

Upper Twelve Mile Creek Action Plan

2021 – 2031



Image courtesy NPCA

Trout Unlimited
CANADA



**NIAGARA
CHAPTER**

Upper Twelve Mile Creek 2021 Action Plan Update

Ensuring the creek we need for the future we want



Funding and support provided by the Niagara Chapter of Trout Unlimited Canada membership and the Niagara Peninsula Conservation Authority.

Trout Unlimited Canada is a registered Canadian not-for-profit organization with the mission to conserve, protect and restore Canada's freshwater ecosystems and their cold-water resources. Staff and volunteers have been working for over 40 years to protect natural spaces and improve Canadian resources. The Niagara Chapter of Trout Unlimited Canada has been working passionately within the upper Twelve Mile Creek watershed for the past 10 years, with a primary focus on habitat and water quality restoration to help conserve Niagara's only cold-water watershed and self-sustaining brook trout population.

This document is not a comprehensive watershed plan. The information and recommendations are provided as guidance, with some actions requiring approvals (permits, authorizations, permissions) from various agencies, while others may require further assessment and study.

We invite you to reproduce or adapt any part of this Action Plan for the purpose of furthering the recovery and restoration of the Upper Twelve Mile Creek watershed.

Feedback and comments are welcome. Contact us at:

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Upper Twelve Mile Creek 2021 Action Plan Update

Table Of Contents

List of Acronyms and Abbreviations	3
Executive Summary	4
Summary Of Recommended Actions	5
Reflections	7
Twelve Mile Creek Watershed Overview	8
Where is Twelve Mile Creek?	8
Where is the upper Twelve Mile Creek?	9
What makes the Twelve Mile Creek unique?	11
Why an urgent need for an action plan 2021 update?	13
The 2021 Action Plan Update Process	15
Scope of work	15
What did we aim to achieve?	15
Who did we engage with and how?	16
What did we learn?	16
How will progress be measured?	18
Recommended metrics and indicators	19
What is the work that needs to be done?	20
Recommendations	22
Issues, opportunities, recommended actions	22
Implementation Chart: Actions, Responsibility, and Schedule	34
References	41

List of Acronyms and Abbreviations

BU	Brock University
CA	Conservation Area
CofSC	City of St. Catharines
CofT	City of Thorold
FSHP	Friends of Short Hills Park
GI	Green Infrastructure
GIS	Geographic Information Systems
HNC	Hamilton Naturalists' Club
LCN	Land Care Niagara
LID	Low Impact Development
MNRF	Ministry of Natural Resources and Forestry
NEC	Niagara Escarpment Commission
NC	Niagara College
NCC	Nature Conservancy of Canada
NPCA	Niagara Peninsula Conservation Authority
NPCF	Niagara Peninsula Conservation Foundation
NR	Niagara Region
NRC	Niagara Restoration Council
STEP	Sustainable Technologies Evaluation Program
SWM	Stormwater Management
SWMWG	Stormwater Management Working Group
TBD	To be determined
TofP	Town of Pelham
TMC	Twelve Mile Creek
TUCN	Trout Unlimited Canada – Niagara Chapter
UofG	University of Guelph
UofT	University of Toronto
UTMC	Upper Twelve Mile Creek
WQ	Water Quality

Executive Summary

The health of the upper Twelve Mile Creek (UTMC) ecosystem is in serious decline. Over the last several decades, land conversion, including urbanization and agriculture, invasive species, and the consequences of accelerated climate change, has caused serious environmental degradation. As the only cold-water system in the Niagara Region, the Niagara Chapter of Trout Unlimited Canada (TUCN) has been working to help advance their mandate of conserving Niagara's last remaining brook trout population. Brook trout are biologically significant, requiring unimpaired habitat, with high water quality conditions. They are a culturally significant fish, viewed as a community indicator of health, wellness, and biological integrity. The declining brook trout populations in the UTMC serve as an early warning system for water quality and habitat impairment, signaling creek health is in jeopardy, and rapid restoration interventions are needed.

This 2021 action plan update evolved from discussion between TUCN, the Region of Niagara and the Niagara Peninsula Conservation Authority (NPCA), where these organizations recognized that in the absence of a current watershed plan, inclusive action was needed in the UTMC watershed, to help ensure targeted restoration and conservation action. TUCN took the lead role in the development of this 2021 updated action plan, focusing only on the UTMC watershed portions that support brook trout and their habitat. TUCN is the owner of this 2021 action plan update and is responsible for its implementation. The NPCA is a lead partner, whose expertise is an essential component for the operationalization of many of the update's recommendations.

The purpose of this action plan update is to create a "road map" or "blueprint" to help guide and inform the remediation and restoration efforts of TUCN, including helping to secure future funding opportunities and creating synergies with partners. The scope of work for this action plan update involved the identification of current issues, opportunities, and recommendations that can be undertaken to help conserve and protect declining brook trout populations in the St. John's and Effingham branches of the UTMC. The ten-year restoration goal of this action plan is to increase brook trout populations in the upper tributaries and expand their range downstream into Short Hills Provincial Park.

Although this update followed the guiding principles of watershed management planning, the update is not a comprehensive watershed plan, but rather a collection of community and partner reflections, perspectives, and best practices, collated into recommendations that can be implemented to help restore the health of the upper watershed. Underpinned by expertise and science, the recommendations are not policy and do not bind TUCN or any of their identified partners as having obligatory implementation responsibility. The recommendations are provided as guidance and are suggested as suitable or appropriate actions that can be undertaken strategically over the next ten years to help ensure the long-term health of the UTMC watershed, with a focus on TUCN's mandate of brook trout protection and recovery. The following summary of recommendations have been developed through extensive community, partner, and stakeholder engagement and input.

Summary of Recommendations

Governance / Management

- Establish an implementation oversight committee (multi-partner collaborative approach)
- Establish a monitoring and data management sub-committee
- Update the Twelve Mile Creek watershed plan
- Form a stormwater management working group (SWMWG)
- Update stormwater management policies
- Adopt a Town of Pelham and City of Thorold erosion control by-law
- Establish a communications sub-committee

Stormwater Management (SWM), Runoff and Flooding

- Implement source controls (lot and property level water / pollution interception / control)
- Implement conveyance controls (once water / pollution impacts move off site)
- Implement end of pipe controls (last chance before water / pollution enter creek)
- Create a green infrastructure and low impact development pilot program

Ecosystem Restoration

- Enhance terrestrial, riparian (land / water interface), and aquatic restoration programs

Studies / Assessments / Monitoring

- Undertake a water budget / balance study to ensure the hydrological regime is protected
- Enhance sediment (suspended, transport) and erosion monitoring
- Undertake a culvert / barrier assessment & mitigation program
- Conduct brook trout population density, distribution, and habitat studies
- Enhanced water quality monitoring
- Improved flow and weather station monitoring
- Enhanced UTM temperature monitoring program

Environmental Awareness / Communications / Marketing

- Explore opportunities for: watershed road signage, walk-shops, workshops, conferences, stewardship project tours, photo contests, webinars, podcasts

Summary of Recommendations (continued)

Community Engagement

- Enhanced volunteer stewardship opportunities for water quality / habitat improvement
- UTMC landowner group / association
- Indigenous Peoples engagement including conversation circle

Reporting

- Undertake annual action plan update, newsletter (quarterly), Media (Conservation Corner), Watershed Report Card

Sustaining Action

- Pursue funding opportunities for action plan implementation / coordination
- Explore Land Acquisition opportunities



Volunteers at work on riparian repair project.

Reflections

The Niagara Region is covered by the Treaty at Niagara and is within the land protected by the Dish With One Spoon Wampum Agreement [1]. This Agreement is an Indigenous citizenship law made between the Haudenosaunee and Anishinaabe nations in 1701, and extends from Montreal, Quebec, all the way to Lake Erie in the Niagara Region [1]. The Wampum Agreement consists of two rules: 1) Take only what you need; 2) Leave the rest for everybody else.

The first human inhabitants of the Great Lakes basin, the original peoples, and the sole occupants of the land for thousands of years, the First Nations People of Turtle Island (current day North America), were the first to discover the wonders of the Twelve Mile Creek watershed. Abundant game, fertile soils and plentiful clean and cool upwelling water enabled the early development of hunting, subsistence agriculture, and fishing. The Niagara Region is the traditional territory of the Haudenosaunee and Anishinaabe peoples, many of whom live and work in the region today. The great standard of living afforded to the residents of Niagara is directly related to the unique and enduring relationship that exists between Indigenous Peoples, their traditional territories, and their deep connections to the air, land, and water they call home.

“And when visiting any home, it is important to ‘knock’ before entering, and to communicate your arrival” [2].

