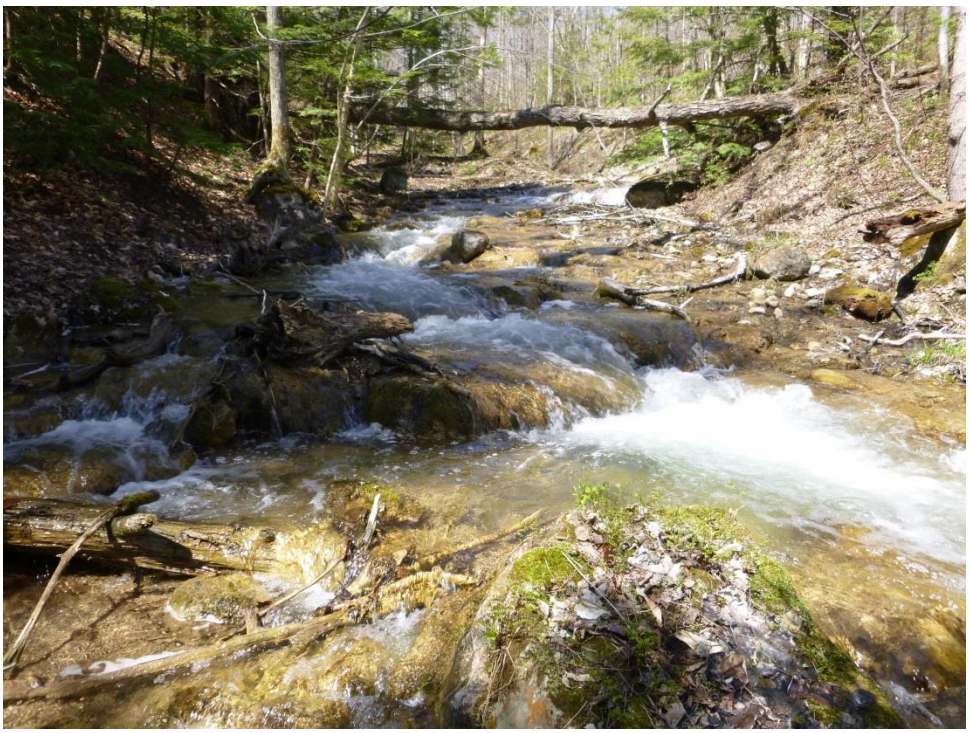
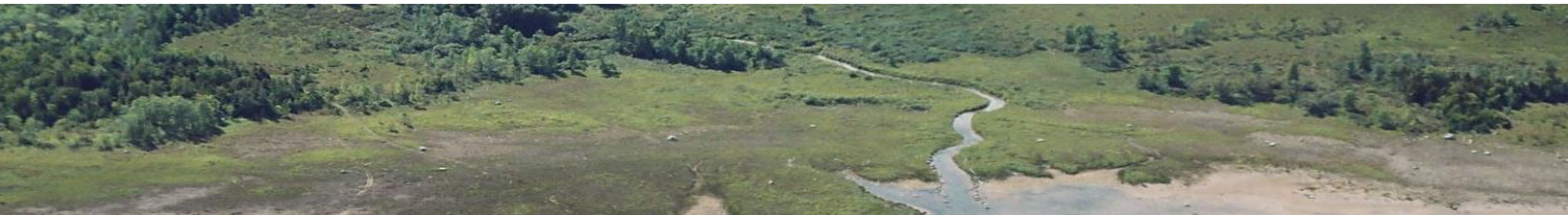
Terrestrial and Aquatic Ecosystem Health in the Silver Creek Watershed, Collingwood, Ontario

Rebecca Ferguson, David Featherstone[1] and Ian Ockenden[1]

January 30, 2017

1 Nottawasaga Valley Conservation Authority staff





Executive Summary

In 2016 the Silver Creek Watershed in Collingwood, Ontario was studied by the Blue Mountain Watershed Trust through their Ontario Trillium Foundation-funded Silver Creek Stewardship Initiative. One of the deliverables of this Initiative was to gain a better understanding of the current ecological health of the watershed through vegetation community mapping (Ecological Land Classification) and aquatic ecosystem studies.

For the Ecological Land Classification component of the study, field surveys were completed throughout the summer using a combination of site visits and "windshield" surveys. Mapping from previously completed Natural Heritage Studies for the Town of Collingwood and available Environmental Impact Studies was also incorporated. Finally, orthointerpretation (2015/2016) was used to complete mapping where no other information was available. Vegetation community mapping was compared to 2013 NVCA mapping efforts (based on 2008 orthophotography) to identify forest and wetland trends in the watershed.

Water chemistry, instream temperature, benthic and fish community data was collected through 2016 as part of continuing monitoring efforts and to update historic data. This data was analyzed to describe stream health and stream function through the watershed.

Terrestrial Habitat Analysis

Vegetation community assessment showed that 56.1% of the watershed is forested. This extent of forest cover supports healthy forest functions including forest interior bird habitat – interior species such as ovenbird, scarlet tanager and black-throated green warbler were regularly observed during site visits in core forests. This percentage of forest cover is exceptionally high within the fragmented southern Ontario landscape.

A significant percentage of forest cover consists of cultural woodlands regenerating from abandoned farm fields over poor soils and steep slopes – forest cover in the watershed is significantly greater today than it was fifty years ago. Cultural (field and thicket) communities are continuing to evolve toward a forested condition. A net gain of forest cover (107 ha) has occurred between 2008 and 2016 as a result of forest regeneration. Some loss of forest cover (23.4 ha) has occurred through urban and recreational development.

Wetland cover is 10.8% and is likely close to historic coverage although some historical loss due to development and pond creation has occurred. At the base of the Escarpment near Grey 19 and Osler Bluff Road, wetlands are regenerating over abandoned farmland. Vernal pool wetlands above the Escarpment support important amphibian breeding habitat. Wetlands north and south of Highway 26 form part of the provincially significant Silver Creek Wetland Complex - coastal marshes near the mouth of Silver Creek are globally rare and, worldwide, are found only along shallowly sloping bedrock shorelines along the Great Lakes.

Hayfields, regenerating fields and thickets cover 14.9% of the watershed. Cultural field communities support important grassland habitat for the threatened bobolink and eastern meadowlark. Cultural fields and thicket cover, if left to regenerate, will eventually form forest cover.

Talus slope forests and cliff/crevice/cave communities along the Escarpment at Scenic Caves are provincially rare – white cedars growing along the cliff face are often hundreds of years old. Scenic Caves has trail systems and interpretive signage that provide an excellent opportunity to view and learn about these areas.

Aquatic Habitat Analysis

Silver Creek arises as a groundwater-fed pond system upstream of Lake of the Clouds. Additional springs enter the Lake of the Clouds impoundment. Downstream of the lake, the creek descends steep Escarpment slopes and is crossed by the Bruce Trail. Neff Creek enters Silver Creek in this area. At Osler Bluffs Road, Silver Creek enters an altered stretch of channel that runs northward, parallel to the road. It crosses Osler Bluffs Road and picks up flow from a tributary system arising from Scenic Caves. Silver Creek enters a narrow, variously forest valley that extends to the Georgian Trail. From Georgian Trail to Highway 26, the creek flows through an active pasture with livestock having full access to riparian areas and the creek itself. Downstream of Highway 26, Silver Creek flows through forest and wetland cover to Nottawasaga Bay.

Stream health data indicates that Silver Creek supports coolwater habitat from its headwater to Nottawasaga Bay. Given suitable flow and absence of other barriers, rainbow trout and Chinook salmon are able to move upstream as far as Lake of Clouds to spawn. This entire reach provides suitable nursery and rearing habitat for young rainbow trout and Chinook salmon prior to their movement to Georgian Bay. Although not captured in recent sampling on the main watercourse, native brook trout likely persist in headwater areas.

Impairments to stream health are associated with upstream impoundments, limited riparian cover, past stream alteration and livestock access. Nutrient inputs are generally low; however, steep slopes throughout much of the watershed make it essential to implement and maintain rigorous erosion and sediment control to keep soil from work sites out of Silver Creek and its tributaries. Significant riparian restoration/livestock management opportunities are present in the reach from the Georgian Trail downstream to Highway 26.

Overall Natural Heritage Analysis

The Silver Creek watershed natural heritage system knits terrestrial, wetland and streams systems together and ensures that the watershed is connected from Escarpment to Bay. This watershed remains one of the most natural areas in the Blue Mountain Watershed Trust area of interest. Its natural heritage system is intimately connected with broader natural heritage systems in the area.

The Silver Creek watershed is intimately connected from Escarpment to Bay. Future development, invasive species and climate change represent potential threats to this connection. Sustainable planning and stewardship are needed to maintain and enhance this special connection. The watershed itself is part of broader connections along the Niagara Escarpment, along the Blue Mountain watersheds and along the Nottawasaga/Georgian Bay shoreline. Continued efforts to educate the community are needed to raise awareness about the important features and functions of the Silver Creek “Escarpment to Bay” area.

