Onterris™

Peterborough County Watershed Plan Equivalent

Volume 1: Characterization

Prepared for: Peterborough County

Prepared by: Onterris Canada Inc. in association with Scheckenberger & Associates and Grounded Solutions

July 2026

Version 1.0

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V0.2	03-Jun-2026	Revised Draft	40848 PCWP Vol.1 2026-06-03 draft v0.2.docx	Issued to client for review
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V1.0	22-Jul-2026	Final	40848 PCWP Vol.1 2026-07-22 final v1.0.docx	Issued to client for release to Council and others

Preamble

This Watershed Plan is intended to be a "living document" which provides a basis for both sources of data / mapping and planning / management guidance that can be updated and adapted over time based on evolving circumstances and the outcomes of collaborative efforts.

This Watershed Plan (Volumes 1 and 2) was developed between the fall of 2024 and the spring of 2026 based on the most current data / mapping and applicable policies / regulations / guidelines made available to the team. It is understood that data / mapping and policies / regulations / guidelines will continue to be updated/change after this Plan is finalized, and that moving forward, future work and studies, based on this Plan, should consider the most current and applicable information, available at that time.

Inclusion of First Nations Historical Context in the Volume 1 Foreword

The Michi Saagiig historical / background context prepared by Gitiga Migizi, a respected Elder and Knowledge Keeper of the Michi Saagiig Nation was provided to the County as part of the feedback on Peterborough County's Draft Watershed Plan by Curve Lake First Nation on April 22, 2026. It has been included in the Foreword to Volume 1 of this Watershed Plan, with Curve Lake First Nation's permission, to recognize and share this context provided from the perspective of the peoples who have lived on these lands for thousands of years.

Note on the Pending Consolidation of Conservation Authorities in Ontario

On March 10, 2026, the Province announced a revised framework to merge Ontario's 36 Conservation Authorities (CAs) into nine (9) Regional CAs. The transition timeframe to this framework is targeted for February 1, 2027.

For Peterborough County, this means there will be one Regional CA (i.e., Eastern Lake Ontario Regional Conservation Authority) instead of the current four CAs (i.e., Otonabee Conservation, Ganaraska Conservation, Crowe Valley Conservation Authority and Kawartha Conservation). However, for the purposes of this Watershed Plan, which was developed over 2025 and finalized in 2026, the references to the four CAs have been retained, as this transition was still in progress at the time of Watershed Plan completion.

Notably, only part of the County (i.e., the southwestern area largely overlapping with Ecoregion 6E) is under the jurisdiction of CAs. The northeastern part of the County (i.e., the area largely overlapping with Ecoregion 5E) remains outside the jurisdiction of any CA, and activities that may impact key environmental resources, including water (as well as fisheries, wildlife and forests) continues to be managed by the Province, currently through the Ontario's Ministry of Natural Resources (OMNR). In addition, Parks Canada continues to actively manage water levels and flows through the Trent-Severn Waterway, with over a quarter of this waterway running through Peterborough County.

Foreword

Michi Saagiig Historical / Background Context (as prepared by Elder Gitiga Migizi (Doug Williams))

The traditional homelands of the Michi Saagiig (Mississauga Anishinaabeg) encompass a vast area of what is now known as southern Ontario. The Michi Saagiig are known as "the people of the big river mouths" and were also known as the "Salmon People" who occupied and fished the north shore of Lake Ontario where the various tributaries emptied into the lake. Their territories extended north into and beyond the Kawarthas as winter hunting grounds on which they would break off into smaller social groups for the season, hunting and trapping on these lands, then returning to the lakeshore in spring for the summer months.

The Michi Saagiig were a highly mobile people, travelling vast distances to procure subsistence for their people. They were also known as the "Peacekeepers" among Indigenous nations. The Michi Saagiig homelands were located directly between two very powerful Confederacies: The Three Fires Confederacy to the north and the Haudenosaunee Confederacy to the south. The Michi Saagiig were the negotiators, the messengers, the diplomats, and they successfully mediated peace throughout this area of Ontario for countless generations.

Michi Saagiig oral histories speak to their people being in this area of Ontario for thousands of years. These stories recount the "Old Ones" who spoke an ancient Algonquian dialect. The histories explain that the current Ojibwa phonology is the 5th transformation of this language, demonstrating a linguistic connection that spans back into deep time. The Michi Saagiig of today are the descendants of the ancient peoples who lived in Ontario during the Archaic and Paleo-Indian periods. They are the original inhabitants of southern Ontario, and they are still here today.

The traditional territories of the Michi Saagiig span from Gananoque in the east, all along the north shore of Lake Ontario, west to the north shore of Lake Erie at Long Point. The territory spreads as far north as the tributaries that flow into these lakes, from Bancroft and north of the Haliburton highlands. This also includes all the tributaries that flow from the height of land north of Toronto like the Oak Ridges Moraine, and all of the rivers that flow into Lake Ontario (the Rideau, the Salmon, the Ganaraska, the Moira, the Trent, the Don, the Rouge, the Etobicoke, the Humber, and the Credit, as well as Wilmot and 16 Mile Creeks) through Burlington Bay and the Niagara region including the Welland and Niagara Rivers, and beyond. The western side of the Michi Saagiig Nation was located around the Grand River which was used as a portage route as the Niagara portage was too dangerous. The Michi Saagiig would portage from present-day Burlington to the Grand River and travel south to the open water on Lake Erie.

Michi Saagiig oral histories also speak to the occurrence of people coming into their territories sometime between 500-1000 A.D. seeking to establish villages and a corn growing economy – these newcomers included peoples that would later be known as the Huron-Wendat, Neutral, Petun/Tobacco Nations. The Michi Saagiig made Treaties with these newcomers and granted them permission to stay with the understanding that they were visitors in these lands. Wampum was made to record these contracts, ceremonies would have bound each nation to their respective responsibilities within the political relationship, and these contracts would have been renewed annually (see Migizi-ban and Kapyrka 2015). These visitors were extremely successful as their corn economy grew as well as their populations. However, it was understood by all nations involved that this area of Ontario were the homeland territories of the Michi Saagiig.

The Odawa Nation worked with the Michi Saagiig to meet with the Huron-Wendat, the Petun, and Neutral Nations to continue the amicable political and economic relationship that existed – a symbiotic relationship that was mainly policed and enforced by the Odawa people.

Problems arose for the Michi Saagiig in the 1600s when the European way of life was introduced into southern Ontario. Also, around the same time, the Haudenosaunee were given firearms by the colonial governments in New York and Albany which ultimately made an expansion possible for them into Michi Saagiig territories. There began skirmishes with the various nations living in Ontario at the time. The Haudenosaunee engaged in fighting with the Huron-Wendat and between that and the onslaught of European diseases, the Iroquoian speaking peoples in Ontario were decimated.

The onset of colonial settlement and missionary involvement severely disrupted the original relationships between these Indigenous nations. Disease and warfare had a devastating impact upon the Indigenous peoples of Ontario, especially the large sedentary villages, which mostly included Iroquoian speaking peoples. The Michi Saagiig were largely able to avoid the devastation caused by these processes by retreating to their wintering grounds to the north, essentially waiting for the smoke to clear.

Michi Saagiig Elder Gitiga Migizi (2017) recounts:

> *We weren't affected as much as the larger villages because we learned to paddle away for several years until everything settled down. And we came back and tried to bury the bones of the Huron but it was overwhelming, it was all over, there were bones all over – that is our story.*
>
> *There is a misnomer here, that this area of Ontario is not our traditional territory and that we came in here after the Huron-Wendat left or were defeated, but that is not true. That is a big misconception of our history that needs to be corrected. We are the traditional people, we are the ones that signed treaties with the Crown. We are recognized as the ones who signed these treaties and we are the ones to be dealt with officially in any matters concerning territory in southern Ontario.*
>
> *We had peacemakers go to the Haudenosaunee and live amongst them in order to change their ways. We had also diplomatically dealt with some of the strong chiefs to the north and tried to make peace as much as possible. So we are very important in terms of keeping the balance of relationships in harmony.*
>
> *Some of the old leaders recognized that it became increasingly difficult to keep the peace after the Europeans introduced guns. But we still continued to meet, and we still continued to have some wampum, which doesn't mean we negated our territory or gave up our territory – we did not do that. We still consider ourselves a sovereign nation*

despite legal challenges against that. We still view ourselves as a nation and the government must negotiate from that basis.

Often times, southern Ontario is described as being “vacant” after the dispersal of the Huron-Wendat peoples in 1649 (who fled east to Quebec and south to the United States). This is misleading as these territories remained the homelands of the Michi Saagiig Nation.

The Michi Saagiig participated in eighteen treaties from 1781 to 1923 to allow the growing number of European settlers to establish in Ontario. Pressures from increased settlement forced the Michi Saagiig to slowly move into small family groups around the present-day communities: Curve Lake First Nation, Hiawatha First Nation, Alderville First Nation, Scugog Island First Nation, New Credit First Nation, and Mississauga First Nation.

The Michi Saagiig have been in Ontario for thousands of years, and they remain here to this day.

**Publication reference: Gitiga Migizi-ban and Julie Kapyrka. 2015. Before, During, and After: Mississauga Presence in the Kawarthas. In Peterborough Archaeology, Dirk Verhulst, editor, pp.127-136. Peterborough, Ontario: Peterborough Chapter of the Ontario Archaeological Society

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In-text Images

In-text Tables

Figures

Note: Figures showing the most current (as of report publishing), available and applicable biophysical and environmental planning information are included in the Peterborough County Watershed Plan Equivalent - Map Book for ease of downloading and reference. Figures 1 through 28 referenced in Volume 1 are listed below for reference.

Appendices

1 Introduction and Study Context

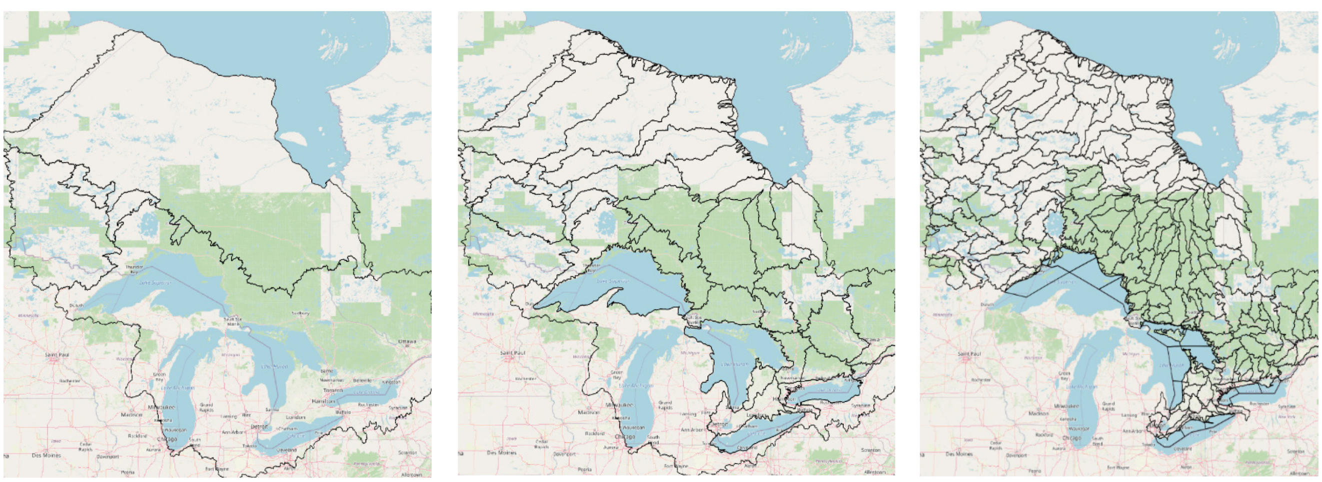
1.1 Introduction

In the fall of 2024 Peterborough County ("the County") retained a multi-disciplinary team led by Montrose Environmental Solutions Canada Inc., now Onterris Canada Inc., and supported by R. Scheckenberger & Associates and Grounded Solutions Services Ltd. ("the Consulting Team") to assist in the development of the County's first Watershed Plan.

In accordance with provincial requirements (see Section 1.2), this Plan has been developed for the Study Area (see Section 1.3) in partnership and collaboration with a Technical Advisory Committee (TAC) including the eight (8) local area municipalities in the County, two First Nations in the County, and four conservation authorities whose jurisdictions overlap with the County (see Figure 1 and Figure 2).

This project is also aligned with the draft provincial guidance for watershed planning (See Section 1.4) and has been informed by input from other Williams Treaties First Nations as well as contributions from a range of local agencies, institutions, utilities, lake and cottage associations, and other local organizations (see Section 1.5).

Watershed planning can occur at various scales and corresponding levels of detail (see Image 1). The overall framework for and guidance in this Plan is provided at the tertiary watershed level (as shown in Image 1). However, this Plan has been developed with consideration for the primary and secondary levels, and also includes information gathered and summarized at the quaternary watershed scale (see Figure 3, Figure 4, and Section 2).



Primary (e.g., St. Lawrence System) | **Secondary (e.g., Madawaska River)** | **Tertiary (e.g., Otonabee River)**

Image 1 Illustration of the Top three Levels of the Provincial Watershed Delineation Hierarchy (Data Source: Ontario Watershed Boundaries [OWB]; MNRF 2020)

Peterborough County is a large upper tier municipality west of the Greater Toronto Area (i.e., over 4,000 km^2) that includes urban and urbanizing centres, extensive agricultural lands and even more extensive water and natural heritage resources.

Biophysically, the County is characterized by thousands of rivers and lakes with extensive shorelines, as well as extensive forests and wetlands. Physically, the County's natural resources are broadly shaped the fact that the southwestern part of the County is south of the Canadian Shield (i.e., Ecoregion 6E) and the northeastern part is on the Canadian Shield (i.e., Ecoregion 5E) with the transition between these two ecoregions known as "the Land Between" (see Image 2).

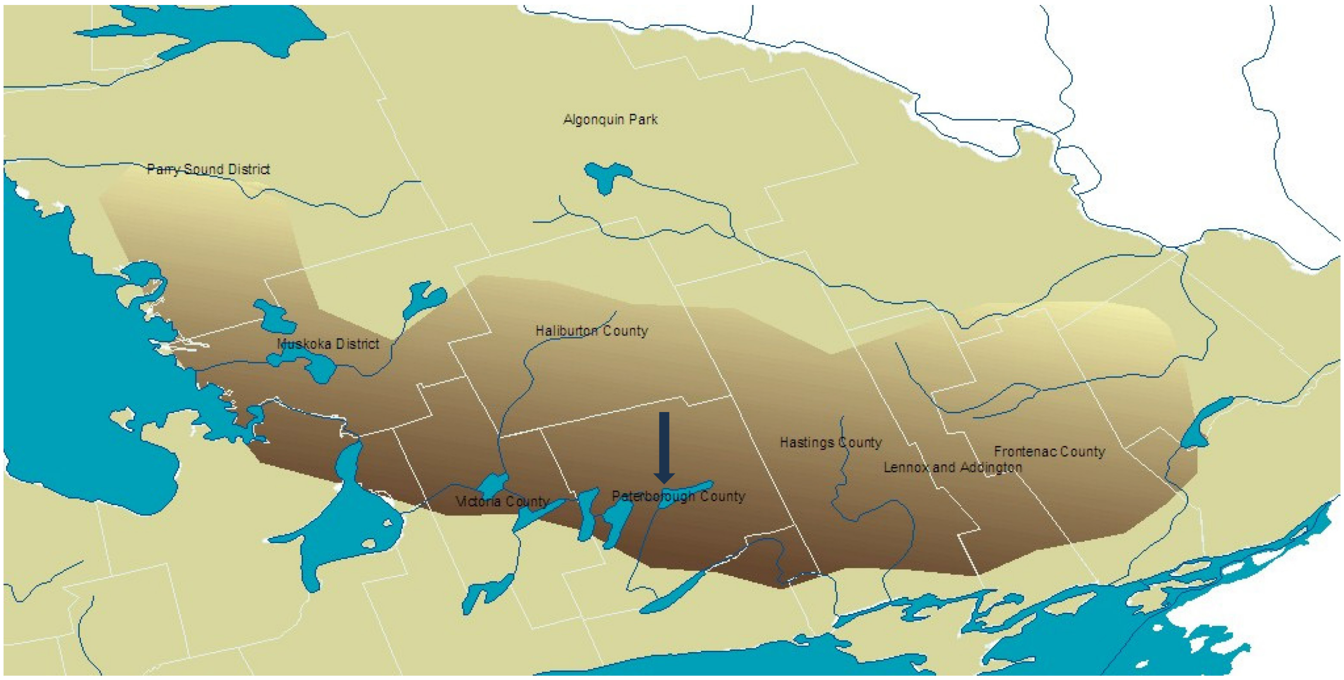


Image 2 Location of Peterborough County in Ontario Showing Transition to the Canadian Shield (Source: Thelandbetween.ca)

This is the first Watershed Plan for this large and biophysically diverse area. As Peterborough County had not previously had its water or natural heritage resources comprehensively characterized, it was considered appropriate and necessary prepare a Watershed Plan "Equivalent", as outlined in the text box below.

A Watershed Plan "Equivalent" is a type of watershed plan recognized by the Province that focuses on the collection and synthesis of all available and relevant data to inform an initial jurisdiction-wide characterization to establish high-level environmental planning and management guidance.

As an "Equivalent", this first Watershed Plan for the County provides (1) a high-level summary and County-wide characterization of existing natural heritage and water resources, including the identification of key data gaps and (2) high-level environmental planning and management guidance that offers the basis for future more detailed area-specific studies (including field data collection and surface / groundwater modelling).

What is a Watershed Plan Equivalent?

The Draft Provincial Watershed Planning guidance (Government of Ontario 2018) includes equivalency and transition provisions which allows for the leveraging information from existing documents and sources to inform growth planning as well as requirements for future watershed studies which are expected to include more area-specific modelling and field data collection.

This Peterborough County Watershed Plan Equivalent is being prepared as a watershed planning ‘equivalent’ document in accordance with provincial direction which allows for the use of existing data in watershed planning. The focus is on the collection, synthesis and analysis of data at the tertiary scale, with collection and synthesis of data at the quaternary scale for areas where growth pressures are greatest.

This Watershed Plan is provided in two volumes as follows:

1. **Peterborough County Watershed Plan Equivalent, Volume 1: Characterization (referred to herein as Volume 1 of the Watershed Plan), and**
2. **Peterborough County Watershed Plan Equivalent, Volume 2: Planning and Management Guidance (referred to herein as Volume 2 of the Watershed Plan).**

This report represents the Peterborough County Watershed Plan Equivalent, Volume 1: Characterization. Notably, Volume 1 of the Watershed Plan incorporates and builds on the information gathered as part of the background review (i.e., Draft Phase 1 Technical Memo, March 2025) summarized in Appendix A, which has been integrated and updated in this report as appropriate based on feedback from those engaged, including the local Conservation Authorities.

1.2 Study Rationale, Purpose and Objectives

This Watershed Plan (i.e., Volume 1 and Volume 2) is needed to address provincial planning requirements (outlined in Section 1.4) and implement the County’s strategic direction.

This Plan was identified as a strategic priority in the County’s 2023-2026 Strategic Plan (2022a) since it is needed to:

- Provide a framework for sustainable and science-based planning that will support the protection of the County’s valued natural heritage and water resources, and
- Provide high-level guidance to inform updates to the County’s and local municipality Official Plans in accordance with current provincial direction.

The overall purpose of this Watershed Plan is to:

- Address the requirements related to watershed planning outlined in the 2024 Provincial Planning Statement (“PPS”) and align with the current provincial guidance related to watershed planning (see Section 1.4)

- Provide a basis and framework for more detailed studies (including modelling and field work) in priority quaternary watersheds in the future, and
- Inform sustainable growth, infrastructure planning, and restoration efforts on a County-wide and tertiary watershed scale.

This Watershed Plan fulfills the purpose outlined above by:

1. Characterizing existing conditions at the tertiary and quaternary watershed scales, including identification of key data gaps and needs (see Volume 1)
2. Establishing a vision, goals and objectives for the watershed (see Volume 2).
3. Providing high-level planning and technical guidance and recommendations to:
    a. Inform the identification of a Water Resource System (WRS) and Natural Heritage System (NHS) (in accordance with the PPS)
    b. Protect the WRS and NHS with consideration for planned growth and climate change
    c. Help advance local outreach and stewardship, and
    d. Inform future, more detailed subwatershed planning among the local municipalities
4. Incorporating input from local First Nations, municipalities, conservation authorities, and others in the community (as outlined in the Phase 1 and Phase 2/3 Engagement Summaries available under separate cover).

1.3 About the Study Area

The Study Area for this Watershed Plan is the entire County of Peterborough (see Figure 1) which includes the following 8 local area municipalities (see Figure 1) and overlaps with the jurisdiction of the four area conservation authorities (see Figure 2):

Local Area Municipalities

- Municipality of Trent Lakes
- Township of Asphodel-Norwood
- Township of Cavan Monaghan
- Township of Douro-Dummer
- Township of Havelock-Belmont-Methuen
- Township of North Kawartha
- Township of Otonabee-South Monaghan
- Township of Selwyn

Local Conservation Authorities

- Crowe Valley Conservation Authority
- Ganaraska Conservation
- Otonabee Conservation
- Kawartha Conservation

The Study Area also overlaps with the Williams Treaties lands (see the text box below) which impacted the following seven First Nations, including two that have reserves within the County, as noted:

- Alderville First Nation
- Beausoleil First Nation
- Chippewas of Georgina Island First Nation
- Chippewas of Rama First Nation
- Curve Lake First Nation**
- Hiawathas First Nation**
- Mississaugas of Scugog Island First Nation

** With reserves within Peterborough County, as shown in Figures 1 through 3.

Notably, the City of Peterborough is not included in this study, as it is a single tier municipality with its own Watershed Plan. However, the City is surrounded by the Study Area and is being engaged because changes upstream of the City have the potential to impact water and natural heritage resources within the City itself, while changes and developments within the City similarly would have the potential to impact water and natural heritage resources in the County, downstream of the City.

A Brief Note on Local Indigenous History / Context

Cited from the Canadian Encyclopedia (accessed in March 2025)

The Williams Treaties were signed in October and November 1923 by the governments of Canada and Ontario and by seven First Nations of the Chippewa of Lake Simcoe (Beausoleil, Georgina Island and Rama) and the Mississauga of the north shore of Lake Ontario (Alderville, Curve Lake, Hiawatha and Scugog Island). As the last historic land cession treaties in Canada, these agreements transferred over 20,000 km^2 of land in south central Ontario to the Crown; in exchange, Indigenous signatories received one-time cash payments. While Chippewa and Mississauga peoples argue that the Williams Treaties also guaranteed their right to hunt and fish on the territory, the federal and provincial governments have interpreted the treaty differently, resulting in legal disputes and negotiations between the three parties about land rights. In 2018, the Williams Treaties First Nations and the Governments of Ontario and Canada came to a final agreement, settling litigation about land surrenders and harvesting rights.

Please see the Foreword to this Plan which provides this historical context from a First Nations perspective.

More information is also available on the respective websites of the First Nations listed above.

In addition to the political boundaries and jurisdictions outlined above, the Study Area includes, and focuses on, the five (5) tertiary watersheds (see Figure 3) and considers the 26 quaternary watersheds (see Figure 4), as described in more detail in Section 2.

1.4 Provincial Watershed Planning Requirements and Guidance

The Province requires planning authorities to use watershed-based assessment and planning to ensure growth and development can be advanced without negatively impacting water resource systems. Where upper tier municipalities (like Peterborough County) are undertaking watershed planning, they must do so in partnership with their local municipalities and First Nations, and in collaboration with their local conservation authorities.

The specific policies from the 2024 PPS that the County and its local area municipalities are required to comply with are outlined in the text boxes below.

Provincial Planning Statement (2024)

Chapter 1: Vision

Ontario will continue to recognize the unique role Indigenous communities have in land use planning and development, and the contribution of Indigenous communities' perspectives and traditional knowledge to land use planning decisions. Meaningful early engagement and constructive, cooperative relationship-building between planning authorities and Indigenous communities will facilitate knowledge-sharing and inform decision-making in land use planning.

Section 8: Definitions

Watershed planning: means planning that provides a framework for establishing comprehensive and integrated goals, objectives, and direction for the protection, enhancement, or restoration of water resources, including the quality and quantity of water, within a watershed and for the assessment of cumulative, cross-jurisdictional, and cross-watershed impacts. Watershed planning evaluates and considers the impacts of a changing climate on water resource systems and is undertaken at many scales. It may inform the identification of water resource systems.

2024 Provincial Planning Statement, Section 4.2: Water

1. *Planning authorities shall protect, improve or restore the quality and quantity of water by:*

    a) *using the watershed as the ecologically meaningful scale for integrated and long-term planning, which can be a foundation for considering cumulative impacts of development;*

    b) *minimizing potential negative impacts, including cross-jurisdictional and cross-watershed impacts;*

    c) *identifying water resource systems;*

d) *maintaining linkages and functions of water resource systems;*

e) *implementing necessary restrictions on development and site alteration to: 1. protect all municipal drinking water supplies and designated vulnerable areas; and 2. protect, improve or restore vulnerable surface and ground water, and their hydrologic functions;*

f) *planning for efficient and sustainable use of water resources, through practices for water conservation and sustaining water quality; and*

g) *ensuring consideration of environmental lake capacity, where applicable.*

2. *Development and site alteration shall be restricted in or near sensitive surface water features and sensitive ground water features such that these features and their related hydrologic functions will be protected, improved or restored, which may require mitigative measures and/or alternative development approaches.*

3. *Municipalities are encouraged to undertake, and large and fast-growing municipalities shall undertake watershed planning to inform planning for sewage and water services and stormwater management, including low impact development, and the protection, improvement or restoration of the quality and quantity of water.*

4. *Despite policy 4.2.3, where planning is conducted by an upper-tier municipality that includes one or more lower-tier large and fast-growing municipalities, the upper-tier municipality shall undertake watershed planning in partnership with lower-tier municipalities, including lower-tier large and fast-growing municipalities.*

5. *All municipalities undertaking watershed planning are encouraged to collaborate with applicable conservation authorities.*

In addition to the watershed planning requirements laid out in the 2024 PPS (as outlined above), Ontario's Draft Watershed Planning guidance document (Government of Ontario 2018) outlines the following seven components that are integral to watershed planning:

1. Water budgets, conservation plans, and surface and groundwater quantity considerations
   - Water budgets are a basic tool to fulfill objectives used in support of water supply and land use management.
2. Water quality for surface and ground water, nutrient loading, and assimilative capacity assessments
   - This includes identification of point and non-point sources of pollution.
3. Consideration / identification of natural hazards (erosion, flooding, dynamic beach)
   - This includes hazardous lands and hazardous sites.
4. Climate change considerations
   - This includes mitigation of greenhouse gases, and adaptations to a changing climate and consideration of green infrastructure that can mitigate effects.

5. Interconnections with natural heritage features, areas, and systems, as well as the benefits of green infrastructure
    - This considers the long-term health and viability of water resources, biodiversity and ecological integrity.
6. Consideration of cumulative impacts
    - This refers to accumulating changes in the environment caused by the combined effects of developments, land use changes, permits, licences, climate change and infrastructure over time.
7. Analysis of land use and management scenarios
    - This refers to consideration of alternative measures and methods that may be used to protect, enhance, or rehabilitate the environmental features identified in the watershed issues and goals.

Furthermore, the 2018 provincial guidance indicates that watershed planning is to involve the steps below and the components listed at a scale appropriate for the given study, recognizing that some components can only be fully addressed at the more area-specific subwatershed scale.

1. Assessment of existing watershed conditions
    - delineation and characterization of the watershed of interest
    - reviewing existing information for use as equivalency or to build on is recommended
    - local relevance can influence what information should be collected or what information may not be relevant
2. Setting a direction
    - setting a vision, objective, goals and targets
    - identify opportunities for protection, enhancement, rehabilitation, and development
    - assessing cumulative effects
    - assessment of land use and management scenarios
3. Implementing the direction
    - direction for implementation in municipal official plan policies for informing land use planning and decision-making
    - water, wastewater and stormwater servicing requirements
    - best management practices and designs for the management of the quantity and quality of surface water and ground water
4. Monitoring and Evaluation
    - monitoring, reporting and analyzing
    - adaptive management, goal and target revision, evaluation of all areas of the plan

The results of the required analyses and characterization of this Watershed Plan (as provided in Volume 1) are to provide the technical background information necessary to support planning for the “protection, restoration, or enhancement of the quality and quantity of water” (as provided in Volume 2).

The outcomes of Watershed Plan are also intended to inform area management plans, provide a watershed scale framework for site scale studies, and inform target setting through future more detailed subwatershed plans.

1.5 Study Approach (including Engagement)

The watershed planning framework is typically a phased process undertaken to:

1. inform land use planning,
2. inform management (including monitoring), and
3. assist in the protection of water quantity and quality.

In Peterborough County, the Watershed Plan was organized into the three phases below (as shown in Image 3) to facilitate the data collection and analysis needed to meet the goals above, while also integrating engagement with key partners and interested parties throughout the process (as shown in Image 3).

1. Phase 1: Project Launch and Background Review
2. Phase 2: Watershed Characterization (including guidance related to Water Resource System (WRS) and Natural Heritage System (NHS) identification)
3. Phase 3: Watershed Planning and Management (including Monitoring) Recommendations

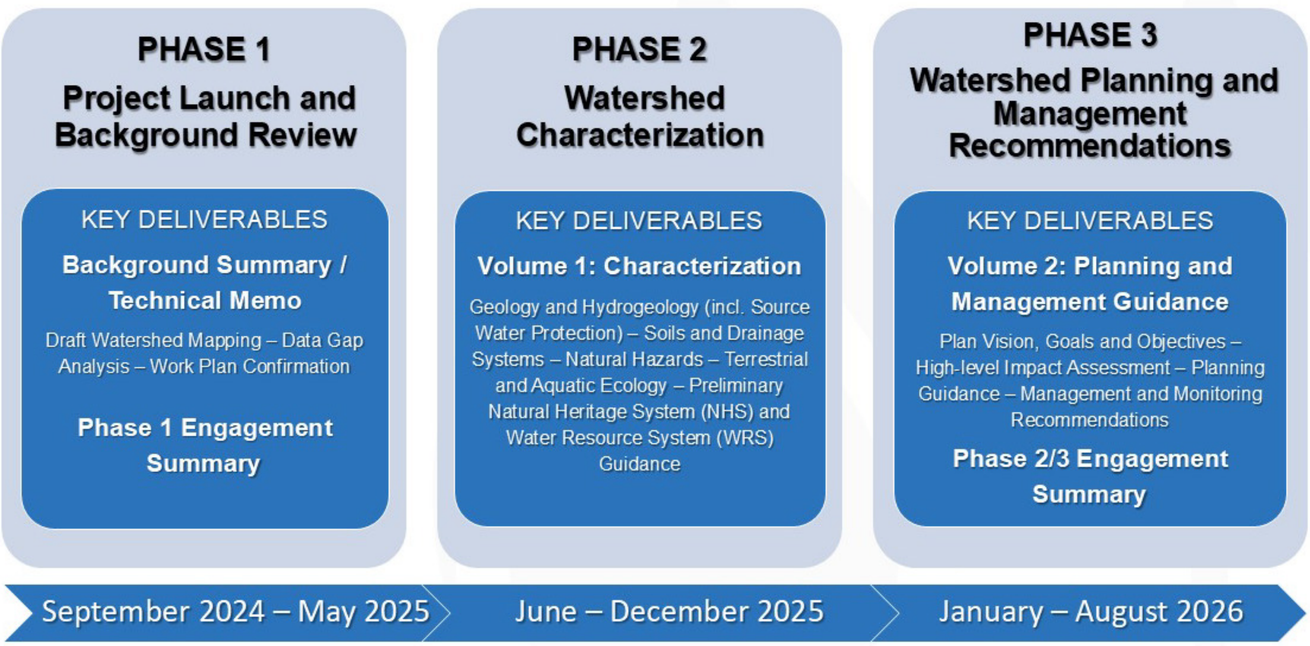


Image 3 Peterborough County Watershed Plan Equivalency Project Phasing and Timing

Peterborough County's Watershed Plan study has also included extensive engagement, as outlined in Image 4, including:

- workshops with the project-specific TAC during each phase of the project
- creation and updating of a project-specific web page for each phase of the project
- outreach to the seven Williams Treaties First Nations and workshops with all interested parties
- outreach to more than 40 local agencies, institutions, lake and cottage associations, and other organizations, and workshops with all interested parties, and
- presentations to Council at the outset of the project and towards project completion.

Image 4 Peterborough County Watershed Plan Equivalency Project Engagement

Through this watershed planning process, several provincial obligations are fulfilled concurrently including climate change planning, as well as the municipalities' responsibility to consider cumulative impacts and engage with local municipalities, agencies and First Nations. Both Volume 1 and Volume 2 of this Watershed Plan were developed collaboratively with a project-specific Technical Advisory Committee (TAC) including representatives from two local First Nations, the four local conservation authorities, and the eight local area municipalities within the County. These deliverables have also been informed by resources and input shared by a range of local agencies, institutions, association and organizations.

An overview of the parties engaged, and the feedback provided is available in the Engagement Summaries available under separate cover on the County's project web page.

1.6 Watershed Plan Volume 1 and Volume 2 Overview

This Watershed Plan has been delivered in two reports, Volume 1: Characterization and Volume 2: Planning and Management Guidance, accompanied by a Map Book. The Map Book includes 47 figures showing the different layers and types of available biophysical and environmental planning information for the County. Figures 1 through 28 are referenced in Volume 1 while Figure 29 through 47 support the text in Volume 2.

This Volume 1 (Characterization) report provides a comprehensive synthesis of the background review findings and data gaps on a County-wide and tertiary watershed scale. This includes high-level summaries of the extent and status, where known, of existing biophysical conditions with consideration for topography and soils, surface and groundwater conditions, aquatic and terrestrial habitat types and areas, and the potential or known natural hazards associated with those areas.

Specifically, Volume 1 of this Watershed Plan includes:

- A summary of the background review findings and gaps identified completed as part of the first phase of this project (Section 2)
- A description of the presence and distribution of various environmental features and their sensitivities across the County (i.e., the Study area) (Section 3), and
- A description of the presence and distribution of various environmental features and their sensitivities in each tertiary watershed in the County:
  - Otonabee River Tertiary Watershed (Section 4)
  - Trent River – Crowe River Tertiary Watershed (Section 5)
  - Gull River Tertiary Watershed (Section 6)
  - Kawartha Lakes Tertiary Watershed (Section 7), and
  - North Lake Ontario Tertiary Watershed (Section 8).

Volume 2 of the Watershed Plan builds on the technical background in Volume 1 to inform the vision, goals and objectives for the Study Area and provide planning and management guidance to meet the established objectives. Volume 2 includes, as it relates to natural heritage and water resources in Peterborough County at the watershed-equivalent scale:

- An overview of the planning context (Section 2)
- A vision, goals and objectives for the Study Area (Section 3)
- High-level guidance related to Natural Heritage System and Water Resource System identification (Section 4)
- Watershed-scale guidance related to water quantity and quality management, planning for climate change, natural hazard identification and management, and natural heritage and water resource system identification (Section 5)
- Land use impact and cumulative impact assessment guidance (Section 6)
- Guidance for prioritizing and scoping future subwatershed studies (Section 7)
- Guidance related to monitoring and adaptive management (Section 8)
- Opportunities for improving Official Plan policies (Section 9)
- Opportunities for enhancing outreach and stewardship (Section 10)

Together, these two volumes comprise the County's first Watershed Plan.

2 Background Review

The background review for this Watershed Plan was extensive and involved the collection, screening and synthesis of available existing data, mapping, reports and other information considered potentially relevant from sources and organizations across the Study Area.

The background review confirmed that the Study Area (which is the County) includes the lands of two First Nation reserves (i.e., Curve Lake First Nation and Hiawatha First Nation) and eight local municipalities (see Figure 1), as well as four conservation authorities whose jurisdiction overlaps with the County (see Figure 2). The background review also confirmed that the land within the County outside Conservation Authority jurisdiction is regulated by the Ministry of Natural Resources (MNR) Districts of Bancroft and Peterborough. The City of Peterborough also sits within the County but has undertaken its own watershed planning and as a single tier municipality is excluded from the Study Area.

This section of the report summarizes the sources reviewed, what was found, and key the data gaps identified for:

- Watershed boundaries (Section 2.1)
- Land use / land cover (Section 2.2)
- Physical environment (including climate, physiography, geology and soils) (Section 2.3)
- Water resources (including surface water and groundwater) (Section 2.4)
- Natural hazards (Section 2.5)
- Aquatic and terrestrial resources (Section 2.6)

This information was gathered from publicly available documents, mapping and data found online and shared by the following, who are all members of the project-specific TAC:

- local Williams Treaties First Nations[1]
- local area municipalities within the County (Asphodel-Norwood Township, Cavan Monaghan Township, Douro-Dummer Township, Havelock-Belmont-Methuen Township, North Kawartha Township, Otonabee-South Monaghan Township, Selwyn Township, Municipality of Trent Lakes)
- Conservation Authorities whose jurisdiction overlaps with the County (Crowe Valley Conservation Authority, Ganaraska Conservation, Kawartha Conservation, and Otonabee Conservation)
- Source Protection Planning Areas (e.g., Trent Conservation Coalition, 2025)
- City of Peterborough, and

[1] The Williams Treaties First Nations include: Alderville First Nation, Beausoleil First Nation, Chippewas of Georgina Island First Nation, Chippewas of Rama First Nation, Curve Lake First Nation, Hiawatha First Nation, and Mississaugas of Scugog Island First Nation.

- other governmental and non-governmental organizations.

A broad collection of background documentation and data, including geospatial data, was reviewed and evaluated for appropriateness for informing this Watershed Plan and in fulfilling the project objectives outlined above (Section 1.2). Table 1 provides an overview of the types of data available for each quaternary watershed in the County and the date range of all reports that cover that watershed.

A full list of reports received for review is included in Appendix A-4, which includes two matrices that detail the vintage and content of reports as applicable to components of the Watershed Planning process.

The following sections provide an overview of relevant data collected by discipline, with key gaps identified as applicable.

In addition to watershed boundaries, which are based primarily on surface water drainage divides, Ontario is also divided by ecoregional boundaries based on local climate, geologic, soil and vegetation conditions. In the County of Peterborough, which is basically bisected by the transitional divide between Ecoregion 5E and 6E (see Figure 24), these units also have particular relevance, both from a biophysical perspective (as described in this Volume 1 of the Watershed Plan) and a natural heritage planning perspective (as described in this Volume 2 of the Watershed Plan).

- Ecoregion 5E is underlain by the Precambrian (Canadian) Shield, and characterized by predominantly rocky terrain, rugged topography, and a thin, patchy soil cover in a landscape dominated by lakes and rivers.
- Ecoregion 6E is primarily underlain by Paleozoic sedimentary bedrock (limestone) buried under deep glacial deposits characterized by the Peterborough Drumlin Field featuring rolling hills of fertile, alkaline glacial till and soft-bottomed rivers like the Otonabee.

Although the information in this Watershed Plan has been necessarily and appropriately presented using tertiary and quaternary watershed scale units, the ecoregional context should also be considered. The extent of each Ecoregion (i.e., 5E or 6E) in each of the tertiary watersheds is noted in Table 2 for reference.

Table 1 Reports Reviewed - Organized by Content and by Quaternary Watershed

Tertiary Watershed	Gull River			Kawartha Lakes									North Lake Ontario Shoreline	Otonabee River						Crowe Bay Dam – Trent River						
Quaternary Watershed / Data Being Sourced	Birchbark Lake - Irondale River	Goose Lake - Burnt River	Farquhar Lake - Irondale River	Nogies Creek	Pigeon Lake - Gannon Narrows	Mississagua River	Eels Creek	Stony Lake - Katchewanooka Lake	Deer Bay Creek	Burleigh Falls Dam - Lower Buckhorn Lake	Bobcaygeon River	Omemee Dam - Pigeon River	Ganaraska River	Lock 19 - Otonabee River	Indian River	Ouse River	Hastings Lock 18 Dam - Trent River	Otonabee River Outlet	Cavan Creek	Paudash Lake Dam - Crowe River	Chandos Lake - Crowe River	Cordova Lake Dam - Crowe River	Kasshabog Lake - North River	Round Lake - North River Outlet	Crowe Bay Dam - Trent River	Crowe Lake - Crowe River
Date Range of Reviewed Reports	2021 - 2022	2019 - 2022	2021 - 2022	2008 - 2024	1983 - 2024	2021 - 2022	2021 - 2022	1983 - 2022	2021 - 2022	1983 - 2022	2008 - 2023	2014 - 2022	2010-2021	1981 - 2024	1983 - 2022	1983 - 2022	1983 - 2006	1983 - 2024	1981 - 2023	1983 - 2024	1983 - 2024	1983 - 2024	1983 - 2024	1983 - 2024	1983 -2022	1983 - 2024
Objectives													•*	•				•								
Physiographic Characterization		•			•			•		•	•	•	•*	•	•	•	•	•	•	•*	•*	•*	•*	•*		•
Climate Change													•*	•				•								
Current Land Use				•	•			•		•	•	•	•*	•	•			•	•	•	•	•	•	•		•
Future Land Use										•				•												
Natural Heritage Resources													•*	•												
Species at Risk													•*		•											
Aquatic Habitat													•*													
Water Quality				•	•			•			•		•*	•	•	•		•	•	•	•	•	•	•		•
Groundwater Resources	•	•		•	•	•	•	•	•	•	•	•	•*	•	•	•		•	•	•	•	•	•	•		•
Water Quantity		•		•	•			•		•	•	•	•*	•	•	•	•	•	•	•*	•*	•*	•*	•*		•
Water Budget		•		•		•	•		•	•	•	•	•*	•	•	•	•	•		•*	•*	•*	•*	•*		•
Geomorphic Study																										
Implementation													•*	•												
Monitoring														•		•	•	•	•							

Note:
*Denotes reports that cover the entire watershed area

2.1 Background Review: Watershed Boundaries

The provincial watershed boundary dataset maintained by the Ministry of Natural Resources (MNR)), which is collectively called Ontario Watershed Boundary (OWB), was last updated on May 8, 2020. This is the dataset used for the watershed boundary delineation mapping in this project. The boundaries relevant to the County (i.e., the Study Area) were based on the recent Ontario Integrated Hydrology (OIH) data produced in the spring/fall of 2019 for areas within Ontario.