It is therefore with great urgency the Niagara Chapter of Trout Unlimited Canada “knocks” at the door of all Niagara residents and community members who live, work, and play in the UTMTC. The UTMTC watershed ecosystem health is in rapid decline. As the only remaining cold-water system in the Niagara Region, it is approaching its tipping point, moving dangerously in the direction of irreversible degradation, unable to sustain the fragile brook trout species it currently supports.

Now is the time for sustainable action - take only what you need and leave the rest for our future generations. It will not be easy. It will take all community members, working collaboratively together to reverse the environmental degradation, and restore the rich cultural and natural heritage for all (humans and non-humans) who call the UTMTC home.



Healthy UTMTC riffle, courtesy NPCA



Impacts from sediment and erosion, courtesy TUCN

Twelve Mile Creek Watershed Overview

Where is Twelve Mile Creek?

The Twelve Mile Creek (TMC) watershed is located within the Regional Municipality of Niagara, originating above (south of) the Niagara Escarpment in the Town of Pelham. The creek travels approximately 22 kilometers through the municipalities of Pelham, Thorold, St. Catharines, and Lincoln. The TMC watershed contains 6 sub-watersheds, including the UTM (St. Johns and Effingham tributaries), Lake Gibson System, Richardson Creek, Francis Creek, Dicks Creek, and the Lower Twelve Mile Creek, draining a total area of 178 square kilometres and out-letting to Lake Ontario at Port Dalhousie (Figure 1).



Figure 1: Entire Twelve Mile Creek watershed area [NPCA].

The headwaters (origin) of Twelve Mile Creek start at several groundwater, spring-fed locations in the upper watershed. These springs are a result of groundwater and surface water interactions created by the Fonthill Kame. The Fonthill Kame-Delta Complex was created 12,500 years ago during the close of the Wisconsin glacial period. As glacial ice flows retreated across the Niagara Region, a massive load of glacial debris (gravel, sand, and silt) was deposited in a large cylindrical shape, creating the Fonthill Kame. The Kame is approximately 6 km in diameter and 75 m high. It is a unique geological feature in Southern Ontario. Located above (south) of the Niagara Escarpment, it is the highest point of natural elevation in the Niagara Region (Figure 2), and the only location where it is possible to see Lake Erie & Lake Ontario at the same time on a clear day.

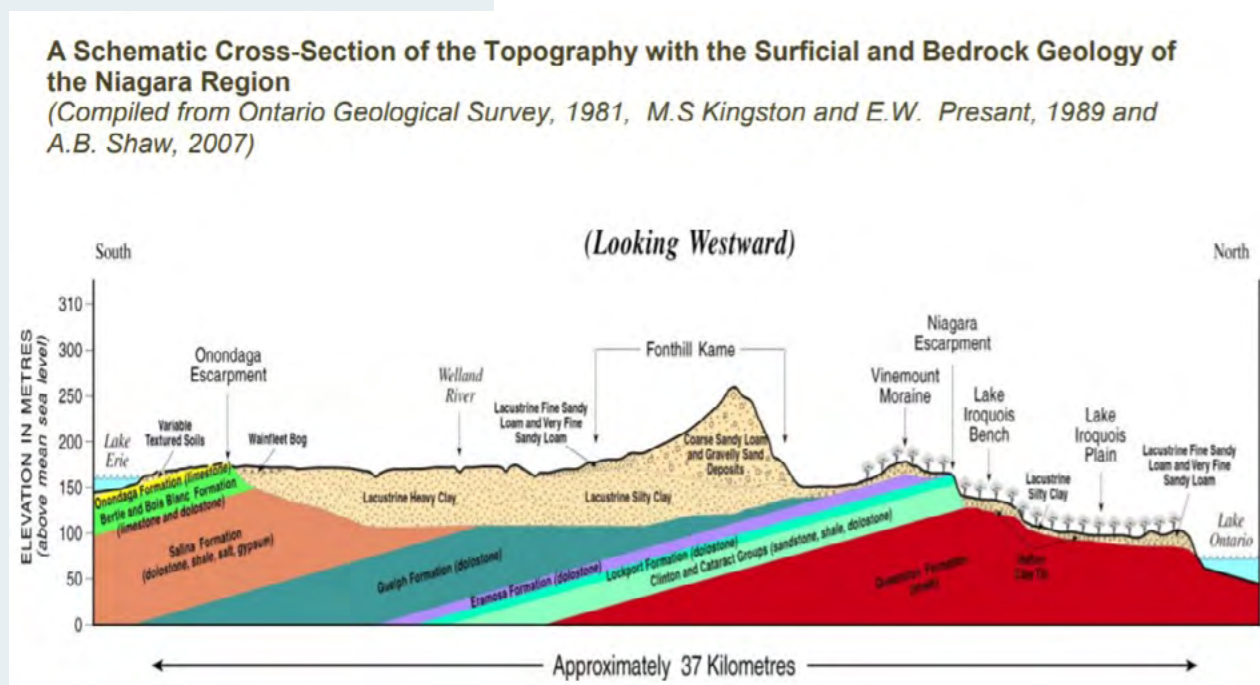


Figure 2: Cross section of Niagara geology [3].

Where is the upper Twelve Mile Creek?

This 2021 action plan update focuses only on the St. John's and Effingham tributaries (branches) of the upper Twelve Mile Creek (Figure 3). These two branches form the upper headwater area and are the only cold-water components of the entire TMC watershed system.

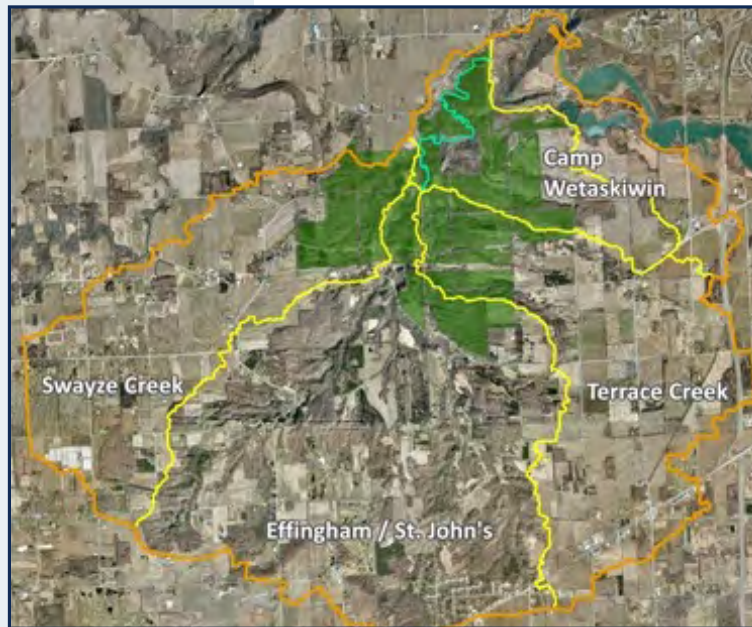


Figure 3: UTMC Effingham and St. John's Tributaries [NPCA]

The UTMC occupies an area of approximately 51 square kilometres (5,100 hectares) and contains approximately 1,657 property parcels. (Figure 4). The watershed is dominated by urban residential, agriculture, horticulture, natural areas including mixed (coniferous and deciduous) forest. The area demonstrates a varied local economy across several other sectors, including small commercial businesses, hospitality, finance, government, and recreation (Figure 5). The impervious area (built surfaces) of the watershed is approaching 25% (Figure 5). Research shows, once the impervious area of a watershed surpasses 10%, health indicators such as good water quality notably decline with ecosystem degradation reaching severe levels at 30% [4].



Figure 4: UTMC land use [NPCA].

Land use category	Land use (%)
Water	0.43
Wetland	4.58
Mixed Forest	27.07
Deciduous Forest	13.35
Coniferous Forest	3.00
Spare Forest	6.33
Grassland, Shrub	2.06
Bare Soil	1.19
Cultivated	16.32
Settlement Open Area	2.27
Pervious Area Total	76.6
Commercial; Industrial	0.93
Residential	17.19
Road	5.28
Impervious Area Total	23.4

Figure 5: UTMC land use by percentage [NPCA].

What makes the upper Twelve Mile Creek watershed unique?

Geology

The Fonthill Kame-Delta Complex forms the headwaters of the UTMW watershed and is a significant cold-water, groundwater recharge area [5]. The Kame has four geologic divisions: a top zone of sand and gravel; an upper area of gravelly sand; a lower area of sand and silt; and a lowermost area of sand, silt, and clay. These four divisions combine to create a very porous soil structure. Extremely large volumes of precipitation (rain and snow melt) are easily absorbed and stored in the Kame's large volume. The porous Kame soils work together with the underlying thick Haldimand clays, creating a pressure differential that allows for the slow and constant release of stored precipitation as groundwater discharge in the form of cold, clear water. This constant flow of water is referred to as baseflow, emerging in the form of groundwater upwelling, creating cold-water springs that form the start (headwaters) of the UTMW and support systemic flows by sustaining outflow in the downstream channels.