Table of Contents

1.0 Introduction

The Southern Georgian Bay coastline in the Blue Mountain/Collingwood area has seen a rapid increase in development over the past two decades. In an attempt to preserve natural features/functions and maintain economic growth, municipalities in this region have begun the process of adopting Natural Heritage Systems into their Official Plans. Natural Heritage System studies involve mapping vegetation communities, wildlife habitat and stream/valleys and functionally linking these features across the landscape. Natural Heritage Systems facilitate informed land use decision-making and identify "best bet" stewardship activities.

The Blue Mountain Watershed Trust successfully received an Ontario Trillium Foundation Seed Grant to focus on the ecological health of the Silver Creek watershed. The purpose of this study is to gain a better understanding of the natural heritage systems of the Silver Creek watershed by identifying vegetation communities, associated wildlife functions and stream health. This information will assist in identifying key connections within the watershed as well as the watershed's role as a component of broader landscape corridors.

The Blue Mountain Watershed Trust is an environmental charity in the Blue Mountain/Collingwood area focused on preserving and enhancing the Blue Mountain Watershed. This is accomplished through community stewardship, monitoring, education and negotiating development with three levels of government.

2.0 Methodology

In 2011, Ecological Land Classification mapping was completed by the Nottawasaga Valley Conservation Authority as part of a Natural Heritage Study for the Town of Collingwood. This work fully mapped vegetation communities within the Collingwood portion of the Silver Creek watershed. During the summer of 2016 Ecological Land Classification (ELC) mapping was undertaken throughout the Town of Blue Mountains portion of the watershed to complete this mapping. ELC site visits were conducted on 20 privately owned properties in the Town of Blue Mountains as well as from roadsides in the area. These properties ranged from 0.5-200 acres and included residents and businesses such as: Scenic Caves, The Scott Mission and Scandinave Spa. ELC mapping was also derived from available Environmental Impact Studies. Where such studies and field data were not available, ELC communities were mapped via orthointerpretation (2015 orthophotos).

2.1 Ecological Land Classification

Due to size of study area and time/budget constraints, standardized ELC methodology including soil classification and stand density using a prism was not completed for this study. An ELC approximation approach was used, focusing on dominant tree, shrub and/or ground cover to derive vegetation community classification. We believe that mapping generated using this approach (and other sources as identified above) provides an excellent watershed-level base for vegetation community analysis but recognize that communities could be further refined if the full methodology was utilized.

Prior to site assessments, orthoimagery was interpreted in ArcGIS to map preliminary polygons. While on properties, trails were used when available with occasional juts in to the forest interior to identify vascular plants and canopy cover. On those properties without trails, bush whacking was the only option

for field validation. GPS units and topographic maps were used to track our location and from there we refined polygons on the topographic map and made field notes.

Road surveys were completed along properties where access was not obtained. However, results for this method were limited because road sides often hosted dense stands of disturbance-tolerant species like staghorn sumac and buckthorn, making it a challenge to accurately determine community types further off-road.

Another method used to derive ELC mapping was to review ELC mapping from Environmental Impact Study reports. For older ELC mapping efforts, cultural communities were reviewed and reclassified (where applicable) to recognize degree of regeneration since the previous mapping effort.

After field work/previous ELC mapping review was completed, polygons were transferred into ArcGIS using field notes, photos and GPS points. Lastly, where information was not available, ELC polygons were interpreted and delineated using orthointerpretation. This completed the ELC vegetation community delineation for the watershed.

2.2 Aquatic Community Sampling

The NVCA has been monitoring Silver Creek in partnership with the Ministry of Environment and Climate Change as part of the Provincial Water Quality Monitoring Program (PWQMN) since 1966. Water samples were collected on Silver Creek at Highway 26 as mid-channel grab samples before being sent for analysis at the MOECC laboratory in Toronto. General chemistry parameters were measured *In situ* using a a YSI multimeter sonde.

Benthic invertebrates were sampled annually by NVCA staff at Highway 26 following the Ontario Benthos Biomonitoring Network Protocol. Other benthic sampling locations, including historical sites were selected strategically to evaluate stream health at important nodal areas.

HOBO temperature loggers were installed in Silver Creek under the 12th Sideroad bridge on June 24, 2016 and under Mountain Road bridge on June 27. On July 13 the Mountain Road logger was moved to Highway 26 bridge. Spot temperature checks were completed on Silver Creek and its tributaries on August 2 between 4 and 6 pm following Stoneman and Jones (1996) and Chu and Jones (2009) methodology. This instream temperature monitoring supplements past efforts on Silver Creek.

On August 24, fish sampling was conducted on an Escarpment site and on lands north of Mountain Road following Ontario Stream Assessment backpack electrofishing protocols. This monitoring provides an update to past fish community monitoring efforts on Silver Creek.

3.0 Terrestrial Results

This section provides a background of natural history in the Silver Creek watershed followed by an analysis of ELC study findings. An assessment of wildlife functions associated with watershed vegetation communities is provided followed by discussion of invasive species and their potential threats.

3.1 Natural History

Following recession of the Wisconsinan glaciers 12,000 years ago, the lower (northern) portion of the Silver Creek watershed below the Escarpment lay at the bottom of proglacial Lake Algonquin which was had a water level more than 60 m above the present-day Georgian Bay shoreline. Tundra then spruce parkland habitat colonized the tills, moraine and bedrock left after the retreat of the glaciers. Further retreat of the glaciers opened up new outlets to the northeast and Lake Algonquin rapidly drained about 10,000 years ago with Georgian Bay eventually becoming a closed basin with a shoreline several km offshore from its present-day shores. Uplift in the north portion of the Georgian Bay basin closed off the northeastern outlets about 7,000 years ago and water levels rose again, reaching a point about 12 m above existing lake levels – this is referred to as the Nipissing Transgression. The expansion of the St. Clair River outlet about 3,800 years ago ended the transgression and a recession of lake levels to present-day elevations. During this period of changing lake levels (and changing climate), vegetation communities evolved toward today's features and functions.

Prior to European settlement the tablelands above the Escarpment would have been dominated by sugar maple forest with occasional mixed/deciduous swamps. The steep slopes of the Niagara Escarpment would have been a combination of deciduous, mixed and conifer forests depending on soil type. The Simcoe Lowlands from the base of the Escarpment to Nipissing Ridge would have hosted sugar maple forests on well-drained soils and mixed lowland/swamp forests in poorly drained areas. Below the ridge, tight soils, bedrock and high water table would have supported cedar/aspen forests and deciduous swamps. Closer to the shoreline, forest cover would have transitioned to coastal marsh.

European settlers moved into the watershed in the mid to late 1800s. Most of the forest cover was converted to agricultural use. On the Escarpment slopes and lowlands, grazing and pasture would have occurred on all but the wettest lands. Much of the marginal farmland has since regenerated back to fields, thickets and forest cover. In recent decades, urban development in the Town of Collingwood and Town of Blue Mountains has resulted in conversion of forest and wetland to residential use.

3.2 ELC Analysis

ELC assessment was undertaken throughout the Silver Creek watershed; however, access was not available to all properties and mapping to Vegetation Type (most refined level of assessment) was not possible across the watershed. Mapping to Community Series was completed for the entire watershed and the results of this assessment are provided in Table 1.

ELC Community Series

Table 1 provides a listing of all ELC Community Series vegetation communities documented during this study. Total area and percent of total natural cover associated with each Community Series is identified in this table. Each Community Series is "rolled up" to describe total forest, wetland and cultural

community cover for the watershed. Figure 1 depicts the types and distribution of Community Series communities while Figure 2 "rolls up" this information to identify forests, wetlands and cultural communities within the watershed.

Natural cover (forests, open wetland and regenerating fields) covers 66.6% of the watershed. Forests (including cultural woodlands, cultural plantations and forested swamp wetlands) are the dominant natural cover comprising 73.4% of all natural cover with regenerating fields (19.3% of natural cover) and open wetland (7.3% of natural cover) providing the remainder of natural cover in the watershed.

ELC Vegetation Types

Appendix A provides a listing of all ELC Vegetation Types identified to date within the Silver Creek watershed. Further studies will no doubt refine Vegetation Type mapping and add to the list of known communities. Though mapping is incomplete, it does point to the many habitat types and significant biodiversity found in the watershed. 61 discrete Vegetation Types were identified through this study. A breakdown of these Vegetation Types is provided below:

- Upland forest (FOC, FOD, FOM) – 26 Vegetation Types
- Swamp Wetlands (SWC, SWD, SWM, SWT) – 15 Vegetation Types
- Marsh Wetlands (MAM, MAS) – 9 Vegetation Types
- Cultural (CUM, CUP, CUS, CUT, CUW) – 8 Vegetation Types
- Alvar/Talus/Cliff – 3 Vegetation Types

Three marsh wetlands – Shrubby Cinquefoil Coastal Meadow Marsh (MAM4-2; Appendix B – Figure 1), Mineral Fen Meadow Marsh (MAM5-1; Appendix B – Figure 2) and Tallgrass Mineral Fen Meadow Marsh (MAM5-2; Appendix B – Figure 3) are associated with globally rare Great Lakes Coastal Marsh communities along the Georgian Bay shoreline. The globally/provincially rare Dry-Fresh Little Bluestem Open Alvar Meadow (ALO1-3; Appendix B – Figure 4) community north of Highway 26 also has strong connections to these communities.

