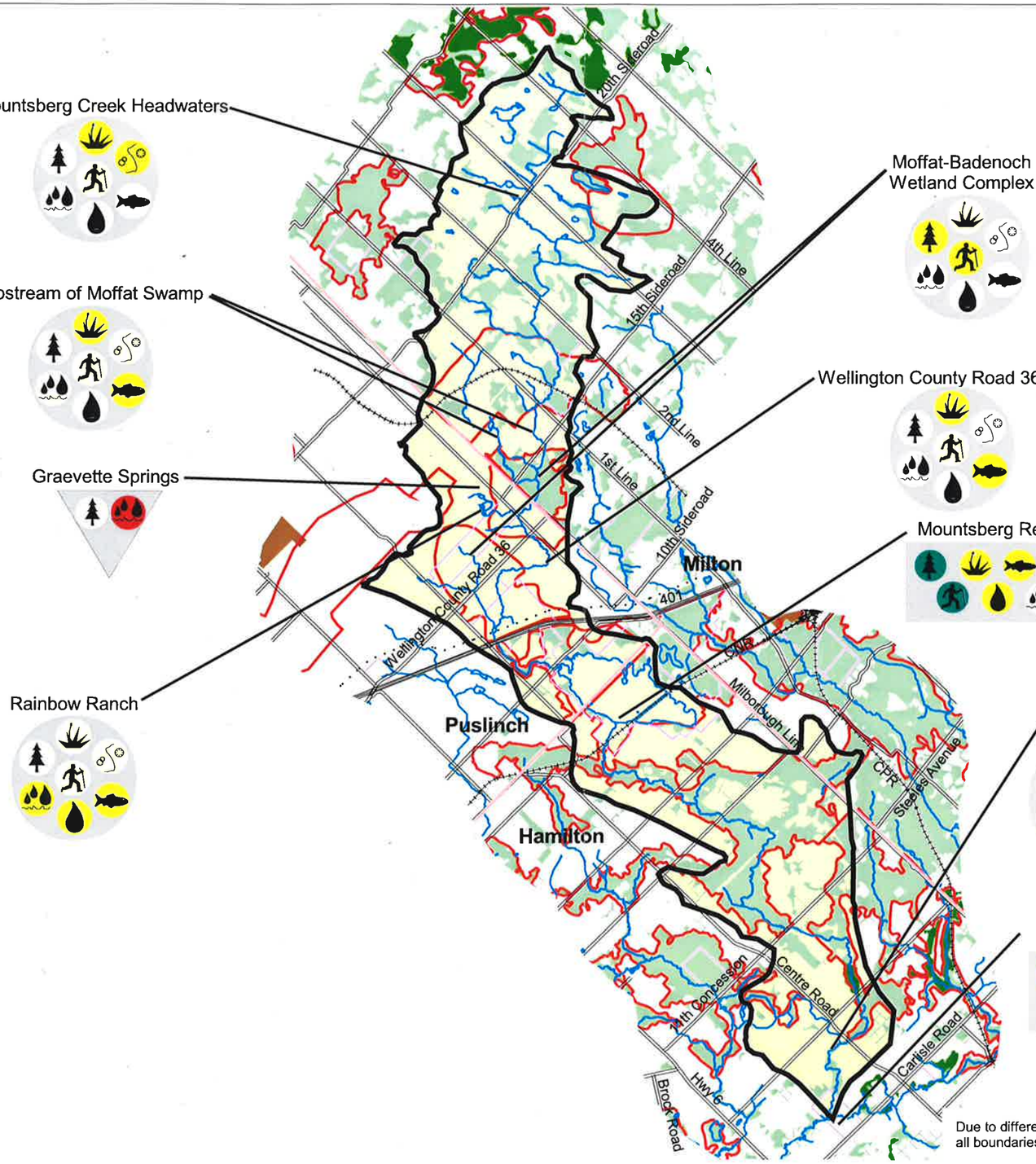
Moffat-Badenoch Wetland Complex

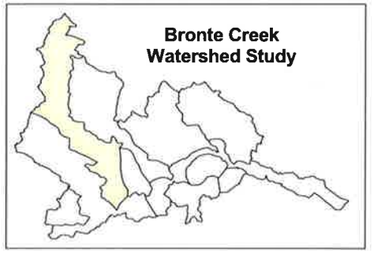
Wellington County Road 36 and Town Line Area

Mountsberg Reservoir and Wetland

Carlisle Area

Courtcliffe Park





Legend

- Municipal Boundary
- Hydro Corridor
- Niagara Escarpment
- Public Lands
- ESAs
- Quarries (Licensed Area)
- Provincially Significant Wetlands
- Locally Significant Wetlands
- Forest Cover
- Mountsberg Watershed

N

0 1000 2000

Metres

Due to differences in mapping data accuracy, all boundaries are approximate.

Conservation Halton

August 2002

Kilbride Creek and Guelph Junction Woods

Fish sampling

Kilbride Creek & Flamboro Creek: Regeneration Plan (Figure 14)

Subwatershed: Kilbride Creek

Municipalities

- Region of Halton - City of Burlington, Town of Milton

Settlement Areas

- Kilbride, Haltonville

Subwatershed Area & Gradient

- Kilbride Creek 34.6 km^2 0.5%

Physiological Features

- Norfolk Sand Plain - sand and silt, high recharge/discharge capability
- Niagara Escarpment and Spillway - sand and gravel deposits, high recharge/discharge capability
- Flamborough Plain- limestone plain overlain by boulder, sand and gravel till, medium recharge/discharge capability

Significant Natural Features

- Progreston North Swamp (ESA) includes North Progreston Swamp (LW)
- Hilton Falls Complex (ESA) includes Halton Forest South (P LS ANSI)
- Guelph Junction Woods (ESA) includes Guelph Junction Wetland Complex (PW)
- Calcium Pits (ESA) includes Kilbride Swamp (R LS ANSI)
- Mountsberg Wildlife Area (ESA) includes Mountsberg Wildlife Centre (R LS ANSI),
- Mountsberg East Wetlands (ESA) includes Guelph Junction Wetland Complex (PW)
- North Progreston Swamp (LW)
- Kilbride Swamp (LW)
- Paris, Galt and Moffat Moraines (P ES ANSI)

Significant Forest Cover

- Progreston North Swamp (ESA)
- Hilton Falls Complex (ESA)
- Guelph Junction Woods (ESA)
- Calcium Pits (ESA)
- Mountsberg Wildlife Area (ESA)
- Mountsberg East Wetlands (ESA)
- East of Twiss Road and South of Steeles Ave.
- Northern portion of subwatershed

Description

Kilbride Creek originates above the Niagara Escarpment within the Guelph Junction Wetland Complex. With the exception of Kilbride, land use within the subwatershed is dominated by rural/agricultural activities. The creek is fed by groundwater discharge and supports a healthy population of resident brook trout. Immediately upstream of Kilbride, flows may become intermittent during drought conditions. Summer instream temperatures in Kilbride Creek are indicative of coolwater and marginal coolwater/warmwater habitats. Areas of groundwater discharge appear to provide coolwater refugia in marginal habitats. Downstream of Kilbride Falls, a natural feature associated with the escarpment, the creek supports brook trout and rainbow trout. Rainbow trout and occasional brown trout inhabit the reach extending from the confluence upstream to the waterfall east of Cedar Springs Road. A diverse assemblage of forage fish species is found throughout. Benthic and water chemistry sampling indicate that water quality in Kilbride Creek is generally non-impaired.