From a review of the OWB layers, Peterborough County is comprised of two secondary scale watersheds: "Lake Ontario' and 'Northern Lake Ontario and Niagara River.' Further, the County drains into five tertiary watersheds: Gull River, Kawartha Lakes, North Lake Ontario Shoreline, Otonabee River, and Trent River – Crowe River. As shown in Figure 3 and Table 2, most of the County is within the Kawartha Lakes and Otonabee River Tertiary watersheds.

The watershed delineations reflect the unique hydrologic and ecological functions of the receivers, specific to the region. As noted above, this Watershed Plan has been structured to assess and report information at the tertiary watershed scale, but also includes some information at the quaternary watershed scale.

The OWB mapping identifies 26 quaternary watersheds within the County. Figure 4 and Table 3 show the nesting of quaternary watersheds within tertiary watersheds along with the associated local area municipalities and major towns where applicable.

Table 2 Area and Proportion of the Study Area that is Drained by each Tertiary Watershed, and that falls into each Ecoregion

	Total Area (Proportion of County)	Area (Proportion of County) in Ecoregion 5E	Area (Proportion of County) in Ecoregion 6E
Peterborough County	4,213 km^2 (100%)	1,950 km^2 (46.29%)	2,263 km^2 (53.71%)
Tertiary Watersheds in Peterborough County			
Kawartha Lakes Tertiary Watershed	2,007 km^2 (47.65%)	1,297 km^2 (30.79%)	710 km^2 (13.85%)
North Lake Ontario Shoreline Tertiary Watershed	6 km^2 (0.15%)	0 km^2 (0.00%)	6 km^2 (0.14%)
Otonabee River Tertiary Watershed	1,353 km^2 (32.10%)	0 km^2 (0.00%)	1,353 km^2 (32.11%)
Trent River - Crowe River Tertiary Watershed	705 km^2 (16.72%)	518 km^2 (12.30%)	187 km^2 (4.44%)
Gull River Tertiary Watershed	142 km^2 (3.37%)	137 km^2 (3.25%)	5 km^2 (0.12%)

Note:
*Areas were calculated in GIS based on shapefiles provided by the County and MNR. Areas include the City of Peterborough.

Table 3 Breakdown of Tertiary Watersheds and Quaternary Watersheds with Associated Local Area Municipalities and Major Towns within the Study Area

Tertiary Watershed	Quaternary Watershed	Local Area Municipalities	Major Town
Gull River	Birchbark Lake - Irondale River	Municipality of Trent Lakes	
	Goose Lake - Burnt River	Municipality of Trent Lakes	
	Farquhar Lake - Irondale River	Municipality of Trent Lakes	
		Township of North Kawartha	
Kawartha Lakes	Nogies Creek	Municipality of Trent Lakes	
	Pigeon Lake - Gannon Narrows	Municipality of Trent Lakes	
		Selwyn Township	
	Mississagua River	Municipality of Trent Lakes	
		Township of North Kawartha	
	Eels Creek	Township of North Kawartha	Apsley
	Stony Lake - Katchewanooka Lake	Selwyn Township	
		Township of Douro-Dummer	
		Township of Havelock-Belmont-Methuen	
		Township of North Kawartha	
	Deer Bay Creek	Township of North Kawartha	
	Burleigh Falls Dam - Lower Buckhorn Lake	Municipality of Trent Lakes	Buckhorn
		Selwyn Township	Bridgenorth
	Bobcaygeon River	Municipality of Trent Lakes	
	Omemee Dam - Pigeon River	Township of Cavan Monaghan	
North Lake Ontario Shoreline	Ganaraska River	Township of Cavan Monaghan	
Otonabee River	Lock 19 - Otonabee River	City of Peterborough**	
		Township of Cavan Monaghan	
		Township of Douro-Dummer	
		Township of Otonabee-South Monaghan	
		Selwyn Township	Lakefield
	Indian River	Township of Douro-Dummer	Douro
		Township of Otonabee-South Monaghan	
	Ouse River	Township of Asphodel-Norwood	Norwood
		Township of Douro-Dummer	
		Township of Havelock-Belmont-Methuen	
		Township of Otonabee-South Monaghan	
	Hastings Lock 18 Dam - Trent River	Township of Asphodel-Norwood	
		Township of Otonabee-South Monaghan	

Tertiary Watershed	Quaternary Watershed	Local Area Municipalities	Major Town
	Otonabee River Outlet	City of Peterborough**	
		Township of Cavan Monaghan	Millbrook
		Township of Otonabee-South Monaghan	
	Cavan Creek	Township of Cavan Monaghan	
		Township of Otonabee-South Monaghan	
Trent River - Crowe River	Paudash Lake Dam - Crowe River	Township of North Kawartha	
	Chandos Lake - Crowe River	Township of North Kawartha	
	Cordova Lake Dam - Crowe River	Township of Havelock-Belmont-Methuen	
		Township of North Kawartha	
	Kasshabog Lake - North River	Township of Douro-Dummer	
		Township of Havelock-Belmont-Methuen	
	Round Lake - North River Outlet	Township of Havelock-Belmont-Methuen	
	Crowe Lake - Crowe River	Township of Havelock-Belmont-Methuen	Havelock
	Crowe Bay Dam - Trent River	Township of Asphodel-Norwood	
		Township of Havelock-Belmont-Methuen	

** The City of Peterborough is within the County but technically outside the Study Area.

2.1.1 Quaternary Watershed Delineation Approach

The quaternary watersheds can be further broken down into subwatersheds. Subwatershed layers were provided by the Conservation Authorities. Notably, current watershed and subwatershed information for Peterborough County from legacy documents, available from the local conservation authorities do not explicitly align with the common industry understanding of “watersheds” or “subwatersheds” as outlined in Section 3.1 and so some of the conservation authorities’ mapping did not fully align with the provincial boundaries used for this project.

The review of watershed and subwatershed boundaries provided by the conservation authorities, were reviewed to determine if any found the following.

- Although they generally align fully or closely with the provincial delineation, some minor discrepancies were identified at the subwatershed and quaternary watersheds (see Figure 4). Notably, minor discrepancies within a given tertiary watershed, were attributed to the fact that provincial and Conservation Authority data sets were each created using different digital elevation models.

- In this Study Area, the northern portion of the County does not have conservation authorities and (see Figure 2) is under provincial (MNR) jurisdiction. Therefore, no Conservation Authority watershed or subwatershed boundaries are available.

Based on these findings and in consultation with the TAC it was agreed the provincial watershed boundaries should be used at all scales Study Area-wide. The differences between the Conservation Authority and the provincial delineations, where they exist, are minor enough that do not change the overall watershed characterizations provided in any meaningful way.

2.2 Background Review: Land Cover / Land Uses

Peterborough County provided the most current and comprehensive land use mapping for the study area in late 2024 (although the associated metadata did not include the date of when the spatial layers were last updated) (Figure 6).

Data gaps in the spatial data include some open water bodies and the City of Peterborough, as this is a single tier municipality within the County that has its own land use mapping. The spatial gaps related to waterbodies are assumed to be available / filled on the City of Peterborough's land use mapping.

2.3 Background Review: Physical Environment

Through the background review, Study Area-wide coverage of all the relevant and applicable physical data sets was identified and used to generate base characterization maps as follows.

- Physiography: Obtained from *Physiography of southern Ontario* (Chapman and Putnam 2007) (Figure 8)
- Topography: Topographic data assumed for this study were provided by Ganaraska Conservation, in the form of a LiDAR Digital terrain model (DTM) raster dataset with a 0.5 m spatial resolution (NAD 1983 UTM Zone 17N). The layer covers the entire Study Area (Figure 9).
- Surficial and Bedrock Geology: Obtained from OGS (2010 and 2011) and Brunton and Dodge 2008 (Figures 10 and 11).
- Surficial Soils and Soils Drainage: Data were obtained from the Soil Survey Complex (OMAFRA 2019). The available soils mapping fully covers the Study Area (Figures 12 and 13).

There are no notable gaps in coverage for any of the categories above. However, area-specific field assessments related to surficial soils and drainage, as well as the extent and significance of karst features where they occur, will be required as part of future subwatershed studies.

2.4 Background Review: Water Resources

2.4.1 Hydrologic, Hydraulic and Stream Morphology Resources

The following section describes the background hydrologic and hydraulic information reviewed and used to characterize how water moves through the watersheds (e.g., hydrology; rainfall, runoff, evapotranspiration, etc.) and how the resulting runoff is conveyed through the watercourse systems within each watershed (i.e., hydraulics). The data reviewed includes floodplain mapping and flood risk studies, watershed planning assessments, baseflow assessments, as well as approved hydrologic and hydraulic models and GIS datasets.

This section also describes the background stream morphology information reviewed and used to characterize the watercourses and drainage features within the Study Area (e.g., substrate, planform, longitudinal profile, etc.). A background review was undertaken to gather information including form, function, and general characterization, located within the Study Area. Reviewed data included previous reports and spatial data (e.g., topography, watercourse mapping), physiography and surficial geology and land use.

The list of all the reports reviewed can be found in Appendix A (also see Section 2.5). The models received include the following.

Models:

- Baxter Creek Hydraulic Model – HEC RAS (WSP 2022)
- Baxter Creek Hydrology Model – Visual OTTHYMO (WSP 2022)
- Bears Creek Hydraulic and Hydrology Models – HEC2 and Visual OTTHYMO (Totten Sims Hubicki Associates; TSH 1991)
- Jackson Creek Hydraulic Model (Jackson Park to Otonabee River)– HEC2 (TSH 1991)
- Jackson Creek Hydrology Model (Hwy 7 to Control Weir)– Visual OTTHYMO (D.M. Wills 2020)
- Jackson Creek Hydraulic Model (Hwy 7 to Control Weir)– HEC RAS (D.M. Wills 2020)
- Lakefield Hydrology Model– Visual OTTHYMO (Otonabee Conservation 2021)
- Lakefield Hydraulic Model – HEC RAS (Otonabee Conservation 2021)
- Meade Creek Hydraulic Model– HEC RAS (Otonabee Conservation 2022a)
- Meade Creek Hydrology Model – Visual OTTHYMO (Otonabee Conservation 2022a)
- Otonabee River Hydraulic and Hydrology Models – HEC2 and Visual OTTHYMO (TSH 1991)
- Ouse River - Norwood Hydraulic Model – HEC RAS (Otonabee Conservation 2022b)
- Ouse River – Norwood Hydrology Model – Visual OTTHYMO (Otonabee Conservation 2022b)
- Riverview Creek Hydraulic and Hydrology Models – HEC2 and Visual OTTHYMO (TSH 1991)
- Thompson Creek Hydraulic Model – HEC RAS (Otonabee Conservation 2023a)
- Thompson Creek Hydrology Model – Visual OTTHYMO (Otonabee Conservation 2023a)

In addition to the reports listed in Appendix A and the models outlined above, supplemental GIS datasets were provided and were used to characterize the existing hydrologic and hydraulic condition of the study area including:

- Watershed boundary mapping (at the tertiary, quaternary, and watershed scales; see Figures 3 and 4)
- Climate and stream gauge monitoring data (see Figure 7)
- Digital Elevation Model (DEM)
- Contour mapping
- Surficial geology and soils mapping (see Figures 10 and 12)
- Land use mapping (see Figure 6), and
- Watercourse and water body mapping (see Figure 14, including 14a through 14f).

2.4.1.1 Hydrologic, Hydraulic and Stream Morphology Data Gaps

The available background data were reviewed to identify relevant gaps that (a) may be filled with supplemental data as part of future studies and (b) to acknowledge the limitations of the available data in assessing the existing conditions. A summary of the data used to support the watershed characterization for this study and any associated data gaps are outlined in the following.

Watercourse Mapping: Watercourse layers were provided by Ganaraska Conservation, Otonabee Conservation, and the City of Peterborough. These layers do not provide full coverage for the study area. The OHN (MNRF 2019) which has full study area coverage was compared to the watercourse layers provided. The data from the City of Peterborough were similar to the OHN watercourse layer, while the layers provided by Otonabee Conservation included only what “major watercourses” (as defined by them) which appear to be equivalent to third order and higher-level watercourses from the OHN watercourse layer. The Ganaraska Conservation watercourse layer included watercourses and flow paths that differed from the OHN watercourse layer. The OHN watercourse layer covers the entire study area and includes the names of primary watercourses but does not include names for smaller watercourse features. The use of OHN watercourse data was determined to be appropriate for this high-level Watershed Plan but will need to be reviewed and refined as part of more detailed studies / analyses to follow (e.g., Subwatershed studies, Secondary Plans, etc.), as outlined in Volume 2 of this Watershed Plan.

Reach Delineation: Available reporting and data did not contain reach delineations for any of the watercourses within the Study Area. However, desktop analysis of current and historical aerial imagery, land cover, and digital elevation models can determine preliminary reach breaks that can then be confirmed and/or updated through field investigations as part of future more detailed subwatershed studies.

Historical Analysis: Orthophotography/historical imagery was not provided as part of the data requests. Open-source imagery can be used to fill this data gap as needed for this and future subwatershed studies.

Geomorphic Characterization: Available reporting lacked information on the geomorphic characterization of area watercourses. The reports did however include some information on general substrates/materials, riparian vegetation, selected photography, and estimated channel dimensions for some areas in the southern portion of the County, generally in the vicinity of the City of Peterborough.

2.4.2 Groundwater Resources

This section provides a review of the most relevant source of information on regional and local groundwater systems within the Study Area. This existing data, mapping and modelling informs the characterization of where groundwater originates, where it discharges, and the most prominent paths it travels (i.e., the hydrogeologic setting) in the following characterization sections of this report.

This section provides a short description of the regional hydrogeological reports considered most relevant for this study and identifies additional reports that were reviewed, but which were considered more localized in scope or less relevant to the overall hydrogeologic setting of the Study Area. Following the more detailed background report overview, the hydrogeological mapping and time-series datasets were reviewed, in addition to summary datasets. Figure 19 presents a spatial overview of the background reports and data coverage that were reviewed as part of this data gap analysis and background review.

Oak Ridges Moraine Groundwater Program (2024)

The Oak Ridges Moraine Groundwater Program (ORMGP) portal provides different types of hydrogeological datasets that are relevant to building a conceptual hydrogeological understanding of the watersheds within the Study Area. The County footprint falls within the coverage of the ORMGP portal which includes, but is not limited to:

- Mapping layers: geologic layers, water table and potentiometric surface maps, land use and source water protection mapping (Highly Vulnerable Aquifers [HVA] and Wellhead Protection Areas Quality and Quantity [WHPA A-E and Qs])
- Groundwater quality and water level time-series data
- A cross-section tool which produces geologic layering in cross-section view (which within the County was finalized in 2010 by ORMGP staff)
- Water budget tool to estimate groundwater recharge, runoff, evapotranspiration and precipitation from a 2018 recharge–runoff model, and
- A library of technical reports across multiple regions.

Trent Assessment Report, Trent Conservation Coalition Source Protection Region (Updated June 2025)

The report summarizes drinking water related technical studies across four source protection areas—Crowe Valley, Kawartha-Haliburton, Lower Trent, and Otonabee-Peterborough and covers the entire Peterborough County. It also includes information and analysis on groundwater recharge, discharge and linkage to natural heritage systems. In each source protection area, the report characterizes the watersheds, evaluates water budgets and quantity stress, and identifies vulnerability zones around municipal groundwater wells and surface water intakes. Significant Groundwater Recharge Areas (SGRAs) were mapped using a methodology described in CAMC-YPDT (2009). This method first involved extrapolating the groundwater recharge estimates from York-Peel-Durham-Toronto (YPDT) regional groundwater model to the entire Trent Region based on the surficial geology, soil and climate normal. The SGRAs were then delineated based recharge thresholds to produce mapping dataset covering the entire Peterborough County.

Conceptual Water Budget: Trent River Watershed (March 2007)

This study provides a conceptual understanding of the Trent River Watershed and includes several subwatersheds. The report is the culmination of multiple subwatershed studies. The report summarizes the geology, physiography, hydrology, and hydrogeology of a large portion of the southern part of the County.

City of Peterborough Watershed Planning Study: Characterization Report (May 2020)

This study provides a comprehensive technical understanding of the natural environment and infrastructure in the 18 subwatersheds that are wholly or partially located within the City of Peterborough and provides some information related to the surrounding County lands. The study summarizes the existing surface and groundwater conditions, as well as the relevant water, wastewater and stormwater conditions and assets within the study area. With regards to hydrogeology, the study describes the groundwater resources in the study area and gives an understanding of the groundwater flow system. Relevant data within the study include physiography, geologic and hydrogeological data, groundwater levels, wellhead protection areas, groundwater recharge zones, and geologic and hydrostratigraphic model data.

The City of Peterborough Watershed Planning Study: Groundwater Resources Report (March 2021)

This study covers a 478 square kilometer area surrounding the City of Peterborough and describes the groundwater resources in the study area and the groundwater flow system. A secondary goal of the study was to provide the critical background information used to develop and calibrate separate and distinct hydrologic and groundwater models. The study contains significant hydrogeological data, and the model boundaries cover the southwest corner of the County.

Township of Douro-Dummer Annual Reports

Annual reports, from 2020 and 2021, were provided for three sites in the Township of Douro-Dummer. These reports discuss annual groundwater monitoring from two landfills (Warsaw Road and Halls Glen landfill sites) and a transfer station (Stoney Lake Road transfer station). The reports are site-specific with data and analysis focused on the site, with no regional investigation. Taken as a whole, they provide geologic and groundwater data for the Township.

In addition to the reports discussed above, the following reports, models and mapping datasets were requested and those received have been reviewed, as outlined below:

Reports – requested and not received:

- Trent Conservation Coalition Groundwater Vulnerability Assessment – TCC Source Protection Region (AECOM December 2009)
- Memo - Significant Groundwater Recharge Areas (SGRAs) for Tier 2 Water Budget Studies in the Trent Conservation Coalition Area (XCG Consultants, October 2010)

Additional Reports – reviewed

- Ganaraska Source Protection Plan, Trent Conservation Coalition Source Protection Region (2021)
- 2023 Source Protection Annual Progress Report, Trent Conservation Coalition Source Protection Region, (2024)
- Trent Source Protection Plan, Trent Conservation Coalition Source Protection Region (2025a)
- Trent Source Water Protection Study Recharge Study: Draft Report (YPDT-CAMC 2009)
- City Of Peterborough Watershed Planning Study: Water Quality Modelling Report (Aquafor Beech 2020)

Mapping and Time-Series Datasets

- Significant Groundwater Recharge Areas [SGRA] (TCC 2010) Significant Groundwater Recharge Areas [SGRA] (TCC 2010)
- Highly Vulnerable Aquifer Areas [HVAs] (TCC 2022)
- Wellhead Protection Areas – Quality [WHPAs A - E] (TCC 2019)
- Physiographic Regions (Chapman and Putnam 1984)
- Bedrock Topography (ORMGP 2022)
- Bedrock Thalwegs, Closed Depressions and Hummocky Areas (ORMGP 2021)
- Surficial Geologic Map (OGS 2024)
- Potential Discharge Areas (ORMGP 2021)
- Water Table (WT) Maps – Depth to WT and WT Elevation (ORMGP 2021)
- Potentiometric Surface (ORMGP 2021)
- Vertical Hydraulic Gradient Map (ORMGP 2021)
- Permits To Take Water [PTTW] (MECP 2024)
- Flowing Wells (ORMGP 2024)
- Hydraulic Properties (ORMGP 2024)
- Groundwater Quality and Levels (PGMN 2024)

- Surface Water Spotflows (ORMGP 2024)

Model Outputs

- Groundwater Recharge Map (ORGMP 2018)

Figure 19 presents a spatial representation of the background reports and data coverage of sources reviewed. Notably, there are numerous MODFLOW models that exist on the ORMGP portal, however, given the scope and scale of this study, they were not reviewed in detail, but some regional characterizations (e.g., HVAs) are derived from this modelling.

2.4.2.1 Groundwater Data Gaps

Due to the County footprint falling within the ORMGP portal coverage, fairly extensive hydrogeological datasets were received and reviewed as part of the data gap analysis. However, the following limitations with respect to the hydrogeological background information were identified.

- Background Report Coverage: The majority of the local scale reporting and modelling data is focused in the southern half of the County, leaving a data gap in the County's north. However, there are regional scale reports (e.g., Trent Region Source Protection Assessment Report) that do cover the entire County (Figure 19).
- Geologic and Hydrogeologic Characterization: In the northern half of the County (on the Canadian Shield), the quaternary deposits are very thin, as such they have not been mapped in the same level of detail and are described as undifferentiated. This will limit some of the detail when describing the regional geological and hydrogeologic setting in the northern portion of the County.
- Groundwater Levels: There are 14 Provincial Groundwater Monitoring Network (PGMN) wells in the County, however the vast majority are focused in the southern portion (see Figure 11), which will limit insights into groundwater dynamics in the northern portion of the County.
- Hydrogeologic and Source Water Protection Mapping: Mapping from the OGS and ORMGP provides coverage of for many critical mapping datasets (e.g., water table elevation and highly vulnerable aquifers) (see Figure 20), however the level of uncertainty associated with these datasets is significantly increased by the sparse point data and geologic mapping in the northern portion of the County.

The largest data gap is in the northern portion of the County, where the usual sources of data such as environmental reports and groundwater models are largely absent, and the hydrogeologic mapping datasets are more uncertain due to sparse input datasets. However, northern portion of the County is dominated by bedrock of the Canadian Shield. As such, the role of groundwater in the overall hydrologic functioning of this part of the watershed is likely controlled by the topography, degree of fracturing, depth to bedrock and shallow soil properties, which is expected to mitigate some of the limitations described as part of the data gap analysis.

2.4.3 Water Quality Resources

Water quality describes the biological, chemical, and physical characteristics of water. Characterization of the water quality (surface and groundwater) within the County has been based upon a desktop review of available information sources from legacy studies. This assessment included screening:

- Locations of water quality monitoring stations,
- Data records for the monitoring stations, and
- Reports on trends in water quality and evaluation based on provincial standards.

The reports reviewed include the following:

- Norwood Mill Pond Water Quality Assessment (Otonabee Conservation 2007)
- 2008 Norwood Mill Pond Water Quality Monitoring Study draft (Otonabee Conservation 2010)
- Ganaraska River Watershed Plan 2010 (GRCA 2010)
- City of Peterborough Watershed Planning Study: Characterization Report (draft) (Aquafor Beech 2020)
- City of Peterborough Watershed Planning Study: Water Quality Modelling Report (Aquafor Beech 2021a)
- Kawartha Conservation Watershed Report Card 2023 (KRCA 2023)
- Otonabee Conservation Watershed Report Card 2023 (Otonabee Conservation 2023b)
- Crowe Valley Conservation Watershed Report Card 2023 (CVCA 2023)

In addition to the reports outlined above, supplemental spatial data were used to characterize the water quality in the County and were screened to identify future data needs for subsequent studies. In addition to the base mapping data, the following were used in the water quality characterization.

- Watershed boundary mapping (at the tertiary, quaternary, and watershed scales) (see Figures 3 and 4)
- Climate and stream gauge monitoring data (see Figure 7)
- Digital Elevation Model (DEM)
- Contour mapping
- Surficial geology and soils mapping (see Figures 10 and 12)
- Land use mapping (see Figure 6),
- Water quality monitoring (Figure 22), and
- Watercourse and water body mapping (see Figure 14, including 14a through 14f).

2.4.3.1 Water Quality Data Gaps

A high-level understanding of surface water and groundwater quality is needed to characterize the conditions across the County and identify next steps in terms of monitoring and related reporting for this Watershed Plan.

Based on the background review completed, there is good coverage of groundwater quality monitoring stations across the County and poorer coverage of surface water quality monitoring stations (see Figure 22).

Groundwater quality data were provided by ORMGP. Further analysis could be supported by a more detailed surface water quality data analysis examining the Provincial Water Quality Objectives (PWQOs) and the Interim PWQOs (MOEE 1994), as well as the Watershed Report Cards available for many of the watersheds. Further analysis will be required as part of future subwatershed studies.

2.4.4 Water Resource System (WRS) Components

The requirement for planning authorities to identify a Water Resource System (WRS) was established through the 2014 Provincial Policy Statement and has been carried forward into the 2024 Provincial Planning Statement (PPS). The 2024 PPS defines the WRS as “a system consisting of ground water features and areas, surface water features (including shoreline areas), natural heritage features and areas, and hydrologic functions, which are necessary for the ecological and hydrological integrity of the watershed.”

Identification of the WRS requires mapping of all surface and groundwater features and establishment of linkages with the NHS. The map sources identified for the groundwater (Section 2.4.2), hydrology and hydraulics (Section 2.4.1) and Stream Morphology (Section 2.4.1) provide the base for development of a preliminary WRS. This includes consideration of the following data sources.

- Highly Vulnerable Aquifer Areas [HVAs] (TCC 2025b)
- Wellhead Protection Areas – Quality [WHPAs A - E] (TCC 2019)
- Potential Discharge Areas (ORMGP 2021)
- Water Table [WT] Maps – Depth to WT and WT Elevation (ORMGP 2021)
- Recharge Map (ORGMP 2018)
- Permit To Take Water [PTTW] (MECP 2021)
- Flowing Wells (ORMGP 2024)
- Groundwater Quality and Levels (PGMN 2024)
- Surface Water Spotflows (ORMGP 2024)
- Digital Elevation Model (DEM)
- Floodlines Hazard Delineations (various)

- Climate and stream gauge monitoring data (various)
- Watercourse and Waterbody Mapping (various)
- Watershed Boundary Mapping (Conservation authorities and OMNRF)

The components of a preliminary WRS and NHS are outlined and discussed in more detail in Volume 2 of the Watershed Plan.

2.5 Background Review: Natural Hazards

The following section describes the background information reviewed to characterize and, where possible, map natural hazards within of the Study Area. The data reviewed included floodplain mapping, flood risk studies, and identified of erosion sites. The following summarizes the data reviewed for the characterization of natural hazards in the Study Area.

Reports:

- A Report on a Floodline Mapping Study: The Village of Lakefield and the Township of North Monaghan (TSH 1981)
- 1983 Interim Watershed Plan Appendices and References (ORCA 1983)
- 2004 Otonabee Region Watershed Baseflow Report (MNR 2004)
- 2006 Otonabee Region Watershed Baseflow Report draft (MNR 2006)
- Ganaraska River Watershed Plan 2010 (GRCA 2010)
- City of Peterborough Watershed Planning Study: Characterization Report (draft) (Aquafor Beech 2020)
- Jackson Creek Floodplain Mapping (D.M. Wills 2020)
- Baxter Creek Flood Plain Mapping Report (WSP 2022)
- Norwood Two-Zone Floodplain Study (Otonabee Conservation 2022b)
- Lakefield Tributaries Floodplain Study (Otonabee Conservation 2022c)
- Meade Creek Floodplain Mapping Project (Otonabee Conservation 2022a)
- Thompson Creek Floodplain Update Study (Otonabee Conservation 2023a)
- City of Peterborough Watershed Planning Study: Implementation Plan (Aquafor Beech 2024)

The reports vary in the depth of detail and types of information provided. Information provided in these reports that provide insight into watercourse conditions and both controlling and modifying influences include:

- Historical analysis
- Subwatershed characterization
- Limited geomorphic characterization

In addition to the reports outlined above, supplemental spatial data was used to characterize the Study Area, outline potential constraints and identify future data needs for subsequent studies related to stream morphology characterization, as follows.

- Watershed boundary mapping (at the tertiary, quaternary, and watershed scales) (see Figures 3 and 4)
- Climate and stream gauge monitoring data (see Figure 7)
- Digital Elevation Model (DEM)
- Contour mapping
- Surficial geology and soils mapping (see Figures 10 and 12)
- Land use mapping (see Figure 6)
- Watercourse and waterbody mapping (see Figure 14, including 14a through 14f), and
- Regulated slope mapping, floodlines and hazard delineation (see Figures 18 and 23)

Notably, the Study Area includes extensive areas of known, inferred, and potential karst landscapes.

Karst topography in Ontario is primarily found in southern Ontario and Manitoulin Island, and is characterized by limestone and dolostone bedrock that has dissolved to form features like caves, sinkholes, and disappearing streams. Depending on the scale and extent of the karst, it can create a significant natural hazard. These areas are shown on Figure 11 (Bedrock Geology).

Floodplain mapping: The primary gap identified as part of the background review is the incomplete spatial coverage of floodplain mapping within the study area. The regions within the Study Area for which floodplain mapping studies have been completed are shown in Figure 23. The approved flood hazard mapping was provided by Otonabee Conservation, Kawartha Conservation, CVCA, and the City of Peterborough. In addition, the background information identified areas where flood hazard delineations studies have been completed, however the floodplain mapping geodata were not provided. These studies include the Miskwaa Ziibi River Floodplain Mapping Study (Water's Edge 2024) and the Flood Plain Mapping Hydrology Report for Crowe River Catchment (EXP 2024) and Chandos FHIMP Modelling and Mapping (EXP 2024). Figure 23 shows the existing floodplain mapping and the areas where floodplain mapping studies have been completed, however no geodata were provided. It is assumed that floodplain mapping (e.g., shapefiles) can be provided for these regions.

Erosion inventory: Only one older report from Otonabee Conservation (1983) included an erosion inventory. This report is over 40 years old and conditions have likely changed since the report was published. However, it can provide some insight into past and ongoing trends in erosion that may be visible in air photograph interpretation. Desktop and field analyses can be used to fill this data gap as needed in future subwatershed studies.

Erosion Hazard Delineation: A regulated slope layer was provided by Kawartha Conservation covering their entire jurisdiction. Regulated slopes (stable top of slope) and meander belts were not provided for the rest of the Study Area. Desktop and field analyses can be used to fill this data gap as needed in future subwatershed studies.

2.6 Background Review: Aquatic and Terrestrial Resources

Aquatic and terrestrial resources typically include both physical and biological features that provide ecological functions (e.g., providing habitat, promoting biodiversity, and/or supporting key life cycle processes). Many of these ecological functions are also recognized as providing what are called "ecosystem service" to the humans who use and benefit from their provision (e.g., air and water filtration, carbon sequestration, temperature moderation, mental and physical health benefits associated with views of and activities in natural greenspaces).

In Ontario, the various aquatic and terrestrial resources are often described under the umbrella term of "natural heritage". Peterborough County is rich in natural heritage with most of its land base covered by a well-connected network of woodlands, wetlands, lakes and rivers supporting a high diversity of species and habitat types.

Background information was collected and reviewed to (a) determine what natural heritage data is available across the County, and (b) identify current gaps in natural heritage information, particularly as they relate to provincial requirements for the identification, protection, maintenance and restoration of natural features and areas for the long term (MMAH 2024). Key sources that have been reviewed include the following, with figures created (as referenced) to reflect what is currently mapped across the County. In all cases, the most current and comprehensive mapping layers were used with data sourced providing County-wide coverage favoured where available.

- The Kawarthas, Naturally Connected (KNC): A Natural Heritage System for the Kawartha Lakes Region Phase 1 Project Report (Van Hemessen 2013) and associated mapping
- Fisheries Assessment Project Report for Watercourses in the City of Peterborough (Otonabee Conservation 2015)
- Targeted Inventories to Support and Enhance Species at Risk Stewardship on Otonabee Conservation Forest Properties (Otonabee Conservation 2011)
- City of Peterborough Watershed Planning Study: Phase 2 Natural Heritage Report (draft) (Aquafor Beech 2021b)
- Watershed Report Cards from the local conservation authorities, where available
- Fisheries and Oceans Canada Aquatic Species at Risk Mapping (DFO 2025)
- Land Information Ontario (LIO; 2025a):
    - Ecozone, ecoregion (see Figure 24) and ecodistrict mapping
    - Aquatic Resource Area fisheries data (see Figures 28 a to h)
    - Watercourses and waterbodies (see Figure 14, including 14a to 14f)
    - Provincial Areas of Natural and Scientific Interest (ANSIs) (see Figure 25)

  - Provincially Significant Wetlands (PSWs), non-PSW wetlands and other wetlands (see Figure 26)
  - Wooded Areas (see Figure 27)
- Natural Heritage Information Centre Records (NHIC; 2025b):
  - Species at Risk (SAR) and rare species occurrences
  - Wildlife Concentration Areas
  - Rare Plant Communities
  - Regional ANSIs (see Figure 25), and
- Wildlife Atlas data (e.g., Ontario Breeding Bird Atlas (OBBA 2025), Ontario Reptile and Amphibian Atlas (Ontario Nature 2025).

Species records with locational information were not mapped due to the sensitive nature of some of this information and the challenge of illustrating these data on a County-wide scale. However, the species records have been summarized with their national and provincial status in tabular format in Appendix B.

A high-level understanding of terrestrial and aquatic habitats and species (including SAR), vegetation communities, designated natural features (e.g., ANSIs, PSWs), Significant Wildlife Habitat (SWH), and fish habitat is an important aspect of characterizing and understanding the County as part of this Watershed Plan.

Based on the background review completed, key gaps identified in relation to natural heritage are as follows:

Aquatics and fisheries data: Study Area-wide coverage for aquatic/fisheries data is moderate to good. LIO data covers systems throughout the County with no major gaps observed. Subwatershed-specific fisheries reports were also received for some subwatersheds and for some Conservation Authorities to supplement the broader data coverage.

Species at Risk (SAR) and Significant Wildlife Habitat (SWH): Coverage of SAR data across the Study area is good with Natural Heritage Information Centre (NHIC) records (1 km x 1 km squares) available for more than 95% of the County. Availability and coverage of SWH data and mapping is, however, low and limited to NHIC records on only a few of the more than 30 types of SWH (e.g., colonially nesting bird habitat, mixed wader nesting colonies, deer overwintering habitat), including many that are likely to occur in various parts of the County. Filling this gap will need to be completed as part of future subwatershed as well as area and/or site-specific studies (e.g., Environmental Impact Studies).

Breeding birds and herpetofauna (i.e., turtles, snakes and amphibians): Study Area wide coverage for breeding bird, turtle, snake and amphibian data is good with wildlife atlas data apparently available for the entire County. Nonetheless, it is anticipated that some additional field studies will need to be required as part of future subwatershed as well as area and/or site-specific studies (e.g., Environmental Impact Studies).

Vegetation community mapping (e.g., using the Ecological Land Classification (ELC) system for southern Ontario): Reasonably current ELC for southern Ontario (Lee et al. 1998) mapping is available for the subwatersheds in both Kawartha Conservation and Ganaraska Conservation's jurisdictions. However, the remainder (i.e., most) of the Study Area does not have ELC coverage.

The main gap identified at the tertiary watershed-scale is the very limited coverage of ELC mapping. This information could have supported more detailed vegetation community and land cover mapping assessments. Therefore, further analysis, including more detailed vegetation community / ELC mapping will be required as part of future subwatershed studies.

High-level Natural Heritage System (NHS) mapping: There is good coverage of high-level desktop mapping of natural heritage Core Areas, Corridors, Riparian Linkages, Barriers, and Adjacent Areas from the Kawarthas, Naturally Connected work completed in 2013. However, these components identified in this mapping do not explicitly align with the 2024 PPS natural feature and area categories, and this wok is now over a decade old so will have less value in parts of the County where land use changes have occurred.

There is also a very high-level NHS that was developed and put forward by the Province in 2021, however this was not accepted by County Council and the local area municipalities because it was so high-level and all-encompassing it failed to (a) recognize the extent of some existing settlements, and (b) provide a useful map for guiding land use planning.

In 2023, a refined NHS based on a synthesis of the Kawarthas, Naturally Connected work and the Provincial NHS from 2021 was put forward by the County (in 2023). However, recent changes to the environmental planning framework in Ontario have once again altered the requirements related to the identification and protection of natural heritage features and areas, with differing requirements now applying to Ecoregion 5E (i.e., the northern and eastern part of the County called "the Land Between" where the landscapes transition to being on the Canadian Shield) and Ecoregion 6E (i.e., the southern and southwestern part of the County in the Great Lakes-St-Lawrence Lowlands) (see Figure 24). These differences are outlined in Volume 2 of the Watershed Plan in more detail.

2.7 Summary of Background Findings and Data Gaps by Tertiary Watershed

A high-level overview of the data gap analysis found that across the County there is good, high-level coverage of:

- hydrogeologic (groundwater) mapping
- soils, topography, and major watercourse mapping
- land use mapping
- woodlands, wetlands (including PSW), and fish habitat
- aquatic and terrestrial Species-at-Risk (SAR), and

- a few types of Significant Wildlife Habitat (SWH).

In the southern part of the County there is good, high-level coverage of:

- groundwater monitoring wells, reporting, and modelling, and
- vegetation community (i.e., ELC) mapping (i.e., Ganaraska Conservation and Kawartha Conservation).

The largest key data gaps include:

- limited and out of date erosion hazard mapping
- limited groundwater monitoring wells, reporting, modelling, and water quality stations in the northern part of the County
- no floodplain mapping for Ganaraska Conservation within the County at the time of this study (notably, Ganaraska Conservation is in the process of producing updated floodplain mapping for a significant portion of its watershed including an area that drains into the western end of Rice Lake that extends into the County)
- no surface water quality monitoring stations in the northern half of the County
- no vegetation community mapping for Otonabee Conservation or Crowe Valley Conservation jurisdictions
- no identification or mapping of key NHS components identified in the 2024 PPS (see Volume 2 of the Watershed Plan)

As noted in Section 1, this Watershed Plan focuses its analysis at the tertiary watershed scale. Therefore, Tables 4 through 8 provide overviews of the data gaps identified in different disciplines by tertiary watershed (i.e., for Gull River, Kawartha Lakes, North Lake Ontario Shoreline, Otonabee River, and Trent River – Crowe River respectively). Refer to Figure 3 for a map of the tertiary watersheds in the Study Area.

Table 4 Summary of Data Gaps for the Gull River Tertiary Watershed

Discipline	Good Coverage	Poor Coverage
Water Resources: Groundwater Quantity / Flows	Good coverage of hydrogeologic mapping datasets	Poor coverage of groundwater monitoring wells, reporting, and modelling. No Significant Groundwater Recharge Areas (SGRAs) dataset or technical memo has been received.
Water Resources: Surface Water Quantity / Flows	Good coverage of soils, topographic, and watercourse mapping is available.	No floodplain mapping.
Water Resources: Surface and Groundwater Quality	-	No coverage of surface water quality monitoring stations. Poor coverage of groundwater quality monitoring station.

Discipline	Good Coverage	Poor Coverage
Water Resources: Fluvial Geomorphology / Watercourse Dynamics	Good coverage of Ontario Hydro Network watercourse mapping is available Countywide.	Watercourse reach delineation and other more detailed assessments are very limited or absent.
Natural Hazards	-	Erosion hazard delineation is very limited.
Natural Heritage: Aquatic Resources	Moderate coverage of fish / fish habitat. Good coverage aquatic Species-at-Risk (SAR).	-
Natural Heritage: Terrestrial Resources	Good coverage of Areas of Natural and Scientific Interest (ANSI), wetlands and terrestrial SAR mapping. Good woodland areas mapping. Good mapping of some natural heritage components (e.g., Core Areas, Corridors, Riparian Linkages, Barriers) but poor alignment with provincial features and areas. Detailed land use mapping is available.	No Ecological Land Classification (ELC) system mapping is available. Significant Wildlife Habitat (SWH) data sources and mapping very limited.

Table 5 Summary of Data Gaps for the Kawartha Lakes Tertiary Watershed

Discipline	Good Coverage	Poor Coverage
Water Resources: Groundwater Quantity / Flows	Good coverage of hydrogeologic mapping datasets.	Less coverage of groundwater monitoring wells, reporting, and modelling. No Significant Groundwater Recharge Areas (SGRAs) dataset or technical memo has been received.
Water Resources: Surface Water Quantity / Flows	Good coverage of soils, topographic, and watercourse mapping is available.	-
Water Resources: Surface and Groundwater Quality	-	Poor coverage of surface water quality monitoring stations. Less coverage of groundwater quality monitoring station in northern half of the watershed.
Water Resources: Fluvial Geomorphology / Watercourse Dynamics	Ontario Hydro Network watercourse mapping is available County-wide.	Watercourse reach delineation and other more detailed assessments are very limited or absent.
Natural Hazards	-	Partial, limited floodplain mapping. Erosion hazard delineation is very limited.

Discipline	Good Coverage	Poor Coverage
Natural Heritage: Aquatic Resources	Moderate coverage of fish / fish habitat. Good coverage aquatic Species-at-Risk (SAR).	Key data gaps in fisheries data noted by Kawartha Conservation include the lack of fisheries data for key areas such as Nogies Creek subwatershed (e.g., Bass Lake and Crystal Lake) and an outdated Fisheries Management Plan for Zone 17.
Natural Heritage: Terrestrial Resources	Good coverage of Areas of Natural and Scientific Interest (ANSI), wetlands and terrestrial SAR mapping. Good woodland areas mapping. Good mapping of some natural heritage components (e.g., Core Areas, Corridors, Riparian Linkages, Barriers) but poor alignment with provincial features and areas. Detailed land use mapping is available.	Ecological Land Classification (ELC) system mapping is limited to the west/southwest of the watershed. Significant Wildlife Habitat (SWH) data sources and mapping very limited.