Two provincially rare forest types – Fresh-Moist Sugar Maple Carbonate Treed Talus (TAT1-4; Appendix B – Figure 5) and White Cedar Treed Carbonate Cliff (CLT1-1; Appendix B – Figure 6) – are present at Scenic Caves along the edge of the Niagara Escarpment. Old growth cedars are present along the Escarpment cliff. Deep crevices and caves add to the value/rarity of this feature. Excellent interpretive trails/signage are associated with the cliff/crevice/cave feature.

Table 1: ELC Community Series in Silver Creek Watershed

ELC Community Series Code	ELC Community Series Name	% Watershed Cover	% Total Natural Cover	Description/Comment
Forest:				
CUP	Cultural Plantation	3.3	4.3	Coniferous plantations in watershed
CUW	Cultural Woodland	13.1	17.2	Variably dominated by apple, ash, aspen/poplar and hawthorn
FOC	Coniferous Forest	1.3	1.7	Usually cedar-dominated
FOD	Deciduous Forest	30.3	39.6	Sugar maple dominant with oak mixed in on Escarpment slopes
FOM	Mixed Forest	2.6	3.4	Conifers often mixed with sugar maple
SWC	Coniferous Swamp	0.4	0.5	Cedar swamps
SWD	Deciduous Swamp	4.7	6.1	Maple and ash swamps
SWM	Mixed Swamp	0.2	0.3	Cedar/mixed deciduous swamps
TAT	Talus Slope Forest	0.1	0.2	One community at Scenic Caves
CLT	Crevice/Cave/Cliff	0.1	0.1	One community at Scenic Caves
Total		56.1	73.4	
Open Wetland:				
MAM	Meadow Marsh	1.6	2.1	Reed-canary grass, sedge and forb marsh
MAS	Shallow Marsh	1.2	1.5	Cattail marshes dominant
SAS	Submerged Aquatic	<0.1	<0.1	One small constructed wetland
SWT	Thicket Swamp	2.8	3.7	Alder, willow and dogwood thickets
Total		5.6	7.3	
Open Regeneration:				
CUM	Cultural Meadow	11.8	15.4	Regenerating fields/hay/ski runs
CUS	Cultural Savannah	0.9	1.1	Regenerating fields
CUT	Cultural Thicket	2.2	2.8	Regenerating fields
Total		14.9	19.3	
Other:				
ALO	Open Alvar Rock Barren	<0.1	<0.1	Little bluestem over bedrock (rare)
TOTAL NATURAL COVER		66.6	100.0	

Figure 1: ELC Community Series Map – Silver Creek Watershed

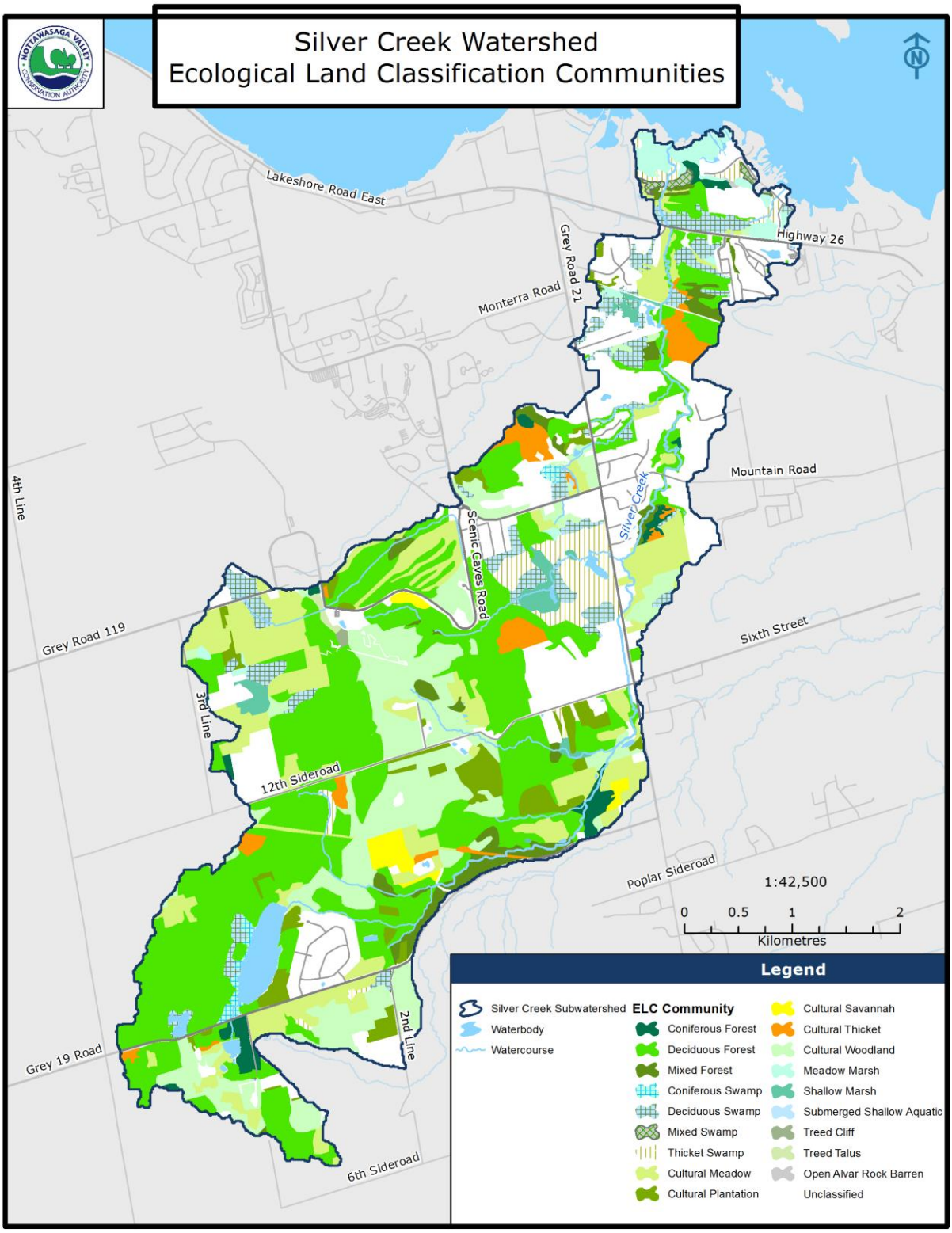
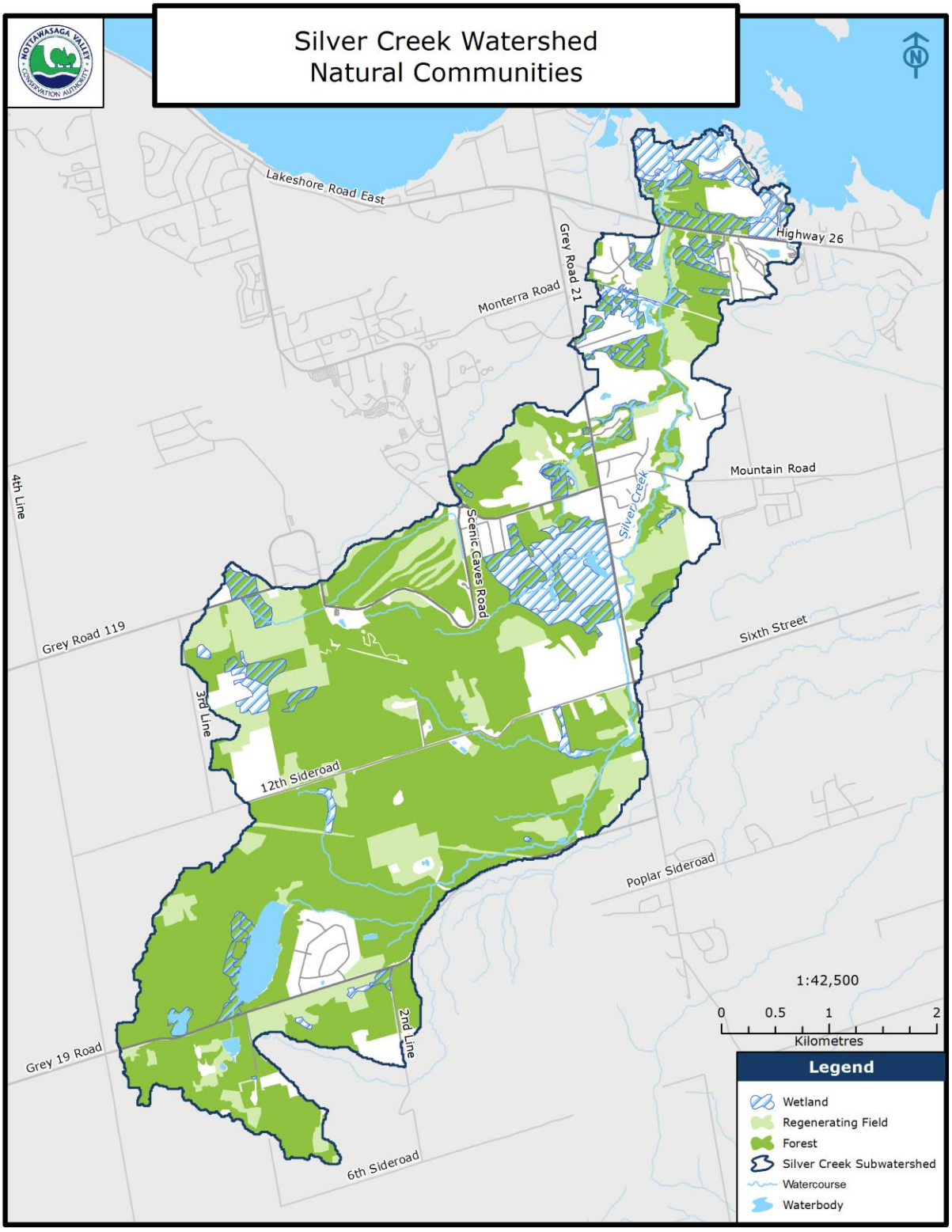


