

Inside this issue:

- History of the United Nations Climate Treaties
- No Better Time than the Present for a Baxter Creek Subwatershed Plan
- World Water Day
- Spring Frogs and Toads Wetland Monitoring
- Baxter Creek Student Project Updates

Welcome to our 2024 Fleming College GeoCommunity students:

- Alanah Reveler
- Jackson Mitchell
- Thiluxsaan “Lux” Puvanendran

To learn more about all our students and alumni visit our website to see our advisor biographies and student projects:

<https://baxtercreekwatershed.org/our-advisors>.



HISTORY OF THE UNITED NATIONS CLIMATE TREATIES

In our last newsletter, we shared our findings relating to an ongoing project to identify local parcels of land that would qualify towards Canada’s goal to conserve 30% of our land & water by 2030. To find land that would meet the biodiversity requirements necessary to qualify towards the 30% land conservation goal we utilized the biodiversity guidelines developed at COP15. If you wondered what ‘biodiversity guidelines’ and ‘COP15’ refer to, and how they relate to our federal, provincial and local climate change targets, keep reading!

The *Conference of the Parties* (COP) is an international climate summit that is held each year organized by the United Nations and is hosted by a different country, with a different theme or convention for each conference. The *Conference of the Parties* includes representatives from the Countries, States or Territories who have signed an international treaty called the *U.N. Framework Convention on Climate Change* (UNFCCC). The Parties have committed to take voluntary actions to prevent severe climate impacts from destroying our planet.

The U.N. Framework Convention on Climate Change (UNFCCC) treaty was signed in 1992 at the Rio Earth Summit, and during the Rio Summit, the Parties reached consensus that a 2-degree Celsius increase to pre-industrial temperatures was ‘*an upper limit beyond which the risks of grave damage to ecosystems, and of non-linear responses, are expected to increase rapidly.*’

In addition to the UNFCCC, the *Convention on Biological Diversity* (CBD) was signed by 150 government leaders at the 1992 Rio Earth Summit. The main objectives of the CBD are the conservation of biological diversity, the sustainable use of the components of biological diversity, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. The CBD is dedicated to promoting sustainable development and the Convention recognizes that biological diversity is about more than plants, animals and microorganisms and their ecosystems; biological diversity is also about humans and empathizes the critical need for food security, clean air and water, homes, and access to medications necessary for basic health needs.

When the ‘Parties’ meet, it is referred to as the *Conference of the Parties* or *COP*. For example, the 15th *Conference of Parties to the United Nations Convention on Biological Diversity* is referred to generally as *COP15*. However, the 15th *Conference of the Parties to the United Nations Framework Convention on Climate Change* is also referred to as *COP15*. The distinction is found in the particular Convention or Conference the Parties are meeting for.

Responding to the threat of a global climate crisis due to ongoing global warming the Parties of the UNFCCC treaty further signed the *Paris Agreement* in 2015, which requires their respective countries to develop action plans to significantly reduce greenhouse gas (GHG) emissions to a level that would limit global warming to no more than 1.5 Celsius. The *Paris Agreement* has resulted in countries developing climate change action plans aimed at reducing total GHG emissions by 30% by 2030, and to further reach net zero emissions by 2050.

In December 2022, Canada hosted the 15th *Conference of Parties*, also known as COP15, to the *United Nations Convention on Biological Diversity* in Montreal, Quebec. The theme of COP15 was Biodiversity, specifically asking parties to reach an agreement on a *Global Biodiversity Framework* (GBF). The GBF would provide a collective roadmap that will guide worldwide efforts on biodiversity conservation until 2030. We can utilize the GBF to identify the land parcels and water bodies that meet the biodiversity requirements to be included in the 30x30 biodiversity conservation/protection designation.

From November 30 to December 13, 2023 the *COP28 United Nations Climate Change Conference* was held in Dubai, UAE. The conference was attended by more than 150 Heads of State and Government leaders. During that time the results were released of the first global stocktake of the world’s efforts to address climate change under the *Paris Agreement*. The main findings were that progress was significantly hindered in all areas of climate action including reducing greenhouse gas emissions, resilience to a changing climate, increasing access to financial and technological support to vulnerable nations. The Parties came to a decision on how to increase progress across all areas by 2030. This includes a call on governments to accelerate the transition away from fossil fuels to renewables such as wind and solar power. It is paramount that our climate action plans provide the financial and technological solutions to expedite our transition away from fossil fuels.

We must continue to recognize the importance of the *United Nations Framework Convention on Climate Change*, the *Paris Agreement* and the *Convention on Biodiversity*. As these each represent a global commitment to reduce our impacts on the planet, by protecting our most diverse lands, water bodies, wildlife and ensuring we all can live with access to clean air, water and food.

"The flowers of late winter and early spring occupy places in our hearts well out of proportion to their size."