Subwatershed: Flamboro Creek

Municipalities

- City of Hamilton
- Region of Halton - City of Burlington, Town of Milton

Subwatershed Area & Gradient

- Flamboro Creek 8.7 km^2 0.5%

Physiological Features

- Flamborough Plain- limestone plain overlain by boulder, sand and gravel till, medium recharge/discharge capability
- Norfolk Sand Plain- sand and silt, high recharge/discharge capability
- Niagara Escarpment and Spillway - sand and gravel deposits, high recharge/discharge capability

Significant Natural Features

- Progreston North Swamp (ESA) includes North Progreston Swamp (LW)
- Carlisle North Forests (ESA)
- Bronte Creek Ravine/ Lowville-Bronte Creek Escarpment Valley (ESA)

Significant Forest Cover

- Progreston North Swamp (ESA)
- Carlisle North Forests (ESA)
- Bronte Creek Ravine/ Lowville-Bronte Creek Escarpment Valley (ESA)
- North-east portion of subwatershed

Description

Flamboro Creek originates from a series of wetlands associated with the Lower Mountsberg Creek complex and the North Progreston Swamp. A large on-line pond within the Carlisle Golf and Country Club property is located at the downstream boundary of the swamp. Downstream of the pond, the creek re-enters a wetland system that gives way to the deeply incised Bronte Creek Escarpment Valley, extending downstream to Bronte Creek. Summer instream temperatures in Flamboro Creek are indicative of coolwater and marginal coolwater/warmwater habitats. Groundwater discharge contributes to coolwater conditions in the headwaters while the large on-line pond associated with the Carlisle Golf and Country Club results in downstream warming which, in turn, is counteracted by extensive groundwater discharge as the tributary enters the Bronte Creek valley. Brook trout are present in the headwaters and in the lower reaches within the Bronte Creek valley. Rainbow trout and brown trout also inhabit the lower reaches of Flamboro Creek. A moderately diverse forage fish community is also present. Benthic and water chemistry sampling indicate that the water quality in Flamboro Creek is generally non-impaired, though thermal impacts and elevated metal and nutrient concentrations have been detected, particularly downstream of the Carlisle Golf and Country Club pond.

Kilbride Creek & Flamboro Creek: Regeneration Actions (Figure 14)

The Kilbride and Flamboro Creeks Regeneration Plan identifies:

- nine reaches with specific stewardship recommendations; and
- one opportunity for a special study.

Stewardship Opportunities

Kilbride Creek near 10th Sideroad, Coral Park, Serbian Orthodox Diocese
Opportunities exist at these sites to improve and enhance riparian buffers to improve water quality and fish habitat. Opportunities also exist to improve stream morphology using natural channel design techniques in the 10th Sideroad area and Serbian Orthodox Diocese area. Furthermore, on-line ponds in these areas could be removed or reconfigured to enhance coolwater habitats.

Mohawk Race Track
Stewardship efforts should examine the opportunities to improve water quantity and quality with respect to the sewage lagoon, manure storage, storm water management facility and large impervious parking area associated with the race track.

Campbellville Industrial Area
The Campbellville Industrial Area is located in the vicinity of the Guelph Junction Woods that encompass portions of two provincially significant wetland complexes. The area represents a major recharge zone. Opportunities exist to reforest wetland areas impacted by the industrial encroachment, prevent further encroachment into the wetland and reestablish riparian buffers separating the industrial area and the wetland. Land use practices on the site should be controlled and proper stormwater management practices should be implemented to protect water quality. Removal of materials and fill dumped into the wetland areas at the site should be made a priority, and further dumping prohibited. Lastly, water quality should continue to be monitored to ensure that the industrial developments are not causing adverse impacts.

Campbellville Aggregate Extraction and Expansion
Stewardship efforts should work in conjunction with the Campbellville Aggregate Extraction and Expansion operations to protect and enhance existing forested areas, fish and wildlife habitat associated with the Guelph Junction Woods ESA and wetlands. Tree cutting and other impacts to existing woodlots should be minimized. Opportunities also exist to enhance stream morphology using natural channel design techniques.

Guelph Junction Woods ESA
Portions of the ESA have been designated as part of the Niagara Escarpment biosphere reserve, and also includes portions of two provincially significant wetland complexes. Stewardship actions to reestablish, maintain and enhance forest habitat is recommended to improve wildlife linkages and corridors and reduce forest fragmentation where possible.

Carlisle North Wetlands
This area encompasses a provincially and a regionally significant wetland complex, that contain several provincially and regionally significant species. The area is important hydrologically in the maintenance of coldwater conditions in the headwaters of Flamboro Creek. The site has potential as a reforestation site to reduce fragmentation and enhance the existing interior forest habitat and linkages.

Carlisle Golf and Country Club
The golf course offers an opportunity for naturalization efforts to coincide with public recreation. Stewardship efforts should focus on encouraging Audubon certification for the golf course, and minimizing the impacts of the golf course on the natural environment by optimizing pesticide and fertilizer use, reducing mowing along the creek edge, and retrofitting on-line ponds and managing water taking in a sustainable manner to provide sufficient downstream flows to maintain aquatic life and protect downstream riparian rights.

Special Studies

Burns Conservation Area
A study should be conducted to investigate the feasibility of retrofitting the pond to minimize thermal impacts downstream. Riparian buffer habitats should be enhanced surrounding the pond. Dissolved oxygen levels should also be monitored to examine opportunities to reduce winter fish kill.

Burns Conservation Area

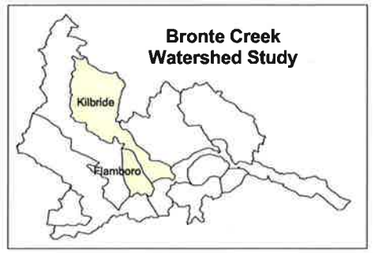
Table 8. Kilbride and Flamboro Creek Subwatersheds Regeneration Actions