Figure 2: Natural Communities – Silver Creek Watershed



3.2.1 Forest Communities

Forest communities consist of upland forests, swamp forests, plantations and cultural (young) woodland. Sugar maple forests are dominant above the Escarpment. Sugar maple and oak forests are common along Escarpment slopes with mixed forests occasionally present. Regenerating swamp forests are present at the base of the Escarpment while mixed forests are associated with the Silver Creek valley downstream to Mountain Road. Mixed forests and deciduous swamps dominate the lowlands north of the Nipissing Ridge to Georgian Bay.

Overall forest cover within the Silver Creek watershed is 56.1%. This percentage is high within the context of the fragmented southern Ontario landscape and is significantly higher than forest cover in the NVCA portion of the Blue Mountain watershed as a whole. Similarly, forest interior habitat (forest cover more than 100 m from a forest edge) is high at 17.8%. Environment Canada's "How Much Habitat is Enough" guidelines (Environment Canada, 2013) suggest that forest cover and forest interior habitat is sufficient to support high quality watershed and habitat functions.

Deciduous forests dominate forest cover in the watershed (54% of total forest cover). Sugar maple forests (FOD5; Appendix B – Figure 7) are the dominant Vegetation Type. Common tree species associated with this community include: ironwood, basswood, red oak and beech with understorey species: white and red trillium, blue cohosh, yellow trout lily and wild sarsaparilla.

Cultural woodlands (Appendix B – Figure 8) represent a significant portion of forest cover within the Silver Creek watershed (23.4% of total forest cover). Generally regenerating over abandoned farmland, these young forests of ash, poplar, apple and hawthorn will eventually transition to mature forest and provide increasing value as forest habitat. Cultural plantations – generally conifer planation within the watershed – account for 5.9% of forest cover and, if managed or allowed to senesce, will eventually succeed to native forest cover. Similar to cultural woodland, this succession will add increasing value to their existing habitat functions.

Swamp forest represents 9.4% of forest cover within the watershed. Deciduous swamp (silver maple and green ash; Appendix B – Figure 9) is the dominant swamp form. Additional regeneration of swamp forest may occur over time in the regenerating wetlands southwest of the Mountain Road/Osler Bluff Road intersection. Wetter swamps provide important breeding habitat for woodland amphibians and, combined with adjacent upland forests, contribute to forest interior habitat.

Two provincially rare forest types – Fresh-Moist Sugar Maple Carbonate Treed Talus and White Cedar Treed Carbonate Cliff – are present at Scenic Caves along the edge of the Niagara Escarpment. Old growth cedars are present along the Escarpment cliff. Deep crevices and caves add to the value/rarity of this feature. Excellent interpretive trails/signage are associated with the cliff/crevice/cave feature.

Forest cover in the Silver Creek Watershed has increased by 107 ha between 2008 and 2015/2016 as a result of cultural woodland regeneration (130.4 ha offset slightly by losses associated with urban and recreational development (23.4 ha). Forest gain is significant but may be tempered by underestimate of forest cover in 2008 – determination of when cultural thickets transition to cultural woodland is a somewhat subjective exercise. Most forests classified as cultural woodland will likely transition into young sugar maple forest over the coming decades.

3.2.2 Wetland Communities

Wetland communities consist of forested swamps, swamp thickets, marshes and shallow open water areas. Forested swamps are present in the headwaters of the Silver Creek watershed. At the base of the Escarpment, a regenerating complex of swamp forest, thicket swamp and marsh is present. A mosaic of lowland forest and forested swamp lies along Silver Creek north of Mountain Road. This mosaic is further entwined with swamp thicket and coastal marsh as Silver Creek nears Georgian Bay.

Overall wetland cover within the Silver Creek watershed is 10.8%. Historical wetland cover is generally predicated by watershed slope – higher gradient (steep) watersheds naturally would have had less wetland cover than low gradient (flat) watersheds. Given the relatively high gradient associated with the Silver Creek watershed, wetland cover is possibly close to historical coverage though wetlands have been lost as a result of pond/lake creation, agricultural conversion and urban development. However, this loss is low relative to other watersheds that drain through urban Collingwood where development has impacted wetlands since the mid 1800s.

Silver Creek wetland coverage is greater than the Blue Mountain watershed (NVCA portion) as a whole. Although some shoreline wetland loss has occurred through development, Environment Canada's "How Much Habitat is Enough" guidelines (Environment Canada, 2013) suggest that wetland cover in the Silver Creek watershed is in good health.

Wetland cover is dominated by forested swamps (49.1% total wetland cover) with additional cover provided by thicket swamp (25.9%; Appendix B – Figure 10), marsh (25.9%; Appendix B – Figure 11) and submerge shallow aquatic wetlands (<0.1%). Deciduous Swamp is the dominant wetland community (43.5% of all wetland cover). Coastal meadow marshes form a significant component of wetland cover north of Highway 26.

Habitat adjacent to wetlands is important for a range of wildlife species that require both upland and wetland habitats to complete their life cycle. Areas within 100 m of wetland boundaries consist of 55.8% natural cover (forests and regenerating cover) which helps support these species. Additional natural cover adjacent to wetlands – particularly those with the potential to support breeding amphibians and waterfowl – would enhance wetland habitat functions within the watershed.

Wetlands have remained relatively constant between 2008 and 2015/2016. A net loss of 0.1 ha of wetland has occurred in the Silver Creek watershed during this time period. Wetland loss is associated with two urban developments and is partially offset by one wetland creation project north of County Road 19. Livestock access to wetlands north of Highway 26 is impacting wetland vegetation and wetland functions.

Wetland Complexes

The Silver Creek Wetland Complex is Provincially Significant and consists of a mosaic of deciduous swamp forests, thicket swamps and marshes. The component of this wetland within the Silver Creek watershed represents one of the last relatively intact coastal wetlands on the Southern Georgian Bay shoreline. This wetland hosts rare plant species such as: Sullivant's milkweed and large purple agalinis as well as Species at Risk such as least bittern (Threatened) and snapping turtle (Special Concern).

Coastal marshes associated with this wetland are globally rare and characterized by species such as Ohio goldenrod, small fringed Gentian and Kalm's St. John's wort. The Silver Creek Wetland Complex is characterized by shallowly sloping limestone shorelines, relatively low nutrient inputs and is highly dependent on variable water levels, which allows for these rare species to exist (Midwood et al., 2012). Water level fluctuations (daily, seasonally and long-term cycles) are essential components of these communities. Although not a wetland, a globally/provincially rare Dry-Fresh Little Bluestem Open Alvar Meadow community north of Highway 26 has a strong connection with the Silver Creek wetland complex.

Several unevaluated wetlands within and adjacent to the Silver Creek watershed could potentially be added to the Silver Creek wetland complex. They appear to meet the criteria for size, hydrological connectivity and proximity as laid out by the Ministry of Natural Resources and Forestry.

An unevaluated wetland complex is present in the area of Lake of the Clouds. Strong springs along the west shore of the lake represent a component of the complex. A large vernal wetland pool along Grey 19 provides important woodland frog and salamander breeding habitat. A mosaic of swamps and ponds south of Grey 19 adds to the value of the wetland.

A large unevaluated wetland lies at the base of the Escarpment slopes southwest of the Mountain Road/Osler Bluff Road intersection. Much of this wetland appears to be regenerating on abandoned farm fields. A variety of meadow marsh, shallow march, thicket swamp and deciduous swamp habitats have regenerated in this area. Located on private land, little is known about communities and associated functions of this wetland.