— Gertrude S. Wister

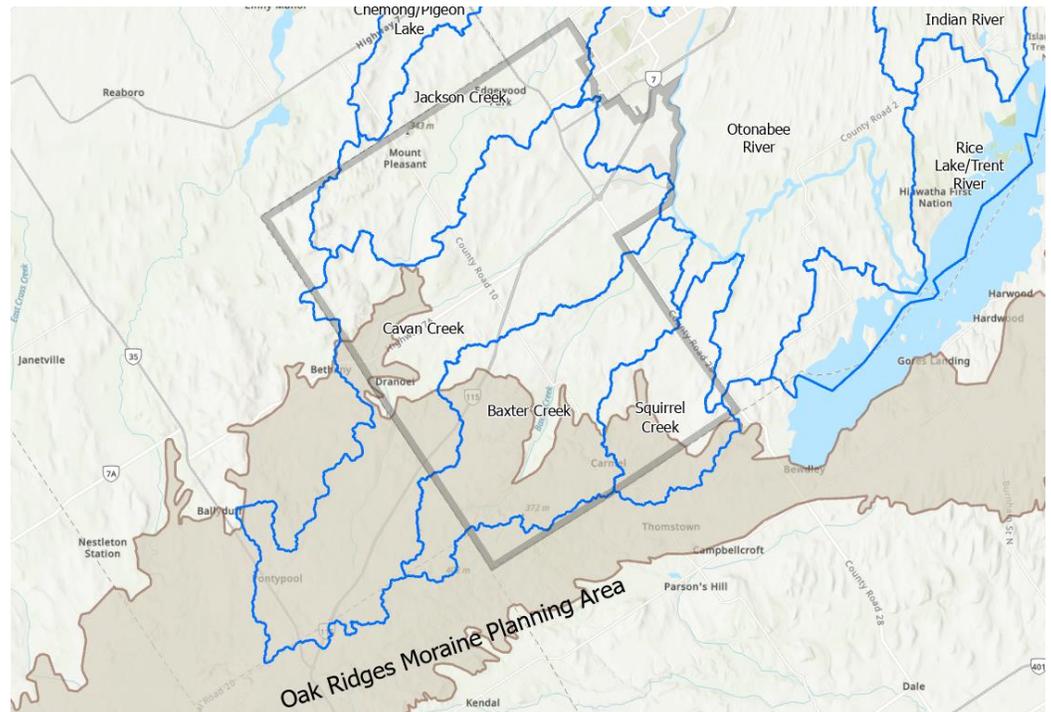
NO BETTER TIME THAN THE PRESENT FOR A BAXTER CREEK SUBWATERSHED PLAN

The Baxter Creek Watershed Alliance (BCWA) has long advocated for the preparation of a subwatershed plan for the Baxter Creek. The BCWA believes watershed planning is among the most important of the required studies necessary to achieve balanced and evidence-based development in Millbrook and the parts of Cavan Monaghan that the Baxter Creek flows through (see map below). As of the April 17, 2024 Peterborough County Council - Regular Meeting, BCWA is encouraged to hear that council has approved report PPW 2024-15, Watershed Plan, be received and that staff be directed to proceed with an RFP for the development of a County Watershed Plan, and that the Watershed Plan also identify priority subwatershed areas that should be the basis for future subwatershed plans (see report [PPW 2024-15](#)).

Watershed planning has been a legislated part of Ontario conservation and land use planning since the *Conservation Authorities Act*

was passed in 1946. Rapid changes in land use that resulted in deforestation from agricultural activities and urbanization caused flooding, soil erosion, siltation of streams, degraded water quality and destruction of fish habitat. The Government of the day acted to address these impacts through the *Conservation Authorities Act*, and established conservation authorities across southern Ontario. We now have 36 conservation authorities, mostly in southern Ontario. Our conservation authority is *Otonabee Conservation* (<https://www.otonabeeconservation.com/>).

Watershed planning is based on the natural boundaries of the watershed, which is defined as a catchment area where all water flows into a particular stream, creek or river based on overland topography. Watershed planning in southern Ontario has been recognized internationally as innovative, and there are many examples across



Subwatersheds of the Otonabee River Basin within Cavan Monaghan, including the subwatersheds of Baxter Creek, Cavan Creek, and Squirrel Creek with their headwaters and source water originating from the Oak Ridges Moraine. Map prepared by Baxter Creek Watershed Alliance using data provided under license from the County of Peterborough, Natural Resources Canada, and the Open Government License Ontario 2023.

