Environmental Management Plan
2020-2024
rare Charitable Research Reserve
(Blair Site)

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Acknowledgements
This document builds on the previous ***rare*** Environmental Management Plans, authored by Bill Wilson, Ken Dance, Lawrence Lamb & Douglas Larson (2002), updated by Bill Wilson, Chris Dalton, Ken Dance, Lawrence Lamb, Doug Larson, John MacDonald & Alan Morgan (2006), and updated by Tom Woodcock et al. (2014).

Current members of the ***rare*** Environmental Advisory Committee are: Chris Dalton, John MacDonald, Stephen Murphy, Mark Pomeroy, Don Russell, Bill Wilson, Brett Woodman, and Tony Zammit.

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Cover Photo *Libellula quadrimaculata* near Cruickston Creek (photo T. Woodcock)

Land Acknowledgment

Founded on December 6 2001, the ***rare*** **Charitable Research Reserve** is a community-driven urban land trust, nature reserve and environmental institute. The reserve's headquarters and first four locations comprise over 950 acres of conservation lands. Most of these lands are located within the Haldimand Tract. Spanning six miles on either side of the Grand River from source to mouth, the Haldimand Tract is land granted to Indigenous Peoples in 1784 to recognise their support for the British in the American Revolution. With the most recent expansion to Guelph/Wellington, ***rare*** also stewards lands that are part of the Upper Canada Treaty No. 3 from 1792.

For all its properties, ***rare*** acknowledges and is grateful to the original stewards of the land. This land has been rich in diverse Indigenous presence since time immemorial. We would like to honour and respect the sovereignty of both First Nations in our area: the Onkwehon:we Peoples of Six Nations of the Grand River and the Anishinaabe Peoples of the Mississaugas of the Credit. Nia:weh and Miigwech to these Nations who share their lands with us. We'd also like to acknowledge the Neutral people and Indigenous Paleo-Hunters, for whom we have archeological evidence dating back 10,500 years. Today, these lands are also home to many other First Nations, Metis and Inuit people who have moved to the area from across Turtle Island. As outlined in the United Nations Declaration of the Rights of Indigenous Peoples, as an organization committed to reconciliation the ***rare*** **Charitable Research Reserve** recognizes that "respect for Indigenous knowledge, cultures and traditional practices contributes to sustainable and equitable development and proper management of the environment", which includes respecting inherent Indigenous rights and responsibilities with regard to environmental stewardship.

Table of Contents

Those wishing to view Appendices may make a request to **rare@raresites.org**

Appendix I. Summary and status of recommendations from previous land management documents
Appendix II. Current list of >4500 species recorded from ***rare*** property
Appendix III. Summary of human cultures identified at ***rare*** (after J. MacDonald)
Appendix IV. Summary of Federal and Provincial Species at Risk (SAR) recorded at ***rare***
Appendix V. Data Sharing, Sensitivity, and Intellectual Property Policy

1.0 INTRODUCTION AND BACKGROUND

1.1 The Green Heart of Waterloo Region

The ***rare*** **Charitable Research Reserve** is an urban land trust and environmental institute based in Waterloo Region/Wellington, with its first three locations, now referred to as the **Blair Site**, protecting almost 900 acres of sensitive lands. Additional management plans will be produced to address conservation on additional properties not contiguous with the Blair Site. Since inception, ***rare*** has taken care of the land on behalf of the community through the use of Western tools in conservation, research and education. As ***rare*** becomes engaged in reconciliation with the Indigenous Peoples of Turtle Island (North America), these pillars have gained flexibility and now equally include and value Indigenous ways of knowing and being — becoming three strands of a strong braid. Together we will steward these lands with respect for generations past, present and those yet to come, intact in perpetuity with trees more than 250 years old, 24 habitat types, and 6 of 8 pre-settlement landscapes. Under the ***rare***sites initiative, application of ***rare*** principles to conservation of additional lands in the Region of Waterloo and Guelph/Wellington County is underway, and addressed separately in ***rare's*** Land Securement Strategy (***rare***sites 2019) for Waterloo Region/Wellington.

The original property of the ***rare*** **Charitable Research Reserve** (the Blair property) contains 24 different habitat types, with upland and lowland forests (including old growth features), agricultural fields, old-field successional communities, meadows and shrub thickets, limestone alvar, cliffs, floodplains, cold-water streams, and a variety of wetland types (ELC classification; NRSI, 2011). Located within the Blair-Bechtel-Cruickston Environmentally Sensitive Landscape (ESL), ***rare*** is in one of the fastest growing urban areas in Ontario. Currently with a combined population of 601,220, Waterloo Region is projected to grow to 742,000 by 2031 (https://www.regionofwaterloo.ca/en/doing-business/demographics.aspx). Consequently, the natural areas both within and adjacent to the Region will be under increased pressure from land use changes. The protection and conservation of natural spaces, the individual or collective members of the land, waters, and/or air, and the ecological goods and services they provide is vital to both the population health of local species, as well as to the physical, social, and economic health of the community. The confluence of the Grand River with one of its major tributaries, the Speed River, is located in the northern portion of the property, and ***rare*** embraces the stewardship of this important natural area.

As the population grows and the surrounding landscape changes, ***rare*** is faced with many challenges, threats, and opportunities. Encroaching land uses, such as residential development and aggregate extraction, have the potential to alter ecological functions and cause damage to the geomorphology of the land, quality and quantity of ground and surface waters, biogeochemical processes, plant, animal, and microbial community structure, and the land as a living entity. It is important that ***rare's*** land management plans are flexible, holistic, and utilize multiple knowledge systems, as each component or important ecological feature is linked and we all live together in partnership with the land, plants, and animals. The unique location of ***rare*** in a rapidly urbanizing area means adapting to changing community conditions while staying true to the vision of the charity, which is to offer the community, including local

Indigenous Peoples, the international community and future generations, a diverse network of connected natural areas, protected intact and in perpetuity.

Within the rapidly growing Region of Waterloo, ***rare*** fills the need for protection of natural spaces. The challenge is how to best protect the environmental features as well as their functions. Acting as a guide for environmental management, the Environmental Management Plan (EMP) has been designed not only to be flexible but to act as a tool to monitor and prioritize stewardship and restoration activities. The Plan will act as a living document, guiding the management and living partnership of people with the plant, animals, and ecosystems. This Environmental Management Plan is revised and updated every five years. A summary of past and current land management recommendations and progress made toward each is included in Appendix 1. The following document is specifically tailored to the original land purchase clustered in the Blair area along Blair Rd. Additional land has since been purchased and all satellite sites will have individually tailored EMPs that are subject to a 5-year review, to ensure best stewardship practices in perpetuity.

1.2 History of *rare*

The history of the original ***rare*** property is diverse and considerable detailed information on natural history and human occupancy of the property is available (Burtt 2018). Historical information on the lands extends back over 11,000 years, a span of time through which Indigenous peoples such as the Paleo-Indigenous hunters, Neutral, Anishinaabe and Onkwehon:we people identified and used this area for its abundant natural resources. Evidence indicates early usage of temporary hunting camps by hunters and gathering groups, to later development of floodplain agriculture with more permanent settlements. Early European contact occurred in the area in the late 1700s as transient fur traders moved further westwards and inland into unexplored areas. In 1784, the lands were granted to Six Nations as part of the Haldimand Treaty spanning six miles wide on either side of the Grand River from source to mouth. In 1817, a land survey described the forest in what is now ***rare*** **Charitable Research Reserve** as consisting of “maple and beech and elm”. The first European settler to the area was Nathaniel Dodge, who built a log cabin on Blair Flats. In the 1822 Plan of Dumfries map, both Dodge and his brother Sylvester Dodge have property on or near what is now ***rare***. The Sylvester Dodge farmstead was sold to Samuel Bowman by 1861. In the 1840s, the William Young family built the stone slit barn and farmhouse, now known as the ***rare*** ECO Centre. William Young sold to Matthew Wilks in the late 1860s.

John Gouinlock, a Scottish immigrant and educator arriving to Canada in the late 1820s, owned property on the east side of ***rare*** (either side of Blair Road), including a log cabin, and began farming the river flats on the north side of Blair Road. The log cabin was destroyed by fire in 1923, and his barn across the street was taken down in the 1950s. In 1853, William Ashton purchased 230 acres of land along the Galt-Blair Road, which he called Cruickston Park. Five years later, he sold his property to Matthew Wilks who continued to purchase land for farming totalling about one thousand acres. The University of Guelph took control of the land in 1973 following a bequest by Matthew Wilks Keefer. Keefer’s vision for this land, then known as the Cruickston Park Estate, stressed the importance and need in the future to undertake “research

close to urbanization within a controlled environment…" and displayed many similarities to the ecological and environmental concerns that remain with ***rare*** today.

In 1996, the University of Guelph severed 53 acres of the Cruickston Park estate and sold it to private owners. With funding from concerned citizens, the remaining 913 acres of Cruickston Park was purchased in 2000 as part of a conservation strategy. In 2001, the Cruickston Charitable Research Reserve was incorporated as a charity and was renamed ***rare*** **Charitable Research Reserve** in 2004. Lamb's Inn was built in Blair, the oldest village in Upper Canada, in 1837. This historic stage coach inn later became well known as Nicholson's Tavern before becoming the headquarters for ***rare*** staff in 2003, along with the three acres it sits on. In 2010, the Thompson Tract (93 acres) was purchased from Langdon Hall, bringing most of the Bauman Creek catchment into the reserve. In 2014, 104 acres had to be severed from the property and sold to the Cruickston Park estate.

The original vision of Matthew Wilks Keefer in 1968 is still closely aligned to ***rare's*** vision in 2014, and we will carry on the legacy of the property in perpetuity. The common denominator of our parallel visions is recognition that the well-being of people and their activities is dependent upon our relationships with the natural environment.

1.3 The *rare* Charitable Research Reserve: A Unique Approach to Conservation

Land trust conservation and stewardship is not just about organizations buying land and protecting it from degradation today. It's about whole communities protecting lands intact in perpetuity. To that end, ***rare*** has developed a unique method of conservation, called the ***rare*** Chain of Learning: the lands are a living laboratory for research and a space for Indigenous knowledge, all of which, in turn, inform restoration practices and education programs that reach even the youngest learners. The education links in this Chain of Learning are called Every Child Outdoors (ECO), a model of hands-on environmental learning, in the out-of-doors — and also our aspiration for children and youth everywhere.

We also acknowledge that what we consider natural landscapes today, in most areas of the country, are landscapes that have been used and modified by humans for thousands of years. While many alterations of landscapes and habitat in Canada, particularly since European settlement, have been detrimental and led to loss of habitat and biodiversity, we believe that sustainability is an attainable goal that can be reached if we recognize people as part of the environment and work together towards responsible stewardship. This concept becomes increasingly important as human population and consumption grows, placing ever-greater demands on the environment. To this end, community education and engagement based on living together in reciprocity is key to our conservation priority.

One of the most comprehensive reports on trends in Canadian wildlife populations was released recently (World Wildlife Fund 2017, 2019) and the results are shocking to many who think of Canada's vast wilderness areas as a refuge for wildlife. A quarter of the Earth's wetlands, 8,500 rivers and more than 2 million freshwater lakes are located in Canada. But, the report shows, during the past four decades, human activity — whether industrial development,

farming, forestry or the expansion of urban areas — as well as climate change, pollution and overfishing have helped shrink the populations of 451 species, representing half of the 903 monitored species in the country. The report also says that the best chance of success at changing these trends comes from an ecosystem-based approach. This approach protects multiple species, while doing important research and developing knowledge of the next generation of land stewards.

In summary, ***rare's*** method of conservation is unique and based on 3 fundamental principles:

1. Undertake research to further science and equally value and support Indigenous ways of knowing and being that will result in best practices for use around the world, including sustainable and reciprocal human interaction with the land;
2. Train the next generation of land stewards who will perpetuate these values; and
3. Create a community of support for them and for shared goals among scientists, Indigenous communities and conservationists at all levels.

1.4 History of Environmental Management Planning at *rare*

Environmental management planning is crucial for protecting natural spaces, their living members, features and functions, and has a long history at ***rare***. Below is a short synopsis of the documents and reports that have been published to date (see also Appendix 1 for details):

- In 2001, Nicholas Hill, Heritage Architect Planner, prepared a report called *Vision Statement: Cruickston Park, a vision for conservation and education*, which presented the Goals and Vision for Cruickston Park.
- In 2001, a biophysical inventory was prepared by the Cruickston Park Ecological Advisory Team (CPEAT). This data was integrated into a report completed by North South Environmental Inc., entitled: *Draft Management Framework for Cruickston Park*.
- In 2002, the CPEAT authored *Cruickston Park into the Future: the Environmental Management Plan for Cruickston Charitable Research Reserve*, which provided an environmental inventory of the property and identified opportunities and recommendations for environmental stewardship.
- In 2006, the Environmental Management Plan (EMP) was updated to reflect the changes in land use and ecological conditions on the reserve and providing an updated biotic inventory of the property.
- In 2008, began to develop action plans in anticipation of future updates to the document.
- In 2011, an inclusion of management targets, updated action plans, and land management policies.
- In 2014, the second complete revision of the EMP was undertaken in order to update species lists, clarify opportunities and priorities, include updates on cultural landscapes and archaeological sites, update maps, and to include regional, provincial, and national policy frameworks.
- In 2019, this revision is prepared for the next five year period, updating the organization's goals, including building better relationships with Indigenous communities, and ongoing expansion under the larger ***rare***sites land trust umbrella.

Separate management plans will be created as additional properties are added. The ***rare***sites Land Securement Strategy was also released in 2019.

The overall purpose of the Environmental Management Plan is to guide future restoration and stewardship planning. It is a transparent report that ensures all parties are confident that the property is being managed appropriately and with foresight. The goals of the 2019 EMP update are to:

- Provide an up-to-date biotic inventory of ***rare*** **Charitable Research Reserve**, following the addition of many species through Bioblitz activities.
- Zone the property based on protection requirements to assist with the prioritization of conservation and restoration efforts
- Honour Indigenous rights and responsibilities, as well as ceremonial and related sites and activities.
- Clarify the context for the preservation of ***rare*** lands and watercourses within regional, provincial, and national contexts.
- Develop detailed action plans for the management and restoration of ***rare's*** natural and cultural features.
- Provide policies to guide management and use of ***rare*** lands that are aligned with good stewardship and appropriate community engagement.

1.5 *rare*sites — A Community Opportunity to Preserve More Land, Together

It has always taken the whole community to ensure that ***rare's*** motto — intact in perpetuity — will be a promise kept. During our Strategy and Planning process in late 2014 and early 2015, we conducted surveys, focus groups, expert interviews and a town hall meeting to explore community needs. It became apparent that one of the biggest issues faced by conservation in the Grand River Watershed and adjacent areas is a lack of grassroots efforts to protect land; we are losing agricultural as well as natural areas at an unprecedented rate.

Our ongoing work at a landscape level, and plans to increase the amount of land we steward, is in keeping with our role to contribute to national targets developed by both Federal and Provincial governments, resulting from Canada's participation in the Convention on Biological Diversity in 2010, held in the prefecture of Aichi, Japan. Our work is especially aimed at helping to meet the Aichi Target 11/Canada Target 1 that aims, by 2020, to conserve at least 17% of terrestrial areas and inland water, and 10% of marine and coastal areas of Canada, through networks of protected areas and other effective area-based measures. As the regional land trust, ***rare*** has not only been stepping up to conserve more land, but has also been building its capacity to steward these conservation lands intact in perpetuity. For ***rare***, the term "region" or "regional" is defined broadly to include Waterloo Region, Wellington County and adjacent areas, with a focus on the Grand River Watershed. With its emphasis on science-based stewardship, Indigenous ways of knowing and being, conservation, research and education, ***rare*** has been working to fill this gap.

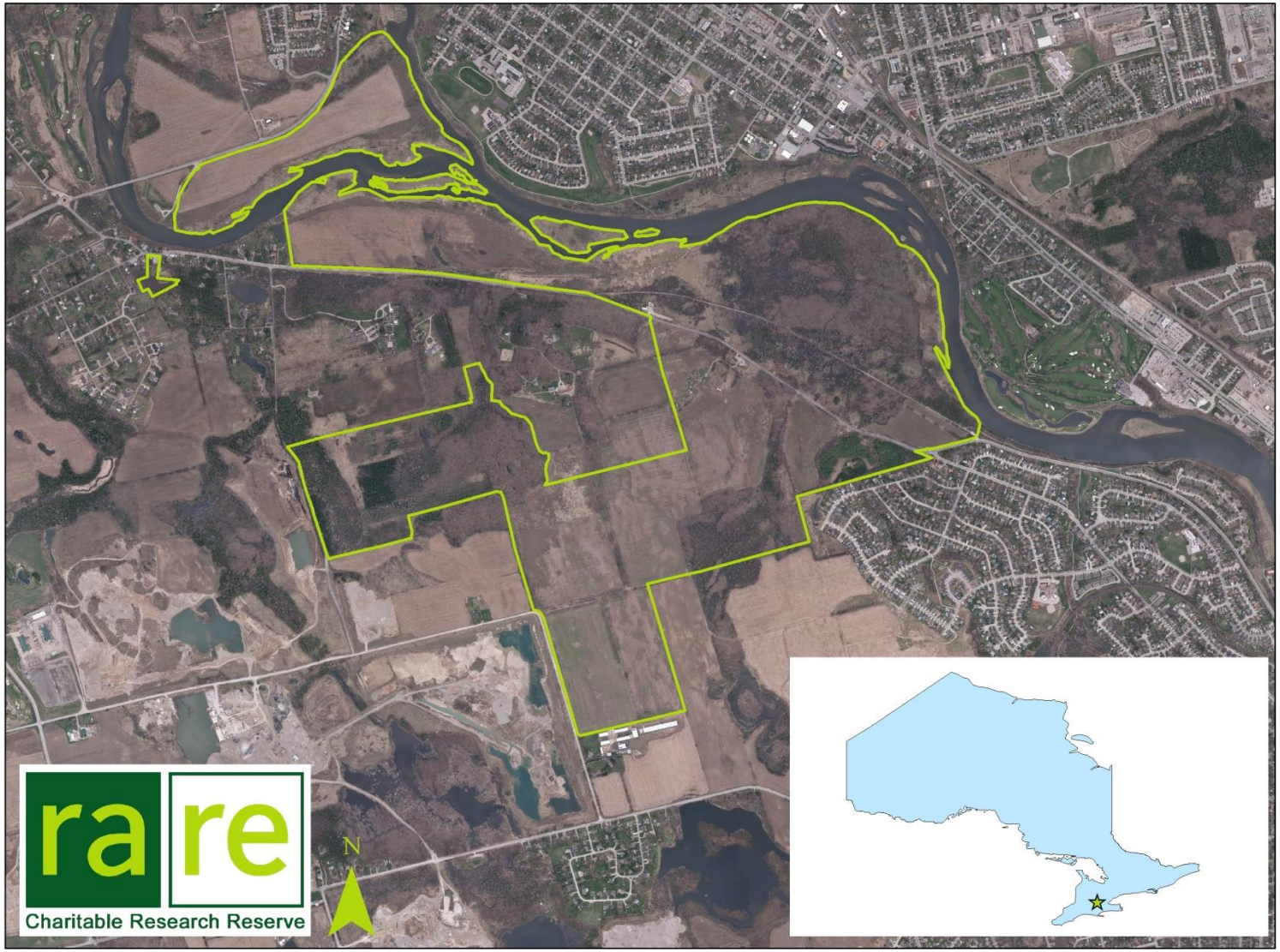

Figure 1.1 Air photo of the ***rare*** **Charitable Research Reserve**, Blair Site, showing location in southern Ontario.

The government also committed to Aichi Target 18: “By 2020, the traditional knowledge, innovations and practices of Indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, (…) and fully integrated and reflected (…) with the full and effective participation of Indigenous and local communities, at all relevant levels”.

After many meetings with community members, a collaborative effort has brought together like-minded organizations and individuals under the ***rare*** umbrella with the goal to protect more land in the Grand River Watershed and surrounding areas in a truly engagement-based fashion. Specifically, we are working towards a community-based land securement strategy, taking advantage of technology for such things as mapping but also for broad-based grassroots fundraising in support of local land securement. In 2019 an 87 acre property was purchased in ***rare's*** Eramosa Conservation Corridor, with additional acquisitions and conservation easements planned. The organization has also been working to acquire donations of conservation lands near the Blair property, and in other desirable areas as identified by our Land Securement Strategy (***rare***sites 2019).

2.0 Detailed Landscape Context and Site Characteristics

2.1 Landscape

The ***rare*** lands contain elements from the Great Lakes-St. Lawrence Forest Region (e.g., yellow birch and eastern white pine), the Boreal Forest Region (e.g., white spruce, paper birch, and trembling aspen), and some Carolinian species of the southeastern Deciduous Forest (e.g., butternut, hackberry, black maple). Within the Canadian classification systems, ***rare*** is located within the Mixedwood Plains Terrestrial Ecozone, at the border between the Moderate Temperate and Cool Temperate Ecoclimatic Regions of the mid-latitudes, and within the St. Lawrence Lowlands Physiographic Region. The combination of variable surficial materials and topography, location at the boundary between climate and vegetation zones, and the tract of land sufficient in size and relatively undisturbed allows landscape level functioning and the complexity of ecosystems and habitats found at ***rare***. In order to facilitate an understanding of the areas of ***rare*** lands, a series of colloquial names are used in this document to identify particular sites (Figure 2.1).

2.2 Geology and Physiography

The ***rare*** **Charitable Research Reserve** is centrally located in the Grand River Basin, with the Grand River flowing through the northern section of the property (Figure 2.2). Much of the southern portion of the property is mantled with deposits from the Wisconsinan glacial period. The northeastern portion of the property is one of the few areas in the Grand River Basin where bedrock is exposed at the surface. Outcrops of upper Middle Silurian Guelph Formation dolostone can be seen on the south bank of the Grand River where they form small bluffs and flat bedrock pavements that support alvar communities.

These 420 million year old rocks are part of the sequence that forms the upper part of the Niagara Escarpment farther to the east. Outcrops of this tropically deposited dolostone can be seen along the river flats northeast of the Slit Barn, where they form small cliff faces in the

riverbank and in the woodland area. Higher outcrops form cliffs at the eastern edge of the property. The well-bedded and jointed nature of the rocks, as well as the small solution holes caused by subsurface drainage and dissolution of the dolostone, can be seen in these outcrops. The porous nature of this bedrock accounts for subsurface drainage that takes place close to the river. Overlying the bedrock geology are sediments that were deposited during the last glaciation, which began 2.59 million years ago. During this time, the region was covered by ice on multiple occasions, but each succeeding glaciation removed, covered or modified the sediments that were deposited by older events. Therefore, the sediment at ***rare*** consists of the youngest deposits of the last ice advance and the materials that have been moved during and since the retreat of the most recent glaciers. As ice advanced across the region, it laid down deposits of glacial till, principally the Port Stanley Till and the Wentworth Till.

Approximately 12,000 years ago, the ice had virtually vanished from the region, and the landscape would have looked much like the northern Arctic does today. The Grand River was much wider and deeper, enlarged by floodwater from the ice melting farther north in the basin. This glacial river carried large quantities of sand and gravel and deposited these sediments south of the Blair-Cambridge Road, forming the higher areas of the property. Where the more porous sand and gravel was deposited over impervious till, such as at Springbank Farm, seepage lines were formed. Glacial erratics can be found throughout the landscape, often piled at field boundaries or utilized in the foundations and walls of older buildings. Several can be seen near the Slit Barn.

2.3 Ecology

The Blair Site of the ***rare*** **Charitable Research Reserve** is home to a great biodiversity, including more than 4500 named species (Appendix 2). This species richness reflects the location along the boundary formed by the Northern Hardwood Forest and Carolinian Forest zones, its varying geographic features, and its management history. This list is constantly changing as new species are recorded and new surveys and taxonomic expertise become available. The conservation and enhancement of the ecological functioning and integrity of the ecosystems and their relationships with the people at ***rare*** is a priority.

Many typical habitats of southwestern Ontario are well-represented at ***rare***: floodplain meadows, upland and lowland forests in various stages of ecological succession, and hedgerows. More unusual habitats at ***rare*** include the regionally and provincially significant fern-dominated plant community on the dolomitic limestone cliffs, mature forests on sizeable, dissected and solution-cavitied dolostone outcroppings, old-growth deciduous forest and extensive old-field, planted tallgrass prairie, and meadow systems on alvar.

A matrix of deciduous forest connects across the ***rare*** property, including the forests of mixed successional stages atop the Cliffs, the mature upland forest and yellow birch swamp of the Hogsback, the old-growth upland of Indian Woods and adjacent naturalizing plantations of the Thompson Tract, and the swamp and rolling uplands surrounding the Bauman Creek corridor. The Hogsback is relatively untouched in both historic and recent times, possibly due to the difficulty of passage through its large wetland. Of the Hogsback's 65 acres of forest, 45 acres

are located on the ***rare*** property, including 40 acres of provincially significant wetland with 29 acres of swamp. Indian Woods deserves special mention due to its distant and minimal logging history, and it approximates an old-growth forest condition.

Three sub-watersheds exist within the property boundaries either from source to mouth or for the majority of their lengths (Figure 2.2). Bauman Creek and Cruickston Creek are fed by groundwater, and are coldwater habitats at base flow. Bauman Creek supports a brook trout population. Newman Creek has its source in a storm water management (SWM) pond adjacent to ***rare*** property that collects runoff from the Newman Subdivision. Both Cruickston and Newman creeks have lost significant portions of their drainage basins to development, and thus the streams carry less water than they did historically, and Newman Creek is now dry for part of the year. The wetlands present on ***rare*** **Charitable Research Reserve** are part of the larger Provincially Significant Wetland system known as the Barrie's Lake-Bauman Creek Wetland Complex, which contains 57% percent swamp, 42% percent marsh, and 1% bog.

The Grand and Speed Rivers frame the northern boundary of the reserve, with their confluence located southeast of Preston Flats and north of Blair Flats. Fast-flowing water keeps the reach above the confluence open most of the time during winter. These reaches provide wintering habitat for waterfowl – geese, puddle ducks and diving ducks – and resting and preening areas for migrating waterfowl, shorebirds and songbirds. Twenty nine species of waterfowl and seventeen species of shorebirds have been documented on the ***rare*** property through ongoing monitoring efforts. Bald eagles have been regularly observed in this habitat since the winter of 1994.

2.4 Cultural Heritage

Cultural environment refers to the present or past physical alterations to the natural environment by deliberate human action through cultural processes. The cultural environment thereby consists of existing built structures, archaeological remains, and the cultural landscape in which they are embedded. A summary of cultures and notable cultural sites identified at ***rare*** can be found in Appendix 3.

2.4.1 Built Structures

There are several heritage buildings on the ***rare*** lands (Figure 2.3). Lamb's Inn is designated under the Ontario Heritage Act, but the remaining buildings have cultural significance and well documented histories,

- Springbank Farmhouse (circa 1840; an addition was built in the 1930s)
- Resource House (circa 1840)
- Slit Barn (circa 1840)
- Lamb's Inn in the Village of Blair (circa 1837). Lamb's Inn is currently undergoing restoration, with Phase I completed in 2018 and Phase II imminent. A small stone cottage behind the inn was conserved during demolition of several dilapidated additions.

Other buildings and infrastructure are of more recent construction,

- Community Gardens Pavilion (2011)
- North House – erected in 2012 at ***rare***, this structure generates many forms of renewable energy including: solar thermal generation, solar photo-voltaic generation and geothermal cooling. The house is situated near Springbank Farmhouse with a southern orientation to maximize passive heating opportunities.
- Community Gardens Greenhouse (2006)
- Community Gardens Sheds – old, Community Roots (2013)
- Community Gardens Washroom Facility (2014)
- Teaching circle at the ECO Trail (2019)

2.4.2 Cultural Landscapes

Cultural landscapes are long-term alterations to the natural or previously altered environment, for aesthetic or cultural purposes. For the alteration to be considered a cultural landscape the change should be exceptional to its immediate surroundings. There are numerous examples of cultural landscapes on the ***rare*** property:

- Pond, surrounding lawn, and gardens at Lamb's Inn
- Lawn, gardens and lilac trees at Resource House
- Rock gardens and lane at Springbank Farmhouse, a relic of the first planned road through the Blair area
- Stone wall dating to 1901 along the north and south sides of modern-day Blair Road
- Pine stump fence (estimated to be approximately 200 years old) on the east side of the Hogsback Forest
- Tent ring in Cliffs and Alvars forest (possible archaeological site)
- The stretch of Sugar Maple trees along Maple Lane
- The Grand Allée as an historic carriageway from 1899 leading into Langdon Hall
- Lilac, Elm, and Oak row at Gouinlock archaeological site

Maple Lane was one of the earliest planned roads in the Region of Waterloo, built in the early 1800s. Blair Road, although considerably changed over the years, was originally an Indigenous trail. Sections of adjacent lands to the road have or had cut field stone walls dating back to 1901 according to farm records (Ayr News, 1993 May 19, vol. 98 no.20). In some areas, for example on the north side of the road across from Springbank Farm, the walls are beneath the current road bed. A few decades ago these stone walls were considerably more extensive than they are today. In the fall of 2013, the entire length of the stone wall on the south side of Blair Road was documented using Global Positioning System (GPS) waypoints, photographs and a written summary. This information was gathered for ***rare*** internal purposes, and for inclusion in Region of Waterloo Right-of-Way easement for Blair Road.

2.4.3 Archaeology

Archaeology is a sampling process of past human behaviour. While not all behaviour leaves traces of materials or lasting alteration to the environment, a few largely inorganic objects remain for detection. Archaeological sites can distill the length of human occupation and the

various adaptations made to the changing environment, as well as yield "ecofacts" that inform us of the various plant and animal species that were present and utilized at any given time in the past. Archaeological sites not only provide information on how people adapted to various environments, but also give evidence of how the environment was changing.