The "Lake of the Clouds" and "Escarpment Base" unevaluated wetlands, as well as the unevaluated wetlands near the Silver Creek complex should be further evaluated using the provincial wetland evaluation system in order to determine their significance and enhance their protection within the watershed.

3.2.3 Cultural Communities

Communities that were historically farmed but have since been left to regenerate are first characterized by common meadow grasses and forbs. Over time, a variety of shrubs and successional tree species colonizes these fields. Cultural communities consist of cultural meadows (old fields), cultural thickets (fields with shrubs), cultural savannah (fields with occasional trees), cultural woodland (young forests) and cultural plantation (often planted conifer forests). Cultural woodland and cultural plantation are often regarded as "forest cover" (as they are in this study). In the Silver Creek watershed most, if not all cultural communities will generally succeed to forest cover unless otherwise managed.

A significant percentage of natural cover (19.3% of total natural cover) is associated with regenerating fields and thickets in the Silver Creek watershed. Rock fencerows are often associated with community edges. Cultural meadow (Appendix B – Figure 12), consisting of regenerating fields, hayfields and ski runs, is the dominant cultural community type in the watershed, making up 79.2% of all cultural cover. Large cultural meadows provide habitat for the Threatened bobolink and eastern meadowlark while cultural thickets may support golden-winged warblers (Special Concern). Regenerating fields and thickets provide "edge" habitat for a number of wildlife species.

The MacMurchy Settlement- at the base of the Escarpment - was the earliest settlement in the watershed (circa 1834). This area is still farmed today. Some of these fields have been retired and planted as part of the Forest Ontario 50 Million Tree Program. These trees/planted fields are very young and are currently identified as cultural (non-forested) communities.

3.3 Significant Species and Wildlife Habitat

Significant wildlife habitats are found throughout the Silver Creek watershed.

Core forests provide deep forest habitat for interior breeding bird species such as ovenbird, scarlet tanager and black-throated green warbler. These large forests also provide dispersal habitat for mole salamanders (i.e. spotted salamanders) and other breeding amphibians – which often dominate the wildlife biomass of these forests. The endangered butternut is present in Escarpment forest stands and the provincially/globally rare Hart's tongue fern is present on the dolostone bedrock tablelands above the Escarpment. Although significant deer yards are not present in the watershed, local white-tailed deer activity is present.

Swamp forests and thickets on the Escarpment include several wetlands that support breeding habitat for a diverse assemblage of amphibians that require a combination of wetlands and upland forest to carry out their life cycles. The endangered Jefferson salamander - which has been recently documented in similar habitat contexts in nearby catchments - may be present.

Regenerated fields and thickets also provide habitat for Species at Risk. Hayfields and open meadows provide habitat for the Threatened bobolink and eastern meadowlark. Thickets may provide habitat golden-winged warbler (Special Concern) as well as for a variety of declining forest edge species.

The coastal marshes along Georgian Bay support a variety of wildlife including rare reptiles and amphibians. Shorebirds and waterfowl utilize this shoreline on their migration routes in the spring and again in late summer/fall. Colonial nesting birds such as great egret, black-crowned night heron, great blue heron, gulls and terns forage along these shoreline wetlands, flying in from nearby nesting islands off the Collingwood shoreline. Smallmouth bass and long-nosed gar are just two of many fish species that utilize these coastal wetlands for spawning and nursery habitat.

3.4 Species at Risk

The federal and provincial governments are responsible for listing Species at Risk. These species lists and associated designations are similar though not always identical. These lists are fluid and change yearly. For example, milksnake was recently removed from the provincial Species at Risk list while several species of bats (in steep decline due to white-nose (fungus) syndrome) have been added.

Provincially Threatened and Endangered species (i.e. bobolink and butternut) receive protection (various mechanisms) through the Provincial Policy Statement, *Endangered Species Act*, and municipal Official Plan policies. With the exception of federal lands, federal Species at Risk that are not on the provincial list (i.e. western chorus frog) receive (lesser) protection under the Significant Wildlife Habitat provisions of the Provincial Policy Statement. Species of Special Concern (both federal and provincial) receive consideration as part of Significant Wildlife Habitat as well.

As noted previously in the report, the diverse assemblage of habitats in the Silver Creek watershed support a number of mammals (bats), birds, herpetofauna and plant species that have been listed as Species at Risk. In addition, a number of bird and plant species within the watershed are considered provincially rare and receive a level of protection through Significant Wildlife Habitat provisions of the Provincial Planning Statement.

3.5 Invasive species

Invasive species are plants, animals, pests or diseases that are generally not native to an area and have characteristics that allow them to outcompete and "take over" their preferred habitats. In some cases – particular with tree pests/diseases - an invasive pest and disease hosts directly on a target native species, driving them toward extinction/extirpation. A number of invasive species were observed in the Silver Creek watershed during this study. Other species such as emerald ash borer were not directly observed but are known to be infesting the watershed.

European buckthorn and garlic mustard have colonized many forests in the Collingwood area and are making inroads into some areas along the Niagara Escarpment including parts of the Bruce Trail. Buckthorn control is extremely labour-intensive and costly. Garlic mustard can be controlled through hand-picking with control efforts likely best spent on new, small stands along Escarpment trails.

Phragmites continues to colonize the Silver Creek Wetlands complex with significant stands just west of Silver Creek along Highway 26 and along the shoreline near the mouth of Silver Creek. Control efforts are best directed to protecting globally rare coastal marsh habitats along the shoreline.

Emerald ash borer is moving into the Silver Creek watershed. Significant impact on ash forests are likely over the next five to ten years. Since most cultural woodlands have a strong ash component, impacts to these woodlands will be significant though, hopefully, other species such as sugar maple, red oak and black cherry will eventually replace ash components of these young stands. Mature green ash swamps within the Silver Creek Wetland Complex will also be impacted. It is unclear what trajectory these communities will take following loss of the dominant ash canopy.

Similar to other part of southern Ontario, butternut canker has already wreaked havoc in the watershed. Though typically a fairly small component of forest cover, butternut is widespread; most butternuts observed appear to have infected with the canker and are various stages of decline in the Silver Creek watershed.

4.0 Silver Creek Biological Community and Water Quality

Stream health data indicates that Silver Creek supports coolwater habitat remaining at or below 24°C from the Escarpment headwaters to Georgian Bay throughout the hottest months of the year. Given suitable flow and absence of other barriers, rainbow trout and Chinook salmon are able to move upstream as far as Lake of Clouds to spawn. This entire reach provides suitable nursery and rearing habitat for young rainbow trout and Chinook salmon prior to their movement to Georgian Bay. Although not captured in recent sampling on the main watercourse, native brook trout likely persist in headwater areas upstream of Lake of the Clouds and on Neff Creek. At Mountain Road there is a historic dam that prevents all fish species except for salmonids from travelling further upstream. Electrofishing

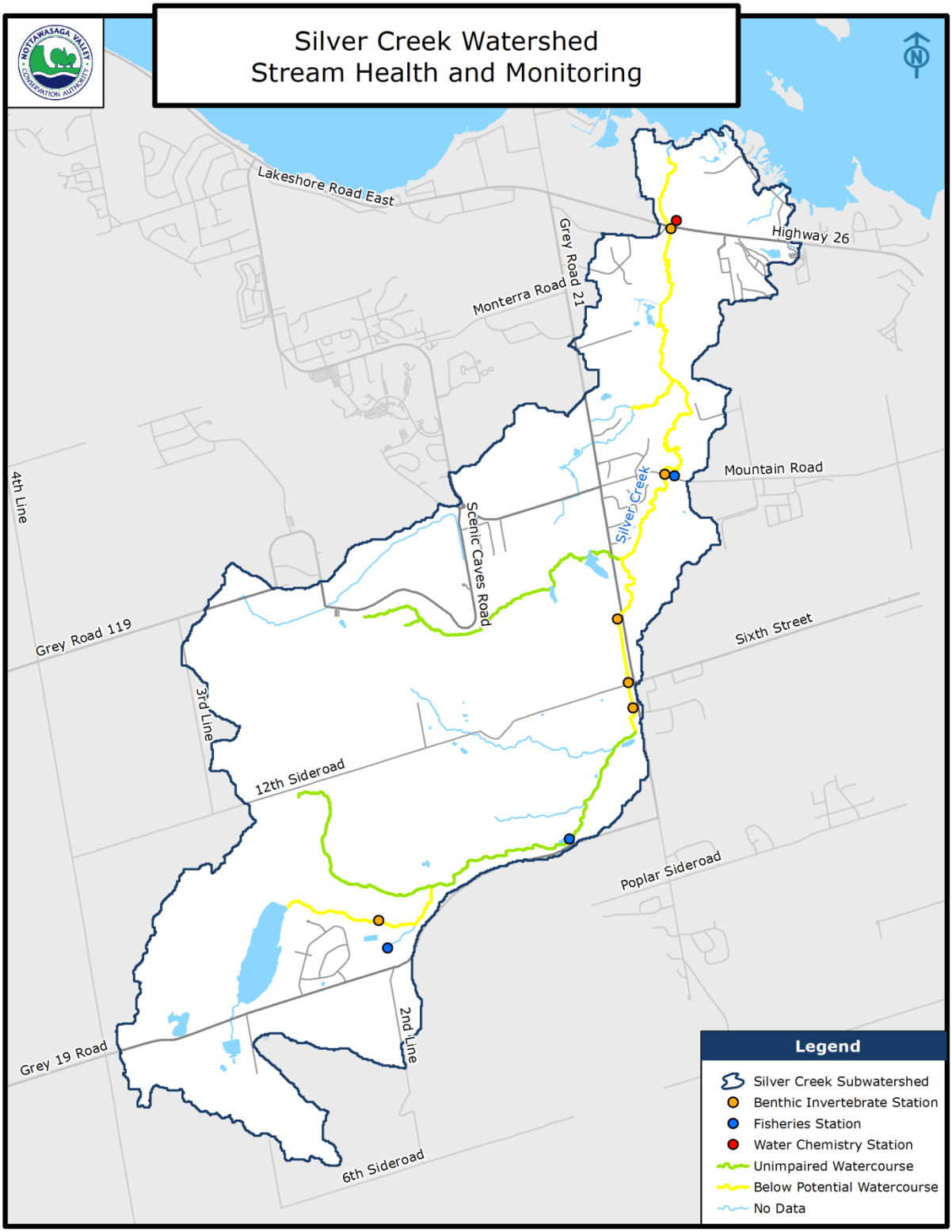
survey results downstream of the dam just off Evergreen Drive were: rainbow trout, Chinook salmon, Johnny darter, northern redbelly dace, creek chub, eastern blacknose dace, longnose dace and fathead minnow.