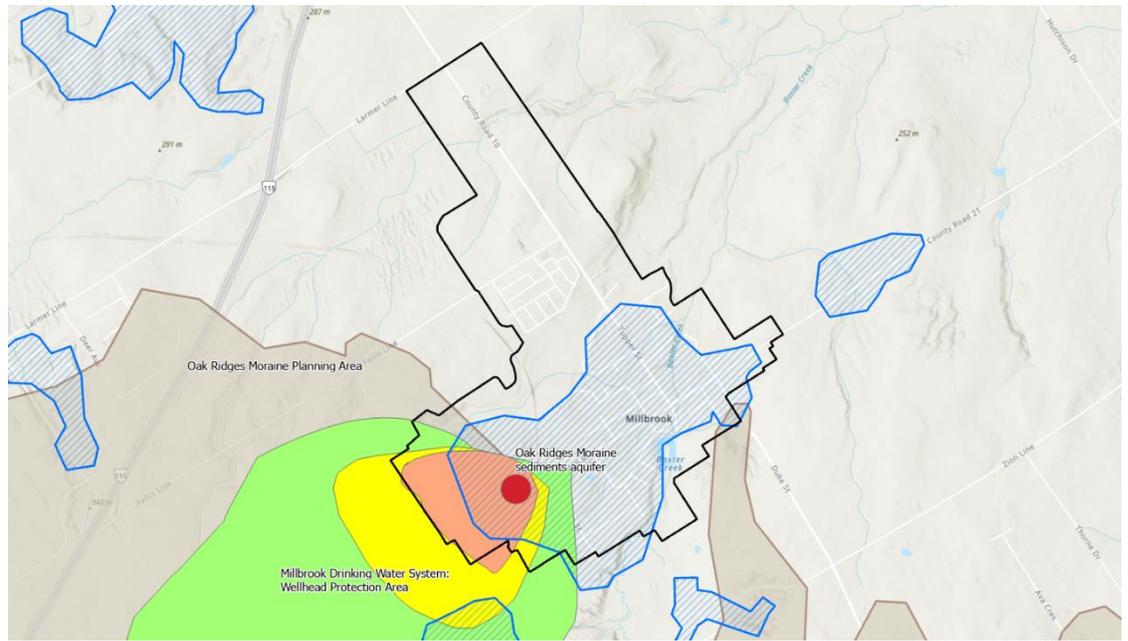
southern Ontario of the success of watershed planning in terms of flood management and protection of people and property (see Grand River: <https://www.grandriver.ca/en/our-watershed/Flooding.aspx#gsc.tab=0>), protection of ecosystems (Ganaraska River: <https://grca.on.ca/wp-content/uploads/2023/10/Cobourg-Creek-Background-Report.pdf>) and restoration and agricultural stewardship (Maitland valley Conservation Authority: <https://mvca.on.ca/stewardship-programs/cover-crops-and-soil-health/>).

Conservation Ontario is an association of the conservation authorities across southern Ontario that advocates for watershed planning. *Conservation Ontario* prepared a document titled *Watershed Management in Ontario: Lessons learned and Best Practices* (see https://conservationontario.ca/fileadmin/pdf/conservation_authorities_section/WatershedManaginOntarioCA.pdf). Best practices indicate watershed planning is a place-based approach that integrates environmental values of the watershed within the context of human development. The same document also indicates that watershed planning involves a shift to an approach based on shared responsibility with government, community members, non-government organizations and scientists. More recent provincial draft guidance from 2018 and 2022 stresses the need to engage broadly with the community including First Nations, Indigenous communities, as well as community-based environmental organizations. Watershed management is both a technical process of monitoring, modelling, and measuring, but also a good governance and social process. Watershed planning represents a fundamental shift in planning and management from a top-down approach to one that is place based and that integrates what happens within a watershed's land base with the aquatic resources of streams, creeks, rivers, lakes, wetlands, groundwater, and other water resources. Watershed management must not only be based on sound science, but also reflect the preferences of the people living in the watershed through consideration of community and ecosystem values. Values may be expressed as desired end uses, desired states (goals, objectives and targets), and/or desired strategies for achieving goals. Stakeholder and public involvement in watershed planning are critical and while this has not yet happened for the Baxter Creek watershed there is certainly interest in supporting the process. Public and stakeholder involvement varies widely but should be started early in the planning process, before key decisions are made, and continue throughout the process. Collaborative processes should dominate public consultation with all parties at the table. Central to watershed planning today are First Nation communities and their interests on their traditional territories that include, for example, the Baxter Creek watershed. First Nation participation should proceed through a nation-to-nation and Duty to Consult processes.

Watershed planning identifies and maps information on the form, function and linkages of the natural system (surface and groundwater, habitats, fisheries and wildlife populations); soils and geology; stream morphology; environmentally sensitive and hazard lands; existing and proposed land uses; best management practices for agriculture; aggregate extraction areas; development servicing; woodlots; cumulative impacts of changes on the natural environment; and monitoring and stewardship opportunities. Importantly, the integration of watershed and land use planning together can be achieved through a watershed management plan.

There is clear direction from the Provincial government that a watershed plan is required for Baxter Creek. *The Oak Ridges Moraine Conservation Act and Plan*, provincial legislation and plan, requires that all watersheds that originate on the Oak Ridges Moraine must have watershed plans completed. The Baxter Creek originates on the Oak Ridges Moraine. The new draft Official Plan for the County of Peterborough, that works with the Cavan Monaghan

Official Plan to guide land use planning, states that the County and local Municipalities including Cavan Monaghan are committed to implementing a watershed-based approach to land use planning and water management. The County Official Plan indicates a watershed management plan will be undertaken by the County of



Millbrook Settlement Area showing the overlapping values of the Oak Ridges Moraine, the Millbrook Drinking Water System Wellhead Protection Area, and the underlying extent of the subsurface Oak Ridges Moraine sediments aquifer. Map prepared by Baxter Creek Watershed Alliance using data provided under license from the County of Peterborough, Natural Resources Canada, and the Open Government License Ontario 2023.

Peterborough, and in collaboration with local municipalities and conservation authorities when financially feasible.