Previous Archaeological Studies

Although D. Boyle and W.J. Wintemberg were conducting archaeology in the Region of Waterloo from the late 1800s, the first archaeological site recorded on ***rare*** property was by George MacDonald in 1961. Two sites were recorded by D. Stothers in the early 1970s during his survey of the Grand River. Two more sites were discovered in the mid-1970s and early 1980s during the assessment of the originally planned Cambridge by-pass. Details can be found in Appendix 3.

Three homes of historical significance once stood on the ***rare*** lands but no longer exist as built heritage. All three have been registered as archaeological sites and therefore are protected under the Ontario Heritage Act,

- Nathaniel Dodge, reputed to be the earliest European settler in the area, had a log home on Blair Flats west of Bauman Creek.
- John Gouinlock had a one and a half storey log home east of Cruickston Creek just south of Blair Road, though it was destroyed by fire in 1923.
- A farmstead once existed on the newly acquired ***rare*** lands east of Langdon Drive. These lands were originally settled by Sylvester Dodge and were later acquired by Samuel Bowman by 1861 (Taylor 1967).

During the time that Cruickston Park was owned by the University of Guelph, Archaeological Research Associates (ARA) was hired to conduct an archaeological assessment of the entire property in 1991 (Parker 1995). As a result of that assessment, 46 additional sites or isolated objects were discovered. Pre-contact sites ranged in date from circa 9500 – 800 B.P. Three Euro-Canadian sites from the 19th century were also found. The lands around the Cruickston Manor and the islands within the Grand River were not assessed. Beginning in 2004, an internal archaeology committee began reassessing ***rare*** lands with the help of numerous volunteers and university students hired under the provincial Summer Experience Program. As a result of these assessments, 36 additional pre-contact Indigenous sites were discovered. Additionally, a probable 18th century Indigenous site was also found. Two pre-contact sites were also test excavated in the savannah-like area north of the Slit Barn. Three areas were assessed by Timmins Martelle Heritage Consultants (TMHC) in 2009 and 2010 prior to the initiation of proposed construction (parking lot and Pavilion), and as a required condition of sale of MTO owned lands (part of the defunct Cambridge bypass). Three object locations were found on what are now ***rare*** lands, two of which were recommended for further study. The potential construction sites also yielded archaeological material, including at the Gouinlock site near Cruickston Creek.

Figure 2.1 Colloquial and common names of landscape features and trails at ***rare*** **Charitable Research Reserve**.

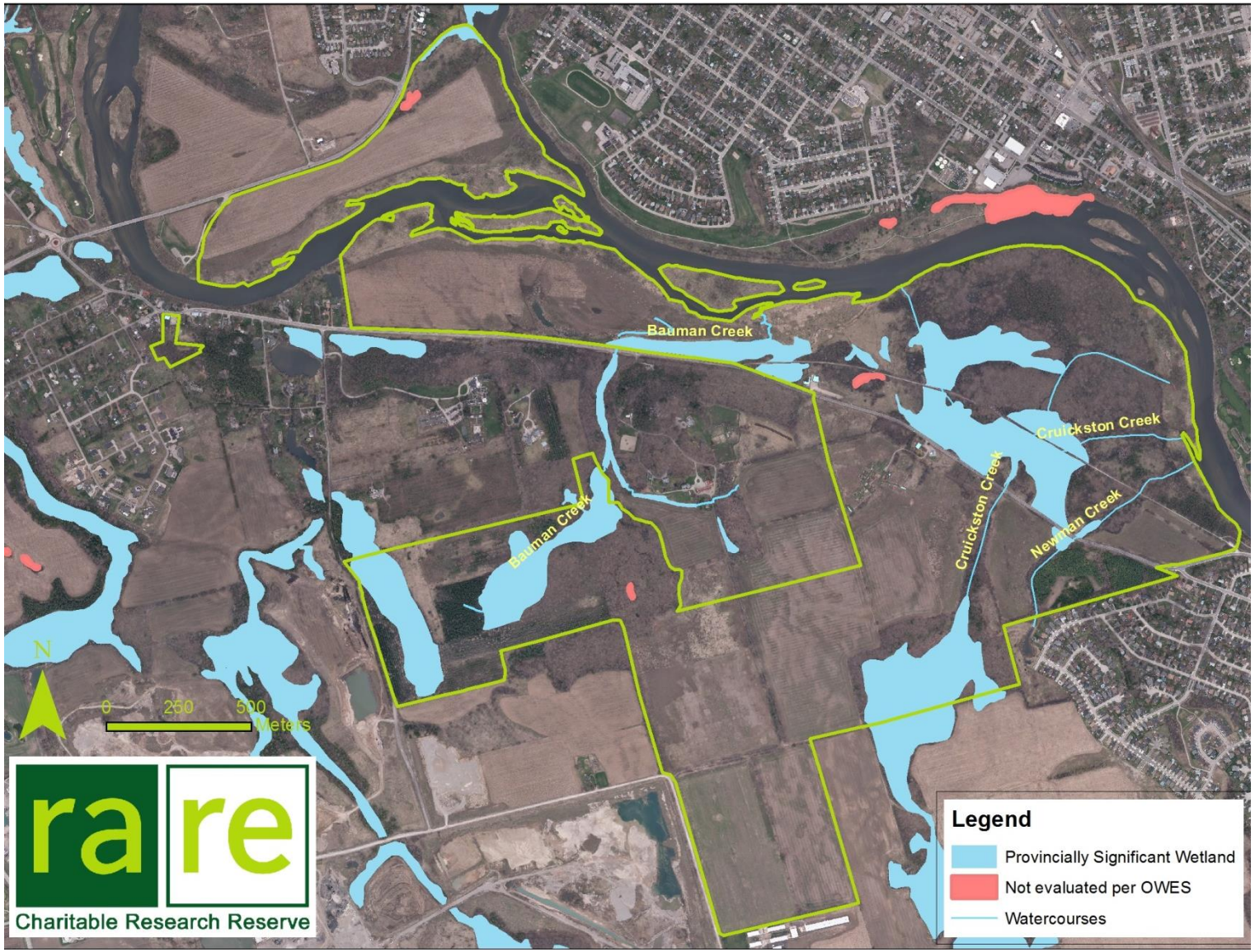

Figure 2.2 Wetlands and watercourses in the vicinity of ***rare*** **Charitable Research Reserve.**

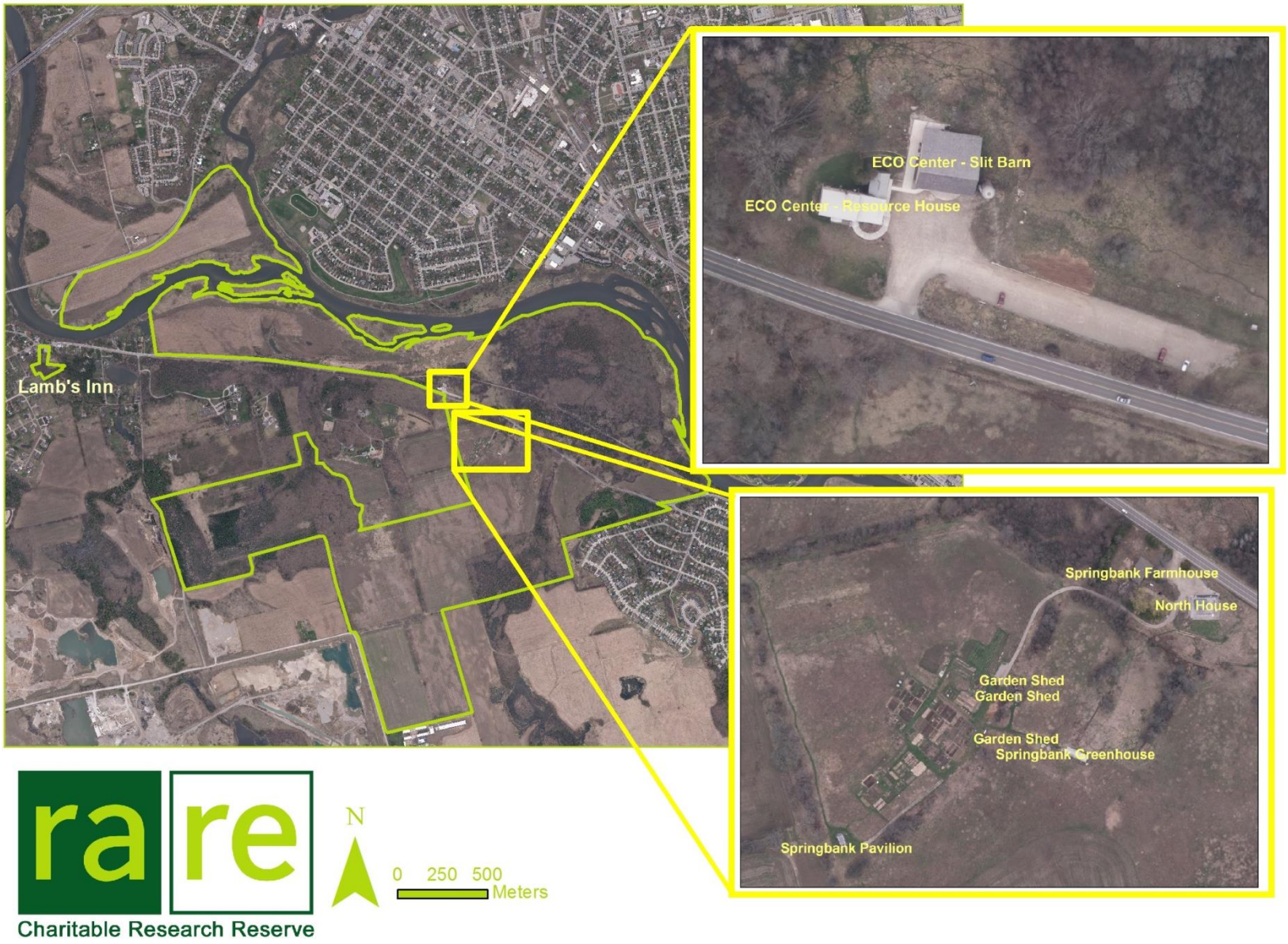

Figure 2.3 Existing buildings at ***rare*** **Charitable Research Reserve**.

3.0 POLICY FRAMEWORK

3.1 Global

There are no global, enforceable policies that legally bind nations or their citizens. However, there are Best Practices publications from such global organizations as United Nations Environment Program (UNEP) relevant to land management at ***rare.*** There are also international agreements and protocols such as the United Nations Sustainable Development Goals and Paris Accord, to which Canada is signatory, that could serve as a guideline for work at ***rare***. Designation as an International Bird Area (IBA) could be considered for the future, due to the importance of the Confluence area to migratory birds in particular, however recent inquiries have suggested that this designation would add little to current protections. Recently, Canada has committed to support international declarations on the Rights of Indigenous Peoples (UNDRIP) and the Convention on Biological Diversity that are relevant to ***rare's*** mission.

3.1.1 United Nations Declaration on the Rights of Indigenous Peoples

The UNDRIP was developed and adopted by the United Nations (2007) as a clear statement and affirmation of equal human rights and responsibilities of Indigenous peoples around the world. The Canadian government became a signatory to the Declaration in 2016. The UNDRIP recognizes "that respect for indigenous knowledge, cultures and traditional practices contributes to sustainable and equitable development and proper management of the environment," and signatory governments are expected to acknowledge and support these rights.

3.1.2 The Aichi Biodiversity Targets

Canada participated in the Convention on Biological Diversity in 2010, held in the prefecture of Aichi, Japan (https://www.cbd.int/sp/targets/). These are a body of 20 targets intended to improve understanding and value of biodiversity and ecological services, and to promote and improve sustainable practices across the globe. Local and Indigenous management, restoration, and resource use are to be encouraged. The ongoing work of ***rare*** at the landscape level, and plans to increase the amount of land we steward, is in keeping with our role to contribute to national targets developed by both Federal and Provincial governments. Our work is especially aimed at helping to meet the Aichi Target 11 that aims, by 2020, to conserve at least 17% of terrestrial areas and inland water, and 10% of marine and coastal areas, through networks of protected areas and other effective area-based measures. Canada, as signatory to the Aichi Targets, has embodied this land protection goal as Canada Target 1. While the federal government has been working toward achieving this target, it has proved difficult in the southern parts of the country where habitat is so degraded and expensive. However, meeting the target in areas like southwestern Ontario is especially important, since most of Canada's biodiversity exists here, and it is the area under the greatest pressure from human land use.

3.2 Federal

3.2.1 Species at Risk Act

The Government of Canada's Species at Risk Act (SARA) was passed to protect endangered or threatened species and their habitats, fulfilling Canada's obligations under the international Convention on Biological Diversity. All species, subspecies or populations identified as at risk

(extirpated, endangered, threatened, special concern) must be protected at ***rare*** in accordance with the Species at Risk Act (Government of Canada 2003; Appendix 4). Under SARA, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has established species designations in order to classify species based on the level of concern/threats to the species (COSEWIC, 2002). The SARA designations are:

- **Special Concern** - any indigenous species at risk because of characteristics that make it particularly sensitive to human activities or natural events
- **Threatened** - any indigenous species at risk of becoming endangered in Canada if limiting factors are not reversed.
- **Endangered** - any indigenous species at risk of immediate extirpation or extinction.
- **Extirpated** - species no longer exist in the wild in Canada, but still occur elsewhere.
- **Extinct** - species that no longer exist anywhere in the world.

3.2.2 Ecological Monitoring and Assessment

The Ecological Monitoring and Assessment Network (EMAN) protocols were developed to provide framework and resources for environmental organizations such as ***rare*** to help guide ecological monitoring and promote best practices (Environment Canada, 1996). Although the project was cancelled by the federal government in September 2010, EMAN facilitated ongoing communication between environmental organizations and compiled protocols and standards. EMAN protocols are still available online despite the program's cancellation, and continue to guide ecological monitoring at ***rare***. In 2016, ***rare*** developed and implemented a protocol for quantifying the impacts of Blair Road on wildlife. Beginning in 2018, the Vegetation Sampling Protocol (VSP) developed at the University of Toronto in collaboration with the Science and Research Branch at OMNRF (http://forests-settled-urban-landscapes.org/VSP/) was implemented for a number of purposes across the ***rare*** property. Adaptation and improvement of monitoring methodology is ongoing.

3.2.3 Canadian Heritage River Systems

The Grand River is designated as a Canadian Heritage River (CHRS) which recognizes its role in the natural and cultural heritage of Ontario and Canada. The designation given by CHRS does not create any legal or regulatory requirements affecting ***rare***, although the designation may present opportunities for funding research or stewardship activities related to the Grand River and its floodplain.

3.2.4. Truth & Reconciliation Commission Calls to Action

The Truth and Reconciliation Commission of Canada (2012) was formed to "redress the legacy of residential schools and advance the process of Canadian reconciliation." The result of the Commission was the publication of 94 "Calls to Action" in 2012. The document advocates, among other things, that Canada adopt and implement UNDRIP (see Section 3.1.1) as a framework to support reconciliation with Indigenous Peoples. Canada is called on to support Indigenous sovereignty and traditional use of land, and honour arrangements subsequently formalized through treaties and other agreements.

3.3 Provincial

3.3.1 Provincial Species at Risk

All species, subspecies or populations identified as at risk on the Species at Risk in Ontario (SARO) List must be protected at ***rare*** in accordance with the Ontario Endangered Species Act (Ontario Ministry of Natural Resources, 2007). The Committee on the Status of Species at Risk in Ontario (COSSARO) reviews and assigns status designations to native Ontario species by the Ontario Ministry of Natural Resources and Forestry (OMNRF) and the national Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The list is updated and revised at least once a year. At the time of writing in 2019, the provincial Endangered Species Act is entering a review process, with the goal of easing the path for development. Under the new program, a cash fee could be paid for habitat loss, with no other consequences or mitigation measures required. Responsibility for SAR has also been transferred to the Ontario Ministry for the Environment, Conservation, and Parks (formerly the Ministry of the Environment and Climate Change). The SARO designations are:

- **EXT – Extinct** – any species formerly native to Ontario that no longer exists anywhere in the wild or in captivity.
- **EXP – Extirpated**– any native species no longer existing in the wild in Ontario, but existing elsewhere in the wild.
- **END – Endangered**– any native species that, on the basis of the best available scientific evidence, is at risk of extinction or extirpation throughout all or a significant portion of its Ontario range if the limiting factors are not reversed. Endangered species are protected under the province's Endangered Species Act. Those designated **END-R – Regulated** are regulated under the provincial Endangered Species Act.
- **SC – Special Concern** – any indigenous species at risk because of characteristics that make it particularly sensitive to human activities or natural events
- **THR – Threatened** – any native species that, on the basis of the best available scientific evidence, is at risk of becoming endangered throughout all or a significant portion of its Ontario range if the limiting factors are not reversed.
- **VUL – Vulnerable** – any native species that, on the basis of the best available scientific evidence, is a species of special concern in Ontario, but is not a threatened or endangered species.

The Natural Heritage Information Centre (NHIC) is a provincial body that represents Ontario's membership in the international NatureServe network of conservation data centres. Information on distributions of listed flora and fauna are maintained, and maps are made available to land managers and other parties as required. The NHIC works with government and non-profit organizations, and manages data about the location of species of conservation concern. The NHIC also assigns conservation rankings based on NaturesServe conservation rankings to species and habitats in Ontario. International global rankings are similar, but preceded with a "G".

- **S1 - Extremely Rare** – usually 5 or fewer occurrences in the entire Ontario range or very few surviving individuals and especially vulnerable to extirpation in the province.
- **S2 - Very Rare** – usually between 5 and 20 occurrences in the entire Ontario range or many individuals in fewer occurrences and often susceptible to extirpation in the province.
- **S3 - Rare to Uncommon** – usually between 20 and 100 occurrences in the entire Ontario range; there may be fewer occurrences, but in such cases there would be a large number of individuals in some populations and these species may be susceptible to large-scale disturbances.
- **S4 – Common** -- apparently secure in Ontario; usually more than 100 occurrences in the province.
- **S5 - Very Common** – secure in Ontario under current conditions.
- **SE - Exotic** – not considered native to Ontario.
- **SH – Historical** – known to have existed in Ontario, but not verified recently and likely not recorded in Ontario in the last 20 years; suitable habitat may still occur in the province and thus the species may be rediscovered.
- **SR – Reported** – reported for Ontario, but inadequate documentation for the report to be accepted or rejected.
- **SRF - Reported Falsely** – false report about the species from Ontario.
- **SX – Extirpated**– extirpated in Ontario.
- **S? - Unranked**– no ranking of the species in Ontario. Where the "?" follows a rank, the rank for Ontario has only been tentatively assigned. S? species are likely rare in Ontario, but insufficient information is available for a more certain rank.

3.3.2 Provincial Policy Statement

Modern provincial legislative policy on development and conservation of land is embodied in the Places to Grow Act (updated in 2019; https://www.placestogrow.ca/index.php). From this document, the Growth Plan for the Greater Golden Horseshoe (GGH) was originally produced in 2006, and updated and consolidated with other documents in 2013 (Ontario Ministry of Infrastructure, 2013). Under the vision of the Places to Grow Act, the Provincial Policy Statement (PPS) sets policy and regulations for land use and development (Ontario Municipal Affairs and Housing, 2020). The PPS integrates economic, environmental, cultural, and social interests of Ontario's citizens. During long-term planning activities, ***rare***sites will use this policy statement to guide land use decision making to incorporate the regulations of the Province of Ontario. Many of the planning policies set forth by the Province are consistent with the ***rare***sites vision, most notably protection of farmland and anti-sprawl measures. The PPS, together with the Ontario Heritage Act (2005), also address protection and conservation of cultural heritage in the province. Current legislation to allow further building in greenfield areas, the More Homes, More Choice Act, is under review at the time of writing.

The Ontario Greenbelt, encompassing approximately two million acres of land, provides permanent environmental and agricultural protection from development and urban sprawl. Although the Region of Waterloo is contained within the GGH, it is not currently part of the

Greenbelt (apart from a small portion of Beverley Swamp). The coordinated review of the Greenbelt and related management plans (Escarpment, Oak Ridges Moraine) underwent a review process completed in 2017. The Greenbelt Act (Ontario Municipal Affairs and Housing, 2005) is guided by the PPS and addresses the importance of protecting a diversity of habitats and features, including agricultural, forest, water, and trail systems. The Greenbelt was ultimately not expanded, and since the 2018 provincial election government efforts have turned to removing protections for land, through means such as the Restoring Ontario's Competitiveness omnibus legislation of 2019.

Table 3.1 Provincially regulated features on and near ***rare*** Blair Site.

Feature	Name of Environmental Feature
Provincially Significant Wetlands	Barrie's Lake Wetland Complex
	Orr's Lake - Bechtel Creek Complex
	Gilholm - Salisbury Wetland
	Speed River Wetland Complex
Evaluated Wetland (GRCA)	Bauman Creek Wetland
Deer Wintering Areas	Bauman Creek, Cliffs/Alvar and Hogsback
Waterfowl Staging or Wintering	Grand River Corridor
Endangered Species	Federally and Provincially regulated species

3.3.3 Conservation Authorities Act

Conservation Authorities in Ontario are catchment-scale legal entities created to oversee conservation, restoration and responsible management of water, land and natural habitat, and also balance human, environmental and economic needs. Their authority is granted by the provincial government, and they are generally considered as quasi-governmental, community based environmental agencies. Ontario's 36 conservation authorities are now organized under the banner of Conservation Ontario. The Grand River Conservation Authority (GRCA) has jurisdiction in these matters over the ***rare*** property, such as activities undertaken on the ***rare*** property that directly or indirectly affects water quality, quantity, or distribution in the landscape, including construction or restoration activities that may cause erosion of sediment. Prior to engaging in such activities, the GRCA must be consulted regarding possible permit requirements. The Conservation Authorities Act (1990) was reviewed and updated by the Province of Ontario between 2017 and 2020.

3.3.4 Provincially Significant Wetlands

The authority which develops and regulates protocols to protect Provincially Significant Wetlands (PSW) is established in the Greenbelt Act, the Planning Act, and the Conservation Authorities Act. PSWs are designated and approved within the framework the Ontario Wetland Evaluation System (Ontario Ministry of Natural Resources, 2013a). There are several PSWs on ***rare*** property, all associated with the Barrie's Lake-Bauman Creek PSW complex (Figure 2.2). The wetlands are located in the Hogsback Forest and Cliffs and Alvars Forest (associated with Cruickston Creek), Indian Woods and Blair Flats (associated with Bauman Creek), and the Thompson Tract (associated with a first-order tributary of Bechtel Creek). Landowners are

required to include PSW policies within their land use planning, and PSW designation may be beneficial in securing funds for stewardship and conservation activities on the property.

3.3.5 Areas of Natural and Scientific Interest

Areas of Natural and Scientific Interest (ANSI) are designated by the provincial government through the OMNR. These areas of classification may be of interest for ***rare*** to apply for areas such as Indian Woods and the Hogsback, as these titles may afford greater protection to these features, for example greater recommended buffer widths. ANSIs are areas that have been identified as containing unique features that have scientific values related to protection, research and education. Most ANSIs are located on private land, and are separated into Earth Science ANSIs and Life Science ANSIs. Life Science ANSIs include areas of significant biodiversity with relatively undisturbed vegetation and landforms. Earth Science ANSIs are areas with significant geological characteristics such as unusual bedrock or important fossil deposits.

Evaluation of both types of ANSIs is done according to the following OMNR criteria:

> **Representation –** of geological themes or landform-vegetation features of an ecodistrict.
> **Condition**—an assessment of the degree of human-induced disturbances.
> **Diversity**—the number of high quality, representative features that exist within a site are assessed.
> **Other ecological considerations**—ecological and hydrological functions, connectivity, size, shape, proximity to other important areas, etc.
> **Special features**—such as populations of species at risk, special habitats, unusual geological or life science features and educational or scientific value.

Earth and Life Science ANSIs are further divided into four categories:

> **Provincially Significant ANSIs**—are sites selected on a systematic basis (using the above criteria) that contribute to the representation of the natural features and landscapes of Ontario. Provincially significant ANSIs are protected under the Planning Act, the PPS, the Greenbelt Plan, the Oak Ridges Moraine Conservation Plan and the Niagara Escarpment Plan.
> **Regionally Significant ANSIs** are described as the "next best" natural areas that also meet the five evaluation criteria that are given protection in only some parts of the province.
> **Locally Significant ANSIs** contain representative vegetation-landform features that meet most of the evaluation criteria for provincial or regional significance, but are already represented elsewhere in the province or ecodistrict.
> **Candidate ANSIs** are areas of natural and scientific interest that have been identified and recommended for protection by MNR or other sources but have not been formally confirmed by the MNR. Confirmation is a six step process and can be made at any time. The six steps include:
>
> - Identify Priorities/work planning

- Plan for ANSI fieldwork
- Landowner/Municipality/ District Notice
- Fieldwork and Data Analysis
- Write Report
- Draft Report Review and Submit

3.4 Region of Waterloo

3.4.1 The Region of Waterloo Official Plan

The Region of Waterloo Official Plan (ROP) includes all policies and plans required to guide strategic development within the Region of Waterloo in the next 20 years. The plan, guided by the Places to Grow Act and PPS, is an effort to guide the development necessary to house a rapidly growing population in a responsible manner, protecting biodiversity, farmland, aquifers, etc as much as possible. The plan includes many policies that affect how ***rare*** operates, including those associated with land use, water, and ecological systems. Within the Region of Waterloo's Strategic Focus 2011-2014 Plan, the Environmental Sustainability Chapter outlines the importance of preserving and protecting water resources, green space and sensitive environmental areas. In section 1.5.3 of the Strategic Focus document, ***rare*** is mentioned as an important partner in helping to protect these resources. The most recent version of the ROP was ratified in 2015 after a long appeals delay before the Ontario Municipal Board (OMB), and resulted in adjustment to the Countryside Line that brings additional greenfield areas adjacent to the Hogsback into potential development. The Region is currently working on the next iteration of the Official Plan, and is also developing a Transportation Master Plan which may have implications for ***rare***.

3.4.2 The Greenlands Network

The Region of Waterloo's Greenlands Network includes areas of environmental policy including:

- Environmentally Sensitive Landscapes
- Significant Valleys in a Landscape Level System
- Significant Habitat of Endangered or Threatened Species
- Regionally Significant Woodlands
- Environmentally Significant Valley Features

Within the Greenlands Network, development or alteration to these Core Environmental Features (CEFs) is not permitted. The Region of Waterloo requires a buffer area of 10 meters from CEFs. However, the City of Cambridge recommends that wetlands should be given a 30 meter buffer (City of Cambridge, 2009). The Region of Waterloo created a planning framework in 2007 to protect ecological systems, giving significant areas a title of being an Environmentally Sensitive Landscapes (ESL). The Blair-Bechtel-Cruickston ESL includes a significant portion of the ***rare*** property, including the confluence of the Speed and Grand River, in addition to covering areas of PSWs and habitats of SARs (Table 3.1).

An Environmentally Sensitive Policy Area (ESPA) is a designation under the ROP that is given to a specific feature within an ESL. ESPAs have restrictions pertaining to the activities that can take place around it (i.e., a buffer area must exist). The Region of Waterloo also designates "Cruickston Park" as an ESPA, which is the former name of what is now ***rare.***

Table 3.2 Environmentally Sensitive Policy Areas on or near ***rare*** Blair Site, as designated by the Region of Waterloo. All are included in the Blair-Bechtel-Cruickston Environmentally Sensitive Landscape. For a complete list of ESPAs, see http://www.regionofwaterloo.ca/en/aboutTheEnvironment/resources/ESPAlist.pdf

Designation	Environmental Feature
ESPA #36 Speed and Grand Confluence	Confluence of Speed and Grand Rivers, including areas within and outside ***rare***
ESPA #38 Cruickston Park	Includes much of ***rare***
ESPA #55 Orr's Lake	Orr's Lake, wetland area south of ***rare***
ESPA #57 Barrie's Lake	Barrie's Lake, wetland area south of ***rare***
ESPA #58 Gilholm Marsh	Gilholm Marsh, southeast of ESPA #55 and south of ESPA #59
ESPA #59 Devil's Creek Swamp and Forest	Devil's Creek Swamp and Forest, forested swamp with trail east of ***rare***
ESPA #92 Cruickston Creek Headwaters	Series of forested wetland areas hydrologically connecting Barrie's Lake with the Hogsback Forest on ***rare*** property

3.5 Municipal Planning

3.5.1 City of Cambridge

The City of Cambridge's Official Plan (COP) outlines many policy areas that exist within ***rare's*** boundary. Similar to the ROP, the COP guides strategic development and conservation within the area thus affecting ***rare*'s** operation. Chapter 3 discusses the City's priority of maintaining and improving natural features such as fish habitat, CEFs, ESLs, and Locally Significant Natural Areas (LSNAs). The COP is reviewed and updated every 5 years. The City of Cambridge OP and its current status may be viewed at https://www.cambridge.ca/en/learn-about/Official-Plan.aspx. The current version of the plan was updated and consolidated in 2018.

3.5.2 Township of North Dumfries

The current version of the plan was updated and consolidated in 2018.The Township of North Dumfries OP aims to connect Provincial Policy Statements with Regional Policy Statements. The OP has a focus on land use and development, with sections 3, 5, 6, and 7 being directly relevant to ***rare's*** planning and operation. These sections are: General Land Use Policies, Natural Resource Management, Environmental Management and Heritage Resource Management, respectively. The OP also includes maps depicting PSWs, ESPAs, EPAs, LSNAs, Significant Woodlands (SWs), and Significant Corridors (SCs), many of which are bordering or existing within ***rare*** property. The Township's OP and its current status can be viewed at

https://www.northdumfries.ca/en/doing-business/planning.aspx. Updated in June 2014, the Township of North Dumfries Trails/ Cycling Master Plan acts as a set of tools to facilitate planning and implementation for recreational trails. The Master Plan summarizes feedback from trail users and decision makers, and can be used as a resource for trail planning at ***rare***.