Cold-water creeks are generally less than 18°C during peak summer air temperatures and greater than 4°C during minimum winter air temperatures (approximating the local average annual air temperature of about 10°C). They are generally rich in biodiversity and the aquatic life they support, including sensitive species of fish and benthic macroinvertebrates (i.e. mayflies, dragonflies, caddisflies, and stoneflies) [6].

Brook Trout (*Salvelinus fontinalis*)

Brook trout are small, brilliantly colored freshwater fish native to the headwaters of clear, cold-water streams in North America. The brook trout's scientific name *Salvelinus fontinalis*, translates as "salmon-like fish of the springs". As an endemic species (always here), brook trout are known as the "painted fish" and are considered a sacred species by many Indigenous Peoples [7]. Brook trout have a dark green back covered with lighter worm-shaped markings, resembling the pattern of sun shining through rippled water. These markings camouflage them from predators such as herons. Their undersides are speckled with yellow spots, and red spots surrounded by blue halos. These markings help them blend in with the gravel and cobble creek beds where they spawn.



Brook Trout, courtesy River Traditions

The brook trout in the UTMC are the only native Salmonid fish species naturally occurring in the in-land waters of the Niagara Region. As the most sensitive Salmonid species (to water quality and habitat degradation), brook trout rely on pollution free, cold-water habitats with overhanging vegetation and groundwater upwellings to support all their life cycle needs. They are intolerant of water temperature above 23°C, with the optimal range between 11 - 16°C [6].

Brook trout are biologically significant as they require pristine, stable habitat with high water quality conditions, and are viewed as community indicators of health and biological integrity.

Brook trout require the same biological attributes humans need in a healthy environment [6,7]. The declining brook trout populations in the UTMC serve as an early warning system for water quality and habitat impairment, signalling creek health is unbalanced, and rapid restoration interventions are needed to ensure their survival. In addition, impaired water quality negatively affects human health, with poor water quality shown to have negative effects on community reputation and property values [8,9].

Flora and Fauna

The Niagara Region is one of the most biologically diverse life zones in North America [10]. The local climate is moderated by the Great Lakes and the Niagara Escarpment, enabling the Niagara Region to support plants and animal species not found in other parts of North America [10]. Although the Fonthill Kame is the driver for the cold-water creek, the Short Hills land feature is an important terrestrial ecosystem within the UTMC watershed [10]. Formed 12,500 years ago through a complex glacial process of ice scouring and deposition, the V-shaped valleys that resulted are referred to as the current day Short Hills topology. This topology along with the Fonthill Kame, shaped the UTMC unique geology, helping to support plants and animals of the Carolinian Life Zone, many



Red Trillium, courtesy NRC



Jack-in-the-pulpit, courtesy NRC

of which are species at risk and protected, provincially and federally. Even though the Carolinian Canada life zone is only 1% of the country's total land area, it supports a greater number of both flora and fauna species than any other ecosystem in Canada [10]. The UTMC contains the highest percentage of protected natural areas in Niagara, including Environmentally Sensitive Areas (ESAs), Areas of Natural and Scientific Interest (ANSIs), St. Johns Conservation Area, the Nature Conservancy of Canada's Lathrop property, the Hamilton Naturalists' Club Short Hills Sanctuary property, and Short Hills Provincial Park [10]. The abundance of forested natural areas has attracted several species at risk, including the Hooded Warbler and Acadian Flycatcher. The UTMC provides one of the most important breeding sites for the Hooded Warbler in all of Canada [11].

People

With over 85 percent of the UTMC watershed in private land ownership, the landowners are well positioned to have a meaningful and cumulative impact on the recovery and future protection of this valuable natural resource. As a priority watershed for restoration, many stewardship programs and partners have been working collaboratively for more than two decades. Through programs including TUCN's Healthy Twelve Mile Creek, the NRC's Restoring the Twelve Mile Creek, LCN's Natural Heritage Framework, and the NPCA's Twelve Mile Creek Watershed Plan, hundreds of landowners have been engaged through "shovel-in-ground" stewardship projects. A good foundation of watershed advocates currently exists, but there is much more work to be done. Many community members are still unaware of how their health is linked to the health of the environment that surrounds them, including the role brook trout play as an early warning system for environmental degradation. Governments and agencies alone cannot solve the issues threatening the UTMC. Landowners play an important role in the implementation of the 2021 action plan update recommendations. By participating in restoration work, especially the work of TUCN's Healthy Twelve Mile Creek program, landowners can help ensure the long-term viability of this critically important ecosystem.

Why an urgent need for a 2021 action plan update?

Over the last several decades, land conversion, including urbanization and agriculture within the UTMC watershed, has caused serious environmental degradation. Increasing human-nature conflicts (urbanization, agriculture, invasive species, accelerated climate change) are pushing the system toward collapse. Community partners are increasingly concerned about losing the healthy cold-water attributes supporting the brook trout and other species of plants and animals that make the UTMC watershed unique.



UTMC flooding & sediment, courtesy NPCA



UTMC flooding & sediment impacts, courtesy NPCA

“The urgent timing of this update and the recommended actions can not be overstated” [12].

The TMC is an important watershed from a biological, cultural, geological, agricultural, and economic perspective. The UTMC has been targeted as a planning and restoration priority since the late 1990’s. The NPCA’s most recent TMC watershed plan was developed in 2006 with a 10-year action plan, which expired in 2016. As a foundational guidance document, the 2006 Twelve Mile Creek action plan needed updating.

Working with the NPCA, the TUCN took a lead role in the coordination of this 2021 action plan update. The work of TUCN is focused on the restoration, preservation, and protection of this cold-water resource by ensuring the recovery and sustainability of brook trout and their habitat. An essential component of their work is ensuring the UTMC watershed contributes to an improved quality of life for all living things, human and non-human, while ensuring there is enough water, of necessary quality, to sustain healthy communities, in harmony with the natural environment. Both the NPCA and TUCN realized the pursuit of a 2021 action plan update for the UTMC provided an enhanced opportunity to synergize the work of the multiple agencies, citizens groups, and landowners already working together for the protection and restoration of the watershed. The goal of this 2021 action plan update is to strengthen partnerships while inspiring all community members to take immediate action towards improving the ecosystem health of the UTMC watershed.

The 2021 Action Plan Update Process

Scope of Work

The scope of work for this 2021 action plan update focused on the upper Twelve Mile Creek watershed, specifically the St. John's and Effingham branches. Informed by the work previously accomplished through the Twelve Mile Creek Watershed Strategy (2000) and the Twelve Mile Creek Watershed Plan (2006), this update focused on six key areas:

1. Literature review
2. Issue identification
3. Partner and community engagement
4. Issues and opportunities synthesis
5. Recommended Actions
6. Implementation framework

The development of this 2021 action plan update followed the guiding principles of integrated resource management, looking through a sustainability science lens for managing human activities and natural resources, by balancing the needs of people with the environment. Great effort was given to incorporate as many perspectives as possible, to ensure community goals are reflected and recommendations are actionable and realistic.

What did we aim to achieve?

The aim of this 2021 action plan update is to create a “road map” or “blueprint” to assist watershed partners in the management of the land, water, and aquatic life, to protect and improve the health of the ecosystem. This 2021 action plan update recommends activities and strategies that can be undertaken by all sectors of the community over the next ten years. The objectives are the preservation and restoration of the creek and its floodplain to a state which balances both the needs of the landowners and the environment. An important component was the engagement with community members, including landowners, interest groups, government officials, and elected representatives during all phases leading to the final action plan product.

Who did we engage with and how?

The engagement process included project initiation announcements through a media release, partner outreach, a TUCN advertisement and article in local media (Voice of Pelham, Niagara This Week), and an interview on 610 CKTB radio. A virtual 2021 action plan update public meeting was held with over 170 participants registered. The meeting provided an overview of the unique characteristics of the UTMC watershed, with an issues / opportunities discussion, followed by a question-and-answer period. A public input portal and email communication system was established for feedback.

Community partners and the public were invited to submit their perspectives of the issues and opportunities for UTMC remediation and recovery. Through questionnaires and a community engagement portal, input was received from the following community partners: TUCN executive, projects committee and membership; NPCA (staff, board, and committees); Niagara Region; Town of Pelham; City of Thorold; City of St. Catharines; Niagara College; Brock University; Friends of Short Hills Park; Land Care Niagara; Niagara Restoration Council; Hamilton Naturalists' Club; Agape Valley; Nature Conservancy of Canada; and the general public, including landowners.