STEWARDSHIP OPPORTUNITIES				
		Buffer Strips and Reforestation	**Stream Morphology, Fish /Wildlife**	**Water Quality and Water Quantity**
	Kilbride Creek near 10th Sideroad	• Reestablish riparian habitat	• Examine opportunities to improve stream morphology where the channel has been altered using natural channel design techniques • Improve fish habitat through reestablishment of riparian buffers	• Improve thermal regime and control sedimentation through riparian buffers
	Mohawk Race Track			• Examine opportunities to improve water quantity and quality with respect to the lagoon, manure storage, large impervious parking area, and SWM facilities, runoff etc.
	Campbellville Industrial Area	• Reforest wetland areas impacted by industrial encroachment • Prevent further encroachment into wetland • Reestablish riparian buffers separating industrial uses and wetland		• Control land use practices on site and require proper stormwater management to protect water quality • Require clean up of dumped materials to ensure water quality protection • Continue to monitor water quality to ensure industrial development is not impacting it
	Campbellville Aggregate Extraction and Expansion	• Protect and enhance forested areas associated with the Guelph Junction Woods ESA and wetland • Minimize impacts on woodlots; tree cutting	• Enhance stream morphology using natural channel design techniques • Minimize impacts on fish and wildlife	
	Guelph Junction Woods ESA	• Reestablish forest habitat to maintain/ enhance interior forest habitat & improve wildlife linkages and corridors • Reforest where opportunities exist to reduce forest fragmentation		
	Coral Park (Trailer Park)	• Expand/enhance riparian buffers	• Improve fish habitat through reestablishment of riparian buffers • Remove or retrofit on-line ponds to improve fish passage	• Improve thermal regime and control sedimentation through riparian buffers and retrofitting on-line ponds
	Serbian Orthodox Diocese	• Expand/enhance riparian buffers	• Modify/improve stream morphology using natural channel design techniques • Improve fish habitat through reestablishment of riparian buffers	• Improve thermal regime and control sedimentation through riparian buffers
	Carlisle North Wetlands	• Reforest where opportunities exist to reduce forest fragmentation and enhance interior forest habitat and linkages		
	Carlisle Golf and Country Club	• Encourage riparian buffers and reduce mowing along creeks	• Encourage Audubon certification or equivalent	• Continue to sustain outflows to the Flamboro Creek to protect downstream riparian rights and aquatic habitats
SPECIAL STUDY				
		Buffer Strips and Reforestation	**Stream Morphology, Fish /Wildlife**	**Water Quality and Water Quantity**
	Burns Conservation Area	• Enhance riparian buffers around pond	• Ensure oxygen levels are sufficient for fish habitat in pond	• Examine opportunities to reduce thermal impacts on downstream tributary • Monitor dissolved oxygen levels; examine opportunities to reduce winter fish kill

Figure 14

Bronte Creek Regeneration Plan

Kilbride and Flamboro Creek Subwatersheds



Regeneration Approach:

- Stewardship Opportunity
- Project Opportunity
- Special Study

Regeneration Actions:

- Buffer
- Reforestation
- Aquatic Habitat
- Access and Interpretation
- Stream Morphology
- Water Quality
- Water Quantity

Regeneration Priority:

- High (modify)
- Moderate (enhance)
- Low (sustain)
- Not Applicable

Kilbride Creek near 10th Sideroad

Mohawk Raceway

Campbellville Industrial Area

Guelph Junction Woods ESA

Coral Park

Burns CA

Campbellville Aggregate Extraction

Carlisle North Wetlands

Serbian Orthodox Diocese

Carlisle Golf Club

Milton

Hamilton

Burlington

20th Sideroad
2nd Line
1st Line
10th Sideroad
4th Line
Guelph Line
Calfass Road
Steeles Avenue
Berry Road
Milborough Line
Britannia Road
Centre Road

Legend

- Municipal Boundary
- Hydro Corridor
- Niagara Escarpment
- Public Lands
- ESAs
- Quarries (Licensed Area)
- Provincially Significant Wetlands
- Locally Significant Wetlands
- Forest Cover
- Watershed Area

N

0 1000 2000

Metres

Due to differences in mapping data accuracy, all boundaries are approximate.

Conservation Halton

August 2002

Limestone Creek below Derry Road

Benthic sampling

Limestone Creek: Regeneration Plan (Figure 15)

Subwatershed: Limestone Creek

Municipalities

- Region of Halton - City of Burlington, Town of Milton

Subwatershed Area & Gradient

- Lowville Creek 34.1 km^2 1.0%

Physiological Features

- Flamborough Plain - limestone plain overlain by boulder, sand and gravel till, medium recharge/discharge capability
- Niagara Escarpment and Spillway - sand and gravel deposits, high Recharge/discharge capability
- Till Moraine
- Peel Plain- clay silt, low recharge/discharge capability

Significant Natural Features

- Crawford Lake/Rattlesnake Point Escarpment Woods (ESA) includes Crawford Lake and Calcium Pits Wetland Complex (PW), Crawford Lake/Milton Outlier Valley (P LS ANSI), Nassagaweya Canyon Wetland (PW), Lowville Re-entrant Valley Central (P ES ANSI)
- Guelph Junction Woods (ESA) includes Crawford Lake and Calcium Pits Wetland Complex (PW)
- Calcium Pits (ESA) includes Crawford Lake & Calcium pits Wetland Complex (PW), Crawford Lake-Milton Outlier Valley (P LS ANSI), Kilbride Swamp (R LS ANSI), Lowville Re-entrant Valley Central (P ES ANSI)
- Milton Heights small portion (ESA)
- Milton Outlier Wetland (LW)
- Nassagaweya Canyon Wetland (PW)

Significant Forest Cover

- Crawford Lake/Rattlesnake Point Escarpment Woods (ESA)
- Guelph Junction Woods (ESA)
- Calcium Pits (ESA)
- Milton Heights small portion (ESA)
- North east and North west portion of subwatershed

Description

The headwaters of Limestone Creek originate from the Crawford Lake/Calcium Pits wetland and from the Nassagaweya Canyon. The west branch is characterized by significant forest cover and groundwater discharge with some adjacent agricultural activity. The east branch arises within the Flamborough Plain feature associated with the Milton Heights outlier. Significant groundwater discharge occurs in the area below the confluence to Derry Road. The creek further bisects several agricultural properties and the Crosswinds Golf and Country Club within the Peel Plain. Limestone Creek supports a diverse coldwater fish community highlighted by the presence of salmonids from its headwaters downstream to its confluence with Bronte Creek. Brook trout are common upstream of Walkers Line to the headwaters of the west branch and to the east branch dam. A small population of resident brown trout appears to inhabit Limestone Creek downstream of Derry Road. Limestone Creek is a significant producer of juvenile rainbow trout which eventually smolt and migrate downstream to Lake Ontario, returning to spawn as adults. Summer instream temperatures in Limestone Creek upstream of Derry Road are indicative of coolwater habitat. Downstream of Derry Road toward its confluence with Bronte Creek, instream temperatures become more marginal for salmonid production concomitant with decreases in riparian cover and groundwater inputs. Benthic and water chemistry sampling indicates that water quality in Limestone is non to slightly impaired; however, there was some indication of elevated nutrient levels.

Limestone Creek: Regeneration Actions (Figure 15)

The Limestone Creek Regeneration plan identifies:

- seven reaches with specific stewardship recommendations; and
- two site regeneration opportunities on public lands.

Stewardship Opportunities

Guelph Junction Woods ESA
The Guelph Junction Woods encompasses portions of two provincially significant wetland complexes and portions have also been designated as part of the Niagara Escarpment Biosphere Reserve. The area further acts as a major recharge zone for groundwater and is the headwater source for portions of Limestone and Kilbride Creeks. Efforts should concentrate on reestablishing, maintaining and enhancing the interior forest habitat, while improving wildlife linkages and corridors. Reforestation opportunities also exist to reduce forest fragmentation. It is further recommended that the ESA boundary be extended to include forests to the east of 2nd Line.