The BCWA believes the time is now for a subwatershed study to be completed. The following are key triggers that indicate a Baxter Creek watershed study is required:

- Minister Zoning Orders (MZOs) that have been approved for Millbrook;
- Potential impacts on groundwater resources, the source of our drinking water in Millbrook, from approved developments and proposed developments (MZOs);
- Updates to official plans (both the Peterborough County Official Plan and Millbrook Official Plan are being updated);
- Potential significant development that has been forecast through 2050 that will have impacts on fish species and water quality in rivers; and
- Water and Wastewater Master Planning Process for Millbrook is underway without watershed planning information guiding the process (<https://www.cavanmonaghan.net/en/roads-and-transportation/water-and-wastewater-master-servicing-plan.aspx>).

The BCWA believes the proposed MZO developments and water and wastewater master servicing planning process should be informed by watershed planning to address potential flooding impacts, impacts on cold-water trout habit of the Baxter Creek and its tributaries, impacts on groundwater and our drinking water source, and impacts on economic development and municipal taxes. BCWA believes we have the ‘cart before the horse’ with the servicing study proceeding in Cavan Monaghan before a subwatershed study is completed for Baxter Creek. The BCWA is providing comments on watershed planning to both the County of Peterborough and Cavan Monaghan Township based on scientific evidence and community values. We will share their responses through subsequent communications including our website (<https://baxtercreekwatrshed.org/>).

WORLD WATER DAY

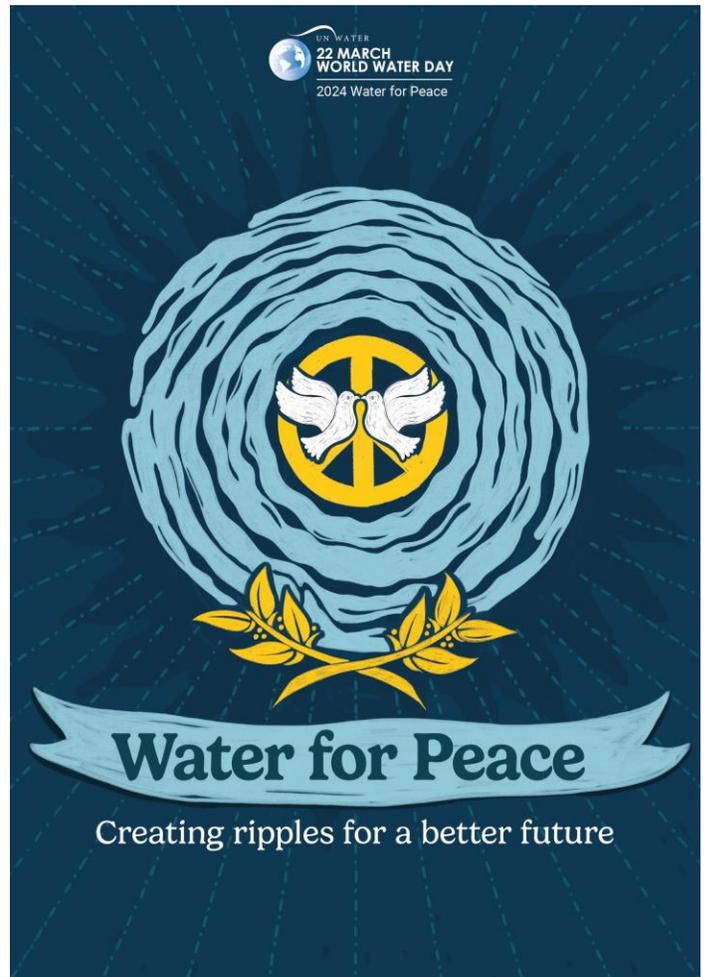
The United Nations declared March 22 as World Water Day. This day is important to highlight that access to water is a basic human right. Billions of people currently are living without access to safe drinking water and sanitation.

On World Water day we are encouraged to act to support access to water for all.

One of UNs Sustainable Development Goals is: Water and Sanitation for all by 2030 highlighted the need to create an annual observance to the importance of water.

Each year on March 22, the UN releases the *UN World Water Development Report* that makes policy recommendations based on the theme of the annual observance. The theme for 2024 is **Water for Peace**. Many communities experience conflict due to a lack of access to water, either due to pollution, proximity or quantity. Climate Change coupled with population growth demands that we protect and conserve this important resource. Water is not something that should be fought over, but instead **Water for Peace** asks that we focus on how we can provide equal access to this basic human need.

For more information on UN World Water Day, visit <https://www.un.org/en/observances/water-day>.



"Spring is the time of plans and projects."

- Leo Tolstoy

SPRING FROGS AND TOADS WETLAND MONITORING

In 2022 BCWA launched a frog and toad (known as anuran) spring monitoring program. This program relies on volunteer citizen scientists to estimate and record the frequency of breeding frogs and toads during three spring periods. The surveys are conducted by listening to the calls of the animals. BCWA has adapted and simplified the national Marsh Monitoring Program standard protocol to meet local monitoring needs.