Table 6 Summary of Data Gaps for the North Lake Ontario Shoreline Tertiary Watershed

Discipline	Good Coverage	Poor Coverage
Water Resources: Groundwater Quantity / Flows	Good coverage of hydrogeologic mapping datasets.	No Significant Groundwater Recharge Areas (SGRAs) dataset or technical memo has been received.
Water Resources: Surface Water Quantity / Flows	Good coverage of soils, topographic, and watercourse mapping is available.	-
Water Resources: Surface and Groundwater Quality	Good coverage of groundwater quality monitoring station.	No coverage of surface water quality monitoring stations.
Water Resources: Fluvial Geomorphology / Watercourse Dynamics	Ontario Hydro Network watercourse mapping is available county wide. Ganaraska Conservation provided refined watercourse mapping for their jurisdiction.	Watercourse reach delineation and other more detailed assessments are very limited or absent.
Natural Hazards	-	No floodplain mapping – understood they don't exist for the portion of watershed within the Study Area. Erosion hazard delineation is very limited.
Natural Heritage: Aquatic Resources	Moderate coverage of fish / fish habitat. Good coverage aquatic Species-at-Risk (SAR).	-

Discipline	Good Coverage	Poor Coverage
Natural Heritage: Terrestrial Resources	Good coverage of Areas of Natural and Scientific Interest (ANSI), wetlands and terrestrial SAR mapping. Good woodland areas mapping. Good mapping of some natural heritage components (e.g., Core Areas, Corridors, Riparian Linkages, Barriers) but poor alignment with provincial features and areas. Detailed land use and Ecological Land Classification (ELC) system mapping are both available.	Significant Wildlife Habitat (SWH) data sources and mapping very limited. No Significant Woodlands or Significant Valleylands mapping.

Table 7 Summary of Data Gaps for the Otonabee River Tertiary Watershed

Discipline	Good Coverage	Poor Coverage
Water Resources: Groundwater Quantity / Flows	Good coverage of hydrogeologic mapping datasets. Good coverage of groundwater monitoring wells, reporting, and modelling.	No Significant Groundwater Recharge Areas (SGRAs) dataset or technical memo has been received.
Water Resources: Surface Water Quantity / Flows	Good coverage of soils, topographic, and watercourse mapping is available.	-
Water Resources: Surface and Groundwater Quality	Good coverage of groundwater quality monitoring station.	Limited coverage of surface water quality monitoring stations.
Water Resources: Fluvial Geomorphology / Watercourse Dynamics	Ontario Hydro Network watercourse mapping is available county wide.	Watercourse reach delineation and other more detailed assessments are very limited or absent.
Natural Hazards	-	Partial coverage floodplain mapping. Erosion hazard delineation is very limited.
Natural Heritage: Aquatic Resources	Moderate coverage of fish / fish habitat. Good coverage aquatic Species-at-Risk (SAR).	-
Natural Heritage: Terrestrial Resources	Good coverage of Areas of Natural and Scientific Interest (ANSI), wetlands and terrestrial SAR mapping. Good woodland areas mapping.	No Ecological Land Classification (ELC) system mapping is available. Significant Wildlife Habitat (SWH) data sources and mapping very limited. No Significant Woodlands or Significant Valleylands mapping.

Discipline	Good Coverage	Poor Coverage
	Good mapping of some natural heritage components (e.g., Core Areas, Corridors, Riparian Linkages, Barriers) but poor alignment with provincial features and areas. Detailed land use mapping is both available.	(NHS mapping with all components only within the City of Peterborough which is outside the Study Area).

Table 8 Summary of Data Gaps for the Trent River – Crowe River Tertiary Watershed

Discipline	Good Coverage	Poor Coverage
Water Resources: Groundwater Quantity / Flows	Good coverage of hydrogeologic mapping datasets across the southern portion of the watershed. Good coverage of groundwater monitoring wells, reporting, and modelling for the southern portion of the watershed.	Less coverage of groundwater monitoring wells, reporting, and modelling for the northern portion of the watershed. No Significant Groundwater Recharge Areas (SGRAs) dataset or technical memo has been received.
Water Resources: Surface Water Quantity / Flows	Good coverage of soils, topographic, and watercourse mapping.	-
Water Resources: Surface and Groundwater Quality	Good coverage of groundwater quality monitoring stations in the southern portion of the watershed.	Poor coverage of surface water quality monitoring stations. Less coverage of groundwater quality monitoring stations in northern portion of the watershed.
Water Resources: Fluvial Geomorphology / Watercourse Dynamics	Ontario Hydro Network watercourse mapping is available county wide.	Watercourse reach delineation and other more detailed assessments are very limited or absent.
Natural Hazards	-	Partial coverage floodplain mapping. Erosion hazard delineation is very limited.
Natural Heritage: Aquatic Resources	Moderate coverage of fish / fish habitat. Good coverage aquatic Species-at-Risk (SAR).	-
Natural Heritage: Terrestrial Resources	Good coverage of Areas of Natural and Scientific Interest (ANSI), wetlands and terrestrial SAR mapping. Good woodland areas mapping. Good mapping of some natural heritage components (e.g., Core Areas, Corridors, Riparian Linkages, Barriers) but poor	Ecoregions 5E and 6E: Significant Wildlife Habitat (SWH) data sources and mapping very limited. Ecoregion 5E: No Significant Woodlands or Significant Valleylands mapping.

Discipline	Good Coverage	Poor Coverage
	alignment with provincial features and areas. Detailed land use and Ecological Land Classification (ELC) system mapping are both available.	

Table 9 provides a brief overview of the gaps identified for the entire Study Area and potential implications for the watershed characterization (found in this Volume 1), and the watershed planning guidance and technical recommendations (provided in Volume 2 under separate cover).

Table 9 Summary of Key Data Gaps Across the Study Area and their Implications by Discipline

Discipline	Key Gap	Implications
Water Resources: Groundwater Quantity / Flows	Good coverage of hydrogeologic mapping datasets across the entire County. Good coverage of groundwater monitoring wells, reporting, and modelling in the southern half of the County. Key Gap: Less coverage of groundwater monitoring wells, reporting, and modelling in the northern half of the County. No County-wide Significant Groundwater Recharge Areas (SGRAs) dataset or technical memo has been received.	Sufficient data are available to characterize the regional geological and hydrogeologic setting in the southern half of the County. In the northern half of the County, need to make assumptions and inferences related to the Canadian Shield (e.g., the overall functioning likely controlled by topography, depth to bedrock and shallow soil properties).
Water Resources: Surface Water Quantity / Flows	Soils, topographic, and watercourse mapping is available County-wide. **Key Gap:** Floodplain mapping is missing from Crowe Valley Conservation and Ganaraska Conservation jurisdictions.	Sufficient data are available to characterize the regional hydrologic and hydraulic setting across the County. The gaps floodplain mapping will need to be filled as part of future studies.
Water Resources: Surface and Groundwater Quality	**Key Gap:** No coverage of surface water quality monitoring stations in the northern half of the County. **Key Gap:** Less coverage of ground water quality monitoring station in the northern half of the County. **Key Gap:** Lake Capacity Studies for priority lakes (still to be identified based on sensitivities and known/anticipated land use pressures) and supporting Lake Management Plans.	Sufficient data are available to characterize the overall surface and ground water quality in the County at a high-level. The gaps in water quality data will need to be filled as part of future studies. Prioritization of Lake Capacity Studies and supporting Lake Management Plans will need to be advanced as part of next steps.

Discipline	Key Gap	Implications
Water Resources: Fluvial Geomorphology / Watercourse Dynamics	Ontario Hydro Network watercourse mapping is available county wide. GRCA provided refined watercourse mapping for their jurisdiction. **Key Gap:** Watercourse reach delineation and other more detailed assessments, including erosion hazard delineation, are very limited or absent.	Limited data are available to characterize watercourses in most of the County. More detailed desktop and field assessments to assess watercourses and headwater drainage features will need to be completed as part of future subwatershed studies.
Natural Hazards	**Key Gap:** Flood plain mapping is spotty and erosion hazard delineation is very limited or absent.	More detailed desktop and field assessments to assess floodplains and erosion hazards will need to be completed as part of future subwatershed studies.
Natural Heritage: Aquatic Resources	**Key Gap:** Updated Fisheries Management Plans in several of the subwatersheds in Ecoregion 5E.	More detailed desktop and field assessments will need to be completed as part of future subwatershed studies to confirm and refine aquatic habitat mapping, and to inform management activities. Prioritization of Fisheries Management Plans will need to be advanced as part of next steps.
Natural Heritage: Terrestrial Resources	Detailed land use mapping is available County-wide. **Key Gap:** Detailed vegetation community and land cover mapping developed based on the current standard – the Ecological Land Classification (ELC) system (is limited to lands in Ganaraska and Kawartha Conservation jurisdictions. **Key Gap:** Ecoregion 5E: A County-wide approach to the Identification of natural features and areas to address current provincial requirements **Key Gap:** Ecoregion 6E: The components needed to identify an NHS in conformity with current provincial direction are not currently defined.	Guidance will be required to address natural heritage requirements in accordance with the 2024 PPS. More detailed desktop and field assessments to map ELC and assess significant wildlife habitat (SWH) will need to be completed as part of future subwatershed studies.

3 General Characterization of Peterborough County

Peterborough County is a large upper tier municipality west of the Greater Toronto Area (i.e., over 4,000 km^2) that has urban and urbanizing centres, extensive agricultural lands and even more extensive water and natural heritage resources. Biophysically, the County is largely characterized by thousands of rivers and lakes with extensive shorelines, as well as extensive forests and wetlands. Physically, the County's natural resources are broadly shaped the fact that the southern third of the County is south of the Canadian Shield and the top two-thirds are in the transition onto the Canadian Shield known as "the Land Between" (see Image 2).

Notably, the City of Peterborough has undertaken its own watershed planning exercise (Aquafor Beech 2024) and as a single tier municipality is excluded from the County's Study Area.

This Section 3 is intended to establish a baseline characterization of the environmental features and systems across the County, with a separate characterization for each of the five tertiary watersheds within Peterborough County provided in following Sections 4 through 8.

All of these characterizations have been based on a desktop review and synthesis of available background information provided for the County, with some scoped analyses where deemed useful. The characterizations cover the physical environment, land use, water resources, natural hazards, and natural heritage components.

This general characterization summarizes the presence and distribution of various environmental features and their sensitivities organized into the following categories:

- Watershed Boundaries and Hierarchies (Section 3.1)
- Land Uses and Land Covers (Section 3.2)
- Physical Environment (including climate, physiography, geology and soils) (Section 3.3)
- Water Resources (including surface and groundwater) (Section 3.4)
- Natural Hazards (including flooding, shorelines and erosion) (Section 3.5), and
- Aquatic and Terrestrial Resources (Section 3.6).

A summary is provided in Section 3.7.

3.1 Watersheds

Watersheds define land wherein water drains to a single common outlet. Watershed delineations reflect the unique topographic, hydrologic, and ecological functions of the receiving waterbodies (e.g., rivers and lakes), specific to the area under study. The draft Provincial guidance for watershed planning (MECP 2022) supports the use of existing data available from provincial, municipal, and conservation authorities, to establish the boundaries of watersheds and subwatersheds (as in this study).

The Provincial watershed boundary dataset, collectively called Ontario Watershed Boundary (OWB), was used to defines the tertiary and quaternary watersheds for this study (see Section 2.1).

Peterborough County overlaps two secondary watersheds, five (5) tertiary watersheds, and 26 quaternary watersheds. As shown in Table 10, 80% of the County is within two tertiary watersheds, Kawartha Lakes and Otonabee River Tertiary watersheds. The five (5) tertiary watersheds are Gull River, Kawartha Lakes, North Lake Ontario Shoreline, Otonabee River, and Trent River – Crowe River (Figure 3 and Table 10).

None of the five watersheds are entirely contained within the County boundary, with less than 1% of the North Lake Ontario Shoreline watershed and over 80% of the Otonabee River Watershed within the Study Area.

Table 10 Tertiary Watershed Areas and Distribution beyond, and within, Peterborough County

Tertiary Watershed Name	Total Tertiary Watershed Area (km^2)	Watershed Area within the County (km^2) *	% of the Total Watershed Area within the Study County*	% of the County in each Tertiary Watershed
Gull River	3,245	142	4	3
Kawartha Lakes	3,085	2,007	65	48
North Lake Ontario Shoreline	1,506	6	<1	<1
Otonabee River	1,659	1,353	82	32
Trent River - Crowe River	3,603	705	20	17

*Areas were calculated in GIS based on shapefiles provided by the County in October 2024 and OMNRF downloaded in January 2025 and include the land area of the City of Peterborough.

The five tertiary watersheds are further subdivided into 26 quaternary watersheds within the County and are mapped in Image 5. Appendix A shows the nesting of tertiary watersheds, quaternary watersheds, local area municipalities, and major communities within the County. Table 11 outlines the area of each quaternary watershed within the County and the proportion of each quaternary watershed within the tertiary watershed (including the City of Peterborough). Subwatersheds that further subdivide the quaternary watersheds are defined by the Conservation Authorities. Not every quaternary watershed has been subdivided into subwatersheds, especially the quaternary watersheds to the north of the County where there is no Conservation Authority. Within the Study Area, 21 subwatersheds have been identified by the Conservation Authorities (Table 11).
The subwatersheds delineated by Crowe Valley Conservation are amalgamations of the quaternary watersheds identified by the OWB (Figure 5). Making a subwatershed larger than the quaternary watersheds delineated by the OWB can be done to facilitate management or to reflect the hydraulic conditions created by dams, canals, or locks. The City of Peterborough, while not specifically included in this study, has further identified subwatersheds that are too small for the scale of this study and were not included in the count of subwatersheds or in Table 11 below.

Future Growth Areas, as identified in Section 3.4, have been included in Table 11 highlighting which tertiary and quaternary watersheds are to be directly or indirectly impacted by growth, based on current growth planning information provided by the County. Directly impacted watersheds contain a community that has been identified as an area of future growth, whereas indirectly impacted watersheds are downstream or adjacent to the directly impacted watersheds.

Table 11 Quaternary Watershed Areas and Distribution within Peterborough County

Tertiary Watershed Name	Quaternary Watershed Name	Area of Watershed Within Peterborough County (km^2)	% of the Tertiary Watershed (1)	Subwatersheds (% within the quaternary watershed) (2)	Future Growth Area
Gull River	Birchbark Lake - Irondale River	36	26	-	-
	Farquhar Lake - Irondale River	5	4	-	-
	Goose Lake - Burnt River	100	71	-	-
Kawartha Lakes	Bobcaygeon River	7	0	Martin Creek North (72%), Pigeon Lake Tributaries (13%), Nogies Creek (6%), Sturgeon Lake Tributaries (8%)	-
	Burleigh Falls Dam - Lower Buckhorn Lake	286	14	Buckhorn/ Lovesick Lake (34%), Chemong/Pigeon Lake (37%)	-
	Deer Bay Creek	164	8	-	-
	Eels Creek	250	12	-	-
	Mississagua River	365	18	-	-
	Nogies Creek	180	9	Nogies Creek (95%)	-
	Omemee Dam - Pigeon River	9	0	Pigeon River (58%), Fleetwood Creek (39%)	-
	Pigeon Lake - Gannon Narrows	356	18	-	-
	Stony Lake - Katchewanooka Lake	391	19	Clear/ Stony Lake (24%), Katchewanooka Lake (21%)	-

Tertiary Watershed Name	Quaternary Watershed Name	Area of Watershed Within Peterborough County (km²)	% of the Tertiary Watershed (1)	Subwatersheds (% within the quaternary watershed) (2)	Future Growth Area
North Lake Ontario Shoreline	Ganaraska River	6	100	Ganaraska River Watershed (96%)	-
Otonabee River	Cavan Creek	116	9	Cavan Creek (98%)	Indirect
	Hastings Lock 18 Dam - Trent River	138	10	Rice Lake/ Trent River (89%)	Direct
	Indian River	207	15	Indian River (96%)	Indirect
	Lock 19 - Otonabee River	300	22	Jackson Creek (34%), Otonabee River (64%)	Direct
	Otonabee River Outlet	301	22	Baxter Creek (27%), Otonabee River (61%), Squirrel Creek (11%)	Direct
	Ouse River	290	21	Ouse River (96%)	Direct
Trent River - Crowe River	Chandos Lake - Crowe River	134	19	Crowe River (99%)*	-
	Cordova Lake Dam - Crowe River	53	7	Crowe River (99%)*	-
	Crowe Bay Dam - Trent River	53	8	Rice Lake/ Trent River (44%)	Direct
	Crowe Lake - Crowe River	139	20	Crowe River (99%)*	Direct
	Kasshabog Lake - North River	179	25	North River (96%)	-
	Paudash Lake Dam - Crowe River	4	1	Crowe River (93%)*	-
	Round Lake - North River Outlet	143	20	Crowe River (96%)*	Direct

Notes:
(1) Based on areas within the County
(2) The delineation for each subwatersheds was provided by each Conservation Authority, it should be noted that they do not share the same scale.
- : No subwatersheds identified at this time.
*: The Crowe River subwatershed, created by Crowe Valley Conservation Authority, is an amalgamation of multiple quaternary watersheds.

3.2 Land Use and Landcover

Peterborough County includes the City of Peterborough and eight townships, which contain towns, villages, and hamlets of varying sizes. Changes in land use, such as the clearing of forests for agriculture or the conversion of rural landscapes into urban developments, fundamentally alter the natural water balance in watersheds. These changes typically result in the replacement of pervious surfaces with impervious surfaces (e.g., asphalt, rooftops, and concrete), significantly reducing infiltration capacity and increasing surface runoff during precipitation events.

As natural vegetation is removed or altered, evapotranspiration rates decline, and the ability of the landscape to store and slowly release water is diminished. In Ontario, these transformations are especially critical due to the province's varied physiography and reliance on both groundwater recharge zones (e.g., Oak Ridges Moraine) and surface water systems for ecological and municipal needs. When porous soils are compacted or covered, stormwater is rapidly routed to streams and rivers, contributing to higher peak flows, increased erosion, and degraded water quality.

In June 2022, the County of Peterborough prepared a new Official Plan to establish a long-term vision and direction for growth and development through to the year 2051, encompassing its eight local municipalities. The amended and Council-adopted Official Plan is available on the County's website. While the County's GIS data do not include metadata indicating when the spatial layers were last updated, a comparison of municipal maps from the 2022 published plan and land use designations within the provided shapefile suggests that the data reflect the changes introduced in the 2022 Official Plan. This plan was updated again in April 2025 to align with the 2024 PPS and other related changes to the environmental planning framework in the Province. It is important to note, however, that the new Official Plan will not come into effect until it receives approval from the Minister of Municipal Affairs and Housing, which remains pending as of the time of writing of this document.

The dataset covers the entire County, except for most open waterbodies and the City of Peterborough. Although geographically located within the County, the City of Peterborough is a separate municipality and is not governed by the County. As such, the Official Plan policies do not apply directly to the City. However, for the purpose of assessing future urban conditions, the City of Peterborough was included in the analysis. Waterbodies were supplemented using the Ontario Hydro Network (OHN) watercourse layers to fill in spatial gaps. The city boundary (assumed as an urban land use designation) and these water (i.e., hydrological) features were integrated into the dataset to ensure completeness and consistency in the representation of land use.

The County of Peterborough's Official Plan (2025) provides broad land use classifications to guide development, land use planning, municipal services, and development regulations. The dataset was simplified to provide a broader understanding of the County's land use. These simplified classifications are summarized in

Table 12. Additional land spaces that do not have any attributes were labeled as "unknown." The consolidated land use mapping is presented on Figure 6.

Seven land use categories were identified (

Table 12). These categories simplified the Official Plan designation and land use to provide an overview of the land use within the study area. Official Plan designations and land use were categorized based on the class provided and confirmed with satellite imagery. If an official plan land use or designation had other land use types within its class, it was sorted into the simplified land use category that represented the majority of the official plan designation or land use.

Mapping of the land uses (Figure 6) clearly demonstrates that the predominant land use within Peterborough County is open space/ natural area. Figure 6 also illustrates spatial differentiation in land use with the northern area of the County dominated by Open Space and the southern area of the County dominated by Agriculture.

Table 12 Land Use Classification Based on OP Designations Assumed from County of Peterborough (2022b)

Simplified Land Use	Official Plan Designation [1]	Official Plan Land Use [1]	% of Peterborough County Area
Agricultural	Agriculture	Agricultural, Agricultural-Special Policy Area, Community Commercial, ORM - Prime Agricultural, Prime Agricultural, Prime Agriculture, Rural Employment	9
Open space/ Natural Areas	Crown Land, First Nations, Natural Core Area, Natural Linkage Area, Parks & Conservation, Provincial Park, Recreation - Open Space, Recreation Commercial, Rural[2], Future Development, Millbrook Special Policy Area, Community Spaces	Natural Core Area, Environmental Constraint Area, Community Spaces, DNA Cluster, Crown Land, First Nations, Environmental Constraint, Environmental Constraint Area, Environmental Protection, EP WPS, Natural Core Area, ORM - Natural Core Area, ORM - Natural Linkage Area, Natural Core Area, Natural Linkage Area, ORM - Natural Linkage Area, Environmental Constraint Area, Open Space, Parks & Open Space, Recreation - Open Space, Recreation/Conservation, Recreational, Recreational - Open Space, Provincial Park, Recreation - Open Space, Recreation Commercial, Environmental Constraint Area, Natural Core Area, Environmental Constraint, Environmental Constraint Area, Environmental Protection, Provincial Park, Rural, Future Development, Shoreline, Millbrook Special Policy Area, Environmental Constraint, Millbrook Special Development Area	69
Industrial	Landfill Site - Area of Influence, Area of Influence, Waste Management Area,	Active Landfill Site, Closed Landfill Site, Former Landfill Site, Waste Disposal, Waste Management Area, Waste Management Area - (Active Site), Waste	2

Simplified Land Use	Official Plan Designation [1]	Official Plan Land Use [1]	% of Peterborough County Area
	Extractive Industrial, Rural Employment, Airport Employment, Airport Industrial, Rural Employment Area	Management Area - (Former Site), Aggregate Resource, Aggregate Resource Extraction, Extractive Industrial, Mineral Aggregate Extractive, Mineral Mining and Aggregate Resource Extraction, ORM - Extractive, Aggregate Resource Extraction, Rural Employment Area, Employment Areas, Landfill Site - Area of Influence, Airport Industrial, ORM - Extractive, Airport Employment, Rural Industrial, Disposal Industrial, Industrial	
Urban	Waterfront Residential, Existing Residential, Rural Settlement, Trailer Park, Existing Residential, Commercial, Commercial Entertainment, Community Commercial, Community Core, Flood Fringe Overlay, Highway Commercial, Institutional, Institutional Special Policy Area # 1, Institutional Special Policy Area # 2, Neighborhood Commercial, Recreation Commercial, Urban Employment Area, Waterfront Residential, urban residential, Estate Residential, Future Development, Residential, Site Specific Policy Area, Hamlet Area, Millbrook Special Development Area, Rural, Rural Employment, Rural Settlement , Commercial Entertainment	Closed Landfill Site, Former Landfill Site, Waste Disposal, Waste Management Area, Waste Management Area - (Active Site), Waste Management Area - (Former Site), Aggregate Resource, Aggregate Resource Extraction, Extractive Industrial, Mineral Aggregate Extractive, Mineral Mining and Aggregate Resource Extraction, ORM - Extractive, Aggregate Resource Extraction, Rural Employment Area, Employment Areas, Landfill Site - Area of Influence, Airport Industrial, ORM - Extractive, Airport Employment, Rural Industrial, Disposal Industrial, Industrial	5
Waterbodies	-	-	11
Wetland	Natural Core Area	Locally Significant Wetland, Provincially Significant Wetland, Provincially Significant Wetlands (PSW)	4
Unknown	-	-	3

Notes:
(1) Received from the County of Peterborough
(2) Rural land classification contains some agricultural land, but the majority is open space
(3) Received from OHN
(4) Simplified land use assumed by Onterris (this was not part of the received shapefile from the County)

3.3 Physical Environment

3.3.1 Climate and Streamflow

A review of publicly available meteorological and streamflow data was completed to inventory the existing and historical monitoring data within the tertiary and quaternary watersheds. Data from Environment Canada, Water Survey of Canada (WSC) and the local conservation authorities were reviewed.

Climate is a pattern or cycle of weather conditions including temperature, precipitation, wind, humidity and cloud movement over a given region, averaged over many years. These climate conditions are critical to validating and calibrating the hydrologic and hydrogeologic/groundwater system modelling and understanding long term data and trends to characterize the surface and subsurface water systems, as well as the interactions of water movement in the watersheds and respective subwatersheds.

Climate data collected within the last 30 years is considered to accurately represent current conditions. For continuous simulation and frequency analysis purposes, a minimum of 20 years of recent rainfall data is generally required.

The most long-term and current set of climate data comes from the Peterborough A climate station located in the Otonabee River tertiary watershed which provides hourly and daily temperature and precipitation data from 1969-2025. The data provided from this climate station summarized monthly mean precipitation and temperature over the recording period, as seen in Image 5. Maximum mean precipitation occurs in June with an (78.7 mm) and the minimum mean precipitation occurs in February (46.1 mm). The mean annual precipitation is 874.1 mm/year for this location. The year with the greatest annual precipitation was 1995 (1,065.2 mm/year) and the year with the lowest annual precipitation was 2016 (419 mm/year) (2016 was missing 39 daily observations which may provide artificially low total annual precipitation).

Temperature data summarized for the Peterborough A climate station included the mean temperature and the maximum and minimum temperature. January had the lowest mean temperatures of -8.3 ˚C. July had the highest mean temperatures of 19.8 ˚C.

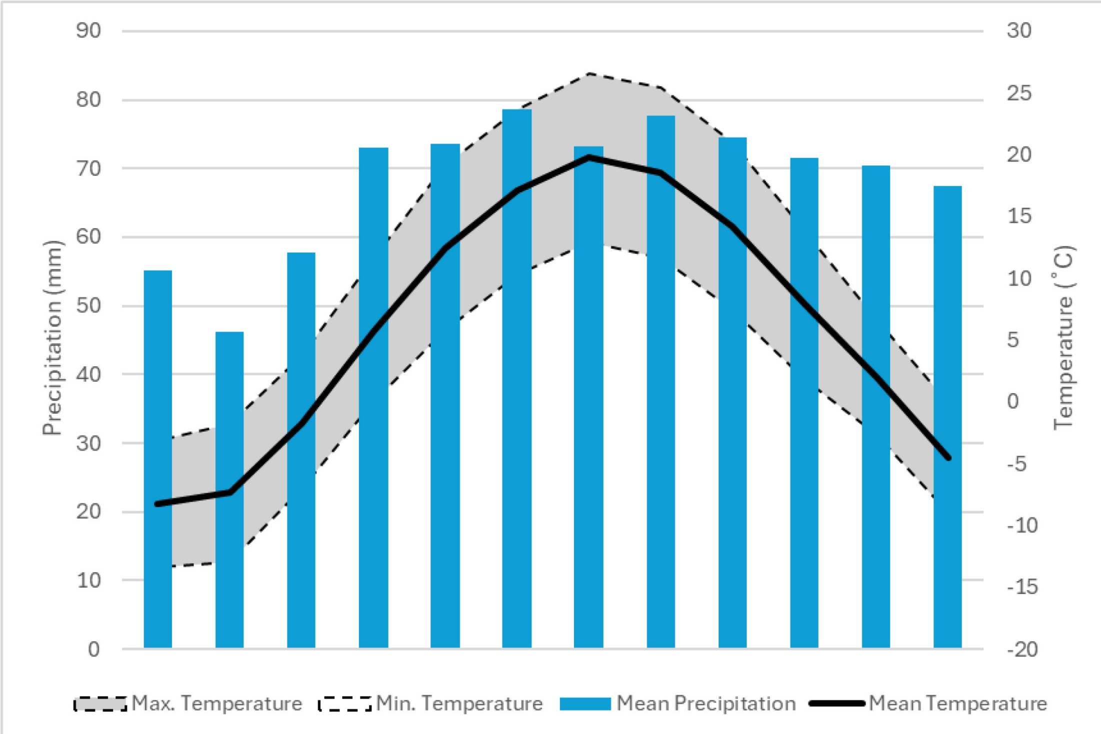


Image 5 Mean Monthly Precipitation and Temperature Paters of Otonabee Tertiary Watershed (2010-2025)

The Trent Conservation Coalition completed a precipitation surface using Triangulated Irregular Network and data provided from selected Environment Canada Climate Stations (2006). This precipitation surface can be found in Map 5 of the *Conceptual Water Budget – Trent River Watershed* Report (TCC 2007). This map includes climate station data from outside of Peterborough County to spatially estimate surface precipitation where climate station data is not available. This source will be utilized to provide approximate precipitation ranges for tertiary watershed that lack long term climate data.

3.3.2 Physiography and Slopes

Physiography refers to the study of the Earth's surface features and landforms. The glacial activity created various physiographic regions and physiographic features reflecting the ways in which surface material was deposited. A physiographic region is defined as a geographic area that shares common geological structures, climate conditions, and evolutionary history (Chapman and Putnam 1984). Understanding physiography is crucial from a water resource perspective, as it provides valuable insights into how land composition influences the movement of both groundwater and surface water. Additionally, the physical characteristics of the landscape play a significant role in determining land use, since the type of surface sediments and landforms can affect activities such as agriculture and aggregate resource extraction.

"Physiography of Southern Ontario" by L.J. Chapman and D.F. Putnam was first printed in 1951 and was republished and updated in 1966 and 1984. The Ontario Geological Survey, Sedimentary Geoscience Section, has captured the physiographic information in an attributed GIS-based map, which was downloaded as a shapefile and clipped to the study area. Overall, there are six physiographic regions in Peterborough County, as depicted in Figure 8.

Other physiographic patterns noted in Figure 8 include closed depressions, drumlins, moraines and Hummocky terrain. Closed depressions—bowl-shaped landforms with no natural outlet—play a key role in both surface and subsurface hydrological processes where they occur (Hayashi et al. 2003). These features collect surface runoff, which may either persist as open water (e.g., wetlands) or infiltrate the ground, depending on substrate composition, potentially contributing to groundwater recharge (Hayashi et al. 2003; Berthold et al. 2004). Closed depressions are common in hummocky, rolling landscapes due to the undulating and complex surface topography. Hummocky terrain is characterized by irregular landscapes containing numerous small mounds or knolls (Boone and Eyles 2001).

Topography is the shape of the land, measured by elevation and how much that elevation changes over a certain distance (slope). It affects how groundwater and surface water move through a watershed. In digital terrain analysis, Digital Elevation Models (DEMs) are widely used to represent surface topography over broad areas as shown in Figure 9 (Wechsler and Kroll 2006).

Surface slope is another critical parameter in hydrological analysis derived from available topographic sources. The slope of the land influences how water infiltrates into the ground, how much runs off the surface, and how quickly it flows. Flat or gently sloped areas allow more water to infiltrate into the ground and reduce runoff speed. Also, flatter slopes are more favorable for urban development due to simpler construction requirements and lower landform modification costs. In contrast, steeper areas cause water to flow faster over the surface, increasing runoff and reducing infiltration. However, steeper slopes pose engineering challenges and increased environmental risks.

A Digital Terrain Model (DTM) with a 30 m spatial resolution is available from the Ganaraska Conservation. For this Quaternary-scale slope assessment, the DTM provides sufficient detail to understand the general slopes int the areas. Slope values were calculated from the DTM (30 m) and categorized into three classes: gentle slopes (0–2%), moderate slopes (2–10%), and steep slopes (>10%), to help assess development suitability.

3.3.3 Surficial Geology

Surficial geology refers to the unconsolidated geological materials that overlies bedrock. In Ontario, these sediments were primarily deposited during the advance and retreat of the Laurentide Ice Sheet. Understanding the surficial geology of a watershed is crucial, as the physical and chemical properties of these deposits strongly influence natural processes and features, particularly surface water and groundwater flow systems. These systems, in turn, support key hydrological functions such as surface runoff, groundwater infiltration, recharge, and discharge, which influence the development of diverse aquatic and terrestrial features. Surficial geology plays a foundational role in shaping ecosystems such as wetlands, fens, and swamps, as well as in governing fluvial processes and hydrological connectivity across the landscape. It also contributes to the formation and function of topsoil, which is discussed further in Section 3.3.5.

The surficial geology of Peterborough County has been characterized using the OGS (2011) for this study. Overall, the surficial geology of Peterborough County consists of 16 distinct geologic units, as depicted in Figure 10. A description of each of the surficial geological units is summarized in Table 13, in order of increasing age (i.e., oldest to most recent).

Table 13 Overview of Surficial Geology within Peterborough County (OGS 2011)

Mapping Unit Surficial Geology Unit Number	Unit Name Surficial Geology Unit	Description of Material Description
1	Precambrian Bedrock	Precambrian Bedrock
2	Precambrian Bedrock-Drift Complex	Bedrock-drift complex in Precambrian terrain
3	Paleozoic Bedrock	Paleozoic Bedrock
4	Bedrock-Drift Complex in Paleozoic Terrain	Bedrock-drift complex in Paleozoic terrain
5a	Till	Silty sand to sand-textured till on Precambrian terrain
5b	Till	Stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain
5c	Till	Stony, sandy silt to silty sand-textured till on Paleozoic terrain
5d	Till	Clay to silt-textured till (derived from glaciolacustrine deposits or shale)
6	Ice-contact Stratified Deposits	Sand and gravel, minor silt, clay and till
7	Glaciofluvial Deposits	River Deposits and Delta topset Facies
8a	Fine-textured Glaciolacustrine Deposits	Silt and clay, minor sand and gravel; massive to laminated
9c	Coarse-textured Glaciolacustrine Deposits	Sand, gravel, minor silt, and clay – foreshore and basinal deposits
12	Old Alluvial Deposits	Clay, silt, sand, gravel, may contain organic remains
17	Eolian Deposits	Fine to very sand and silt
19	Modern Alluvial Deposits	Clay, silt, sand, gravel, many contain organic remains
20	Organic Deposits	Peat, muck, and marl

Note:
(1) Description from OGS (2011)

Surficial Geological Units composed of highly permeable materials, such as sands and gravels, have moderate to high infiltration and groundwater recharge capacity. These include ice-contact stratified deposits (Unit 6), glaciofluvial deposits (Unit 7), and coarse-textured glaciolacustrine deposits (Unit 9c). These materials allow water to percolate through the ground, helping recharge aquifers. Similarly, eolian deposits (Unit 17) and modern alluvial deposits (Unit 19) also tend to be porous and support moderate to high infiltration, depending on local conditions.

In contrast, several geological units exhibit low infiltration and groundwater recharge capacity, and tend to promote surface runoff (e.g., Units 5d, 8a, and 20). Bedrock units (Units 1–4), are largely impermeable and restrict infiltration and recharge unless extensively fractured. Fine-textured deposits, such as clay-rich tills (Unit 5d) and glaciolacustrine sediments (Unit 8a), also have low permeability. Organic deposits (Unit 20), including peat and muck, retain water but drain poorly, often resulting in surface water accumulation and the formation of ponds, lakes, wetlands, and increased runoff.

Some surficial deposits offer low to moderate or variable infiltration potential, depending on texture and composition. These include other till units (5a–5c), which range from silty sands to sandy silts, and old alluvial deposits (Unit 12), which can contain a mix of permeable and impermeable materials. Their capacity for recharge or runoff is highly dependent on local site characteristics and layering.

Understanding the distribution of these units is essential for watershed planning and land development, as it informs decisions about stormwater management, infrastructure placement, and groundwater protection.

3.3.4 Bedrock Geology and Bedrock Topography

The bedrock geology refers to the type and composition of the rock beneath the surficial materials. The bedrock geology plays a crucial role in groundwater movement, aquifer formation, surface water runoff, and aggregate resources.

The bedrock geology of Peterborough County has been mapped by the Ontario Geological Survey (OGS) (2011). The formation comprises seven primary geological units, as depicted in Figure 11. Table 14 describes these units, organized in descending chronological order—from the most recent to the oldest.

Permeable bedrock formations, such as fractured limestone and sandstone (Unit 54a), play a vital role in supporting groundwater recharge by allowing water to infiltrate into underlying aquifers. In contrast, Precambrian units (Units 44 to 49) have low permeability, with limited infiltration capacity causing water to remain at or near the surface. Areas characterized by bedrock-drift complexes—where thin layers of glacial deposits overlay the bedrock—exhibit variable recharge potential. These zones are particularly vulnerable to contamination due to the limited protective cover, which reduces natural filtration and increases exposure to surface pollutants.

Table 14 Overview of Bedrock Geology within Peterborough County

Geological Unit Number	Bedrock Geology Unit	Description
54a	Ottawa Group; Simcoe Group; Shadow Lake Formation	Limestone, dolostone, shale, arkose, sandstone
49	-	Mafic to ultramafic plutonic rocks - diorite, gabbro, peridotite, pyroxenite, anorthosite, derived metamorphic rocks
48		Alkalic plutonic rocks - nepheline syenite, alkalic syenite, fenite; associated mafic, ultramafic and carbonatitic rocks
47		Early felsic plutonic rock - granodiorite, tonalite, monzogranite, syenogranite; derived gneisses and migmatites
46	Grenville Supergroup and Flinton Group	Carbonate metasedimentary rocks - marble, calc-silicate rocks, skarn, tectonic breccias
45		Clastic metasedimentary rocks – conglomerate, wacke, quartz arenite, arkose, limestone, siltstone, chert, minor iron formation, and minor metavolcanic rocks
44		Mafic to felsic metavolcanic rocks - flows, tuffs, breccias, minor iron formation, minor metasedimentary rocks; includes reworked pyroclastic units, amphibolite

Bedrock topography and structural features, such as bedrock valleys and faults, play an important role in influencing groundwater movement. The ability of bedrock units to transmit water depends largely on the degree of fracturing, which is typically most intense near the bedrock surface and along structural features (Figure 11). In carbonate rocks such as limestone and dolostone, porosity can be further enhanced through dissolution processes, where flowing water enlarges fractures and creates conduits known as karst features. Karst is discussed further in Section 3.5.5 under Natural Hazards, due to its association with land subsidence risks in karst-prone areas.

Bedrock is at surface or overlain by thin soils in the northern half of the study area. In the southern portion of the study area bedrock depths range from approximately 30 m on the till plains to more than 50 m below the Oak Ridges Moraine in the southern portions of the study area. The Kawartha Lakes occupy bedrock lows formed through glacial erosions in the north. Bedrock valleys were also carved in the bedrock that are oriented roughly north-south in areas beneath the Oak Ridges Moraine in the south. Where these valleys are infilled by sand and gravel they may represent significant aquifers (e.g. near Millbrook). The bedrock topography and structural features (bedrock thalwegs and tunnel channel thalwegs) are illustrated in Figure 11. The data were obtained from the web mapping services of the Oak Ridges Moraine Groundwater Program (ORMGP) using the ORMGP 2021 database (2025a).

Understanding the distribution and characteristics of bedrock geology and topography is critical for effective watershed planning and land development. This information helps identify areas suitable for infrastructure foundations, groundwater protection, resource exploration, and stormwater management. It also highlights regions that may present geotechnical or hydrological challenges.

Integrating bedrock data into planning frameworks enables more sustainable, resilient, and environmentally responsible land use decisions.

3.3.5 Soils

Understanding soil properties is important for evaluating the hydrologic response (e.g., surface runoff, infiltration, and groundwater recharge) of watersheds in Peterborough County. In Ontario, soils are classified and described through soil surveys based on a combination of their physical, chemical, and morphological characteristics, as well as their origin (parent material) and landscape position. These surveys follow standardized Canadian and provincial soil classification systems, especially those used by OMAFRA (Ontario Ministry of Agriculture, Food and Rural Affairs). The principal unit of classification is the soil series, which describe soils that have similar horizons, texture, structure, drainage, and development.

Some of the key soil characteristics used in OMAFRA'S Classification

- Parent Material and Surficial geology (described in Section 6.1.3) correspond to glacial and postglacial processes and origin of the soil.
- Soil Texture (Figure 12): associated sediments from parent material with different proportion of sand, silt, and clay (e.g., loam, clay loam, sandy loam). Texture indicates the relative content of particles the soil contains (e.g., clay, sand, and silt). Texture influences the amount of air and water the soil can hold and how easily water can move through the soil.
- Soil Horizons: A (topsoil), B (subsoil), C (parent material); depth, structure, and color are described.
- Drainage: describes the relative rate at which water will pass through the soil horizon.
- Slope: Terrain features influencing runoff and erosion.

Soil data have been summarized based on their drainage characteristics, which provide an indication of the soil's ability to drain water and therein create runoff. This classification can infer the soil's potential response to urbanization, as well as the applicability and suitability for select stormwater management (SWM) practices should future development advance (i.e., source controls for best management practices).

Drainage classes were sourced from the Soil Complex Survey (OMAFRA 2019), and drainage potential was interpreted using Onterris designations. Table 15 summarizes these classifications, and Figure 13 includes corresponding mapping within the County.