Sherman Sand and Gravel
The current sand and gravel pit operation offers an opportunity to work in conjunction with Sherman Sand and Gravel to rehabilitate and naturalize the existing operations approaching and following decommissioning. This effort should focus on enhancing the connection between the Niagara Escarpment and Limestone Creek, while enhancing riparian buffers and forest linkages and maintaining and enhancing coldwater habitats. It is also suggested that the on-line pond be removed to improve water quality and improve fish passage and habitat.

Money's Mushrooms
The Money's Mushrooms farm, located on Guelph Line, is adjacent to and includes portions of the Crawford Lake/Rattlesnake Point Escarpment Woods ESA. This ESA contains portions of two provincially significant wetland complexes and is associated with significant areas of groundwater recharge and discharge. Opportunities exist on the site for reforestation that would reestablish wildlife corridors and linkages to connect the escarpment with the Limestone Creek, and increase interior forest habitat. The proposed decommissioning and naturalization of the settling lagoon will help ensure long-term water quality in the tributary as well as increasing wildlife habitat.

West Branch, East Branch and Main Branch (below escarpment)
Many stewardship opportunities exist along several branches of Limestone Creek. Stewardship efforts should focus on reestablishing riparian habitats to maintain and enhance coldwater habitats. Reforestation opportunities also exist that would enhance interior forest habitat and improve wildlife linkages. In the west branch, efforts should be made to maintain permanent flow in the southern tributary, protect discharge areas and investigate the effects of Islay Lake and the existing fish ponds on water quality.

Limestone Creek at Britannia Road

Crosswinds Golf Course
Crosswinds Golf Course offers an opportunity for naturalization efforts to coincide with public recreation. Stewardship efforts should focus on encouraging Audubon certification for the golf course, minimizing the impacts of the golf course on the natural environment by optimizing pesticide and fertilizer use, and maintaining and protecting restored forests and riparian habitats.

Project Opportunities

Walkers Line Municipal Well
Wellhead protection should be made a priority to ensure water quality is not compromised. Future expansion and development should not impact base flows and fisheries in the area.

Rattlesnake Point, Crawford Lake and Kelso Conservation Areas
These public and well-used conservation areas offer a unique opportunity to promote environmental awareness and stewardship through interpretive programs and signage. Further opportunities exist to enhance, maintain, and protect forest habitat and wildlife linkages. The balance between public use and protection of natural heritage features should be investigated and should include a sustainability study that encompasses trail use, bike use and rock climbing. These natural areas contain very delicate natural ecosystems such as the old growth cedar forests and cliff communities that should be protected through the park master planning process.

Money's Mushroom farm – a stewardship opportunity

Table 9. Limestone Creek Subwatershed Regeneration Actions

STEWARDSHIP OPPORTUNITIES				
		Buffer Strips and Reforestation	**Stream Morphology, Fish /Wildlife**	**Water Quality and Water Quantity**
	Guelph Junction Woods ESA	• Reestablish forest habitat to maintain/ enhance interior forest habitat & improve wildlife linkages and corridors • Reforest where opportunities exist to reduce forest fragmentation • Extend ESA boundary to include forests to the east of 2nd Line		
	Sherman Sand & Gravel	• Opportunity to rehabilitate/ naturalize the sand and gravel pit following decommissioning to enhance the connection between the Niagara Escarpment and Limestone Creek • Enhance riparian buffers to maintain/enhance coldwater habitat & improve linkages	• Take pond offline to improve fish passage/ habitat	• Improve thermal regime through removal of on-line pond and riparian buffers
	Money's Mushrooms	• Opportunity to reconnect Limestone Creek with the Niagara Escarpment through reforestation • Decommission lagoon	• Opportunity to reestablish wildlife corridor /linkage through reforestation	• Decommission lagoon to benefit water quality in tributary
	West Branch	• Reestablish riparian habitat to maintain/ enhance coldwater habitat & improve linkages • Reforest where opportunities exist to enhance interior forest habitat	• Improve fish habitat through reestablishment of riparian buffers	• Maintain permanent flow in southern tributary & protect areas of discharge • Investigate fish ponds for potential nutrient enrichment • Improve thermal regime through reestablishment of riparian buffers and examine opportunities to retrofit Islay Lake outlet
	Crosswinds Golf Course	• Maintain and protect restored forest & riparian habitats	• Encourage Audubon certification or equivalent	• Optimize pesticide/fertilizer use to protect water quality
	East Branch	• Reestablish riparian habitat to maintain/enhance coldwater habitat & improve linkages • Reforest where opportunities exist	• Improve fish habitat through reestablishment of riparian buffers	• Encourage farmers to restrict livestock/farm animal access to creek to reduce erosion and nutrient enrichment
	Main Branch (below escarpment)	• Reestablish riparian habitat to maintain/enhance coldwater habitat & improve linkages • Protect existing forest habitat and reforest where opportunities exist		• Improve thermal regime through reestablishment of riparian buffers
PROJECT OPPORTUNITIES				
		Buffer Strips and Reforestation	**Stream Morphology, Fish /Wildlife**	**Water Quality and Water Quantity**
	Walkers Line Municipal well			• Well head protection (quality); ensure any future expansion does not impact base flows/fisheries
	Rattlesnake Point Conservation Area Crawford Lake Conservation Area Kelso Conservation Area	• Reforest where opportunities exist to reduce fragmentation, maintain /enhance interior forest habitat, and improve wildlife linkages • Investigate opportunities to balance public use and natural heritage protection • Undertake sustainability study (trail use, biking, climbing)		

Figure 15

Bronte Creek Regeneration Plan
Limestone Creek Subwatershed

Regeneration Approach:

- Stewardship Opportunity
- Project Opportunity
- Special Study

Regeneration Actions:

- Buffer
- Stream Morphology
- Reforestation
- Water Quality
- Aquatic Habitat
- Water Quantity
- Access and Interpretation

Regeneration Priority:

- High (modify)
- Moderate (enhance)
- Low (sustain)
- Not Applicable

Municipal Well

Kelso, Crawford & Rattlesnake CAs

Crosswinds Golf Course

East Branch

Main Branch (below escarpment)

Guelph Junction Woods ESA

Sherman Sand & Gravel

Money's Mushrooms

West Branch

Milton

Burlington

401

Guelph Line

2nd Line

GR

No. 3 Sideroad

Steeles Ave

Milborough Line

Derry Road

Britannia Road

Walkers Line

Bell School Line

Bronte Creek Watershed Study

Legend

- Municipal Boundary
- Hydro Corridor
- Niagara Escarpment
- Public Lands
- ESAs
- Quarries (Licensed Area)
- Provincially Significant Wetlands
- Locally Significant Wetlands
- Forest Cover
- Limestone Creek Watershed

N

0 500 1000 1500 2000

Metres

Due to differences in mapping data accuracy, all boundaries are approximate.