In 2022 the monitoring program was first launched with a few sites and was entirely based on using a paper form to record call events. In 2023, a Fleming GeoCommunity student developed a mobile mapping application to assist with field data entry. This year BCWA is expanding the surveys to capture more data about breeding anurans across the watershed, with the objective to increase our understanding of both the abundance, distribution, species, and range of habitats these animals rely on for breeding.

If you are interested in volunteering to help complete these field surveys please visit our website at <https://baxtercreekwatershed.org/> and register as a general member or subscribe to our newsletter to receive updates on workshops we are holding throughout the spring. Alternatively please email us for more information at baxtercreekwatershed@gmail.com.

BAXTER CREEK STUDENT PROJECT UPDATES

The Trent Community Research Centre's Annual Celebration of Community-Based Research in 2024 was held at Market Hall Performing Arts Centre in Peterborough on Thursday, March 28, 12-4pm. The event was a testament to the impactful work undertaken by Trent students throughout the academic year and served as a platform to recognize and celebrate the achievements of community-based research initiatives at the University. The event was well attended by Trent university students, faculty, as well as a wide range of community-based organizations.

The 2024 Celebration of Research highlighted the outcomes of these efforts, showcasing a diverse array of innovative projects aimed at promoting social, cultural, economic, and environmental well-being. Four BCWA poster projects were presented by students at the event and there was also a panel discussion. BCWA was invited to sit on the panel discussion of the importance of collaboration to achieve organizational missions. The panel worked through a series of questions on the topic of “Building Capacity through Collaboration” and was facilitated by Dr. Raymond Dart from the School of Business at Trent.

To learn more about this event please visit the Trent web page: <https://www.trentu.ca/community-based-research/celebration>.

The following BCWA community-based research initiatives were showcased at the event:

Keyana Kamps, #6036: Groundwater Review of Former Millbrook Jail Lands and Watershed Baxter Creek Watershed Alliance (BCWA) (Trent, Community Research Centre, Department of Forensic Science)

Provost Award for Academic Achievement (\$500)

Awarded to the project that best demonstrates rigorous community-based research practices to produce results of particularly high academic merit.

Sponsored by Trent University, Office of the Provost & Vice President Academic

- Keyana completed a series of former Millbrook Correctional Centre (MCC) employee interviews to provide a baseline to understand the range of activities at the former institution which may have contributed to contamination at the site. Through a Freedom of Information request to Infrastructure Ontario, Keyana was provided copies of at least five environmental reports and studies related to the decommissioning of the former MCC which were formerly not on the public record.

Groundwater Contamination Review of Former Millbrook Correctional Centre and Watershed

Background

- Site of Former Millbrook Correctional Centre, closed in 2003 and demolished in 2015.
- Upon completion of environmental assessments, contamination was confirmed on site.
- Main contaminant of concern is perchloroethylene (PCE), a dense non-aqueous phase liquid, typically found in industrial and dry cleaning settings as a solvent or degreaser.
- Ontario Drinking Water Quality Standard (ODWS) for PCE is 10 ug/L, and Site Condition Standard (SCS) is 1.6 ug/L.

Methods

- Analysis of studies and reports completed in Infrastructure Ontario (IO), identifying key details and gaps.
- Literature review focused on contaminants of concern, in response to gaps in IO reports.
- Interviews with former employees of the correctional centre to gain firsthand knowledge of chemical disposal and waste removal procedures on site.

Research Objectives

This project aims to raise awareness regarding the extent of contamination, potential risks, and responsibilities associated with owning and maintaining the property.

- Who is liable for contamination and who is responsible for clean-up or remediation?
- What are the potential drawdown effects and other environmental impacts from contamination?
- What value does the property have for conservation?
- What are the potential risks of high-intensity residential development?

Main Findings

- PCE concentrations have been observed in multiple test wells installed in layers 1 and 2.
- PCE concentrations have been observed consistently in layer 3, primarily in MW3-14 and MW6-16, but on a decreasing trend from 2014-2023.
- No PCE concentrations detected above ODWS of 10 ug/L.
- PCE concentrations above SCS of 1.6 ug/L in MW1-14 and MW3-14.
- Ongoing testing will remain to account for most recent findings of TCE and Chloroform exceedances in MW1-14 and MW17, respectively.

Significance of the Site

- Situated within the Baxter Creek subwatershed, with groundwater linkages to the Oak Ridges Moraine.
- Within the Source Water Protection Area for the Millbrook Municipal wells.
- Significant ecological features on the property that serve as breeding habitats for grassland birds.
- Baxter Creek tributary serves as a headwater and groundwater recharge area.