What did we learn?

The community engagement process from the NPCA 2006 watershed plan identified the following three main issues [13]:

- A lack of interagency communication and collaboration;
- Uncertainty pertaining to the roles and responsibilities of government agencies;
- The need to promote partnerships between municipalities, public interest groups, and citizens, including landowners.

The 2021 action plan update community engagement identified similar issues, signaling better communication, collaboration, and effective partnerships as priority areas that need to be addressed (Figure 6). Sedimentation, erosion, degraded water quality, and loss of aquatic habitat including the decline of brook trout were also significant community concerns (Figure 6).

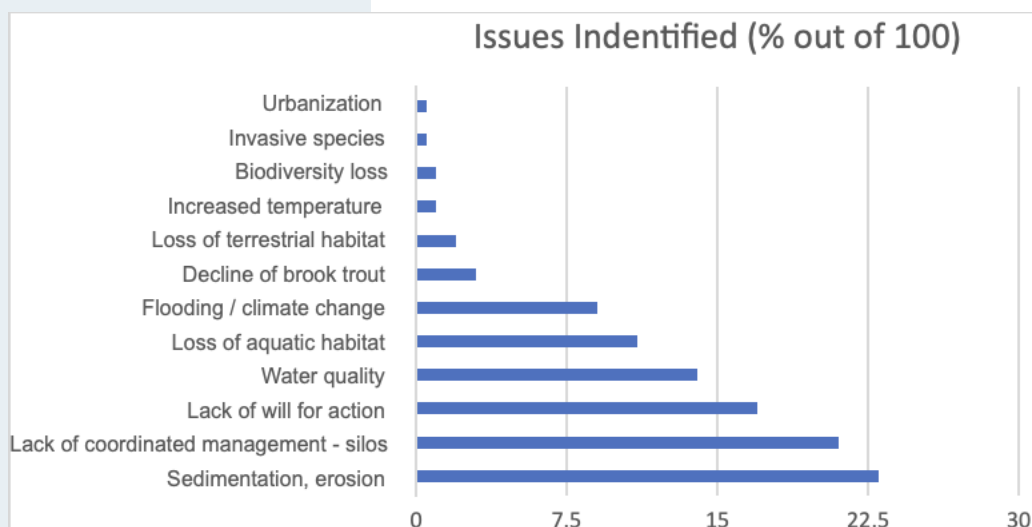


Figure 6: Identified issues from UTMCM 2021 action plan update engagement process.

Flooding and creek damage from increased severe storm events were a priority concern for landowners who own property in the floodplain or in proximity to the creek. The effects of accelerated climate change in relation to the increased storms, coupled with expanding urbanization and run-off in the headwaters was a common concern (Figure 7). Community residents are worried about the long-term sustainability and ecosystem health of the UTMCM, with many not understanding what they as individuals can do to improve the situation.



Sulphur Spring Rd flooding in 2014, courtesy NPCA



Property flooding in 2014 at Roland Rd, courtesy NPCA

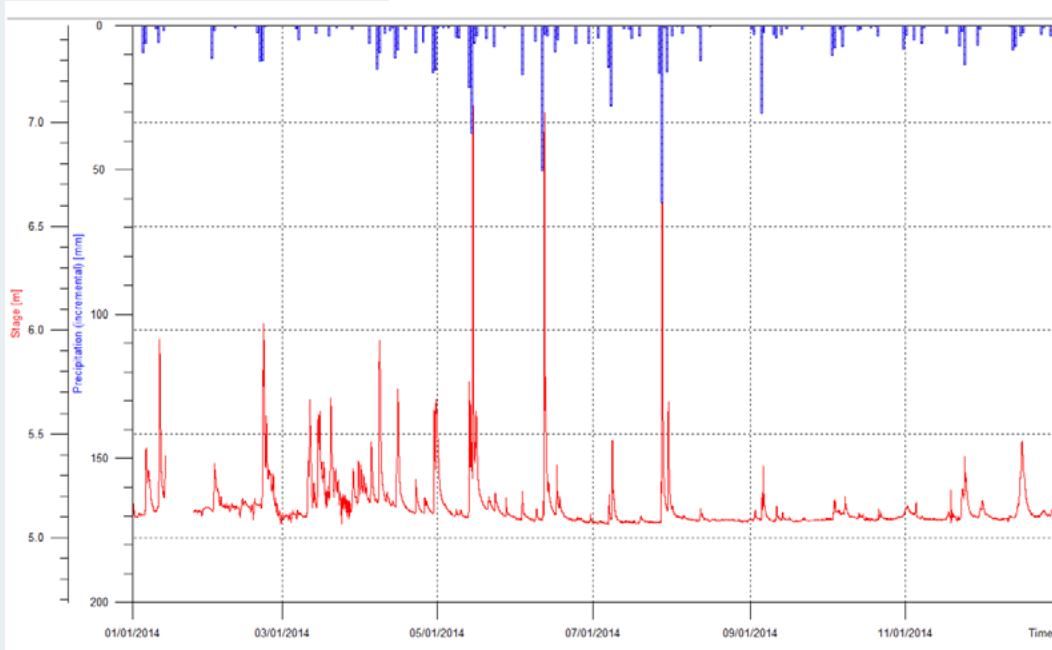


Figure 7: Twelve Mile Creek Hydrograph at DeCew Road showing multiple 2014 severe storm events where the UTM rose several meters in less than half a day [NPCA].

How will progress be measured?

You cannot manage what you do not measure. To effectively manage and measure progress, metrics must be meaningful. They should help solve a problem and quantify success. Metrics should be cost-effective and properly resourced with people possessing the necessary skills, tools, and time to conduct the required work. The following metrics have been selected as meaningful and realistic indicators to describe the current conditions (2021) of the UTM and provide a benchmark to measure future progress against (Table 1). These metrics will also assist in tracking and reporting 2021 action plan update implementation progress.



UTMC water quality monitoring, courtesy NPCA

Table 1: Metrics and Indicators

What will be measured?	Why measure?	Who will measure?	When will it be measured?
Percent watershed Impervious area	> 10% impervious area signals poor ecosystem health [4,14,15]	NPCA GIS	Year 1 (2022), 4 (2025), 7 (2028), 10 (2031)
Percent Rural Forest Cover	< 30% results in biodiversity loss [16]	NPCA GIS	Year 1 (2022), 5 (2026), 10 (2031)
Percent Urban Canopy Cover in headwaters	1 large tree intercepts 20 – 50% of rain [17]	NPCA GIS	Year 1 (2022), 5 (2026), 10 (2031)
Percent riparian buffer cover	> 75% to maintain temperature and filter sediment [16]	NPCA GIS	Year 1 (2022), 5 (2026), 10 (2031)
Wetlands	40% of historic wetlands restored [16]	NPCA GIS	Year 1 (2022), 5 (2026), 10 (2031)
Water Temperature and dissolved oxygen (DO)	All UTM tributaries < 20°C [5] DO > 9.5 mg/L [18]	NPCA, TUCN, NC students	Continuous datalogger monitoring
Total sediment load (transport rate)	Amount of sediment transported over time	NPCA, TUCN, NC students	Spring. Added to enhanced monitoring schedule
Suspended Solids	< 25 mg/L [19,20]	NPCA, TUCN, NC students	Added to enhanced monitoring schedule
Chloride (Road salt)	< 120 mg/L [18,20]	NPCA, TUCN, TofP, CofT, NR, NC students	Added to enhanced monitoring schedule
Number of restoration projects completed	Measure program(s) uptake	NPCA, TUCN, LCN, NRC, NCC	Annually
Number of trees planted (rural and urban)	Maintain accurate tree accounting	NPCA, TUCN, LCN, NRC, CofT, NR, TofP	Annually
Number of community partners engaged	Measure community and political will	NPCA, TUCN, LCN, NRC, TofP	Annually
Number of action plan recommendations implemented	Measure of action plan progress	Action plan Coordinator (see recommendations)	Annual progress report, watershed report card (every three years)

What is the work that needs to be done?

The identified issues were used to help inform and develop the 2021 action plan update recommendations, including the management activities needed to address them. The variety and complexity of the issues demonstrates the need to establish recommendations that are specific, measurable, and have responsibility structures and timeframes. To help ensure effective and efficient delivery, the recommendations also have associated timelines, estimated costs, and suggestions on progress monitoring and reporting.

Oversight Committee

The establishment of an oversight committee is seen as a valuable contribution to the overall health and protection of the UTM. An oversight committee will help ensure the efficient implementation and coordination of recommendations while promoting:

- Interagency communication, collaboration, and synergy;
- Partnerships between agencies, interest groups, and landowners;
- Coordination of work, programs, and funding resources.