Conservation Halton

August 2002

The Colling Tract - Reforestation in the Lowville Creek watershed

Stewardship in action

TAKING RESPONSIBILITY

Implementation Actions and Strategies

The Stakeholders have identified a series of implementation actions and strategies that pertain to the watershed as a whole. The groups or agencies responsible and the priority for their implementation have been identified in Table 10. Some actions will be implemented through the planning process, others will be accomplished through the enforcement of regulations, and others through projects on public lands. However, the most important of the partners are the landowners and citizens of the watershed who will undertake restoration projects on their own lands.

The regeneration actions can be simply divided into four groups:

- Planning and regulatory actions that are mandated and prevent the deterioration of the landscape.
- Project opportunities on public lands which can set an example and create a legacy for future generations.
- Stewardship opportunities on private lands which may be undertaken if there is a desire to embrace regeneration.
- Studies that will assist groups of individual stakeholders to solve problems and the community to create opportunities.

Conservation Halton will oversee the implementation of the strategies and recommendations of Bronte Creek Watershed Study and report on progress on a regular basis. The study will be revisited, normally on a five year basis.

The Bronte Creek watershed must be protected for future generations

Table 10. Implementation Actions and Strategies

RECOMMENDATIONS/TARGETS		AGENCIES / GROUPS RESPONSIBLE													STRATEGIES / TASKS	
		Federal Government	Min. of Environment	Min. of Agriculture	Min. of Nat. Resources	Niagara Escarpment C.	Hamilton, Halton, Wellington	Local Municipality	Development Industry	Farm Community	Conservation Groups	Recreation Industry	Private Landowners	Stewardship	Conservation Halton	• Lead agency • Involved stakeholder	Priority (L) Low, (O) Ongoing, (I) Immediate
CARING FOR SURFACE WATER																	
1	Protect and enhance surface water quality		•	•						•				•	•	Identify all non-point pollution sources.	O
				•						•				•		Encourage all watershed farmers to complete and implement Environmental Farm Plans.	O
			•				•	•			•				•	Educate residents & businesses in pollution control techniques, e.g. household hazardous waste.	O
					•			•		•	•		•	•	•	Increase riparian buffers/habitat adjacent to watercourse.	O
							•	•		•			•	•	•	Implement regional Clean Water Program to assist with funding of stewardship initiatives.	I
			•				•	•						•		Educate homeowners on proper care/maintenance of septic systems.	O
			•		•		•	•	•					•	•	Encourage infiltration techniques to move water to groundwater to compensate for loses to impervious surfaces.	O
				•			•								•	Monitor surface water quality.	
			•				•	•				•	•	•		Encourage reduction/elimination of fertilizer and pesticide use for aesthetic purposes & BMPs for all other fertilizer and pesticide use.	O
								•			•			•	•	Implement Yellow Fish Road Program in urban areas.	L
2	Reduce sources of thermal pollution				•		•	•					•		•	Inventory all dams in watershed.	I
										•			•	•	•	Encourage landowners to remove on-line ponds.	I
					•					•			•	•	•	Retrofit on-line ponds with bottom-draw outlets.	I
		•			•										•	Prohibit new on-line ponds.	I
					•										•	Conduct feasibility study for techniques to reduce thermal impacts of Mountsberg Reservoir.	L
								•	•				•	•	•	Encourage cooling trenches, french drains etc. as part of stormwater management.	L
3	Reduce and/or mitigate the impacts of erosion							•							•	Identify all erosion-prone areas.	O
				•				•		•			•	•	•	Remediate all priority erosion-prone areas.	O
								•	•	•					•	Enact topsoil preservation/site alteration by-laws.	O
			•				•	•	•						•	Implement/enforce quality control on SWM facilities.	O
								•	•						•	Establish baseline data for compliance monitoring during subwatershed studies.	L
							•	•	•						•	Require subwatershed studies for all future development.	I
4	Protect areas of recharge and discharge				•		•								•	Identify all areas of discharge/recharge.	O
						•	•	•	•	•	•		•	•	•	Protect areas of discharge/recharge through acquisition, donation, conservation easements, and stewardship agreements.	O
								•	•	•			•	•	•	Protect areas of discharge/recharge with protective buffers.	O
					•	•	•	•							•	Protect all areas of discharge/recharge through Officials Plans, Site Plans and Zoning By-laws and the review of planning permit applications.	O

RECOMMENDATIONS/TARGETS		AGENCIES / GROUPS RESPONSIBLE														STRATEGIES / TASKS	
		Federal Government	Min. of Environment	Min. of Agriculture	Min. of Nat. Resources	Niagara Escarpment C.	Hamilton, Halton, Wellington	Local Municipality	Development Industry	Farm Community	Conservation Groups	Recreation Industry	Private Landowners	Stewardship	Conservation Halton	• Lead agency • Involved stakeholder	Priority (L) Low, (O) Ongoing, (I) Immediate
CARING FOR GROUND WATER																	
1	Protect groundwater quality		•				•			•					•	Conduct groundwater monitoring of water quality.	O
			•				•			•			•	•	•	Ensure wellhead protection, capping of unused wells.	I
								•		•			•	•	•	Encourage capture/treatment of local runoff to protect areas of recharge and wells.	O
2	Protect groundwater quantity						•								•	Complete aquifer mapping.	I
			•				•			•					•	Conduct groundwater monitoring of water levels.	O
			•				•	•							•	Update well water data base	I
			•				•	•							•	Update Permit To Take Water database, require renewal of expired permits.	I
			•				•	•							•	Revise/strengthen Permit To Take Water Process.	I
		•	•		•		•								•	Produce a water balance model encompassing surface & groundwater	L
CARING FOR NATURE																	
1	Protect wetlands					•	•	•	•	•			•		•	Protect all PS wetlands through Official Plans and Zoning By-laws as per the Provincial Policy Statement.	O
						•	•	•	•				•		•	Continue to protect all wetlands through CA regulations.	O
						•	•	•			•		•	•	•	Protect all wetlands through acquisition, donation, conservation easements, and stewardship agreements.	O
2	Improve quality of wetlands								•	•	•	•	•	•	•	Restore former wetlands/increase wetland areas (+1%).	O
3	Protect forest habitats					•	•	•	•	•	•	•	•	•	•	Maximize forest cover through stewardship opportunities.	O
					•	•	•	•	•	•			•		•	Protect significant woodlands through Official Plans and Zoning By-laws as per the Provincial policy statement.	I
						•	•	•			•		•		•	Protect forests through acquisition, donation, conservation easements, and stewardship agreements.	O
							•	•			•		•	•	•	Co-ordinate forest protection strategies/land acquisition between Regions, CA & private landowners.	I
							•	•						•	•	Enforce protection with existing tree cutting by-laws.	I
							•	•							•	Update/enact tree cutting by-laws	I
							•	•			•				•	Identify priority protection areas, significant woodlands, "core areas", "nodes" & embody in Official Plans, planning docs, secondary plans, etc.	O
							•	•							•	Restrict /prevent development in forested areas below the escarpment; Minimize impacts above the escarpment	I
							•						•		•	Manage plantations to convert to mixed forests.	O
					•		•	•					•		•	Protect truly unique forested areas from <u>all activities.</u>	I
						•	•	•	•						•	Protect forests through development application process.	O