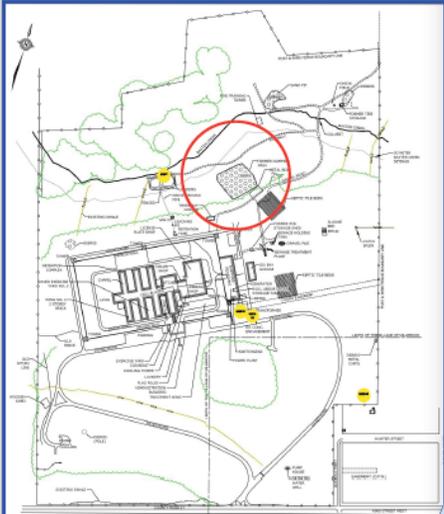


Figure 1. Map of former correctional centre highlighting the dumping area and monitoring wells of interest

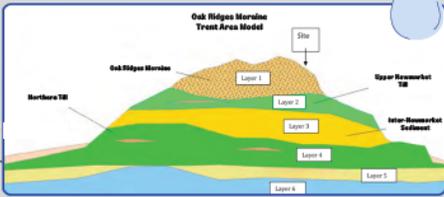


Figure 2. Groundwater layers of interest



Figure 3. Data plots of PCE concentrations obtained from 2014-2022 in MW3-14, 6-16, and 1-14.

Researcher: Keyana Kamps
 Faculty Supervisor: Dr. Joel Cahn
 FRSC-4890V (2023-24)
 TCRC Coordinator(s): Brittany Finigan & Carolyn Mount
 Host(s): Craig Onafrychuk, Noel Kerin, Barb Heidenrele





The former Millbrook Correctional Centre lands (locally known as the "old Millbrook jail lands" or "Jail Hill") was a maximum-security correctional centre from 1955 to 2003. There have been numerous technical studies completed on the property assessing potential chemical contamination of the surficial geology of the property which is located within the Wellhead Projection Area of the village. This project brings that period of record together to make it fully accessible through the BCWA website in a dedicated webpage with an annotated

summary of each report for the community. This will help provide background information to inform eligible organizations interested in acquiring the property through the provincial surplus process of the brownfield contamination conditions and liabilities as well as the conservation values of the property.

The project compiled technical studies on the former Millbrook Correctional Centre lands, focusing on chemical contamination assessments within the village’s Wellhead Protection Area. Through a dedicated webpage on the BCWA website, it offered accessible summaries of each report, advocating for land conservation and protection against intense residential development.

Faculty Supervisor: Joel Cahn, Forensic Science

Host Organization: Baxter Creek Watershed Alliance

Mariah Shaw, “Baxter Creek Benthos Study” (Trent, Community Research Centre, School of the Environment)

- The benthos project assesses the Baxter Creek watershed through the collection of data on benthos species. Benthic macroinvertebrates are aquatic animals without backbones that are large enough to see without a microscope. They include crustaceans and immature forms of aquatic insects such as stonefly

Baxter Creek Benthos Survey

Background

The **Baxter Creek Watershed Alliance (BCWA)** prioritizes education and engagement within the community to protect and care for a clean, healthy watershed. **Benthic macroinvertebrates** are excellent bioindicators for water quality as they have recognized community responses. The **Baxter Creek Watershed** is exposed to a variety of **land uses**. To determine water quality, samples were collected to provide a **baseline assessment**.

Figure 2: Researcher collecting samples using the Kick and Sweep method

Figure 3: Researcher identifying and processing samples using a microscope

Research Questions

- What is the baseline composition of the benthic communities of the Baxter Creek Watershed?
- What insights do benthic communities provide about water quality in the Baxter Creek Watershed?
- What are the external factors influencing stream quality?

Data Analysis

- % EPT, % Composition, HBI, Hill Numbers, Simpson's Diversity Index were calculated.
- These **biotic indices** are used to summarize the biological condition of the stream and may reveal if pollution is present.

Site Code	% EPT
BXCRC-01	~30
BXCRC-02	~10
BXCRC-03	~45
BXCRC-04	~55
Average	~35

Figure 5: % EPT (Ephemeroptera, Plecoptera, Trichoptera) plotted for each of the four sites selected. The red line indicates the average % EPT of Baxter Creek across the sites. As benthos are considered to be highly sensitive to pollution, a higher value of EPT indicates good environmental conditions.

Methodology

- Sampling and data collection in the field were based on the **OBBN protocols**.
- Sampling took place on October 23, 2023, and November 5, 2023, at four sites along Baxter Creek.
- The **traveling kick-and-sweep transect method** was used to collect 3 subsamples from each site.
- In the lab, Organisms were tallied and sorted using the **teaspoon-bucket method**.

Figure 1: Aerial Map indicating all 4 sampling sites in the Baxter Creek Watershed

Key Terms

Benthic macroinvertebrates: small aquatic organisms that live at the bottom of water bodies.
OBBN: Ontario Benthos Biomonitoring Network.
%EPT: Percent of Ephemeroptera, Plecoptera, Trichoptera.
HBI: Hilsenhoff Biotic Index.

Preliminary Results

% EPT were excellent in each site except in BXCRC-02, this was reflected in pollution tolerant benthos found at BXCRC-02 and high number of pollution sensitive benthos found at BXCRC-01, BXCRC-03, BXCRC-04. While most of the sites had healthy **% Composition, HBI and Simpson Diversity Indices**, the biotic indices measured at BXCRC-02 were low. The sampling sites selected may reflect the impact on **anthropogenic land use** on stream quality from recent subdivision developments in Millbrook, the Water Treatment Plant, agricultural fields, and the Baxter Creek golf course.