Table 15 Drainage Designations

Drainage potential (assigned by Onterris)	Drainage classes	Description
Unknown	Not Applicable (NA)	The drainage class "Not Applicable (–)" typically refers to areas with unclassified soils or regions underlying water features where drainage characteristics have not been assigned.
	Variable (VA)	Soils classified as "Variable (VA)" are commonly found within or near existing urban areas, where development has disturbed natural soil conditions.
	Unknown (UN)	The Soil Survey Complex dataset provides comprehensive coverage of the county, except for a few small gaps near the northern boundary. To address these gaps, Onterris introduced an additional class, "UN," to represent unknown areas.
High	Very Rapidly (VR)	The soil types denoted here represent higher infiltrative soils and thereby constitute areas that may be more sensitive to urbanization, as the impervious coverage resulting from urban development would generate a more significant change in the local hydrologic relationships. These could include sensitivity to changes in peak flows to receiving systems, impacts to the local water balance, as well as higher susceptibility for urban contaminants draining within the soils and potentially entering the subsurface systems.
	Rapidly (R)	
	Moderately Well (MW)	
	Well (W)	
Medium	Imperfectly (I)	Mix between well-drained and poorly drained conditions and would therefore generally represent characteristics of both categories.
Low	Poorly (P)	Indicate areas less sensitive to urban development, seeing as under the current or native soil conditions, poorly drained soils generally consist of less permeable material and would typically produce higher runoff in their in-situ condition.

3.4 Water Resources

3.4.1 Surface Water Features - Definitions

Surface water features include the watercourses (e.g. rivers, creeks, and streams), drains (e.g., municipal or otherwise), and headwater drainage features (HDF). The characterization of surface water features determines the role of the feature within the water resource system (WRS), the sensitivity of the feature to changes in hydrologic regime due to potential development, ecological impacts, and identification of fluvial erosion hazards.

To identify and characterize watercourses and HDFs, a clear understanding on their definitions is required. The following definitions have been adapted from the guidance document Evaluation, Classification and Management of Headwater Drainage Features Guidelines (TRCA and CVC 2014), O. Reg. 41/24 (Government of Ontario 2024), and professional experience in other jurisdictions.

- **Watercourses:** Watercourses are defined as permanent to intermittent flowing drainage features with a defined bed and banks or sides (O. Reg. 41/24; Government of Ontario 2024). They exhibit clear evidence of active channel processes including planform, profile, and material sorting, with evidence of a balance between erosion and deposition throughout the reach. They are often second-order or greater features but may be first order when verified by the evaluating practitioner(s). Watercourses are regulated features by the Conservation Authorities Act.
- **Headwater Drainage Features (HDFs):** represent non-permanently flowing drainage features that do not have naturally defined bed, banks, or sides have been designated as HDFs. Headwater drainage features may also include anthropogenically modified channels that result in features with defined bed and bank (i.e., a drainage feature dug/cut into the land surface) or that develop seasonally (e.g., as spring freshet concentrates flows in depressions, causing channel development into surfaces that lack vegetation cover). HDFs are generally first order and zero order intermittent and ephemeral channels, swales and connected headwater wetland, but do not include rills or furrows. They are not typically identified as a regulated feature, and fish may or may not be found within the feature. While not typically regulated, the features are an important part of the surface drainage network and require appropriate management consideration. Setbacks or buffers for HDFs that are to remain on the surface as part of the connected drainage network should be determined appropriately thorough consultation with the local regulatory agencies and municipalities.

The role of these features within the drainage network and on the land-surface needs to be assessed and quantified as part of future subwatershed studies to identify opportunities and constraints, and to identify mitigation strategies, within the context of any proposed land use changes.

3.4.2 Trent Severn Waterway

The Trent–Severn Waterway is a 386-kilometre (240-mile) canal system that links Lake Ontario at Trenton to Georgian Bay on Lake Huron at Port Severn. It follows several major natural waterways, including the Trent River, Otonabee River, Kawartha Lakes, Lake Simcoe, Lake Couchiching, and the Severn River. It began as a military route after the War of 1812, with the first lock built in Bobcaygeon in 1833. By the late 1800s, the system expanded to support Ontario's growing lumber and agriculture industries. Major engineering milestones include the Peterborough Lift Lock (1904) and Kirkfield Lift Lock (1907). Construction of all the dams and locks to permit through navigation was completed in 1920, however, it was already outdated for commercial use due to railroads. Today, it is a National Historic Site with 44 locks, including the two hydraulic lift locks, two flight locks and one marine railway at Big Chute, valued for recreation, heritage, and water management (CSCE 2026).

The Trent River basin encompasses some 218 lakes in the Haliburton Highlands region, 37 of which are directly controlled by Waterway dams. Water from these lakes flows south along either the Gull River, Burnt River, Nogies Creek, Mississagua River, Eels Creek or Jack Creek systems into the Kawartha Lakes. The Kawarthas drain down the Otonabee River into Rice Lake and on to Trenton on Lake Ontario via the Trent River. The Crowe River drains the eastern-most lakes in the Trent Watershed. Lake Scugog drains northward from the Oak Ridges Moraine to Sturgeon Lake.

The Trent–Severn Waterway plays a critical role in regulating water levels across the Peterborough region's watersheds, particularly the Otonabee River and connected lakes. With approximately 160 water control structures, including adjustable dams, the system allows for active water management throughout the year and in response to changing weather conditions. It is important to recognize that several dams within the drainage areas of the Trent Severn Waterway were originally constructed to float timber the sawmills, which created lakes where they previously did not exist. Many of these dams continue to be maintained to keep these areas as lakes for the cottages and homes that have become established around them, but do not have a formal flood control function. Parks Canada, among other activities, works to manage the system to mitigate flood risks to the greatest extent possible.

To mitigate flood risks lakes are drawn down in the fall and early winter to prepare for spring snowmelt and reduce flood risks, then recharged during the spring freshet. In summer, water is released from reservoir lakes to maintain navigable levels along the waterway. This regulation also helps mitigate localized events such as heavy rainfall, mid-winter thaws, or ice build-up, which are especially relevant in areas like the Otonabee and Trent Rivers. While essential for navigation and flood control, this artificial regulation alters natural flow regimes and can impact aquatic habitats and sediment dynamics within the watershed (TSW 2025).

3.4.3 Surface Drainage

The drainage network that develops on a landscape is determined by general precipitation patterns (i.e., how much precipitation falls on the ground), and characteristics of the ground surface that affect how the precipitation is distributed with respect to evaporation, infiltration, or runoff (e.g., geology, soils, vegetation, topography) (Knighton 1998). The permeability of the surficial geology in natural settings determines the drainage density; the topography (often influenced by geological composition and processes) influences drainage pattern. Hydrology (streamflow) and geology (sediment supply/bedrock) form the primary influencing factors of channel form that are further influenced by secondary factors such as vegetative cover, land use, and alterations to the watercourse (i.e., by animal or human actions). Over time, a watercourse develops a channel form that is adjusted to, or in equilibrium with, primary and secondary influences.

Watercourses receive water and sediment from adjacent and upstream watershed areas and convey these downstream through their drainage network. Since any part of the drainage network is part of a spatial continuum, for which the geometry naturally adjusts over time, the understanding of channel conditions and functions requires a spatial and temporal context. Interpretation of the distribution and timing of adjustments throughout a drainage network is essential when evaluating channel stability and evolution (response) in the context of disturbances to the controlling and influencing factors of channel form (e.g. climate change; land use conversion; construction). Channel adjustments can occur under a single precipitation event (flood), or over decades in response to either local (e.g. straightening) or broad scale changes (e.g., deforestation). At the watershed scale, such analysis may be relatively high-level and inferred, while at the subwatershed scale, changes in channel form may be detailed.

To support watershed and subwatershed characterization, it is essential to distinguish watercourses and HDFs at the reach scale; reaches are lengths of channel that have similar controls (e.g., vegetation, boundary materials) and exhibit similar characteristics (e.g., sinuosity, width, depth, substrate). There are features visible on aerial imagery that are not included in the OHN watercourse mapping, highlighting a data gap that will need to be addressed as part of subsequent subwatershed studies. This analysis would involve digital elevation model (DEM) processing to determine likely flow paths and then refinement of the network against aerial imagery and field verification. Watercourse and HDF identification should be conducted in partnership with the Conservation Authorities for efficiency, as they are the regulators for watercourse features.

The Ontario Hydro Network (OHN) Watercourse and Waterbody (downloaded from Ontario GeoHub on 16-02-2025 were used to support watershed characterization (Figure 14). Watercourse layers were provided by some of the conservation authorities and by the City of Peterborough, however the OHN layers were deemed most appropriate for scale of this characterization.

3.4.3.1 Drainage Network Characteristics

There are several methods to characterize a drainage network including stream order, channel pattern, sinuosity, and drainage density. At a high level, drainage density provides an easily measurable characteristic that represents the length of channel available to drain surface water and is simply expressed as the ratio of channel length to drainage area. In natural watercourses, a low drainage density typically indicates more infiltration and less runoff, resulting in longer lag times and lower peak flows. A higher natural drainage density indicates a proportionally larger number of watercourses that convey water over a less pervious landscape. Surficial bedrock can naturally limit infiltration, resulting in a greater need for surface water storage and conveyance. Drainage density drainage patterns can be anthropogenically altered (i.e., tile drains, stormwater management, topographic regrading) often reducing drainage density relative to what might otherwise occur naturally.

For the study area many waterbodies exist that follow valley trends as a result of topography, geology, and alteration (e.g. dams, locks). As a result, these have been captured in the characterization of the drainage network. Waterbody area has been calculated and is the total surface area of waterbodies pulled from the OHN waterbody layer but excluded features with attributes of “river” and “canal” which are captured in the available watercourse mapping.

3.4.3.2 Drainage Network Alterations

Historically, agricultural practices directly alter small watercourses and HDFs by realigning (straightening or relocating), damming, or piping/burying watercourses among other alterations. Similarly, urbanization has historically modified drainage networks through the realignment, channelization, or removal of surface water features, and development of stormwater networks.

Drainage network alterations often result in a loss of channel length which, in turn, increases the energy and erosive power within the altered channel section; the altered flow and energy condition persists downstream. These changes can lead to increased channel bank and bed erosion, and sediment transport potential.

Additionally, impounding water though damming and lock construction, is a factor to be considered when assessing channel alteration. Damming of watercourses can alter flow regimes/conveyance, sediment transport, and erosion processes.

3.4.3.3 Drainage Network Conditions and Processes

As noted in preceding sections, dominant channel processes within a watercourse are influenced by many varying factors (directly and indirectly). Understanding the processes at work and their resulting conditions within a subwatershed is key to understanding the impacts or potential impacts of changes to controlling factors and influences. Taking inventory of present fluvial processes and observed erosional and depositional features are the basis of this kind of characterization, where available.

3.4.3.4 Streamflow

In addition to climate data, streamflow monitoring is required for hydrologic model calibration/validation, as well as overall characterization of the area watersheds. Like the climate data, streamflow monitoring networks operated by Environment Canada's Water Survey Canada (WSC) have been reviewed. The majority of the currently active WSC gauges are operated with real-time monitoring, which would provide great utility for purposes such as flood forecasting.

A review of publicly available streamflow data was completed to inventory the existing and historic monitoring data within the tertiary and quaternary watersheds. Data from Environment Canada, Water Survey of Canada and the local conservation authorities were reviewed.

3.4.4 Hydrogeology

Hydrogeology characterizes where groundwater occurs, and how it moves, and interacts with the surrounding environment. In a watershed, the groundwater flow system is a key part of the Watershed Resource System (WRS), providing drinking water and supporting the ecological health of the Natural Heritage System (NHS), including features like wetlands and coldwater streams.
A central focus of hydrogeologic characterization is understanding how groundwater interacts with surface water, and how these interactions are influenced by geological conditions, ecosystem

needs, and groundwater use. The goal is to build a strong understanding that supports watershed management planning, ensuring groundwater and ecosystem functions are maintained during and after future development. This section covers hydrostratigraphy, Provincial Groundwater Monitoring Network (PGMN) wells, groundwater recharge and discharge areas, and groundwater users.

3.4.4.1 Hydrostratigraphy

Hydrostratigraphy is the grouping of geologic units based on their ability to transmit and store water and supply water to a well, stream or wetland. Aquifers are able to readily transmit water and are often comprised of sand, silt or fractured limestone units. Aquitards are less efficient at transmitting water and are often comprised of clays, silts, shales, and granites. The ability of hydrostratigraphic unit to transmit water can be assessed by pumping tests or slug tests that provide quantitative estimates of hydraulic conditions and storage. Aquifer units are defined solely by their capacity to provide water, disregarding factors such as water quality or vulnerability to surface contamination.

In order from youngest to oldest, Table 16 summarizes the hydrostratigraphic units of County of Peterborough.

Table 16 Overview of Hydrostratigraphic Units in Peterborough County

Hydrostratigraphic Unit	Map Units*	Aquifer or Aquitard	Lithology
Post Glacial Sediments (Recent Deposits)	12,17 19,20,	Aquitard/ Aquifer	A thin, discontinuous layer of post-glacial deposits consisting of organics, aeolian, and alluvial sediments, forming a thin covering over the Quaternary sediments.
Oak Ridges Aquifer Complex	6,7	Aquifer	The Oak Ridges Moraine generally consists of varying proportions of diamicton with bedded silt, sand, and gravel.
Upper Newmarket Till	5b	Aquitard	Upper Newmarket Till consists of sandy silt to silt till and glaciolacustrine silt and clays.
Inter-Newmarket Sediment	5a	Aquifer	The inter-Newmarket Sediment unit is an intervening coarser granular layer that forms channels between the Upper and Lower Newmarket Till units. It consists of silt, sand, and gravel.
Lower Newmarket Till	5c	Aquitard	The Lower Newmarket Till consists of consolidated, dense diamicton primarily of calcite-cemented sandy silt to silt sand with limestone clasts.
Thorncliffe Formation	-	Aquifer	The Thorncliffe Formation consists of sand and silty sand with silt and clay.
Sunnybrook Drift	-	Aquitard	The Sunnybrook Drift consists of silts and clays. Due to its low permeability, the Sunnybrook Drift serves as an aquitard, separating the two deep aquifers: Thorncliffe and Scarborough Formation.

Hydrostratigraphic Unit	Map Units*	Aquifer or Aquitard	Lithology
Scarborough Formation	-	Aquifer	The Scarborough Formation comprises fluvial and deltaic deposits that transition from a lower unit rich in silt and clay to channelized cross-bedded sands at the surface. The upper sand unit of the formation acts as a deep aquifer and is the second of the two deep aquifers locally present.
Precambrian Bedrock	44-49	Aquitard/ Poor Aquifer	Igneous and Metamorphic Rock Units, range from aquitard to poor aquifer able to support residential supply. Ability to supply water depends on degree of fracturing and karst.
Paleozoic Bedrock	54a	Aquifer	Limestone and Dolostone with moderate to high permeability may support residential to municipal groundwater supply. Ability to supply water depends on degree of fracturing.

Data Source: (ORMGP 2022; Barnett et al. 1998; Sharpe et al., 1999; Soil Engineers Ltd., 2021) * Figures 10 and 11.

3.4.4.2 Provincial Groundwater Monitoring Network Wells

The Provincial Groundwater Monitoring Network (PGMN) was established to gather long-term baseline data on the quantity and quality of key aquifers across Ontario (NVCA 2013). Data from PGMN wells allow for assessments of groundwater conditions and serve as an early warning system for changes in water levels and quality, whether due to climatic conditions or human activities. Understanding current and emerging trends in groundwater conditions is crucial for informing groundwater policies and management programs.

In collaboration with the Ministry of the Environment, Conservation and Parks (MECP), local Conservation Authorities oversee and monitor PGMN well locations within their respective jurisdiction.

Each PGMN well is equipped with continuous data logging instruments that correct for barometric pressure and record water levels and temperature hourly. A total of 14 PGMN wells have been identified within Peterborough County, as illustrated in Figures 10 and 11.

3.4.4.3 Groundwater Recharge Areas

Groundwater recharge is the portion of rainfall and snowmelt that infiltrates into the ground and reaches the water table. Groundwater recharge is influenced by the hydraulic conductivity of surficial materials, vegetation (evapotranspiration), and soil moisture conditions in an area. Additional factors which influence groundwater recharge include topography (slope), imperviousness, groundwater vertical hydraulic gradients and precipitation trends. In general, recharge rates are higher in coarse-grained sediments compared to finer-grained deposits. Steep slopes promote runoff, and less infiltration while lower slopes or flat areas allow for the ponding of water and increased infiltration. In areas where the water table is shallow, recharge capacity is reduced.

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Groundwater recharge areas are depicted on Figures 19a to 19f for Peterborough County. The mapping was developed by extrapolating the groundwater recharge estimates (Table 17 – adapted from Table 1 in YPDT-CAMC 2009) regional groundwater model to the entire Trent Region based on the surficial geology, soil and climate normal mapping (TCC 2025). The maps and Table 17 highlights that recharge rates are lowest (on the order of 60 mm/year) where the surficial geology is dominated by bedrock (the vast majority of the northern portion of Peterborough County) and finer grained unconsolidated deposits. The higher recharge areas are found where more permeable sands and gravels are present, specifically on topographic highs in landscapes with more local relief (e.g., the crest hummocks or drumlin features). Combining the annual recharge rate estimates in Table 17 and the relative surficial geologic coverage across the County, the annual average groundwater recharge is approximately 85 mm/year.

Another source of groundwater recharge estimate come from the results from water budget modelling conducted as part of the Tier 1 Water Budget and Water Quantity Stress Assessment (XCG 2008). This report used a lumped hydrological model (CANWET Model) calibrated to stream baseflow estimates to evaluate the water budget on Tier 1 subwatersheds. Using this approach yielded an average groundwater recharge of 175 mm/year for the County of Peterborough.

Each of these approaches to estimating groundwater recharge has an associated uncertainty:

- Extrapolating the recharge estimates to the whole county using surficial geologic mapping does not account for the effects of local topographic relief especially in the bedrock dominated portions in the north of the County.
- Uncertainties from the water budget model come from this approach inherently averaging out the natural processes that affect groundwater recharge (lumped model/subwatershed-based). In addition, baseflow estimates used in the calibration process have uncertainties related to their method of analysis (e.g. regression analysis of hydrographs).

In the Tertiary watershed sections, average groundwater recharge rates will be presented from the calibrated water budget model coming from the Tier 1 report.

Table 17 Estimated Recharge Rates*

Surficial Geologic Material	Estimated Annual Recharge Rate (mm/year)
Bedrock / Glacio-lacustrine silts / Recent Alluvium or Peat	60
Till (Newmarket or Halton)	90
Eolian Deposits	220
Glacio-lacustrine sand	240
Glacio-fluvial sands or Kame Deposits	320
Moraine Sand/Gravel	360

Data Source: *Adapted Table 1 from TCC (2009)

3.4.4.4 Groundwater Discharge Areas

Discharge areas are locations where groundwater emerges at the surface through springs or seeps, often flowing into wetlands or watercourses. The areas are typically associated with shallow water table (less than 2 metres below ground surface). The groundwater discharge areas depicted in Figures 20a to 20f for Peterborough County were derived from the ORMGP portal using the ORMGP 2021 database using observed groundwater levels (ORMGP 2022).

Groundwater discharge is significantly influenced by subsurface stratigraphy. In Peterborough County, the deep groundwater system remains largely disconnected from the surface due to the persistent presence of shallow to intermediate aquitards, which act as confining layers over the deeper aquifers. While surface discharge does occur in select areas, the shallow groundwater system generally has limited discharge potential, primarily due to the presence of low-permeability tills, such as the Halton and Newmarket Tills, near the surface.

However, in some parts of the County where these tills are thin or absent, particularly in the southern portions of the County, the potential for groundwater discharge increases. In such zones, areas of groundwater discharge or gaining conditions in wetlands and creeks are often associated with the shallow aquifer (e.g., Oak Ridges Moraine Deposits), which are not confined by the shallow aquitard (e.g., Halton Till). This lack of confinement allows for direct hydraulic connectivity between the aquifer and surficial deposits, thereby enhancing the likelihood of groundwater discharge at the surface.

To support an understanding of the relationship between groundwater discharge and water table dynamics, the depth to the water table has been mapped and presented in Figures 20a to 20f. The depth to the water table has been sourced from the ORMGP portal using the "Depth to Water Table 0 (WT0)" metadata. The data is derived from shallow wells, which are less than 20 m deep (ORMGP 2022). Additional discussion of the depth to water table is presenting in each of the Tertiary Watershed chapters.

3.4.5 Water Use and Source Water

Groundwater has been, and continues to be, a source of municipal water for numerous communities within Peterborough County (see Figures 21a to 21f). Non-municipal water-taking locations within Peterborough County include a Permit to Take Water (PTTW) and non-permitted taking (e.g., domestic taking from overburden and bedrock sources). Overburden completion refers to wells finished in unconsolidated materials above the bedrock. Conversely, wells that reach bedrock are classified as bedrock completion wells. Figures 21a to 21f. These records were downloaded on April 25, 2025, from the ORMGP database (ORMGP 2022).

The primary purposes for water extraction in Peterborough County include water supply (i.e., domestic purposes), industrial and commercial activities, recreation, dewatering, and remediation. The water utilized in this watershed is derived from groundwater, surface water, and a combination of both sources. Within Peterborough County, 11,227 (40%) water wells are completed within the overburden and 17,492 (60%) within bedrock.

Peterborough County intersects the Otonabee-Peterborough, Crowe Valley, Kawartha-Haliburton, Lower-Trent, and Ganaraska Region Source Protection Areas. The Trent and Ganaraska Source Protection Plans, established under the Clean Water Act, 2006 (2025a) and approved on October 23, 2014, mandate that municipal Official Plans align with the Source Protection Plan policies as per Section 26 of the *Planning Act.*

Focusing on the municipal drinking water supply, the provincially approved Source Protection Plan delineates key groundwater-related vulnerable areas. These include wellhead protection areas, highly vulnerable aquifers, significant groundwater recharge areas, and intake protection zones for surface water (Figures 19a to 19f and 21a to 21f).

3.4.5.1 Wellhead Protection Areas

Wellhead protection areas (WHPAs) are zones surrounding a wellhead that contribute water to the wells and travel time to the well is 25 years or less. These are also areas where land use activities could potentially affect the quality or quantity of water entering the well. WHPAs were delineated by all municipal wells under the *Clean Water Act*, 2006 is a piece of provincial legislation designed to safeguard Ontario’s sources of drinking water. Ontario Regulation 287/07 (O. Reg. 287/07; Government of Ontario 2025b) outlines twenty-two (22) prescribed drinking water threats to water quality or quantity (*Clean Water Act*, 2006). WHPAs are delineated normally based on numerical modelling that identifies the areas contributing groundwater to the well and the rate at which water moves underground to a well, which is influenced by factors such as the type of aquifer, slope, soil composition, and the volume of water pumped from the well. The WHPAs' locations and descriptions are presented in Figures 21a to 21f.

3.4.5.2 Highly Vulnerable Aquifers

Highly Vulnerable Aquifers (HVAs) consist of granular aquifer materials or fractured rock with high permeability, which are exposed near the ground surface and have a relatively shallow water table.

The vulnerability of these aquifers decreases when they are covered by a greater thickness of fine-grained, low-permeability soils (NVCA 2015). The HVAs face significant risks of contamination from both natural processes and human activities. Like WHPAs, land use within HVAs may be subject to limitations, as outlined in municipal Official Plans. The HVAs are presented in the Figures 21a to 21f.

3.4.5.3 Significant Groundwater Recharge Areas

Significant Groundwater Recharge Areas (SGRAs) were mapped using a methodology described in CAMC-YPDT (2009) as part of the TCC (2009) Recharge Study based on the recharge mapping described in above. The SGRAs were then delineated based on recharge thresholds from the water budget surplus method to produce a mapping dataset covering the entire Peterborough County. SGRAs include any area where recharge exceeds 153.7 mm/year in southern portion and 267.1 mm/year in the north portion of the Peterborough County which corresponds to areas where recharge represents 55% or more of difference between precipitation and actual evapotranspiration and the mapped water is greater than 2 m below ground surface. The Significant Groundwater Recharge Areas (SGRAs) in Peterborough County are presented in Figures 19a to 19f.

3.4.5.4 Intake Protection Zones (IPZs)

Municipal drinking water vulnerability is evaluated through the delineation of surface water Intake Protection Zones (IPZs) likely WHPAs. IPZ-1 and IPZ-2 define the adjacent land and water areas contributing to a surface water intake. These zones collectively represent the area within which the presence of contaminants could adversely affect the quality of the drinking water supply. The IPZ-1 and IPZ-2 in Peterborough County are presented in Figures 21a to 21f.

3.4.6 Water Quality

3.4.6.1 Surface Water Quality

The MECP, in collaboration with conservation authorities, manages the surface water quality monitoring network. High-quality streams and lakes are vital for supporting fisheries, wildlife habitats, human drinking needs, recreation, agriculture, and industry. Degraded water quality in streams and lakes poses health risks to local residents, livestock, and wildlife (Figure 22). A comprehensive understanding of the watershed's water quality is essential for formulating effective management strategies.

The conservation authorities have been actively monitoring surface water quality, collecting samples from several locations across the watersheds. Some sampling locations operate in partnership with the MECP under the Provincial Water Quality Monitoring Network (PWQMN) program.

As part of this study, Watershed Report Cards published by the Conservation Authorities were reviewed to assess surface water quality and overall watershed health. The Watershed Report Cards provide a more generalized analysis compared to the detailed evaluations in Conservation

Authorities' annual water quality reports. Future quaternary watershed plans should aim for more comprehensive assessments.

3.4.6.2 Groundwater Quality

The Conservation Authorities conduct ongoing groundwater quality monitoring through the Provincial Groundwater Monitoring Network (PGWMN), collecting samples from designated locations across the watershed. As part of this study, Watershed Report Cards published by the Conservation Authorities were reviewed to assess groundwater water quality and watershed health. The Watershed Report Cards provide a more generalized analysis compared to the detailed evaluations in Conservation Authorities' annual water quality reports. Groundwater quality is discussed further I the Tertiary Watershed Chapters.

3.5 Natural Hazards

Natural hazards are features of the landscape and physical environmental processes that have the potential to impact public safety and infrastructure. The area Conservation Authorities are mandated through the *Conservation Authority Act* to regulate lands that are potentially subject to five types of natural hazards:

- flooding
- shoreline
- erosion
- unstable soils
- unstable bedrock (Karst)
- dynamic beaches

These areas are subject to regulation by Conservation Authorities, or by the regional Ministry of Natural Resources. These hazards and the setbacks are intended to avoid interaction with development and maintain or improve public safety. As planning progresses to local scales (e.g., subwatershed studies or site plans) setbacks may be refined based on updated survey and analyses, or specific guidance for work within the hazard may be proposed.

For each Tertiary Watershed, regulatory mapping was requested from the applicable Conservation Authority or downloaded from Ontario Geological Survey (OGS) for the following natural hazards. Requests and data searches included:

- Karst Topography
- Regulated Floodplains
- Regulated Top of Slope (Allowance)
- Meander Belts

The purpose of this section is to characterize the existing status of natural hazards mapping within the County, to assist in developing management strategies around hazards and the associated constraints (as provided in Volume 2).

3.5.1 Flood Hazards

3.5.1.1 Flood Hazard Mapping

Flood hazard mapping identifies areas most likely to flood during extreme weather events, using historical storms like Hurricane Hazel and the Timmins Storm. Flood depths from these storm events are applied to topographic base maps, and through hydraulic modelling used to visualize flood risk by preparing flood line mapping.

These maps guide land use planning in developed and developing areas to protect people and infrastructure. In new developments, construction is generally avoided within flood hazard zones to preserve natural flood storage and flow paths.

In 2004, the City of Peterborough experienced severe flooding when a summer storm overwhelmed its stormwater systems and natural drainage channels. This led to multiple flood risk studies aimed at reducing future impacts. Although the City of Peterborough lies outside the current watershed study area, its experience may inform future land use planning in other jurisdictions to minimize flood risks.

Floodplain mapping has been completed for several areas within the Otonabee River watershed, including Peterborough, the Trent–Crowe River watershed, and the Kawartha watershed. These maps are shown in Figure 23.

3.5.1.2 Dams

Dams may be constructed to support recreation, but they can also be designed to play a crucial role in floodplain management, particularly through their ability to reduce flood risk. By storing excess streamflow during periods of heavy rainfall and/or snowmelt, dams enable the controlled release of water to downstream watercourses, helping to prevent flooding from extending into floodplain areas. Currently, there are 83 dams located along various watercourses and waterbodies within Peterborough County. These dams are owned and operated by a range of stakeholders, including the Province of Ontario, conservation authorities, municipalities, and private landowners. Each dam owner is responsible for the ongoing operation, inspection, and maintenance of their respective structures to ensure they function safely and effectively.

While large dams can disrupt the environment, including the degradation of aquatic ecosystems, blockage of fish migration routes, degradation of wetlands, altered sediment transport, and reduced water quality, their role in mitigating flood risks, protecting downstream communities, and enabling long-term water management (i.e., low flow augmentation) often outweighs these negative effects when dams are properly designed, maintained, and integrated into broader watershed management strategies.

A summary of the number of dams situated within each Tertiary watershed is in Table 18; private dams were not included in this summary.

Table 18 Number of Dams within Peterborough County (GeoHub 2025)

Tertiary Watershed	Ownership		
	Provincial	Conservation Authority	Municipal
Otonabee River	2	5	4
Trent River – Crowe River	9	3	1
Gull River	0	0	0
Kawartha Lakes	4	0	0
North Lake Ontario Shoreline	0	0	0

3.5.2 Shoreline Hazards and Dynamic Beach

Shoreline hazards include hazards due to flooding, erosion and dynamic beaches. These are defined in the OMNR (2001) Great Lakes St. Lawrence River System and Large Inland Lakes – Technical Guides. Large inland lakes are defined by the 2024 PPS as “those waterbodies having a surface area of equal to or greater than 100 square kilometers where there is not a measurable or predictable response to a single runoff event.”

None of the lakes within Peterborough County are defined as large inland lakes and therefore shoreline hazards are not applicable. That is, Shoreline flood hazards are defined by the 100-year monthly mean lake level plus the 100-year storm surge plus an allowance for wave action. There are however historic observed flood hazard lines that have been mapped for some of the lakes within the County. These data have not been integrated into the mapping for this Watershed Plan but should be considered and evaluated as part of any future subwatershed studies and / or more area-specific environmental studies in this watershed.

Similarly, shoreline mapping of the Kawartha Lakes and Trent Severn Waterway have been mapped to provide a flood hazard level by Parks Canada. Otonabee Conservation uses these levels as a flood hazard around these waterbodies. These data have also not been integrated into the mapping for this Watershed Plan but should be considered and evaluated as part of any future subwatershed studies and / or more area-specific environmental studies in this watershed as per O. Reg. 41/24.

Dynamic beach is defined in OMNR (2001) as a term used to emphasize and describe beach profiles that “undergo changes on a broad range of time scales, from hours or days to years and decades, in response to changing wave, wind and water level conditions and to changes in the rate of sediment supply to a particular section of shoreline.” No shorelines within Peterborough County are considered to be dynamic beaches.

3.5.3 Erosion

Erosion is a natural and continuous process which includes sediment or soil creation and displacement. The degree of erosion present within a landscape depends on physiographic characteristics, including geology and soils, surface slopes, and vegetative cover. Although erosion is a natural process within the landscape, human-related activities can cause accelerated erosion. This often occurs in response to hydrological changes (flow magnitude, flow volume) resulting from altered land use (e.g., urbanization) and inadequate stormwater management; it is important to note that erosion does not only occur during high flood events but also occurs during frequent smaller events. While stormwater management can control flow magnitude and manage flow volumes and rates, a loss of sediment load occurs; each of these factors can change the natural processes of watercourses and can lead to increased erosion and/or alterations in channel function. Changes in hydrology and sediment supply have resulted in:

- Stream widening and bank erosion;
- Streambed changes due to sedimentation (including increased deposition of fines);
- Stream downcutting; and
- Loss of riparian tree canopy.

Erosion hazards associated with river and valley systems form a component of regulated natural hazards to ensure that natural processes can be sustained while not posing a risk to public safety. The natural hazards for watercourses include lateral and downstream migration though the floodplain for unconfined watercourses and valley wall instability for confined watercourses. Determining erosion hazard limits for those processes supports planning to avoid risks to property and infrastructure. Provisional stable top of slope and associated setbacks delineate the erosion hazard for confined watercourses and valley walls. Meander belts delineate the erosion hazard limits for unconfined watercourses. Together they represent a constraint to development that is typically integrated into the Natural Heritage System.

3.5.3.1 Meander Belt Width and Long-Term Stable Top of Slope

A meander belt is the space a watercourse currently occupies or can occupy within its floodplain and is the relevant erosion hazard for unconfined systems (i.e., when a watercourse is located within a discernable valley). Meander belt mapping has not been completed for any of the watercourses within the County, except within the City of Peterborough.

Where a watercourse is situated in proximity to a valley wall, then the watercourse is considered to be confined, or partially confined. In this case, long term stable top of slope setbacks are delineated with consideration of valley toe erosion due to river processes and slope stability.

The stable top of slope, or long-term stable top of slope is regulated to avoid hazards associated with slope instability, these are typically associated with valley systems, but unstable slopes can also exist in absence of associated riverine features. Kawartha Conservation provided “regulated slope” mapping that has metadata to identify he regulated features as erosion hazards. However, specific input to the regulated slope mapping (e.g., stable slope angles and allowances) are unknown. Figure 18 includes regulated slope mapping from Kawartha Conservation. It can be assumed that similar erosion hazards exist throughout the County that should be assessed and mapped.

3.5.4 Unstable Soils

Unstable soils include sensitive marine clays (e.g. Leda clays) and organic soils (OMNR 2001). When unstable soils are identified in an area, then the results of site specific studies for the basis for applying OMNR (2001) criteria to delineate the unstable soil hazard areas as a basis for defining the Regulation Limit. Geotechnical expertise can confirm the presence and hazards associated with unstable soils at the subwatershed or site scale.

3.5.4.1 Marine Clays

Sensitive marine clays are those that were deposited during the last glacial period in the Champlain Sea. When these clays are undisturbed, they can appear as solid and stable but when they are disturbed by excessive vibration or shock, or when they become saturated with water, then the clays can liquify (OMNR 2001). The triggers that can cause a disturbance may include natural occurrences (e.g., earthquake, thunder, heavy rainfall etc.) or human activity (e.g., blasting, heavy traffic). The resulting failures or earthflows can be sudden and catastrophic. OMNR (2001) suggests that planning authorities should be mindful of sensitive marine clays regardless of their location (i.e., not just along watercourses). Therefore, although soil mapping from LIO (2017) does not indicate that there are Leda or other sensitive marine clays in the Peterborough County watershed, the soil conditions should be reviewed for all development applications through site specific studies

3.5.4.2 Organic Soils

Organic soils and peat are formed by the decomposition of vegetative and organic materials into humus, a process known as humification (OMNR 2001). The process of humification releases humic acid into the ground water systems, creating a methane gas which is highly explosive (OMNR 2001). OMNR (2001) indicates that a soil is considered to be organic when the percentage of soil weight loss, when heated, is 5 to 80 per cent (OMNR 2001). This criterion results in a wide range of soils being classified as organic. The most common type of organic soil is peat which typically lacks structure, erodes easily and compresses. Review of LIO (2017) mapping suggests that alluvial and organic surficial deposits occur within the County (see Figure 12) and therefore should be evaluated in the future to determine if unstable soils are in the area.

3.5.5 Unstable Bedrock (Karst)

The Ontario Geological Survey (OGS) identified karst landscapes using field data and published reports (Brunton and Dodge, 2008). Karst landscapes are characterized by unique features formed through the chemical dissolution of sedimentary bedrock, such as carbonates (limestone and dolostone) and evaporites (gypsum and salt). These landscapes often include closed-surface depressions and underground drainage systems. Depending on the extent of karst development, they can feature caves, caverns, and sinkholes. Such landforms indicate areas that may be vulnerable and could pose challenges for urban development. Therefore, specific management practices may be required to address these challenges.

The karst mapping was published by OGS in 2008, and the data have been divided into three main categories, each of which are identified within the county in Figure 11 (Brunton and Dodge 2008):

- **Known Karst**: “Observed, measured field data or data from published reports. Key features include karren, cave types and associated precipitates, sinkholes, and disappearing streams.”
- **Inferred karst**: “Regions of carbonate bedrock units highlighted as most vulnerable or susceptible to karstification, where direct field observation has not been made by OGS staff or other sources. A natural extrapolation of the known karst areas for given rock units.”
- **Potential Karst**: “Areas of carbonate rock units identified as most susceptible to karst processes.”

3.6 Aquatic and Terrestrial Resources

3.6.1.1 Aquatic Resources

Aquatic resources within the County are comprised of an extensive network of rivers, streams, lakes, ponds, and wetlands that support many aquatic species and habitat types (Figure 28a to 28f). Watercourses include both permanent and intermittent features, and the majority (approximately 62%) have warmwater thermal regimes based on information available from Land Information Ontario (LIO). Cold and coolwater systems are also present to a lesser extent (comprising approximately 26% of mapped watercourse segments).

Located within Fisheries Management Zone 17 and overlapping with the jurisdictions of the Crowe Valley Conservation Authority (CVCA), Otonabee Conservation and Ganaraska Conservation, aquatic systems within the County contain a high diversity of fish species. In total, 69 different species were reported from background sources (e.g., Natural Heritage Information Centre [NHIC], Land Information Ontario [LIO], iNaturalist, Fisheries and Oceans Canada [DFO]). The County’s lakes are similar in fish community composition due to the presence of similar habitat types and their connectivity with the Trent-Severn Waterway (MNR 2009). The MNR has delineated ‘Fish Activity Areas’ throughout the County, including known spawning areas for a variety of species (Figure 28a to 28f).

Of the fish species reported from the County, three are considered SAR under the provincial *Endangered Species Act*, 2007 (ESA) and/or federal *Species at Risk Act* (SARA):

- Lake Sturgeon (Great Lakes - Upper St. Lawrence River population) (*Acipenser fulvescens* pop. 3) – Endangered,
- American Eel (*Anguilla rostrata*) – Endangered, and
- Northern Sunfish (*Lepomis peltastes*) – Special Concern

A list of all fish species reported for the County by background sources is provided in Appendix B.

3.6.1.2 Terrestrial Resources

Terrestrial resources within the County are comprised of valuable natural features including wetlands, woodlands, habitats for vegetation and wildlife (including SAR), and specific land areas designated for their unique natural features, ecological value, or scientific significance (i.e., ANSIs).

The County falls within two distinct ecoregions: Ecoregion 6E – Mixedwood Plains (54%) to the south, and Ecoregion 5E – Ontario Shield (46%) to the north (see Figure 24).

The following sections present a brief and high-level natural heritage characterization of the entire County; detailed information (where available) for each tertiary watershed is also presented further below in this report.

Wetlands

Coarse-level wetland mapping available from LIO (last updated in September 2025) delineates Provincially Significant Wetlands (PSWs), Evaluated Non-Significant Wetlands (non-PSW), and Unevaluated Wetlands (Figure 26). Within the Study Area, most wetlands mapped by the province are unevaluated and identified as swamp vegetation communities. According to LIO mapping, the overall wetland coverage for the County is approximately 862 km^2, or 20%. Table 19 summarizes the relative proportions of PSW, non-PSW, and Unevaluated Wetland.

The most current available wetlands mapping is shown in Figure 26. Notably, the vast majority of wetlands in the County remain unevaluated.

Table 19 Peterborough County Wetlands, Woodlands, and Areas of Natural and Scientific Interest (ANSIs)

Parameter	Value
Wetlands	
Provincially Significant Wetland	223 km^2 (5.3%)
Non-Provincially Significant Wetland	32 km^2 (0.7%)
Unevaluated Wetland	608 km^2 (14.4%)
Total Wetland Area	**862 km^2 (20%)**
Woodlands	
Total Wooded Area	2,229 km^2 (53%)
Areas of Natural and Scientific Interest (ANSIs)	
Provincially Significant ANSI (Life Science)	6
Regionally Significant ANSI (Life Science)	21
Provincially Significant ANSI (Earth Science)	14
Regionally Significant ANSI (Earth Science)	7
Total Number of Candidate and Confirmed ANSIs	48

Areas of Natural and Scientific Interest

There are also 48 Areas of Natural and Scientific Interest (ANSIs) in the County, as shown in Figure 25, as well as 6 provincial parks, including the very extensive Kawartha Highlands Signature Site Park. These ANSIs include a mix of provincially and regionally significant features, with some being life science and some being earth science features, as summarized in Table 19.

Woodlands

Coarse-level wooded area mapping available from LIO (last updated in March 2025) indicates that approximately 53% (or 2,229 km^2) of the County is comprised of woodlands (Figure 27). In accordance with the Natural Heritage Reference Manual, where woodland cover is between 31% and 60%, individual woodlands may be considered significant if they are 50 ha or greater (MNR 2010).

The northern portion of the County (e.g., the portion within Ecoregion 5E as shown on Figure 24) has large areas of contiguous woodland cover, while forested areas in the southern portion are smaller and more fragmented. More detailed review, verification and analysis of this woodlands mapping is anticipated as part of forthcoming NHS identification.

Vegetation

Over 1,000 species of vascular flora are known to occur in the County, with species comprised of a mixture of northern and southern species (Burke et al. 1999). Although reasonably current ecological land classification (ELC) mapping (as per Lee et al. 1998) is available for the subwatersheds in both Kawartha Conservation and Ganaraska Conservation's jurisdictions, most of the Study Area does not have current ELC mapping data. However, NHIC reports that at least three vegetation community types considered rare within the province have the potential to be present within the county:

- Dry Tallgrass Prairie Type (TPO1-1)
- Dry Black Oak-Pine Tallgrass Savannah Type (TPS1-2)
- Dry Bur Oak - Shagbark Hickory Tallgrass Woodland Type (TPW1-2)

SAR Vegetation

In total, seven vascular flora species and two lichen species designated as Threatened, Endangered, or Special Concern under the provincial ESA are also reported as potentially present within the County by NHIC (Table 20).