4.0 BIOLOGICAL RESOURCES AND ACTION PLANS

4.1 Biotic Inventory

Several biotic inventories have been conducted on the original ***rare*** property, and efforts to identify and document all species occurring on the property are ongoing. Biotic inventories should be conducted regularly as taxonomic expertise becomes available, and in order to document new species that are regularly established through immigration and introduction. Biotic inventories can contribute to the knowledge of species diversity at ***rare***, provide information on the distribution of species throughout the property, and track changes in species over time in response to environmental change. Knowledge about changes in species diversity and distribution over time can be used to inform conservation decisions and evaluate past conservation efforts. Refer to ***rare*** Data Sharing and Sensitivity Policy in Appendix 5.

Beginning in 2015, ***rare*** has conducted an annual BioBlitz primarily focused in the Cliffs and Alvars and nearby areas. These events have variously involved taxonomic experts, staff, and community members. The Center for Biodiversity Genomics (formerly the Biodiversity Institute of Ontario) at the University of Guelph have contributed greatly to the documentation of species at ***rare*** during these events.

4.2 Vegetation Communities

North-South Environmental Inc. summarized the CPEAT findings for significant native vascular plants in the 2001 Draft Management Framework for Cruickston Park. Findings from these vegetation surveys were included in the ***rare*** 2006 Environmental Management Plan. Ecological Land Classification (ELC) of the ***rare*** property using vegetation and soil characteristics was conducted in 2011 by Natural Resource Solutions Inc. (NRSI) (Figure 4.1). This assessment is in need of updating, particularly around agricultural lands that have been moved into restoration projects, research projects, or buffers. In the process, a master plant list was created that included plants found in the ELC polygons, as well as plants that were observed in previous studies. In 2018, ***rare*** began utilizing the Vegetation Sampling Protocol with three main goals: 1) to inform about the presence and extent of invasive species on our property; 2) to expand knowledge regarding what plants currently exist on property, and; 3) to quantify any temporal changes in vegetation with future resampling. While the ELC and VSP are the most comprehensive vegetation studies of the entire property, a number of vegetation studies, including both qualitative and quantitative assessments, have been undertaken on the ***rare*** property since the mid-1970s. Plant observations have also been made tangentially during other environmental research at ***rare***. These studies include:

- Lothian (1976)
- Bogart et al. (1980)

- Eagles Planning Ltd. (1991)
- City of Cambridge along the Grand Trunk Trail (Thompson & Associates, 1996)
- Ecologistics Limited (1996)
- ESG International Inc. (2000)
- Field Botanists of Ontario (multiple visits)
- University of Waterloo and University of Guelph student projects and theses (multiple)
- Bainard et al. (2011)
- Harvey and MacDougall (2014)
- Quantitative botanical survey of Hogsback (NRSI 2015)
- Telfer et al. (2015), and annual bioblitz events in 2015-2018
- Kuzmina et al. (2018)

A list of at-risk species on the property can be found in Appendix 4. A complete list of all plant species currently recorded at ***rare*** can be found in Appendix 2.

4.3 Aquatic Species

Aquatic invertebrate sampling was first conducted at ***rare*** in 2003 by Ken Dance, and consisted of sampling two locations on Cruickston Creek upstream of Blair Road. In addition to this study, aquatic sampling has been conducted several times:

- In 2001, Ken Dance mapped smallmouth bass nest concentrations in the Grand River along the length of the reserve.
- Sean Barfoot (2003) collected water quality samples from eight sites on Bauman Creek.
- In 2006, ***rare*** partnered with Environment Canada's Ecological Monitoring and Assessment Network (EMAN) to establish a permanent long term aquatic monitoring program on the cold and cool water creeks and wetlands of the property, following Ontario Benthos Biomonitoring Network (OBBN) protocols. Sampling has since been repeated at three year intervals occurring in both spring and fall. Initially four sites were established on Bauman Creek and two on Cruickston Creek (2006), expanded to include three additional Cruickston Creek sites and two new wetland sites in Blair Flats and Preston Flats (2009). One additional Bauman Creek site was added in 2012 due to low water flow at existing site. New sites on Newman Creek and in the northern reach of Cruickston Creek were established in 2016.
- In 2009 and 2016, ***rare*** (with Mark Pomeroy) conducted electrofishing in both Bauman Creek and Cruickston Creek, with a breeding population of brook trout recorded in the former.
- In 2012, the University of Waterloo Ecohydrology group began an ongoing study examining the hydrology and nutrient biogeochemistry on Bauman Creek.
- In 2013, Keegan Hicks (University of Waterloo) studied fish in the Grand River as part of a research project.
- In 2015, DNA barcoding of aquatic species, particularly mites, occurred in conjunction with research from the Centre for Biodiversity Genomics (University of Guelph) and the August bioblitz event.

- In 2015 a restoration project at Cruickston Creek removed a perched culvert under the old Blair Road, recreated approximately 10 meters of channel, and installed a footbridge in anticipation of the new trail leading from the Cambridge West development to Springbank Farm and the Community Gardens.
- In November 2016 Bauman Creek underwent a major restoration to remove a non-functional culvert and unneeded farm lane, and re-construct the channel. Approximately 75 meters of channel was realigned, with a cross vane at the upstream end of the restoration to supply some water to the wetland area that had been developing on Blair Flats since 2009. Electrofishing was carried out in 2017 following this restoration. In 2017 through 2019, downstream areas where the channel had become poorly defined were realigned and appropriate substrate added to allow development of riffle and pool areas. In Winter 2019 a trout redd was observed in the restored area of the channel.
- In 2018 and 2019, Heather Ikert (University of Waterloo) studied fish in Bauman Creek as part of a research project.

In the past electrofishing surveys were done opportunistically, but recently the Research department has organized monitoring of fish communities in all three ***rare*** streams. Bauman Creek has been sampled more extensively after the channel restoration in 2016. Bauman is the only creek that has been conclusively found to include fish habitat. Aquatic habitat, fish species and communities present in the Grand and Speed Rivers are also documented in the Grand River Fisheries Management Plan (GRCA, 2005, 2006), and ESG International Inc. (2000).

4.4 Birds (provided by W.G. Wilson)

4.4.1 General Monitoring

Bird studies at ***rare*** have included both qualitative and quantitative surveys with emphasis upon monitoring the species composition, but species abundance and species-habitat associations are also documented. Since 1971, there has been ongoing recreational birding and monitoring of bird activity along the Grand and Speed River shorelines adjacent to and within ***rare***. A 1976 environmental assessment of The University of Guelph Cruickston Park Farm included a breeding bird census of the Hogsback and Cliffs and Alvars forests (Bogart et al. 1980). In addition, the Eagles report (Eagles Planning Ltd. 1991) also included a qualitative assessment of bird species encountered from May to September of 1991, in the forested areas of the property (including Indian Woods, Hogsback, Cliffs and Alvars, Barn and Slope Woods).

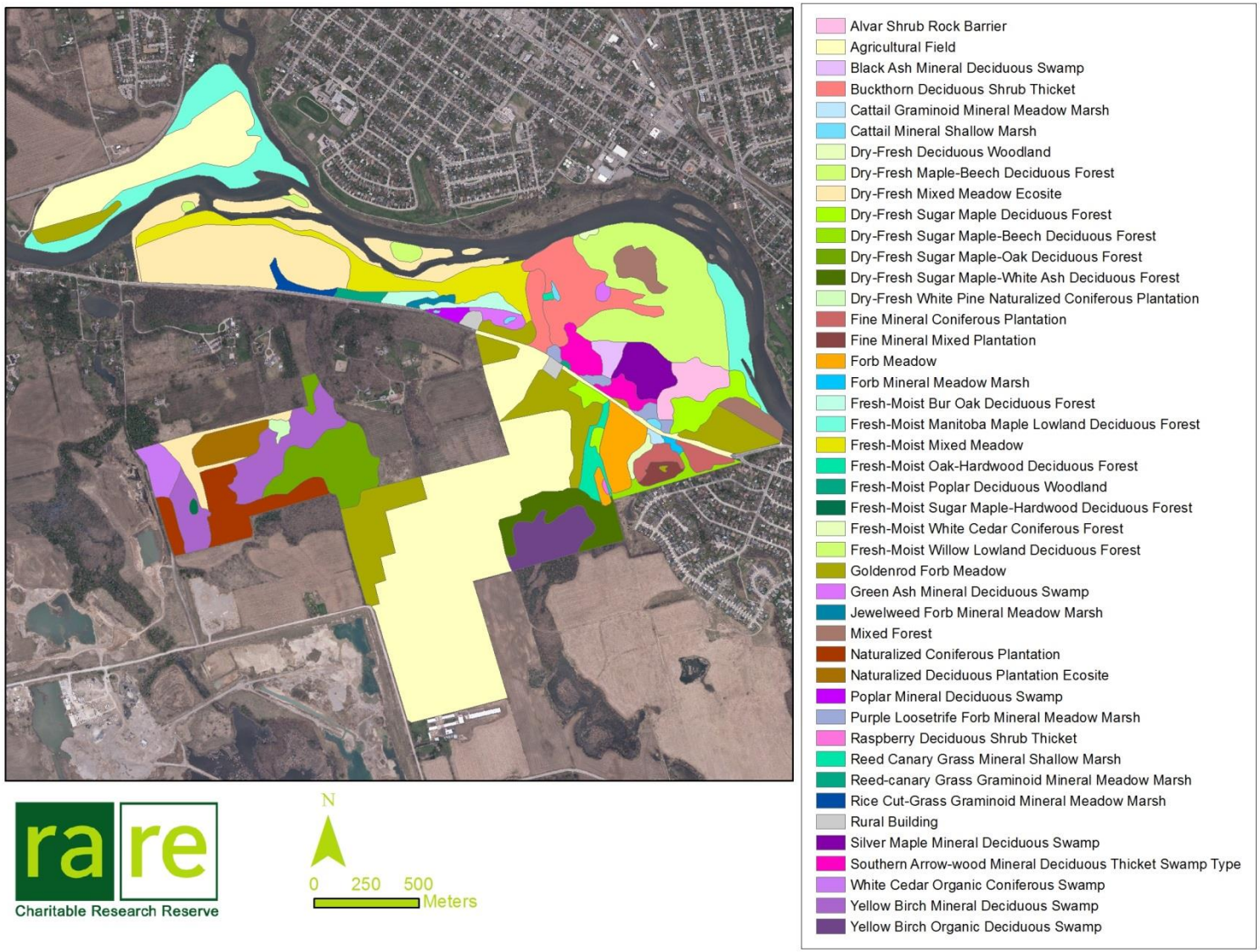

Figure 4.1. The 44 Ecological Land Classification habitat categories on the ***rare*** property (NRSI, 2011)

The protocols for bird monitoring at ***rare*** are revisited annually and restated to monitors annually. Monitoring Protocols are:

- Monitor between the following times: half-hour before sunrise and 10 a.m. Cold temperatures early in the spring season or later in the fall season may recommend starting later – 8 a.m.+ and/or extending the completion time to 10:30 a.m.
- Most monitoring can be completed in 1 hour, 15 minutes +/- 15 minutes.
- Time spent "tracking down" a bird should not count in the total monitoring time. Simply note the approximate length of the diversion and continue on.
- Do not monitor in high winds or moderate to heavy rainfall. The decision to monitor is up to individual monitors as is re-scheduling.
- Opportunistic birding: consider such birding to include to/from your trail/route and during time on the property that is not during monitoring. Opportunistic sightings made during the monitoring morning should be recorded under "Comments" at the end of the species list on the monitoring data sheet.
- Submit monitoring data on the provided, updated data sheet after each monitoring session to Rob Unruh. Numbers of individuals of a species observed should be recorded along with totals of individual birds and species. Estimate flocks/larger numbers of individuals with approximate numbers followed by plus sign, e.g. Red-winged Blackbird 100+.

Note that for uncertain identification, there are categories for identification of particular taxa, e.g. blackbird spp., sparrow spp. etc.

4.4.2 Bird records and reports prior to 2000

- Waterloo Region bird records from the late 1950s, and in the 1980s and 1990s, Waterloo Region Nature (WRN; formerly Kitchener-Waterloo Field Naturalists) list bird species found in what is now ***rare***, formerly Cruickston Park.
- Bird records (Wilson birding journals) within a 3km radius of the confluence of the Grand and Speed rivers – seasonally since 1971, weekly from 1994 to 2003 and monthly, 2004 to 2009 – have been summarized in a seasonal checklist, *Birds along the Cambridge Riverbank Trail System: Linear Trail and Environs* (Wilson 2009; see also Grand Actions Registry, http://www.grandriver.ca/GrandActionsRegistry/).
- In 1973-1974, a vegetation study by Lothian (1976) listed bird observations in an appendix.
- A 1976 environmental assessment of Cruickston Park Farm included a breeding bird census of the forests of the Hogsback and Cliffs and Alvars (Bogart et al. 1980).
- A terrestrial biology study (Eagles Planning Ltd. 1991) included a qualitative assessment of bird species encountered from May to September of 1991 in the forested areas of the property including Indian Woods, Hogsback, Cliffs and Alvars, Barn and Slope Woods.
- Bird species within riparian habitats of Cruickston Park Farm, particularly over-wintering waterfowl along the Speed and Grand Rivers, 1971 to 1995, are noted in a report concerning Environmentally Sensitive Policy Area 36 (ESPA 36) (Wilson 1995).

- The environmental assessment of lands for the Cambridge Arterial Route Selection Study (CARSS) included breeding bird surveys of the property from late May to early July 1999 (ESG International Inc. 2000).

4.4.3 Bird monitoring, inventories and reports 2001-2019

- Bird studies at ***rare*** have included both qualitative and quantitative surveys with emphasis upon monitoring the species composition; species abundance and species-habitat associations are also documented. Documents are available that describe the results of these bird studies conducted at ***rare*** as well as a Bird Migration Monitoring Database designed and compiled by Rob Unruh, 2008 to 2017.
- In 2001, Wilson conducted a point count breeding bird survey along transects in ***rare's*** riparian zone, agricultural fields and hedgerows, as well as in Indian Woods, the Hogsback, and the Cliffs and Alvars; protocol followed the point count method used in Forest Bird Monitoring Program (FBMP). This survey was part of a four-season bio-inventory conducted for the *Environmental Management Plan* (EAC, formerly the Cruickston Park Ecological Advisory Team [CPEAT], 2002) and *Management Framework for Cruickston Park* (North-South Environmental Inc. 2001).
- Beginning in 2001, an Excel database, *Comparative Status of Bird Species in Cruickston Park* (now ***rare***) was created in which the bird species recorded during the above bio-inventory for ***rare*** were compared to the Priority Species for WR by Couturier (1999), to previous birds recorded on the property (see 4.4.1) as well as to the breeding status of birds recorded in Atlas Square 17NJ50 during the second breeding bird atlas of Ontario (2001-2005 OBBA2) and to their status in COSSARO and COSEWIC.
- Andy Steinberg, ***rare*** volunteer bird monitor, completed a point count survey at the same established point count stations of 2001, over several breeding seasons from 2007 to 2009, 2012, and 2016.
- Bird monitoring was undertaken at ***rare*** for ten years from 2008 to 2017 during which time 30 ***rare*** volunteer bird monitors recorded birds seen and/or heard along as many as six public-access trails; seven monitoring routes established off-trail in core areas of conservation and research areas; six fields with no public access; and one off-property trail with excellent sight lines of the Grand River and ***rare***'s northeasterly boundary. Not all were monitored in the same seasons or indeed the same years. All were monitored during the migration periods, mid-April to end of May, and/or mid-August to end of October, following a prescribed protocol (see below).
- During OBBA2, Jerry Guenther, Ruth Kroft and Bill Wilson completed 212 hours of breeding bird surveys on the property as part of the Cambridge North Atlas Square, 17NJ50.
- Winter birding added sightings to the bird monitoring database. Opportunistic birding and bird walks by ***rare*** volunteer bird monitors during winter visits extended bird record data into January through March. For several years, the annual OMNRF winter waterfowl count held during early January included as many as five locations from which to count waterfowl on the river corridors through ***rare.***

- Site-specific monitoring was done for post-restoration and future land-use proposals. From 2017 to 2019, ***rare*** volunteer bird monitor Tony Zammit, following The Great Lakes Monitoring Program protocol, monitored the post-restoration of Cruickston Creek along the north side of Blair Road. Future land use proposals for Preston Flats resulted in the monitoring of the hayfield, the open wooded area and overgrown railway berm as well as a portion of the Linear Trail across the Speed River.
- Environmentally Sensitive Policy Area #36 which is part of the Blair-Bechtel-Cruickston Environmentally Sensitive Landscape (ESL2), is a key component within the central Grand River corridor and the landscape of ***rare***. From July 2015 to date (Dec 2019), regular – almost daily – monitoring of birds has taken place from one location overlooking the confluence of the Grand and Speed rivers including ***rare*** shorelines, islands and the river corridor.
- Since 2018, birders, including monitors, are asked to share their significant bird sightings with ***rare*** and to submit their observations to eBird using the Hotspot *Cambridge—**rare** Charitable Research Reserve*. The Program Scientist in charge of monitoring, Jenna Quinn, maintains the ***rare*** Bird Monitoring Database and the ***rare*** List of Bird Species https://raresites.org/conservation/flora_fauna/bird-species/list-of-bird-species/
- In April 2018, Jenna Quinn outlined monitoring plans for the future: continuation of the monitoring of Bank Swallows and Barn Swallows, Bobolink and Eastern Meadowlark, Eastern Bluebird; continuation of citizen-science initiatives, viz. Alan Wormington/Hamilton Fall Count, Cambridge and Kitchener Christmas Bird Counts, annual counts whose extensive coverage circles include significant portions of ***rare***; continuation of BioBlitz. Beginning in 2017 and continuing, the Christmas Bird Count for kids (aka CBC4Kids) provides a January outing experience for children and their families. This birding activity is offered in partnership with WRN Kids.
- Future bird monitoring extends to ***rare's*** new property along the Eramosa River, Wellington County. In late July 2019, a BioBlitz on the property included the listing of bird species and numbers of individuals. Future plans for bird monitoring and inventory at this site are being formulated.

4.4.4 Monitoring and studies of Species at Risk

Bald Eagle

Reports by the Ontario Ministry of Natural Resources and Forestry (OMNRF 2001, 2002) detailed the occurrence (perch site locations, feeding areas and nocturnal roost sites) for wintering Bald Eagles along the Grand and Speed rivers through ***rare*** and on ***rare*** property. High Risk Zones were identified which led to recommendations for seasonal closure of ***rare's*** River Trail and Blair-Moyers Landing adjacent to ***rare*** lands.

From 2000 to 2011, ***rare*** lands were included in an ongoing monitoring program in the Central Grand River watershed for overwintering Bald Eagles by OMNR, ***rare*** volunteer bird monitors and members of WRN (Timmerman and Wilson, 2009; Wilson 2017, 2018). Bald Eagle not only continue to overwinter in the Central Grand River watershed but a pair established the first

nest in WR in 2010, about 1.6 km upstream along the Grand River from ***rare***; was confirmed to be a year-round resident in 2012, and fledged young in 2016.

Although Bald Eagle is no longer considered a Species at Risk in southern Ontario, Birds Canada cautions that this successful comeback is dependent upon clean water, available food and breeding habitat (CBC News 19 August 2016). Such conditions exist along the central Grand River watershed of which ***rare*** is a key component. Opportunistic sightings of Bald Eagle continued throughout 2015 to 2019 when two young successfully fledged from the upstream nest. In 2019, 5.5+ km of river corridors (Grand and Speed) through ***rare*** remain habitat for both breeding and overwintering Bald Eagles. These sightings include observations and in some cases photos of adults, sub-adults and juveniles perched along the rivers, bathing and drinking water in the shallows, feeding on fish, gulls and carcasses and hunting gulls and waterfowl.

Bobolink

Historically, the highest breeding diversity of Bobolink was in extensive tall grass prairies of the continent. Due to agricultural and urban development, grasslands are now among the most threatened habitats in southern Ontario. In June 2010, Bobolink was listed as Threatened in Ontario. In April 2011, a 3-year moratorium was placed on Bobolink exempting it from the ESA requirement on haying/pasturelands. Bobolink can breed successfully in hayfields, an anthropogenic grassland habitat, in pastures undergoing rotations longer than 65 days, and in older hayfields on marginal lands. Hayfields with harvest delay from last week of June to end of first week of July can result in 70% successful fledging (Renfrew et al. 2015). In May 2013, Bobolink and Eastern Meadowlark, both Species at Risk, received recovery strategies in Ontario. (McCracken et al. 2013.)

The monitoring of South Field, specifically South Field West (SFW), began 4 July 2008, primarily to assess the use of this hayfield by grassland species. The western portion of South Field was planted in hay beginning in 2007. Bobolink was first observed in South Field in spring 2012; only one remained for a few days (Jerry Guenther pers comm). With sightings of both Bobolink and Eastern Meadowlark in SFW, a monitoring protocol was established in 2013 which included non-invasive observation from the field periphery. Monitoring from early May to mid-July helped determine the best date for mowing of the hay crop in order to maximize survival of the young Bobolink (Wilson 2017). The date chosen was 15 July or later which is maintained to this day by the lessee, Brian Domm Farms Ltd. Monitoring in 2018 and 2019 continued.

In 2016, South Field East (SFE) was converted to hayfield. Monitoring began in 2016 with anticipation that this hayfield would also provide breeding habitat for Bobolink and Eastern Meadowlark. Monitoring SFE mirrored monitoring in SFW between 2016 to 2019.
Bobolink have also been observed in open areas of the property, including Sparrow Field, Blair Flats, Osprey Meadow and ***rare*** Community Gardens, but only South Field appears to offer breeding habitat at this time.

Eastern Bluebird

An Eastern Bluebird Box Program was initiated at ***rare*** in 2010. The aim of the program was to provide additional nesting cavities for Eastern Bluebird given their Threatened status in the 1960s and 70s. Programs such as those at ***rare*** have led to the recovery of the species in Ontario. Tree Swallows also readily use the bird boxes. Boxes may be removed, replaced or relocated each season based on success or failure of the previous year and condition of the box. After falling dormant in 2012 due to limited staff and volunteer commitment, ***rare*** volunteers Anne McLagan and Bill Read (Founder and President of the Ontario Eastern Bluebird Society) revived the program by relocating some boxes and removing inefficient ones. They made sure all nest boxes had predator protection and removed all boxes in Preston Flats that had *Peromyscus* (Deer Mouse and/or White-Footed Mouse) infestation. Regular monitoring resumed.

With volunteer support, this program continues annually. There are boxes on ***rare*** lands located in Blair Flats, South Field, Community Gardens, and around the perimeter of the Hogsback and Indian Woods. Successful nesting has occurred in South Field, Regeneration Field adjacent to Indian Woods and in Blair Flats where, for example, in 2019, a nesting pair raised three young; as well, 47 Tree Swallows were fledged (B. Read, pers. comm.)

Eastern Meadowlark

Since grassland monitoring began in fields near South Gate, Eastern Meadowlark have been observed early in the breeding season. Sightings have also been reported elsewhere in appropriate habitat throughout ***rare***, e.g. Osprey Meadow, Preston Flats. In 2014, monitoring of all fields in the vicinity of South Gate confirmed Eastern Meadowlark (maximum = 3 adults) on territory beginning 13 April and last observed 29 September. Observation of a fledgling with parents in SFW near a suspected nest site on 17 July 2014, suggested nesting. In 2019 sightings of this species continue to be made in both SFW and SFE.

Barn and Bank Swallows

Both swallow species are designated Threatened in Canada by COSEWIC and in Ontario under the Endangered Species Act (ESA). In January 2015, ***rare*** partnered with Birds Canada (BC) and put up artificial nesting structures for Barn and Bank Swallows.

In 2015, Bird Ecology and Conservation Ontario (BECO; https://www.beco-birds.org/portfolio-item/barn-swallows-and-social-cues/) in collaboration with BC set-up two roof structures for Barn Swallows on the property as part of their evaluation protocol of the use of social cues at replacement nest structures. In that year and the following, 2016, their personnel monitored each site on a weekly basis. From 2017 to 2019, ***rare*** volunteer bird monitors continued the monitoring.

In 2016, an artificial nesting site for Bank Swallows – basically a mound of dirt in an undisturbed area overlooking open terrestrial habitat – was set up in SFE. Design input came from Canadian Wildlife Service (CWS) and materials from Dufferin Aggregates. The site, about 600m from Barrie's Lake, is not as close to water as natural Bank Swallow sites in this area, e.g. river bank,

aggregate pits and, more recently, a stock pile of soil since utilized for road work. Weather delayed completion of the mound in 2016; monitoring began late and all results were negative. Bank Swallow is single-brooded so that having a prepared structure by their spring arrival – last week of April – is imperative. Monitoring continued in 2017. Improvements were made to the mound by tweaking the design, e.g. clearing vegetation on and about the structure, adding a perching wire above the face, and installation of a data logger into a false burrow. As of 2019, all results at this artificial site are negative.

4.4.4 Bird Banding Migration Stations

Bird banding at ***rare*** began 29 September 2002 west and southwest of the buildings at Springbank Farm along Blair Road. As many as five nets adjacent to the forest edge and hedgerows were set-up by Bander-in-Charge (BIC) Dallas Johnston assisted by members of WRN and ***rare*** volunteer bird monitors. Banding during the spring and fall migration continued until 2004 when Johnston moved out of the area. Banding was re-established 24 May 2008 by BIC Kevin Grundy with assistance from members of WRN and ***rare*** volunteer bird monitors and banding assistants. Test trials over two weekends confirmed that sites selected east of the Resource House and Slit Barn would provide a good selection of bird species and numbers so that in fall 2008 the banding program was expanded to 12 weeks, mid-August to first weekend of November. As many as five banding lanes with five to seven banding nets were maintained during bird migration from 2008 to 2016 by Grundy. Beginning in fall 2009 and intermittently during the migration seasons, when time and schedule permitted, Brett Fried and Erica Hentsch banded along the north-south hedgerows and line of vegetation east of the Community Gardens' laneway. Beginning in 2014, banding lanes near the ECO Centre were closed by late September and banding then took place north of South Gate within the regeneration field east along the fence line of the Grand Allee (aka South Gate site) to specifically band mid-fall migrating warblers and sparrows.

During banding, as many as seven ***rare*** trails and monitoring routes on and adjacent to the ***rare*** property were monitored usually between 07h00 and 09h00. As well, during banding hours, opportunistic sightings of birds were recorded by both the banders, their assistants and often ***rare*** volunteer bird monitors. This latter activity continued during all banding periods at ***rare***. Following Grundy's departure after the fall 2016 banding season, banding at ***rare*** was redefined in terms of educational demonstrations, evaluations of a few property locations to assess sites for future land use, and to augment bird monitoring. Not all sites visited were considered appropriate to establish banding lanes. In fall 2016, Ross Dickson banded east of the ECO-Centre and Slit Barn; in 2017 he banded within Neuman Field and in the regeneration/aspen grove west of the foot bridge over Cruickston Creek. All banding data was submitted to ***rare*** and compiled in their database.

4.4.5 Osprey Towers

Acting on a 2004 EAC recommendation, a tower with an Osprey nesting platform was erected northeast of the ECO Centre in the Osprey Meadow, 9 May 2007. Osprey first bred and fledged young from this nest in 2009. A second Osprey tower was erected in November 2014 at the eastern end of the property in George Street Field (Figure 2.1); both nests have been occupied

annually. In late June 2017, predator guards were wrapped around the bases of both poles. During the installation, ***rare*** volunteers monitored Osprey activity and counted number of young (Wilson 2017).

4.4.6 Motus Tower

The Motus Wildlife Tracking System, a North American radio-telemetry project, (https://motus.org/), was established at ***rare*** by Birds Canada (BC) in partnership with Acadia, Guelph and Western universities, Environment Canada and collaborating researchers and organizations. In 2015, a Motus Tower was erected on the knoll east of the ***rare*** Community Gardens.

4.4.7 Bird Research Projects

rare promotes the use of its lands for peer-reviewed research. Research projects about birds on the property during the last five years are:

- *Why do avian color patterns differ in sympatry?* (Kenyon, thesis in progress).
- *Wax Ester Composition of Songbird Preen Oil varies seasonally and differs between sexes, ages and populations* (Grieves et al. 2019).
- *Radio-tagged fledglings of Savannah Sparrow Passerculus sandwichensis at risk of entanglement in vegetation* (Van Vliet and Stutchbury 2018).
- *Analysis of bird banding and monitoring data from the **rare** Charitable Research Reserve in Cambridge Ontario, 2008 to 2012.* (Vanier 2015).

Recommendations (Birds):

1. Bobolink exhibit strong site fidelity, and will return to within 50 m of nesting area. With the successful nesting by Bobolink in 2013 and 2014, and Eastern Meadowlark in 2014, research opportunities exist with respect to these Species at Risk. Hayfields in which harvest is delayed from last week of June to end of first week of July can result in 70% successful fledging, although it is associated with some loss of hay quality. Consideration should be given to establish South Field East (SFE) as a hayfield thus doubling the area of this habitat.
2. Monitoring and banding efforts at ***rare*** could be combined to target a specific species or suite of species for research studies particularly with respect to grassland species.
3. Consideration should be given to monitoring breeding bird species at ***rare*** that have been given SAR status, e.g. Eastern Wood-Pewee and Wood Thrush.