Silver Creek's cool temperatures and rocky substrate also support a relatively healthy benthic community. Benthic invertebrates have been sampled at three locations on Silver Creek: The Bruce Trail, 12th Sideroad and Highway 26 (annual sampling), providing a greater watershed picture of biological health. Biological health is determined by analyzing a variety of metrics including %worms, %chironomids (midges) and %EPT (mayflies, stoneflies and caddisflies). A broad index - the Hilsenhoff Family Biotic Index - is used to determine the biodiversity and percentages of pollution tolerant/intolerant species. At the Bruce Trail site, %EPT has decreased by 50%, and HBI has changed from 3.45 (excellent) to 5.30 (good), indicating some degradation in water quality from an unknown source. Biological communities at 12th Sideroad and Highway 26 have not changed in recent years.

Despite strong groundwater sources and relatively healthy conditions, impairments to stream health are associated with upstream impoundments, limited riparian cover, past stream alteration and livestock access. Stream health in these areas is generally regarded as "fair" (below potential). Areas isolated from these influences i.e. Neff Creek and Scenic Cave tributaries and main branch from Bruce Trail to Osler Bluff Road are considered in good health (unimpaired). Figure 3 identifies stream health mapping and reach assessment based on evaluated stream reaches.

Silver Creek's water quality is generally good based on PWQMN sampling results at Highway 26. Nutrients are typically low during baseflow conditions and occasionally exceed Provincial Water Quality Objectives during storm flow conditions- which is a typical pattern for most watercourses (even the most pristine). Steep slopes throughout much of the watershed make it essential to implement and maintain rigorous erosion and sediment control to keep soil/high sediment runoff from work sites out of Silver Creek and its tributaries. Significant riparian restoration/livestock management opportunities are present in the reach from the Georgian Trail downstream to Highway 26.

Figure 3: Stream Health and Monitoring Stations – Silver Creek Watershed



5.0 Natural Heritage System

This study has been valuable in understanding landscape features and connectivity from the Niagara Escarpment to Georgian Bay, neighbouring watersheds and the greater Niagara Escarpment corridor. The three broad vegetation communities: forest, wetland and cultural are found throughout the Silver Creek Watershed and play important roles in watershed hydrology, soil structure and wildlife habitat. Having a balance between these three vegetation types is important for many species that require multiple habitats to complete different life stages.

The Silver Creek natural heritage system knits terrestrial, wetland and streams systems together and ensures that the watershed is connected from Escarpment to Bay. This watershed remains one of the most natural areas in the Blue Mountain Watershed Trust area of interest. Recent municipal natural heritage system approaches (Grey County and Town of Collingwood; not fully implemented to date) have sought to identify key system elements within their portion of the Silver Creek watershed. BMWT applauds these efforts noting that it is essential to enshrine this system within their Official Plan schedules and policies.

The Silver Creek watershed natural heritage system is intimately connected with broader natural heritage systems in the area. Significant connections to the following systems are present:

- Black Ash Creek
- Townline Creek
- Beaver River/Kolapore Uplands
- Silver Creek Wetland Complex (to the east and west)
- Nottawasaga Bay shoreline
- Niagara Escarpment

6.0 Ecological Threats and Opportunities

Vegetative communities in the Silver Creek Watershed have been recovering over the last century from farming practices. Old fields have been left to regenerate, which has increased the forest cover in this watershed compared to other areas that are seeing losses from development and agricultural expansion. Although the watershed is generally healthy within the context of the Blue Mountain watersheds and southern Ontario itself, several factors threaten the continued presence and health of the Escarpment to Bay natural heritage system. Conversely, there are opportunities to restore and rebuild the natural heritage system. These challenges are outlined below.

6.1 Development

Development pressures within the Silver Creek watershed include residential development and recreational development.

Residential Development

Future development at Castle Glen (subject to further study) is likely to consist of both residential and recreational (golf course) development. This development has been subject to various levels of planning

approval since the early 1970s. Development will likely result in the loss of mature upland forest as well as regenerating cultural communities.

Development pressures north and south of Highway 26 may impact upland forests and regenerating areas. Higher level planning approvals are in place or pending in these areas. Although some loss of natural cover is likely to occur, this may be offset by restoration opportunities including reforestation and riparian floodplain restoration.

Development is occurring at the southwest corner of Grey 19 and Osler Bluff Road (Windfall Developments). Loss of regenerating forest and a small wetland will occur over time in this area. Loss of the small wetland has been offset by wetland pond creation next to the westernmost tributary of Silver Creek.

Deferred Development and Hazard designations areassociated with the properties southwest of the Mountain Road/Osler Bluffs Road intersection to the south of Windfall. This property includes a mosaic of regenerating habitats including a complex of unevaluated wetlands. The Scenic Caves tributary flows through this property. Comprehensive Environmental Impact Studies should be required prior to consideration of development in this area.

Recreational Development

The Blue Mountain Resort (BMR) lies at the northwestern boundary of the Silver Creek watershed. BMR recently expanded their ski runs to the south ("The Orchard" and also hosts summer mountain biking which requires an extensive trail system. To the south of BMR is Scenic Caves which also has an intricate cross country ski and hiking trail systems covering an area of 500 acres. They also offer Eco Tours which involves walking on wooden structures that are strung between trees throughout the mid-canopy layer. Although these trail systems offer an opportunity for recreation and nature interpretation, poorly planned trail networks have the potential to impact natural heritage features and functions. Research is needed to determine the environmental impact of trail systems and careful planning is required to create/maintain a sustainable trail network.

Poorly planned active recreational development can lead to a number of environmental issues, including:

- Creation of new forest edges which are subject to a variety of impacts (sunscald, windthrow, invasive species)
- Fragmentation of core forest habitat for breeding birds, breeding amphibians and mammals
- Increased access to habitats of rare species which may be impacted through noise, vehicle traffic and collection
- Sedimentation issues due to exposed soil and loss of root systems
- Compacted soils reduce permeability of rainwater, therefore creating runoff and erosion concerns
- Introduction of invasive terrestrial species through soil disturbance, movement of equipment and people

Recreation in nature is important for fostering a connection between ourselves and the environment. However, there needs to be a balance in order to maintain the features and functions of natural spaces.

6.2 Invasive Species

Invasive species are a major threat to ecosystem health in the Silver Creek watershed. Dutch elm disease has already caused almost 100% loss of elm trees in the watershed. Beech bark disease and emerald ash borer will result in the same fate for American beech and all ash species. A significant invasive species threat to Canada's forests is the Asian long-horned beetle, as its preferred host species is maple and can host on other deciduous species such as poplar and birch. If the Asian long-horned beetle becomes established in Ontario, the Escarpment forests in the Silver Creek would be severely impacted.

Invasive plants such as garlic mustard and European buckthorn are threats to mixed and deciduous forest ecosystems as they outcompete native plants like trilliums, ferns and trout lilies. These invasive plants also threaten food and habitat resources used by native birds and mammals. Dog strangling vine – found in a handful of locations along the Collingwood shoreline – also has the potential to expand its range and significantly impact the forests of the watershed.

Phragmites poses the greatest current threat to coastal marshes in the watershed. This invasive grass is found throughout the Silver Creek Wetlands and is threatening the entire stretch of coastal marshes along the Georgian Bay shoreline. This invasion is in its early stages and there is still time for control efforts to achieve positive results. For more information on this please read NVCA's "*Phragmites* Management in Collingwood".