TARGETS/RECOMMENDATIONS		AGENCIES / GROUPS RESPONSIBLE													STRATEGIES / TASKS	
		Federal Government	Min. of Environment	Min. of Agriculture	Min. of Nat. Resources	Niagara Escarpment C.	Hamilton, Halton, Wellington	Local Municipality	Development Industry	Farm Community	Conservation Groups	Recreation Industry	Private Landowners	Stewardship	Conservation Halton	• Lead agency • Involved stakeholder	Priority (L) Low, (O) Ongoing, (I) Immediate
CARING FOR NATURE																	
4	Protect/expand interior forest habitat						•	•			•		•	•	•	Encourage tree planting (infill) to increase forest cover through stewardship opportunities.	O
							•	•		•	•			•	•	Use AOC targets as min.: % total forest cover > 30%; minimum size of largest forest patch = 200ha; % forest cover 100-200m from forest fringe >10%; % forest cover 200m+ from forest fringe >5%	I
							•	•		•				•	•	Restore/replant forest cover on marginal lands.	L
5	Protect/restore critical / sensitive habitat		•		•	•	•	•			•				•	Define areas of critical habitat.	O
					•		•	•					•	•	•	Protect areas of critical habitat.	O
					•		•	•			•		•		•	Active management of some sensitive areas (i.e. burning prairie areas).	O
					•		•		•						•	Undertake ecological land classification to determine extent of habitat types and their sensitivity.	I
					•		•	•							•	Designate & manage representative grasslands as ESAs	I
							•	•							•	Use existing boundaries for ESAs, ANSIs, wetlands etc., to prevent development in and protect critical habitats	O
6	Protect/enhance natural corridors and linkages						•	•			•					Identify inter and intra watershed natural corridors (Hamilton Natural Heritage System & Halton study).	O
							•	•			•		•	•	•	Protect, enhance and restore linkages, including tableland linkages.	O
							•								•	Identify tablelands to be used in linkage plans.	I
							•	•			•		•		•	Limit access points to critical natural areas.	O
7	Protect/restore fish habitat									•	•			•		Restore/enhance riparian buffers	O
		•			•						•		•	•	•	Retrofit dams to reduce thermal impacts	L
		•			•						•		•	•	•	Remove barriers to fish movement	L
			•				•	•	•		•		•	•	•	Reduce/eliminate online ponds	I
							•	•		•	•			•	•	Use AOC targets as min.: % of 1st to 3rd order streams > 75% vegetated; % of 1st to 3rd order streams with 30+m buffered > 75%	I
													•		•	Extend moderate flow periods.	O
													•		•	Enhance base flows.	O
							•	•	•	•			•		•	Manage stormwater/runoff through best management practices	O
							•	•	•				•		•	Reduce siltation/impacts of erosion.	O
8	Reduce/eliminate proliferation of non-native/invasive species						•	•	•				•	•	•	Limit reforestation/plantings to native/local species only.	O
							•	•							•	Survey all sensitive natural areas for invasive species & eliminate where possible.	I
							•	•	•				•	•	•	Minimize impacts of invasive species by decreasing edge effects	L
														•	•	Educate public on impacts of non-native/invasive species.	O

TARGETS/RECOMMENDATIONS		AGENCIES / GROUPS RESPONSIBLE														STRATEGIES / TASKS	
		Federal Government	Min. of Environment	Min. of Agriculture	Min. of Nat. Resources	Niagara Escarpment C.	Hamilton, Halton, Wellington	Local Municipality	Development Industry	Farm Community	Conservation Groups	Recreation Industry	Private Landowners	Stewardship	Conservation Halton	• Lead agency • Involved stakeholder	Priority (L) Low, (O) Ongoing, (I) Immediate
CARING FOR NATURE																	
9	Protect/enhance viewscapes					•	•	•					•	•		Protect/enhance viewscapes.	L
						•	•	•							•	Restrict development that mars viewscape.	L
						•	•	•	•				•		•	Restrict development near or on prominent or important natural features (Earth Science ANSI).	L
10	Reduce use/misuse of pesticides						•	•	•	•			•	•		Protect natural areas & creeks from herbicides/pesticides.	O
							•	•		•	•	•	•	•	•	Provide input into (Regional, Municipal) pesticide use guidelines (re: health and safety issues).	O
		•	•	•			•	•						•	•	Define cosmetic and non-cosmetic use of pesticides.	O
							•	•		•			•	•	•	Introduce buffers to prevent spraying near creeks or natural areas.	O
							•	•		•			•	•	•	Minimize impacts on non-target species.	O
			•	•	•		•	•		•			•	•	•	Educate the public on use/misuse of pesticides.	O
11	Protect/enhance non-forest habitats						•	•		•			•	•	•	Protect/enhance alvars and prairie grasslands through public ownership, stewardship agreements, easements etc.	I
							•				•				•	Evaluate grasslands as important ecosystems.	I
							•				•		•		•	Actively manage grassland areas, alvars etc.	L
12	Protect/enhance wildlife populations						•	•			•			•	•	Enhance, restore and maintain the watershed to support the natural range of species expected to occur.	I
															•	Increase the diversity of breeding birds.	L
							•	•		•					•	Reduce/control incidence of nuisance wildlife.	L
CARING FOR AGRICULTURE																	
1	Maintain healthy and productive agriculture		•	•	•		•	•		•		•	•		•	Ensure adequate water supplies.	I
							•	•							•	Improve monitoring of base flows and water use and make recommendations for current and projected water needs.	I
2	Reduce and/or mitigate the impacts of excess nutrients			•			•	•		•				•		Encourage use of best management practices.	O
				•			•	•		•				•	•	Encourage15 m buffers between agricultural activities & creeks/wetlands.	O
				•			•	•		•				•	•	Restrict livestock access to creeks/wetlands.	O
3	Reduce and/or mitigate the impacts of erosion	•		•	•					•				•		Encourage conservation tillage.	O
		•		•						•				•		Educate landowners on erosion issues.	O
4	Reduce/mitigate the impacts of intensive livestock operations		•	•			•	•	•	•			•		•	Encourage adoption of provincial/ municipal legislation controlling factory farms.	O
							•	•		•					•	Control through Official Plans.	O
5	Preserve/protect farm land			•			•	•		•					•	Ensure farmland is protected in Official Plans.	O
		•		•			•			•				•		Investigate mechanisms to preserve/protect farmland.	O
		•		•			•			•			•	•		Investigate incentives to preserve/protect farmland.	O