4.5 Mammals

No formal comprehensive inventory of mammals at ***rare*** has been completed to date. In 1993 and 1994, Erwin Meissner and Bill Wilson undertook mapping of mammal distributions at a number of sites in North Dumfries Township, which included small mammal trapping on the ***rare*** property and monitoring animal mortalities along Blair Road. During 2001, the Cruickston Park Ecological Advisory Team recorded sightings including road mortalities and mammal activities in and around ***rare*** (North-South Environmental 2001). In the spring and summer of 2009, NRSI conducted bat monitoring to identify species and passage rate using ultrasound bat

detectors at four monitoring stations on ***rare*** property. Since that time, new mammal observations have been added based on staff and volunteer sightings. Additionally, the following projects and studies have contributed to our understanding of mammals at ***rare***:

- In conjunction with the University of Guelph Blair Flats tall grass prairie research project headed by Dr. Andrew MacDougall, a graduate student conducted small mammal trapping in 2012-2013.
- Observers at the confluence of the Speed and Grand rivers have observed and photographed coyote, beaver, white-tailed deer, mink, otter, red fox, muskrat.
- From 2016-2018, University of Guelph graduate students conducted mammal trapping as part of a study on urban adaptation in Eastern Grey Squirrels.
- In partnership with OLTA, one acoustic bat monitor was deployed at the lookout and three evening bat transect walks occurred in summer 2017.
- At bioblitz events from 2015 to 2018, mammal surveys occurred including bat netting, small mammal trapping, and motion sensor camera traps.
- Motion sensitive trap cameras were deployed from 2018-2019 as part of a University of Guelph research project.
- Mammals were frequently documented during road impact surveys from 2015 to 2019.

Recommendations (Mammals):

1. A formal inventory of mammal species occurring on the property should be conducted, by an outside consultant if necessary.
2. Exploration of white-tail deer population management, likely by traditional hunt.

4.6 Herpetofauna

In 2001, Ken Dance conducted area searches for breeding frogs and salamanders; reptiles were inventoried from spring through fall of the same year. The environmental assessment study of the Slit Barn property conducted by NRSI in 2008 included the monitoring of three stations for calling anurans and eight snake boards, as well as area searches throughout the study area.

In 2006, a plethodontid (lungless) salamander monitoring program was established at ***rare*** following the protocols developed by EMAN and Parks Canada. Salamander monitoring was conducted in 2006 in Indian Woods, and from 2008 onwards in both Indian Woods and the Hogsback, and it will continue annually at both locations. Artificial cover objects are monitored weekly for nine weeks from the end of August to the end of October; this protocol is designed to monitor plethodontid salamanders, although mole (Ambystomatidae) salamanders may also be detected during monitoring. An education plot was established in Cliffs and Alvars in 2013. This plot if not formally monitored, but allows for educational opportunities with salamander monitoring. In 2014-2015, ***rare*** investigated the existence of Jefferson complex salamanders on the property. Seventeen total salamander tail clippings were sent for genetic analysis, and the presence of Jefferson-dominated polyploids on the reserve was confirmed.

Additional herpetofauna projects and studies have occurred over time at ***rare***, including:

- A collaborative queensnake project in southern Ontario (NRSI, Ontario Nature, Nature Conservancy of Canada, Huron Stewardship Council, University of Toronto, Scarborough)
- Multiple research projects on emerging infectious diseases (Laurentian University; Trent University)
- A University of Waterloo research project on amphibian detection via eDNA.
- Frequent documentation during road impact surveys from 2015-2019.

4.7 Other Taxa

4.7.1 Mosses and Liverworts

A species list of mosses and liverworts for the ***rare*** property was developed in 2004 by Wynn Watson. Collection locations included the Hogsback, Indian Woods, Slope Woods, Cliffs and Alvars forests, Barn Woods, Blair shoreline, Grand Trunk Trail, farm fields, and Cruickston Creek. Limited additions have been made to this inventory via iNaturalist in recent years.

4.7.2 Fungi

The species list for fungi at ***rare*** has been developed over five annual mushroom forays (2007-2011) with the Mycological Society of Toronto and during bioblitz events (2015-2018). All forays were conducted in the fall, in either the Indian Woods or Cliffs and Alvars forest, and bioblitz events occurred primarily in the summer. Public mushroom forays have been discontinued, since they may encourage unsupervised foraging on the property, and could also lead to liability problems if non-experts misidentify mushrooms.

4.7.3 Lichens

Some survey of the lichen flora of ***rare*** has occurred, with 55 named species listed. Observation and identification occurred through the lichen monitoring program (2004, 2008, 2014) at ***rare*** and at bioblitz events (2015-2018). Further taxonomic work by appropriate specialists should be encouraged.

4.7.4 Insects

A species list for insects at ***rare*** was started in 2006 by S.A. Marshall's lab at the University of Guelph. Five sites (Cruickston Creek, Resource House, Cliffs and Alvars Floodplains, Grand Trunk Trail and Preston Flats) were hand sampled, and pan and Malaise trapped. Additional surveys and sampling efforts have occurred throughout the years that have further contributed to this list, including:

- Establishment of a butterfly monitoring protocol for ***rare*** in 2006 and continued annually from 2009 onward. An annual North American Butterfly Association butterfly count complements this data and occurs each July since 2006 (except 2007 and 2014 due to weather cancellations).
- A citizen science-based pollinator research project by Heather Andrachuk (2009).
- A research project by Adam Brunke (2009-2011) investigating rove beetles.
- A research project conducted by Tom Woodcock (2010-2012) that focused on pollinator species (Apoidea, Syrphidae) (Woodcock et al. 2014).

- An Odonate survey conducted by Jennette Fox (University of Ottawa) in 2011 of Blair Flats and (eastern) Cliffs and Alvars.
- Toronto Entomologist Association survey in 2012.
- A moth workshop held in September 2012 at ***rare***, and later efforts to identify moths by Ross Dickson at ECO Centre.
- A Wilfrid Laurier research project into an invasive fruit fly pest by Yvonne Young (2016).
- Studies in 2017 (Victoria MacPhail; York University) and 2018 (Janean Sharkey, University of Guelph) on native bee species.

The most significant insect surveying that has occurred on the ***rare*** reserve has been in partnership with Centre for Biodiversity Genomics (University of Guelph) and utilized DNA barcoding methods to identify insects collected largely via Malaise traps. This occurred in 2015 as a part of ***rare's*** first bioblitz event, and in subsequent years additional surveying efforts continued via Malaise traps in select areas of the property. Specifically, Malaise traps deployed across the Thompson Tract, the Indian Woods, the Hogsback, and the Cliffs and Alvars forests are being used to link the parasitic Hymenoptera community (parasitoid wasps) to vegetation and habitat characteristics that predict the abundance, diversity, and impact of these beneficial natural enemies. These metrics, in relation to vegetation, will hopefully provide conservation targets to maintain or enhance parasitoid populations and diversity, ultimately which can be used to create more resilient forests at ***rare***.

Recommendations:

1. Continue to seek morphological and molecular taxonomic experts to expand species lists and survey new groups. Of particular interest are terrestrial insects not covered by specific monitoring programs and non-insect invertebrate fauna.

5.0 PRIORITY PROTECTION CLASSIFICATION AND POLICIES

The property has been divided into Priority Protection Areas (Figure 5.1) based on the vulnerability to disturbance of the natural features and living members each contains. The system is adapted from Conservation Halton's Master Plan for Glenorchy Conservation Area (http://www.conservationhalton.ca/parks-master-planning). We recognize that the well-being of people and their activities is dependent upon our relationship with the natural environment, and strive to balance the role and relationship of all living relatives existing in the environment. Each designation has corresponding management implications, and will guide future decisions related to land use, criteria for public access, and protection and restoration efforts. The sensitivity of Very High Priority Protection Areas is reflected in the more restrictive management policies with minimal public access. Most public use will be focused on Low Priority Protection Areas. The criteria used to designate the zones are based on well-known and understood natural heritage features and special land use designations, and their sensitivity to impacts from land uses such as recreation, agriculture, and development. The criteria for each zone and associated management policies are described below.

5.1 Very High Priority Protection (VHP)

5.1.1 Criteria

Very High Priority Protection Areas include one or more of the following:

- Provincially Significant Wetlands
- High constraint stream corridors
- Rare vegetation communities
- Regulated Species at Risk (provincial or national)
- Vernal pools
- Seeps
- Limestone cliffs and outcrops
- Monitoring plots
- Old growth forests

5.1.2 Policy

- The management goal for Very High Priority Protection Areas is to preserve and manage these areas so that they may persist intact in perpetuity. Educational material, communicated through trail signage, the ***rare*** website, trail maps and handouts, should be provided to the public to explain the significance and sensitivity of the area's natural features

Permitted Activities:

- Stewardship
    - Localized restoration activities
    - Invasive species management
- Indigenous cultural and subsistence activities, including traditional stewardship of medicines and other culturally significant species
- Low impact public use of pre-existing authorized trails, provided that the negative impacts associated with the trail use are minimized and do not threaten the integrity of the natural feature. Low impact trail use includes hiking on the trail independently or on guided tours and does not include cycling, geocaching, or any off-trail use. In the long term, trails superfluous to requirements, including unauthorized and "social" trails should be closed and restored
- Trail maintenance so long as trails are authorized to remain in use
- Management of hazardous trees
- Research, arts, or other inquiry approved through the Research and Land Use application process that cannot be conducted in lower priority protection areas
- Passive off-trail use when pre-approved by ***rare*** (i.e. Bird Monitors)***.***

5.2 High Priority Protection (HP)

5.2.1 Criteria

High Priority Protection Areas include one or more of the following:

- Core features of ESPAs (Environmentally Sensitive Policy Areas)
- Significant valleys and bottomlands

- Natural forest cover
- Medium constraint stream corridors
- Species of Special Concern (provincial and national)
- Regionally rare species
- Other wetland, not under PSW designation
- Candidate Significant Wildlife Habitat
- Veteran mast trees

5.2.2 Policy

The management goal for High Priority Protection Areas is to protect and possibly improve the integrity of the lands, with the recognition that many of ***rare's*** high-use public trails in the Cliffs and Alvars Forest fall within this protection category. Educational material, communicated through trail signage, the ***rare*** website, trail maps and handouts, should be provided to the public to explain the significance of the area's natural features and the impacts of unauthorized trail use and off-trail use

Permitted activities include all those listed for the Very High category, plus:

- Stewardship
    - Restoration activities at large scales (i.e. landscape level restoration of habitat, such as prairie plantings and creation of forested corridors, prescribed burns) as required for proper management
- Public use of existing trails, limited to hiking and other permitted recreational activities (cycling, geocaching) specific to the trail, independently or on guided tours
- Trail maintenance as required for pre-existing and new trails, including installation and maintenance of boardwalks, trail markers and signs, addition of trail substrate (woodchips etc.), and installation of trailheads, signs, trail markers
- Public and staff use of existing infrastructure (gates, kiosks, etc)
    - Existing infrastructure should be maintained to mitigate negative environmental impacts and ensure public safety
    - Special consideration should be given to the mitigation of negative environmental impacts during any required renovations
- Landscaping, fencing and signage may be employed to confine public use to the preferred, designated areas.
- Digging or other movement of earth with explicit approval of ***rare***.

5.3 Medium Priority Protection (MP)

5.3.1 Criteria

Medium Priority Protection Areas are areas or features that are not covered under the VHP or HP designations that contain:

- Linkages
- Hedgerows
- Lookouts
- Restoration sites

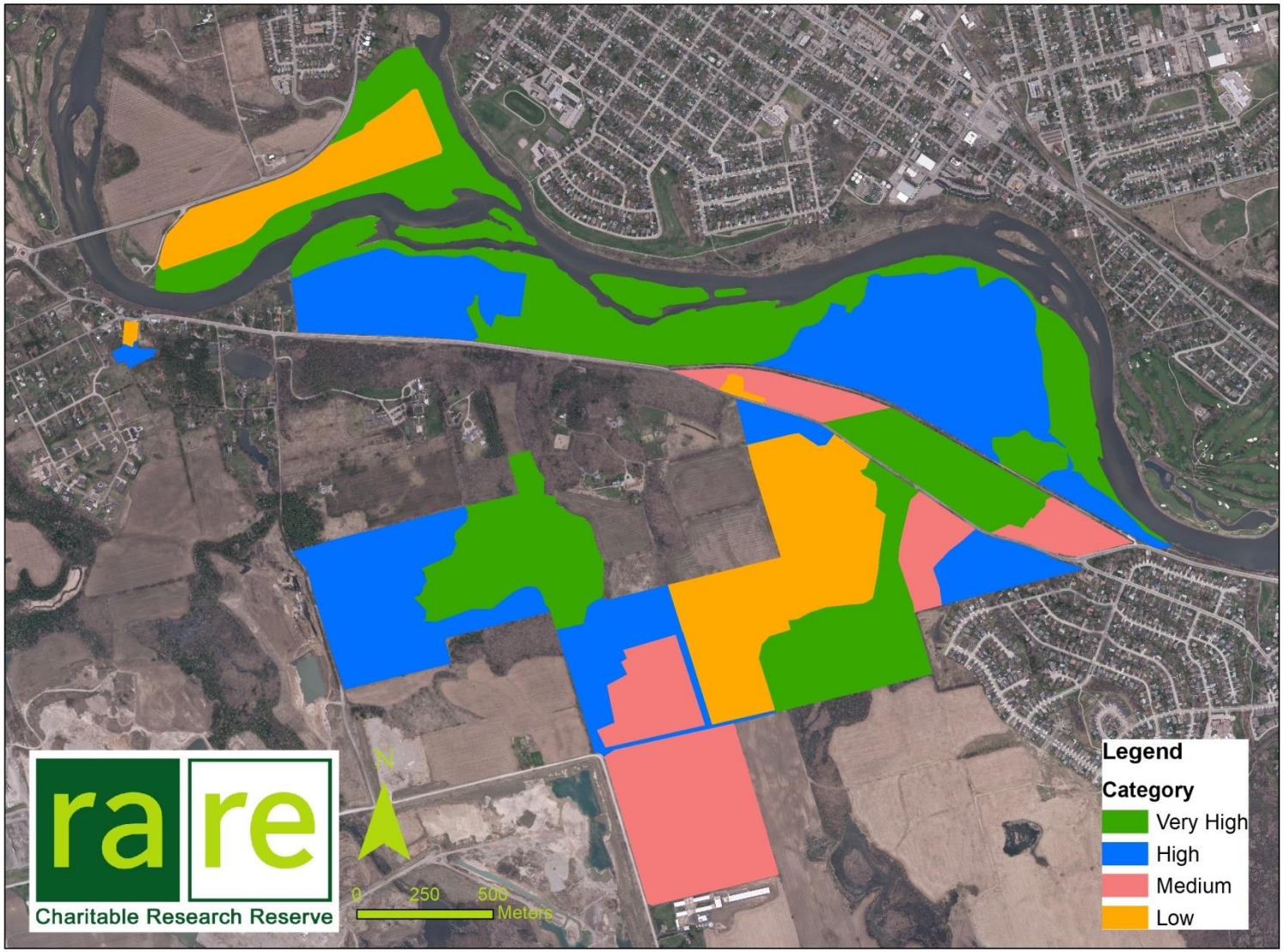

Figure 5.1 Location of Priority Protection Areas at ***rare***.

5.3.2 Policy

The management goal for Medium Priority Protection Areas is to restore degraded or agricultural lands to a natural state and to provide linkages between disconnected natural features, if applicable. Educational material, communicated through trail signage, the ***rare*** website, trail maps and handouts, should be provided to the public to explain the vision and methods behind the restoration projects on the property.

Permitted activities include all those listed for above categories, plus:

- Creation of new trails which may include vegetation removal.
    - Trailhead infrastructure may be required for new trails: parking lots, washroom facilities, fencing
- Construction of new facilities that are of high priority in advancing ***rare's*** vision and mission may be permitted provided an environmental impact mitigation plan is established

5.4 Low Priority Protection (LP)

5.4.1 Criteria

Low Priority Protection Areas are all areas that are not included in the other priority protection zones.

5.4.2 Policy

The management goals for Low Priority Protection Areas are to provide areas for demonstration, community gardens, the practice of sustainable commercial agriculture, and provide a staging area for facilities and infrastructure to support ***rare*** programs. Focus is on recreation, education, agriculture, infrastructure and facilities in these areas in a manner that is sustainable and conducive to the organization's goals. Educational material, communicated through trail signage, the ***rare*** website, trail maps and handouts, should be provided to the public to explain the vision and methods behind the agricultural practices on the property.

Permitted Activities include all those listed for above categories, plus:

- Agriculture
    - Areas in agriculture should be managed to provide wildlife corridors and buffers to connect and protect natural features
    - Commercial agriculture should use ecological/sustainable practices
- Restoration and improvement of hedgerows and buffers through planting and invasive species management
- Demonstration and community gardens which provide agricultural education and outreach to the community – integral to ***rare's*** education program
- Regular public use of existing or newly created public trails and open access areas. Regular trail use includes hiking on the trail independently or on guided tours, and possibly cycling and geocaching in suitable areas; open use areas may include picnic areas, benches, and pavilions/shelters.

6.0 BIODIVERSITY: THREATS, OPPORTUNITIES, AND RECOMMENDATIONS

6.1 Biodiversity Targets and Threats Framework

The biodiversity target framework presented here was adopted from The Nature Conservancy's Conservation Action Planning (CAP) Handbook (Nature Conservancy, 2007). This approach is widely used by conservation practitioners and provides a familiar, straightforward model for the ***rare*** Environmental Management Plan. Biodiversity targets are a suite of ecologically valuable landscape zones, features, and communities that have been selected for conservation at ***rare***. Recognizing that all living things exist in relationship with one another, the targets were chosen to represent as much of the biodiversity at ***rare*** as possible. They serve as "umbrella" features, by which the conservation of the target would result in the subsequent conservation of many other related biodiversity features, including species of concern. In previous years, some damage from trespassers off-trail and poaching has been observed. Indigenous peoples who are welcome to engage in traditional stewardship of medicines and other culturally significant practices on these lands.

Health and viability of each biodiversity target are monitored by a number of key ecological attributes, determined for each target type. It was then determined whether the indicators for these attributes fell within a range of acceptable variation for the target. The attributes are compared to scientifically based criteria for each target, and rated using the system described in Table 6.1.

To understand the threats facing the viability of the targets, the stresses to the key ecological attributes were then identified, as well as the sources of these stresses. The severity and scope of each stress was rated, and the sources of the stress were assessed by rating their contribution to the degradation of the target, and the irreversibility of the source (i.e. how difficult is the source to eliminate or remediate under present conditions) and/or of its effects on the target (Table 6.2).

Table 6.1 Scale of ecological attribute ratings, as measured using an appropriate indicator.

Poor	Allowing the ecological attribute to remain in this condition without human intervention for an extended period of time will make restoration extremely difficult or impossible.
Fair	The ecological attribute lies outside of its range of acceptable variation and requires human intervention. If unchecked, the target will be vulnerable to serious degradation.
Good	The ecological attribute is within a range of acceptable variation; it may require some human intervention.
Very Good	The ecological attribute is within a range of acceptable variation; it requires little or no human intervention, but may require protection.

Table 6.2 Characteristics of stresses to persistence, integrity, or function of conservation targets (adapted from Nature Conservancy, 2007).

	Low	Medium	High	Very High
Severity of stress	The threat is likely to cause no more than slight impairment of the target over some portion of the site.	The threat is likely to moderately degrade the target over some portion of the site.	The threat is likely to seriously degrade the target over some portion of the site.	The threat is likely to destroy or eliminate the target over some portion of the site.
Scope of stress	The threat is likely to be highly localized in its scope or affect the target over a limited portion of the site.	The threat is likely to be localized in its scope and affect the target over a limited to moderate portion of the site.	The threat is likely to be widespread in its scope and affect the target across much of the site.	The threat is likely to be widespread or pervasive in its scope and affect the target throughout the site.
Contribution of source to stress	The source is a minor contributor of the particular stress.	The source is a moderate contributor of the particular stress.	The source is a major contributor of the particular stress.	The source is a very strong contributor of the particular stress.
Irreversibility of the effects of a source of stress	The source produces a stress that is easily reversible at a relatively low cost.	The source produces a stress that is reversible with a reasonable commitment of resources.	The source produces a stress that is reversible, but not practically affordable.	The source produces a stress that is not reversible using currently available methods.

6.2 Streams and Rivers

6.2.1 Monitoring

The standard method for stream monitoring is the Ontario Benthos Biomonitoring Network (OBBN) monitoring program which is used at ***rare***. Available OBBN indicators (dissolved oxygen, pH, conductivity, %EPT (a benthic invertebrate index)) are expected to fall within acceptable ranges, triggering an investigation if they do not. Nutrient concentrations, temperature, discharge, and habitat characteristics are all used in support of monitoring efforts, particularly as the restoration in Bauman Creek is observed through time. Details of ***rare's*** aquatic monitoring program are available in Abram et al. (2018).

6.2.2 Cruickston Creek

6.2.2.1 Target Description

Cruickston Creek is a first-order cool-water tributary of the Grand River. It is two kilometers in length and drains an area of approximately 90.23 ha (Hunter and Associates 2016). Its headwaters are located in the wetland of the Hogsback Forest, and it flows north under Blair Road into the Cliffs and Alvars forest area (Figure 2.2). It is thought that historically the drainage

area was considerably larger, as the wetlands in the Hogsback south of ***rare*** property drained toward ***rare*** prior to the construction of the farm lane. Restoration of the original connection is a possibility, although would need to be balanced with water quantity needs of other habitats such as Barrie's Lake, currently suffering from reduced input of water, and SAR populations in the existing wetland areas. Cruickston Creek is included in the Class 1 Barrie's Lake – Bauman Creek PSW Complex. The majority of the creek is forested, except for a small stretch immediately south of Blair Road and a small area north of Blair Road before the stream channel disappears into a silver maple swamp. The channel is poorly defined in some areas, particularly at base flow.

The former agricultural fields immediately east and west of the creek just south of Blair Road have undergone restoration efforts. The entire six acre field to the east and eight acres to the west were removed from agricultural production between 2003 and 2006 and have been left to naturalize. Native trees have been planted on both east and west sides of the creek. Conventional agriculture is still conducted west of the creek beyond the restoration area.

Downstream at Cruickston Creek there was a 30cm perched culvert which was removed in winter 2015, with associated channel and riparian habitat restoration. There are no records of fish historically occupying Cruickston Creek south of Blair Road, and recent electrofishing results (McCarter 2009; Abram et al. 2018) supported this, but a more extensive fish survey is required to confirm the absence of fish populations here. However, there have been no monitoring activities in the lower reach of the creek as it approaches its confluence with the Grand River, and it is possible that this reach provides fish habitat.

6.2.2.2 Target Viability

Table 6.3 Variation of indicator values for key attributes at Cruickston Creek. Bolded values indicate the mean value of the indicator observed at ***rare***. Asterisks indicate that on at least one occasion, a value that falls outside of the acceptable range has been recorded. Values are means from the most recent available sampling year (2018).

Key Attribute	Indicator	Poor	Fair	Good	Very Good	Range Source
Water Quality	Dissolved Oxygen (mg/L)	<6.5*	**6.5-9.5***	>9.5		CCME 1999
	pH			**6.5-9**[b]		Environment Canada, 2011
	Chloride (mg/L)	>120	25-120	**10-24**	<10	CCME 2011
	Nitrate-N (mg/L)	>13	4-13	2.7-4	**<2.7**	CCME 2012
	Phosphate-P (ug/L)	>100	50-100	**20-50**	10-20	CCME 2004
	Conductivity (µS/cm)		**≥500**[a]	≤500[a]		Carr and Rickwood, 2008
Benthic Invertebrate Community Assemblage	%EPT (Ephemeroptera – Plecoptera – Trichoptera)	0-1	2-5	6-10	**>10**	TRCA 2009
	% Oligochaeta	>30	10-30		**<10**	Conservation Halton 2017
	Shannon Diversity Index	**<3.0**	3.0-4.0		>4.0	Conservation Halton 2017

	Hilsenhoff Biotic Index	**<6.0**	6.0-7.0		>7.0	Conservation Halton 2017
	Taxa Richness	**<13**			>13	Conservation Halton 2017
Stability of Fluvial Geomorphology	Bank Erosion Hazard Index	Bank erosion and stress have not yet been measured for Cruickston Creek. As a natural channel, stability is not necessarily a target.				Rosgen, 2008
	Near Bank Shear Stress					

[a] A groundwater-fed stream on calcareous bedrock will have high conductivity values at base flow under most conditions, without it being indicative of a water quality problem

[b] Higher or lower pH values could indicate impairment

No monitoring sites on Cruickston Creek exceeded the Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for Protection of Aquatic Life for chloride and total nitrate nitrogen. Aluminum, iron, and total phosphorus thresholds were exceeded in certain areas at certain times (see Abram et al. 2018 for further details). Consultation with a fluvial geomorphologist (Trevor Chandler, pers. comm. 2011) suggested that the perched culvert south of Blair Road was causing degradation to the stream. Informal monitoring in that area following the removal of the culvert and installation of the bridge has shown that the project appears to have had a positive effect on benthic macroinvertebrate richness and density, however continued monitoring is required.

6.2.2.3 Threats to Target

Table 6.4 Target stresses at Cruickston Creek.

Stresses	Altered Key Ecological Attribute	Severity	Scope	Notes
1	Degraded water quality	Medium	Medium	Preliminary viability analysis suggests that water quality is fair to good. Effects of water degradation would be expected at sites downstream of Blair Rd.
2	Reduced water quantity	Medium	High	It is likely that the drainage area has been reduced over its historic level by the construction of a farm lane. Further reduction is possible due to the planned Cambridge West development.

Table 6.5 Sources of stresses at Cruickston Creek.

Source		Stress 1	Stress 2	Notes
Blair Road Pollution (salt, particulate)	Contribution	Medium		Road runoff may introduce salt and sediment in the creek. Controlling road traffic and pollution may not be possible while Blair Road is in use. Increasing chloride levels in drinking water has led the Region of Waterloo to attempt to reduce salt use.
	Irreversibility	High		
Agricultural Runoff	Contribution	Low		Runoff from agricultural field uphill of Cruickston Creek could include chemical fertilizer, pesticide and sediment. There is now a large buffer between the field and the stream, with potential to take more of the field out of conventional
	Irreversibility	Low		

				cropping.
Gaps in Riparian Cover	Contribution	Low		Exposed sections of the creek could elevate water temperature and degrade cold/cool water habitat (MTE Consultants, 2013). Active planting on both sides of the creek upstream of Blair Road occurred 2015-2017, riparian lands currently undergoing natural succession.
	Irreversibility	Low		
Residential Development of Neighbouring Lands	Contribution	High	High	Significant additional housing development is pending adjacent to the Hogsback and Cruickston Creek drainage. Storm water could be diverted into stream - altering flow, sediment load and water quality (chemistry, temperature). Water quantity could also be reduced. Increased human traffic, invasive plants, etc
	Irreversibility	High	High	

6.2.2.4 Opportunities

There have been no formal studies by ***rare*** of the lower reaches of Cruickston Creek where it drains into the fractured limestone terrain above the Grand River. Bhamjee (2014; University of Guelph) studied flow, sediment, and pollutant movement in the portion of the creek north of Blair Road. To understand the health of the entire system, the lower reaches were mapped in 2013, and updated on ***rare's*** base map. The lower reach may provide potential fish habitat, which could be determined using visual assessment in spring, summer and fall, or electrofishing. However, some of the channel is dry for portions of the year, rendering those reaches uninhabitable for fish.

We can elucidate water quality effects by monitoring for specific water quality indicators (e.g. phosphorus and nitrogen for agricultural runoff, salts and sediments for Blair Road) upstream and downstream of these potential inputs. For details, see Abram et al. (2018). Should they be found to be impairing water quality in Cruickston Creek, strategic actions could include the retirement of the nearby agricultural field from conventional agriculture, supplementation of buffer plantings, and consultation with Region of Waterloo staff to discuss possible methods to mitigate effects of Blair Road runoff, such as a Reduced Salt Zone designation.

In response to the impending subdivision construction on the southeast side of the Hogsback forest, consultation with City of Cambridge and Township of North Dumfries Planning staff and the developers throughout the subdivision application process will be critical in protecting the long term health and functioning of Cruickston Creek. This increase in the human population of the catchment and the coincident increase in unauthorized use expected to occur requires proactive steps to protect this Very High Priority area. The developer of the land adjacent to the Hogsback (Huron Creek Holdings) has agreed to several measures to reduce human impact in the Hogsback, at their expense. Examples include construction of a trail from the updated Newman Drive storm water management (SWM) pond to Springbank Farm, and constructing fencing along rear of lots with a statement in homeowners' purchase agreements prohibiting encroachment. Where fencing is not installed, native vegetation that will discourage unauthorized use (e.g. hawthorn, raspberry, prickly-ash) will be planted. Storm water plans

include measures to divert road runoff from the stream, with lot-level measures such as infiltration galleries to allow infiltration of clean water.

6.2.2.5 Recommendations (5-year horizon)

- Continue monitoring of benthic macroinvertebrate community, dissolved oxygen, pH, conductivity and temperature as part of regular aquatic monitoring efforts every three years.
- Investigate the feasibility and process for getting a Reduced Salt Zone designation for Blair Road.
- Investigate the feasibility and process for lowering the speed limit on Blair Road, which will improve safety for wildlife, drivers, cyclists, and trail users. It may also reduce traffic volume as the road will become less attractive as a route around Cambridge.
- Identify and complete intensive sampling protocol (i.e. DFO protocol) to confirm presence or absence of fish in Cruickston Creek.
- In cooperation with the residential developers, divert human traffic patterns away from the Hogsback. The approach will be construction of a new trail in/near the buffer area of the development (as part of the amenities provided to residents), together with closure of existing trails and plantings to make human access difficult. Buffer areas of the appropriate width must be included in the plan, to ensure the protection of ***rare*** lands.
- Consider retiring additional portions of Fields 303 and 308 (west and north of the Hogsback forest) from production to mitigate possible runoff problems (pesticide, fertilizer). Long-term, this field is planned to contain wildlife corridors linking forest habitat in the Hogsback and Indian Woods.
- Continue invasive vegetation control (particularly buckthorn and *Phragmites*) and restoration plantings in the Cruickston catchment.