Table 20 Species at Risk Vegetation Species Reported from Peterborough County

Common Name	Scientific Name	S-Rank	ESA Status	SARA Status	Data Source	Habitat
Vascular Flora						
American Chestnut	*Castanea dentata*	S1S2	END	END	NHIC	Dry upland deciduous forests
Black Ash	*Fraxinus nigra*	S4	END	NS	NHIC	Swamps, floodplains, fens
Butternut	*Juglans cinerea*	S2?	END	END	NHIC	Deciduous forests
Crooked-stem Aster	*Symphyotrichum prenanthoides*	S2?	SC	SC	NHIC	Forest edges or openings, river or stream banks
Dense Blazing Star	*Liatris spicata*	S2	THR	THR	iNaturalist	Moist prairies, grassland savannahs
Eastern Prairie Fringed Orchid	*Platanthera leucophaea*	S2	END	END	iNaturalist	Wetlands, fens, swamps, tallgrass prairies
Ogden's Pondweed	*Potamogeton x ogdenii*	SNA	END	END	NHIC	Clear, slow-moving streams
Lichens						
Flooded Jellyskin	*Leptogium rivulare*	S3	NAR	SC	NHIC	Forested vernal pools
Pale-bellied Frost Lichen	*Physconia subpallida*	S3	END	END	NHIC	Bark of hardwood trees

Notes:
ESA – *Endangered Species Act*
SARA – *Species at Risk Act*
NHIC – Natural Heritage Information Centre
END – Endangered
THR – Threatened
SC – Special Concern
NAR – Not at Risk
SNA – Status Not Assessed

Wildlife

Wildlife atlas, NHIC, and iNaturalist records indicate a high diversity of wildlife species within the County. Background sources indicate that 251 bird species, 18 amphibian species (frogs, toads, salamanders), 17 reptile species (turtles, snakes, skinks), 54 mammal species, and over 450 insect species are known to occur (or have the potential to be present) within the Study Area. Full lists of all species reported from the County are provided in Appendix B.

SAR Wildlife

In total, 55 SAR listed as Threatened, Endangered, or Special Concern under the provincial ESA may occur within the County, as reported by NHIC, wildlife atlases, and iNaturalist. This includes 31 bird species, 7 reptile species, 9 mammal species, and 8 insect species (Table 21).

Species listed as Endangered or Threatened are protected under the ESA; however, species listed as Special Concern do not receive the same protections. Nonetheless, these species are important as they have the potential to be uplisted to Endangered or Threatened in the future and still represent species in decline.

Table 21 Species at Risk Wildlife Species Reported from Peterborough County

Common Name	Scientific Name	S-Rank	ESA Status	SARA Status	Data Source	Habitat
Birds						
Bank Swallow	*Riparia riparia*	S4B	THR	THR	NHIC, OBBA	Vertical faces in silt and sand deposits
Barn Swallow	*Hirundo rustica*	S4B	SC	SC	NHIC, OBBA	Buildings and open structures with ledges
Black Tern	*Chlidonias niger*	S3B, S4M	SC	NS	NHIC, OBBA	Shallow marshes
Bobolink	*Dolichonyx oryzivorus*	S4B	THR	THR	NHIC, OBBA	Grasslands
Canada Warbler	*Cardellina canadensis*	S5B	SC	THR	NHIC, OBBA	Deciduous swamps
Cerulean Warbler	*Setophaga cerulea*	S2B	THR	END	NHIC, OBBA	Mature deciduous swamps with open understories
Chimney Swift	*Chaetura pelagica*	S3B	THR	THR	NHIC, OBBA	Buildings with uncapped chimneys
Common Nighthawk	*Chordeiles minor*	S4B	SC	SC	NHIC, OBBA	Open gravel areas within limited ground vegetation
Eastern Meadowlark	*Sturnella magna*	S4B, S3N	THR	THR	NHIC, OBBA	Early successional grasslands and thickets
Eastern Whip-poor-will	*Antrostomus vociferus*	S4B	THR	THR	NHIC, OBBA	Savannahs and open forests
Eastern Wood-pewee	*Contopus virens*	S4B	SC	SC	NHIC, OBBA	Deciduous and mixed forests
Evening Grosbeak	*Coccothraustes vespertinus*	S4	SC	SC	NHIC, OBBA	Open mature mixed forests with firs
Golden Eagle	*Aquila chrysaetos*	S1B, S4N	END	NS	iNaturalist	Remote undisturbed areas, steep cliffs or riverbanks
Golden-winged Warbler	*Vermivora chrysoptera*	S3B	SC	THR	NHIC, OBBA	Recently disturbed areas surrounded by mature forest
Grasshopper Sparrow	*Ammodramus savannarum*	S4B	SC	SC	NHIC, OBBA	Grasslands
Henslow's Sparrow	*Ammodramus henslowii*	S1B	END	END	NHIC	Grasslands
Horned Grebe	*Podiceps auritus*	S1B, S3N, S4M	SC	NS	iNaturalist	Small ponds, marshes, shallow bays

Common Name	Scientific Name	S-Rank	ESA Status	SARA Status	Data Source	Habitat
King Rail	*Rallus elegans*	S1B	END	END	NHIC	Marshes with open water
Least Bittern	*Ixobrychus exilis*	S4B	THR	THR	NHIC, OBBA	Cattail marshes with open water and channels
Lesser Yellowlegs	*Tringa flavipes*	S3S4B,S5M	THR	THR	iNaturalist	Boreal wetlands
Loggerhead Shrike	*Lanius ludovicianus*	S1B	END	END	NHIC	Pastures or grasslands with scattered trees and shrubs
Louisiana Waterthrush	*Parkesia motacilla*	S2B	THR	THR	NHIC	Forested ravines with fast-flowing streams
Olive-sided Flycatcher	*Contopus cooperi*	S4B	SC	SC	NHIC, OBBA	Coniferous or mixed forest adjacent to wetlands or rivers
Peregrine Falcon	*Falco peregrinus*	S4	SC	NS	NHIC, OBBA	Steep cliffs close to large waterbodies
Red-headed Woodpecker	*Melanerpes erythrocephalus*	S3	END	END	NHIC, OBBA	Open forests and forest edges
Red-necked Phalarope	*Phalaropus lobatus*	S3B, S4M	SC	SC	iNaturalist	Coastal and inland marshes, shallow ponds
Rusty Blackbird	*Euphagus carolinus*	S4B, S3N	SC	SC	iNaturalist	Coniferous forests with nearby wetlands
Short-eared Owl	*Asio flammeus*	S4?B, S2S3N	THR	SC	iNaturalist	Grasslands, marshes, tundra
Wood Thrush	*Hylocichla mustelina*	S4B	SC	THR	NHIC, OBBA	Mature deciduous and mixed forests with dense understories
Yellow Rail	*Coturnicops noveboracensis*	S3B	SC	SC	iNaturalist	Shallow wetlands
Yellow-breasted Chat	*Icteria virens*	S1B	END	END	NHIC	Thickets and overgrown clearings
Reptiles and Amphibians						
Blanding's Turtle	*Emydoidea blandingii*	S3	THR	END	NHIC, ORAA	Large wetlands and shallow lakes
Common Five-lined Skink (Great Lakes/St. Lawrence population)	*Plestiodon fasciatus pop. 2*	S3	SC	SC	NHIC, ORAA	Rocky outcroppings in forest openings
Eastern Hog-nosed Snake	*Heterodon platirhinos*	S3	THR	THR	ORAA	Sandy, well-drained habitats
Eastern Milksnake	*Lampropeltis triangulum*	S4	NAR	SC	NHIC, ORAA	Rocky outcrops, fields, forest edges

Common Name	Scientific Name	S-Rank	ESA Status	SARA Status	Data Source	Habitat
Eastern Musk Turtle	*Sternotherus odoratus*	S3	SC	SC	NHIC, ORAA	Ponds, lakes, marshes, and slow-moving rivers
Northern Map Turtle	*Graptemys geographica*	S3	SC	SC	NHIC, ORAA	Rivers and lakeshores
Northern Ribbonsnake	*Thamnophis saurita*	S4	SC	SC	NHIC, ORAA	Marshes and streambanks
Snapping Turtle	*Chelydra serpentina*	S4	SC	SC	NHIC, ORAA	Wetlands, ponds, and shallow lakes
Western Chorus Frog - Great Lakes - St. Lawrence - Canadian Shield population	*Pseudacris maculata pop. 1*	S4	NAR	THR	NHIC, ORAA	Vernal pools, fishless ponds, flooded meadows and ditches
Mammals						
Eastern Red Bat	*Lasiurus borealis*	S4	END	NS	Ontario Mammals	Forested habitats
Eastern Small-footed Myotis	*Myotis leibii*	S2S3	END	NS	Humphrey 2017	Rocky outcrops, buildings, bridges
Eastern Wolf	*Canis sp. cf. lycaon*	S2	THR	THR	NHIC	Deciduous and mixed forest landscapes
Grey Fox	*Urocyon cinereoargenteus*	S1	THR	THR	Ontario Mammals	Deciduous forests and marshes
Hoary Bat	*Lasiurus cinereus*	S4	END	NS	Ontario Mammals	Forested habitats
Little Brown Myotis	*Myotis lucifugus*	S3	END	END	ECCC 2018	Forested habitats, buildings
Northern Myotis	*Myotis septentrionalis*	S3	END	END	ECCC 2018	Forested habitats
Silver-haired Bat	*Lasionycteris noctivagans*	S4	END	NS	Ontario Mammals	Forested habitats
Tri-colored Bat	*Perimyotis subflavus*	S3?	END	END	ECCC 2018	Forested habitats
Insects						
American Bumble Bee	*Bombus pensylvanicus*	S3S4	SC	SC	NHIC	Farmlands, meadows, grasslands
Gypsy Cuckoo Bumble Bee	*Bombus bohemicus*	S1S2	END	END	NHIC	Open meadows, agricultural and urban areas, boreal woodlands
Monarch	*Danaus plexippus*	S2N,S4B	SC	SC	OBA	Meadows with milkweed
Mottled Duskywing	*Erynnis martialis*	S2	END	END	OBA	Dry habitats with sparse vegetation
Nine-spotted Lady Beetle	*Coccinella novemnotata*	S1	END	END	NHIC	Habitat generalist
Transverse Lady Beetle	*Coccinella transversoguttata*	S1	END	SC	NHIC	Habitat generalist

Common Name	Scientific Name	S-Rank	ESA Status	SARA Status	Data Source	Habitat
West Virginia White	*Pieris virginiensis*	S3	SC	NS	NHIC	Moist deciduous woodlots
Yellow-banded Bumble Bee	*Bombus terricola*	S3S5	SC	SC	NHIC	Habitat generalist

Notes:
ESA – *Endangered Species Act;* SARA – *Species at Risk Act*
NHIC – Natural Heritage Information Centre; END – Endangered
THR – Threatened; SC – Special Concern
NAR – Not at Risk; NS – No Status
SNA – Status Not Assessed; OBBA – Ontario Breeding Bird Atlas
ORAA – Ontario Reptile and Amphibian Atlas; OBA – Ontario Butterfly Atlas

Significant Wildlife Habitat

In Ecoregion 6E, 38 SWH types have the potential to occur, while in Ecoregion 5E, 43 SWH types may be present. Of these, known records are limited to NHIC, which reports on only a few SWH types; however, based on NHIC records and LIO, the following SWH types are reported within the County:

- Colonially-nesting bird breeding habitat (including mixed wader nesting colonies and colonial waterbird nesting areas)
- Deer and moose winter congregation areas
- Savannah and tallgrass prairie rare vegetation communities

3.7 Tertiary Watersheds – Summary Characterization

Sections 4 through 8 (inclusive) provide a detailed overview of watershed characterization at a tertiary scale based on available data, including many technical components and interpretations. To better enable a broader understanding of the results of the watershed characterization, Table 22 provides a high-level summary of the key findings, for which more detail can be found in Sections 7 through 11.

Table 22 Summary Table for the Characterization for Tertiary Watersheds in the County

	Description	Key Highlights				
		Otonabee Tertiary Watershed	Trent River - Crowe River Tertiary Watershed	Gull River Tertiary Watershed	Kawartha Lakes Tertiary Watershed	North Lake Ontario Shoreline Watershed
Climate	Climate data, with streamflow data, are critical to validating and calibrating hydrologic and hydrogeologic/groundwater system modelling. By understanding long term data and trends the surface and subsurface water systems can be characterized. Climate data collected within the last 30 years are considered to accurately represent current conditions with a minimum of 20 years of recent precipitation data required for continuous simulation and frequency analysis purposes. Reliable, long-term monitoring is critical for accurate watershed modeling, flood forecasting, and planning for future development.	• The Otonabee River watershed contains the highest number of climate monitoring stations in the county (21). • Gaps in spatial coverage, especially in the Hastings Lock 18 Dam – Trent River and Cavan Creek subwatersheds. • Only a few stations have long-term records (>20 years), needed for frequency analysis and model calibration. • Combined climate and flow data near the City of Peterborough and Norwood can support strong hydrologic assessments.	• The watershed does not contain any publicly available climate stations.	• There is a single historical climate monitoring station located in the Goose Lake – Burnt River quaternary watershed operational between 1897 and 1950. These data are out of date and are not suitable for current conditions characterization or modeling purposes.	• There are seven historical climate monitoring station located in the watershed, none of which were operational post 1994. These data are out of date and are not suitable for current conditions characterization or modeling purposes.	• The watershed does not contain any publicly available climate stations.
Physiography and Slopes	Physiography refers to the earth's surface features and landforms. Within the county these features have been heavily influenced by historic glacial activity. Slopes is a critical parameter in hydrological analysis as it influences surface water conveyance and infiltration. Land use planning must consider slope conditions to minimize soil loss and maintain slope stability.	• The Otonabee River Tertiary Watershed encompasses three distinct physiographic regions: the Peterborough Drumlin Field, the Oak Ridges Moraine, and the Dummer Moraines. • The watershed features a gently rolling terrain shaped by glacial activity, including drumlins, till plains, and outwash deposits. • 46% of the watershed has a moderate slope and 52% has a gentle slope.	• The Trent River – Crowe River Tertiary Watershed encompasses five physiographic regions: the Algonquin Highlands, the Dummer Moraines, the Georgian Bay Fringe, the Iroquois Plain, and the Peterborough Drumlin Field. • Chandos Lake – Crowe River and Paudash Lake Dam – Crowe River are entirely situated within the Algonquin Highlands region. • 50% of the watershed has a moderate slope and 46% has a gentle slope.	• The Gull River Tertiary Watershed spans three physiographic regions: the Algonquin Highlands, the Dummer Moraines, and the Georgian Bay Fringe. The watershed is predominantly within the Georgian Bay Fringe, with smaller areas extending into the Algonquin Highlands and Dummer Moraines. • 57% of the watershed has a moderate slope and 38% has a gentle slope.	• The Kawartha Lakes Tertiary Watershed encompasses four physiographic regions: the Algonquin Highlands, Dummer Moraines, Peterborough Drumlin Field, and Georgian Bay Fringe, with the latter dominating the watershed and covering approximately 55% of its area. • 50% of the watershed has a moderate slope and 45% has a gentle slope.	• The physiography within the North Lake Ontario Shoreline Tertiary Watershed is entirely composed of the Oak Ridge Moraines physiographic region. • 68% of the watershed has a moderate slope and 22% has a gentle slope.
Surficial Geology	Surficial geology pertains to the unconsolidated geological materials that lie above the bedrock. The composition of this material affects stormwater management, infiltration potential, and erosion control.	• The surficial geology of the Otonabee River Tertiary Watershed consists of 13 distinct geologic units (1, 3, 5b, 5c, 5d, 6, 7, 8a, 9c, 12, 17, 19, and 20).	• The surficial geology of the Otonabee River Tertiary Watershed consists of 13 distinct geologic units (1, 2, 3, 5a, 5b, 5c, 6, 7, 9c, and 20).	• The surficial geology of the Gull River Tertiary Watershed consists of 10 distinct geologic units (1, 2, 3, 4, 6, 7, 8a, 9c, 19, and 20).	• The surficial geology of the Kawartha Lakes Tertiary Watershed consists of 13 distinct geologic units (1, 2, 3, 4, 5a, 5b, 5c, 6, 7, 8a, 9c, 19, and 20).	• The surficial geology of the North Lake Ontario Shoreline Tertiary Watershed consists of 8 distinct geologic units (5b, 6, 7, 8a, 9c, 12, 17, and 19).

	Description	Key Highlights				
		Otonabee Tertiary Watershed	Trent River - Crowe River Tertiary Watershed	Gull River Tertiary Watershed	Kawartha Lakes Tertiary Watershed	North Lake Ontario Shoreline Watershed
	Understanding surface materials is critical for siting infrastructure and natural heritage planning.[1]					
Bedrock Geology and Bedrock Topography	Bedrock geology and topography refers to composition and morphology of the bedrock. The underlying bedrock influences groundwater movement, aggregate resources, and surface water features. Shallow bedrock limits infiltration and can affect septic system performance. Bedrock exposure may increase the risk of contamination to aquifers where overburden is thin.	• The bedrock surface generally dips towards the south.				• The bedrock surface generally dips towards the southeast
		• The watershed is primarily comprised of Paleozoic sedimentary rocks (Unit 54a) and clastic metasedimentary rocks (Unit 45). Of these, Paleozoic sedimentary rocks (Unit 54a) dominate the watershed, forming the majority of its subsurface composition. • The elevation of the bedrock surface approximately ranges from over 270 masl in the north and northwest (near the Kawartha Lakes Tertiary Watershed boundary) to 150 masl near the southern boundary.	• The watershed is primarily comprised of seven geologic units: 44 to 49 and 54a. Of these, Paleozoic sedimentary rocks (Unit 54a) dominate the watershed, forming the majority of its subsurface composition. • The elevation of the bedrock surface approximately ranges from over 370 masl in the north (near Silent Lake Provincial Park) to 165 masl near the southern boundary (within the quarry pit near Preneveau).	• The watershed is primarily comprised of seven distinct geological units: 44 to 49 and 54a. Of these, Unit 46 (Carbonate metasedimentary rocks) dominates the watershed, forming the majority of its subsurface composition. • The elevation of the bedrock surface approximately ranges from over 376 masl in the northeastern part of the Gull River Tertiary watershed to 275 masl near the northwestern and southern parts of the Gull River Tertiary watershed.	• The watershed is primarily comprised of seven distinct geological units: 44 to 49 and 54a. • The elevation of the bedrock surface approximately ranges from over 395 masl in the northeastern part of the watershed to 240 masl near the southern boundary. • Lower bedrock surface elevations have been documented across the central to southern regions of the watershed, associated with the regional lake systems.	• The watershed is primarily comprised of Paleozoic sedimentary rocks (Unit 54a). • The elevation of the bedrock surface approximately ranges from over 162 masl in the southeast of the North Lake Ontario Shoreline Tertiary Watershed (near the County of Northumberland boundary) to 183 masl near the northwest and western boundary (approaching the Municipality of Durham).
Soils	Soil type affects stormwater infiltration, runoff, and erosion potential. Compacted or fine-textured soils may require enhanced drainage or the implementation of low-impact development techniques. Protecting organic soils and wetlands is important for maintaining water quality, water retention and infiltration.	• The soil drainage potential across the watershed is predominantly High (61%). • The predominant soil type Otonabee Loam (a diamicton soil, 29%) associated with the Peterborough Drumlin Field's compact glacial till.	• The soil drainage potential across the watershed is predominantly High (70%). • There are many different soils within this watershed, the dominant two are Chandos Loamy Sand (11%) and Dummer Loam (9%).	• The soil drainage potential across the watershed is predominantly High (81%). • The predominant soil type is Tweed Sandy Loam (44%).	• The soil drainage potential across the watershed is predominantly High (69%). • There are many different soils within this watershed, the dominant two are Monteagle Sandy Loam (11%) and Tweed Sandy Loam (8%).	• The soil drainage potential across the watershed is entirely High (100%). • There are two dominant soil types within this watershed, Pontypool Gravelly Sand (51%) and Pontypool Sand (40%).
Land Use	Land use is generally characterized as rural, agricultural, natural, or urban land uses. Urbanization increases impervious surfaces, leading to higher runoff and degraded water quality. Agricultural practices can contribute to nutrient loading and increased watercourse sedimentation. Land use changes can significantly impact hydrologic functions and natural features.	• The predominant land use in with watershed is rural development (38%) followed by agricultural use (24%). • This watershed contains the City of Peterborough which represents most of the urban residential land use within the watershed (8%). • Lakefield, Millbrook, and Norwood are all located within this watershed and have been identified as	• The predominant land use in with watershed is rural development (52%), open space (20%), and waterbodies (12%). • Within the watershed urban residential land use and urban development represent 4% and 1% respectively. • Havelock is located within this watershed and has been	• The predominant land use in with watershed is rural development (59%), open space (29%), and waterbodies (6%). • Within the watershed urban residential land use and urban development represent 2% and <1% respectively. • There are no future growth areas within this watershed per Hemson (2022).	• The predominant land use in with watershed is rural development (47%), open space (26%), and waterbodies (14%). • Within the watershed urban residential land use and urban development represent 3% and <1% respectively. • Lakefield is located within this watershed and has been identified as future growth areas by Hemson (2022).	• The predominant land use in with watershed is open space (98%). • Within the watershed urban residential land use and urban development are not present in the watershed. • There are no future growth areas within this watershed per Hemson (2022).

	Description	Key Highlights				
		Otonabee Tertiary Watershed	Trent River - Crowe River Tertiary Watershed	Gull River Tertiary Watershed	Kawartha Lakes Tertiary Watershed	North Lake Ontario Shoreline Watershed
		future growth areas by Hemson (2022).	identified as future growth areas by Hemson (2022).			
Surface Drainage	Surface drainage is defined by a network of creeks, wetlands, and small tributaries that direct water toward the larger Rivers and Lakes. The surface drainage system is influenced naturally by landform and soil characteristics and anthropogenically with most runoff flowing through defined channels and low-lying areas. Alteration of natural drainage (e.g., through development or ditching) can increase flood risk and degrade aquatic habitats. Preserving headwater drainage features is important for maintaining baseflow and water quality. Poorly drained areas may require stormwater management solutions to prevent standing water and erosion.	• No erosion inventory data within this watershed (see Otonabee Tertiary Watershed for exception). • No HDF data were available. • There are no municipal drains within this watershed.				
		• The Otonabee River Tertiary watershed represents 32% of the entire County. • Drainage density within the quaternary watersheds ranges from 1.05 to 1.77 km/km^2. Shoreline perimeter length ranges from 44 to 162 km. • In 1983 an erosion inventory was completed for Baxter Creek, Cavan Creek, and Otonabee River, that while out of date can help inform impact assessments related to changes within their watersheds. • Flow paths have been altered in association with agricultural processes and flow regimes have been altered by damming and lock construction.	• The Trent River – Crowe River Tertiary watershed represents 17% of the entire County. • Drainage density within the quaternary watersheds ranges from 1.00 to 1.89 km/km^2. Shoreline perimeter length ranges from 13 to 751 km. • There is minimal evidence of flow paths alteration primarily evident in the south. • Damming and lock construction impacts all the quaternary watershed directly or indirectly.	• The Gull River Tertiary watershed represents 3% of the entire County. • Drainage density within the quaternary watersheds ranges from 1.30 to 2.28 km/km^2. Shoreline perimeter length ranges from 20 to 144 km. • There is very limited evidence of flow path alteration only associated with road drainage in the watershed. • Flow regimes have been altered by damming and lock construction beyond the County boundary further downstream.	• The Kawartha Lakes Tertiary watershed represents 48% of the entire County. • Drainage density within the quaternary watersheds ranges from 0.60 to 1.81 km/km^2. Shoreline perimeter length ranges from 1 to 1121 km. • There is minimal evidence of flow paths alteration primarily evident in the southwestern portion of the watershed associated with agriculture. • Flow regimes have been altered by damming and lock construction.	• The Kawartha Lakes Tertiary watershed represents <1% of the entire County. • Drainage density within the quaternary watersheds is 0.60 km/km^2. Shoreline perimeter length is 1 km. • There is no evidence of flow path alteration evident in the watershed. • Flow regimes appear to have not been altered by damming and lock construction.
Streamflow	Stream flow data, with climate data, are critical to validating and calibrating hydrologic and hydrogeologic/groundwater system modelling. By understanding long term data and trends the surface and subsurface water systems can be characterized. Streamflow data collected within the last 30 years are considered to accurately represent current conditions. Reliable, long-term monitoring is critical for accurate watershed modeling, flood forecasting, and planning for future development.	• Has the most stream gauging station within the County. • There are twelve stream gauging stations distributed across most of the watershed's quaternary sub-areas. • Of those 12 only 8 are currently active, and only 4 have data for the last 20 years.	• There is one stream gauging station located at Crowe River near Glen Alda. • The station has a period of record from 1968 to 2025.	• There is no stream gauging station within the watershed.	• There are two historical stream gauging stations within the watershed. Monitoring was discontinued for both station in 1993. • These data are out of date and are not suitable for current conditions characterization or modeling purposes.	• There is no stream gauging station within the watershed.

<table>
<tr><th rowspan="2"></th><th rowspan="2">Description</th><th colspan="5">Key Highlights</th></tr>
<tr><th>Otonabee Tertiary Watershed</th><th>Trent River - Crowe River Tertiary Watershed</th><th>Gull River Tertiary Watershed</th><th>Kawartha Lakes Tertiary Watershed</th><th>North Lake Ontario Shoreline Watershed</th></tr>
<tr><td rowspan="2">Hydrogeology</td><td rowspan="2">Hydrogeology is the characterization of groundwater flow. Understanding groundwater flow properties and functions is essential to establish a basis for how best to mitigate potential impacts from future land use changes. Alteration to the hydrogeologic system can impact groundwater-surface water interactions and the interrelationships between the hydrogeologic conditions, the ecosystem, and groundwater use.</td><td colspan="5">• The groundwater discharge areas within the watershed are well-aligned with cold streams, water courses and wetlands.
• Groundwater usage
• IPZ – only within one or two Tertiary watershed</td></tr>
<tr><td>• Four hydrostratigraphic units are present as an aquifer that overlies the bedrock and include: Oak Ridges Aquifer Complex, Inter-Newmarket Sediment, Thorncliffe Formation, and Scarborough Formation.
• Among the six Quaternary Watersheds, the mean annual groundwater recharge rates range from 319 mm to 446 mm per year, indicating moderate levels of groundwater replenishment.
• Highest mean recharge is in the Ouse River Quaternary Watershed (446 mm/year).
• Groundwater use is dominated by private wells, with limited municipal supply. Most wells are completed in Quaternary deposits, though bedrock aquifers remain important in certain areas, reflecting both geological conditions and rural water supply needs.
• The Highly Vulnerable Aquifers (HVAs) encompass a substantial portion of the northern, central, and eastern regions of the Otonabee River Tertiary Watershed, with the greatest concentration located within the Ouse River Quaternary Watershed.
• The highest concentration of Significant Groundwater Recharge Areas are primarily associated with sandy and gravelly soils, with the highest concentrations occurring in the central-southwestern and</td><td>• The Oak Ridges Aquifer Complex and deeper aquifer units like the Thorncliffe Formation and Sunnybrook Drift appear only in select locations, most prominently at Crowe Bay Dam — Trent River, indicating localized hydrogeological complexity and potential aquifer development.
• Three of the seven quaternary watersheds do not have available groundwater recharge rate data. For the remaining four quaternary watersheds with data the mean annual groundwater recharge rates range from 438 mm to 559 mm per year, indicating moderate to high levels of groundwater replenishment.
• Groundwater use in watershed is dominated by private wells, with very limited municipal supply (6 wells). There are at most six municipal wells in any of the quaternary watersheds, compared with hundreds of private wells.
• The Highly Vulnerable Aquifers encompass most of the watershed, underscoring the critical importance of regulation and protection.
• The highest concentration Significant Groundwater Recharge Areas are primarily associated with sandy and gravelly soils, with the highest concentrations across the southern extent of the watershed.</td><td>• All three Quaternary Watersheds contain glaciolacustrine, fluvial, or recent deposits, while the Upper Newmarket Till and Inter-Newmarket Sediment are limited to the Birchbark Lake–Irondale River watershed. Shallow and deeper aquifer units, including the Oak Ridges Aquifer Complex, Thorncliffe Formation, and Scarborough Drift, are largely absent across the tertiary watershed.
• Goose Lake – Burnt River and Birchbark Lake – Irondale River Quaternary Watersheds have the highest mean annual groundwater recharge rates of 458 mm/year and 456 mm/year respectively, indicating moderate variability across the tertiary watershed.
• Groundwater use within the watershed is almost entirely private wells, with no municipal wells recorded. About 90% of wells are completed in bedrock aquifers and only minor use of Quaternary deposits.
• The Gull River Tertiary watershed is largely underlain by designated Highly Vulnerable Aquifers.
• The highest concentration of Significant Groundwater Recharge Areas predominantly occur in the north to and northwestern portions of the watershed, illustrating a strong hydrogeological linkage between SGRAs and</td><td>• Most Quaternary watersheds contain glaciolacustrine, fluvial, or recent deposits and Upper Newmarket Till, while Halton Till and the Oak Ridges Aquifer Complex are largely absent, appearing only in the Omemee Dam–Pigeon River watershed. Deeper aquifers like the Thorncliffe Formation are generally widespread, though absent in the Bobcaygeon River watershed, and the Scarborough Formation occurs only in select areas, indicating localized hydrogeological variability and potential aquifer development zones.
• Mean annual groundwater recharge rates across the nine Quaternary watersheds range between 375 mm/year to 560 mm/year, with Eels Creek exhibiting the highest rate at 560 mm/year. Overall, the watersheds display a combination of moderate to high recharge conditions.
• Groundwater use in the watershed is almost entirely private wells, with municipal wells present only in limited locations. 85% of wells tap bedrock aquifers, while Quaternary deposits account for a small fraction, highlighting a strong regional reliance on bedrock groundwater.
• The watershed is largely underlain by designated HVAs.
• The distribution of Significant Groundwater Recharge Areas</td><td>• Nine of the ten hydrostratigraphic units occur in the watershed, with only Halton Till absent. Shallow, intermediate, and deeper aquifers—including the Oak Ridges Aquifer Complex, Inter-Newmarket Till, Thorncliffe Formation, and Scarborough Drift—are present throughout the watershed.
• The mean annual groundwater recharge rate of 582 mm/year, reflecting a moderate level of recharge primarily driven by the presence of coarse-grained sediments and elevated topography.
• Groundwater use in the watershed is minimal and entirely reliant on private wells, primarily drawing from shallow Quaternary aquifers, with bedrock aquifers playing a minor role.
• The watershed is largely underlain by designated HVAs and is mostly designated as Significant Groundwater Recharge Areas.
• The predominance of sandy and gravelly soils has resulted in most of the watershed being located within SGRAs.
• There are no IPZs located within the watershed.</td></tr>
</table>

	Description	Key Highlights				
		Otonabee Tertiary Watershed	Trent River - Crowe River Tertiary Watershed	Gull River Tertiary Watershed	Kawartha Lakes Tertiary Watershed	North Lake Ontario Shoreline Watershed
		southeastern portions of the watershed. • Three municipal surface water intakes are located within the Otonabee River Tertiary Watershed, with associated Intake Protection Zones extending along the Otonabee and Trent Rivers around Lakefield, Peterborough, and Hastings, encompassing connected water bodies and adjacent lands.	• There are no municipal surface water intakes located within the watershed.	wetlands within the watershed. • The Intake Protection Zones within the watershed are situated at the Town of Kinmount, where the Burnt River passes through the County of Haliburton into the northern boundary of the County to protect the municipal water intake at the Town of Kinmount.	within the watershed is dispersed across the region. • The Intake Protection Zones are centralized around Lakefield and the connected water bodies upstream, as well as portions of the river corridor running south through Peterborough.	
Water Quality	Water quality is determined by comparing set parameters measured from a water body or groundwater well with set thresholds or standards. These parameters can indicate the health of streams, lakes, and groundwater aquifers, which support ecosystems, recreation, and local water needs. Maintaining and improving water quality is important to protect ecosystems, human health, and water uses.	• According to the 2023 Watershed Report Card, the Otonabee Watershed received an overall grade of B, reflecting generally good surface water quality conditions. • Surface water quality is monitored at 20 locations in the watershed, with most sites part of the Provincial Water Quality Monitoring Network. • Groundwater monitoring results from 2017 to 2021 indicated that concentrations of key parameters remained within the acceptable limits established under the Ontario Drinking Water Quality Standards and the Canadian Water Quality Guidelines.	• According to the 2023 Watershed Report Card, the Trent River – Crowe River Watershed received an overall grade of A, indicating excellent surface water quality. • Groundwater monitoring results from 2017 to 2021 indicated that concentrations of key parameters remained within the acceptable limits established under the Ontario Drinking Water Quality Standards and the Canadian Water Quality Guidelines.	• The Gull River Tertiary Watershed in Peterborough County is not regulated by a Conservation Authority. Therefore, groundwater and surface water quality data are not available.	• This tertiary watershed is divided into Otonabee Conservation jurisdiction, Kawartha Conservation jurisdiction, and land not regulated by a Conservation Authority. Therefore, groundwater and surface water quality data are not available for the unregulated land. • According to the 2023 Watershed Report Cards, Otonabee Conservation received an overall grade of B, reflecting generally good surface water quality, while Kawartha Conservation received a grade of C, indicating fair water quality. Between 2017 and 2021, concentrations of selected groundwater parameters at the study sites remained within the limits established by the Ontario Drinking Water Quality Standards and the Canadian Water Quality Guidelines.	• According to the 2023 Watershed Report Card (Ganaraska Conservation 2023), surface water quality in the region was graded C (fair). • Groundwater quality remained within provincial and federal standards for nitrate and chloride between 2017 and 2021.

	Description	Key Highlights				
		Otonabee Tertiary Watershed	Trent River - Crowe River Tertiary Watershed	Gull River Tertiary Watershed	Kawartha Lakes Tertiary Watershed	North Lake Ontario Shoreline Watershed
Natural Hazards	These hazards pose physical risks and limit safe development generally near watercourses and valleys. Within the County three types of natural hazards were identified: Karst features: Landscapes with or prone to sinkholes, underground drainage, and cavities formed in carbonate rock that are susceptible to collapse. Floodplains: Areas prone to flooding during major storm events, Erosion hazards: Include unstable regulated top of slope areas and meander belts, These hazards present significant risk to development.	• Erosion hazard mapping was not available and is assumed to have not been completed for the watercourses of the watershed.				
		• Karst: • Inian River, Lock 19 – Otonabee River, and Ouse River watersheds have known karst (1% or less) and potential karst (23%, 15%, and 53% respectively). • Ouse River is the only watershed with inferred karst (1%). • Floodplain area had been partially mapped with the largest area being 34 km² mapped in the Otonabee River Outlet watershed.	• Karst: • Known karst: Crowe Bay Dam – Trent River (6%), Crowe Lake – Crowe River (4%), and Round Lake – North River Outlet (1%). • Inferred karst: all but three watersheds have 1% or more. • Potential karst: Crowe Bay Dam – Trent River (75%), Crowe Lake – Crowe River (48%), and Round Lake – North River Outlet (39%). • Floodplain area had been partially mapped with focus on dammed watercourses. Crowe Bay Dam – Trent River is the only watershed with no floodplain mapping.	• Karst: • Known karst: Goose Lake – Burnt River (1%). • Inferred karst: Goose Lake – Burnt River (<1%). • Potential karst: Goose Lake – Burnt River (<1%). • Floodplain area has not been mapped within this watershed.	• Karst: • Known karst: Nogies Creek (9%), Pigeon Lake–Gannon Narrows (8%), and Burleigh Falls Dam–Lower Buckhorn Lake (1%). • Inferred karst: all but Omemee Dam – Pigeon River. • Potential karst: all but Omemee Dam – Pigeon River. • Floodplain mapping has been carried out for Nogies Creek and Miskwaa Ziibi River area had been partially mapped with focus on dammed watercourses.	• Karst: there is no karst hazard identified within the watershed. • Floodplain area has not been mapped within this watershed.
Aquatic and Terrestrial Features	Aquatic resources within the County are comprised of an extensive network of rivers, streams, lakes, ponds, and wetlands that support many aquatic species and habitat types. Terrestrial resources within the County are comprised of valuable natural features including wetlands, woodlands, habitats for vegetation and wildlife (including SAR), and specific land areas designated for their unique natural features, ecological value, or scientific significance (i.e., ANSIs).	• Watercourses include both permanent and intermittent features, and the majority (approximately 62%) have warmwater thermal regimes and cold and cool water systems are also present to a lesser extent (comprising approximately 26%). • There are three SAR fish species identified within the County: Lake Sturgeon (Great Lakes - Upper St. Lawrence River population) (*Acipenser fulvescens* pop. 3) – Endangered, American Eel (*Anguilla rostrata*) – Endangered, and Northern Sunfish (*Lepomis peltastes*) – Special Concern. • The County falls within two distinct ecoregions: Ecoregion 6E – Mixedwood Plains (54%) to the south, and Ecoregion 5E – Ontario Shield (46%) to the north. • There are seven vascular flora species, two lichen species, and 55 wildlife species designated as Threatened, Endangered, or Special Concern under the provincial ESA within the county.				
		• Mapped wetlands within the watershed: 307 km² (23%). • Mapped woodlands within the watershed: 397 km² (29%). • There are 28 candidate and confirmed ANSIs within the watershed.	• Mapped wetlands within the watershed: 307 km² (21%). • Mapped woodlands within the watershed: 397 km² (65%). • There are 5 candidate and confirmed ANSIs within the watershed.	• Mapped wetlands within the watershed: 45 km² (32%). • Mapped woodlands within the watershed: 110 km² (77%). • There are no candidate or confirmed ANSIs within the watershed.	• Mapped wetlands within the watershed: 361 km² (18%). • Mapped woodlands within the watershed: 1259 km² (63%). • There are 14 candidate and confirmed ANSIs within the watershed.	• Mapped wetlands within the watershed: 0.2 km² (0.3%). • Mapped woodlands within the watershed: 6.07 km² (94%). • There is one candidate or confirmed ANSI within the watershed.

4 Otonabee River Tertiary Watershed Characterization

4.1 Physical Environment

4.1.1 Climate

The existing and historical climate stations within the Otonabee River tertiary watershed have been summarized at the quaternary scale to illustrate spatial coverage across the broader tertiary area, as shown in Figure 7. Table 23 provides additional details about each station, including period of record, time interval, and data type. Climate stations managed by local municipalities were not made available for this study; if present, then these may provide additional information relating to historical climate data across the watershed. Climate gauge data were only provided by Kawartha Conservation in shapefile format; however, it does not overlap with the Otonabee River watershed and lacks the key attributes presented in Table 23.The Otonabee River watershed contains the highest number of weather stations within the County. As illustrated in Figure 7, the climate monitoring network includes twenty-one (21) stations distributed across five (5) of the six (6) quaternary watersheds within the Otonabee River tertiary system. The Hastings Lock 18 Dam – Trent River quaternary watershed is the only watershed currently lacking a climate station within its boundaries. The portion of Hastings Lock 18 Dam – Trent River quaternary watershed within the County is comprised largely of Rice Lake and located at the edge of the southern boundary of the County. The closest and most recent climate station would be from Ouse River Northwood (Station ID: 6165715).

The stations vary widely in terms of the period of record, with some providing historical data as far back as the mid-1800s, while others continue to operate and collect data up to the present day. Based on the current dataset, only three stations remain active and are reporting data through 2025. These are PETERBOROUGH A (Station ID: 6166415) and TAPLEY (Station ID: 6168525) in the Cavan Creek watershed, and PETERBOROUGH TRENTU FARM (Station ID: 6166457) in the Lock 19 – Otonabee River watershed. The stations are all located at the west side of the tertiary watershed leaving a data gap for active climate stations on the east side. These stations provide hourly data, offering high-resolution temporal information that supports detailed hydrologic analysis.

For continuous simulation and frequency analysis purposes, six (6) of the fourteen (14) stations with rainfall records meet or exceed the 20-year threshold, however, only two (2) of the six (6) contain data from the last 30 years. These two stations are TAPLEY (Station ID: 6168525) and PETERBOROUGH A (Station ID: 6166415) in the Cavan Creek watershed.

The Peterborough A climate station provides the longest term and most current climate data for Peterborough County. This climate data provides an annual precipitation of 874.1 mm/ year based on data from 1969-2025. This climate station is located in the southwest end of the Otonabee Tertiary Watershed and there may be variability within this range throughout the watershed.