Georgian Bay is currently impacted by zebra/quagga mussels and round goby. These species have altered the lake food web, impacting native zooplankton and fish species. Dense mussel beds (and associated nutrient/fecal deposition) have created conditions conducive to growth of botulism bacteria. These bacteria bioaccumulate in the food chain and can reach toxic levels in fish-eating birds and nearshore fish including the Threatened lake sturgeon. Significant die-offs of these species have been observed in recent years. This impacts the nearshore functions of the Silver Creek shoreline.

6.3 Climate Change

Climate change will affect both terrestrial and aquatic ecosystems in this area. In the summer of 2016 alone there were 17 days over 30°C in Collingwood, Ontario (Environment Canada, 2016). Globally, January to September 2016 was recorded the hottest on record at 1.2°C above pre-industrial levels and 0.88°C above the average for the 1961-1990 reference period (WMO, 2016). MNRF climate change projections for the Collingwood area (Ecorgeion 6E) indicate increased air temperatures with precipitation patterns staying around the same (McKenney et al. 2010). These projections can be found in Appendix B.

For terrestrial ecosystems the biggest concern with increasing temperatures is the ability for invasive species to thrive and move further north. Warmer summer temperatures create ideal habitats for some invasive species and without harsh winter temperatures they can overwinter. Warmer temperatures also threaten terrestrial ecosystems by increasing the frequency of forest fires.

Silver Creek is formed through groundwater-fed seeps and springs on the Escarpment. These groundwater-fed features maintain creek flows during the summer months. Groundwater recharge is dependent on snowpack, snow and rainfall events, evaporation rates and soil permeability. Warmer winter temperatures may increase the amount of winter rainfall and reduce the snow pack on the Escarpment which will impact groundwater recharge and surface runoff regimes (Dove-Thompson et al.

2011). Increased surface runoff and decreased groundwater recharge during the winter months, in comgination with increased evapotranspiration during the summer could lead to reduced baseflow in Silver Creek during the summer months.

Warmer summer temperatures and decreased baseflow would impact coldwater habitat in Silver Creek and its tributariers. Changes in timing of flow events and increased incidence of severe weather events (droughts and floods) may impact migratory spawning runs (rainbow trout and Chinook salmon). To minimize the impacts of climate change on the aquatic ecosystems within the Silver Creek watershed, it will be important to maintain and enhance riparian habitat/shading. Vegetative shading can "hold" instream temperatures and reduce thermal impacts associated with climate change. Mitigating the impacts of on-line lakes and ponds through decommissioning, changeover to off-line systems and implementation of bottom-draw outlet designs is another key means by which to address the impacts of climate change.

Although climate change may have the greatest impacts on aquatic resources within the watershed, the watershed is also part of larger north-south linkages along the Escarpment and from the Escarpment to the Bay. Enhancement of natural linkages will facilitate the flow of biota as they adapt to climate change. Vigilance will be required to ensure that this flow minimizes/avoids the impacts associated with invasive species that can also move along these linkages.

6.4 Natural Heritage System Opportunities

All is not doom and gloom. There are opportunities to restore and enhance the Silver Creek watershed natural heritage system.

Working with landowners to mitigate the impacts of on-line ponds can improve fish habitat and make the Silver Creek system more resilient to climate change. Improving riparian habitat through reforestation also enhances stream health and provides shading which can mitigate the impacts of climate change.

Working with landowners to fence livestock away from streams, forests and wetlands provides a rapid method to improve natural heritage system health – and even the health of livestock. The future acquisition of some floodplain properties by public agencies provides a significant opportunity to renaturalize floodplains and reconnect Silver Creek to adjacent forests and wetlands.

As natural areas in the downstream portion of the watershed come into public ownership, there are opportunities to formalize trail systems to bring the public into some natural areas and provide a significant opportunity for nature interpretation. There are also opportunities to close off existing informal trail systems through sensitive natural areas. It is critical to develop and manage trail systems in a sustainable way to achieve public benefits while protecting sensitive ecosystems and associated functions.

Natural regeneration continues to occur within the watershed. Forest cover is anticipated to further increase and mature if this natural process is allowed to continue. This will naturally improve forest, wetland and stream functions in the watershed and bolster the its resilience to climate change.

Focused public efforts to control invasive species in sensitive habitats can help mitigate the impacts of these species in the watershed. If access can be obtained, expanding the West Collingwood Phragmites

control project westward along the Silver Creek shoreline should be considered to protect the globally rare coastal wetlands along this shore.

7.0 Conclusions and Recommendations

The Silver Creek watershed is a unique and diverse ecosystem, supporting a variety of natural features and rare species. All of these ecotypes and their connectivity are essential for different life stages of species from the Escarpment to Georgian Bay.

Development pressures in a relatively natural watershed can lead to fragmentation of core habitats, facilitate introduction of invasive species, and reduce resilience to climate change. A larger landscape-scale perspective and continuing to develop and implement Natural Heritage Systems will ensure that sensitive areas are protected in perpetuity and allow municipalities to focus on sustainable economic growth.

Now, more than ever, monitoring of wildlife populations, vegetation communities and water quality is important in order to better prepare for future threats and to minimize impacts. Studies should be completed to determine the impact trail networks have on terrestrial ecosystems and wildlife habitat on the Escarpment. Trails are important to connect the general public with nature but they can be incorporated in a way that protects significant habitat by guiding them away and closing off access to significant habitats while still fulfilling recreation opportunities.

More community-based stewardship initiatives are required to raise awareness for environmental issues like invasive species, development and harmful land use practices. There are options for landowners to work with conservation groups such as Ducks Unlimited Canada and Nottawasaga Valley Conservation Authority to create wetland and pollinator habitat and participate in tree planting. By making landowners more aware of their property ecology and providing options for best management practices, each individual can have a positive impact.

Businesses and different levels of government have an important role in protecting natural features through responsible planning. More water quality monitoring is needed on smaller tributaries and throughout waterways from their headwaters to their discharge point, to fully understand how the system is changing throughout the landscape and what land use practices may be influencing these changes. For terrestrial ecosystems where invasive species are present or waterways flagged as “below potential” or “impaired”, management and restoration plans should be developed and implemented. By making better decisions, providing education and monitoring, a proactive approach can be taken to preserve and enhance watershed health in this area.

References

Chu, C., Jones, N., Piggott, A., Buttle, J. (2009). Evaluation of a Simple Method to Classify the Thermal Characteristics of Streams Using a Nomogram of Daily Maximum Air and Water Temperatures. *North American Journal of Fisheries Management.*29:1605–1619.

Cvetkovic, M., Wei, A. and Chow-Fraser, P. (2010). Relative importance of macrophyte community versus water quality variables for predicting fish assemblages in coastal wetlands of the Laurentian Great Lakes. Journal of Great Lakes Research. 36: 64– 73.

Dove-Thompson, D., Lewis, C., Gray, P., Chu, C., and Dunlop, W. (2011). A Summary of the Effects of Climate Change on Ontario's Aquatic Ecosystems*. Ministry of Natural Resources and Forestry.* Retrieved online on November 16, 2016 from, http://files.ontario.ca/environment-and-energy/aquatics-climate/stdprod_088243.pdf

Environment Canada. 2013. How Much Habitat is Enough? Third Edition. Environment Canada, Toronto, Ontario.

Featherstone, D. and N. Fortini. 2011. Town of Collingwood Natural Heritage System (Draft). Prepared for the Town of Collingwood.

Jones, C, Somers, K., Craig, B. and Reynoldson, T. (2007). Ontario Benthos Biomonitoring Network. *Ministry of Environment and Climate Change*. Retrieved online on December 5 from, http://www.saugeenconservation.com/download/benthos/2009/OBBN%20Protocol%20Manual.pdf

Jones, N. (2011). Electrofishing Rivers: Nearshore Community Sampling Methodologies for Ontario's Flowing Waters. *Ministry of Natural Resources and Forestry.* Retrieved online on December 5 from, https://dr6j45jk9xcmk.cloudfront.net/documents/2576/stdprod-103415.pdf

Lee, H., Bakowsky, W., Riley, J., Bowles, J., Puddister, M., Uhlig, P. and McMurray, S. (1998). Ecological Land Classification for Southern Ontario: First Approximation and Its Application. Ontario Ministry of Natural Resources. South Central Science Section, Science Development and Transfer Branch. SCSS Field Guide FG-02.