6.2.3 Bauman Creek

6.2.3.1 Target Description

Bauman Creek is a first-order, coldwater tributary of the Grand River. This creek is less than two kilometers in total length and drains an area of approximately 211 hectares (Hunter and Associates 2016). Its headwaters are located in the wetland of the Thompson Tract deciduous swamp. It flows north-east through Indian Woods, adjacent to Brewery Lane, crossing under Blair Road and immediately turning east across Blair Flats to meet the Grand River. The creek is part of the Class 1 Barrie's Lake – Bauman Creek Provincially Significant Wetland Complex. The entirety of the creek upstream of Blair Road is forested and possesses a meandering channel with varying gradient, while the lower reaches of the creek are completely exposed and very low gradient as they cross Blair Flats (located in the Grand River floodplain).

From aerial photographs, we know that the Blair Flats were used as cropland in the 1940s and 1950s, and Bauman Creek flowed into the Grand River to the east. In the 1970s, the Flats were being used as cattle pastureland, and were converted back into cropland in 1978. In order to keep the fields dry enough to farm, the lower reach of Bauman Creek was channelized by Domm Farms in 1978 (Barfoot, 2003). It is currently unknown if the creek had been deliberately

channelized while in cropland earlier in the 20th century. In 2009, the Blair Flats were retired from agriculture, and the western portion, totalling 43 acres, was planted in tall-grass prairie as part of a research program led by Andrew MacDougall, University of Guelph. The eastern portion was left to naturalize. Shortly thereafter, a marsh began to form in the centre of the Blair Flats, and the straightened and relocated channel has exhibited reduced flows and an increase in in-channel vegetation typical of stagnant water features. This was the result of a dysfunctional culvert under the farm lane that allowed access to the eastern part of Blair Flats, which was no longer being maintained. Due to the formation of the wetland and gradual, natural infilling of the channel, no water reached the Grand River via overland, channelized flow

In November 2016, the culvert and a portion of the farm lane were removed and habitat restored along approximately 60m of the stream bed, restoring flow to the channel all the way to the Grand River. Special dispensation was obtained to work outside the fisheries window by OMNRF, since the channel being restored did not exist at that time. This also returned water to the forested PSW between the channel and Blair Road. In 2018, further restoration activities were performed to better define the channel, which had infilled with sediment and vegetation. Further activities were completed in the summer of 2019. All in-water restoration efforts respected the Fisheries Mitigation window for brook trout.

Upstream of Blair Road there is a cement impoundment south of Slope Woods. This impoundment, located on the portion of Bauman Creek that crosses private property south of Blair Road, was built prior to 1950 to hold water for the Cruickston Estate (Barfoot, 2003), but is no longer used for this purpose. No fish were observed upstream of the impoundment, until electrofishing recorded multiple specimens in 2018. Access to upstream reaches may increase as the impoundment continues to deteriorate. However, catastrophic failure of the impoundment may also occur, which could release accumulated sediment into the brook trout habitat. It is unknown how long this disturbance would last or the severity of the effect on the trout population. Ideally, the impoundment would be decommissioned in a responsible manner prior to failure. The impoundment is no longer on ***rare*** property, and is now the responsibility of a different land owner.

6.2.3.2 Target Viability

Table 6.6 Variation in indicator values for key attributes related to target viability of Bauman Creek. Bolded values indicate the mean value of the indicator observed at ***rare***. Asterisks indicate that on at least one occasion, a value that falls outside of the acceptable range has been recorded. Values are means from the most recent available sampling year (2018).

Key Attribute	Indicator	Poor	Fair	Good	Very Good	Range Source
Water Quality	Dissolved Oxygen(mg/L)	<6.5	6.5-9.5	**≥9.5**		CCME 1999
	pH			**6.5-9**[b]		Environment Canada, 2011
	Chloride (mg/L)	>120	**25-120**	10-24	<10	CCME 2011
	Nitrate-N (mg/L)	>13	4-13	**2.7-4**	<2.7	CCME 2012
	Phosphate-P (ug/L)	>100	50-100	20-50	**10-20**	CCME 2004

	Conductivity (µS/cm)		**≥500[a]**	≤500[a]		Carr and Rickwood, 2008
Benthic Invertebrate Community Assemblage	%EPT (Ephemeroptera, Plecoptera, Trichoptera)	0-1	2-5	6-10	**>10**	TRCA 2009
	% Oligochaeta	>30	10-30		**<10**	Conservation Halton 2017
	Shannon Diversity Index	**<3.0**	3.0-4.0		>4.0	Conservation Halton 2017
	Hilsenhoff Biotic Index	**<6.0**	6.0-7.0		>7.0	Conservation Halton 2017
	Taxa Richness	**<13**			>13	Conservation Halton 2017
Presence of Brook Trout	Population self-sustainability	No Brook Trout Present	Brook Trout population dominated by one age class	**Self-sustaining population present**		
Stability of Fluvial Geomorphology	Bank Erosion Hazard Index	Bank erosion and stress have not yet been measured for Bauman Creek. As a natural channel, stability is not necessarily a target.				Rosgen, 2008
	Near Bank Shear Stress					

[a] A groundwater-fed stream on calcareous bedrock will have high conductivity values at base flow under most conditions, without it being indicative of a water quality problem
[b] Higher or lower pH values could indicate impairment

No monitoring sites on Bauman Creek exceeded the CCME Water Quality Guidelines for chloride, total nitrate nitrogen, and total phosphorus. Aluminum, iron, and lead thresholds were exceeded in certain areas at certain times (see Abram et al. 2018 for further details).

The presence of brook trout is an indicator of stream health for Bauman Creek. Brook trout is an indicator species of healthy coldwater systems, and its preferred habitat conditions include forested riparian cover, high quality low nutrient water, and cold water temperature (maximum temperature below 19°C). Brook trout spawn on zones of groundwater upwelling, sometimes regardless of the substrate present. In 2009 and 2016, ***rare*** staff led by EAC member M. Pomeroy sampled the fish community of a section of the middle reaches of Bauman Creek located just upstream of Blair Road. Multi-pass electrofishing yielded 53 brook trout in 2009 and 57 brook trout in 2016 of varying sizes and ages. Results in 2016 and 2017 on the north side of Blair Rd yielded 27 brook trout. Since connectivity to the Grand River has been lost, we assume that the population in the creek is self-sustaining, breeding in the reach south of Blair Road and downstream of the impoundment. The restoration of the reach of the stream on Blair Flats restored the connection to the river, and provides improved habitat and contact with groundwater. Evidence of breeding was observed in the restoration area in Fall 2018. Tree planting in this area will provide shading of the channel in the future.

The fluvial geomorphology and channel stability of Bauman Creek is a key attribute of the target that has yet to be formally studied. Data and observations from Barfoot (2003) and Water's Edge (2015) suggest that the impoundment is a barrier to fish movement, and causes slow creek flow, sediment accumulation, and increased water temperatures. The monitoring of indicators like Bank Erosion Hazard Index (BEHI) and Near Bank Shear Stress (NBSS) would allow us to assess the stability of the creek, and provide a baseline for comparison if the impoundment is removed. These indicators could be monitored in-house by ***rare*** staff and volunteers under the guidance of a fluvial geomorphologist. Unfortunately, the relevant reach is no longer owned by ***rare***. Downstream of Blair Road, a dynamic channel is desirable as the stream recovers from former channelization and diversion.

6.2.3.3 Threats to Target

Table 6.7 Target stresses at Bauman Creek.

Stresses	Altered Key Ecological Attribute	Severity	Scope	Notes
1	Channel Instability	High	High	Old impoundment could fail and release sediment and temporarily increase flows which could disturb Brook Trout redds and stream morphology.
2	Degraded water quality	Medium	Medium	Data suggest that water quality is fair to good. Effects of water degradation would be seen at sites near Blair Rd. and downstream.
3	Riparian Habitat Quality	High	Medium	Invasive species, most notably non-native *Phragmites* (Common Reed) pose a threat to the riparian plant community and must be controlled.

Table 6.8 Sources of stresses at Bauman Creek.

Source		Stress 1	Stress 2	Stress 3	Notes
Impoundment	Contribution	High	Medium		The old impoundment is currently holding sediment, slowing flow and increasing water temperature, however the impact on the Creek does not appear to be severe. Failure of the impoundment would cause major disturbance to creek stability, biotic habitat and water quality over a short to mid period of time. The reserve no longer controls the dam itself, and the current owner(s) should be made aware of their responsibilities.
	Irreversibility	Medium	Medium		
Blair Road Pollution (salt, particulate)	Contribution		Medium		Road runoff may introduce salt and sediment in the creek. Controlling road traffic and pollution may not be possible while Blair Road remains in use.
	Irreversibility		High		
Agricultural Pollution	Contribution		Low		Barfoot (2003) found nitrate content to be highest in the headwaters, indicating agricultural pollutants may be entering

	Irreversibility		Medium		creek system through groundwater discharge. A horse paddock has been added to the Manor property since this study was undertaken, which could also be impacting water quality. Niederkorn (2015) found many groundwater and surface water samples exceed the MOE and CCME nitrate limits, and recommended further research to determine the source of the nitrate rich groundwater.
Gaps in Riparian Cover	Contribution		Medium		Exposed/under-vegetated sections of the creek could elevate water temperature and degrade coldwater habitat. Maximum temperature data has not been collected. Riparian lands in the lower reaches have had several hundred trees, shrubs, forbs planted, and are currently undergoing natural succession.
	Irreversibility		Low		
Invasive Plants	Contribution			Medium	*Phragmites* is a concern in the portion of Bauman Creek downstream of Blair Rd.
	Irreversibility			Medium	The infestation is still at a controllable level, provided that sufficient labour can be obtained to remove plants appropriately. A variety of methods are being used, as appropriate, including mechanical control, chemical control, experimental infrared treatment, goat (and possibly pig) grazing, etc.
Aggregate Extraction on Neighbouring Lands	Contribution	Very High	Very High		Aggregate extraction is ongoing on the property to the south of the Thompson Tract, and has restarted on the property to the west. Nearby extraction could impact water quality and quantity) entering Bauman Creek.
	Irreversibility	High	High		

6.2.3.4 Opportunities

Bauman Creek and the surrounding floodplain (i.e. that portion of Blair Flats east of the MacDougall Prairie restoration) has been a focus of stewardship and restoration activities. With the exception of invasive plant problems, notably an increasing *Phragmites* infestation, the restoration is largely completed. Riparian vegetation and channel habitat will be monitored closely in the coming years, to determine the success of activities.

An old impoundment, in existence on private land near the property boundary, is affecting the creek by acting as a barrier to fish movement, accumulating sediment, and likely causing increased water temperatures. The greatest risk is impoundment failure, which would release a surge of the water and sediment that has built up behind the dam over decades. Should failure occur during spawning, the Brook Trout population of Bauman Creek could be temporarily

compromised due to suffocation of eggs by sediment. It would be valuable to ascertain the plans of the landowner regarding maintenance and ultimate fate of this impoundment.

6.2.3.5 Recommendations (5-year horizon)

- Continue monitoring of benthic macroinvertebrates, dissolved oxygen, pH, conductivity and temperature as part of regular aquatic monitoring efforts every three years.
- Investigate the feasibility and process for getting a Reduced Salt Zone designation for Blair Road.
- The Bauman Creek impoundment should be decommissioned at the earliest opportunity, however the section of the creek containing the impoundment is no longer owned by ***rare***. This situation should be brought to the attention of the Region of Waterloo.
- Establish communication with the landowners operating aggregate extraction pits near to the ***rare*** property to gain a better understanding of their project timelines and rehabilitation plans. Consultation with Township of North Dumfries regarding aggregate policies and licensing should be pursued.
- Assess the need for regenerating riparian forest on ***rare*** property south of Blair Road to preserve coldwater habitat.
- Prioritize management of *Phragmites* targeting the newly restored Bauman Creek corridor where new populations are establishing; continue spading efforts and attempt live-staking willows to stabilize the bank and outcompete *Phragmites.*

6.2.4 Newman Creek

6.2.4.1 Target Description

Newman Creek is a first-order intermittent stream with its origin in the Newman Drive stormwater management (SWM) pond shortly before it enters ***rare*** property. It drains an area of approximately 20.46ha (Hunter and Associates 2016). It flows through a small naturalized riparian corridor along the western edge of the Newman plantation, crosses beneath Blair Road and enters a small wetland area. It has occasional channelized flow through the Cliffs and Alvars forest before disappearing into the ground and ultimately reaching the Grand River via seepage. For much of the year it contains very little water, as two-thirds of its catchment area was lost to development; the so-called Princess Street catchment now drains directly to the Grand River (Hunter and Associates 2016). Current expansion and improvements of the SWM pond associated with the Cambridge West development provides an opportunity to improve water quantity in Newman Creek, as storing water and releasing it appropriately could stabilize the creek's hydroperiod. Adequate shading of the pond, appropriate release depth, and so forth are all considerations to bear in mind for the design to improve the health of Newman Creek. No fish have been recorded in Newman Creek, and invertebrate sampling has recently been started as part of regular monitoring.

6.2.4.2 Target Viability

Table 6.9 Variation of indicator values for key attributes related to target viability. Bolded values indicate the value of the indicator observed at ***rare***. Asterisks indicate that on at least one occasion, a value that falls outside of the acceptable range has been recorded. Values are means from the most recent available sampling year.

Key Attribute	Indicator	Poor	Fair	Good	Very Good	Range Source
Water Quality	Dissolved Oxygen(mg/L)	<6.5	**6.5-9.5**	≥9.5		Canadian Council of Ministers of the Environment, 1999
	pH		**<6.5** [b]	6.5-9 [b]		Environment Canada, 2011
	Chloride (mg/L)	>120	**25-120**	10-24	<10	CCME 2011
Benthic Invertebrate Community Assemblage	%EPT (Ephemeroptera, Plecoptera, Trichoptera)	0-1	2-5	**6-10**	>10	TRCA 2009
	% Oligochaeta	**>30**	10-30		<10	Conservation Halton 2017
	Shannon Diversity Index	**<3.0**	3.0-4.0		>4.0	Conservation Halton 2017
	Hilsenhoff Biotic Index	<6.0	**6.0-7.0**		>7.0	Conservation Halton 2017
	Taxa Richness	**<13**			>13	Conservation Halton 2017
Stability of Fluvial Geomorphology	Bank Erosion Hazard Index	Bank erosion and stress have not yet been measured for Newman Creek. As a natural channel, stability is not necessarily a target.				Rosgen, 2008
	Near Bank Shear Stress					

[b] Higher or lower pH values could indicate impairment

6.2.4.3 Threats to Target

Table 6.10 Target stresses

Stresses	Altered Key Ecological Attribute	Severity	Scope	Notes
1	Degraded Water Quality	High	High	The entire drainage area of Newman Creek is in the subdivision, from which water is collected into the SWM pond that forms the creek's source. Thermal regime is also an issue, as the creek water resides in an exposed pond for an unknown time period. The new infrastructure may have 'cooling' infrastructure, but details are scarce. The new infrastructure will also collect water from roofs and yards only, which may improve water quality but further decrease quantity (see below).
2	Reduced Water Quantity	Very High	High	About 2/3 of the Newman Creek drainage basin was diverted directly to the Grand River during earlier development ("Princess Street Catchment"). Further reduction may result from the Cambridge West development in the SWM pond is not correctly engineered with the Newman Creek hydroperiod in mind.
3	Proximity of Development	High	High	Further development will bring more people into

				proximity to the creek. The new trail, fencing and vegetation promised by developers may improve the situation of unauthorized use over current. We are working with the developers to improve the security.

Table 6.11 Sources of stresses to target

Source		Stress 1	Stress 2	Stress 3	Notes
Human Encroachment / Disturbance	Contribution	Med		High	The Cambridge West development will further surround ***rare*** property with urban land use. Exclusion of trespassers from the Hogsback, Neuman Field, and the Newman Creek area is a priority for mitigating effects of development.
	Irreversibility	Very High		Very High	
Decreased Hydroperiod	Contribution		Very High	High	Continued consultation with SWM infrastructure engineers is ongoing, to educate them about the ecology and significance of small streams, and how engineering solutions to loss of water quantity must be central to their design.
	Irreversibility		High	High	
Blair Road Pollution (salt, particulate)	Contribution	High			Road runoff may introduce salt and sediment in the creek. Controlling road traffic and pollution may not be possible while Blair Road remains in use.
	Irreversibility	High			

6.2.4.4 Opportunities

Newman Creek has suffered serious impairment since the development of much of its catchment area prior to the establishment of ***rare***. We have an opportunity with the updating of storm water management infrastructure to manage and improve the hydroperiod for the stream.

6.2.4.5 Recommendations (5 year horizon)

- Continue monitoring of benthic macroinvertebrates, dissolved oxygen, pH, conductivity and temperature as part of regular aquatic monitoring efforts every three years. Of species interest are intermittent-stream specialists, particularly stoneflies and caddisflies, that may have suffered severe habitat loss in southern Ontario, and may represent a conservation opportunity.
- Investigate the feasibility and process for getting a Reduced Salt Zone designation for Blair Road.
- Continue to consult with engineers responsible for SWM pond design, in an effort to stabilize hydroperiod in Newman Creek. Currently, the stream does not have reliable flow later than May, whereas an intermittent stream of that type, supported by groundwater and wetlands in the area might be expected to hold surface water until

mid-July in an average year. Supporting a longer and more reliable hydroperiod will benefit organisms in the stream, some of which may be specialists, adapted to this type of habitat.

6.3 Forested Features

6.3.1 Monitoring

The Toronto and Region Conservation Authority (TRCA) uses a Terrestrial Natural Heritage Approach to assess the terrestrial conditions of its watersheds, using quantity and distribution of natural cover, matrix influence, patch size and shape, and landscape connectivity as indicators of watershed status. On the scale of individual natural habitat patches, the TRCA Landscape Analysis Model (LAM) is used to score each patch based on its size, shape and matrix influence (TRCA 2002). The LAM models matrix influence by assigning scores to the land uses within 2 km of the habitat patch; scores reflect the negative or positive effect that the surrounding land uses will have on the habitat. We have used a simplified version of this analysis and summarized the matrix influence as the primary land uses neighbouring our forest features. We assumed that developed lands such as residential neighbourhoods and aggregate extraction pits have a negative effect on the forest, due to such potential stresses as hydrological disturbance, wildlife displacement, water, noise and light pollution, human encroachment, and introduction of invasive species. Agricultural fields are categorized as having a neutral effect on neighbouring habitat, balancing negative influences such as agricultural runoff, soil degradation and habitat loss against positive influences such as the provision of suitable movement corridors from some species (Environment Canada, 2004). Finally, we assumed that lands in native cover have a positive effect on the forest.

There are a number of other indicators of forest health that could be used, such as, the presence of overwintering bald eagles or breeding interior birds such as the ovenbird, veery, or pileated woodpecker (Ontario Ministry of Natural Resources, 2000a), presence of federally, provincially or regionally significant species, and measures of habitat diversity and old growth indicators such as snags, downed woody debris, tree age, tree size and tip-ups (Mosseler et al., 2001; Stewart et al., 2003). Forest health monitoring using the EMAN protocol is used in plots in ***rare*** forested features. The opportunity exists to establish monitoring programs to evaluate how these indicators change over time. Starting in 2018, ***rare*** has adopted the Vegetation Sampling Protocol (VSP) developed at the University of Toronto in collaboration with the Science and Research Branch at OMNRF (http://forests-settled-urban-landscapes.org/VSP/)) to characterize plant assemblages in our forested areas. Using VSP to inventory and monitor plant communities across ***rare*** is particularly important as climate change and invasive species, such as the emerald ash borer (EAB; *Agrilus planipennis*), alter the composition, structure, and function of native vegetation in our forest systems.

6.3.2 Hogsback Forest

6.3.2.1 Target Description

The Hogsback Forest is located in the southeast part of the property, and it is comprised of mixed swamp interspersed with ridges of upland forest. The Hogsback is one of the most

valuable landscape features of ***rare***. It has been left relatively untouched in both historic and recent times, possibly due to the difficulty of passage through its large wetland. Of the Hogsback's 65 acres of forest, which includes 40 acres of PSW, 45 acres (including 29 acres of the wetland) are located on ***rare*** property. The cool-water Cruickston Creek exits this swamp along a wooded corridor and flows north across Blair Road to the Grand River through the Cliffs and Alvars forest. The forest lowlands are characterized in the ELC as yellow birch organic deciduous swamp, which is interspersed and abutted by rolling uplands of mature dry-fresh sugar maple - white ash deciduous forest (Figure 4.1). The Cruickston Creek corridor at the north end of the Hogsback is classified as Fresh-Moist Oak Hardwood Deciduous Forest. Because Cruickston Creek has its source in the Hogsback forest, any stresses and threats to the Hogsback are also considered stresses and threats to Cruickston Creek.

The Hogsback is surrounded on most sides by agricultural fields, and the Newman Drive subdivision lies to its east. The former agricultural fields immediately east and west of the Cruickston Creek just north of the Hogsback have undergone restoration efforts; the entire six acre field to the east and eight acres to the west were removed from agricultural production between 2003 and 2006 and have been left to naturalize. Native trees have been planted on both east and west sides of the creek. Beginning in 2014, a campaign of buckthorn removal and native plantings of trees, shrubs, and forbs was undertaken around the entire perimeter of the Hogsback that is on ***rare*** property. This project was completed in 2016, and monitoring of the plantings and the resurgence of buckthorn populations are ongoing. Conventional agriculture is still conducted in the field west of the creek.

Two new subdivisions (Cambridge West and adjacent land in North Dumfries), totalling an estimated 2000 new dwellings, have been largely approved and construction is imminent to the east and southeast of the Hogsback. This development raises issues of increased human encroachment and its associated pressures (i.e. trespassing, unauthorized trails, litter and dumping, motor vehicles, poaching of wild organisms), increased invasive plant pressure, and changes in quality and quantity of water supplied to the wetland and Cruickston Creek due to increases impervious surfaces, salt and fertilizer use, etc. The fencing and proximity of human dwellings may reduce some of these trespasses, and ***rare*** is working closely with the developers of Cambridge West to ensure that fencing and plantings will be sufficient to deter unauthorized access. The developers have also agreed to donate the remainder of the Hogsback feature on their property (approximately 87 acres), which will be added to the main property at ***rare***.

6.3.2.2 Target Viability

Table 6.9 Variation in indicator values for key attributes related to target viability. Bolded values indicate the value of the indicator observed at ***rare***. Asterisks indicate that on at least one occasion, a value that falls outside of the acceptable range has been recorded.

Key Attribute	Indicator	Poor	Fair	Good	Very Good	Range Source
Forest Size	Forest Area (ha)	<10	**10-50**	50-250	>250	Toronto and Region Conservation Authority, 2007.
	Wetland Area (ha)	<3	3-10	10-20	**>20**	Toronto and Region

						Conservation Authority, 2007.
	Forest Interior Area (ha)	0	**<40**	40-100	>100	Ontario Ministry of Natural Resources, 2000b.
Habitat Matrix & Connectivity	Minimum Corridor Width (m)	0	**<50**	50-100	>100	Environment Canada, 2004.
	Primary Use of Neighbouring Lands	**Developed (Urban, Mineral Extraction)**	**Agricultural**	**Native Cover**		Toronto and Region Conservation Authority, 2007.
Invasive Plant Species Dominance	Invasives among dominant plant species in ELC communities?	Yes		**No**		

The influence of non-native plant species has been summarized here based on whether invasive exotic species were present among the most dominant species recorded during Ecological Land Classification.

6.3.2.3 Threats to Target

Table 6.10 Target stresses

Stresses	Altered Key Ecological Attribute	Severity	Scope	Notes
1	Presence of Invasive Species	High	High	Buckthorn (Common and Glossy) is among the understory species in all ELC polygons that comprise the Hogsback, but are mostly in the edge areas. Other invasive plants (i.e. Lily-of-the-Valley, Japanese Barberry) occur in isolated pockets.
2	Physical Disturbance to Flora and Fauna	Medium	Medium	Many neighbouring fields are farmed right to the forest edge. Buffers were planted to a width of 15m in 2014-2016on the west and north sides. The agricultural fields to the east and south are scheduled for residential development, which currently provides for a 30m buffer. Human encroachment in the Hogsback includes trails, dumping, hunting, motorized and non-motorized vehicles and fort construction, and severity may increase in the future. Browsing by the large deer population may suppress understory plant growth.
3	Isolation from Other Natural Features	Medium	High	There are high quality habitat patches within 2km of the Hogsback, but they are generally separated by agricultural lands and Blair Road. It is a long-term plan to plant a forest corridor to connect the Hogsback with Indian Woods (Section 6.3.4).
4	Hydrological Disturbance	High	Very High	Degradation of Hogsback wetland and groundwater supply would affect Cruickston Creek and Grand River. General hydrology studies were completed for the ***rare*** property by Hunter and Associates in 2003, although the report was not acquired until 2016.

5	Noise Pollution	Low	High	Noise from aggregate operations, Blair Road and nearby residential developments can be heard throughout the forest.

Table 6.11 Sources of stresses to target

Source		Stress 1	Stress 2	Stress 3	Stress 4	Stress 5	Notes
Human Encroachment / Disturbance	Contribution	Medium	High				Trails, dumping, structures and firepits are present in the upland sections of the forest. Disturbance could encourage invasion by exotic plant species.
	Irreversibility	High	Medium				
Proximity to Conventional Agriculture	Contribution		Medium	Medium	Medium		Forest contiguous with several agricultural fields with few corridors of natural cover. Disturbance caused by agriculture could include pollution from pesticides and fertilizers, and soil and hydrological disruption. Agricultural fields to the south and east will be developed into residential use.
	Irreversibility		Medium	Medium	High		
Proximity of Developed Lands	Contribution			High	High	Very High	Hogsback is near to Newman Drive subdivision, roads and gravel pits, all of which may be contributing air, water and noise pollution, as well as barriers to wildlife movement.
	Irreversibility			Very High	Very High	Very High	

6.3.2.4 Opportunities

The health of Cruickston Creek, particularly in its upper reaches, serves as an indicator of the conditions in the Hogsback. A public relations and enforcement strategy should be developed to mitigate unauthorized access and human encroachment in the Hogsback. Continued, meaningful consultation with City of Cambridge planning staff, the developers, West Galt Neighbourhood Protection Association (NPA; established January 2014), and Cambridge Heritage Groups, and other private landowners throughout the subdivision application process will be critical in protecting the long term health of Cruickston Creek and the Hogsback. Three approaches are planned, and have been agreed to by the developers of the subdivision.

- Construction of a trail from the area north of the storm water pond through Neuman Field, across the footbridge at Cruickston Creek and along old Blair Road to the parking

lot at Springbank Farmhouse. The trail will pass down the eastern edge of Neuman Field, with the intent of keeping hikers away from the Hogsback.

- Fencing at the back of yards that are adjacent to the Hogsback. The developers have agreed to include a clause in their sales agreement, which home buyers must sign, that describes ***rare*** and disallow installation of gates etc that would allow access to our property
- The developers, as part of their required restoration of the hedgerows and forest edge areas, have agreed to plant vegetation that will discourage trespassing in unfenced areas. This could include native species of *Rubus*, *Crataegus, Zanthoxylum*, etc appropriate to the area.

The habitat patch size of the Hogsback could be increased through passive regeneration, which would include the retirement of neighbouring agricultural land, and by active restoration, which could include planting of native seeds, seedlings, trees and shrubs, creation of pit and mound micro-topography etc. Depending on its location, this restoration could also increase forest interior area. Connectivity between the Hogsback and Indian Woods/Sparrow Field could be improved by the creation of a corridor of native vegetation between the two features. The corridor should be a minimum of 50 to 100 meters wide to provide a viable passageway for species movement (Environment Canada, 2004). Restoration of the edge of the Hogsback adjacent to the Cambridge West development is also anticipated, to be carried out by the developer (Huron Creek Holdings) under ***rare*** guidance. The planting of suitable native vegetation can discourage trespass and encroachment associated with residential development.

6.3.2.5 Recommendations (5-year horizon)

- Continue to work with developers on a mitigation plan to address the unauthorized access from Newman Drive and new Cambridge West subdivisions. Planting of appropriate native vegetation to discourage access and working with new home owners on rules related to living next to ***rare***.
- There is potential to expand the protected area of the Hogsback feature via an EcoGift of 87 acres of forest and wetland between ***rare*** property and Roseville Road ("Hogsback South").
- Connect the Hogsback with the Indian Woods/Sparrow Field natural feature by creating a wide corridor of native vegetation through passive regeneration or active restoration. The hedgerow leading from the Hogsback to Springbank farm could be widened to a minimum width of 50 meters (Environment Canada, 2004). Because this hedgerow is on the border of the ***rare*** property, it is necessary to confine attention to its south side. Consider including human food plants and pollinator support ('fedges').
- Continue buckthorn monitoring, focus on less widespread invasives such as Japanese barberry, Lily-of-the-valley.
- Repeat Vegetation Sample Protocol every five years.

6.3.3 Cliffs Forest

6.3.3.1 Target Description

The Cliffs Forest sits atop the reef-formed limestone outcrops along the south shoreline of the Grand River, containing canopied interior cliffs that give way to pitted limestone plains and alvars. A fern-dominated plant community exists along the cliff faces with associated rim flora that includes very old eastern white cedar and eastern hemlock, assemblages which are similar to the ancient cedar forests along the Niagara Escarpment. The large trees along the cliffs at the river's edge have been popular perching spots for overwintering bald eagles since the mid-1990s; a ten year volunteer project monitoring the area's winter bald eagle population concluded in 2011. The treed limestone plain has both mature and mid-successional deciduous forest with diversity of vegetative community types and smaller areas of shrubland and marsh (Figure 4.1). The spring ephemeral wildflower display along the River Trail is one of the recreational highlights at ***rare***. A number of hiking trails traverse the Cliffs Forest, including the River Trail, which follows the Grand River along the cliff-top, the Woodland Trail, which runs north-south and connects the River trail to the Grand Trunk Trail, the Alvar trail, which connects the eastern portion of the River Trail to the Woodland Trail, and the Osprey Loop which connects the Grand Trunk Trail to the western end of the River Trail. There are also a number of smaller, unsanctioned footpaths that fragment the forest and require closure and rehabilitation. The Grand Trunk Trail (a rail trail that traverses the southern portion of the Cliffs and Alvars) is maintained by the City of Cambridge. The Cliffs Forest contains the lower reaches of Newman Creek and Cruickston Creek, which have undefined channels in places. Cruickston Creek also splits into two paths in this area. There are also several unnamed ephemeral streams.