Although TUCN is the owner of the 2021 action plan update and is responsible for its implementation, the research is clear - participatory and collaborative forms of governance lead to more effective improvements in environmental quality, with the public more trusting of governance and management structures consisting of many organizations [21]. The inclusion of multi-agency partners, stakeholders, and community members has been found to increase the acceptance of decisions and improves compliance and implementation on the ground [21,22]. An oversight committee is a forum for partners to come together in the spirit of collaboration, to work together on actions within the UTM.



Courtesy NPCA

Water Budget Study

The establishment of a water budget is an important study recommendation to provide an accounting of all inflows, outflows, and changes in storage (water balance) in the headwaters. Currently, the water inputs are greater than the storage and infiltration capacity, as evident in the overwhelming of SWM infrastructure. The increased development and corresponding stormwater runoff in the headwaters are significant factors contributing to the ecological degradation of the UTMC. Understanding the hydrological regime is essential to ensuring future development, planning, and engineering decisions are grounded in science.

Next Steps

The following recommendations and considerations will be instrumental in restoring and protecting the UTMC watershed and all its residents (human and non-human) from further environmental decline while ensuring the sustainability of Niagara's only cold-water, brook trout resource.



Implementation Recommendations

Recommended Action	Identified Issue	Opportunity
Governance / Management		
Establish an implementation oversight committee (multi-partner collaborative approach)	The top issues identified by community partners is the lack of public and political will for action, and the need for integrated resource management in the UTMC. There is confusion about who is responsible for what (i.e., stormwater management, data collection, monitoring, reporting) and the lack of a consistent, coordinated, and properly resourced restoration approach. These are similar to issues identified over 17 years ago during the NPCA's 2006 watershed planning process, with the lack of interagency communication and collaboration identified as a top concern at that time.	The establishment of an implementation committee co-chaired by TUCN and NPCA leadership can ensure the coordinated and collaborative delivery of action plan recommendations [20,21]. The Town of Pelham has been identified as the preferred agency to host this committee. The municipal offices are located in the headwaters of the watershed, with the Town having an existing committee establishment structure, designed to promote partnerships between municipalities, public interest groups and citizens, including landowners. An implementation committee will also ensure a multi-partner collaborative approach for advising on community issues.
Establish a monitoring and data management sub-committee	Since 1994, many partners have been working within the UTMC, undertaking studies, and collecting data through various monitoring programs. With multiple agencies running parallel monitoring programs, there is a need for a coordinated approach to minimize duplication of efforts and resources. There are many reports that are housed at various locations including BU, NC, NPCA, TofP, and TUCN.	With multiple agencies and groups collecting information and conducting studies, there is a need for a data sub-committee (established under the implementation committee umbrella) and a central repository for storing and disseminating information. The NPCA working with NC is well positioned to provide repository services for data storage and dissemination.

Recommended Action	Identified Issue	Opportunity
Governance / Management continued		
Update the Twelve Mile Creek watershed plan	This UTMC action plan update is not a comprehensive watershed plan, but rather a targeted framework to deal with the urgency of remediation needs of the St. Johns and Effingham tributaries only.	An updated watershed plan for the entire TMC system is needed for proper watershed characterization and to ensure a holistic approach to ecosystem recovery, including meaningful long-term monitoring and reporting. The NPCA and the NR are well positioned to advance this through collaboration as was done in 2006.
Form a stormwater management working group (SWMWG)	Stormwater management in Niagara is poorly coordinated, relies on outdated policies, and does not support the implementation of technologies that embrace green infrastructure and low impact development. Agencies responsible for the oversight of SWM are often deficient in financial and human resources. Additionally, incentives to encourage the uptake and adoption of innovative SWM technologies by consultants, developers, and landowners are lacking.	As a mandatory requirement, SWM in Niagara should be coordinated and consistent across all agencies, and development platforms (consultants, contractors). The formation of a working group with representation from all partners can ensure a coordinated approach to SWM for all of Niagara. The establishment of a SWM Working Group (SWMWG) should include expertise from outside of Niagara (i.e., STEP program), looking at areas such as Waterloo and Halton where great success in the implementation of GI and LID has been realized.

Recommended Action	Identified Issue	Opportunity
Governance / Management continued		
Update stormwater management policies	The Ministry of the Environment Stormwater Management Planning and Design Manual (2003), as a foundational provincial guidance document, is outdated. As a result, SWM policies at the Regional, Municipal and Conservation Authority level that are guided by this document, are also outdated, and are informed by traditional (versus current and innovative) approaches to SWM. [23]	The Region of Niagara is in the process of updating their SWM policies and their Official Plan. This process could be informed by the SWMWG and the UTMC oversight committee, with the resulting regional policies grounded in the most current GI and LID science. As umbrella policies, the Region's policies could serve as a model for municipalities and the NPCA. Any new development or construction with drainage into UTMC should have LID's incorporated into designs, such as pervious driveways, swales for groundwater infiltration etc. This needs to become a mandated requirement into new home and subdivision design.
Adopt a Town of Pelham and City of Thorold erosion control by-law	The increase in impervious area from urbanization, leads to increased surface runoff, erosion, and sedimentation. The effects of these increases include degraded water quality, loss of aquatic habitat, creek channel instability, and hazards, such as bank destabilization and fallen trees. Many municipalities mitigate the effects of increased impervious areas through erosion control by-laws. The Town of Pelham nor the City of Thorold have erosion control by-laws.	Erosion control by-laws for the TofP and CofT will provide another tool for the reduction and elimination of sediment and runoff entering the UTMC. Erosion control by-laws provide site level erosion and runoff control techniques to reduce and prevent impacts from construction sites. Measures include reducing disturbed soils, securing soils and materials (i.e., tarps, straw, re-seeding within specific timeframes), and redirecting and preventing water from having off-site impacts.

Recommended Action	Identified Issue	Opportunity
Establish a communications sub-committee	The lack of communication and/or inconsistent messaging around the importance of the UTM C watershed (beyond brook trout) has been identified as a priority issue. It is poorly understood how dangerously close the community is to losing the very attributes that make the system unique and special.	The establishment of a communications sub-committee (under the implementation committee umbrella) can lead to improved communications, especially linking brook trout as an indicator species to the broader ecosystem goals of improved habitat and water quality for the watershed. Effective communication is a key component to assist with ensuring all partners are working productively and respectfully towards shared goals.
Stormwater Management (SWM), Runoff and Flooding		
Implement source controls (lot and property level water / pollution interception / control)	Water management in the UTM C relies heavily on traditional approaches to SWM, moving precipitation and runoff as quickly as possible away from where it intercepts surfaces (i.e., roof-tops), to downstream catchment areas (i.e., stormwater retention ponds). In the UTM C, this rapid transfer of water is overwhelming the current SWM infrastructure and significantly impacting water quality and in-stream habitat. In addition, the natural water balance of the UTM C has been severely impacted. GI including LID solutions mimic and incorporate natural features to capture, redirect, and redistribute stormwater. LID approaches to water management more closely replicate the natural (pre-development) environment and include technologies such as permeable pavement (roads, parking lots), soak-a-way pits, rain gardens, rain barrels, green roofs, bioswales and constructed wetlands.	Science-based, contemporary approaches to SWM from concept through to implementation and long-term maintenance are needed. The first step to achieve this is the updating of SWM policies to better mimic the natural environment and pre-development water balances. Looking at source controls and infiltration methods should be the first step for capturing and controlling lot level runoff. Conveyance controls through infiltration can better deal with water once it leaves a property. End of pipe controls should replicate natural wetland design and function, to help capture and slow runoff before it enters the creek, while mitigating downstream erosion, sedimentation, and pollution impacts. Natural systems are more flexible and adaptive than engineered infrastructure, playing an important role in mitigating increased runoff from urbanization and severe storms.
Implement conveyance controls (once water / pollution impacts move off site)		
Implement end of pipe controls (before water / pollution enter creek)		