Table 23 Climate Monitoring Gauges and Sources within Otonabee River Watershed

Quaternary Watershed	Source	Station Name	Station ID	Time interval	Period of Record	Years of Data	Data Type	Lat	Long	Status
Cavan Creek	Environment Canada	IDA	6153678	Daily	1967-1969	2	Precipitation	44.25	-78.433	Inactive
	Environment Canada	PETERBOROUGH A	6166415	Hourly	2010-2025	10	Temperature, Precipitation	44.23	-78.363	Active
	Environment Canada	TAPLEY	6168525	Daily	2005-2025	10	Precipitation	44.171	-78.501	Active
Indian River	Environment Canada	JERMYN	6163872	Daily	1895-1905	4	Precipitation	44.317	-78.167	Inactive
	Environment Canada	WARSAW	616RKR0	Daily	1991-2008	105	Precipitation	44.463	-78.13	Inactive
Lock 19 - Otonabee River	Environment Canada	OTONABEE	6165880	Daily	1895-1911	16	Precipitation	44.333	-78.3	Inactive
	Environment Canada	PETERBOROUGH CHEX	6166425	Daily	1960-1961	104	Precipitation, Temperature	44.333	-78.3	Inactive
	Environment Canada	PETERBOROUGH DOBBIN TS	6166428	Daily	1965-1994	1	Precipitation, Temperature	44.317	-78.4	Inactive
	Environment Canada	PETERBOROUGH ONT HYDRO	6166443	Daily	1949-1965	36	Precipitation, Temperature	44.333	-78.317	Inactive
	Environment Canada	PETERBOROUGH TRENT U	6166455	Daily	1968-2012	15	Precipitation, Temperature	44.35	-78.3	Inactive
	Environment Canada	PETERBOROUGH TRENT U	6166456	Daily	2005-2023	6	Temperature	44.35	-78.3	Inactive
	Environment Canada	PETERBOROUGH TRENTU FARM	6166457	Hourly	2022-2025	1	Temperature, Precipitation	44.354	-78.278	Active
Otonabee River Outlet	Environment Canada	MILLBROOK	6155154	Daily	1975-1985	29	Precipitation	44.15	-78.483	Inactive
	Environment Canada	PETERBOROUGH	6166416	Daily	1866-1970	16	Precipitation, Temperature	44.283	-78.317	Inactive
	Environment Canada	PETERBOROUGH	616I002	Hourly	1995-1996	29	Temperature, Precipitation	44.283	-78.317	Inactive
	Environment Canada	PETERBOROUGH A	6166418	Hourly	1969-2005	10	Temperature, Precipitation	44.233	-78.367	Inactive

Quaternary Watershed	Source	Station Name	Station ID	Time interval	Period of Record	Years of Data	Data Type	Lat	Long	Status
	Environment Canada	PETERBOROUGH AWOS	6166420	Hourly	2004-2010	44	Temperature	44.233	-78.367	Inactive
	Environment Canada	PETERBOROUGH STP	6166450	Daily	1964-1993	18	Precipitation, Temperature	44.283	-78.317	Inactive
	Environment Canada	PETERBOROUGH TORRANCE	6166452	Daily	1990-2000	20	Precipitation, Temperature	44.233	-78.317	Inactive
Ouse River	Environment Canada	NORWOOD	6165715	Daily	1998-2002	17	Precipitation, Temperature	44.35	-78	Inactive
	Environment Canada	NORWOOD	6165716	Daily	1875-1980	3	Precipitation, Temperature	44.383	-77.967	Inactive

Map 5 of the *Conceptual Water Budget – Trent River Watershed* Report demonstrated an annual precipitation range within the Otonabee River Tertiary Watershed of 797-961 mm/year based on data from 2006 and earlier (2007). Higher annual precipitation is located at the north and southwest areas and lower annual precipitation is located in the central and east areas of the tertiary watershed. This range is consistent with the annual precipitation value provided from the Peterborough A climate station.

4.1.2 Physiography and Slopes

The physiographic regions within the Otonabee River Tertiary Watershed directly result from the deposition and erosion during glacial and post-glacial events According to Chapman and Putnam (1984), the watershed encompasses three distinct physiographic regions: the Peterborough Drumlin Field, the Oak Ridges Moraine, and the Dummer Moraines. As shown in Table 24, the Peterborough Drumlin Field is the dominant physiographic region across all the quaternary watersheds, except for the Ouse River. The Ouse River displays a mixed composition, approximately 35% in the Peterborough Drumlin Field and 65% in the Dummer Moraines. The Otonabee River outlet is primarily composed of the Peterborough Drumlin Field (95%), with a smaller portion (5%) in the Oak Ridges Moraine. No other watershed shows coverage within the Oak Ridges Moraine, making the Otonabee River outlet unique in this regard. Cavan Creek and Hastings are the only quaternary watersheds entirely located within the Peterborough Drumlin Field. A summary of the physiographic regions within each quaternary watershed is shown in Figure 8 and Table 24.

Table 24 Physiographic Regions within the Otonabee River Watershed

Quaternary Watershed	Area of Quaternary Watershed (km^2)	Proportion within Tertiary Watershed (%)	Physiography Region (%)		
			Peterborough Drumlin Field	Dummer Moraines	Oak Ridges Moraine
Cavan Creek	116	9	100	-	<1
Hastings Lock 18 Dam - Trent River	138	10	100	-	-
Indian River	207	15	73	27	-
Lock 19 - Otonabee River	300	22	87	13	-
Otonabee River Outlet	301	22	95	-	5
Ouse River	290	21	35	65	-

-: a particular physiography region is not present within the quaternary watershed (no data reported)

A description of the physiographic regions identified within the Otonabee River watershed is provided in Section 3.3.2.

Other prominent patterns visible in Figure 8 include the presence of hummocky terrain and closed depressions. These features are often associated with glacially derived moraine deposits and are more prominently observed in the Otonabee River watershed than in any other watershed in the County.

The distinctive topography of the Otonabee River watershed reflects its glacial geological history. As shown in Figure 9, the ground surface elevation within the Otonabee River watershed ranges from a minimum elevation of 185 metres above sea level (masl) at Rice Lake to a maximum of about 405 masl in the northern part of the watershed.

The ground slopes within the Otonabee River watershed and the six (6) respective quaternary watershed areas have been assessed for each of the three (3) general categories as noted and summarized in Table 25. The majority of the Otonabee River watershed area (52%) has been categorized as having a gentle surface slope, with an additional 46% of land area within the moderate category. The remaining 2% land area is categorized as steep which is attributed to the landscapes near drumlins. It should be noted that the majority of quaternary watersheds share similar slope distributions.

Table 25 Surface Slope Distribution within the Otonabee River Tertiary Watershed

Quaternary Watershed	Area of Quaternary Watershed (km^2)	Proportion within Tertiary Watershed (%)	Surface Slope Distribution (%)		
			Gentile Slope (0-2%)	Moderate Slope (2-10%)	Steep Slope (>10%)
Cavan Creek	116	9	46	52	2
Hastings Lock 18 Dam - Trent River	138	10	5	43	3
Indian River	207	15	51	46	3
Lock 19 - Otonabee River	300	22	51	46	2
Otonabee River Outlet	301	22	48	49	3
Ouse River	290	21	60	39	1
Average for Otonabee River Tertiary Watershed			52	46	2

The four future growth areas within the Otonabee Quaternary Watershed were approximately digitized from the Hemson (2022) report to identify their locations on the maps. Table 26 provides a summary of the slope distribution within these potential future growth areas.

Table 26 Surface Slope Distribution within the Designated Future Growth Areas in Peterborough County

Settlement (Future Development Lands)	Total Area of Settlement (km^2)	Area within Tertiary Watershed (km^2)	Surface Slope Distribution (%)		
			Mild (0-2%)	Medium (2-10%)	Steep (>10%)
Norwood	3	3	54	44	2
Lakefield	2	2	47	52	2
Milbrook	2	2	48	52	0

Within the Otonabee River tertiary watershed, future development lands in Lakefield, Milbrook, and Norwood are characterized by gentle and moderate slopes, each making up just about half of the development area. A very small percent of these areas contains steep slopes (2% or less). The slopes of the future growth areas are consistent with the slope analysis for the tertiary watershed.

4.1.3 Surficial Geology

The surficial geology of the Otonabee River Tertiary Watershed consists of 13 distinct geologic units (1, 3, 5b, 5c, 5d, 6, 7, 8a, 9c, 12, 17, 19, and 20), as depicted in Figure 10 and Table 13.

Comprehensive information on surficial geology, along with detailed descriptions of individual surficial geological units, is provided in Section 3.3.3.

4.1.4 Bedrock Geology and Bedrock Topography

As illustrated in Figure 11, the bedrock geology of the Otonabee River Tertiary watershed is primarily comprised of two distinct geological units: Paleozoic sedimentary rocks (Unit 54a) and clastic metasedimentary rocks (Unit 45). Of these, Paleozoic sedimentary rocks (Unit 54a) dominate the watershed, forming the majority of its subsurface composition.

The elevation of the bedrock surface approximately ranges from over 270 metres above sea level (masl) in the north and northwest of the Otonabee River Tertiary Watershed (near the Kawartha Lakes Tertiary Watershed boundary) to 150 masl near the southern boundary (approaching the County of Northumberland and Lake Rice) (Figure 11). The bedrock surface generally dips towards the south (ORMGP 2022).

Additionally, bedrock thalwegs and tunnel channel thalwegs are present within the Otonabee River Tertiary Watershed (Figure 11). The bedrock thalweg trends north to south and is roughly aligned with the main channels of the Otonabee River and Indian River. These thalweg features are characterized by deepened valleys that correspond with the pathways of contemporary rivers, lakes, and wetlands, suggesting a strong geomorphic relationship between bedrock structure and surface hydrology. The tunnel channel thalwegs generally run parallel or subparallel to the bedrock thalwegs and are situated in the southwestern part of the Otonabee River Tertiary Watershed.

Comprehensive information on bedrock geology and bedrock topography applicable to the County, along with detailed descriptions of each bedrock geological unit, is provided in Section 3.3.4.

4.1.5 Soils

Drainage classes were sourced from the Soil Complex Survey (OMAFRA 2019) and categorized by drainage potential. Table 27 summarizes these classifications. Figure 13 illustrates the spatial distribution of the various drainage classes and surficial soils within the Otonabee River Watershed, while Table 27 outlines their respective proportions.

Table 27 Soil Drainage within the Otonabee River Tertiary Watershed

Quaternary Watershed	% of Quaternary Watershed within Tertiary	Area of Quaternary Watershed (km^2)	Soil Drainage Distribution (%)			
			Unknown	High	Medium	Low
Cavan Creek	9	116	3	73	6	17
Hastings Lock 18 Dam - Trent River	10	138	<1	53	3	44
Indian River	15	207	<1	65	9	26
Lock 19 - Otonabee River	22	300	8	59	6	27
Otonabee River Outlet	22	301	7	61	10	21
Ouse River	21	290	<1	59	11	29
Average for Otonabee River Tertiary Watershed			**4**	**61**	**8**	**27**

Notes:
-: a particular soil drainage class is not reported within the quaternary watershed (no data reported)
Unknown is comprised of not applicable, variable, and unknown draining soil
High is comprised of very rapid, rapidly, moderately well, and well draining soil
Medium is comprised of imperfectly draining soil
Low is comprised of poorly and very poorly draining soil

A wide range of soil types is found within the Otonabee River watershed (Figure 12). According to the broader classification system used for this study, grouping soils into unknown, high, medium, and low drainage potential, it was determined that all quaternary watersheds within the Otonabee study area are predominantly composed of soils with high drainage potential (Figure 13). The subwatersheds with the highest proportion of well-drained soils include Cavan Creek (67%) and Otonabee River Outlet (42%), while Hastings Lock 18 Dam shows the highest proportion of very poorly drained soils (38%), indicating more variable surficial conditions and potentially lower-lying terrain.

Most of the Otonabee Tertiary watershed lies within the Peterborough Drumlin Field, a prominent physiographic region shaped by glacial activity and composed predominantly of compact glacial till (sandy to loamy diamicton soils). These drumlin landforms are generally well-drained and highly permeable due to the sandy nature of the soil, which allow for high rates of recharge, contributing to the classification of over 60% of soils in the watershed as well-drained or highly permeable (see Figure 13). For more visual information, also refer to Figures 9 and 10.

Outside of the Peterborough Drumlin Field, additional regions such as the Oak Ridges Moraine and hummocky terrains also contribute to high drainage potential. These areas are composed primarily of sands and gravels, sometimes covered by a thin veneer of till. Their high permeability and topographic relief promote groundwater recharge and reduced surface runoff. Similarly, the Dummer Moraines along the northern boundary, composed of thin tills with coarse limestone fragments, are also associated with enhanced infiltration and high groundwater recharge. Taken together, the dominance of well-drained soils across glacial drumlins, sandy moraines, and coarse-textured uplands supports the finding that most of the Otonabee River watershed has high drainage potential. These conditions suggest that large portions of the watershed are conducive to infiltration-driven hydrology, with limited runoff generation per hectare, especially in undeveloped or natural landscapes.

In contrast, approximately 27% of soils are classified as imperfectly or poorly drained. These are primarily associated with the interdrumlin areas—the lower, flatter zones between drumlins—where water tends to accumulate due to finer textures or low-relief topography. These areas typically exhibit lower permeability and increased runoff potential, which may indicate a moderate sensitivity to urbanization.

An additional 4% of soils fall into a variable or unknown category, largely corresponding to areas of existing urban development such as Peterborough, Millbrook, and Norwood, where soils have been disturbed or data are limited. While drainage conditions vary across individual quaternary subwatersheds, the dominant soil drainage classification across the watershed remains well- to rapidly drained, shaped by the underlying glacial till and drumlinized terrain.

4.2 Land Use

As per Table 28, the proposed land use distribution across the Otonabee River Watershed is represented by most lands being designated for open space/natural area (52%) and agricultural use (25%), followed by urban (8%), wetlands (8%) and waterbodies (5%). Industrial activities and unknown land use cover two percent of land within Otonabee watershed. The distribution of these land use classes is shown in Figure 6.

The Otonabee River watershed urban areas include the City of Peterborough itself (which represents most of the urban area for this watershed) as well as smaller settlements like Lakefield, Millbrook, and Norwood (which are considered hamlets or villages). These three settlements represent future growth areas for the County as identified by Hemson (2022), refer to Table 29 and Figure 6.

Table 28 Simplified Land Use Distribution for Otonabee River Watershed

Quaternary Watershed	Proportion of Tertiary Watershed (%)	Area (km^2)	Land Use Distribution (%) within each Quaternary Watershed						
			Agricultural	Industrial	Open Space/ Natural Area	Unknown	Urban	Waterbodies	Wetland
Cavan Creek	9	116	46	2	49	3	2	0	0
Hastings Lock 18 Dam - Trent River	10	138	27	4	30	1	2	29	9
Indian River	15	207	14	1	69	3	3	2	10
Lock 19 - Otonabee River	22	300	12	2	57	3	18	2	9
Otonabee River Outlet	22	301	44	2	35	3	12	2	6
Ouse River	21	290	16	2	65	2	3	1	13
Average for Otonabee River			**25**	**2**	**52**	**2**	**8**	**5**	**8**

The land use classifications have been simplified from the Official Plan designations to form more concise understanding of the land use.

Table 12 summarizes which OP designations make up each land use.

Table 29 Future Growth Areas in the Otonabee River Watershed

Settlement (Future development lands)	Total Proposed area of Settlement (km^2)	Area within Tertiary Watershed (km^2)
Lakefield	2	2
Milbrook	2	2
Norwood	3	3

4.3 Water Resource System

4.3.1 Surface Drainage

The Otonabee River watershed is a receiver of water from the Kawartha Lakes tertiary watershed at Lakefield, located to the south-west of the County (Figure 4). Within the Otonabee River tertiary watershed, the drainage network has origins in the Peterborough Drumlin Field, the Dummer Moraines, and the Oak Ridges Moraine (see Section 3.1.2 for further details). Within the County, the Otonabee River watershed is 1,353 km^2 which is 82% of the total tertiary watershed, accounting for 32% of the entire County (Table 1 in Section 5.2). There are 6 quaternary watersheds and 8 subwatersheds currently identified by Otonabee Conservation within the Otonabee River tertiary watershed (Table 30). The largest two quaternary watersheds within the Otonabee River tertiary watershed in the County are Lock 19 – Otonabee River and Otonabee River Outlet which have drainage areas of 300 and 301 km^2 respectively within the County.

Table 30 Drainage Area and Subwatersheds within the Otonabee River Tertiary Watershed

Quaternary Watershed Name	Area of Quaternary Watershed (km^2)	% within Tertiary (1)	Subwatershed #	Subwatersheds (% within the Quaternary Watershed) (2)
Cavan Creek	116	9	1	Cavan Creek (98%)
Hastings Lock 18 Dam - Trent River	138	10	1	Rice Lake/ Trent River (89%)
Indian River	207	15	1	Indian River (96%)
Lock 19 - Otonabee River	300	22	2	Jackson Creek (34%), Otonabee River (64%)
Otonabee River Outlet	301	22	3	Baxter Creek (27%), Otonabee River (61%), Squirrel Creek (11%)
Ouse River	290	21	1	Ouse River (96%)

Notes:
(1) Based on areas within the County boundary inclusive of the City of Peterborough.
(2) The delineation for each subwatershed was provided by each Conservation Authority, it should be noted that they do not share the same scale.

The main branch of the Otonabee River originates at the outlet of Katchewanooka Lake to the north and drains into Rice Lake to the south. The Otonabee River flows through the Town of Lakefield, the City of Peterborough, and the Hiawatha First Nation’s Reserve. The Otonabee River is the primary watercourse within the Lock 19 – Otonabee River and Otonabee River Outlet quaternary watersheds. There are three other predominant watercourses within the tertiary watershed including Cavan Creek, Indian River, and Ouse River. Cavan Creek drains into the Otonabee River south of the City of Peterborough. Indian River and Ouse River each drain into the west end of Rice Lake respectively. Rice Lake is the largest waterbody within the tertiary watershed and is located to the southeast of the tertiary watershed along the County border.

4.3.1.1 Drainage Network Characteristics

An overview of key drainage attributes of each quaternary watershed situated within the portion of the Otonabee River tertiary watershed that falls within the County is provided in Table 31.

Hastings Lock 18 Dam – Trent River has the lowest drainage density (1.05 km/km^2) of the quaternary watersheds (Table 31). This quaternary watershed contains Rice Lake which represents 27% of the total surface area of the watershed within the County. Waterbodies are not included in the calculation of total watercourse length but are included in the total watershed area used in calculating the drainage density. As a result, generally the larger the proportion of surface area covered by watercourses the lower the drainage density.

Lock 19 – Otonabee River has the highest drainage density of the quaternary watersheds with a value of 1.77 km/km^2 (Table 31). There are 532 km of watercourses and 3 km^2 of waterbody area, representing 1% of the total quaternary watershed area. This quaternary watershed receives the outflow from Katchewanooka Lake and contains both Lakefield and the northern half of the City of Peterborough.

Waterbody area is the total surface area of waterbodies pulled from the OHN waterbody layer but excluded features with attributes of “river” and “canal” which are captured in the available watercourse mapping. Cavan Creek, Lock 19 – Otonabee River, and Ouse River watersheds each had the smallest proportion of waterbodies of <1, 3, and 2 km^2 respectively (Table 31). Hastings Lock 18 Dam – Trent River has the highest proportion of waterbody area at 27% as it includes Rice Lake (Table 31). Lock 19 – Otonabee River Outlet and Ouse River have proportionally very little waterbody area, but each have the two highest shoreline perimeter values (155 and 162 km respectively) because of the higher density of small waterbodies within those watersheds (Table 31).

Table 31 Drainage Network Characteristics of the Quaternary Watersheds within the Otonabee River Watershed

Quaternary Watershed	Area (km²)	% Tertiary Watershed Area	Watercourse Length (km)	Drainage Density (km/km²)	Waterbody Area (km²)	% Waterbody Area	Shoreline Perimeter (km)
Cavan Creek	116	9	196	1.68	<1	<1	44
Hastings Lock 18 Dam - Trent River	138	10	144	1.05	38	27	108
Indian River	207	15	284	1.37	40	19	97
Lock 19 - Otonabee River	300	22	532	1.77	3	1	155
Otonabee River Outlet	301	22	524	1.74	39	13	141
Ouse River	290	21	363	1.25	2	<1	162

4.3.1.2 Drainage Network Alterations

As noted in the introduction of Section 3.1.1, there was no explicit HDF mapping provided for the Otonabee River Watershed, therefore alteration to HDFs has not been characterized.

A cursory review of watercourse mapping and aerial imagery reveals obvious channel realignment across all quaternary watersheds in the Otonabee River Watershed, with the highest concentration in the southwest. In contrast, watercourses in the northern Ouse River watershed remain largely unaltered, likely due to greater rural land use and wetland coverage (see Section 3.1.6).

The impacts of flow regime changes and channel alterations in the Otonabee River watershed are not well understood. One key factor is water impoundment through dams and locks, which can affect flow patterns, lake levels, sediment transport, and erosion. This is especially relevant given the watershed’s connection to the Trent Severn Waterway.

Of the six quaternary watersheds, three contain dams or lie directly downstream of dammed watersheds. The other three are indirectly affected, as they include tributaries of the altered watersheds. Even indirectly impacted watersheds may experience similar changes, though to a lesser degree, due to upstream and downstream connectivity.

4.3.1.3 Drainage Network Conditions and Processes

Erosion sites were inventoried along Baxter Creek, Cavan Creek, and Otonabee River through the 1983 Interim Watershed Plan (ORCA 1983). While these data are out of date, this is the type of inventory that can help inform the impact assessments related to land use change within a watershed. Three areas of Otonabee River watershed have been identified as Future Growth Areas (Hemson 2022), a conditions assessment and evaluation of stream process (including erosion sensitivity) exist as gaps in characterization. Further investigation into the fluvial processes of the watershed is recommended at the subwatershed study stage.

4.3.1.4 Streamflow

A summary identifying the data type, method of collection, period of record and time intervals for each station was prepared to assess the quality of the data source for future modelling exercises and identify any gaps accordingly. This information is summarized on Figure 7 and Table 32.

The Otonabee River watershed hosts the highest number of stream gauge stations within the County. As illustrated in Table 9, the water monitoring network includes twelve (12) stations distributed across four (4) of the six (6) quaternary watersheds within the Otonabee River tertiary system. The Hastings Lock 18 Dam – Trent River and Cavan Creek quaternary watersheds are currently lacking water stations within their boundaries. Of the twelve (12) stations, four (4) recorded water level only (2/4 are within lakes), while eight (8) streamflow.

The length of the period of record for streamflow gauges is also crucial as for climate, long-term streamflow monitoring can provide the opportunity for single site frequency analyses to aid in the corroboration of the results of hydrologic modelling, with observed data. Having sufficient active streamflow gauge locations and data will be important for the selection and evaluation of calibration/validation events for subsequent hydrologic modelling studies, flood frequency analyses, determine the return period flows at a specific location, and having a robust rating curve. In this context, two (2) of the twelve (12) stations stand out for their long-term records: Jackson Creek at Peterborough and Ouse River near Westwood (Peterborough). These stations have the longest data records, with approximately 58 years of streamflow data.

Table 32 Water Monitoring Gauges and Sources within Otonabee River Watershed

Quaternary Watershed	Station Name	ID	Time interval	Period of Record	Data Type	Gross Drainage (km^2)	Active or Discontinued	Current Operation Schedule	Lat	LongT
Indian River	INDIAN RIVER ABOVE HOPE MILL DAM	02HJ009	Daily	2019 - 2025	Water Level	N/A	Continuous	Continuous	44.28405	-78.1722
	INDIAN RIVER AT GILCHRIST BAY	02HJ008	Daily	2006-2019	Flow	N/A	Discontinued	N/A	44.54047	-78.0954
	INDIAN RIVER AT GILCHRIST BAY	02HH004	Daily	2002-2005	Flow	N/A	Discontinued		44.54047	-78.0954
	INDIAN RIVER BELOW HOPE MILL DAM	02HJ012	Daily	2020-2025	Water level	N/A	Active	Continuous	44.28405	-78.1722
Lock 19 - Otonabee River	JACKSON CREEK AT PETERBOROUGH	02HJ001	Daily	1962-2025	Flow	116	Active	Continuous	44.30278	-78.3214
	JACKSON CREEK NEAR JACKSON HEIGHTS	02HJ006	Daily	2005-2025	Flow	107	Active	Continuous	44.30983	-78.3707
	OTONABEE RIVER AT LAKEFIELD	02HJ002	Daily	1962-1963; 1965-1985; 1989-2002	Flow	7360	Discontinued	N/A	44.42225	-78.2757
Otonabee River Outlet	OTONABEE RIVER NEAR ROBINSONS ISLAND	02HJ010	Daily	2019-2025	Water Level	N/A	Active	Continuous	44.25861	-78.3344
	SQUIRREL CREEK NEAR BAILIEBORO	02HJ005	Daily	2002-2019	Flow	11.6	Discontinued	N/A	44.12325	-78.3887

Quaternary Watershed	Station Name	ID	Time interval	Period of Record	Data Type	Gross Drainage (km^2)	Active or Discontinued	Current Operation Schedule	Lat	LongT
	BAXTER CREEK AT MILLBROOK	02HJ007	Daily	2005-2025	Flow	45.5	Active	Continuous	44.15028	-78.4467
Ouse River	OUSE RIVER AT NORWOOD	02HJ011	Daily	2020-2025	Water Level	N/A	Active	Continuous	44.38494	-77.9761
	OUSE RIVER NEAR WESTWOOD	02HJ003	Daily	1967-1994; 2002-2025	Flow	283	Active	Continuous	44.29806	-78.0449

For the areas targeted for future development, some gauge stations that could be useful to future modellers are shown in Table 6.1-LU- 3:

Table 33 Active Stations in Future Growth Areas

Settlement (Future development lands)	Climate Stations	Water stations
Lakefield	-	-
Milbrook	-	Baxter Creek at Millbrook (active)
Norwood	-	Ouse River at Norwood (active)

-: no active stations were found

4.3.2 Hydrogeology

An introduction to the hydrogeological setting is provided in Section 3.4.4. This section outlines the datasets and tools used to develop the hydrogeological characterization of the Otonabee River Tertiary Watershed. Key inputs include hydrostratigraphic data, Provincial Groundwater Monitoring Network (PGMN) wells, groundwater recharge and discharge areas, groundwater use information, and source water protection reports.

4.3.2.1 Hydrostratigraphy

Table 34 lists the hydrostratigraphic units identified in the Otonabee River Tertiary Watershed using the cross-section tool and isopach maps on the ORPGP portal (2022).

Comprehensive information on hydrostratigraphy, along with detailed descriptions of each hydrostratigraphy unit, is provided in Section 3.4.4.1.

The main aquifer units comprise the Oak Ridges Moraine Deposits, Inter-Newmarket Sediment, Thorncliffe Formation, and Scarborough Formation. Conversely, the primary aquitards include the Upper Newmarket Till, Lower Newmarket Till, and Sunnybrook Drift. The bedrock units may serve as either an aquitard or an aquifer, depending on their porosity, permeability, weathering, or fracturing.

All listed quaternary watersheds contain Glaciolacustrine/Fluvial/Recent Deposits. The Oak Ridges Aquifer Complex and associated Newmarket Till layers are present throughout the Otonabee River Tertiary watershed in Peterborough County. Deeper units such as the Thorncliffe Formation, Sunnybrook Drift, and Scarborough Formation are also widely represented, suggesting substantial vertical stratification and groundwater storage potential.

Table 34 Hydrostratigraphic Units within the Otonabee River Tertiary Watershed in Peterborough County

Quaternary Watershed	Present in Tertiary Watershed (Yes / No)								
	Glaciolacustrine/Fluvial/Recent Deposits	Oak Ridges Aquifer Complex	Upper New Market Till	Inter-Newmarket Sediment	Lower Newmarket Till	Thorncliffe Formation	Sunnybrook Drift	Scarborough Formation	Bedrock
Cavan Creek	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Hastings Lock 18 Dam - Trent River	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Indian River	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lock 19 - Otonabee River	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Otonabee River Outlet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ouse River	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Data Source: (ORMGP 2022)

4.3.2.2 Provincial Groundwater Monitoring Network Wells

There are nine PGMN locations within the Otonabee Tertiary Watershed (Figure 22). The characteristics of each established PGMN well are summarized in Table 35.

As shown in Table 35, the nine PGMN wells within the Otonabee River Tertiary Watershed exhibit variations in total depth, ranging from 7.2 to 45 metres. These wells are completed in different aquifers, with two in overburden and six in bedrock. The groundwater level monitoring program for these wells spanned from 2002 to 2016.

The groundwater levels in the nine PGMN wells across the watershed ranged from 186.81 meters above sea level (masl) at well W0000225-1 to 231.84 masl at well W0000196-1. Most wells displayed a narrow range of groundwater fluctuation (less than 5 m), indicating a relatively stable water table throughout the monitoring period and seasonal changes of +/- 1 to 2 m in most wells.

It is recommended that future quaternary watershed plans/subwatershed studies incorporate more comprehensive assessments of groundwater levels, alongside systematic seasonal monitoring, to effectively capture temporal variations and support informed water resource management and monitoring the effects of land use change.

Table 35 Overview of PGMN Wells within the Otonabee River Tertiary Watershed in Peterborough County

PGMN Well ID	Quaternary Watershed	Township	Ground Surface Elevation (masl)	Total Well Depth (m bgs)	Screen Interval or open hole interval (m bgs)	Completion Aquifer	Groundwater Level Monitoring Program Range (Years)	Groundwater Levels within the Monitoring Program Range (masl)
W0000192-1	Otonabee River Outlet	Monaghan	212.3	37.2	Screen Interval (36.2 - 37.2)	Overburden (Fine Gravel/ Coarse Sand)	2003-09-29 to 2016-10-25	201.21-204.86
W0000195-1	Indian River	Dummer	221.3	15.3	Open Hole Interval (6.1-15.9)	Bedrock (Limestone)	2003-01-14 to 2016-10-24	216.97-218.74
W0000196-1	Indian River	Dummer	233.8	15.3	Open Hole Interval (6.7 - 15.3)	Bedrock (Limestone)	2003-01-14 to 2016-10-24	227.56-231.84
W0000198-1	Ouse River	Dummer	232.7	45.0	Open Hole Interval (6.7 – 45.0)	Bedrock (Limestone)	2002-11-14 to 2011-04-27	226.56-229.12
W0000206-1	Indian River	Otonabee	198.0	11.6	Open Hole Interval (5.5 - 11.6)	Bedrock (Limestone)	2003-01-14 to 2016-10-24	196.81-198.14
W0000225-1	Otonabee River Outlet	South Monaghan	191.3	22.6	Open Hole Interval (12.2-22.5)	Bedrock (Limestone)	2003-01-14 to 2016-10-25	186.81-190.35
W0000254-1	Ouse River	Asphodel	189.5	12.0	Open Hole Interval (4.4 – 12.0)	Bedrock (Interbedded Limestone and Shale)	2003-02-12 to 2016-10-24	187.32-188.81
W0000255-2	Otonabee River Outlet	Cavan	195.7	7.2	Screen Interval (5.7- 7.2)	Overburden (Sand)	2003-03-12 to 2016-10-25	193.26-195.70
W0000253-1	Lock 19 – Otonabee River	Otonabee	208.44	9.91	-	Overburden (Gravel and Sand)	2003-03-12 to 2016-10-24	203.58 – 207.14

m bgs – Metres Below Ground Surface
masl – Metres Above Sea Level
PGMN – Provincial Groundwater Monitoring Network
Data Source: (MECP 2023; ORMGP 2022)
"-" – Data are not available on the MECP website.

4.3.2.3 Groundwater Recharge Area

The mean annual groundwater recharge rates from the CANWET Model (TCC 2008) for the Otonabee River Tertiary Watershed is 103 mm/year and the SGRAs mapped from TCC (2009) are illustrated in Figures 19a to 19f. The basis for the recharge estimates is provided in Section 3.4.4.3.

Across the Otonabee River Tertiary Watershed recharge rates show variation reflecting differences in hydrological dynamics, geological, and land-use characteristics. Recharge rates range from 60 mm to 120 mm per year, indicating moderate levels of groundwater replenishment.

The highest recharge rates from the CANWET Model and the highest density of SGRAs are found in Quaternary watersheds with the higher proportion of coarser grained granular deposits (i.e., sands and gravels) and the highest topographic relief, specifically in southwest, in Cavan Creek, Lock 19 - Otonabee River Otonabee River Outlet Quaternary Watersheds. The low recharge rate watersheds have lower topographic relief and are those that are more dominated and fine-grained deposits such as the glacial till dominated Quaternary watersheds such as the Ouse River towards the northeast.

Implementation of infiltration based Low Impact Development is more feasible in higher recharge areas and is likely required as part of development to maintain downgradient groundwater discharge function.

4.3.2.4 Groundwater Discharge Area

The groundwater discharge areas within the Otonabee River Tertiary Watershed are well-aligned with cold streams, watercourses and wetlands, as illustrated in Figures 20a to 20f. The method used to map discharge areas is presented in section 3.4.4.4. Table 36 summarizes the mean depth to the water table for the quaternary watersheds in the Otonabee River Tertiary Watershed.

Table 36 Summary of Mean Depth to Water Table Rate within the Otonabee River Tertiary Watershed in Peterborough County

Quaternary Watershed	% of Quaternary Watershed Within Tertiary	Area of Quaternary Watershed (km^2)	Mean Depth to Water Table (m bgs)
Cavan Creek	9	116	7.4
Hastings Lock 18 Dam - Trent River	10	138	5.5
Indian River	15	207	6.7
Lock 19 - Otonabee River	22	300	5.8
Otonabee River Outlet	22	301	8.1
Ouse River	21	290	4.9

Source: (ORMGP 2022)
m bgs – metres below ground surface

Among the six Quaternary Watersheds, the mean depth to the water table ranges from approximately 5.5 to 8.1 m bgs, indicating generally shallow groundwater systems that are relatively accessible for extraction and monitoring.

The Ouse River watershed has the shallowest water table at 4.9 m bgs, suggesting high groundwater availability and potentially greater vulnerability to surface contamination. Similarly, Hastings Lock 18 Dam - Trent River and Lock 19 - Otonabee River show depths of 5.5 and 5.8 m, respectively, both indicative of favorable conditions for groundwater recharge and use.

In contrast, Otonabee River Outlet has the deepest water table at 8.1 meters, which may reflect more complex subsurface geology or lower recharge rates. Cavan Creek and Indian River fall in the mid-range, with depths of 7.4 and 6.7 m, respectively. These figures suggest moderate accessibility, likely influenced by local topography and aquifer characteristics.

Overall, the data reveal a pattern of relatively shallow water tables across the Tertiary Watershed, which is positive for the availability of groundwater resource. However, the variation in depth underscores the need for site-specific strategies when planning for water extraction, land use change, and environmental protection to avoid basement flooding and maintain discharge to sensitive wetland and coldwater streams.

Typically, a shallow water table is associated with stream valleys and wetlands, while a deeper water table is found in areas with higher ground surfaces, such as the Peterborough Drumlins, which are distributed across the Otonabee River Tertiary Watershed.

4.3.2.5 Groundwater Users

The groundwater users for the Otonabee River Tertiary Watershed have been presented in Figures 21a to 21f and summarized in Table 37.

Table 37 has categorized wells into three types for this study: 1) municipal wells, 2) overburden completion, and 3) bedrock completion.

Table 37 Summary of Groundwater Users within the Otonabee River Tertiary Watershed in Peterborough County

Quaternary Watershed	% of Quaternary Watershed within Tertiary	Area of Quaternary Watershed within the County (km²)	Water Well Record Type – Number of wells within each Quaternary watershed			Water Well Record Type - (%) within each Quaternary watershed		
			Municipal Well	Quaternary Completion	Bedrock Completion	Municipal Well	Quaternary Completion	Bedrock Completion
Cavan Creek	9	116	2	1324	289	<1	82	18
Hastings Lock 18 Dam - Trent River	10	138	2	505	414	<1	55	45
Indian River	15	207	5	367	1193	<1	23	76
Lock 19 - Otonabee River	22	300	1	2961	1806	<1	62	38
Otonabee River Outlet	22	301	11	2977	864	<1	77	22
Ouse River	21	290	4	227	788	<1	22	77
Average for Otonabee River Tertiary Watershed						<1	52	48

Groundwater use across the Quaternary watersheds within the Otonabee River Tertiary Watershed shows a strong reliance on private well supplies, with notable variation in well construction types. The total number of municipal wells is relatively small compared to private wells, indicating that most groundwater users in the area rely on individual water supply systems rather than municipally serviced drinking water.

In nearly all Quaternary watersheds, wells completed in Quaternary deposits dominate over bedrock completions. For example, in Cavan Creek, 82% of wells are in Quaternary deposits, while 18% are bedrock completions. Similarly, Otonabee River Outlet has 77% Quaternary completions and 22% bedrock. The trend is consistent across other watersheds, with bedrock wells representing a smaller share of groundwater users. The average for the Tertiary watershed is 52% Quaternary completions and 48% bedrock completions, showing that while unconsolidated deposits are the primary aquifer source, bedrock aquifers remain important in certain areas.

The distribution of municipal wells is sparse, with only a handful located within each watershed. For instance, the Otonabee River Outlet and Lock 19 watersheds contain 11 and 1 municipal wells, respectively, compared to thousands of private wells in Quaternary deposits. This highlights the localized role of municipal supply in contrast to the widespread use of private groundwater systems. Overall, groundwater users in the Otonabee River Tertiary Watershed primarily depend on Quaternary aquifers, with some reliance on bedrock, reflecting both geological conditions and rural water supply needs.

Furthermore, information on the groundwater users is provided in Section 3.4.5.

4.3.2.6 Source Water Protection

The Otonabee River Tertiary Watershed is encompassed by three Source Protection Areas: Otonabee-Peterborough, Crowe Valley, and Ganaraska Region, with the majority of its area lying within the Otonabee-Peterborough Source Protection Area.

Wellhead Protection Areas

There are WHPAs located within the Otonabee River Tertiary Watershed. The WHPAs' locations and descriptions are presented in Figures 21a to 21f.

The municipal residential groundwater supply systems within the Otonabee River Tertiary Watershed include:

- Crystal Springs Subdivision in the Township of Otonabee-South Monaghan - two groundwater supply water wells
- Keener Heights Subdivision in the Town of Keene - two groundwater supply water wells
- Town of Norwood – four groundwater supply water wells
- Town of Millbrook – three groundwater supply water wells

- Fraserville (Lansdowne Site) in the Township of Cavan Monaghan– one planned groundwater supply water well

Comprehensive information on the WHPAs is provided in Section 3.4.5.

Highly Vulnerable Aquifers

Within the Otonabee River Tertiary Watershed, there is extensive coverage of HVAs, as illustrated in Figures 21a to 21f. The HVAs encompass a substantial portion of the northern, central, and eastern regions of the Otonabee River Tertiary Watershed, with the greatest concentration located within the Ouse River Quaternary Watershed.

The extensive presence of HVAs within the Tertiary Watershed underscores the critical importance of implementing land use regulations, comprehensive source water protection strategies, and proactive environmental planning to preserve groundwater quality and ensure a sustainable supply throughout the Otonabee River Watershed.

More detailed information on the HVAs is provided in Section 3.4.5.

Significant Groundwater Recharge Areas

The SGRAs coverage for the Otonabee River Tertiary Watershed is presented in Figures 19a to 19f. The SGRAs predominantly occur in regions with sandy and gravelly soils. The areas are most prominently concentrated in the central-southwestern and southeastern portions of the watershed. In addition, Figures 19a to 19f illustrate a strong hydrogeological linkage between SGRAs, wetlands, and cold-water streams within the Otonabee River Tertiary Watershed, highlighting a critical ecological and hydrological connection that supports overall watershed health and resilience.

Similar to HVAs, potential policy applications for SGRAs align with the Provincial Planning Statement and the relevant municipal official plans. In areas designated as SGRAs, it is recommended that recharge rates be maintained when development or site alterations are proposed in addition to recharge areas that have lower recharge rates but are linked to sensitive wetland and stream features.

Comprehensive information on the SGRAs is provided in Section 3.4.5.

Intake Protection Zones (IPZs)

There are three intakes present within the Otonabee River Tertiary Watershed. As illustrated in Figures 21a to 21f, the IPZs are located along the Otonabee River, extending north from the City of Peterborough into the County of Peterborough. They cover areas around Lakefield and the connected water bodies upstream, as well as portions of the river corridor running south through Peterborough. In addition, the IPZs are centered around the community of Hastings, where the Trent River flows through the County of Northumberland and into Peterborough County. The zones extend upstream and downstream along the river, including connected water bodies and adjacent lands.

More information on the IPZs is provided in Section 3.4.5.

4.3.3 Water Quality

4.3.3.1 Surface Water Quality

The Otonabee Conservation conducts ongoing surface water quality monitoring throughout its watershed, collecting samples from numerous sites. The resulting data inform evaluations of both surface water conditions and broader watershed health, with key insights presented in the Watershed Report Card (Otonabee Conservation 2023b). Table 38 presents the 2023 surface water quality evaluations for eight subwatersheds within the Otonabee River Tertiary Watershed. According to the 2023 Watershed Report Card (Otonabee Conservation 2023b), the Otonabee Watershed received an overall grade of B, indicating generally good surface water quality across the region.

The Watershed Report Cards provide a more generalized analysis compared to the detailed evaluations in the Conservation Authority's annual water quality reports. Future quaternary watershed plans should aim for more comprehensive assessments.

Additional information on the surface water quality is provided in Section 3.4.6.

Table 38 Summary of Surface Water Quality within Otonabee River Tertiary Watershed in Peterborough County

Quaternary Watershed	Subwatersheds (% within the Quaternary Watershed) (1)	Surface Water Quality Grade (2)	2023 Watershed Report Card Summary (3)
Cavan Creek	Cavan Creek (98%)	B - Good	Overall B Grade for the Watershed Since the 2018 Watershed Report card, the water quality improved from good to excellent for Indian River and from fair to good for Jackson Creek and Otonabee River.
Hastings Lock 18 Dam - Trent River	Rice Lake/ Trent River (89%)	C - Fair	
Indian River	Indian River (96%)	A - Excellent	
Ouse River	Ouse River (96%)	B – Good	
Lock 19 - Otonabee River	Jackson Creek (34%), Otonabee River (64%)	B – Good	
Otonabee River Outlet	Squirrel Creek (11%)	C – Fair	
	Baxter Creek (27%), Otonabee River (61%)	B – Good	

Notes:
(1) The delineation for each subwatershed was provided by each Conservation Authority; it should be noted that they do not share the same scale.
(2) Two indicators were utilized to evaluate the quality of surface water: phosphorus and benthic macroinvertebrates. Phosphorus, a nutrient found both naturally and through human activities, can lead to algae blooms, excessive plant growth, and reduced oxygen levels when present in high concentrations. In contrast, benthic macroinvertebrates, due to their varying sensitivities to water quality, are reliable indicators of the long-term health of aquatic environments (Otonabee Conservation 2023b).
(3) Source: (Otonabee Conservation 2023b)

4.3.3.2 Ground Water Quality

The Otonabee Conservation conducts ongoing groundwater quality monitoring throughout its watershed, collecting samples from numerous sites. The data obtained from these sites are used to assess groundwater conditions and inform evaluations of overall watershed health, with key insights presented in the Watershed Report Card (Otonabee Conservation 2023b).