6.3.3.2 Target Viability

The Cliffs Forest is well connected to natural features in its immediate vicinity (Blair Flats, Cruickston Creek corridor and the Hogsback), however the lands directly across the river from it and to its east are developed as residential neighbourhoods. Given this combination of positive and negative neighbouring land uses, we take the landscape matrix influence on the Cliffs Forest as fair. Some baseline data already exist for the Cliffs Forest (***rare*** EMAN and VSP monitoring, breeding bird survey data and Ecological Land Classification (NRSI 2011)).

Table 6.12 Variation in indicator values for key attributes related to target viability. Bolded values indicate the value of the indicator observed at ***rare***. Asterisks indicate that on at least one occasion, a value that falls outside of the acceptable range has been recorded.

Key Attribute	Indicator	Poor	Fair	Good	Very Good	Range Source
Forest Size	Forest area (ha)	<10	10-50	**50-250**	>250	Toronto and Region Conservation Authority, 2007
	Wetland area (ha)	<3	3-10	**10-20**	>20	Toronto and Region Conservation Authority, 2007
	Forest interior area (ha)	0	**<40**	40-100	>100	Ontario Ministry of Natural Resources,

						2000b
Habitat Matrix & Connectivity	Minimum Corridor Width (m)	0	**<50**	50-100	>100	Environment Canada, 2004.
	Primary Use of Neighbouring Lands	Developed	**Agricultural**	**Native Cover**		Toronto and Region Conservation Authority, 2007
Invasive Plant Species Dominance	Invasives among dominant plant species in ELC communities?	**Yes**		No		

6.3.3.3 Threats to Target

Table 6.13 Target stresses

Stresses	Altered Key Ecological Attribute	Severity	Scope	Notes
1	Presence of Invasive Species	High	Very High	Buckthorn (Common and Glossy) is very common throughout the Cliffs Forest, and the shrublands on the margins of the forest are strongly dominated by buckthorn. Invasive Tartarian honeysuckle, barnyard grass, and Scots pine are also common within the Cliffs Forest. Garlic Mustard and Greater Celandine are found in the area of the Cliffs themselves.
2	Physical Disturbance to Flora and Fauna	High	Medium	Human encroachment in the Cliffs Forest includes unauthorized trail formation, mountain biking, off-leash dogs, plant harvesting, poaching, campfires and squatting (camping). Browsing by the large deer population may suppress understory plant growth.
3	Isolation from Other Natural Features	Medium	High	The north side of the Grand River is completely developed, as are the lands to the east along Blair Road. The forest is contiguous with the Blair Flats. Blair Road lies between the Cliffs Forest and the other natural features on the ***rare*** property.
4	Hydrological Disturbance	Medium	Medium	Hydrology was studied for the entire ***rare*** property in 2003, but the report was not acquired until 2016 (Hunter and Associates 2016). Cruickston wetland and groundwater supply caused by nearby development would affect Cruickston and Newman Creeks which in turn would affect the hydrology of the Cliffs Forest and the water quality of the Grand River. Newman Creek currently has its source in a stormwater management pond west of the Newman Road subdivision. This pond is scheduled for renovation and enlargement during the next phase of development, results are uncertain at this time.
5	Noise Pollution	Low	High	Noise from Blair Road, train traffic, urban areas of Preston and the adjacent residential developments can be heard throughout the forest.

Table 6.14 Sources of stresses to target

Source		Stress 1	Stress 2	Stress 3	Stress 4	Stress 5	Notes
Human Encroachment / Disturbance	Contribution	Medium	Very High				Unauthorized trails, firepits, structures and off-trail-use commonly occur along the cliffs. Disturbance could encourage invasion by exotic plant species or disturb wildlife and sensitive flora.
	Irreversibility	High	Medium				
Proximity of Developed Lands	Contribution			High		Very High	Cliffs Forest is across the Grand River from Preston, and adjacent to a residential neighbourhood. Nearby subdivisions, roads, gravel pits, and agricultural lands may all be contributing air, water and noise pollution, as well as barriers to wildlife movement.
	Irreversibility			Very High		Very High	
Proposed Residential Development	Contribution			Medium	Very High	Very High	Potential Threat - Residential development is proposed adjacent to Hogsback on its east side. Development could disrupt or degrade the water supply to Cruickston Creek, Newman Creek and subsequently the PSWs and the Grand River.
	Irreversibility			Very High	Very High	Very High	

6.3.3.4 Opportunities

The health of Cruickston Creek and Newman Creek can serve as partial indicators of the conditions in the Cliffs Forest. Given the intermittent nature of Cruickston and Newman Creeks as they pass over the fractured solution-cavitied limestone of the Cliffs and Alvars area, the hydrology of these watercourses is not yet fully understood. Approximately 2 km of unauthorized trails pass through the Cliffs and Alvars region of the property, reducing the area

of undisturbed forest available to sensitive flora and fauna. Access to these trails should be blocked and the pathway may require rehabilitation to encourage re-vegetation by native forest species. Possible restoration activities required to achieve the goal of native regeneration may include the scarification of the unauthorized trail surface to encourage vegetative growth, seeding with native forest plant species to limit invasion by alien species, and invasive plant species removal or management. However, several failed rehabilitation efforts has shown that the best approach is physical blockage of the trail using the abundance of non-native shrubs in the area. A particular problem area is the steeply sloping trail leading down to the river, where part of the authorized River Trail is eroding and creating a hazard. Painted trail blazes have been added to authorized trails in an attempt to improve way finding.

A public relations and enforcement strategy should be developed to mitigate unauthorized trail use and human encroachment in the Cliffs Forest. Student projects by Wilfrid Laurier University "Psychology and the Environment" course in 2011, and the University of Guelph (Bottke et al. 2015), will inform our future efforts to gain compliance from visitors, and how best to educate them about ***rare*** and its mission. Should destructive encroachment continue in the future, ***rare*** could pursue legal enforcement of trail regulations through the Trespass to Property Act.

Consultation with City of Cambridge Planning staff and the developers throughout the Cambridge West subdivision application process will be critical in protecting the long term health and functioning of Cruickston and Newman Creeks. There are regulated Species at Risk in the area that must be protected at ***rare*** in accordance with the Species at Risk Act and the Endangered Species Act.

6.3.3.5 Recommendations (5 year horizon)

- Continue to close and rehabilitate unauthorized trails within the Cliffs Forest. Trail closures should include explanatory signage, monitoring and enforcement. Trail rehabilitation may include native plantings and invasive plant species management. In the past, trail closure and planting activities have been largely unsuccessful due to persistent vandalism. Efforts to close these trails and others will be pursued more aggressively in the future using different methods. There are also some safety considerations on the River Trail that need to be addressed where it approaches the cliffs and lookouts.
- Develop an impact mitigation plan to address unauthorized trail use and human encroachment. This plan should include public outreach, increased staff and volunteer presence on the trails and, if necessary, legal enforcement of trail regulations.
- An Invasive Species Management Plan will be updated for several problem invasive plant species in the Cliffs Forest in 2019. Specifically, control is needed for the buckthorn-dominated shrub thickets on the margins of the Cliffs Forest with the goal of increasing native vegetative cover in these communities.
- Repeat VSP every 5 years.

6.3.4 Indian Woods & Thompson Tract

6.3.4.1 Target Description

Indian Woods is located east of the Grand Allée on the west side of the reserve, south of Blair Road. It is considered by many to be the "jewel in the crown" of ***rare*** because of its old-growth conditions, which are now uncommon in southwestern Ontario (less than .07%; Ontario Nature). Indian Woods is contiguous to Manor Woods, Slope Woods, the deciduous swamp containing Bauman Creek, and the plantations on the Thompson Tract. The area of contiguous natural forest cover on ***rare*** property west of Brewery Lane totals approximately 23.2 hectares, containing approximately 5.7 hectares of Provincially Significant Wetland belonging to the Barrie's Lake – Bauman Creek Wetland Complex. Indian Woods is home to more than a dozen species of birds (i.e. Red-breasted nuthatch, Great crested flycatcher, Wood thrush) that are dependent upon its very large, old trees with cavitied trunks and branches, decaying windfalls, swamp, and sunlit forest gaps. The ponds and vernal pools attract wood ducks and provide spring habitat for eight species of frogs and four salamander species.

The upland deciduous forest part of Indian Woods is classified in the Ecological Land Classification as dry-fresh sugar maple – oak deciduous forest (Figure 4.1), and the lowland forest containing the Bauman Creek headwaters and wetland is classified as yellow birch mineral deciduous swamp. In December 2010, ***rare*** purchased the Thompson Tract, a 93 acre parcel which contains a significant portion of the upper Bauman Creek catchment. Stresses and threats to the Indian Woods forest area are also considered stresses and threats to Bauman Creek (section 6.2.3).

The Indian Woods forest area is bordered to the north and north-east by wooded land (forest and plantation), with the Langdon Hall property to the north-west and other private property to the north-east. The former agricultural field immediately south of Indian Woods has undergone restoration efforts, with sections being retired from agriculture to regenerate naturally since 2007. The last farmed section of Sparrow Field (Figure 2.1) was taken out of cultivation in spring 2012. Conventional agriculture is still conducted on the manor property.

6.3.4.2 Target Viability

Indian Woods is fairly well connected to other natural features in its immediate vicinity, including the naturalizing plantations on the Thompson Tract, Sparrow Field, Slope Woods and the Manor Woods. The Bauman Creek corridor connects the Indian Woods forest area to the Blair Flats, however Blair Road may present a barrier to movement for many species. Outside the ***rare*** property, lands near to the Indian Woods forest are generally either in agriculture or aggregate extraction. Given this combination of neighbouring land uses, we assume that the landscape matrix influence on the Indian Woods forest area is fair to good. Restoration of the Thompson Tract plantations will be ongoing, after thinning and some planting has occurred these areas are returning to a more naturalized state. Additional thinning may occur in the future. There are persistent problems in this area with dumping, especially near the trail heads, off-leash dogs and dog waste.

Table 6.15 Variation of indicator values for key attributes related to target viability. Bolded values indicate the value of the indicator observed at ***rare***. Asterisks indicate that on at least one occasion, a value that falls outside of the acceptable range has been recorded.

Key Attribute	Indicator	Poor	Fair	Good	Very Good	Range Source
Forest Size	Forest area (ha)	<10	**10-50**	50-250	>250	Toronto and Region Conservation Authority, 2007
	Wetland area (ha)	<3	**3-10**	10-20	>20	Toronto and Region Conservation Authority, 2007
	Forest interior area (ha)	0	**<40**	40-100	>100	Ontario Ministry of Natural Resources, 2000b
Habitat Matrix & Connectivity	Minimum Corridor Width (m)	0	**<50**	50-100	>100	Environment Canada, 2004.
	Primary Use of Neighbouring Lands	Developed	**Agricultural**	**Native Cover**		Toronto and Region Conservation Authority, 2007
Invasive Plant Species Dominance	Invasives among dominant plant species in ELC communities?	Yes		**No**		

6.3.4.3 Threats to Target

Table 6.16 Target stresses

Stresses	Altered Key Ecological Attribute	Severity	Scope	Notes
1	Presence of Invasive Species	High	High	Common buckthorn is abundant in swamp understory. Garlic mustard is abundant in upland ground layer of Indian Woods.
2	Physical Disturbance to Flora and Fauna	Medium	Low	Human encroachment previously observed in the Indian Woods area includes off-leash dogs, off-trail use, plant/mushroom harvesting, and dirt biking. The Grand Allée (authorized) passes beside Indian Woods; no unauthorized trails are known. Browsing by the large deer population may suppress understory plant growth. One neighbouring field is farmed to the forest drip line.
3	Isolation from Other Natural Features	Medium	High	The Indian Woods forest area connects without barriers to Sparrow Field, Manor woods and Slope woods, as well as to the Thompson Tract, which contains some naturalizing plantations of native trees. The Indian Woods forest area is separated from the Blair Flats and Cliffs and Alvars natural cover by Blair Road and it is separated from the Hogsback by a large agricultural field.
4	Hydrological Disturbance	Medium	Medium	Hydrology has not yet been studied for this target. However, any alterations to wetland water quantity and quality would affect Bauman Creek. Hydrological conditions may be affected by nearby aggregate

				operations. Increased surface flow and sediment load from adjacent agricultural field may occur.
5	Energy (Noise and Light) Pollution	Low	High	Noise and light from aggregate operations, Blair Road, neighbouring houses and nearby farming operations can be heard and seen throughout the forest.

Table 6.17 Sources of stresses to target

Source		Stress 1	Stress 2	Stress 3	Stress 4	Stress 5	Notes
Human Encroachment / Disturbance	Contribution	Med.	High			Low	The Grand Allée (authorized) passes through Indian Woods forest area, and some unauthorized use occurs (off-trail, off-leash dogs, horseback riders, dirt bikes, foraging). Disturbance could encourage invasion by exotic plant species or disturb wildlife and sensitive flora.
	Irreversibility	High	Med.			Low	
Proximity of Conventional Agriculture	Contribution	Low	Med.	Med.	Med.	Low	The forest is neighboured by agricultural fields to its east (Indian Woods Field) and to its south. Disturbance caused by agriculture could include pollution from pesticides and fertilizers, and soil and hydrological disruption.
	Irreversibility	High	Med.	High	High	Low	
Proximity of Developed Lands	Contribution	Low		Low	Low	Low	Nearby residential development is small scale (Manor property, Langdon Road area). Could be contributing mild water, noise and light pollution, as well as barriers to wildlife movement
	Irreversibility	High		Very High	High	High	
Aggregate Extraction on Neighbouring Lands	Contribution			High	Very High	Very High	Aggregate extraction on property south of Thompson Tract has recently begun. The pit across Langdon Road from Maple Lane was reopened in winter 2011/2012. Aggregate extraction on nearby properties could impact the water input (quantity/quality) into
	Irreversibility			High	Very High	Very High	

							Bauman Creek and the swamp. The operations may contribute noise and light pollution and create a barrier to wildlife movement. The opening of new pits could displace wildlife while reducing native cover in the area.

6.3.4.4 Opportunities

The Indian Woods forest area provides a fairly uncommon example of natural old-growth forest in southern Ontario. The Indian Woods section of the forest was spared from management or harvesting, and is not thought to require restoration as much as protection from human encroachment. The health of Bauman Creek, particularly in its upper reaches, serves as an indicator of the conditions in Indian Woods and its surrounding forests. Connectivity between the Hogsback and Indian Woods could be improved by the creation of a corridor of native vegetation between the two features. The corridor should be a minimum of 50 to 100 meters wide to provide a viable passageway for species movement (Environment Canada, 2004). In the long term, development of such a corridor across Sparrow Field (retired from agriculture) and Middle Field (still in conventional agriculture) is a priority.

The impacts associated with trail-use appear to be less severe in the Indian Woods forest area compared to the Cliffs Forest, and there are currently no known unauthorized trails. However, we need to enforce our regulations regarding foraging, off-trail use, off-leash dogs and motor vehicles. New interpretive signage installed in 2017 includes posted trail regulations.

6.3.4.5 Recommendations (5 year horizon)

- Develop a visitor impact mitigation plan to address trail misuse in the Indian Woods forest area. This plan should include public outreach, increased staff and volunteer presence on the trails and, if necessary, legal enforcement of trail regulations. Develop a new trail map for the Thompson Tract and Indian Woods area, and expand trail user survey activities to include this area.
- Connect the Hogsback with Indian Woods by creating a wide corridor of native forest vegetation through passive regeneration or active restoration. Dedicated invasive species management in this corridor and the hedgerow surrounding south Grand Allee. Dense populations of Buckthorn, Autumn Olive, and Barberry have potential to spread quickly along this planted corridor if not adequately controlled.
- Meet with the other owners of the deciduous forest contiguous with Indian Woods to discuss target objectives and shared conservation responsibilities.
- Continue the naturalization of the Thompson Tract plantations. Continued thinning and planting efforts will be required for the purposes of restoration, and possibly earn money from sale of superfluous trees logged using ecologically sound methods.
- Repeat VSP every 5 years.

6.3.5 Eastern Plantation and Adjacent Forest

6.3.5.1 Target Description

This is an area of roughly triangular shape, approximately 19 acres, bounded to the west by Newman Creek, to the north by Blair Road, and to the south by residences on Newman Drive. It is at the extreme eastern end of the ***rare*** property. It is connected to the Hogsback forest to the west by the hedgerow along the south edge of Neuman Field. Until approximately 1980 this was an agricultural field, then most was turned into a tree plantation. Currently there are two areas of pine plantation (5.2 acres and 4.2 acres) and a spruce plantation (2.4 acres). The plantations are separated by areas of naturalized forest and meadow. The forested riparian corridor of Newman Creek forms the western boundary. The plantations have had no maintenance in quite some time, and are very dense with little vegetation in the heavily shaded understory. The possibility of having the pine commercially thinned has been suggested as a possible revenue source, as the trees are deemed high quality for such uses as furniture or flooring.

Although there are no wetlands delineated in the area, the terrain is wet and difficult to move through. The difficulty of the terrain has meant that trespassing and littering are lower than on some areas of the property, despite the proximity of residential development. As with most of the eastern end of ***rare***, the Cambridge West development will bring a large number of new residents into contact with the conservation lands. There has been some encroachment from neighbouring residences, such as discarding yard waste and litter onto ***rare*** property, which in some cases has resulted in clear nodes of invasive species establishment.

6.3.5.2 Target Viability

This is a small area that is highly impacted by development, albeit with the difficulty of the terrain excluding some forms of human impact. As the planned restoration of Newman Creek proceeds, more attention should be paid to thinning and naturalizing the forest plantations. Continued vigilance is required to manage dumping and encroachment from certain Newman Drive residences.

Table 6.18 Variation of indicator values for key attributes related to target viability. Bolded values indicate the value of the indicator observed at ***rare***. Asterisks indicate that on at least one occasion, a value that falls outside of the acceptable range has been recorded.

Key Attribute	Indicator	Poor	Fair	Good	Very Good	Range Source
Forest Size	Forest area (ha)	**<10**	10-50	50-250	>250	Toronto and Region Conservation Authority, 2007
	Wetland area (ha)	**<3**	3-10	10-20	>20	Toronto and Region Conservation Authority, 2007
	Forest interior area (ha)	**0**	<40	40-100	>100	Ontario Ministry of Natural Resources, 2000b
Habitat Matrix &	Minimum Corridor	0	**<50**	50-100	>100	Environment

Connectivity	Width (m)					Canada, 2004.
	Primary Use of Neighbouring Lands	**Developed**	Agricultural	**Native Cover**		Toronto and Region Conservation Authority, 2007
Invasive Plant Species Dominance	Invasives among dominant plant species in ELC communities?	Yes		**No**		

6.3.4.3 Threats to Target

Table 6.19 Target stresses

Stresses	Altered Key Ecological Attribute	Severity	Scope	Notes
1	Presence of Invasive Species	High	High	Invasive species that have encroached through backyards into the eastern plantation include buckthorn, garlic mustard, periwinkle, and most notably Japanese Knotweed. Common buckthorn is abundant in some areas, particularly outside of the plantation.
2	Physical Disturbance to Flora and Fauna	Medium	Low	Some trespass and encroachment from neighbouring homes. Recreation (cycling and motor vehicles) and hunting have been recorded in this area.
3	Isolation from Other Natural Features	Medium	High	The feature is not well connected with other natural areas, with the exception of the western side. Neuman Field and the Hogsback lie to the west, there are plans to augment the hedgerow that connects the forested area as part of development-related offsets.
4	Hydrological Disturbance	Medium	Medium	This feature includes some wetland, and the riparian corridor of Newman Creek along its western edge. Much of the water that would have entered this area has been diverted by development (Hunter and Associates 2016)
5	Energy (Noise and Light) Pollution	Medium	High	This narrow area is surrounded on two sides by development, and on the north by Blair Rd.

Table 6.20 Sources of stresses to target

Source		Stress 1	Stress 2	Stress 3	Stress 4	Stress 5	Notes
Human Encroachment / Disturbance	Contribution	Med.	Med.			Low	Proximity to human development and lack of interior space
	Irreversibility	High	Med.			Low	
Proximity of Conventional Agriculture	Contribution						Nearby fields have been retired from agriculture

	Irreversibility						
Proximity of Developed Lands	Contribution	Med.	Med.	Med.	High	Low	Every aspect of this area is defined by the surrounding, and increasing, development
	Irreversibility	High	Med.	Very High	High	High	
Aggregate Extraction on Neighbouring Lands	Contribution						No aggregate operations in the immediate vicinity
	Irreversibility						

6.3.5.4 Opportunities

Through collaboration with Huron Creek Holdings, ***rare*** will host some of the offset plantings that they are required to complete, to improve connection to Hogsback by increasing the corridor width of the hedgerow at the south edge of Neuman Field. Despite issues with some homeowners backing on our property, we've created many positive connections with community members as well. Consider a regular (annual?) invasive species management event focused specifically on the areas behind people's backyards, marketed to members of this subdivision. We could do education about backyard invasives, form some connections, and create a social pressure on others to improve their behaviour.

6.3.5.5 Recommendations (5 year horizon)

- Although this part of the property is very difficult to move through, encroachment remains an issue. Dumping and recreational activities are significant. Many neighbours are supportive of ***rare***, and some even offer to help with invasives control adjacent to their property.
- Common buckthorn is the most common invasive in this forest, generally in the non-plantation areas. Due to poor landscaping hygiene by a neighbour (39 Newman Drive), Japanese Knotweed has become established in the area. This property has recently been sold, approach new owners about helping them eradicate the plant.
- Explore the possibilities of plantation thinning, which has not been carried out since they were planted in the early 1980s. There is a possibility of the pine being saleable within the next five years, which could gain revenue for ***rare*** and have the area professionally thinned.
- Monitor effects of development, including the new trail connecting the storm water infrastructure upstream of Newman Pond to the Springbank Farm area.

6.4 Open Spaces

Most of the open spaces on ***rare*** property are current or former agricultural fields, with a history of both pasture and row cropping (see Appendix, Figure I.1). Some areas are also active floodplains and serve an important functional role in the ecology of the Grand River, and several major flooding events that have resulted in closure of adjacent roads have occurred in recent years. Apart from ongoing efforts to document and control invasive species, a wide variety of activities are occurring in the open spaces. While not actively opposing natural successional processes, ***rare*** perceives the importance of open spaces in the landscape matrix. Many of the natural processes that maintain open space habitats, most notably fire, are suppressed in the urban environment, with only occasional (and expensive) prescribed burns permitted in select areas. There is also a tendency to perceive restoration in open spaces as establishment of forest habitat, with active tree planting an important method to acquire restoration funding and engage the community. Current land use of ***rare's*** open spaces include conventional row crops (Fields 303 and 308, also known as Middle Field), hay fields (Preston Flats and South Field), tallgrass prairie restoration research sites (Blair Flats West and Sparrow Field) and naturalized space (Blair Flats East, Cruickston/Neuman Field, Crabapple Field, much of Springbank Farm). VSP will be completed in open areas in 2020 and 2021, and repeated on a 5-year cycle.

6.4.1 Sparrow Field

6.4.1.1 Target Description

Sparrow Field (see Figure 2.1) is a former agricultural field of approximately 51 acres, of which 25.5 acres is devoted to a University of Guelph tallgrass prairie research site, that was retired from cultivation in 2009. The tallgrass vegetation is mowed in patches of various sizes, and has been maintained since the completion of the original research project in 2015. In addition to the research plots, the field also has naturalized buffer along the western and northern edge, which has been showing a tendency to return to forest. Natural seedling recruitment from the adjacent forests have been augmented by tree planting, and removal of a serious infestation of common buckthorn in an effort to improve hedgerows around Sparrow Field, edge habitat of Indian Woods and the vegetation adjacent to the Grand Allée trail. Eventually, buffer plantings will be extended across Middle Field to connect with the Hogsback, and result in a forested corridor.

6.4.1.2 Target Viability

Sparrow Field has become important habitat and a productive research site at ***rare***. If prairie vegetation is to be maintained in a portion of the field, a prescribed burn will have to occur. This could also help address the buckthorn infestation. Red fescue has occurred in part of the field (north-east), and control attempted using herbicide by the University of Guelph researcher (A. MacDougall).

Table 6.21 Variation of indicator values for key attributes related to target viability. Bolded values indicate the value of the indicator observed at ***rare***. Asterisks indicate that on at least one occasion, a value that falls outside of the acceptable range has been recorded.

Key Attribute	Indicator	Poor	Fair	Good	Very Good
Size	Open Space Area (ha)	<2	2-5	**5-20**	>20
Land Use	Primary Use of Neighbouring Lands	Developed (Urban, Mineral Extraction)	Agriculture	**Naturalized Meadow**	**Native Cover**
Invasive Plant Species Dominance	Invasives among dominant plant species in ELC communities?	Yes		**No**	

6.4.1.3 Threats to Target

Table 6.22 Target stresses

Stresses	Altered Key Ecological Attribute	Severity	Scope	Notes
1	Presence of Invasive Species	Low	Low	Some non-native species are present outside the research plots, including some that can be problematic invasives (i.e. creeping red fescue, *Festuca rubra*). The research plots themselves consist of native prairie species or crop plants, depending on the research project.
2	Physical Disturbance to Flora and Fauna	Low	Low	As a research plot, parts of the field are subject to annual mowing. Periodic intrusion by motor vehicles, such as dirt bikes and snowmobiles.
3	Energy (Noise and Light) Pollution	Low	Low	This field is one of the furthest areas from sources of noise and light pollution on the property. We will continue to advocate to minimize additional sources of light, such as in the Cambridge West housing development.

Table 6.23 Sources of stresses to target

Source		Stress 1	Stress 2	Stress 3	Notes
Human Encroachment/ Disturbance	Contribution	Low	Low		Some unauthorized use in this area occurs, which can compromise wildlife use and the research project
	Irreversibility	Low	Low		
Proximity of Conventional Agriculture	Contribution			Low	Conventional agriculture remains in the 54 acre field to the east. This field is expected to be restored in the future to open space and a forest corridor connection between the Hogsback and Indian Woods.
	Irreversibility			Low	
Proximity of Developed Lands, including aggregate extraction	Contribution			Med.	Numerous gravel pits in the area, notably on adjacent land to the west and southwest, can contribute noise and dust while in operation.
	Irreversibility			High	

6.4.1.4 Opportunities

The restoration of Sparrow Field from conventional agriculture use was a two-step process, with uncontrolled naturalization followed by seeding of the tallgrass prairie research plots. It is scheduled to continue for the foreseeable future. The remainder of the field is showing a tendency to naturalize to forest, which could benefit Indian Woods by improving edge habitat. In recent years there have been efforts to guide this process by removing invasives and planting native species, largely through the TD Tree Days program. This relationship should continue, with the goal to create a forested corridor at least 50m wide between the Hogsback and Indian Woods.

6.4.1.5 Recommendations (5 year horizon)

- Since this is a tallgrass prairie research site, it could benefit from periodic prescribed burning, which would also improve control of non-native species without herbicide use. This would need to be carried out in coordination with the University of Guelph researcher responsible for management of the project.
- Continue buckthorn control and edge augmentation of Indian Woods, including management of the hedgerow adjacent to the Grand Allee. Continue trials of Garlon RTU herbicide on buckthorn in the Grand Allee hedgerow.
- Improvement of Indian Woods edge habitat and tree planting at the edge of Sparrow Field will be the initial stage of expanding forest habitat into the corridor across Middle Field that will connect the Hogsback and Indian Woods.
- Complete Vegetation Sampling Protocol surveys.

6.4.2 Blair Flats

6.4.2.1 Target Description

Blair Flats is a large (117 acres) active floodplain of the Grand River. It has a long agricultural history, with forage crops, row crops, and livestock all having been produced in this area. It also has numerous archaeological sites which require protection. In 2009, Blair Flats was retired from agriculture. Together with Preston Flats, it forms part of ***rare*** that surrounds the confluence of the Speed and Grand Rivers, a highly important area for migratory waterfowl and other wildlife. In recent years Blair Flats has been inundated on several occasions, regularly during spring thaw and irregularly resulting from ice jams in winter, or large storm events in summer, with several flood events resulting in closure of Blair Road. The feature has a very high value to the community as green infrastructure for flood mitigation.

The western portion includes the 44.5 acres that was planted in tallgrass prairie as a University of Guelph research site, and study continues there currently. This part of Blair Flats was burned in 2015, and another burn is expected within the next year or two. The remainder was allowed to naturalize, and currently supports meadow vegetation with a large number of exotic and native plants. The far eastern portion is adjacent to the Osprey Loop trail, and contains one of ***rare's*** two osprey nesting towers. At the eastern edge of the main prairie planting is ***rare's*** iconic bur oak (*Quercus macrocarpa*), near which is a memorial plaque that ***rare*** has agreed to keep clear of vegetation.