TARGETS/RECOMMENDATIONS		AGENCIES / GROUPS RESPONSIBLE													STRATEGIES / TASKS	
		Federal Government	Min. of Environment	Min. of Agriculture	Min. of Nat. Resources	Niagara Escarpment C.	Hamilton, Halton, Wellington	Local Municipality	Development Industry	Farm Community	Conservation Groups	Recreation Industry	Private Landowners	Stewardship	Conservation Halton	• Lead agency • Involved stakeholder	Priority (L) Low, (O) Ongoing, (I) Immediate
CARING FOR COMMUNITY																	
1	Reduce and/or mitigate the impacts of urban development	•	•				•	•	•					•	•	Promote the goals of Smart Growth.	O
							•	•	•							Mitigate impacts of SWM through best management practices.	O
							•	•	•				•		•	Maintain/increase creek & valley setbacks.	O
							•	•					•		•	Increase creek blocks in public ownership.	I
		•					•	•	•		•		•		•	Increase green spaces, recreational paths in urban areas.	I
							•	•	•							Maintain Burlington urban boundary.	I
							•	•	•				•	•	•	Encourage naturalization of urban properties.	O
			•				•	•	•				•	•	•	Promote infiltration; discourage runoff.	I
		•	•	•	•		•	•	•		•	•	•	•	•	Encourage water conservation programs	I
2	Protect wellhead areas					•	•	•								Develop planning policies for wellhead protection.	I
			•				•	•		•			•			Decommission old/abandoned wells.	I
			•				•	•			•		•	•	•	Public education.	O
3	Improve transportation		•				•	•					•			Reduce use/extent of road salting.	O
		•	•				•	•	•		•			•		Promote increase use of public transit	O
			•	•	•	•	•	•							•	Study proposed Mid Peninsula Hwy. to ensure no environmental impact	I
							•	•							•	Ensure roads/bridges are sensitive to natural features.	O
							•	•							•	Minimize impacts of roads/bridges.	O
							•	•	•							Ensure transportation routes do not increase urban areas.	O
4	Reduce the threat of flooding		•				•	•							•	Ensure CA regulations are enforced.	O
						•	•	•	•			•			•	Prohibit development in flood plains as per Provincial Policy Statement	O
5	Reduce potential for loss of life/ property						•	•						•	•	Public education on flooding & flood plain issues.	O
							•	•							•	Improve flood warning system.	I
					•			•							•	Ensure adequate resources for thorough flood warning system.	I
6	Reduce/mitigate impacts of public use of natural areas				•		•	•							•	Control parking/access to natural areas	O
			•				•	•							•	Designate sensitive areas off-limits to public use.	I
								•			•				•	Conduct visitor impact study on natural areas.	I
							•	•	•		•		•	•		Implement water conservation program (eg. rain barrels, cisterns).	O
						•	•	•							•	Ensure trail planning avoids sensitive natural areas.	O
7	Reduce/mitigate impacts of quarries						•	•							•	Review Nelson Quarry final rehabilitation plan,	I
							•	•							•	Ensure water resources are protected in Nelson Quarry final rehabilitation plan.	I
8	Reduce/mitigate impacts of golf course development.						•	•				•		•	•	Encourage all golf courses to meet “Audubon” rating.	L
							•	•		•			•	•	•	Reduce us of pesticides and fertilizer.	L
9	Improve stream morphology	•					•	•	•		•	•	•	•	•	Promote channel morphologies that are in balance with the natural tendencies of the reach.	O
		•					•	•	•		•	•	•	•	•	Use natural channel designs to rehabilitate stream reaches	O
							•	•						•	•	Develop demonstration projects for public education.	O

Glossary of Technical Terms

The following is a list of definitions for technical and scientific terms found in the report.

Algae – Simple photosynthetic plants found in all aquatic ecosystems.

Aquatic - Relating to water. May be used to describe plants, animals and other life in streams, rivers and lakes.

Area of Natural and Scientific Interest (ANSI) – Areas of land and water containing natural landscapes or features that have been identified as having life science or earth science values related to protection, scientific study or education. The areas vary in their level of significance and their vulnerability to environmental stresses.

Bacteria - Group of unicellular or multicellular, microscopic organisms lacking chlorophyll found in all aquatic ecosystems. Some are disease-causing.

Barrier to Fish Passage – Term pertains to any natural or artificial obstruction to movement of fish upstream (i.e. waterfalls, dams, drop structures).

Base flow - The year-round discharge of groundwater into a stream.

Bedrock - The solid rock underlying soils and the loose surface mantle of the earth.

Benthic Macroinvertebrate – Refers to "bottom dwelling" organisms that are associated with the bottom of a watercourse or water body for at least part of their life cycle. These organisms do not have a backbone and can be readily seen by the eye. Representative groups include aquatic insects such as stoneflies, mayflies, caddisflies, beetles, striders, sow bugs, scuds, crayfish, clams, snails and worms.

Benthic Organism – An organism that inhabits the bottom of a watercourse or body of water.

Biodiversity - The diversity of plant and animal species required for ecosystem health.

Bioengineering – An applied science that combines engineering, biological and ecological concepts to construct living structures for erosion and sediment control.

BP – Before Present

Buffer Strip - A naturally vegetated or potentially planted or revegetated area that borders natural areas wetlands or watercourses and provides ecological functions such as habitat, passage or buffering from adjacent negative impacts.

Carolinian Forest Zone - Deciduous forest community more commonly associated with the southeastern United States. In Canada, this zone is restricted to southern Ontario, in particular the area south of an imaginary line drawn from Grand Bend to Toronto.

Coldwater Fishery Habitat– Term that pertains to streams containing or have the potential to contain self-sustaining populations of salmonids (trout and salmon).

Conservation – The wise use, protection and rehabilitation of natural resources according to the principles that will assure their highest economic, social and environmental benefits.

Conservation Tillage – Modified farming practices that emphasize preservation of soils and reduction of impacts on the natural environment through the use of such techniques as no-till and winter cover on agricultural fields. Such practices help reduce soil erosion and nutrient run-off.

Corridor – The naturally vegetated or potentially revegetated areas that link or border natural areas and provide ecological functions such as habitat, passage, hydrological flow connection or buffering from adjacent impacts. They can also occur across or along uplands, lowlands or slopes.

Development – Means the creation of a new lot, a change of landuse or the construction of buildings and structures, requiring approval under the Planning Act; but does not include activities that create or maintain infrastructure authorized under an environmental assessment process; or works subject to the Drainage Act.

Drumlin – An elongated hill or ridge of till and fine glacial deposits of subglacial origin, usually oval or egg-shaped.

E. coli – *Escherichia coli*, a common type of bacteria found in the intestines of all warm-blooded animals. Because it does not reproduce outside the gut, *E. coli* are used as an indicator organism by the MOE for bacterial pollution.

Ecosystem – An ecosystem consists of the air, land, water and living organisms, including humans, and the interactions among them. It includes the community of living things and the complex of physical and chemical factors forming the environment.

Emergent Vegetation - Marsh vegetation which rises above the water surface. Robust emergents include cattails and bulrushes. Grasses and sedges are typical of slender emergents.

Environmentally Significant/Sensitive Area - A regionally ecologically significant area that is given special policy consideration in municipal Official Plans.

Esker – A long and narrow ridge of sand or gravel, which was once the bed of a stream flowing beneath or in the ice of a glacier.

Estuary – A partially enclosed embayment where river water and lake or sea water meet and mix.

Eutrophication – The rapid, unchecked growth of aquatic plants due to an excess of nutrients.