According to the 2023 Watershed Report Card, groundwater quality in the Otonabee Region Watershed was evaluated through the analysis of key chemical indicators, including nitrate, nitrite, and chloride—substances that, at elevated levels, may pose risks to human health. As reported in the 2023 Watershed Report Card (Otonabee Conservation 2023b), concentrations of these parameters at the monitoring sites remained within the acceptable limits defined by the Ontario Drinking Water Quality Standards and the Canadian Water Quality Guidelines during the monitoring period from 2017 to 2021.

The Watershed Report Cards provide a more generalized analysis compared to the detailed evaluations in the Conservation Authority's annual water quality reports. Future quaternary watershed plans should aim for more comprehensive assessments.

4.4 Natural Hazards

Detail on the types of natural hazards, associated setbacks, and applicable agencies or regulators are included in Section 3.5. The following summarizes the results for the Otonabee River Tertiary Watershed.

Table 39 Natural Hazards within the Otonabee River Tertiary Watershed by Quaternary Watershed

Quaternary Watershed	% of the Watershed Within the Tertiary Watershed	Area of Quaternary Watershed (km^2)	Natural Hazard					
			Known Karst (%)	Inferred Karst (%)	Potential Karst (%)	Floodplain Area (km^2)	Regulated Top of Slope Area (km^2)	Meander Belt Area (km^2)
Cavan Creek	9	116	0	0	0	3	-	-
Hastings Lock 18 Dam - Trent River	10	138	0	0	0	-	-	-
Indian River	15	207	1	0	23	6	-	-
Lock 19 - Otonabee River	22	300	<1	0	15	15	-	-
Otonabee River Outlet	22	301	0	0	0	34	-	-
Ouse River	21	290	<1	1	53	2	-	-

Karst landscapes are illustrated in Figure 11. As shown in Table 39, the extent of karst features is generally low, with known karst limited to only 1% of the Indian River watershed and less than 1% in both the Ouse River and Lock 19–Otonabee River watersheds. Inferred karst is identified only in the Ouse River watershed (1%), while potential karst is more extensive, with notable areas in the Indian River (23%) and Ouse River (53%) watersheds. The remaining watersheds, including Cavan Creek, Hastings Lock 18 Dam–Trent River, and Otonabee River Outlet, show no known, inferred, or potential karst.

From a land use perspective, areas containing known karst present the highest risk for instability and groundwater vulnerability, and therefore development in these zones should be restricted or subject to rigorous geotechnical and hydrogeological investigation before proceeding. Inferred and potential karst areas require a precautionary approach, where site-specific subsurface studies are needed to confirm risks before development is approved. These lands are more suitable for conservation, agriculture, or passive recreational uses rather than intensive urban or industrial development. In watersheds without karst features, typical planning policies may apply, though other natural hazards such as floodplains, regulated slopes, and meander belts should continue to guide land use decisions.

The Indian and Ouse River watersheds are most sensitive to karst-related risks. Planning should emphasize low-intensity land uses here, while directing higher-intensity development to areas without mapped karst—provided other environmental constraints are addressed.

Meander belt and regulated top of slope mapping has not been provided for the watercourses of the Otonabee River watershed within the County. This is a notable gap that should be addressed to inform future subwatershed studies.

The **Otonabee River** has the largest floodplain coverage (2.5% of its area); all other quaternary watersheds have <1.1%. This data should inform growth planning and development constraints.

4.5 Aquatic and Terrestrial Features

Table 40 presents a summary of the lakes, rivers, creeks, fish habitat, and thermal regime information available from background sources to provide a high-level characterization of the aquatic features within the Otonabee River tertiary watershed. Similarly, a high-level analysis of terrestrial features within the tertiary watershed is presented in Table 41.

Table 40 Otonabee River Tertiary Watershed Aquatic Feature Characterization by Type

Lakes	Lily Lake, White Lake, Buckley Lake, Quarry Lake, Best’s Pond, Rotten Lake, Rive Lake, Long Lake, Maloney’s Lake, Little Lake
Rivers	West Ouse River, Otonabee River, Indian River, Ouse River, Trent River
Creeks	Cavan Creek, Jackson Creek, Baxter Creek, May’s Creek, Birdsall Creek, Squirrel Creek, Meade Creek, Sawer Creek, Wood Duck Creek, Steamboat Creek, Lepers Creek, Kent Creek, Whitlaw Creek, Bears Creek

Fish Species	Banded Killifish, Black Crappie, Blacknose Shiner, Bluegill, Bluntnose Minnow, Brassy Minnow, Brook Silverside, Brook Stickleback, Brook Trout, Brown Bullhead, Brown Trout, Burbot, Central Mudminnow, Central Stoneroller, Common Carp, Common Shiner, Creek Chub, Emerald Shiner, Fallfish, Fathead Minnow, Finescale Dace, Golden Shiner, Hornyhead Chub, Johnny Darter, Largemouth Bass, Logperch, Longnose Dace, Longnose Sucker, Mottled Sculpin, Muskellunge, Northern Pearl Dace, Northern Redbelly Dace, Pumpkinseed, River Chub, Rock Bass, Rosyface Shiner, Smallmouth Bass, Slimy Sculpin, Striped Bass, Threespine Stickleback, Walleye, Western Blacknose Dace, White Sucker, Yellow Perch
Fish Activity Areas	Muskellunge, Walleye, Smallmouth Bass, and Largemouth Bass Spawning Areas
Thermal Regime (1)	Warm: 48% Cold: 38% Unknown: 14%

Note:
(1) Total mapped watercourse segments: 2351

Table 41 Otonabee River Tertiary Watershed Wetlands, Woodlands, and Areas of Natural and Scientific Interest (ANSIs)

Parameter	Value
Total Tertiary Watershed Area (1)	**1,353 km^2**
Wetlands	
Provincially Significant Wetland	142 km^2 (10.5%)
Non-Provincially Significant Wetland	21 km^2 (1.6%)
Unevaluated Wetland	144 km^2 (10.6%)
Total Wetland Area	307 km^2 (23%)
Wetland Types (% of mapped wetlands)	
Bog	1.33%
Fen	0.00%
Marsh	7.27%
Open Water	0.73%
Swamp	90.67%
Unknown	0.01%
Woodlands	
Total Wooded Area	**397 km^2 (29%)**
Areas of Natural and Scientific Interest (ANSIs)	
Provincially Significant ANSI (Life Science)	3
Regionally Significant ANSI (Life Science)	10
Provincially Significant ANSI (Earth Science)	11
Regionally Significant ANSI (Earth Science)	4
Total Number of Candidate and Confirmed ANSIs	28

Note:
(1) Corresponds to the total area of the watershed overlapping with County boundaries

4.6 Characterization Summary – Otonabee Tertiary Watershed

Table 42 Summary Table for the Otonabee Tertiary Watershed

	Description	Key Highlights/Opportunities
Surface Drainage	Surface drainage in the watershed is defined by a network of creeks, wetlands, and small tributaries that direct water toward the Otonabee River. The natural drainage system is influenced by landform and soil characteristics, with most runoff flowing through defined channels and low-lying areas.	• Alteration of natural drainage (e.g., through development or ditching) can increase flood risk and degrade aquatic habitats. • Preserving headwater drainage features is important for maintaining baseflow and water quality. • Poorly drained areas may require stormwater management solutions to prevent standing water and erosion.
Physiography and Slopes	The watershed features gently rolling terrain shaped by glacial activity, including drumlins, till plains, and outwash deposits. Slopes vary, with steeper areas near drumlins and valleys, and flatter terrain in the lowlands and plains. This variation influences erosion potential and water movement.	• The Otonabee River Tertiary Watershed encompasses three distinct physiographic regions: the Peterborough Drumlin Field, the Oak Ridges Moraine, and the Dummer Moraines. • Steep slopes are prone to erosion and may limit development suitability. Slope variation affects how quickly runoff reaches streams, influencing flood potential. • Land use planning must consider slope conditions to minimize soil loss and maintain slope stability.
Surficial Geology	The watershed is underlain by glacial deposits, including till, sand, gravel, and clay. These surficial materials influence groundwater recharge, surface runoff, and erosion potential. Coarse materials like sand and gravel allow for better infiltration, while clay-rich areas reduce permeability.	• The surficial geology of the Otonabee River Tertiary Watershed consists of 13 distinct geologic units (1, 3, 5b, 5c, 5d, 6, 7, 8a, 9c, 12, 17, 19, and 20). • Areas with low permeability may lead to more surface runoff and localized flooding. • Soil composition affects stormwater management, infiltration potential, and erosion control. • Understanding surface materials is critical for siting infrastructure and natural heritage planning.
Bedrock Geology and Bedrock Topography	The watershed is underlain primarily by Paleozoic limestone and shale bedrock, which is typically buried under glacial deposits. In some areas, particularly near valleys and uplands, bedrock is closer to the surface and influences local groundwater movement and surface topography.	• The bedrock geology of the Otonabee River Tertiary watershed is primarily comprised of two distinct geological units: Paleozoic sedimentary rocks (Unit 54a) and clastic metasedimentary rocks (Unit 45). Of these, Paleozoic sedimentary rocks (Unit 54a) dominate the watershed, forming the majority of its subsurface composition. • The elevation of the bedrock surface approximately ranges from over 270 masl in the north and northwest of the Otonabee River Tertiary Watershed (near the Kawartha Lakes Tertiary Watershed

	Description	Key Highlights/Opportunities
		boundary) to 150 masl near the southern boundary (approaching the County of Northumberland and Lake Rice). • The bedrock surface generally dips towards the south. • Shallow bedrock limits infiltration and can affect septic system performance. • Bedrock-controlled valleys and ridges may guide surface drainage and groundwater flow. • Bedrock exposure may increase the risk of contamination to aquifers where overburden is thin.
Soils	Soils in the watershed include loams, clays, sands, and organic soils, varying by location. These influence how water moves through the landscape, crop suitability, and susceptibility to erosion or compaction. Areas of organic soils, like wetlands, are important for water retention and filtration.	• Soil type affects stormwater infiltration, runoff, and erosion potential. • Compacted or fine-textured soils may require enhanced drainage or low-impact development techniques. • Protecting organic soils and wetlands is important for maintaining water quality and baseflow.
Land Use	The watershed includes a mix of rural, agricultural, natural, and urban land uses. Urban areas are concentrated around Peterborough and smaller settlements, while agriculture dominates elsewhere. Natural areas, including forests and wetlands, are scattered throughout.	• Urbanization increases impervious surfaces, leading to higher runoff and degraded water quality. • Agricultural practices can contribute to nutrient loading and sedimentation. • Land use changes should be carefully managed to protect hydrologic functions and natural features.
Hydrogeology	The Otonabee River Tertiary Watershed contains a mix of aquifers (permeable sand and gravel) and aquitards (less permeable clay), which influence how groundwater moves and where it can be accessed. Groundwater levels, recharge areas, and flow patterns have been mapped, showing water generally flows from higher elevations in the north toward lower areas like Rice Lake. Eight monitoring wells track water levels and quality, and groundwater is widely used for drinking water and other purposes. Significant recharge areas and vulnerable aquifers are present throughout the watershed, especially in sandy regions.	• Four hydrostratigraphic units are present as an aquifer that overlies the bedrock and include: Oak Ridges Aquifer Complex, Inter-Newmarket Sediment, Thorncliffe Formation, and Scarborough Formation. • Among the six Quaternary Watersheds, the mean annual groundwater recharge rates range from 319 mm to 446 mm per year, indicating moderate levels of groundwater replenishment across the watershed, with the Ouse River Quaternary Watershed has the highest mean annual groundwater recharge rate at 446 mm. • The groundwater discharge areas within the Otonabee River Tertiary Watershed are well-aligned with cold streams, water courses and wetlands. • Groundwater use in the Otonabee River Tertiary Watershed is dominated by private wells, with limited municipal supply. Most wells are completed in Quaternary deposits, though bedrock aquifers remain

	Description	Key Highlights/Opportunities
		important in certain areas, reflecting both geological conditions and rural water supply needs. • The HVAs encompass a substantial portion of the northern, central, and eastern regions of the Otonabee River Tertiary Watershed, with the greatest concentration located within the Ouse River Quaternary Watershed. The SGRAs are primarily associated with sandy and gravelly soils, with the highest concentrations occurring in the central-southwestern and southeastern portions of the watershed. • Three municipal surface water intakes are located within the Otonabee River Tertiary Watershed, with associated IPZs extending along the Otonabee and Trent Rivers around Lakefield, Peterborough, and Hastings, encompassing connected water bodies and adjacent lands. • Aquifer characteristics and transmissivity vary, affecting groundwater availability and flow. • Some areas have higher recharge rates, making them important for groundwater sustainability. • Monitoring gaps exist in long-term water quality and quantity trends. • Groundwater supplies drinking water for multiple communities—protection from contamination is critical. • Key areas such as significant groundwater recharge zones, wellhead protection areas, and vulnerable aquifers must be considered in land use planning to safeguard groundwater resources.
Water Quality	The Otonabee Conservation monitors surface water quality across 20 locations in the watershed, with most sites part of the Provincial Water Quality Monitoring Network. Water samples are collected seasonally and used to evaluate the health of streams and lakes, which support ecosystems, recreation, and local water needs. The latest watershed report card (2023) gave the Otonabee Watershed a grade of B, indicating generally good surface water quality.	• According to the 2023 Watershed Report Card, the Otonabee Watershed received an overall grade of B, reflecting generally good surface water quality conditions. Groundwater monitoring results from 2017 to 2021 indicated that concentrations of key parameters remained within the acceptable limits established under the Ontario Drinking Water Quality Standards and the Canadian Water Quality Guidelines. • Some subwatersheds show lower surface water quality, requiring targeted attention.

	Description	Key Highlights/Opportunities
		• Current monitoring provides general assessments; future planning should include more detailed evaluations. • Maintaining and improving water quality is important to protect ecosystems, human health, and water uses. • Long-term data from existing monitoring can support better-informed watershed management strategies.
Monitoring Data	The Otonabee River watershed contains the highest number of climate and streamflow monitoring stations in the county. Twenty-one weather stations and twelve stream gauges are distributed across most of the watershed's quaternary sub-areas. These stations vary in age and data type, with some dating back to the 1800s. Only a few climate stations and streamflow gauges remain active today, but they provide valuable high-resolution data. Some sites, like those near Peterborough and Norwood, offer long-term datasets that are particularly useful for detailed hydrologic analysis.	• Gaps in spatial coverage, especially in the Hastings Lock 18 Dam – Trent River and Cavan Creek subwatersheds. • Limited number of active climate and streamflow stations for current and future modelling. • Only a few stations have long-term records (>20 years), needed for frequency analysis and model calibration. • Combined climate and flow data near Norwood can support strong hydrologic assessments. • Reliable, long-term monitoring is critical for accurate watershed modeling, flood forecasting, and planning for future development.
Natural Heritage	Numerous lakes, rivers, and creeks support a diverse fish community; most aquatic features are characterized by a warmwater thermal regime. Woodlands and wetlands cover approximately 52% of the watershed. In total, 28 ANSIs overlap with the watershed boundaries. SAR and SWH have the potential to be present.	• ELC coverage is limited or absent and will require additional study at future development stages • Site-specific studies will be necessary to confirm existing conditions and determine the presence of significant species and habitats
Natural Hazards	These hazards pose physical risks and limit safe development near watercourses and valleys. • Floodplains: Areas prone to flooding during major storm events. • Erosion hazards: Include unstable slopes, meander belts, and valley walls subject to erosion or failure. • Karst features: Landscapes with sinkholes, underground drainage, and cavities formed in carbonate rock.	• Need to Identify and map: ○ Regulated floodplains ○ Erosion-prone areas (meander belts, top-of-slope setbacks) ○ Karst landscapes (known, inferred, and potential) • Assess constraints these hazards pose to development. • Use hazard data to inform land use planning and protect natural systems.

5 Trent River – Crowe River Tertiary Watershed Characterization

5.1 Physical Environment

5.1.1 Climate

The Trent River - Crowe River Tertiary Watershed does not contain any climate stations. For future studies the best available closest climate station should be used to provide the most accurate representation for the area. Otonabee tertiary watershed is the only watershed within the County with active climate stations, making them the best available data for the Trent River- Crowe River Tertiary watershed at the time of this study, see Section 4.1.1.

Since there are no climate stations in the Trent River - Crowe River Tertiary Watershed within Peterborough County, the Precipitation Surface in Map 5 of the *Conceptual Water Budget – Trent River Watershed* Report was considered to provide an approximate annual precipitation range for this tertiary watershed (2007). Map 5 demonstrated an annual precipitation range within the Trent River - Crowe River Tertiary Watershed of 829- 1028 mm/year based on data from 2006 and earlier (2007).

5.1.2 Physiography and Slopes

The physiographic regions within the Trent River – Crowe River Tertiary Watershed is primarily composed of Georgian Bay Fringe, Algonquin Highlands, Dummer Moraines, Peterborough Drumlin Fields, and Iroquois Plain physiographic regions. As seen in Table 43, Georgian Bay Fringe is the predominant physiographic region, making up 42% of the watershed. The Algonquin Highland region encompassed all of Chandos lake and Paudash Lake Dam quaternary watersheds. The other quaternary watersheds are composed of mix of physiographic regions. A summary of the physiographic regions within each quaternary watershed is shown in Figure 8 and Table 43**.**

A description of the physiographic regions within the Trent River – Crowe River Tertiary Watershed is provided in Appendix C.

Trent River – Crowe River Tertiary Watershed does not contain many prominent physiographical patterns, however, there are some closed depressions the southwest area within the Crowe Bay Dam – Trent River and Kasshabog Lake – North River quaternary watersheds, visible in Figure 8. The Crowe Bay Dam – Trent River quaternary watershed also contains a small portion of Hummocky Terrain in this area.

As shown in Figure 9, the ground surface elevation within the Trent River – Crowe River watershed ranges from a minimum elevation of 170 masl within the Crowe Lake - Crowe River quaternary watershed to a maximum of about 390 masl in the Paudash Lake Dam - Crowe River quaternary watershed.

Table 43 Physiography Regions within the Trent River – Crowe River Watershed

Quaternary Watershed	Area of quaternary watershed (km^2)	Proportion within Tertiary Watershed (%)	Physiography Region (%)				
			Algonquin Highlands	Dummer Moraines	Georgian Bay Fringe	Iroquois Plain	Peterborough Drumlin Field
Chandos Lake - Crowe River	134	19	100	-	-	-	-
Cordova Lake Dam - Crowe River	53	7	60	-	40	-	-
Crowe Bay Dam - Trent River	53	8	-	29	-	29	42
Crowe Lake - Crowe River	139	20	-	83	17	<1	<1
Kasshabog Lake - North River	179	25	<1	9	90	-	-
Paudash Lake Dam - Crowe River	4	1	100	-	-	-	-

-: a particular physiography region is not present within the quaternary watershed (no data reported)

Within the Trent River – Crowe River watershed gentle, moderate, and steep slope categories were used to describe the distribution of surface slopes, as noted and summarized in Table 44. The majority of the watershed (50%) is classified as having moderate slopes. Gentle slopes make up 46% of the watershed and only 4% of the watershed classified as steep slopes. The large portion of moderate and gentle slopes can be attributed to the large area of bare rock ridges and shallow till that makes of the center portion of the tertiary watershed.

Table 44 Surface Slope Distribution within the Trent River – Crowe Tertiary Watershed

Quaternary Watershed	Area of Quaternary Watershed (km^2)	Proportion within Tertiary Watershed (%)	Surface Slope Distribution (%)		
			Gentle Slope (0-2%)	Moderate Slope (2-10%)	Steep Slope (>10%)
Chandos Lake - Crowe River	134	19	39	54	7
Cordova Lake Dam - Crowe River	53	7	41	53	6
Crowe Bay Dam - Trent River	53	8	55	44	1
Crowe Lake - Crowe River	139	20	55	43	2
Kasshabog Lake - North River	179	25	43	52	6
Paudash Lake Dam - Crowe River	4	1	23	64	13
Round Lake - North River Outlet	143	20	48	50	3
Average for Trent River Tertiary Watershed			**46**	**50**	**4**

Based on the Hemson (2022) report, the Havelock future growth area falls within this watershed. Table 45 provides a rough summary of the slope distribution within this potential development areas.

Table 45 Surface Slope Distribution within the Designated Future Development Land within Trent River – Crowe Tertiary Watershed

Settlement (Future Development Lands)	Total area of Settlement (km^2)	Area within Tertiary Watershed (km^2)	Surface Slope Distribution (%)		
			Gentle Slope (0-2%)	Moderate Slope (2-10%)	Steep Slope (>10%)
Havelock	2	2	65	35	0

The Havelock development area is characterized by predominately gentle slopes (65%). The slope distribution for this future growth area differs from the overall tertiary watershed with more gently sloped surfaces, less moderately sloped surfaces, and no steep slopes.

5.1.3 Surficial Geology

The surficial geology of the Trent River – Crowe River Tertiary Watershed consists of 11 distinct geologic units (1, 2, 3, 4, 5a, 5b, 5c, 6, 7, 9c, and 20), as depicted in Figure 10 and Table 5.

Comprehensive information on surficial geology, along with detailed descriptions of individual surficial geological units, is provided in Section 3.3.3.

5.1.4 Bedrock Geology and Bedrock Topography

As illustrated in Figure 11, the bedrock geology of the Trent River – Crowe River Tertiary watershed is primarily comprised of seven distinct geological units: 44 to 49 and 54a. The description of each bedrock geology unit is summarized in Table 6.

The elevation of the bedrock surface approximately ranges from over 370 masl in the northern part of the Trent River – Crowe River Tertiary Watershed (near the Silent Lake Provincial Park) to 165 masl near the southern boundary (within the quarry pit near Preneveau; Figure 11). The bedrock surface generally dips towards the south (ORMGP 2022).

Bedrock thalwegs are present within the Trent River–Crowe River Tertiary Watershed (Figure 11), while tunnel channel thalwegs are notably absent. The bedrock thalwegs generally trend in a north-south and northeast-southwest direction, broadly aligning with the courses of existing rivers, wetlands, and lakes. These features are characterized by deepened valleys that correspond with the pathways of contemporary rivers, lakes, and wetlands, suggesting a strong geomorphic relationship between bedrock structure and surface hydrology.

Comprehensive information on bedrock geology and bedrock topography applicable to the County, along with detailed descriptions of each bedrock geological unit, is provided in Section 3.3.4.

5.1.5 Soils

Figure 13 illustrates the spatial distribution of the various drainage classes and surficial soils within the Trent River – Crowe River Watershed, while Table 46 outlines their respective proportions. Table 46 summarizes the drainage potential classifications.

Table 46 Soil Drainage within the Trent River - Crowe River Watershed

Quaternary Watershed	% of Quaternary Watershed within Tertiary	Area of Quaternary Watershed (km^2)	Soil Drainage Distribution (%)			
			Unknown	High	Medium	Low
Chandos Lake - Crowe River	19	134	-	67	6	28
Cordova Lake Dam - Crowe River	7	53	-	64	2	34
Crowe Bay Dam - Trent River	8	53	<1	68	6	25
Crowe Lake - Crowe River	20	139	-	69	1	30
Kasshabog Lake - North River	25	179	<1	71	5	24
Paudash Lake Dam - Crowe River	1	4	<1	73	-	26
Round Lake - North River Outlet	20	143	-	74	-	26
Average for Trent River - Crowe River Tertiary Watershed			**<1**	**70**	**3**	**27**

Notes:
"-: a particular soil drainage class is not reported within the quaternary watershed (no data reported)
Unknown is comprised of not applicable, variable, and unknown draining soil
High is comprised of very rapid, rapidly, moderately well, and well draining soil
Medium is comprised of imperfectly draining soil
Low is comprised of poorly and very poorly draining soil"

According to the broader classification system, it was determined that all quaternary watersheds within the tertiary watershed are predominantly composed of soils with high drainage potential. The quaternary watersheds with the highest proportion of well-drained soils include Round Lake (42%) and Crowe Bay Dam (30%). All quaternary watersheds contained around 25% of very poorly drained soils with the highest being 29% for Cordova Lake Dam and the lowest being 12% for Crowe Bay Dam.

5.2 Land Use

As demonstrated in Table 47 the proposed land use distribution across the Trent River - Crowe River Watershed is represented by most lands being designated for open space / natural areas (81%), and waterbodies (12%). The other land use types make up a very small portion of this watershed (3% or less).

Urban land makes up a small portion of the land use within the tertiary watershed (2%). The Havelock settlement is classified as a future growth area for the county, refer to Table 48. Industrial activities occupy 3% of land within the watershed. The distribution of these land use classes is shown in Figure 6.

Table 47 Simplified Land Use Distribution for Trent River - Crowe River Watershed

Quaternary Watershed	Proportion of Tertiary Watershed (%)	Area (km²)	Land Use Distribution (%) within each Quaternary Watershed						
			Agricultural	Industrial	Open Space/ Natural Area	Unknown	Urban	Waterbodies	Wetland
Chandos Lake - Crowe River	19	134	0	0	77	2	6	16	0
Cordova Lake Dam - Crowe River	7	53	0	0	92	2	0	10	0
Crowe Bay Dam - Trent River	8	53	29	2	60	3	1	3	3
Crowe Lake - Crowe River	20	139	0	4	82	3	2	11	0
Kasshabog Lake - North River	25	179	0	7	80	3	0	15	0
Paudash Lake Dam - Crowe River	1	4	0	0	106	2	0	6	0
Round Lake - North River Outlet	20	143	0	3	89	3	0	9	1
Average for Trent River - Crowe River			**2**	**3**	**81**	**3**	**2**	**12**	**0**

Note:

The land use classifications have been simplified from the Official Plan designations to form more concise understand of the land use.

Table 12 summarizes which OP designations make up each land use.

Table 48 Areas of Future Growth Settlements in Trent River - Crowe River Watershed

Settlement (Future Development Lands)	Total Area of Settlement (km^2)	Area within Tertiary Watershed (km^2)
Havelock	2	2

5.3 Water Resource System

5.3.1 Surface Drainage

The Trent River – Crowe River watershed is a receiver for water from the Otonabee River watershed through Rice Lake located to the east of the County (Figure 4). Within the watershed, the drainage network has origins in the Peterborough Drumlin Field, Algonquin Highlands, Dummer Moraines, Georgian Bay Fringe, and Iroquois Plain (see Section 3.2.2 for further details). Within the County, the Trent River – Crowe River watershed is 705 km^2 which is 20% of the total tertiary watershed and accounting for 17% of the entire County (Table 6 in Section 3.1).

There are 7 quaternary watersheds, and 3 subwatersheds currently identified by Crowe Valley Conservation within the Trent River – Crowe River tertiary watershed (Table 49). Otonabee Conservation's Rice Lake/Trent River subwatershed extends to cover a portion of the Crowe Bay Dam – Trent River watershed. The remainder of the Crowe Bay Dam – Trent River watershed is not captured by a subwatershed created by either Otonabee Conservation or Crowe Valley Conservation. The largest quaternary watershed within the Trent River – Crowe River tertiary watershed is Kasshabog Lake - North River with a drainage area of 179 km^2 representing 25% of the tertiary watershed area within the County. The smallest watershed within the tertiary watershed is Paudash Lake Dam – Crowe River with a drainage area of 4 km^2 representing approximately 1% of the tertiary watershed within the County.

Table 49 Drainage Area and Subwatersheds within the Trent River – Crowe River Tertiary Watershed

Quaternary Watershed Name	Area of quaternary Watershed (km^2)	% within Tertiary (1)	Subwatersheds (% within the Quaternary Watershed) (2)
Chandos Lake - Crowe River	134	19	Crowe River (99%)
Cordova Lake Dam - Crowe River	53	7	Crowe River (99%)
Crowe Bay Dam - Trent River	53	8	Rice Lake/ Trent River (44%)
Crowe Lake - Crowe River	139	20	Crowe River (99%)
Kasshabog Lake - North River	179	25	North River (96%)
Paudash Lake Dam - Crowe River	4	1	Crowe River (93%)
Round Lake - North River Outlet	143	20	Crowe River (96%)

Notes:
(1) Based on areas within the County
(2) The delineation for each subwatersheds was provided by each Conservation Authority, it should be noted that they do not share the same scale.

Trent River, Crowe River, and North River are the three predominant watercourses within the Trent River – Crowe River watershed. Trent River originates at the outlet of Rice Lake and receives flow from Crowe River south of the County (Figure 14e). The headwaters of Crowe River originate in the northern portion of the tertiary watershed and generally flows south to the confluence with Trent River (Figures 14d and 14e). Crowe River is the primary watercourse within five of the quaternary watersheds. North River is the smallest of the three largest watercourses, originating within the Kasshabog Lake – North River watershed and outletting into Belmont Lake where it converges with Crowe River (Figure 14e).

5.3.1.1 Drainage Network Characteristics

An overview of key drainage network attributes of each quaternary watershed situated within the portion of the Trent River – Crowe River watershed that falls within the County is provided in Table 50.

Paudash Lake Dam – Crowe River has the lowest drainage density (1.00 km/km^2) of the quaternary watersheds (Table 50). The watershed within the County is 4 km^2 and consists of headwaters for the larger watershed beyond the County. The two factors contribute to the lower drainage density of the watershed. Crowe Lake – Crowe River has a drainage area of 139 km^2 and has the second lowest drainage density of 1.19 km/km^2 (Table 50). Crowe Lake – Crowe River contains both Belmont Lake and Crowe Lake which along with other smaller waterbodies represents 12% of the total surface area of the watershed within the County. Waterbodies are not included in the calculation of total watercourse length but are included in the total watershed area used in calculating the drainage density. As a result, generally the larger the proportion of surface area covered by watercourses the lower the drainage density.

Cordova Lake Dam – Crowe River has the highest drainage density of the quaternary watersheds at 1.89 km/km^2 (Table 50). There are 99 km of watercourses and 5 km^2 of waterbody area, representing 9% of the total quaternary watershed area. This quaternary watershed receives the outflow from Chandos Lake.

Cavan Creek, Lock 19 – Otonabee River, and Ouse River watersheds each had the smallest proportion of waterbodies of <1, 3, and 2 km^2 respectively (Table 50). Hastings Lock 18 Dam – Trent River has the highest proportion of waterbody area at 27% as it includes Rice Lake (Table 50). Crowe Bay Dam – Trent River and Paudash Lake Dam – Crowe River have less than 1 km^2 of waterbody area and have 25 and 13 km of shoreline perimeter respectively (Table 50). Kasshabog lake – North River contains 32 km^2 of waterbody area representing 18% of the watershed area and with a shoreline perimeter of 751 km, the largest values of the quaternary watersheds (Table 50).

Table 50 Morphometric Characteristics of the Quaternary Watersheds within the Trent River – Crowe River Watershed

Quaternary Watershed	Area (km²)	% Tertiary Watershed Area	Watercourse Length (km)	Drainage Density (km/km²)	Waterbody Area (km²)	% Waterbody Area	Shoreline Perimeter (km)
Chandos Lake - Crowe River	134	19	183	1.37	21	16	212
Cordova Lake Dam - Crowe River	53	7	99	1.89	5	9	157
Crowe Bay Dam - Trent River	53	8	78	1.47	<1	<1	25
Crowe Lake - Crowe River	139	20	165	1.19	17	12	271
Kasshabog Lake - North River	179	25	258	1.44	32	18	751
Paudash Lake Dam - Crowe River	4	1	4	1.00	<1	5	13
Round Lake - North River Outlet	143	20	231	1.61	13	9	469

5.3.1.2 Drainage Network Alterations

As noted in the introduction of Section 3.2.1 HDF mapping was not available the Trent River - Crowe River Watershed and so the alteration to HDFs has not been characterized.

A cursory review of the watercourse mapping and available aerial imagery reveals evidence of channel realignment within the southern quaternary watersheds in the Trent River - Crowe River Tertiary Watershed. Watercourses in the northern half of the tertiary watershed do not appear to have been realigned likely due to the higher proportions of rural (non-agricultural) land use and wetlands (see Section 3.2.6).

Of the quaternary watershed, five of the watersheds contain dams or are immediately downstream of a watershed containing dams. The remaining two are indirectly impacted by damming as they contain tributaries of the directly altered streams. The indirectly impacted watersheds can respond through adjustment as conveyance of water and sediment is impounded upstream and/or downstream.

5.3.1.3 Drainage Network Conditions and Processes

There was no information provided on the current state of erosion and deposition within the Trent River – Crowe River watershed. This is the type of information that can help inform the impact assessments related to change within a watershed. Since the Round Lake – North River Outlet, Crowe Lake – Crowe River, and Crowe Bay Dam – Trent River include areas of future development (Hemson 2022), a conditions assessment and evaluation of stream process (including erosion sensitivity) exist as gaps in characterization. Further investigation into the fluvial processes of the watershed is recommended at the subwatershed study stage.

5.3.1.4 Streamflow Data

The Trent River - Crowe River Tertiary Watershed has one stream flow gauge located at Crowe River near Glen Alda. A summary identifying the data type, method of collection, period of record and time intervals for each station was prepared to assess the quality of the data source for future modelling exercises and identify any gaps accordingly. This information is summarized on Figure 7 and Table 51.

Table 51 Water Monitoring Gauges and Sources within Trent River – Crowe River Watershed

Quaternary Watershed	Station Name	ID	Time interval	Period of Record	Data Type	Gross Drainage (km^2)	Active or Discontinued	Current Operation Schedule	Lat	Long
Chandos Lake - Crowe River	CROWE RIVER NEAR GLEN ALDA	02HK005	Daily	1968-2025	Flow	456	Active	N/A	44.84444	-77.9311

5.3.2 Hydrogeology

An introduction to the hydrogeological setting is provided in Section 3.4.5.

This section outlines the datasets and tools used to develop the hydrogeological characterization of the Trent River – Crowe River Tertiary Watershed. Key inputs include hydrostratigraphic data, Provincial Groundwater Monitoring Network (PGMN) wells, groundwater recharge and discharge areas, groundwater use information, and source water protection reports.

5.3.2.1 Hydrostratigraphy

Table 52 lists the hydrostratigraphic units identified in the Trent River – Crowe River Tertiary Watershed using the cross-section tool and isopach maps on the ORMGP portal (2022).

Additional information on hydrostratigraphy, along with detailed descriptions of each hydrostratigraphy unit, is provided in Section 3.4.4.1.

Table 52 Hydrostratigraphic Units within the Trent River – Crowe River Tertiary Watershed in Peterborough County

Quaternary Watershed	Present in Tertiary Watershed (Yes / No)								
	Glaciolacustrine/Fluvial/ Recent Deposits	Oak Ridges Aquifer Complex	Upper New Market Till	Inter-Newmarket Sediment	Lower Newmarket Till	Thorncliffe Formation	Sunnybrook Drift	Scarborough Formation	Bedrock
Chandos Lake - Crowe River	Yes	No	Yes	No	No	No	No	No	Yes
Cordova Lake Dam - Crowe River	Yes	No	Yes	No	No	No	No	No	Yes
Crowe Bay Dam - Trent River	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Crowe Lake - Crowe River	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Kasshabog Lake - North River	Yes	No	Yes	Yes	Yes	No	No	No	Yes
Paudash Lake Dam - Crowe River	Yes	No	Yes	No	No	No	No	No	Yes
Round Lake - North River Outlet	Yes	No	Yes	Yes	Yes	No	Yes	No	Yes

Data Source: (ORMGP 2022)

Most quaternary watersheds consistently feature Glaciolacustrine/Fluvial/Recent Deposits. The Oak Ridges Aquifer Complex and deeper aquifer units like the Thorncliffe Formation and Sunnybrook Drift appear only in a few locations—most prominently at Crowe Bay Dam— Trent River, indicating localized hydrogeological complexity and potential aquifer development.

5.3.2.2 Provincial Groundwater Monitoring Network Wells

There is one PGMN location within the Trent River – Crowe River Tertiary Watershed (Figure 22). The characteristics of the established PGMN well are summarized in Table 53.

As shown in Figure 22, the PGMN Well ID W0000258-1, located in the Crowe Bay Dam – Trent River Quaternary watershed within Belmont and Methuen Township. The well is completed in limestone bedrock, with a total depth of 70 m bgs and an open hole interval ranging from 7.01 to 70.0 m bgs. Groundwater levels were monitored from February 12, 2003, to May 30, 2018, with recorded water levels ranging between 191.47 and 203.45 masl. Continued monitoring of this location and additional new locations will help to understand long and short-term trends in water levels, and the influence of climate change and groundwater use on the bedrock aquifer.

It is recommended that future subwatershed studies incorporate more comprehensive assessments of groundwater levels (additional monitoring wells in bedrock and overburden aquifer units), alongside systematic seasonal monitoring, to effectively capture temporal variations and support informed water resource management and monitoring the effects of land use change.

5.3.2.3 Groundwater Recharge Area

The mean annual groundwater recharge rates from the CANWET Model (TCC 2008) for the Trent River – Crowe River Tertiary Watershed is 122 mm/year and the SGRAs mapped from TCC (2009) are illustrated in Figures 19a to 19f. The basis for the recharge estimates is provided in Section 3.4.4.3.

Across the Trent River – Crowe River Tertiary Watershed recharge rates show less variation in recharge rates, predominantly ranging from 115 mm to 135 mm per year, with some smaller watersheds in the range of 60 mm per year.

The highest recharge rates from the CANWET Model and the highest density of SGRAs are found in Quaternary watersheds with the higher proportion of coarser grained granular deposits (i.e. sands and gravels) such as Chandos Lake - Crowe River and Crowe Lake - Crowe River Quaternary Watersheds. The low recharge rate Crowe Bay Dam - Trent River and Kasshabog Lake - North River Quaternary Watersheds are dominated by Paleozoic Bedrock of lower permeability and high proportion of water bodies, as such, these watersheds have little to no SGRAs.

Implementation of infiltration based Low Impact Development measures is more feasible in higher recharge areas and is likely required as part of development to maintain downgradient groundwater discharge function.

Table 53 Overview of PGMN Well within the Trent River – Crowe River Tertiary Watershed in Peterborough County

PGMN Well ID	Quaternary Watershed	Township	Ground Surface Elevation (masl)	Total Well Depth (m bgs)	Screen Interval or Open Hole Interval (m bgs)	Completion Aquifer	Groundwater Level Monitoring Program Range (Years)	Groundwater Level Monitoring Program Range (masl)
W0000258-1	Crowe Bay Dam – Trent River	Belmont and Methuen	204.74	70	Open Hole Interval: 7.01 - 70.0	Bedrock (Limestone)	2003-02-12 to 2018-05-30	191.47-203.45

Notes:
m bgs – metre below ground surface
masl – metres above sea level
PGMN – Provincial Groundwater Monitoring Network
Data Source: (MECP 2023; ORMGP 2022)

5.3.2.4 Groundwater Discharge Area

The groundwater discharge areas within the Trent River – Crowe River Tertiary Watershed are well-aligned with coldwater streams, watercourses and wetlands, as illustrated in Figures 20a to 20f. The method used to map discharge areas is presented in Section 3.4.4.4. Table 54 summarizes the mean depth to the water table for the quaternary watersheds in Trent River – Crowe River Tertiary Watershed.

Table 54 Summary of Mean Depth to Water Table Rate within the Trent River – Crowe River Tertiary Watershed in Peterborough County

Quaternary Watershed	% of Quaternary Watershed Within Tertiary	Area of Quaternary Watershed (km^2)	Mean Depth to Water Table (m bgs)
Chandos Lake - Crowe River	19	134	5
Cordova Lake Dam - Crowe River	7	53	7
Crowe Bay Dam - Trent River	8	53	5
Crowe Lake - Crowe River	20	139	7
Kasshabog Lake - North River	25	179	8
Paudash Lake Dam - Crowe River	1	4	18
Round Lake - North River Outlet	20	143	6

Source: (ORMGP 2022)
m bgs – metres below ground surface

Among the seven Quaternary Watersheds, the mean depth to the water table ranges from approximately 5 to 18 m bgs, highlighting significant variation in groundwater accessibility across the Tertiary Watershed.

Most of the watersheds exhibit relatively shallow water tables, with Chandos Lake - Crowe River and Crowe Bay Dam - Trent River both showing depths of 5 m, suggesting easier access to groundwater and potentially higher susceptibility to surface influences. Similarly, Round Lake - North River Outlet has a depth of 6 m, while Cordova Lake Dam and Crowe Lake - Crowe River are slightly deeper at 7 m. These shallow depths are typical of areas with permeable soils and active recharge zones.

Kasshabog Lake - North River presents a slightly deeper water table at 8 m, which may reflect more complex subsurface geology or reduced recharge rates. However, the most striking outlier is Paudash Lake Dam - Crowe River, with a depth of 18 meters—more than double that of any other watershed listed. This suggests a significantly deeper aquifer system, which could be due to topographic elevation, bedrock conditions, or limited recharge.

Overall, the data indicate that most watersheds in this region have accessible groundwater resources, with only one showing a notably deeper water table. These variations are important for water resource planning, especially in terms of well construction, groundwater sustainability, and vulnerability to contamination.