Recommended Action	Identified Issue	Opportunity
Stormwater Management (SWM), Runoff and Flooding continued		
Create a green infrastructure and low impact development pilot program, including training for developers and practitioners	The transition to sustainable community planning through the incorporation of GI and LID has been a slow process in many Canadian municipalities. This slow uptake is due to the lack of financial and human resource capacities, short term political cycles, and the lack of community engagement and participation [24]. Successful GI and LID infrastructure capital projects require varying types of expertise and levels of vested interest, with the full participation of all stakeholders and partners. Urban ecosystems with integrated GI and LID perform better than traditional engineered solutions, can cost anywhere from 5-30% less to construct, and can reduce life-time maintenance costs by well over 25% [25].	The shift to green ecosystem planning and implementation is essential for the sustainability and resiliency of the UTMC, especially considering the vulnerabilities of the system to increased severe storms from accelerated climate change. A GI and LID pilot program that includes training and effectively working with the many successful municipal examples (i.e., Waterloo, Halton, Town of Lincoln), should be investigated to offer development incentives for the incorporation of GI and LID into development and construction projects (businesses, subdivisions, and private lands). Examples include; expedited permitting, decreased development fees, and rebates to property owners for reducing stormwater runoff i.e., permeable pavement (driveways, walkways, parking lots), rain gardens, rain-barrels, green roofs, naturalization, urban planting.
Align Climate Change Adaptation to GI and LID development pilot program with the Town of Pelhams climate change adaptation planning process, which includes the Town's planned development of LID guidelines for inclusion into a revised engineering policy manual		
Create and implement Town of Pelham LID policy for development		

Recommended Action	Identified Issue	Opportunity
Ecosystem Restoration		
Enhanced terrestrial (land), riparian (land / water interface), and aquatic (in-stream) restoration programs	<p>Loss of ecosystem function is a priority issue, including the loss of biodiversity, terrestrial habitat (forest, urban tree canopy), riparian buffers, bank erosion, in-stream habitat degradation, including sedimentation of spawning beds, in-filling of riffles and pools, increased stream temperature, invasive species, and warming effects from on-line ponds.</p> <p>The percent of impervious surface area (built surfaces) in a watershed is a key metric used to determine the severity of impact to creek health. The UTM C watershed has an impervious area approaching 25% (Figure 5). Health indicators (i.e., water quality) notably decline when impervious area exceeds 10%, with degradation reaching severe and catastrophic levels at 30% and higher [4].</p>	<p>It is recommended the NPCA re-establish a dedicated restoration priority focus for the UTM C and continue the work of the 2006 watershed plan. Increasing natural areas, thereby decreasing impervious surfaces, will improve the health of the entire UTM C. It will reduce flooding, erosion, and mitigate the effects of accelerated climate change. Ecosystem restoration programs (all partners) need to work together to expand natural areas (forest, meadow, buffers, urban tree canopy). Opportunities for connecting fragmented habitats, in-filling forest patches, reforestation / naturalization of marginal and unused agricultural land, expanding natural areas on golf courses and other areas should be considered. Buffers and in-stream enhancements should be a priority.</p>

Recommended Action	Identified Issue	Opportunity
Studies / Assessments / Monitoring		
Undertake a water budget study	A water budget determines how precipitation is distributed across the landscape by quantifying the following three components of the hydrologic cycle: soil infiltration, surface runoff, and evapotranspiration. It is a measure of the water flow into and out of a defined area. In natural areas these components are balanced. In the UTM, increased urbanization in Fonthill has caused a significant water imbalance in the headwater areas due to impervious surfaces which generate more runoff and reduce infiltration and evapotranspiration. The water inputs are greater than the storage and infiltration capacity, as evident in the constant overwhelming of SWM infrastructure, including the SWM pond at Rice Road and Hwy#20, the SWM pond at Haist Street, and the SWM system at Station Street.	A water budget study for the UTM is required to provide an accurate accounting of all inflows, outflows, and changes in storage (water balance) in the headwaters. A better understanding of the hydrological characteristics of the upper catchment area is necessary in understanding the quantity of available water, to better support planning and design considerations for water resource infrastructure including SWM, LID, culverts, and road repairs (i.e., Sulphur Spring Road). Measures to protect existing headwater water balances should be mandatory for new and proposed development, with no net losses to hydrological functions. Water balance analysis must demonstrate that pre-development hydrological regimes will be maintained in a post-development scenario.
Enhanced sediment and erosion monitoring	Sediment, erosion, and pollution from runoff (i.e., fertilizer, road salt) is a priority issue impacting water quality, habitat, and brook trout. Sediment from runoff covers critical spawning substrate (gravel and cobble) that brook trout require for reproduction. The lack of suitable spawning habitat is a large contributor to their population decline.	Building on the work of BM consulting [26] there is opportunity to further delineate areas of priority for sediment and erosion reduction within the UTM. Further monitoring and studies (geomorphology) are needed to establish erosion rates, sediment transport, and total sediment load. This information will help prioritize future restoration efforts and measure ecosystem recovery.

Recommended Action	Identified Issue	Opportunity
Studies / Assessments / Monitoring continued		
Undertake culvert / barrier assessment & mitigation program	Within the UTMCM, many barriers (on-line ponds built within the creek channel), weirs, and malfunctioning culverts impact water flow and fish movement. On-line ponds such as the one located at St Johns Conservation Area are of concern in a cold-water system as they create large open water features allowing increased surface exposure to sunlight. These ponds create increased water temperatures (thermal pollution), which can be lethal for brook trout.	On-line pond and barrier remediation has been an on-going priority in the UTMCM for the past two decades. Building on the past work an updated inventory and mapping of barrier locations should be undertaken. This information will lead to the second phase of barrier prioritizing for remediation / removal.
<p>Conduct brook trout population, distribution, and habitat studies</p> <p>eDNA - Environmental DNA sampling.</p> <p>Redd* study (determining brook trout nesting sites)</p> <p>*the origin of the term redd is unclear; it is thought to be influenced by a 15th century Old English term rædan, meaning "to arrange". [27]</p>	A once abundant fish, brook trout populations are declining in the UTMCM. TUCN, NRC and MNRF have been studying the distribution and population of brook trout for many years. As a secretive species and with most of the UTMCM in private landownership, determining exactly which portions of the creek brook trout are utilizing for their life-cycle needs (spawning to overwintering) is not well understood. A better understanding of the areas and habitat they utilize can better inform restoration efforts including a possible future brook trout reintroduction program but should only be considered after experts agree the UTMCM conditions have been restored to ensure their success.	<p>eDNA analysis collects the naturally shed DNA (skin, feces, reproductive) aquatic organisms deposit into the water they occupy. eDNA is collected through sediment and water quality samples. For brook trout, this method has been shown to be effective for helping to estimate approximate areas in a system where they can be found.</p> <p>Female brook trout lay eggs in gravel excavated nests called a redd. Mapping the distribution of redds in the UTMCM can help determine spawning habitat without locating the fish species themselves. Redd studies can help target restoration efforts and can also determine restoration project effectiveness.</p>

Recommended Action	Identified Issue	Opportunity
Studies / Assessments / Monitoring continued		
Enhanced water quality monitoring	Stream flow and water quality parameters are important indicators for measuring aquatic health. The NPCA has been monitoring water quality since 1994, with a dedicated program established in 2001 that includes 6 permanent monitoring stations in the UTMW watershed. The NPCA water quality monitoring program is designed to provide a snapshot of overall watershed health and is not typically designed to track-down specific water quality impairment sources. The rigour needed to inform restoration (issue and opportunity) in the UTMW could be enhanced.	Building on the existing NPCA water quality monitoring program and with input from the monitoring and data management sub-committee, data gaps need to be filled. This would include the need for collecting flow, temperature, sediment, turbidity, nutrients, chloride, and biological data (benthic) data at additional locations. Additional monitoring sites at key locations in the upper watershed need to be established as part of continuous monitoring, with established transects for routine stream assessment looking at in-stream habitat (bed particle analysis), riparian cover, and contaminant loading.
Improved flow and weather station monitoring	The flow station on the St. Johns branch has been off-line since 2015, with the Effingham branch needing frequent repair. Reliable and accurate water quality data is an essential component to ensuring accurate restoration treatments. The lack of reliable data has led to many other agencies including TUCN, NRC and NC to conduct parallel data monitoring. This has led to duplication of effort, and confusion around data storage and accessibility.	Ensure dedicated flow and weather (precipitation) stations for St. Johns and Effingham branches of the UTMW.