The eastern portion also contains the channel of the lower reach of Bauman Creek between Blair Road and the Grand River. This area has been a focus for removal of invasive shrubs and planting with native trees, shrubs, and forbs. Following the restoration of the channel of Bauman Creek in 2016, riparian tree planting was performed in 2017 and 2018. Strong seasonal flooding in some years has resulted in damage to vegetation, and may play a role in the maintenance of open space. The restoration of the creek has restored water to the Provincially Significant Wetland at the eastern end of the Flats, but has also resulted in a decrease of water supply to the incipient marsh that was collecting the diverted water prior to restoration. An opportunity to improve this marsh exists, by creating some deeper pools that will retain water throughout the year, and reduce the cattail (*Typha latifolia*) that has developed. Returning water to the Provincially Significant Wetland adjacent to Bauman Creek has improved the condition of the PSW, which was drying out due to the diversion of water. Species of riparian trees chosen for planting in the restoration area was done with the intent of extending that forested wetland along the riparian zone north of Blair Road. Pressure from invasive *Phragmites* is growing in this area, with several stands across Blair Flats, and addressing it is a central management concern. The opportunity to compare several control methods both conventional (herbicide, mechanical removal) and less so (thermal treatment, goat grazing) is being taken.

6.4.2.2 Target Viability

As a critical flood regulation area for the Grand River, which contributes to its overall health, Blair Flats is one of ***rare's*** most important ecological features. Continued research and restoration, including removal of invasive plant species, will be ongoing in this area.

Table 6.24 Variation of indicator values for key attributes related to target viability. Bolded values indicate the value of the indicator observed at ***rare***. Asterisks indicate that on at least one occasion, a value that falls outside of the acceptable range has been recorded.

Key Attribute	Indicator	Poor	Fair	Good	Very Good
Size	Open Space Area (ha)	<2	2-5	5-20	**>20**
Land Use	Primary Use of Neighbouring Lands	Developed (Urban, Mineral Extraction)	Agriculture	**Naturalized Meadow**	Native Cover
Invasive Plant Species Dominance	Invasives among dominant plant species in ELC communities?	**Yes**		No	

6.4.2.3 Threats to Target

Table 6.25 Target stresses

Stresses	Altered Key Ecological Attribute	Severity	Scope	Notes
1	Presence of Invasive Species	High	Medium	There is significant invasive and exotic species pressure here, except in the tallgrass research site. *Phragmites*, reed canary grass, giant hogweed, common buckthorn are all present.
2	Physical Disturbance to Flora and Fauna	Low	Low	Non-natural disturbance levels are low, however several significant floods, both with and without ice

				jams have occurred in recent years, which resulted in damage to planted saplings.
3	Energy (Noise and Light) Pollution	High	High	Proximity to Blair Road

Table 6.26 Sources of stresses to target

Source		Stress 1	Stress 2	Stress 3	Notes
Human Encroachment/ Disturbance	Contribution	High	High	High	While unauthorized human activity is not common, the nearby roadway can affect a number of issues, such as distribution of invasive species and wildlife mortality.
	Irreversibility	Very High	Very High	Very High	
Proximity of Conventional Agriculture	Contribution				Since the retirement of all of Blair Flats from agriculture, there is no conventional agriculture in the vicinity.
	Irreversibility				
Proximity of Developed Lands, including aggregate extraction	Contribution			High	Noise of traffic, salt, mortality of wildlife are all contributors to problems with conservation on Blair Flats.
	Irreversibility			Very High	

6.4.2.4 Opportunities

Blair Flats has been a focus of significant research and restoration activities since retirement from conventional agriculture in 2009, which should continue into the foreseeable future. It is also one of the largest functioning floodplain areas associated with the Grand River in the Region of Waterloo, which should be used as an educational opportunity as flooding and flood damage to property appears to be increasing in frequency. Restoration activities at the eastern end of the floodplain and the channel of Bauman Creek concluded in fall of 2019, with a re-focus of activities on invasive plant control. *Phragmites* in particular is a difficult, but not insurmountable problem, and the use of this area for small-scale comparative research into control of that species is expected to continue. Finally, the wetland to the west of Bauman Creek that was formed by the dysfunctional culvert that has since been removed, is developing into a small marsh habitat, that should be encouraged. EAC members have suggested that excavation of two small depressions would allow open water to be maintained throughout the year and improve the quality of the habitat.

6.4.2.5 Recommendations (5 year horizon)

- Seek funding to improve the habitat quality in the Blair Flats wetland immediately to the west of Bauman Creek downstream of Blair Road. This will need to include permitting costs for the GRCA, design, and construction.
- Continue *Phragmites* removal in Blair Flats, with a mix of comparative research approaches and simple removal where possible. A holistic approach that includes the planting of native species in areas of *Phragmites* removal is critical for success.

- Continued monitoring and removal of giant hogweed in the riparian area of the Grand River and on the Islands.
- Continue a prescribed burn regime every 4 to 7 years as required, with the next burn occurring in 2020 or 2021.
- Complete Vegetation Sampling Protocol surveys.

6.4.3 Crabapple Field

6.4.3.1 Target Description

Crabapple Field, also known as George Street Field, was retired from row cropping in 2006 and allowed to naturalize. It contains a variety of exotic and native plants, and suffers from significant pressure from invasive buckthorn, barberry, and honeysuckle. It is a considerably drier site than the floodplain area. It is also the site of ***rare's*** oldest continuous research project in genetics of native crabapple, and an osprey nesting tower was installed in the field in 2016. It could likely benefit from a prescribed burn to control the invasive shrubs, but this may be challenging due to its proximity to a major road, public trail, and residential development.

6.4.3.2 Target Viability

Table 6.27 Variation of indicator values for key attributes related to target viability. Bolded values indicate the value of the indicator observed at ***rare***. Asterisks indicate that on at least one occasion, a value that falls outside of the acceptable range has been recorded.

Key Attribute	Indicator	Poor	Fair	Good	Very Good
Size	Open Space Area (ha)	<2	**2-5**	5-20	>20
Land Use	Primary Use of Neighbouring Lands	Developed (Urban, Mineral Extraction)	Agriculture	Naturalized Meadow	**Native Cover**
Invasive Plant Species Dominance	Invasives among dominant plant species in ELC communities?	**Yes**		No	

6.4.3.3 Threats to Target

Table 6.28 Target stresses

Stresses	Altered Key Ecological Attribute	Severity	Scope	Notes
1	Presence of Invasive Species	High	High	Exotic species dominate the meadow, which has not had restoration planting or invasives control. True invasives, such as buckthorn, are beginning to become a problem, although individual plants remain small except near the edges.
2	Physical Disturbance to Flora and Fauna	Low	Low	There is little human activity in this field. Disturbance is related to the proximity of the road and a well-used Grand Trunk trail.
3	Energy (Noise and Light) Pollution	High	High	Proximity to Blair Road

Table 6.29 Sources of stresses to target

Source		Stress 1	Stress 2	Stress 3	Notes
Human Encroachment/ Disturbance	Contribution	Low			Current human traffic likely has little impact on invasive species.
	Irreversibility	High			
Proximity of Conventional Agriculture	Contribution				No agricultural use remains in the vicinity
	Irreversibility				
Proximity of Developed Lands, including aggregate extraction	Contribution			High	Use of Blair Road and the Grand Trunk trail is only projected to increase as population in the area increases. Currently off-trail use of the area is low, vigilance required to ensure it does not increase.
	Irreversibility			Very High	

6.4.3.4 Opportunities

This area is an important site for ongoing research projects. Crabapple Field could also be restored to a dry open habitat with native vegetation, following a burn. At one end of the Grand Trunk trail, it is a 'gateway' feature to the ***rare*** property, with the Osprey Tower and interpretive signage, and could be considered for restoration with drought-tolerant meadow vegetation. This open area remains a primary candidate for emerging research and land use projects at ***rare***.

6.4.3.5 Recommendations (5 year horizon)

- Buckthorn removal has not been carried out in this field, but should begin before the problem becomes more serious. Currently, many of the individuals are small and suitable for mechanical removal. Larger specimens near the edges and into adjacent forest should be removed also, at least females, possibly with herbicide.
- Consider a prescribed burn, possibly followed by native seeding in the meadow. This may be difficult due to the presence of research projects, in addition to proximity to a major road, public trail, and residential development.
- Complete VSP

6.4.4 Cruickston and Neuman Fields

6.4.4.1 Target Description

These are former agricultural areas located on either side of the Hogsback and Cruickston Creek. They were retired from conventional agriculture in 2003 and allowed to naturalize, in an effort to reduce agricultural impacts to Cruickston Creek. The meadow vegetation consists of a variety of exotic and native plants, and significant tree planting has occurred along the edge of the Hogsback and the riparian area of Cruickston Creek upstream of Blair Road, in an effort to improve forest edge habitat and shade the creek. Buckthorn removal was a focus prior to planting, and the area continues to receive attention for buckthorn. There are also some small

areas of *Phragmites*, which will be addressed via spading or wicking with herbicide. The western portion, known as Cruickston Field, is strongly sloped, and has undergone significant natural regeneration of tree cover from natural sources as well.

Neuman Field, the eastern portion, is considerably larger and is becoming one of the more active restoration sites in response to the development of Cambridge West, where up to 2000 dwellings will be built adjacent to ***rare*** property in the coming years. Restoration and trail building plans, funded by the developer of the portion of Cambridge West immediately adjacent to ***rare*** (Huron Creek Holdings), is planned. The developer is legally required to develop a number of compensation plans to restore natural features removed by the development, and ***rare*** has agreed to host compensatory plantings of butternut (including companion trees), construction of a snake hibernaculum, and widening of the existing hedgerow at the northern edge of Neuman Field to compensate for tree loss due to construction. Many of these will be located in Neuman Field, although it is possible that not all will be able to be accommodated here if a significant open space is to be maintained. The developer has also agreed to construct a trail across Neuman Field leading to Springbank Farm and the Community Gardens, in an effort to divert potential traffic from the Hogsback, which will incorporate the bridge installed across Cruickston Creek in 2015. Furthermore, the developer has agreed to cooperate in vegetation selection and planting strategies for the edge of the Hogsback adjacent to the development, to improve the habitat, offset some of the lost vegetation, and discourage trespassing in sensitive features. This Hogsback edge, only a fraction of an acre, will be transferred to ***rare*** following completion of the development. Finally, they have agreed to include ***rare*** literature in homeowner packages as a means to introduce the organization, and to include a clause in the purchase agreement that forbids alteration of fences between the homeowner and ***rare***, and encroachment onto ***rare*** property.

6.4.4.2 Target Viability

This area has remained largely untouched, apart from improvements to the riparian zone of Cruickston Creek and the Hogsback edge. This area is regenerating well with native trees and shrubs, and the western portion (Cruickston Field) is also undergoing succession naturally via seeding from the Hogsback and expansion of a stand of trembling aspen (*Populus tremuloides*) near the top of the slope near Springbank Farm field. Neuman Field will likely remain a naturalized meadow, with a strong dominance of exotic species, for the foreseeable future, until offset activity and trail building are complete. There may be opportunity to work with the Cambridge West developers for further habitat improvement, such as native meadow plant seeding, associated with their work.

Table 6.30 Variation of indicator values for key attributes related to target viability. Bolded values indicate the value of the indicator observed at ***rare***. Asterisks indicate that on at least one occasion, a value that falls outside of the acceptable range has been recorded.

Key Attribute	Indicator	Poor	Fair	Good	Very Good
Size	Open Space Area (ha)	<2	2-5	**5-20**	>20
Land Use	Primary Use of Neighbouring Lands	**Developed (Urban, Mineral Extraction)**	Agriculture	Naturalized Meadow	Native Cover

Invasive Plant Species Dominance	Invasives among dominant plant species in ELC communities?	Yes		**No**	

6.4.4.3 Threats to Target

Table 6.231 Target stresses

Stresses	Altered Key Ecological Attribute	Severity	Scope	Notes
1	Presence of Invasive Species	Medium	Medium	Buckthorn control around the field margins has been ongoing since 2015. There are four patches of *Phragmites* in wet areas These patches are good candidates for herbicide due to their distance from wetlands and watercourses.
2	Physical Disturbance to Flora and Fauna	Low	Low	There is some trespassing in the area. A key to future integrity of the habitat will be to educate users of the new trail and adjacent residents about rare. Close attention to potential encroachment will be required.
3	Energy (Noise and Light) Pollution	High	High	The proximity of Blair Road to the north and residential development to the south and east will continue to increase, particularly as land to the south is converted from agriculture to residences.

Table 6.32 Sources of stresses to target

Source		Stress 1	Stress 2	Stress 3	Notes
Human Encroachment/ Disturbance	Contribution	Low	Low		There will be an increase in human presence in this area as nearby land is developed, and a trail installed as an amenity to residents. Depending on the behaviour of the guests, impacts of Stresses 1 and 2 could change.
	Irreversibility	Very High	Very High		
Proximity of Conventional Agriculture	Contribution				There is no longer conventional agriculture in the vicinity.
	Irreversibility				
Proximity of Developed Lands, including aggregate extraction	Contribution			Med.	There will be an increase in human presence in this area as nearby land is developed, and a trail installed as an amenity to residents.
	Irreversibility			Very High	

6.4.4.4 Opportunities

Neuman Field is an area of rapid change over the next decade, both positive and negative, due to the adjacent Cambridge West development. The loss of forest and hedgerow habitat, butternut trees and a snake hibernaculum to development on adjacent land has provided the opportunity to host offsets in and around Neuman Field, which will ultimately decrease the area of open space, but improve the edge habitat and connectivity of adjacent forests

(Hogsback, Eastern Plantations).The construction of a trail through this field is also expected, as an effort to improve access to Springbank Farm and the Community Gardens (via the bridge at Cruickston Creek), and to direct human traffic away from the more sensitive Hogsback.

6.4.4.5 Recommendations (5 year horizon)

- Invasive management for small amounts of *Phragmites* in the central part of the field. Common buckthorn continues to be an issue, particularly at forest edges.
- Planting of forests and hedgerows will be carried out by developers, as offsets for loss of butternut and of vegetation in general related to the development. This will include augmentation of edge habitat of the Hogsback and Eastern Plantation, the hedgerow at the south edge of Neuman Field, and edge habitat adjacent to the storm water management infrastructure and backyard fences. It will include vegetation types selected in consultation with ***rare***, including those that will discourage human incursion into sensitive features.
- The offset snake hibernaculum was installed near the southwest corner of Neuman Field in Autumn 2019. It should be useable in the winter, the proponents will revisit and likely add substrate in spring or summer 2020 after material has settled and the necessary improvements can be determined.
- The construction of the trail is expected to be concurrent with the plantings and the construction at the adjacent storm water management pond. Opportunity must be taken to engage and educate existing and new homeowners to be good stewards and good neighbours. Ensure that developers live up to their agreement to include ***rare*** materials in homeowner packages, signage on fences that prohibit alteration and trespass, and an obligation in the sales contract that the fences cannot be altered, and a prohibition against encroachment.
- Evaluate possibility of additional butterfly transect in this area following construction of trail.
- Complete Vegetation Sampling Protocol surveys.

6.4.5 Fields 303 and 308

6.4.5.1 Target Description

This area currently has 54 acres of row crops, the only remaining area in conventional cultivation at ***rare***, leased annually to a tenant farmer. While this arrangement is likely to continue into the foreseeable future, the so-called Middle Field will eventually be restored to native meadow habitat or hay field, possibly in conjunction with a suitable research project, and accompanied by the planting of trees to form a corridor >50m in width between Indian Woods and the Hogsback. This project has begun with tree planting events and buckthorn removal along the Grand Allee and Indian Woods edges, but will take several years and an estimated 12 000 trees to complete, once the fields are retired from cultivation. This will be assisted by natural tree recruitment from both forest features.

6.4.5.2 Target Viability

Table 6.33 Variation of indicator values for key attributes related to target viability. Bolded values indicate the value of the indicator observed at ***rare***. Asterisks indicate that on at least one occasion, a value that falls outside of the acceptable range has been recorded.

Key Attribute	Indicator	Poor	Fair	Good	Very Good
Size	Open Space Area (ha)	<2	2-5	5-20	**>20**
Land Use	Primary Use of Neighbouring Lands	Developed (Urban, Mineral Extraction)	**Agriculture**	**Naturalized Meadow**	Native Cover

6.4.5.3 Threats to Target

Table 6.34 Target stresses

Stresses	Altered Key Ecological Attribute	Severity	Scope	Notes
1	Presence of Invasive Species	Low	Low	As an agricultural field planted with non-native species, this is not a relevant characteristic.
2	Physical Disturbance to Flora and Fauna	Low	Low	As this is a conventional field, there is a possibility of non-target pesticide effects on adjacent habitats.
3	Energy (Noise and Light) Pollution	Low	Low	This field is surrounded by ***rare*** property on all sides, is one of the least impacted areas of the property for noise and light pollution

Table 6.35 Sources of stresses to target

Source		Stress 1	Stress 2	Stress 3	Notes
Human Encroachment/ Disturbance	Contribution	Med.			There is little unauthorized human disturbance in the area. Agriculture has resulted in some exotic species in field margins and in the edges of adjacent habitats.
	Irreversibility	Low			
Proximity of Conventional Agriculture	Contribution				This field is currently cultivated, in a conventional corn-soy-wheat rotation
	Irreversibility				
Proximity of Developed Lands, including aggregate extraction	Contribution				This field is surrounded by ***rare*** property on all sides
	Irreversibility				

6.4.5.4 Opportunities

This field is expected to remain in conventional row crops for the near future, although alternatives are being sought, including restoration to meadow vegetation for the benefit of grassland birds, and the planting of a forest corridor to connect the Hogsback and Indian Woods.

6.4.5.5 Recommendations (5 year horizon)

- Investigate funding opportunities, such as grassland bird habitat offsetting, that could result in retirement and restoration of this area. Possibilities for larger scale agricultural experiments or Gardens endeavours could also be considered.
- When the fields are retired, continue planting forest corridor along hedgerow area to connect Hogsback and Indian Woods. Current planting efforts are focused on Grand Allee hedgerow and Sparrow Field edges.
- Continue to monitor and ensure the recommended buffer is maintained.

6.4.6 Springbank Farm

6.4.6.1 Target Description

The Springbank area derives its name from the numerous small spring streams that arise from the slope, fed by groundwater in glacial aggregate deposits in the area. Despite being one of the highest points on the ***rare*** property, the water is fairly abundant in the area, with small seepages scattered across the meadows. The Springbank Farm area has a variety of uses, including ***rare's*** Community Gardens efforts which will not be considered by this EMP as they are managed by separate Gardens personnel. This area also includes the naturalized meadows east and west of the Community Gardens, the (now bisected) Toboggan Hill which is a naturalized meadow split between ***rare*** and the neighbouring property, and some nearby forested areas and riparian zones for ephemeral spring streams. The site also includes North House and Springbank Farm house, two parking lots, and several installations in the Savvas Chamberlain Family Pollinator Conservatory, including the Butterfly Loop trail. Toboggan Hill contains the Springbank South parking lot, constructed in 2016, and a short trail that runs through the forest to the original Springbank parking lot. A MOTUS Wildlife Tracking Tower is sited at the highest point of the field behind the greenhouse.

6.4.6.2 Target Viability

Most of this area is former agricultural fields that were taken out of cultivation in the early 2000s and left to naturalize. The Community Garden was established in the area directly behind the Springbank Farmhouse. In 2012 North House, the demonstration sustainable living home, was installed to the east of the Springbank parking lot.

The Garden is currently undergoing an expansion, and may come to occupy the entire area within the Butterfly Loop trail. Andrew Judge, faculty member at Conestoga College and recipient of the ***rare*** 2018 Ages Foundation Fellowship, has created an Indigenous Food and Medicine Garden at Springbank Farm called Minjimendan, which is planned for expansion into the space, and focused on Indigenous land restoration methods.

There are no current plans to restore the meadow areas on Toboggan Hill or between the Community Gardens and the Hogsback, although this is a focal area for *Phragmites* removal. The riparian areas of the ephemeral spring streams, an unusual habitat in the area, should also be protected from encroachment by other activities.

Table 6.36 Variation of indicator values for key attributes related to target viability. Bolded values indicate the value of the indicator observed at ***rare***. Asterisks indicate that on at least one occasion, a value that falls outside of the acceptable range has been recorded.

Key Attribute	Indicator	Poor	Fair	Good	Very Good
Size	Open Space Area (ha)	<2	2-5	**5-20**	>20
Land Use	Primary Use of Neighbouring Lands	Developed (Urban, Mineral Extraction)	**Agriculture**	Naturalized Meadow	**Native Cover**
Invasive Plant Species Dominance	Invasives among dominant plant species in ELC communities?	**Yes**		No	

6.4.6.3 Threats to Target

Table 6.37 Target stresses

Stresses	Altered Key Ecological Attribute	Severity	Scope	Notes
1	Presence of Invasive Species	High	High	The area has significant infestation of buckthorn and other undesirable shrubs. There are also some large stands of *Phragmites* which are being addressed through a variety of methods, including grazing by goats. In the naturalized meadows, many of the plant species are exotic.
2	Physical Disturbance to Flora and Fauna	Med	Med	Except in the immediate area of the Community Garden there is little authorized human use. Trespassing by dog-walkers has been noted in the naturalized fields.
3	Energy (Noise and Light) Pollution	Med	Low	Blair Road is a persistent intrusion in terms of pollution, but it is only a serious problem in close proximity (<50 m) from the road itself.

Table 6.38 Sources of stresses to target

Source		Stress 1	Stress 2	Stress 3	Notes
Human Encroachment/ Disturbance	Contribution	Med			The human presence at the gardens has contributed to some invasive plants in the area, notably giant hogweed and wild parsnip.
	Irreversibility	Med			
Proximity of Conventional Agriculture	Contribution		Low		There is conventional agriculture to the south of the area, may contribute some noise, dust, non target pesticide effects
	Irreversibility		Low		
Proximity of Developed Lands, including aggregate extraction	Contribution		Med	High	The proximity of Blair Road (15 000 cars per day) contributes a variety of pollutants, and contributes to wildlife mortality.
	Irreversibility		High	High	

6.4.6.4 Opportunities

The use of the Springbank Farm and Community Gardens area is not expected to change significantly in the foreseeable future. New Gardens initiatives are ongoing, and projects in the area will focus on invasive plant removal and installations for the Savvas Chamberlain Family Pollinator Conservatory. The construction of a trail connecting the Cambridge West development to the Springbank Farmhouse parking lot via Neuman Field, across the Cruickston Creek Bridge and through the forested area and behind North House along old Blair Road is planned, but timing remains uncertain. Installations for the Pollinator Conservatory are planned with the location of this trail in mind.

6.4.6.5 Recommendations (5 year horizon)

- Continue to engage with developers regarding the construction of the trail connecting Cambridge West to Springbank Farm via the Cruickston Creek bridge. See Section 6.4.4 for more detail on plans related to the Cambridge West residential development.
- Continue removal efforts for serious invasives in this area, particularly buckthorn and *Phragmites*. Continue work to eradicate giant hogweed from the meadow areas around the Gardens' greenhouse.
- Seek funding for an additional Land Management greenhouse, to be installed near the existing greenhouse, to house the Native Plant Propagation Project.
- Continue to develop the Savvas Chamberlain Family Pollinator Conservatory, which is currently scheduled to continue through 2021. Since its inception, four projects have been completed, with a fifth planned for 2020 (a moon garden highlighting nocturnal pollinators).

6.4.7 South Field

6.4.7.1 Target Description

South Field is a former agricultural field that has been planted in commercial hay as part of a grassland bird conservation research project. The field is divided into West and East portions by a discontinuous hedgerow. South Field West was retired from conventional row crops and seeded in hay in 2006. Due to nesting success by grassland birds noted by ***rare*** bird monitors, South Field East was converted to hay in 2016, and the two fields total 60.6 acres of habitat. In order to improve the chances for offspring success, hay mowing is not permitted until the bird monitors are satisfied that fledging is complete. The experiment is now complete, and decommissioning of the structure is expected in the next year or two.

6.4.7.2 Target Viability

We expect South Field to remain under its current management plan for the foreseeable future, in order to monitor its growing success as breeding habitat for at-risk grassland birds.

Table 6.39 Variation of indicator values for key attributes related to target viability. Bolded values indicate the value of the indicator observed at ***rare***. Asterisks indicate that on at least one occasion, a value that falls outside of the acceptable range has been recorded.

Key Attribute	Indicator	Poor	Fair	Good	Very Good
Size	Open Space Area (ha)	<2	2-5	5-20	**>20**
Land Use	Primary Use of Neighbouring Lands	Developed (Urban, Mineral Extraction)	**Agriculture**	**Naturalized Meadow**	Native Cover
Invasive Plant Species Dominance	Invasives among dominant plant species in ELC communities?	Yes		**No**	

6.4.7.3 Threats to Target

Table 6.40 Target stresses

Stresses	Altered Key Ecological Attribute	Severity	Scope	Notes
1	Presence of Invasive Species	Low	Low	There are some invasives, such as buckthorn, in the hedgerow areas. Most of the area is planted in a mixed hay largely composed of non-native species.
2	Physical Disturbance to Flora and Fauna	Low	Low	Little disturbance, aside from actual hay harvest activities.
3	Energy (Noise and Light) Pollution	Med	Med	Proximity to gravel pits and other farm lands can lead to noise, dust, etc. The only residential development in the area is rural.

Table 6.41 Sources of stresses to target

Source		Stress 1	Stress 2	Stress 3	Notes
Human Encroachment/ Disturbance	Contribution				There is little unauthorized use in South Field, although there is occasional traffic on adjacent South Lane and in Sparrow Field
	Irreversibility				
Proximity of Conventional Agriculture	Contribution			Low	There is conventional cropping to the east of the field, and a large poultry operation to the south.
	Irreversibility			High	
Proximity of Developed Lands, including aggregate extraction	Contribution			Med	There are two gravel pits nearby, and some gravel traffic on Whistle Bare Road. The pit between Whistle Bare Road and Altrieve Lake is no longer active, but will need to be rehabilitated.
	Irreversibility			High	

6.4.7.4 Opportunities

We do not expect changes to the use of South Field in the foreseeable future. Some attention should be paid to the removal of invasive shrubs such as buckthorn in the surrounding hedgerows.

6.4.7.5 Recommendations (5 year horizon)

- Remove invasive shrubs in the hedgerows adjacent to South Field.
- Retirement of Bank Swallow nesting structure

6.4.8 Preston Flats

6.4.8.1 Target Description

Preston Flats is a 100 acre parcel located in the City of Cambridge. It includes shoreline of both the Grand and Speed Rivers, and the confluence of these rivers is found at the eastern end of the parcel. Preston Flats includes a 41 acre agricultural field, which is currently in commercial hay, and approximately 58 acres in a mix of meadow, mixed riparian vegetation, riparian forest, and some small wetland areas including riparian PSW. The entire area is active floodplain for the Grand River, which limits the possible land uses. Together with Blair Flats, it forms part of ***rare*** that surrounds the confluence of the Speed and Grand Rivers, a highly important area for migratory waterfowl and other wildlife. The Preston Flats wetland, located adjacent to Fountain Street, has impaired water quality, particularly by salt (Abram et al. 2018).

6.4.8.2 Target Viability

The agricultural portion of Preston Flats is likely to remain in hay for the foreseeable future. This was originally a soil conditioning method, as the soil was degraded and low in organic matter after long-term row cropping with inorganic fertilizer. Preston Flats is close to urban development and a busy road (Fountain Street), and as such is subject to significant human impact. It is also adjacent to the City of Cambridge park at Moyer's Blair Landing, which has a large parking area and may encourage trespassing onto ***rare*** property. The City is also working on a footbridge and trail connection between the Bob McMullen Linear Trail in Preston and the multi-use trails adjacent to Fountain Street, which is currently in the Environmental Assessment stage. This would include a footbridge across the Speed River and a trail that would cross ***rare*** property. While this may be desirable from the point of view of active transportation, there can be little benefit to habitats on ***rare*** property, and the City must remain aware of their obligations to minimize impact to Preston Flats after construction is completed.

Table 6.42 Variation of indicator values for key attributes related to target viability. Bolded values indicate the value of the indicator observed at ***rare***. Asterisks indicate that on at least one occasion, a value that falls outside of the acceptable range has been recorded.

Key Attribute	Indicator	Poor	Fair	Good	Very Good
Size	Open Space Area (ha)	<2	2-5	**5-20**	>20
Land Use	Primary Use of Neighbouring Lands	**Developed (Urban, Mineral Extraction)**	Agriculture	Naturalized Meadow	**Native Cover**
Invasive Plant Species Dominance	Invasives among dominant plant species in ELC communities?	Yes		**No**	

6.4.8.3 Threats to Target

Table 6.43 Target stresses

Stresses	Altered Key Ecological Attribute	Severity	Scope	Notes
1	Presence of Invasive Species	Med	High	There are some invasives, such as buckthorn and giant hogweed, in the riparian areas. Most of the area is planted in a mixed hay largely composed of non-native species.
2	Physical Disturbance to Flora and Fauna	Med	Med	Regular hay mowing, periodic flooding
3	Energy (Noise and Light) Pollution	High	High	The proximity of the City of Cambridge and Fountain Street contribute noise, light, dust to the area.

Table 6.44 Sources of stresses to target

Source		Stress 1	Stress 2	Stress 3	Notes
Human Encroachment/ Disturbance	Contribution		Med	Med	Possible effects of increased residential development and the possible footbridge are unknown at this time.
	Irreversibility		High	High	
Proximity of Conventional Agriculture	Contribution				This field is currently cultivated in conventional hay. The agricultural field across Fountain Street is currently fallow, potentially awaiting development as soccer fields.
	Irreversibility				
Proximity of Developed Lands, including aggregate extraction	Contribution	Med	Med	Med	This area is in close proximity to the City and to Fountain St. The contribution to these problems could increase if greater access to the land is granted by the footbridge and trail.
	Irreversibility	High	High	High	

6.4.8.4 Opportunities

Other than control of invasive plants, mostly buckthorn but also giant hogweed and Himalayan balsam, in the portions of Preston Flats outside the hayfield, this area does not require significant stewardship activities. Continued vigilance for dumping, parties, and other forms of human damage is important in this area due to its proximity to the City.