Recommendations

- Based on the baseline data collected in this study, we recommend that sampling of Baxter Creek Watershed should occur annually in the spring for at least 5 years.
- Future sampling should occur at a variety of sites throughout the watershed in addition to the four sites in this study. This will allow for the observation of patterns and trends in the benthic communities.
- Comparing this data to different watersheds in the area may also be a priority as further analysis between watersheds can occur.

Key Terms

Figure 4: Pollution tolerances of benthic invertebrates depending on taxonomic order

Researcher: Mariah Shaw
 Faculty Supervisor: Kaitlyn Fleming, TCRC Coordinator: Brittany Finigan
 Host Supervisor: Craig Onafrychuk
 2023/2024 ERSC 4830Y

and mayfly nymphs. Benthic invertebrates are indicator species of water quality.

This project provided Mariah a hands-on learning experience, as well as being trained and demonstrating their Ontario Benthos Biomonitoring Network (OBBN) certified skills. The research determined the identification of benthic species and then used benthos baseline data to determine associations with water quality and habitat assessment within the watercourses and water bodies on the Baxter Creek sub watershed. This data collection will further the current knowledge of the site and will aid in creating a stream rehabilitation action plan to help preserve the area for generations to enjoy.

Mariah completed the laboratory analysis of benthic samples collected in the fall of last year for her research poster and paper. Under the supervision of Dr. Kaitlyn Fleming at Trent University, this project is a baseline study for a new multi-year benthos study across Baxter Creek sub watershed. Dr. Fleming is now looking to further expand the study next year, by including hydrometric water flow data from the Water Survey of Canada gauging station at Distillery Street in Millbrook to understand the seasonal impacts on benthic populations. In collaboration with researchers from BCWA, next year Trent is looking to also expand benthic studies to storm water ponds across the built-up area of Millbrook. Permissions for sampling these new sites will be submitted to the Township before any field work begins.

Student Researcher(s): Mariah Shaw

Faculty Supervisor: Kaitlyn Fleming, School of Environment

Host Organization: Baxter Creek Watershed Alliance (BCWA)

Scott Stebbing, #6153: Baxter Creek Watershed Water Quality Stage 2 Analysis (Trent, Community Research Centre, School of the Environment)

- Scott's research is building on the water quality study initiated last year by Brooke Ceci. Scott has been conducting statistical analysis to normalize the results, including a Mann Kendall Trend Test (sometimes called the M-K test) which is used to analyze water quality data collected over time for consistently increasing or decreasing trends.

The purpose of the project is to allow students to continue building on the first phase the Baxter Creek watershed water quality study completed in March 2023. This study will build on the foundational understanding of the period of record of water quality/chemistry data within the Baxter Creek watershed and provide information to the community on the state of the resource. Students will work with data from both the

Long-term trends in Water Quality of Baxter Creek

Researcher: Scott Stebbing

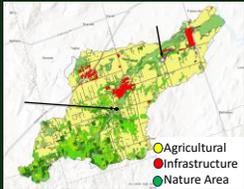





BAXTER CREEK

This study is hosted by Baxter Creek Watershed Alliance which works to monitor and protect this watershed by supporting student research, raising community awareness and farm stewardship.

Baxter Creek watershed area is 90.95 km² with land type of 38.5% wooded area, 8% wetlands, 7.1% floodplain, and 46.4% agriculture. Temperate climate with ~ 905 mm of precipitation per year, annual mean temperature of 6.9 °C, and mean elevation of 264.7 m.



PARAMETERS

- Nitrogen
- Phosphorus
- Dissolved Organic Carbon
- Sodium
- Chloride

FIGURE 1: MAP OF WATERSHED & SAMPLE SITES

OBJECTIVES

My objective was to analyze a long-term data series for nutrients, carbon and their ratios (stoichiometry), and test the relationship of these trends with Discharge and season.

WHY THESE PARAMETERS?

These parameters are principal macronutrients affecting biological communities, with excessive quantities raising eutrophication concerns for downstream communities.

DATA SOURCING

The Ministry of Environment Conservation and Parks Provincial Water Quality Monitoring Network samples Baxter creek yearly with exact months sampled varying annually. Flow data from Water Survey of Canada.

STATISTICAL ANALYSES

Data were analyzed with Mann-Kendall test in RStudio of the Seasonal averages per parameter. P values were used to evaluate significance. One way ANOVA and Tukey post-hoc test to examine differences amongst seasons. A general linear model was used to investigate the interacting effects of season and discharge on parameter concentrations.

SEASONS

Spring March-May
Summer June-Aug.
Autumn Sept.-Nov.

SEASONALITY

Nitrates, DOC, TN had significant seasonal differences between Summer and Autumn. Baxter Creek Discharge also varied by season with spring melt as the maximum discharge.

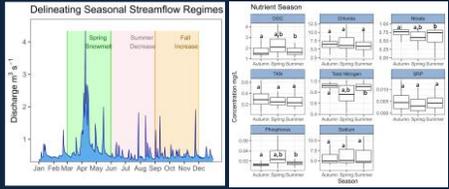


FIGURE 2: SEASONALITY

LONG TERM TRENDS

Soluble Reactive Phosphorus (SRP) is the most bioavailable nutrient for algal growth. SRP has been increasing in the summer which is concerning for the development of algal blooms. Total Nitrogen has also been increasing in the spring and summer. Chlorides in autumn was also observed increasing significantly. Other parameters were not significant.