Natural Heritage Solutions Inc. (2012). Town of Collingwood Natural Heritage System Peer Review. Retrieved online on December 5, 2016 from, http://www.collingwood.ca/devcomattachments/FaceBook/NaturalHeritage/NaturalHeritageSolutionsPeerReview/NRSI_1344_Peer%20Review_Final_2012_08_24_KSW_compressed.pdf

McKenney, D., Pedlar, J., Lawrence, K., Gray, P., Colombo, S. and Crins, W. (2010). Current and Projected Future Climatic Conditions for Ecoregions and Selected Natural Heritage Areas in Ontario. *Ministry of Natural Resources and Forestry.* Retrieved online on November 16, 2016 from, http://www.web2.mnr.gov.on.ca/mnr/ecomapbrowser/CCRR-16_apr_12_2010.pdf

Midwood, J., Rokitnicki-Wojcik, D. and Chow-Fraser, P. (2012). Development of an Inventory of Coastal Wetlands for Eastern Georgian Bay, Lake Huron. ISRN Ecology. 1-13.

Stoneman, C. and Jones, M. (1996). A simple method to evaluate the thermal stability of trout streams. *North American Journal of Fisheries Management*. 16:728–737.

Appendix A - ELC Vegetation Types in Silver Creek Watershed

ELC Vegetation Type Code	ELC Vegetation Type Name	Description/Comment
Cultural		
CUM1-1	Dry-Moist Old Field Meadow	Large areas scattered throughout watershed. Potential bobolink/eastern meadowlark habitat.
CUP3-1	Red Pine Coniferous Plantation	
CUP3-2	White Pine Coniferous Plantation	
CUP3-3	Scots Pine Coniferous Plantation	
CUP3-4	Jack Pine Coniferous Plantation	
CUP3-8	White Spruce-European Larch Coniferous Plantation	
CUS1-1	Hawthorn Cultural Savannah	Regenerating fields
CUT1-5	Raspberry Cultural Thicket	Regenerating fields
Forest		
FOC1-2	Dry-Fresh White Pine-Red Pine Coniferous Forest	
FOC2-2	Dry-Fresh White Cedar Coniferous Forest	
FOC4-1	Fresh-Moist White Cedar Coniferous Forest	
FOD1-1	Dry-Fresh Red Oak Deciduous Forest	Escarpment slopes near Scenic Caves
FOD2-4	Dry-Fresh Oak-Hardwood Deciduous Forest	Escarpment slopes near Scenic Caves
FOD3-1	Dry-Fresh Poplar Deciduous Forest	Younger, regenerating forest type
FOD5-1	Dry-Fresh Sugar Maple Deciduous Forest	Large stands above Escarpment near Castle Glen. Possibly the dominant upland forest type.
FOD5-3	Dry-Fresh Sugar Maple-Oak Deciduous Forest	
FOD5-4	Dry-Fresh Sugar Maple-Ironwood Deciduous Forest	Large tract south of Concession 12, east of Castle Glen. Younger forest nearing climax condition.
FOD5-6	Dry-Fresh Sugar Maple-Basswood Deciduous Forest	
FOD5-7	Dry-Fresh Sugar Maple-Black Cherry Deciduous Forest	
FOD5-8	Dry-Fresh Sugar Maple-White Ash Deciduous Forest	Large tract east of Scenic Caves

ELC Vegetation Type Code	ELC Vegetation Type Name	Description/Comment
FOD5-10	Dry-Fresh Sugar Maple-White Birch-Poplar Deciduous Forest	
FOD6-1	Fresh-Moist Sugar Maple-Lowland Ash Deciduous Forest	
FOD7-1	Fresh-Moist White Elm Lowland Deciduous Forest	
FOD7-2	Fresh-Moist Ash Lowland Deciduous Forest	
FOD7-3	Fresh-Moist Willow Lowland Deciduous Forest	
FOD8-1	Fresh-Moist Poplar Deciduous Forest	
FOM2-2	Dry-Fresh White Pine-Sugar Maple Mixed Forest	
FOM3-2	Dry-Fresh Sugar Maple-Hemlock Mixed Forest	
FOM4-2	Dry-Fresh White Cedar-Poplar Mixed Forest	
FOM5-2	Dry-Fresh Poplar Mixed Forest	
FOM6-1	Fresh-Moist Sugar Maple-Hemlock Mixed Forest	
FOM7-1	Fresh-Moist White Cedar-Sugar Maple Mixed Forest	
FOM7-2	Fresh-Moist White Cedar-Hardwood Mixed Forest	Large tract along north side of Grey 19
FOM8-1	Fresh-Moist Poplar Mixed Forest	
Marsh		
MAM2-2	Reed-canary Grass Mineral Meadow Marsh	
MAM2-5	Narrow-leaved Sedge Mineral Meadow Marsh	
MAM2-10	Forb Mineral Meadow Marsh	
MAM4-2	Shrubby Cinquefoil Coastal Meadow Marsh	Part of globally rare Great Lakes Coastal Marsh complex (generally north of Hwy 26)
MAM5-1	Mineral Fen Meadow Marsh	Part of globally rare Great Lakes Coastal Marsh complex
MAM5-2	Tallgrass Mineral Fen Meadow Marsh	Part of globally rare Great Lakes Coastal Marsh complex
MAS2-1	Cattail Mineral Shallow Marsh	Possible large area in Escarpment Base wetland (orthointerpretation).

ELC Vegetation Type Code	ELC Vegetation Type Name	Description/Comment
MAS2-4	Broad-leaved Sedge Shallow Marsh	Rare watershed habitat type. Significant amphibian breeding.
MAS3-1	Cattail Organic Shallow Marsh	
Swamp		
SWC1-1	White Cedar Mineral Coniferous Swamp	
SWC3-2	White Cedar-Conifer Organic Coniferous Swamp	Significant spring discharge area along west side of Lake of the Clouds.
SWD2-2	Green Ash Mineral Deciduous Swamp	Regenerating in Escarpment Base wetlands. Common in Silver Creek wetland complex.
SWD3-1	Red Maple Mineral Deciduous Swamp	
SWD3-3	Swamp Maple Mineral Deciduous Swamp	
SWD3-4	Manitoba Maple Mineral Deciduous Swamp	
SWD4-1	Willow Mineral Deciduous Swamp	
SWD4-3	White Birch-Poplar Mineral Deciduous Swamp	
SWD5-1	Black Ash Organic Deciduous Swamp	
SWM1-1	White Cedar-Hardwood Mineral Mixed Swamp	
SWM3-2	Poplar-Conifer Mineral Mixed Swamp	
SWT2-1	Alder Mineral Thicket Swamp	
SWT2-2	Willow Mineral Thicket Swamp	
SWT2-5	Red-osier Mineral Thicket Swamp	Possible large area in Escarpment Base wetland (orthointerpretation).
SWT2-8	Silky Dogwood Mineral Thicket Swamp	
Alvar		
ALO1-3	Dry-Fresh Little Bluestem Open Alvar Meadow	Globally/provincially rare; small <0.5 ha community north of Hwy 26 next to Silver Creek PSW
Talus		
TAT1-4	Fresh-Moist Sugar Maple Carbonate Treed Talus	Provincially rare community next to Scenic Caves cliff.
Cliff/Crevice		
CLT1-1	White Cedar Treed Carbonate Cliff	Globally/provincially rare community at Scenic Caves. Crevice and cave components. Old-growth cedars.

Appendix B: Rare and Dominant Vegetation Community Type Photos

Figure 1: Shrubby Cinquefoil Coastal Meadow Marsh (MAM4-2)

Figure 2: Mineral Fen Meadow Marsh (MAM5-1)

Figure 3: Tallgrass Mineral Fen Meadow Marsh (MAM5-2)

Figure 4: Little Bluestem Open Alvar Meadow (ALO1-3)

Figure 5: Sugar Maple Carbonate Treed Talus (TAT1-4)

Figure 6: White Cedar Treed Carbonate Cliff (CLT1-1)

Figure 7: Dry-Fresh Sugar Maple Deciduous Forest (FOD5)


Figure 8: Cultural Woodland (CUW)

Figure 9: Green Ash Mineral Deciduous Swamp (SWD2-2)

Figure 10: Thicket Swamp (SWT)

Figure 11: Cattail Mineral Marsh (MAS2-1)

Figure 12: Cultural Meadow (CUM1-1)

Appendix C: Climate Change Projections for Ecoregion 6E

Ecoregion	Climate Variable	1971-2010			2011-1040			2041-2070			2071-2100		
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
6E	Annual Mean Temperature (°C)	4.7	8.1	6.4	6.4	9.8	8	7.2	10.7	8.9	8.4	11.9	10.1
	Maximum Temperature (°C)	23	27.4	25.6	25.5	29.1	27.8	26.6	30.3	28.9	27.7	31.4	30
	Minimum Temperature (°C)	-18.6	-9.7	-12.9	-16.5	-8.4	-11.5	-15.8	-7.8	-11.0	-13.6	-5.6	-8.7
	Annual Precipitation (mm)	741	1111	926	786.5	1090.8	924	803.3	1115	946.5	800.8	1109.3	941.3
	Precipitation- Warmest Quarter (mm)	205	290	237	206.5	291.5	244	208.5	294.5	245.8	198	292.5	237.5
	Precipitation- Coldest Quarter (mm)	137	307	221	140.3	304.3	217.8	146.3	315.8	228	151.5	320	230.5