6.4.8.5 Recommendations (5 year horizon)

- Monitor the planning and development of the Preston Flats trail, as it has the potential to impact both habitat and archaeological resources at ***rare***.
- Continue invasives removal, particularly monitoring and removal of giant hogweed in the riparian area of the Grand River.
- Continue monitoring for human impacts resulting from trespassing, such as fires, dumping, and littering. It will be important to establish baseline data in the event that the footbridge and trail are constructed.
- Complete Vegetation Sampling Protocol surveys.

7.0 LAND MANAGEMENT POLICIES

7.1 Agriculture

Agriculture has a long history at ***rare***, from pre-Columbian cultivation to modern conventional farming still carried out on the property (Newell 2011; Schneider 2012). At the inception of the charity in 2001, approximately 400 acres were leased to Domm Farms Ltd. for conventional corn-soy-wheat operations. Since then, parcels totaling more than 350 acres have been taken out of conventional production and been actively restored or allowed to naturalize (Newell 2011). It is the intent to remove all conventional agriculture from the property in favour of research, restoration, and/or conservation projects. However, an important aspect of conservation in the modern world is the promotion of ecologically responsible agriculture, as a means to conserve ecosystem services and promote the value of farmland, which is under high development pressure in the immediate vicinity of ***rare***. Additionally, it is advantageous to potential future research, arts, and land use projects to have agricultural environments present on site. Thus, 50 or more acres at ***rare*** should be permanently reserved for sustainable agriculture promotion and education (Newell 2011). Preston Flats (41 acres) was converted to hay in 2016 in order to replenish soil organic matter, although future activity at this site is undetermined.

Agriculture is an important way to engage the community, as seen by the success of the Springbank Community Gardens. Part of the future vision of ***rare*** should include research and advocacy for ecologically responsible agriculture through such avenues as community education, promotion of good and integrative farming practice, and participation in the local food system. Between the years of 2003 and 2006, a Community Supported Agriculture (CSA) known as '***rare* Organics**' was operated at Springbank Farm. When it was discontinued, it was replaced with what is now known as Springbank Community Gardens (4.55 acres, 1.84 ha). The Gardens include 110 10'x30' plots rented annually to members of the general public for a nominal fee (includes some supplies and assistance). There is also an education demonstration garden established in 2009 for visiting school groups, and a Foodbank Garden established in 2012. Now up and running, several thousand pounds of organic produce are donated each year to local food banks. The Gardens area also includes sheds, a greenhouse, portable toilet facilities, and social space. In 2017, an orchard of fruit trees was established as part of the Food Bank garden, and in 2018 Andrew Judge (Conestoga College) designed and created Minjimendan, an Indigenous Food and Medicine garden.

Conversion of South Field east and west to hay due to the nesting of bobolink, resulted in the amendment of future lease agreements with Domm Farms to include practices friendly to this Species at Risk. Pesticide use on the property continues to be a concern, and it is ***rare's*** goal to prohibit all prophylactic and otherwise unnecessary use of pesticides. Judicious use of herbicides is an appropriate tool for control of invasive plant species. Neonicotinoid insecticides in particular should not be allowed on the property, and use of untreated seed was established as a condition of any leases beginning in the 2016 growing season, which coincided with the Province of Ontario ban on unnecessary use of neonicotinoids. Prophylactic use of RoundUp (glyphosate) continues to be reviewed.

7.2 Species at Risk Permits

For species that are listed as at risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) but are not listed under the SARA, ***rare*** will use best efforts to protect them in the same manner as legally regulated species. Species that are ranked provincially by the Natural Heritage Information Centre as S1 (Critically Imperiled), S2 (Imperiled), or S3 (Vulnerable) but are not regulated under the SARA or ESA, will be protected at ***rare*** through the identification and protection of Significant Wildlife Habitat (SWH). Candidate SWH will be identified through Ecological Land Classification, and confirmed through field studies as outlined in the MNR SWH Technical Guide. Best efforts will be made to conserve SWH in a manner consistent with regulated species at risk. Species designated as Significant by the Region of Waterloo will also be accommodated.

Regulated species listings are found on the Government of Canada's SARA Public Registry (Government of Canada, 2003) and the Ontario Ministry of Natural Resource's SARO List (Ministry of Natural Resources, 2013b). COSEWIC lists of Wildlife Species at Risk and Species Status Reports can be found online. A list of species at risk (as listed by SARA, COSEWIC, ESA and the Committee on the Status of Species at Risk in Ontario (COSSARO)) observed at ***rare*** will be updated as changes are made to the official registries. Specific information about locations or observations of species at risk will be available to ***rare*** staff and approved researchers only. For research, arts, and land use projects involving and impacting regulated species at risk, the appropriate permits (Animal Care Protocol, Department of Fisheries and Oceans, ESA, SARA, Wildlife Scientific Collectors Authorization etc.) will be reviewed during the research and land use application process and kept on record at ***rare***. Once the permits have been approved, all research projects must still undergo the normal Research and Land Use approval process.

7.3 Alterations to the Landscape

When a project is being contemplated for approval, it must follow the consultation and approval process for Research, Arts, and Land Use projects, in order to ensure that the project proceeds in a way that is as sensitive to the natural and cultural heritage of ***rare*** as possible (see Research Policies and Procedures document for more information).

From a land management perspective, the following issues should be considered for any alterations:

- Ensure erosion/sediment controls are appropriately installed and functioning on a weekly basis and following all major precipitation events
- Ensure that all project design specifications (related to ecology/biology) are followed (e.g. appropriate application of a previously agreed-upon re-seeding mixture where soil has been disturbed)
- Ensure adherence to appropriate timing windows (e.g. in-water work, breeding birds, snakes)
- Ensure implementation of all accepted recommendations from the Consultation and Approval Process
- Where applicable, coordinate with on-site contractor to resolve minor issues with mitigation measures (e.g. maintenance of sediment controls)

- Where applicable, ensure adherence to appropriate agency permitting and associated monitoring requirements
- Where applicable, oversee or conduct mid- to long-term monitoring of site remediation.

In the event that work is being completed on public infrastructure through or immediately adjacent to ***rare*** property, the monitoring program should be developed in coordination with the appropriate municipal project manager or other responsible staff.

7.4 Hazardous Plants

7.4.1 Giant Hogweed

Giant hogweed (*Heracleum mantegazzianum*) is a plant in the family Apiaceae, native to the Caucasus Region and Central Asia. In 2008, giant hogweed was designated as a local noxious weed by Waterloo Regional Council, meaning that landowners have a responsibility to destroy it. It may reach 2–5 meters and in rare cases can be up to 7 meters tall. When removing giant hogweed, care must be taken not to damage Purplestem Angelica (*Angelica atropurpurea*), a native plant resembling giant hogweed that occurs in similar habitats.

Giant hogweed is a phototoxic plant; its sap can cause phytophotodermatitis (severe skin inflammations) when the skin is exposed to sunlight or ultraviolet light. Initially the skin turns red and starts itching, then blisters form within 48 hours. Hospitalization may be necessary. The blisters form black or purplish scars that can last several years. Presence of minute amounts of sap in the eyes can lead to temporary or even permanent blindness. These reactions are caused by the presence of linear derivatives of furocoumarin in its leaves, roots, stems, flowers and seeds. Children should be kept away from giant hogweed. Protective clothing, including eye protection, should be worn when handling or digging it. Clothing, tools, and other objects that have been exposed to giant hogweed should be washed to prevent further transmission. If skin is exposed, the affected area should be washed thoroughly with soap and water and the exposed skin protected from the sun for several days. The USDA Forest Service reports that pigs and cattle can eat Giant Hogweed without apparent harm. The cultivated parsnip (*Pastinaca sativa*), which is not native to North America, has formed feral patches in the vicinity of Springbank Farm and the Gardens. The foliage of parsnip can also have toxic or irritating effects on human skin when handled.

For extensive hogweed colonies, the Region of Waterloo suggests the application of glyphosate (Round-up) in late April or early May. Small quantities of glyphosate may be applied for control of noxious weeds on private property without a license. Signs warning of pesticide use must be posted for a minimum of 24 hours pre-application and 48 hours post-application, in accordance with the Pesticide Act. Alternate treatment options can be explored provided they are scientifically defensible. All staff and groups visiting these areas (e.g. community gardeners, researchers) should be notified of the location and timing of the application. For small hogweed colonies or single plants, individual plants may be removed mechanically by using a shovel to dig out the plant (and its tap root). In areas of limited use and access, the plant may be left to decompose in the field; otherwise it should be double-bagged and disposed of with the municipal garbage. Staff removing the plants should take caution to cover all exposed skin,

wear eye protection, face masks and thick rubber gloves. Giant hogweed located near active or passive use areas should be clearly marked with signage or caution tape until removal. Areas where giant hogweed has been observed in the past will be monitored for re-occurrence. All staff and volunteers working on the property will be trained to identify giant hogweed, and will be instructed to report any plant observations to the Land Management staff. Whatever the method, every effort must be made to remove the plant prior to seed set or it will be impossible to control the infestation.

7.4.2 Poison Ivy

Poison Ivy (*Toxicodendron radicans*), is a native plant that is produces urushiol, a clear liquid compound found within the sap of the plant that causes an itching rash for most people who touch it. Poison Ivy can be found growing in any of the following three forms: as a trailing vine that is 10–25 centimeters tall (4 to 10 inches), as a shrub up to 1.2 meters tall (4 feet), and as a climbing vine that grows on trees or some other support. It grows in a wide variety of soil types, and soil pH from 6.0 (acidic) to 7.9 (moderately alkaline).

Urushiol-induced contact dermatitis is an allergic reaction. Around 15% to 30% of people show no initial response, but most people will become sensitized with repeated or more concentrated exposure. Reactions can progress to anaphylaxis. Poison Ivy must not be burned as a control or disposal method, as severe reactions in the respiratory system may be caused by the smoke. Urushiol can maintain efficacy for several years, so handling dead leaves or vines can cause a reaction. Oil transferred from the plant to other objects (such as pet fur) can cause the rash if it comes into contact with the skin. Clothing, tools, and other objects that have been exposed to the oil should be washed to prevent further transmission.

Poison Ivy is a native plant, and as such will not be subject to control treatments. Education will be provided to volunteer groups and participants in outdoor events regarding Poison Ivy safety and proper attire for trail use on the property. For public use areas with Poison Ivy present, periodic inspection and signage will be considered sufficient. Currently, temporary signage is installed during the summer at trailheads where poison ivy is known to occur adjacent to the trails. In 2019, this included Maple Lane, and all trailheads for the Cliffs & Alvars trail system.

7.4.3 Evaluation Procedure

An organized approach will be used to assess plant hazards at ***rare***. The Land Management staff will arrange for training and inspections according to the area as noted above. The staff member in charge of the inspection is responsible for establishing a regular inspection of property locations as indicated by usage above, filling in the 'Plant Inspection Form' located on ***rare's*** computer network, and arranging for the hazard can be dealt with as soon as possible. The Land Management staff is responsible for:

- Ensuring staff are trained, that they follow proper safety procedures and carry out assessments according to usage area requirements.
- Receiving reports and keeping detailed documentation of procedures and outcomes.
- Assessing reports of hazardous plants and making recommendations in writing to the ED regarding abatement.

- Arranging and overseeing the approved work according to the safety procedures.
- Preparing a report, annually, on work completed and future work plans, for the ED and the Board.

7.5 Recreation

The responsible and respectful enjoyment of the conservation lands will create a positive experience for all visitors. As such, our aim is to balance the enjoyment of recreational users with their safety and that of others, and to prevent recreation that imperils the protection of ***rare*** lands and wildlife. The general trail use guidelines and recreation policies aim to protect the ecological integrity of ***rare*** lands by mitigating the trampling of vegetation, off-trail soil compaction, disturbance to wildlife, and the spread of invasive species. These guidelines and policies will also serve to prevent conflicts between trail-users and to protect visitors from off-trail hazards (e.g. Poison Ivy, ticks).

7.5.1 General Trail Use

Trail-use guidelines will be posted at all of the major trail-heads and on trail maps, and the rationale behind these guidelines will be provided on the ***rare*** website and any other trail-related materials. The trail guidelines should be conveyed in a manner that encourages the public to play an active role in the protection of the ***rare*** property.

General Trail Use Guidelines:

- Stay on the trail at all times
- Do not harass the wildlife
- Do not damage or collect the flora
- Do not create any harmful alteration, disruption or destruction to the natural landscape
- Carry out all litter
- Bicycles are only permitted on designated trails (refer to ***rare*** bicycling policy)
- Dogs are only permitted on designated trails, and must be leashed at all times and cleaned-up after (refer to ***rare*** dog policy); service dogs are permitted on all trails
- Geocaching is permitted with ***rare's*** advance authorization for cache placement, caches must be accessible without leaving the trail (i.e. within one meter of the trail edge; refer to ***rare*** geocaching policy)

Persons not complying with the General Trail Use Guidelines who are not exempt (i.e. given pre-authorization such researchers, monitors, or artists; or Indigenous persons engaging in traditional or subsistence activities for personal use), or engaged in the following activities anywhere on the property, shall be considered to be trespassing, and appropriate steps up to and including prosecution of the offenders will be taken:

- Use of motor vehicles
- After-dusk use of trails, unless participating in an official ***rare*** event
- Camping
- Campfires
- Hunting or fishing

- Foraging
- Horseback riding
- Dumping of Litter

7.5.2 Off-Trail Use

Trail use regulations specify that visitors must remain on designated trails to minimize disturbance to the natural environment. Possible impacts of off-trail use include the trampling of sensitive vegetation, soil compaction, disturbance to wildlife and the distribution of seeds of invasive species. Staff and certain authorized volunteers (e.g. bird monitors) are encouraged to wear ***rare*** branded vests, shirts, and/or hats when off-trail. However, occasional low-impact off-trail use may be considered for projects determined to be of educational or cultural significance. Visitors who may wish to access off-trail locations for valid reasons includes Indigenous peoples engaging in traditional cultural or subsistence activities, researchers, monitors, photographers, other artists and naturalists.

1. Visitors wishing to access off-trail locations must first contact ***rare*** staff and submit a proposal detailing the nature of the project, the desired project location and the project's potential environmental impacts
2. The proposal will be reviewed by ***rare*** staff, and expert advisors as needed
3. If the proposal is approved, the visitor will be given an orientation by ***rare*** staff detailing where they are permitted to go and how to minimize disturbance to the environment
4. For all proposals, ***rare*** staff will look for opportunities to direct visitors to on-trail or other low sensitivity areas that meet project criteria

7.5.3 Cycling and Running

Our aim is to balance the enjoyment of bicyclists and runners with the protection of ***rare*** lands and other trail users. Cycling and running share the characteristics of being fast-moving activities, with a high potential for conflict with other users (e.g. surprising hikers, forcing hikers from the trail suddenly, collisions) and safety considerations for other trail users and for the participants themselves, particularly on rougher terrain. Additionally, cyclists may impact natural areas in the following ways:

- Trail erosion from braking and skidding
- Development of linear ruts on the trails
- Addition of unauthorized constructed features to existing trails (i.e. jumps, ramps, and other obstacles)
- Creation of unauthorized trails (which damages vegetation)
- Accidental or intentional widening of narrow trails (which damages vegetation)

Recognizing that ***rare*** is in an urban area and alternative and sustainable transportation is desirable, we encourage the use of certain trails for transportation purposes. Bicycling and running will be restricted to trails at least 3 meters wide through areas not considered to be sensitive. Permitted ***rare*** trails include the Grand Allée and Maple Lane, and the City of Cambridge permits bicycles on the Grand Trunk Trail. All other trails will be considered off-limits to bicyclists and runners entirely in order to address the potential impacts listed above,

especially where the trails are narrow and/or vegetation is sensitive. The public are prohibited from using motorized vehicles of any kind anywhere on the property.

There will be signs and information campaigns clearly indicating on which trails bicycles and runners are allowed, and information on alternate destinations will be provided on the website (e.g. link to the Waterloo Cycling Club Trails page). Included in the information campaign will be guidelines that expressly prohibit modifications of the trails such as construction of ramps or creation of unauthorized trails.

7.5.4 Dogs

Dog walking is a popular recreational use of the trails at ***rare***. Our aim is to permit the enjoyment of dog-walkers where it does not compromise the protection of our lands and other trail users. However, dogs can have an impact on natural areas, through disturbance to wildlife and the transfer of the seeds of invasive species; they can also negatively affect the trail experience for other users and pose a safety risk for the organization. Off-leash dogs in particular pose a threat to the safety of wildlife within the reserve, as they have the potential to chase, injure or kill animals, trample off-trail vegetation and generally disrupt the behaviour of the native fauna living in the reserve, for example, by flushing birds off nests. The safety of the off-leash dogs is also at risk; frightened animals may become aggressive when defending themselves, and there is a potential for disease exchange between pets and wildlife (e.g. leptospirosis, raccoon roundworm, rabies, *Echinococcus multilocularis*).

Recognizing that ***rare*** is in an urban area and that dogs are often part of the link to the natural world for urban dwellers, dogs on leash are acceptable on the Grand Allée and Maple Lane, and the City of Cambridge permits dogs on leash on the Grand Trunk Trail. Some trails will be considered off-limits to dogs entirely in order to address the implications listed above, especially in areas where the presence of dogs would have a particularly negative impact on the natural environment, such as narrow trails passing through areas of sensitive vegetation. Dogs will be prohibited from all other trails, and there will be no off-leash areas on the property. There will be signs and information campaigns clearly indicating on which trails leashed dogs are allowed. The trails on which dogs are permitted will be subject to our current knowledge of the ecological sensitivity of the area. Persistent violators of these rules will be served with a Notice of Trespass that will ban them from the property.

7.5.5 Geocaching

Geocaching is a form of recreational treasure hunting, where geocachers using GPS receivers locate hidden outdoor caches containing a log of past geocachers, notes and possibly trade items. While geocaching has the benefit of encouraging people to go out into nature, caches often receive a large amount of foot traffic which can cause increased environmental disturbance.

There are a number of geocaches already on the ***rare*** property (the most recent maps of ***rare*** caches can be found at www.geocaching.com). At least once per year, each cache on the property should be located, the contents of the cache recorded and the site photographed. The

suitability of each existing geocache should be assessed using the guidelines detailed below. Caches deemed unsuitable should be removed or relocated, with notification and explanation sent to the cache creator (if known) and the geocaching websites listing the cache. When possible, the cache founder will be contacted and given the opportunity to retrieve the cache and reposition it to a new location approved in consultation with ***rare*** staff.

Geocache location guidelines (adapted from the Parks Canada Geocaching Guidelines):

- When placing or seeking a cache, geocachers must travel on marked open trails or in publicly accessible areas (e.g. Lamb's Inn Garden, Springbank Farm) at all times. All caches must be accessible from the trail or the public area.
- Geocachers are required to meet with ***rare*** staff to discuss the proposed location of their cache and to obtain authorization prior to placing a cache.
- Caches are permitted in Low and Medium priority protection areas and possibly in High priority protection areas provided the cache will not cause any significant disturbance to sensitive natural or cultural resources. Digging of holes or damage to vegetation, rock faces, or any other feature when placing the geocache is prohibited.
- Information provided on the ***rare*** website will advise geocachers of the maximum distance that a cache can be located off-trail in order to reduce off-trail search radius.

An opportunity exists for ***rare*** to use geocaching on the property as an educational and interpretive tool on the trails. Natural history notes or other ***rare*** material could be included in new ***rare***-authorized caches on the property, or "Chirps" (small, locked, and hidden signaling devices) could be used to send interpretive messages to the GPS receivers of geocachers as they walk along the trail system.

7.5.6 Foraging

Foraging is defined as "the process of searching for and gathering food or provisions from wild plants or fungi". Prior to European settlement, the people who lived in the area would have engaged in foraging, and this was likely continued by early settlers. Foraging by Indigenous peoples using traditional reciprocal methods and at low population numbers is sustainable, but with a much higher human population density today opening the property to foraging by everyone can seriously damage or extirpate populations of edible, medicinal, or decorative species. Markets exist for some flora, such as fiddleheads and wild leeks, which can lead to serious over-harvesting as people forage for profit rather than for their own consumption. Other possible impacts include:

- Trampling or removal of sensitive vegetation which may affect the composition of plant communities and in turn the wildlife that relies on them
- Disturbance to the soil by the removal of vegetation and off-trail travel, which may make the disturbed areas more susceptible to colonization by invasive species
- Other impacts of off-trail travel, including disturbance to wildlife and spreading seeds of invasive species

Due to the potential for ecological damage, removal of plants, animals, rocks, objects, or other items from the property at ***rare*** is prohibited. Indigenous peoples are welcome to engage in traditional stewardship of medicines and other culturally relevant species, objects, and practices on these lands. As with all activities on the ***rare*** property, any consumption of materials taken from the property is at the user's own liability and risk.

7.6 Hazardous Tree Management

This hazard tree policy has been designed as a proactive approach to ensure that tree hazards are identified and eliminated on ***rare*** property. All active trails and public areas are inspected monthly at a minimum, as well as after any major storm events or high winds. All trail monitoring activities are recorded in a log book, including whether hazardous trees were found. Where budgetary constraints limit the ability to eliminate all tree hazards, priority shall be placed on trees deemed to be of a high-risk nature. A standardized rating system will be used to determine hazard potential and level of risk. The full tree management policy at ***rare*** is available in a separate document. It is policy at ***rare*** that trees will be managed with minimal interference to natural processes, and it is recognized that standing dead and dying trees are an integral part of the ecosystem. However, active management may be allowed when:

1. The structure or function of an ecosystem has been seriously altered and manipulation is the only possible alternative available to restore ecological integrity;
2. Public health or safety is threatened;
3. The objectives of the Environmental Management Plan cannot be achieved otherwise.

The desired abatement method for tree hazards too large for staff to handle will be determined by the arborist, in consultation with ***rare*** staff. The arborist will provide technical advice on how to deal with the tree hazard. This information will be delivered in writing to the management who will then determine how the abatement process should proceed and who will conduct the necessary work. Abatement options include,

- Pruning – hazardous parts of the tree are removed
- Removal – the entire hazardous tree is removed
- Exclusion – usage patterns of the site are altered to remove the target potential of the tree (not always an option).

If trees cannot be removed or the hazard dealt with in a timely fashion, then the target areas must be closed to public use and staff access will be restricted until the hazards have been abated. When a tree has been assessed as a ‘serious hazard,’ it must be marked for future abatement procedures. Once a tree has been identified as a serious hazard, the target area should remain closed until the hazard has been abated.

7.7 Invasive and Exotic Species Management

7.7.1 Plants

Management of invasive plant species is a key stewardship priority at ***rare***, and is summarized in the action plans of Cymbaly (2007, 2008), Pope (2014), and Marshall (2019), which are available upon request. Invasive plant species have been observed through the diverse array of

habitats on the property. In addition to natural modes of dispersal such as wind and bird droppings, a key vector of invasion is recreational use of the property. Seeds and other plant materials can be transported via hiking shoes, clothing, and pets to new areas within the property as well as outside the borders of ***rare***. For this reason, use of ***rare*** property for recreational purposes must continue to be restricted exclusively to the existing trail system and limiting areas where pets are permitted. Removal efforts are to be focused within or immediately adjacent to areas of ecological significance.

The opportunity for invasive species research should also be recognized. As one of the core values of ***rare***, the research potential for some of the invasive species on the property could greatly contribute to the growing body of knowledge about invasive species. Results from invasive alien research may provide valuable insights into the ecology of invaders and improve best management practices. Examples of prior invasive species research includes research conducted on the interactions between the invasive alien plant species garlic mustard (*Alliaria petiolata*) and the native bloodroot (*Sanguinaria canadensis*) in 2013 and research on management of giant hogweed in 2016. In 2019 a grant from the Region of Waterloo Community Environmental fund allowed research on *Phragmites* to be scaled up significantly. Detailed mapping of all patches on the property took place, followed by experimental trials comparing spading, grazing, infrared treatment, and pesticide use. Pesticides were also tested on buckthorn. These experimental plots will continue to be monitored for results, which will inform invasive species management efforts moving forward.

The species included in the 2013 work plans were designated priority species based upon a formula that incorporated both the invasive potential and the existing establishment on ***rare*** property. Invasive potential rankings were taken from the Invasive Exotic Species Ranking for Southern Ontario and ranged from Category 1 (very aggressive invaders) to Category 5 (suspected invaders). Extent of establishment on ***rare*** property was quantitatively categorized by assigning a value from 1-3 to the size of infestations reported in 2007. Species that were found in small and confined populations were assigned a value of 1, sporadic infestations were assigned a value of 2, and widespread infestations were assigned a value of 3. The sum of these two categories was calculated for each species and those with an end-product of 4 or less were considered first priority species. Some species whose sum was equal to or less than 4 are not included explicitly in the invasive alien plant species work plans because they were not observed within the priority areas (i.e. Common Periwinkle). In the future, these species could be included in further work plans that extend to other areas of the property. Some additional species were added to these work plans because they are problematic and/or listed as noxious weeds within the Region of Waterloo (i.e. Buckthorns, Barberries). Priority species for removal anywhere on the property in 2013 included Common Reed (*Phragmites australis*), Autumn Olive (*Eleagnus umbellatus*), Multiflora Rose (*Rosa multiflora*), Goutweed (*Aegopodium podagraria*), Mossy Stonecrop (*Sedum acre*), Common Periwinkle (*Vinca minor*), White Mulberry (*Morus alba*), Norway Maple (*Acer platanoides*), Common Buckthorn (*Rhamnus cathartica*), Glossy Buckthorn (*R. frangula*), Non-native Bush Honeysuckles (*Lonicera* spp.), Common Barberry (*Berberis vulgaris*), Japanese Barberry (*Berberis thunbergii*), Himalayan

Balsam (*Impatiens glandulifera*), Greater Celandine (*Chelidonium majus*), and Reed Canarygrass (*Phalaris arundinacea*).

The 2019 invasive plant action plan is currently being prepared, and will be available shortly. It will be building upon the work done in the previous plans, as well as considering new establishments of invasive species on the property and recent research done on removal efforts and species invasiveness. Work plans will be based around a four-step system of Prevention, Early Detection & Rapid Removal, Eradication, and Containment/Control, and will use the priority areas designated in this EMP to further determine the urgency of invasive species removal throughout the property.

7.7.2 Animals

Mature ash trees (*Fraxinus* spp.) on the property are susceptible to attack by Emerald Ash Borer (*Agrilus planipennis*; EAB). As of 2014, most of the mature specimens in the Hogsback Forest, Indian Woods, and Cliffs and Alvars Forest, and other forested parts of the property, are dead or irreversibly dying due to infestation. Trees that are still living may present some resistance to the borer, and the Gosling Research Institute for Plant Preservation (GRIPP) at the University of Guelph should be given the opportunity to collect genetic material for further investigation. Our current research focuses on understanding and monitoring vegetation and how it relates to natural enemy abundance and diversity, an important facet of resilient forests. A link between vegetation and habitat characteristics using VSP and natural enemies may help to provide a strong basis on which to create and improve ecological restoration and rehabilitation programs for ***rare*** moving forward, especially in 'aftermath' forests post-EAB invasion.

7.7.3 Diseases

The most important non-native tree disease on the ***rare*** property is Butternut canker (*Sirococcus clavigignenti- juglandacearum*), which attacks the endangered butternut tree (Davis & Meyer, 2004). In 2009, Drs. Kirk Broders and Greg Boland from the University of Guelph evaluated the bud, flower, and seed infection of Butternut by the canker pathogen and investigated the role of infected seed in disease dispersal, resulting in three peer-reviewed scientific publications. Collection of tree materials by GRIPP has occurred, and ***rare*** continues to monitor the health of the remaining Butternut trees on property.

Several emerging infectious diseases have been identified as a major threat to native species of amphibians and reptiles, namely: Snake Fungal Disease (SFD; caused by the fungus *Ophidiomyces ophiodiicola*), Chytridiomycosis (chytrid Fungus; *Batrachochytrium dendrobatidis*), and ranavirus. SFD has been confirmed in several locations across southern and central Ontario and most prominently impacts the respiratory system in non-venomous species like those at ***rare*** (Canadian Wildlife Health Cooperative, n.d). Chytrid fungus is known in Ontario, but more research is required to further understand its impacts, symptoms, and relationships with documented amphibian declines. It was documented as present at the ***rare*** Charitable Research Reserve by Kirsten McMillan (Laurentian University) in 2015 where she found it in high prevalence but with weak infection loads and no obvious signs of disease or recorded related mortalities. In 2017, a study focusing on establishing risk maps for both

chytrid and ranavirus in at-risk amphibians was conducted in part at ***rare*** by Dr. Amanda Bennett (Trent University). Ranaviruses have a high mortality rate and associated frog and salamander mortalities in Canada have been recorded in at least five provinces (Canadian Wildlife Health Cooperative, n.d.). There is currently no treatment and ***rare*** should be monitoring for any large mortality events, particularly in and near breeding ponds in spring and summer.

7.8 Strategic Land Acquisition Plan

In the past, ***rare*** has considered parcels of land to be particularly desirable if,

- They are contiguous with the current property
- They present opportunities for research in restoration and rehabilitation of lands (especially aggregate pits).
- They would secure portions of existing land features not entirely on ***rare*** property, or mitigate stress to existing landscape features through a variety of mechanisms (i.e. wildlife corridors, safe wildlife crossings, storm water or groundwater management, etc).

Since the previous edition of the EMP, ***rare***sites has developed as the regional land securement program under the ***rare*** umbrella serving Waterloo-Wellington. Following certification as an EcoGifts Recipient in 2014, the organization expanded its vision to include stewardship of conservation lands in the broader area.

In the long term, ***rare*** is interested in and has begun to expand its land base through purchase or donation through such mechanisms as bequests, private donations, or transfer from individuals or businesses as a charitable donation, or through establishment of conservation easements (***rare***sites, 2019)

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