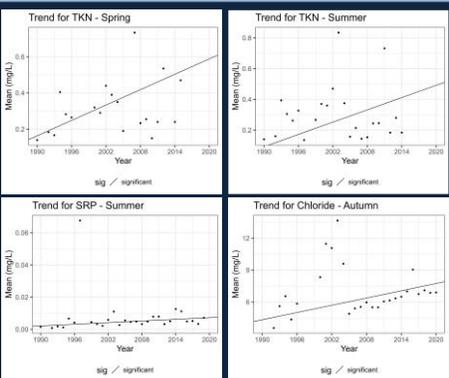


FIGURE 3: SIGNIFICANT LONG TERM TRENDS

STOICHIOMETRIC RATIO TRENDS

The balance of organic carbon (DOC), nitrogen (N), and phosphorus (P) plays a crucial role in aquatic ecosystems and is important to better understand how microbes process nutrients. DOC: SRP is declining which could be problematic for downstream eutrophication.

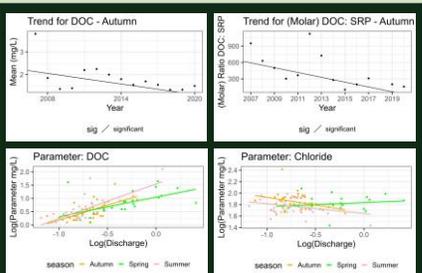


FIGURE 4: RATIO SEASONAL TRENDS AND PARAMETER VS DISCHARGE PLOTS

SUMMARY

SI found increases in concentrations of chlorides, soluble reactive phosphorus, total nitrogen, and nitrates whereas dissolved organic carbon is decreasing but this varied by season.

FUTURE AREAS FOR STUDY

Consider discharge, temperature, or precipitation for possible trends, non-linear trend analysis, consider micronutrient trends, analysis of fluctuations in Dissolved Oxygen, update calculations as more data becomes available

ACKNOWLEDGMENTS

Faculty Supervisor: Marguerite A. Xenopoulos, James Kelley
TCRC Supervisor: Brittany Finigan Host Supervisor: Craig Onafrychuk
BIOL 4891H 2024 Winter

For more information contact: scottstebbing@trentu.ca

MECP Provincial Water Quality Monitoring Network and potentially from the Trent University Institute of Watershed Science to review the data from existing water chemistry records for Baxter at Cedar Valley and Zion Line. Students will build on previous analysis of the data and report on the summary of the records while discussing the potential sources or activities for the current chemical components. A fundamental requirement will be the need to normalize the time series data based on seasonality, sampling regime, remove outliers, and apply other essential statistical data preparatory methods. This study will in turn help the preservation of the watershed and will encourage community awareness.

Faculty Supervisor: Maggie Xenopoulos, Biology

Host Organization: Baxter Creek Watershed Alliance

Noah Mantle, #6037- An Assessment of Options for the Needler's Mill Lands and Former Community Arena.

- Located in the village of Millbrook, beside the Baxter Creek and its dam is a parcel of municipal land occupied by the Village's historic Needler's Mill, a parking lot and a Community Centre and former hockey arena now requiring extensive rehabilitation and restoration to make it accessible and safe. For the benefit of community residents and Council, the project is to provide a social, cultural, environmental and economic impact assessment of the transformation of the area into a multi-use municipal park tentatively named Needler's Common Town Square. Options for the site, both physical lands use and future stewardship, are to be evaluated.

Student Researcher(s): Noah Mantle

Faculty Supervisor: Roger Picton, School of Environment

Host Organization: Cavan Monaghan Community for Common Ground & Baxter Creek Watershed Alliance

Other student projects currently on the way:

Ben Krawec, “Baxter Creek Watershed Tree Canopy Analysis”

- This study is one piece of a much larger project being conducted by the Baxter Creek Watershed Alliance. The overall objective of the project is to create a workably accurate 3-dimensional model of the woodlands within the Baxter Creek Watershed.

Alanah Reveler, Jackson Mitchell, Thiluxsaan Puvanendran, “Baxter Creek Watershed Hub Phase Three”, Fleming College GeoCommunity Project

- This project is in the early stages and will be completed by the end of June 2024.

The main goals are to support a watershed planning process by developing an integrated two-dimensional (2D) geographic hydro-model database for the Baxter Creek watershed, and a three-dimensional (3D) “Digital Twin” of the built-up settlement area of Millbrook.

The 2D hydro-model “geodatabase” will consist of key surface hydrologic features (a mapping requirement under the Oak Ridges Moraine Conservation Plan), and additional online mapping tools to share this information with partners, collaborators, and the public. The Baxter Creek subwatershed will be a prototype and pilot study to be used a template to implement a 2D geodatabase for Cavan Creek and Squirrel Creek subwatersheds.

The deliverables will provide BCWA and members of the community with a visual and analytical representation to highlight and engage in discussions regarding the importance of environmental ecosystems and the impact of growth on them.

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