Flood Plain -The area, usually lowlands, adjoining a watercourse that has been, or may be covered by flood water. In general, the flood plain is a part of the river's natural space in times of flooding.

Fluvial - Relating to rivers and streams.

Groundwater - Water that has infiltrated below the earth's surface. Like surface water, it moves in response to gravity, but its movement may be restricted by impermeable rock or clay layers.

Habitat - The place where an animal or plant naturally or normally lives. It is composed of food, water, shelter and space.

Headwater - The source of a stream.

Hummocky – Irregular, pitted, rolling terrain.

Hydrologic Cycle – The cycle of water movement from the atmosphere to the earth and back to the atmosphere through various stages or processes, as precipitation, interception, runoff, infiltration, percolation, storage, evaporation and transpiration.

Indigenous – Species that have originated naturally in a particular region or environment

Infrastructure - The collection of utilities and services that provide energy, communication and transportation.

Intermittent Tributaries - Watercourses that convey flows on a seasonal/event basis. Flows are generally continuous during the spring months but are intermittent during the remainder of the year. May provide fish habitat.

Land Stewardship - A land and water conservation program to assist watershed landowners and residents in becoming environmental stewards of their land.

Leachate - A solution or product created by the percolation of water through soil or waste material.

Marsh – Wetland dominated by grassy vegetation such as cattails and sedges.

MNR - Ministry of Natural Resources.

MOE - Ministry of Environment

Migratory Habitat - Aquatic and/or terrestrial linkages which support the unrestricted passage of fish and wildlife between habitat types.

Mitigation - Includes the prevention, modification or alleviation of impacts on the natural environment. Also includes any action with the intent to enhance beneficial effects.

Monitor -- Procedures used to methodically inspect and collect data on changes in the watershed.

Moraine – A depositional feature whose form is independent of the underlying topography and is constructed by the accumulation of glacial deposits. There are several types of moraines including lateral, medial, ground and terminal. These moraines form from different processes and are composed of very different types of materials.

Natural Heritage -- Natural heritage is a concept used across North America as a framework and context for initiatives to conserve and steward natural areas, species and ecosystems at risk. Natural heritage includes geological features and landforms; associated terrestrial and aquatic ecosystems; their plant species, populations and communities; and all native animals species, their habitats and sustaining environment.

Neotropical Bird Species - Migratory bird species that overwinter in Central America and South America, migrating north in late spring for breeding. Warblers and scarlet tanagers are among the most visible of these species in southern Ontario.

OMAFRA - Ontario Ministry of Agriculture, Food and Rural Affairs.

On-Line Ponds – Ponds, usually man-made, located in a watercourse and controlled by a structure such as a dam, weir etc. Located so that all the water of the watercourse must pass through the pond as it passes from upstream to below the pond.

Pesticide – Organic or inorganic compounds used to control noxious "pests" that attack crops, animals and man. They are usually subdivided into chemical compounds sharing common characteristics.

Phosphorus – A non-metallic element that can occur in numerous organic or inorganic forms and is present in the aquatic ecosystem in dissolved or particulate form. It plays a major role in the biological process.

Polycyclic Aromatic Hydrocarbons (PAHs) – Byproducts of the combustion of fossil fuels, PAHs tend to concentrate in soils and sediments. They are delivered by airborne deposition or roadway runoff.

Provincially Significant Wetland -- Class 1, 2, and 3 wetland in that part of the Great Lakes - St. Lawrence Region below the line approximating the south edge of the Canadian Shield, defined in "An Evaluation System for Wetlands of Ontario South of the Precambrian Shield. Second Edition, 1984", as amended from time to time; and those wetlands identified as Provincially Significant Wetlands by the Ministry of Natural Resources through an evaluation system(s) developed specifically for other areas of Ontario.

Recharge Zone - Where runoff from precipitation and snow melt seeps into the soil and becomes groundwater.

Rehabilitation - The returning of land to its prior use or productivity.

Remediation - The rehabilitation of a site for valuable land uses but not necessarily restoring the site to its original natural state.

Resource Management - The wise use of a particular natural resource to achieve specific ends.

Restoration - The altering or re-establishment of a site to a defined, indigenous, historic condition.

Riparian - Relating to or living or located on the bank of a watercourse or a body of water.

Savanna – A grassland containing scattered trees and drought-resistant undergrowth.

Sediment - Small particle of rock, sand and organic matter that is carried in water or settles to the bottom of a watercourse.

Septic Tile Bed – Private sewage treatment system made up of a settling/storage tank and treatment trench. Found on most rural properties, if properly designed and maintained, can have a service life of 15 – 30 years. Government studies estimate that up to 30 % of all septic systems in Ontario are not functioning properly or are failing.

Spawning and Nursery Habitat - Aquatic habitat which supports the reproduction and early life stages of fish.

Stakeholder - An individual who has a personal investment or interest in the watershed planning and management process.

Stewardship - The act of taking responsibility for the well-being of the natural environment.

Stress - A force acting on an object or system, resulting in a corresponding response.

Stormwater Management - The planned set of public policies and activities undertaken to regulate stormwater runoff under various specified conditions within various portions of the urban drainage system. In general, stormwater management is primarily concerned with limiting future flood damages and environmental impacts resulting from development.

Subwatershed – Subunits of a watershed. It includes all the land and water that drains directly into individual tributaries within a watershed. Subwatershed boundaries are defined by the height of the land.

Swamp – Wooded wetlands in which water is near or above ground level.

Terrestrial - Of or relating to land, as distinct from water or air. May be used to describe plants, animals and invertebrates.

Threatened Species - Any indigenous species of fauna or flora that, on the basis of the best available scientific evidence, is indicated to be experiencing a definite non-cyclical decline throughout all or a significant portion of its Ontario range, and that it is likely to become an endangered species if the factors responsible for the decline continue unabated.

Urban runoff - Rain water and snowmelt, usually containing litter, organic and bacterial wastes, draining from city streets and gutters to storm sewers, ditches and local streams.

Warmwater Forage Fish Habitat – Refers to streams which are lacking warmwater sportfish, but, contain any combination of minnow species classified as baitfish by MNR. This typically includes streams with intermittent or low discharge.

Warmwater Sportfish Habitat – Refers to streams that contain any combination of smallmouth bass, largemouth bass, northern pike, walleye, yellow perch or panfish.

Water Quality - The chemical, physical and biological condition of water related to beneficial use.

Watershed - All the land and water that drains directly into a river, lake or bay. It includes hills, lowlands and the body of water into which the land drains, as well as its branches and tributaries. Watershed boundaries are defined by the height of the land.

Watershed Planning - A form of holistic planning that integrates watershed ecosystem resource management and land use planning.

Wetland - Lands that are seasonally or permanently covered by shallow water, as well as lands where the water table is close to or at the surface. The presence of abundant water causes the formation of hydric soils and favours the dominance of either hydrophytic or water tolerant plants. The four major types of wetlands are swamps, marshes, bogs and fens.

Winterkill – Oxygen reduction or anoxia resulting from excessive snow or ice cover in shallow, productive ponds or lakes leading to the death of fish.