Recommended Action	Identified Issue	Opportunity
Studies / Assessments / Monitoring continued		
Enhanced UTMC temperature monitoring program	Changes to water temperature can have catastrophic impacts on aquatic life, especially for a cold-water system. For brook trout, water becomes lethal at 24°C, with an optimum temperature range of 11°C - 16°C, with spawning occurring at 16°C [6]. Existing UTMC water temperature studies show that water temperatures fall outside the optimal range for brook trout, with frequency increasing downstream to the confluence at St. Johns and Effingham tributaries at Roland Rd. Downstream of the confluence, temperature exceed the optimal range by over 50% with the optimal range in exceedance 70% of the time at DeCew Rd (Short Hills Park) [22].	To prevent the further degradation of brook trout habitat, it is essential to coordinate and enhance existing temperature monitoring programs within the upper watershed. In 2013, the NPCA reinitiated (from 2006) temperature monitoring in 8 UTMC locations. TUCN, in partnership with NC has been collecting temperature data in key locations in the UTMC to help prioritize restoration efforts, including the removal and modification of on-line ponds.
Environmental Awareness / Communications / Marketing		
Explore opportunities for: watershed road signage, walk-shops, workshops, conferences, stewardship project tours, photo contests, webinars, podcasts, etc.	<p>This comment captures the issue <i>"I fear the majority (thousands) of citizens in the watershed lack basic knowledge about the environmentally precarious future for this watershed and the creek. Yes, many are learning how important a healthy creek is for brook trout - but do they truly understand or care why we are talking about brook trout? After all the communication, articles, events, literature and initiatives, the community still lacks knowledge and understanding"</i>.</p> <p>Although brook trout are generally understood as an indicator of water quality, the connection between human health and a healthy brook trout population is weak.</p>	There is a need to change the narrative for the protection of the UTMC to better link the relevance of brook trout to improved human health. With many community members unaware of how their health and well-being are linked to the health of the environment that surrounds them, there is a need to better connect how healthy brook trout populations link to improved human health and wellness. As a biological early warning system of water quality and habitat losses, opportunities for improved awareness through communications and marketing can bring a better understanding of the relevance of healthy brook trout populations to the health and well-being of the UTMC community.

Recommended Action	Identified Issue	Opportunity
Community Engagement		
Enhanced volunteer stewardship opportunities for water quality and habitat improvement	This comment captures this issue <i>"Can we really make a difference? Or are we simply applying small Band-Aids, ...one repair at a time? Can we really, truly expect that this watershed will be intact in 20 years after the scale of development and the population growth we see coming?"</i> Government and agencies alone cannot solve the issues threatening the UTMC, as 85% of the watershed is held in private property ownership, making landowners important stewards and action plan implementers.	Through the past implementation of NPCA's watershed plan, hundreds of landowners have undertaken stewardship projects. A strong community foundation of watershed advocates exists. Engaging the community in "hands-on" opportunities such as: Bring Back the Brookies, Buffer-in-a-Box, Yellow Fish Road, Buffers for Bees, pollinator gardens, rain gardens, rain barrel program, can continue to offer opportunities to change attitudes and behaviours towards the environment.
Reporting		
<p>Annual 2021 action plan update report</p> <p>Newsletter (quarterly progress)</p> <p>Media (Conservation Corner)</p> <p>Watershed Report Card</p>	Although the UTMC has been a priority watershed for restoration for over two decades, and much work has been accomplished, a significant knowledge gap exists in terms of progress reporting. This makes it difficult to verify what actions from the 2006 watershed plan have been accomplished to date. Learning from the past, it is imperative to build in sustainable structures for implementation, monitoring, and reporting.	An annual 2021 action plan update will track and report on the progress of recommendation implementation. A work plan of activities should be set each year by the oversight committee with roles, responsibilities, and expected timelines. Progress should be communicated through quarterly newsletters, with media engagement. Watershed Report Cards can effectively measure action plan progress and are used across Ontario by CA's, including the NPCA, with many good examples for guidance.
Sustaining Action		
Pursue funding opportunities for 2021 action plan update implementation	There are no sustainable (long-term) financial and human resources allocated for the implementation and coordination of the 2021 UTMC action plan update. Historically, the NPCA provided dedicated human and financial resources for the oversight and implementation of actions under the Twelve Mile Creek watershed plan, which ended in 2017.	Dedicated long-term funding for the coordination and implementation of the UTMC 2021 action plan update is recommended. Opportunities with the NPCF and other partners should be pursued, similar to the 10-year funding commitment provided for the implementation of the 1999 - 2009 Welland River watershed strategy [28].

Implementation Chart

Action	Work to be done	Partners	Metric	Funding	Schedule
Governance / Management					
Establish oversight committee	Establish implementation committee to ensure the coordinated, and collaborative delivery of 2021 action plan update recommendations	TUCN, NPCA, ToFP, NR, CofSC, CofT, NRC, LCN, NCC, Agape, HN, FSHP	TUCN, ToFP staff to pursue council resolution to support committee formation	In-kind staff / partner time	June 2021
Establish communications sub-committee	Establish sub-committee to ensure all partners are working productively and respectfully towards shared goals	TUCN, NP-CA, ToFP	Oversight committee to advise on structure	In-kind staff / partner time	July 2021
Establish monitoring and data sub-committee	Establish sub-committee to advise on monitoring and data storage needs	TUCN, NPCA, NC	Oversight committee to advise on structure	In-kind staff / partner time	July 2021
Form stormwater management working group (SWMWG)	Establish SWMWG to inform update SWM policies and insure a coordinated approach to SWM across the NR	TUCN, NR, NPCA, ToFP, SOC, CofT	Oversight committee to ensure progress	In-kind staff / partner time	July 2021 - Partnership meetings
Update stormwater Management Policies	SWMWG to work with NR, NPCA to inform SWM policy update to ensure GI and LID, for CofT and ToFP adoption	NR, NPCA, TUCN, ToFP, SOC, CofT	Oversight committee to ensure progress	Staff / partner time	August 2021 - Partnership meetings
Update Twelve Mile Creek watershed plan	Undertake a comprehensive updated watershed plan for the entire TMC	NR, NPCA - through natural heritage planning	Oversight committee to ensure progress	\$75,000 staff time	August 2021 - Partnership meetings
Create Town of Pelham and City of Thorold erosion control By-law	Develop and adopt a Town of Pelham and City of Thorold Erosion Control By-law informed by the SWMWG	TUCN, ToFP, CofT	TUCN, ToFP staff to pursue council resolution to support	Staff / partner time	Sept 2021 - Partnership meetings

Action	Work to be done	Partners	Metric	Funding	Schedule
Stormwater Management, Runoff, and Flooding					
Create GI and LID pilot program including training for local developers, planning, and engineering staff.	Establish incentive pilot program for reducing stormwater runoff through SWM rebates	Lead by TUCN, NPCA, NR with SWM-WG, informed by STEP [29]	Oversight committee to ensure progress	\$50,000 / year (partnership funding – TofP, NPCA, NR, CofT)	Sept 2021- Partnership meetings
Create LID Policy	Develop and adopt a Town of Pelham LID policy for new development	TUCN, TofP,	TUCN, TofP staff to obtain council support	Staff / partner time	Sept 2021- Partnership
Implement GI and LID source controls	Incentives for capturing and controlling property level runoff (rain gardens, rain barrows, green roofs, urban planting).	Lead by SWMWG, informed by STEP [29]	Oversight committee to ensure progress	TBD	Fall 2021 – on-going
Implement GI and LID conveyance controls	Incentives for the uptake of infiltration technologies such permeable pavement, bioswales, soak-a-way pits, naturalization, urban tree planting	Lead by SWMWG, informed by STEP [29]	Oversight committee to ensure progress	TBD	Fall 2021 – on-going
Implement GI and LID end of pipe controls	Incentives for reducing reliance on end-of-pipe controls by looking at source and conveyance controls. Where feasible incorporate constructed wetlands that mimic natural function	Lead by SWMWG, informed by STEP [29]	Oversight committee to ensure progress	TBD	Fall 2021 – on-going
Implement Rice Rd & Hwy 20 SWM outflow modifications	Outflow emergency works implementation	TofP, TUCN, Pelham Cares, NPCA, NR	TofP in collaboration with TUCN to monitor progress	\$70,000 (TofP) NPCA & NR partnership funding	Summer 2021
Undertake Rice Rd & Hwy 20 SWM naturalization	Increase canopy tree cover for shade	TofP, NPCA, NR	Oversight committee to ensure progress	\$10,000 (trees & watering)	Fall 2021, 2022, 2023

Action	Work to be done	Partners	Metric	Funding	Schedule
Stormwater Management, Runoff, and Flooding Continued					
Undertake Station Street SWM modifications	Outflow emergency works implementation	TUCN, TofP	TofP in collaboration with TUCN to monitor progress	TofP budgeted item	Summer 2021
Undertake Sulphur Spring Road repair	Emergency works implementation	TUCN, TofP, NPCA	TofP, NPCA in collaboration with TUCN to monitor progress	TofP budgeted item	Summer 2021
Ecosystem Restoration					
Undertake priority restoration mapping	Update priority mapping to show opportunity areas for riparian buffers, forest cover, fragmented natural areas, in-stream aquatic habitat restoration, and floodplain reconnection due to entrenched channels.	NPCA, NC, TUCN	Oversight committee to ensure progress	In-kind staff time	Fall 2021, updated 2025, 2030
Update restoration database	Update / continue NPCA restoration database to ensure completed project tracking and reporting	NPCA, other community partners	Oversight committee to ensure progress	In-kind staff time	On-going (2021-2031)
Reinstate dedicated UTMC restoration program	Re-establish dedicated restoration priority focus for the UTMC	NPCA	NPCA and NPCF to determine action	\$50,000 / year for projects	Budget year 2022
Implement enhanced terrestrial (land) restoration	Prioritize habitat areas, in-filling forest patches, reforestation, afforestation, naturalization, expand natural areas on golf courses, open areas. Implement BM Geospatial recommendations [26]	NPCA, TUCN, LCN, NRC, NC, landowners	Oversight committee to ensure progress and coordination	In-kind staff / partner time	On-going restoration work (2021-2031)

Action	Work to be done	Partners	Metric	Funding	Schedule
Ecosystem Restoration Continued					
Implement enhanced riparian (land / water interface) restoration	Riparian buffer establishment with a minimum 30 metres should be a restoration priority to ensure pollution filtration and creek shading for 75% of UTM tributaries [16]	NPCA, TUCN, LCN, NRC, NC, landowners, CofT, ToFP	Oversight committee to ensure progress and coordination	In-kind staff / partner time	On-going restoration work (2021-2031)
Implement enhanced aquatic restoration	Removal of in-stream barriers, and restoration of priority areas (from priority mapping) to ensure the re-creation of high-quality aquatic habitat in degraded reaches of the system including functional riffle-pool sequences	NPCA, TUCN, LCN, NRC, NC, CofP, ToFP, landowners	Oversight committee to ensure progress and coordination	In-kind staff / partner time	On-going restoration work (2021-2031)
Create tree cover accounting program	Establish tree cover accounting program working with TreeOcode Niagara [30]	NPCA, TUCN, LCN, NRC, landowners	Oversight committee for coordination	In-kind staff / partner time	Winter 2022
Undertake St. John's CA on-line pond remediation	Remove thermal barrier, re-establish creek channel around existing pond, naturalize to functioning wetland	NPCA, TUCN, NC	Environmental Assessment required, Oversight committee to ensure progress	\$250,000	June 2021 AP presentation to NPCA- to start talks
Implement Cannery pond re-channelization	Remove thermal barrier, re-establish creek channel around existing pond, naturalize to functioning wetland	CofSC, TUCN, NCC, landowner, NC	TUCN to ensure progress	\$250,000	Fall 2021
Implement Lathrop property pond naturalization [31]	Naturalize ponds to wetland function and restore connectivity to creek floodplain	NCC, TUCN, NPCA	TUCN to ensure progress	\$200,000	2022

Action	Work to be done	Partners	Metric	Funding	Schedule
Studies / Assessments / Monitoring					
Undertake water budget study	Study for the UTMC to ensure accurate accounting of all inflows, outflows, and changes in storage (water balance)	TUCN, NPCA, TofP	TUCN to ensure progress	Apply for funding grants	2022
Undertake water balance predevelopment studies	Water balance analysis must demonstrate hydrological regimes will be maintained in post-developments	TUCN, NPCA, TofP	TUCN to ensure progress	Apply for funding grants	2022
Undertake sediment and erosion monitoring	Sediment transport and bedload study to benchmark recovery, remediation and prioritize future restoration	NPCA, TUCN, NC	Oversight committee to ensure progress and coordination	In-kind staff / partner time	Budget year 2022 – ongoing
Implement culvert / barrier assessment & mitigation program	Inventory and map barrier locations. Second phase - prioritizing for remediation / removal	NPCA, TUCN, NRC, TofP, CofP, landowners	Oversight committee to ensure progress and coordination	Inventory – TUCN. Removal - case-by case partnerships	Assessment Winter 2022 Removal 2022-2031
Undertake brook trout eDNA studies	Continue eDNA analysis and partnership	TUCN, UofG, UofT landowners,	TUCN to ensure progress	TUCN grants in partnership with UofG, UofT	2022 – ongoing
Undertake brook trout Redd studies	Undertake Redd mapping and distribution studies	TUCN, NPCA, NRC, Landowners, MNRF	TUCN to ensure progress	TUCN grants in partnership with NPCA, MNRF	2022 – ongoing
Undertake enhanced water quality monitoring	Additional monitoring at key locations in the UTMC, established transects for routine stream assessment looking at in-stream habitat (bed particle analysis) and riparian cover. Fill data gap for flow, velocity, turbidity, chloride, benthic	NPCA, NC	Oversight committee to ensure progress and coordination	In-kind staff / partner time	Budget year 2022 – ongoing

Action	Work to be done	Partners	Metric	Funding	Schedule
Studies / Assessments / Monitoring continued					
Undertake improved flow and weather station monitoring	Ensure dedicated flow and weather (precipitation) stations for St Johns and Effingham branches	NPCA	Oversight committee to ensure progress and coordination	In-kind staff / partner time	Budget year 2022 – ongoing
Undertake enhanced UTMC temperature / dissolved oxygen monitoring program	Coordinate and enhance existing temperature monitoring programs within the UTMC watershed	NPCA, TUCN, LCN, NRC, NC, landowners	Oversight committee to ensure progress and coordination	In-kind staff / partner time	On-going restoration work (2021-2031)
Environmental Awareness / Communications					
Watershed road signage, walk-shops, work-shops, conferences, stewardship project tours, photo contests, webinars, podcasts	Work to change the narrative for the protection of the UTMC to better link the importance of brook trout to improved human health. Improve awareness by linking to the things that are relevant to the community and landowners	TUCN and all partners	Communications sub-committee to monitor progress	In-kind staff / partner time / funding applications for specific activities	On-going work (2021-2031)
Community Engagement					
UTMC landowner group / association	Historically, the Friends of Twelve Mile Creek was an active community group with some members interested in forming a landowner group.	TUCN and oversight committee to advise	Communications sub-committee to monitor progress	Landowner in-kind contributions	2021 – start conversations

Action	Work to be done	Partners	Metric	Funding	Schedule
Community Engagement continued					
Enhanced “hands-on” volunteer opportunities for water quality and habitat improvement	Canopies for Communities – create urban tree program similar to NPCA Canopies for Kids	TUCN	Oversight committee	\$50,000 / yr. for trees and watering	2022 - 2031
	Bring Back the Brookies program	TUCN	TUCN to monitor progress	TUCN in process of securing funding, In-kind staff / partner time	2021 current program
	Buffer-in-a-Box	TUCN	TUCN to monitor progress	TUCN in process of securing funding, In-kind staff / partner time	2021 proposed program
	Buffers for Bees	NRC, NPCA	TUCN to monitor progress	\$10,000 / yr. for plant material	2021 current program
	Yellow-fish Road® (avenue for targeted headwater urban area communication)	NPCA is local coordinator, TUCN	Oversight committee	In-kind staff / partner time	2021 current program
	Trees for Tribes [32] – program creation	TBD	TBD	TBD	2022
Indigenous People engagement including conversation circle [33]	Utilize local Indigenous knowledge for brook trout occurrences including presence / absence in Short Hills Park	TUCN, BU	Communications sub-committee to monitor progress	In-kind staff / partner time	2022
Reporting					
Annual 2021 action plan update report	A work plan of activities should be set each year by the oversight committee with roles, responsibilities, and expected timelines.	Oversight committee	Communications sub-committee to monitor progress	In-kind staff / partner time	Annually starting in 2022
Annual monitoring and data report	A detailed report of annual monitoring and data collection done in the UTMC	TUCN, NPCA	Oversight committee to help coordinate	In-kind staff / partner time	Annually starting in 2021

Action	Work to be done	Partners	Metric	Funding	Schedule
Reporting continued					
Watershed Report Card	Undertake annual Watershed Report Card. Oversight committee to advise on indicators to measure from Table 1	Communications sub-committee	Oversight committee	In-kind staff / partner time	2021 baseline 2025, 2028, 2031
Newsletter (quarterly progress)	2021 action plan update progress communicated through quarterly newsletters by all partners	TUCN	Communications sub-committee to monitor progress	In-kind staff / partner time	Quarterly starting in fall 2021
Media (Conservation Corner)	Conservation corner article in Voice of Pelham with one focus topic monthly	Communications sub-committee	Oversight committee	In-kind staff / partner time	Fall 2021
Sustaining Action					
Pursue funding opportunities for 2021 action plan update implementation	Pursue 10-year funding commitment for 2021 action plan update coordination from NPCF	TUCN, and all partners	Oversight committee	In-kind staff / partner time	On-going
Land Acquisition opportunities	Pursue opportunities to acquire land that is vulnerable to development / land conversion, and properties for restoration	NPCA, NCC, HNC, interested land-owners	Oversight committee	In-kind staff / partner time	On-going

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