5.3.2.5 Groundwater Users

Groundwater has served as a vital source of municipal water for numerous communities within the Trent River – Crowe River Tertiary watershed in Peterborough County (see Figures 21a to 21f).

Table 55 has categorized wells into three types for this study: 1) municipal wells, 2) overburden completion, and 3) bedrock completion.

Groundwater use within the Trent River – Crowe River Tertiary Watershed is primarily supported by private wells, with very limited municipal well development across the Quaternary watersheds. The number of municipal wells ranges from zero to six in individual watersheds, compared with hundreds of private wells, showing that most groundwater reliance in this area is on individual water supply systems.

Most wells are completed in bedrock aquifers, with Quaternary completions representing a smaller proportion of total wells. For example, in the Chandos Lake – Crowe River watershed, 92% of wells are bedrock completions, while only 7% are in Quaternary deposits. Similarly, the Kasshabog Lake – North River watershed has 91% bedrock completions and only 9% Quaternary. On average, across the Tertiary watershed, about 85% of wells are bedrock completions, while just 14% are Quaternary completions.

The distribution of wells shows that groundwater users across the Trent River – Crowe River Tertiary Watershed depend heavily on bedrock aquifers, with Quaternary deposits playing a much smaller role. Municipal wells remain sparse, highlighting the rural and private nature of groundwater reliance in this area. Overall, bedrock sources are the dominant groundwater supply for users across the watershed.

5.3.2.6 Source Water Protection

The Trent River – Crowe River Tertiary Watershed is encompassed by three Source Protection Areas: Otonabee-Peterborough, Crowe Valley, and Lower Trent, with the majority of its area lying within the Crowe Valley Source Protection Area.

Wellhead Protection Areas

There are WHPAs located within the Trent River – Crowe River Tertiary Watershed. The WHPAs' locations and descriptions are presented in Figures 21a to 21f.

The municipal residential groundwater supply systems within the Trent River – Crowe River Tertiary Watershed include:

- Town of Havelock – three groundwater supply water wells

Comprehensive information on the WHPAs is provided in Section 3.4.5.

Table 55 Summary of Groundwater Users within the Trent River – Crowe River Tertiary Watershed in Peterborough County

Quaternary Watershed	% of Quaternary Watershed within Tertiary	Area of Quaternary Watershed within the County (km^2)	Water Well Record Type – Number of wells within each Quaternary Watershed			Water Well Record Type - (%) within each Quaternary watershed		
			Municipal Well	Quaternary Completion	Bedrock Completion	Municipal Well	Quaternary Completion	Bedrock Completion
Chandos Lake - Crowe River	19	134	1	39	490	<1	7	92
Cordova Lake Dam - Crowe River	7	53	0	14	127	0	10	90
Crowe Bay Dam - Trent River	8	53	6	63	310	2	17	82
Crowe Lake - Crowe River	20	139	2	216	861	<1	20	80
Kasshabog Lake - North River	25	179	0	19	185	0	9	91
Paudash Lake Dam - Crowe River	1	4	0	0	0	0	0	0
Round Lake - North River Outlet	20	143	1	70	235	<1	23	77
Average for Trent River - Crowe River Tertiary Watershed						<1	14	85

Data Source: (ORMGP 2022)

Highly Vulnerable Aquifers

The Trent River–Crowe River Tertiary Watershed is predominantly situated within designated HVAs, as illustrated in Figures 21a to 21f.

The extensive presence of HVAs within the Tertiary Watershed underscores the critical importance of implementing land use regulations, comprehensive source water protection strategies, and proactive environmental planning to preserve groundwater quality and ensure a sustainable supply throughout the Trent River – Crowe River Watershed.

More detailed information on the HVAs is provided in Section 3.4.5.

Significant Groundwater Recharge Areas

The SGRAs coverage for the Trent River – Crowe River Tertiary Watershed is presented in Figures 19a to 19f. The SGRAs predominantly occur in the northern and southern portions of the Trent River-Crowe River Tertiary Watershed.

The sandy composition of the Trent River-Crowe River Tertiary Watershed contributes to the widespread presence of SGRAs across the southern extent. In addition, Figures 19a to 19f further illustrate a strong hydrogeological linkage between SGRAs, wetlands, and cold-water streams within the Trent River – Crowe River Tertiary Watershed, highlighting a critical ecological and hydrological connection that supports overall watershed health and resilience.

Similar to HVAs, potential policy applications for SGRAs align with the Provincial Planning Statement and the relevant municipal official plans. In areas designated as SGRAs, it is recommended that recharge rates be preserved when development or site alterations are proposed in addition to recharge areas that have lower recharge rates but are linked to sensitive wetland and stream features.

Comprehensive information on the SGRAs is provided in Section 3.4.5.

Intake Protection Zones (IPZs)

There are no IPZs located within the Trent River – Crowe River Tertiary Watershed.

5.3.3 Water Quality

5.3.3.1 Surface Water Quality

The Crowe Valley Conservation conducts ongoing surface water quality monitoring throughout its watershed, collecting samples from numerous sites. The resulting data informs evaluations of both surface water conditions and broader watershed health, with key insights presented in the Watershed Report Card (Crowe Valley Conservation, 2023). Table 56 presents the 2023 surface water quality evaluations for subwatersheds within the Trent River – Crowe River Tertiary Watershed. According to the 2023 Watershed Report Card (Crowe Valley Conservation, 2023), the

Crowe River Watershed received an overall grade of A, indicating excellent surface water quality across the region.

Table 56 Summary of Surface Water Quality within Trent River – Crowe River Tertiary Watershed in Peterborough County

Quaternary Watershed	Subwatersheds (% within the Quaternary Watershed) (1)	Surface Water Quality Grade (2)	2023 Watershed Report Cards Summary (3)
Chandos Lake - Crowe River	Crowe River (99%)	A - Excellent	• Overall, A Grade for the Crowe River Watershed (Crowe Valley Conservation, 2023) • Since the 2018 Watershed Report card, the water quality declined from excellent to good for the North River (Crowe Valley Conservation, 2023).
Cordova Lake Dam - Crowe River	Crowe River (99%)	A – Excellent	
Crowe Bay Dam - Trent River(4)	Rice Lake/ Trent River (44%)	A - Excellent	
Crowe Lake - Crowe River	Crowe River (99%)	A – Excellent	
Kasshabog Lake - North River	North River (96%)	B – Good	
Paudash Lake Dam - Crowe River	Crowe River (93%)	A – Excellent	
Round Lake - North River Outlet	Crowe River (96%)	A – Excellent	

Notes:
(1) The delineation for each subwatershed was provided by each Conservation Authority; it should be noted that they do not share the same scale.
(2) Two indicators were utilized to evaluate the quality of surface water: phosphorus and benthic macroinvertebrates. Phosphorus, a nutrient found both naturally and through human activities, can lead to algae blooms, excessive plant growth, and reduced oxygen levels when present in high concentrations. In contrast, benthic macroinvertebrates, due to their varying sensitivities to water quality, are reliable indicators of the long-term health of aquatic environments (CVCA 2023).
(3) Source: (CVCA 2023).
(4) No assessment has been conducted for the Crowe Bay Dam–Trent River Quaternary Watershed situated south of Havelock within the County of Peterborough (LTRCA 2023)

The Watershed Report Cards provide a more generalized analysis compared to the detailed evaluations in the Conservation Authority's annual water quality reports. Future quaternary watershed plans should aim for more comprehensive assessments.

Additional information on the surface water quality is provided in Section 3.4.6.

5.3.3.2 Ground Water Quality

The Crowe Valley Conservation conducts ongoing groundwater quality monitoring throughout its watershed, collecting samples from numerous sites. The data obtained from these sites are used to assess groundwater conditions and inform evaluations of overall watershed health, with key insights presented in the Watershed Report Card (CVCA 2023).

According to the 2023 Watershed Report Card, groundwater quality in the Crowe Valley Conservation was evaluated through the analysis of key chemical indicators, including nitrate and chloride—substances that, at elevated levels, may pose risks to human health. As reported in the 2023 Watershed Report Card (CVCA 2023), concentrations of these parameters at the monitoring sites remained within the acceptable limits defined by the Ontario Drinking Water Quality Standards and the Canadian Water Quality Guidelines during the monitoring period from 2017 to 2021.

The Watershed Report Cards provide a more generalized analysis compared to the detailed evaluations in Conservation's annual water quality reports. Future quaternary watershed plans should aim for more comprehensive assessments.

5.4 Natural Hazards

Detail on the types of natural hazards, associated setbacks, and applicable agencies or regulators are included in Section 3.5. The following summarizes the results for the Trent River – Crowe River Tertiary Watershed.

Table 57 Natural Hazards within the Trent River - Crowe River Tertiary Watershed by Quaternary Watershed

Quaternary Watershed	% of the Watershed Within the Tertiary Watershed	Area of Quaternary Watershed (Km^2)	Natural Hazard					
			Known Karst (%)	Inferred Karst (%)	Potential Karst (%)	Floodplain Area (km2)	Regulated Top of Slope Area (km2)	Meander Belt Area (km2)
Chandos Lake - Crowe River	18.96	133.57	0	0	0	32	-	-
Cordova Lake Dam - Crowe River	7.46	52.58	0	<1	0	13	-	-
Crowe Bay Dam - Trent River	7.55	53.21	6	1	75	0	-	-
Crowe Lake - Crowe River	19.73	139.01	4	1	48	19	-	-
Kasshabog Lake - North River	25.38	178.78	0	7	2	21	-	-
Paudash Lake Dam - Crowe River	0.62	4.33	0	0	0	9	-	-
Round Lake - North River Outlet	20.30	143.02	1	4	39	32	-	-

Karst landscapes are illustrated in Figure 11. As shown in Table 57, Known karst features are most prominent in the Crowe Bay Dam–Trent River watershed (6%) and the Crowe Lake–Crowe River watershed (4%), with smaller areas also identified in the Round Lake–North River Outlet watershed (1%). Inferred karst occurs in several watersheds, including Crowe Bay Dam–Trent River (1%), Crowe Lake–Crowe River (1%), Cordova Lake Dam–Crowe River (<1%), Kasshabog Lake–North River (7%), and Round Lake–North River Outlet (4%). Potential karst is most extensive in Crowe Bay Dam–Trent River (75%), followed by Crowe Lake–Crowe River (48%) and Round Lake–North River Outlet (39%). In contrast, Chandos Lake–Crowe River and Paudash Lake Dam–Crowe River show no mapped karst features.

In terms of land use, areas with known karst should be treated with caution due to the potential for instability and groundwater vulnerability. Development in these zones should be avoided where possible or supported only after detailed geotechnical and hydrogeological investigations confirm stability and protection measures. Inferred and potential karst areas, particularly those in the Crowe Bay, Crowe Lake, Kasshabog Lake, and Round Lake watersheds, require a precautionary approach. Site-specific subsurface studies should be mandatory prior to development approvals, and land uses such as conservation, agriculture, or passive recreation are more appropriate than intensive urban or industrial uses. Watersheds without karst, such as Chandos Lake–Crowe River and Paudash Lake Dam–Crowe River, are better suited to accommodate development pressures, though planning must still account for other natural hazards such as floodplains, regulated slopes, and meander belts.

The highest sensitivity to karst hazards is observed in the following watersheds: Crowe Bay Dam–Trent River, Crowe Lake–Crowe River, and Round Lake–North River Outlet. These areas exhibit overlapping known, inferred, and potential karst features with other natural hazards. As such, they should be prioritized for conservation and low-intensity land uses. Higher-intensity development should be directed to areas with limited or no karst presence, provided that floodplain and slope constraints are adequately addressed.

Meander belt and regulated top-of-slope mapping is currently unavailable for watercourses in the Trent River–Crowe River watershed within the County. This represents a significant gap that should be addressed to support future subwatershed studies and improve hazard delineation.

With respect to the floodplain distribution, the Chandos Lake quaternary watershed contains the largest proportion of delineated floodplain area at 4.5% of its total area. All other quaternary watersheds within the Trent River tertiary watershed have less than 3% floodplain coverage. This data should inform subwatershed studies and be used to identify development constraints and guide planning in potential growth areas.

5.5 Aquatic and Terrestrial Features

To provide a high-level characterization of the aquatic features within the Trent River – Crowe River tertiary watershed, Table 58 presents a summary of the lakes, rivers, creeks, fish habitat, and thermal regime information available from background sources. Similarly, a high-level analysis of terrestrial features within the tertiary watershed is presented in Table 58.

Table 58 Trent River – Crowe River Tertiary Watershed Aquatic Feature Characterization

Lakes	Quiet Lake, Tallan Lake, Chandos Lake, Little Tallan Lake, Devils Lake, Kasshabog Lake, East Twin Lake, Sams Lake, Blind Lake, Oak Lake, Black Lake, Sandy Lake, West Twin Lake, Rock Lake, Bott's Lake, Clydesdale Lake, Little Loon Lake, Imp Lake, Horse Lake, Bog Lake, Barrette Lake, Big Mountain Lake, Bottle Lake, Blue Lake, Little Chandos Lake, Lasswade Lake, Grassy Lake, Methuen lake, Tangamong Lake, Belmont Lake, Round Lake, Lost Lake, Beloporine Creek, Little Whitney Lake, Cordova Lake, South Lake, Long Lake, Crowe Lake
Rivers	Crowe River, North River, Trent River
Creeks	Tallan Creek, Plato Creek, Whitney Creek, Otter Creek, Beloporine Creek
Fish Species	Banded Killifish, Blacknose Shiner, Bluntnose Minnow, Brassy Minnow, Brook Stickleback, Brook Trout, Central Mudminnow, Common Shiner, Creek Chub, Fallfish, Finescale Dace, Golden Shiner, Iowa Darter, Largemouth Bass, Muskellunge, Northern Pearl Dace, Northern Redbelly Dace, Pumpkinseed, Rainbow Trout, Rock Bass, Smallmouth Bass, Western Blacknose Dace, White Sucker, Yellow Perch
Fish Activity Areas	White Sucker, Cisco, Lake Trout, Muskellunge, Walleye, Smallmouth Bass, and Largemouth Bass Spawning Areas
Thermal Regime (1)	Warm: 88% Cold: 22%

Note:
(1) Total mapped watercourse segments: 1014

Table 59 Trent River – Crowe River Tertiary Watershed Wetlands, Woodlands, and Areas of Natural and Scientific Interest (ANSIs)

Parameter	Value
Total Tertiary Watershed Area[1]	**705 km^2**
Wetlands	
Provincially Significant Wetland	29 km^2 (4.1%)
Non-Provincially Significant Wetland	4 km^2 (0.5%)
Unevaluated Wetland	114 km^2 (16.2%)
Total Wetland Area	**147 km^2 (21%)**
Wetland Types (% of mapped wetlands)	
Bog	0.21%
Fen	0.87%
Marsh	8.16%
Open Water	1.24%
Swamp	64.71%
Unknown	24.82%
Woodlands	
Total Wooded Area	**457 km^2 (65%)**
Areas of Natural and Scientific Interest (ANSIs)	
Provincially Significant ANSI (Life Science)	1
Regionally Significant ANSI (Life Science)	3

Parameter	Value
Provincially Significant ANSI (Earth Science)	0
Regionally Significant ANSI (Earth Science)	1
Total Number of Candidate and Confirmed ANSIs	**5**

Note:
Corresponds to the total area of the watershed overlapping with County boundaries

6 Gull River Tertiary Watershed Characterization

6.1 Physical Environment

6.1.1 Climate

The Gull River Watershed has one climate station located at Goose Lake - Burnt River. This climate station is inactive and recorded data from 1897 to 1950. Since the data from these stations are now over 75 years old, it is not representative of current conditions. As such the best available, closest climate station should be used to provide the most accurate representation for the area. Otonabee tertiary watershed is the only watershed within the County with active climate stations, making it the best available data for the Gull River Tertiary watershed at the time of this study, see Section 4.1.1.

Table 60 Climate Monitoring Gauges and Sources within Gull River Watershed

Quaternary Watershed	Source	Station Name	Station ID	Time interval	Period of Record	Years of Data	Data Type	Lat	Long	Status
Goose Lake - Burnt River	Environment Canada	KINMOUNT	6164198	Daily	1897-1950	53	Precipitation	44.75	-78.633	Inactive

Since there are no active climate stations in the Gull River Tertiary Watershed within Peterborough County, the Precipitation Surface in Map 5 of the *Conceptual Water Budget – Trent River Watershed* Report was considered to provide an approximate annual precipitation range for this tertiary watershed (2007). Map 5 demonstrated an annual precipitation range within the Gull River Tertiary Watershed of 993- 1092 mm/year based on data from 2006 and earlier (2007). The Gull River tertiary watershed has the highest annual precipitation range out of all the tertiary watershed within Peterborough County.

6.1.2 Physiography and Slopes

The Gull River Watershed is primarily composed of Georgian Bay Fringe and contains a small portion of Algonquin Highlands and Dummer Moraines. As seen in Table 61, Georgian Bay Fringe is the dominant physiographic region, making up 93% of the overall watershed. The Georgian Bay

Fringe region encompassed all of Birchbark Lake - Irondale River and Farquhar Lake - Irondale River quaternary watersheds. The Goose Lake - Burnt River quaternary watershed is mainly composed of the Georgian Bay Fringe (93%) and a small portion of Dummer Moraines (5%) and Algonquin Highlands (1%). A summary of the physiographic regions within each quaternary watershed is shown in Figure 8 and Table 61.

Table 61 Physiographic Regions within the Gull River Tertiary Watershed

Quaternary Watershed	Area of quaternary watershed (km^2)	Proportion within Tertiary Watershed (%)	Physiography Region (%)		
			Algonquin Highlands	Dummer Moraines	Georgian Bay Fringe
Birchbark Lake - Irondale River	36	26	-	-	100
Farquhar Lake - Irondale River	5	4	-	-	100
Goose Lake - Burnt River	100	71	1	5	93

-: a particular physiography region is not present within the quaternary watershed (no data reported)

A description of the physiographic regions within the Gull River Tertiary Watershed is provided in Appendix C.

Gull River Tertiary Watershed does not contain any Hummocky Terrain or closed depressions or other prominent patterns visible in Figure 8.

The result of the DEM slope analysis found that the Gull River Watershed has a maximum ground surface elevation of 405 masl in the Farquhar Lake - Irondale River quaternary watershed and a minimum elevation of 270 masl at Goose Lake – Burnt River quaternary watershed, represented in Figure 9.

Table 62 summarizes the distribution of ground slopes by the gentle, moderate, and steep categories. The majority of the watershed (57%) is classified as having moderate slopes. Gentle slopes also make up a significant portion (38%) of the overall watershed while steep slopes only classify 5% of the watershed. The high portion of medium slopes can be attributed to the large regions of bare rock ridges and shallow till and shallow till and rock ridges in this area.

Table 62 Surface Slope Distribution within the Gull Tertiary Watershed

Quaternary Watershed	Area of Quaternary Watershed (km^2)	Proportion within Tertiary Watershed (%)	Surface Slope Distribution (%)		
			Gentle Slope (0-2%)	Moderate Slope (2-10%)	Steep Slope (>10%)
Birchbark Lake - Irondale River	36	26	32	60	8
Farquhar Lake - Irondale River	5	4	36	61	3
Goose Lake - Burnt River	100	71	41	55	4
Average for Gull River Tertiary Watershed			**38**	**57**	**5**

6.1.3 Surficial Geology

The surficial geology of the Gull River Tertiary Watershed consists of 10 distinct geologic units (1, 2, 3, 4, 6, 7, 8a, 9c, 19, and 20), as depicted in Figure 10 and Table 13.

Comprehensive information on surficial geology, along with detailed descriptions of individual surficial geological units, is provided in Section 3.3.3.

6.1.4 Bedrock Geology and Bedrock Topography

As illustrated in Figure 11, the bedrock geology of the Gull River Tertiary Watershed is primarily comprised of seven distinct geological units: 44 to 49, and 54a. Of these, Unit 46 (Carbonate metasedimentary rocks) dominates the watershed, forming the majority of its subsurface composition.

The elevation of the bedrock surface approximately ranges from over 376 masl in the northeastern part of the Gull River Tertiary watershed to 275 masl near the northwestern and southern parts of the Gull River Tertiary watershed. The bedrock surface generally dips towards the south (ORMGP 2022).

Bedrock thalweg is present within the Gull River Tertiary Watershed (Figure 11), while tunnel channel thalwegs are notably absent. The bedrock thalweg generally trends in a northeast–southwest direction, broadly aligning with the courses of existing rivers, wetlands, and lakes. These features are characterized by deepened valleys that correspond with the pathways of contemporary rivers, lakes, and wetlands, suggesting a strong geomorphic relationship between bedrock structure and surface hydrology.

Comprehensive information on bedrock geology and bedrock topography applicable to the County, along with detailed descriptions of each bedrock geological unit, is provided in Section 3.3.4.

6.1.5 Soils

Figure 13 illustrates the spatial distribution of the various drainage classes and surficial soils within the Gull River Watershed, while Table 63 outlines their respective proportions. Table 63 summarizes the drainage potential classifications.

Table 63 Soil Drainage within the Gull River Watershed

Quaternary Watershed	% of Quaternary Watershed within Tertiary	Area of Quaternary Watershed (km²)	Soil Drainage Distribution (%)			
			Unknown	High	Medium	Low
Cavan Creek	26	36	<1	70	11	18
Hastings Lock 18 Dam - Trent River	4	5	8	24	56	13
Indian River	71	100	<1	87	<1	12
Average for Gull River Tertiary Watershed			**<1**	**81**	**5**	**14**

Notes:
"-: a particular soil drainage class is not reported within the quaternary watershed (no data reported)
Unknown is comprised of not applicable, variable, and unknown draining soil
High is comprised of very rapid, rapidly, moderately well, and well draining soil
Medium is comprised of imperfectly draining soil
Low is comprised of poorly and very poorly draining soil"

According to the broader classification system used for this study, it was determined that all quaternary watersheds within the County are predominantly composed of soils with high, rapid, drainage potential. None of the quaternary watersheds contain well-drained soil. Soil with low drainage potential made up 14% of the watershed, with the majority being very poor.

6.2 Land Use

As demonstrated in Table 64 **Error! Reference source not found.** the proposed land use distribution across the Gull River Watershed is represented by most lands being designated for open space / natural areas (88%), and waterbodies (6%). The other land use types make up a very small portion of this watershed (3% or less).

Urban lands make up a small portion of the land use within the tertiary watershed, only 3% of the watershed. The distribution of these land use classes is shown in Figure 6.

Table 64 Simplified Land Use Distribution for Gull River Watershed

Quaternary Watershed	Proportion of Tertiary Watershed (%)	Area (km^2)	Land Use Distribution (%) within each Quaternary Watershed						
			Agri-cultural	Industrial	Open Space/ Natural Area	Unknown	Urban	Water-bodies	Wetland
Birchbark Lake - Irondale River	25.56	36	0	0	78	2	5	15	0
Farquhar Lake - Irondale River	3.84	5	0	0	90	3	0	6	0
Goose Lake - Burnt River	70.6	100	0	5	92	2	2	3	0
Average for Gull River			**0**	**3**	**88**	**2**	**3**	**6**	**0**

Note: The land use classifications have been simplified from the Official Plan designations to form more concise understand of the land use.

Table 12 summarizes which OP designations make up each land use.

6.3 Water Resources

6.3.1 Surface Drainage

The Gull River watershed is located to the northwest of the Study Area, accounting for 3% of the total County surface area (Figure 4). Within the watershed, watercourses have their origins almost entirely in the Georgian Bay Fringe (see Section 3.3.2 for further details). 142 km^2 or 4% of the total watershed area is within the County boundary (Table 10). The watershed within the County falls outside the jurisdiction of any Conservation Authority and is regulated by the MNR Districts of Bancroft and Peterborough.

There are 3 quaternary watersheds within the Gull River tertiary watershed (Table 65). The largest quaternary watershed of the Gull River tertiary watershed within the County is Goose Lake – Burnt River with a drainage area of 100 km^2 representing 71% of the tertiary watershed area. The smallest watershed within the tertiary watershed is Farquhar Lake - Irondale River with a drainage area of 5 km^2 representing approximately 4% of the tertiary watershed within the study area. Farquhar Lake – Irondale River is the upstream most watershed of the three quaternary watersheds and Goose lake – Burnt River is the most downstream (Figure 14a).

Table 65 Drainage Area and Subwatersheds within the Gull River Tertiary Watershed

Quaternary Watershed Name	Area of Quaternary Watershed (km^2)	% within Tertiary (1)	Subwatersheds (% within the quaternary watershed) (2)
Birchbark Lake - Irondale River	36	26	NI
Farquhar Lake - Irondale River	5	4	NI
Goose Lake - Burnt River	100	71	NI

Notes:
(1) Based on areas within the County
(2) The delineation for each subwatersheds was provided by each Conservation Authority, it should be noted that they do not share the same scale.
NI: No subwatersheds identified at this time.

Burnt River and Irondale River are the predominant watercourses within the quaternary watersheds but neither of them intersects the Study Area. Headwater tributaries of those watercourses originate within the study area. Union Creek is the largest of the tributaries and is located within the Goose Lake – Burnt River watershed in the north-west corner of the County (Figure 14a). Irondale River and Union Creek are both tributaries of Burnt River that converge beyond the County boundary (Figure 14a).

6.3.1.1 Drainage Network Characteristics

An overview of key morphometric attributes of each quaternary watershed situated within the portion of the Gull River watershed that falls within the County is provided in Table 66.

Watershed topography is dominated by depressions, and the land is generally impermeable, resulting in a relatively high drainage density. The following provides an overview of each quaternary watershed:

Farquhar Lake – Irondale River has the lowest drainage density (1.30 km/km^2) of the quaternary watersheds because it is 4 km^2 and contains less than 1 km^2 of waterbodies (Table 66). Birchbark Lake – Irondale River has a drainage area of 36 km^2 and has the second lowest drainage density of 1.52 km/km^2 (Table 66). Birchbark Lake – Irondale River contains Birchbark Lake which along with a few smaller waterbodies represents 15% of the total surface area of the watershed within the Study Area. Waterbodies are not included in the calculation of total watercourse length but are included in the total watershed area used in calculating the drainage density. As a result, generally the larger the proportion of surface area covered by watercourses the lower the drainage density.

Goose Lake – Burnt River has an area of 100 km^2 and 229 km of watercourses resulting in the highest drainage density of the quaternary watersheds at 2.28 km/km^2 (Table 66). The watershed contains 3 km^2 of waterbodies, representing 3% of the total quaternary watershed area. This quaternary watershed contains Union Creek.

The total area of waterbodies for all three quaternary watersheds is small (Table 66). Birchbark Lake - Irondale River has the highest proportion of waterbody area at 15% as it includes Birchbark Lake (Table 66). Farquhar Lake – Irondale River has less than 1 km^2 of waterbody area representing 6% of the water body area and 20 km of shoreline perimeter (Table 66). Goose Lake – Burnt River contains 3 km^2 of waterbody area representing 3% of the watershed area and with a shoreline perimeter of 144 km, the longest shoreline perimeter of the quaternary watersheds (Table 66).

Table 66 Morphometric Characteristics of the Quaternary Watersheds within the Gull River Watershed

Quaternary Watershed	Area (km^2)	% Tertiary Watershed Area	Watercourse Length (km)	Drainage Density (km/km^2)	Waterbody Area (km^2)	% Waterbody Area	Shoreline Perimeter (km)
Birchbark Lake - Irondale River	36	26	55	1.52	5	15	86
Farquhar Lake - Irondale River	5	4	7	1.30	<1	6	20
Goose Lake - Burnt River	100	71	229	2.28	3	3	144

6.3.1.2 Drainage Network Alterations

Cursory review of the watercourse mapping and available aerial imagery shows little evidence of drainage network alteration within the Gull River watershed. The Gull River watershed is predominantly “parks and conservation” and “rural” (non-agricultural) land uses that are not associated with significant drainage network alterations (See Section 3.3.6 for land use information). Alterations within the watershed can be assumed to have occurred through the creation of roadside drainage and ditches. However, broader pronounced channel alterations are less likely due to shallow bedrock and bedrock outcrops throughout.

The Gull River watershed within the County is not part of the Trent Severn Waterway and cursory review did not find any dams or locks. This should be confirmed at future stages, as there are likely some anthropogenic alterations to flow and sediment conveyance that cannot be identified nor mapped at the current study scale.

6.3.1.3 Drainage Network Conditions and Processes

Data and reporting are not available to characterize erosion and deposition within the Gull River watershed. The dominance of bare rock ridges and shallow till within the watershed limit the available sediment that can be readily transported. Further investigations into the fluvial processes of the watershed are recommended for future subwatershed studies.

6.3.1.4 Streamflow Data

The Gull River Tertiary Watershed does not contain any Water Survey Canada stream flow gauges at the time of this study.

6.3.2 Hydrogeology

The hydrogeological characterization is summarized in Section 3.4.4. An introduction to the hydrogeological setting is provided in Section 6.4.5.

This section outlines the datasets and tools used to develop the hydrogeological characterization of the Gull River Tertiary Watershed. Key inputs include hydrostratigraphic data, Provincial Groundwater Monitoring Network (PGMN) wells, groundwater recharge and discharge areas, groundwater use information, and source water protection data.

6.3.2.1 Hydrostratigraphy

Table 67 lists the hydrostratigraphic units identified in the Gull River Tertiary Watershed using the cross-section tool and isopach maps on the ORPGP portal (2022).

Comprehensive information on hydrostratigraphy, along with detailed descriptions of each hydrostratigraphy unit, is provided in Section 3.4.4.1.

Table 67 Hydrostratigraphic Units within the Gull River Tertiary Watershed in Peterborough County

Quaternary Watershed	Present in Tertiary Watershed (Yes / No)								
	Glaciolacustrine/Fluvial/ Recent Deposits	Oak Ridges Aquifer Complex	Upper New Market Till	Inter-Newmarket Sediment	Lower Newmarket Till	Thorncliffe Formation	Sunnybrook Drift	Scarborough Formation	Bedrock
Birchbark Lake - Irondale River	Y	N	Y	Y	N	N	N	N	Y
Farquhar Lake - Irondale River	Y	N	N	N	N	N	N	N	Y
Goose Lake - Burnt River	Y	N	N	N	N	N	N	N	Y

Data Source: (ORMGP 2022)

All three watersheds, Birchbark Lake, Farquhar Lake, and Goose Lake, contain Glaciolacustrine/Fluvial/Recent Deposits. The Upper Newmarket Till and Inter-Newmarket Sediment only appears to be presented at Birchbark Lake – Irondale River Quaternary watershed. The shallow aquifer unit – Oak Ridges Aquifer Complex and deeper aquifer units like the Thorncliffe Formation, and Scarborough Drift are notably absent throughout the Gull River Tertiary watershed in Peterborough County which is mostly bedrock at surface.

6.3.2.2 Provincial Groundwater Monitoring Network Wells

There are no PGMN wells within the Gull River Tertiary Watershed in Peterborough County. The vast majority of the PGMN wells are focused in the southern portion, which will limit insights into groundwater dynamics in northern portion of the County.

It is recommended that future quaternary subwatershed plans incorporate more comprehensive assessments of groundwater levels, alongside systematic seasonal monitoring, to effectively capture temporal variations and support informed water resource management.

6.3.2.3 Groundwater Recharge Area

The mean annual groundwater recharge rates from the CANWET Model (TCC 2008) for the Gull River Tertiary Watershed is 484 mm/year and the SGRAs mapped from TCC (2009) are illustrated in Figures 19a to 19f. The basis for the recharge estimates is provided in Section 3.4.4.3.

Based on the CANWET Model results, the Gull River Tertiary Watershed has the highest recharge rates in the County and since it is smaller in size, the recharge rates are generally uniform with very smaller portions having recharge rates in the range of 120 to 160 mm per year. In the Goose Lake - Burnt River Quaternary Watershed (the majority of the Tertiary Watershed) the SGRAs corresponds with the areas with a high proportion of coarser granular deposits.

Implementation of infiltration based Low Impact Development is more feasible in higher recharge areas and is likely required as part of development to maintain downgradient groundwater discharge function.

6.3.2.4 Groundwater Discharge Area

The groundwater discharge areas within the Gull River Tertiary Watershed are well-aligned with coldwater streams, watercourses, and wetlands, as illustrated in Figures 20a to 20f. The method used to map discharge areas is presented in Section 3.4.4.4. Table 68 summarizes the mean depth to the water table for the Gull River Tertiary Watershed.

Table 68 Summary of Mean Depth to Water Table within the Gull River Tertiary Watershed in Peterborough County

Quaternary Watershed	% of Quaternary Watershed Within Tertiary	Area of Quaternary Watershed (km^2)	Mean Depth to Water Table (m bgs)
Birchbark Lake - Irondale River	26	36	7
Farquhar Lake - Irondale River	4	5	1
Goose Lake - Burnt River	71	100	6

Source: (ORMGP 2022)
m bgs – metres below ground surface

Among the three Quaternary Watersheds, the mean depth to the water table ranges from approximately 1 m bgs at the Farquhar Lake – Irondale River to 7 m bgs at the Birchbark Lake – Irondale River, indicating generally shallow aquifers that are likely responsive to surface recharge and environmental changes.

In general, shallow groundwater levels are commonly associated with low-lying features such as stream valleys and wetlands, while deeper water tables prevail in regions of higher elevation.

Together, these watersheds demonstrate a range of groundwater conditions, with generally shallow depths that support accessible water resources where limestone bedrock is present, but is less available in areas with metamorphic or igneous bedrock at surface.

6.3.2.5 Groundwater Users

The groundwater users for the Gull River Tertiary Watershed have been presented in Figures 21a to 21f and summarized in Table 69.

Table 69 has been categorized wells into three types for this study: 1) municipal wells, 2) overburden completion, and 3) bedrock completion.

Groundwater use within the Gull River Tertiary Watershed is almost entirely based on private wells, with no municipal wells recorded across the Quaternary watersheds. This reflects the lower population density. The total number of wells is relatively small compared with other tertiary watersheds, but the distribution indicates consistent reliance on private groundwater supplies for local users.

Most wells in this watershed are completed in bedrock aquifers, with Quaternary completions making up only a minor share. For example, in the Birchbark Lake – Irondale River watershed, 91% of wells are completed in bedrock and only 9% in Quaternary deposits. Similarly, in the Goose Lake – Burnt River watershed, 90% of wells are bedrock completions and 10% are Quaternary. Across the Tertiary watershed as a whole, about 90% of wells are bedrock completions, with just 10% completed in Quaternary deposits.

The Farquhar Lake – Irondale River watershed stands out with no well records reported, suggesting very limited groundwater development in that area. Overall, the Gull River Tertiary Watershed demonstrates a strong dependence on bedrock aquifers, with groundwater use concentrated in small pockets of development supported mainly by private wells.

Furthermore, information on the groundwater users is provided in Section 3.4.5.

Table 69 Summary of Groundwater Users within the Gull River Tertiary Watershed in Peterborough County

Quaternary Watershed	% of Quaternary Watershed within Tertiary	Area of Quaternary Watershed within the County (km^2)	Water Well Record Type – Number of wells within each Quaternary Watershed			Water Well Record Type - (%) within each Quaternary Watershed		
			Municipal Well	Quaternary Completion	Bedrock Completion	Municipal Well	Quaternary Completion	Bedrock Completion
Birchbark Lake - Irondale River	25.56	26	36	0	5	50	0	9	91
Farquhar Lake - Irondale River	3.84	4	5	0	0	0	0	0	0
Goose Lake - Burnt River	70.60	71	100	0	25	219	0	10	90
Average for Gull River Tertiary Watershed							0	10	90

Data Source: (ORMGP 2022)

6.3.2.6 Source Water Protection

The Gull River Tertiary Watershed falls under the Kawartha-Haliburton Source Protection Area.

Wellhead Protection Areas

Based on Figures 21a to 21f, there are no WHPAs located within the Gull River Tertiary Watershed. Comprehensive information on the WHPAs is provided in Section 3.4.5.

Highly Vulnerable Aquifers

The Gull River Tertiary Watershed is predominantly situated within designated HVAs, as illustrated in Figures 21a to 21f.

The extensive presence of HVAs within the Tertiary Watershed underscores the critical importance of implementing land use regulations, comprehensive source water protection strategies, and proactive environmental planning to preserve groundwater quality and ensure a sustainable supply throughout the Gull River Watershed.

More information on the HVAs is provided in Section 3.4.5.

Significant Groundwater Recharge Areas

The SGRAs coverage for the Gull River Tertiary Watershed is presented in Figures 19a to 19f. The SGRAs predominantly occur in the north to northwestern portions of the Gull River Tertiary Watershed in areas with sand and gravel at surface. SGRAs in bedrock are localized and align with areas of lower topography and limestone or metasedimentary rocks.

Similar to HVAs, potential policy applications for SGRAs align with the Provincial Planning Statement and the relevant municipal official plans. In areas designated as SGRAs, it is recommended that recharge rates be maintained when development or site alterations are proposed in addition to recharge areas that have lower recharge rates but are linked to sensitive wetland and stream features.

Comprehensive information on the SGRAs is provided in Section 6.4.6.3.

Intake Protection Zones (IPZs)

As shown in Figures 21a to 21f, the IPZs within the Gull River Tertiary Watershed are situated at the Town of Kinmount, where the Burnt River passes through the County of Haliburton into the northern boundary of the County of Peterborough. These zones extend both upstream and downstream along the river, encompassing adjacent water bodies and surrounding lands that contribute to the municipal water intake at Town of Kinmount.

More information on the IPZs is provided in Section 3.4.5.

6.3.3 Water Quality

6.3.3.1 Surface Water Quality

The Gull River Tertiary Watershed in Peterborough County is not regulated by a Conservation Authority. Therefore, surface water quality data are not available. However, future quaternary watershed plans should aim for more comprehensive assessments.

6.3.3.2 Ground Water Quality

The Gull River Tertiary Watershed in Peterborough County is not regulated by a Conservation Authority. Therefore, groundwater quality data are not available. However, future quaternary watershed plans should aim for more comprehensive assessments.

6.4 Natural Hazards

Detail on the types of natural hazards, associated setbacks, and applicable agencies or regulators are included in Section 3.5. The following summarizes the results for the Gull River Tertiary Watershed.

Table 70 Natural Hazards within the Gull River Tertiary Watershed by Quaternary Watershed

Quaternary Watershed	% of the Watershed Within the Tertiary Watershed	Area of Quaternary Watershed (Km^2)	Natural Hazard					
			Known Karst (%)	Inferred Karst (%)	Potential Karst (%)	Floodplain Area (km^2)	Regulated Top of Slope Area (km^2)	Meander Belt Area (km^2)
Birchbark Lake - Irondale River	25.56	36.32	0	0	0	-	-	-
Farquhar Lake - Irondale River	3.84	5.46	0	0	0	-	-	-
Goose Lake - Burnt River	70.60	100.30	1	<1	<1	-	0.44	-

The karst landscapes are illustrated in Figure 11, with proportions calculated in table 64. Known karst is present only in the Goose Lake–Burnt River watershed at 1%. Inferred karst occurs at less than 1% in Goose Lake–Burnt River, with no inferred karst in the other watersheds. Potential karst is also very limited, appearing at less than 1% in Goose Lake–Burnt River and absent elsewhere. Overall, these watersheds demonstrate very low susceptibility to karst-related hazards.

From a land use perspective, the low prevalence of karst features suggests that most areas within these watersheds are generally suitable for development or other land uses. In the small portion of Goose Lake–Burnt River where known or inferred karst exists, a cautious approach is recommended, including site-specific geotechnical and hydrogeological investigations to support development design. Birchbark Lake–Irondale River and Farquhar Lake–Irondale River are effectively free of karst-related constraints, so standard land use planning can proceed, while still considering other natural hazards such as floodplains, slopes, or meander belts where applicable.

Meander belt mapping is not available for the Gull River tertiary watershed. Requirements for meander belts should be confirmed at the subwatershed study stage, and if necessary, meander belts should be delineated with appropriate regulatory allowances.

Kawartha Conservation provided “regulated slope” mapping for its jurisdiction within the watershed, though it does not fully align with the tertiary and quaternary watershed boundaries used for this characterization. It is assumed that this mapping is the regulated erosion hazard associated with slopes (i.e. stable top of slope) and should be confirmed through future study. This mapping covers only a small portion of Goose Lake – Burnt River. Roughly 4 km^2 of the that watershed, delineated as part of the OWB watershed boundary mapping is within Kawartha Conservation’s jurisdiction based on mapping provided by Kawartha Conservation. Goose Lake – Burnt River contains 0.44 km^2 of regulated top of slope (Table 70) which likely underestimates the proportion of land area with steep slopes within the watershed, beyond the Kawartha Conservation jurisdiction. Further studies are required to fill the gaps for the regulatory top of slope for remaining quaternary watersheds.

The floodplain as delineated does extend into the portion of the Gull River Tertiary watershed located in the County, and therefore has no floodplain hazards. This information should be confirmed and/or updated as appropriate to inform subwatershed studies and planning development.

6.5 Aquatic and Terrestrial Features

To provide a high-level characterization of the aquatic features within the Gull River tertiary watershed, Table 71 presents a summary of the lakes, rivers, creeks, fish habitat, and thermal regime information available from background sources. Similarly, a high-level analysis of terrestrial features within the tertiary watershed is presented in Table 72.

Table 71 Gull River Tertiary Watershed Aquatic Feature Characterization

Lakes	Fortescue Lake, Salmon Lake, Birchbark Lake, Union Lake, Kinmount Lake, White Lake, Venner Lake
Rivers	Irondale River
Creeks	No data available
Fish Species	No data available.
Fish Activity Areas	Lake Trout, Muskellunge, Smallmouth Bass, and Largemouth Bass Spawning Areas.
Thermal Regime (1)	Warm: 100%

Total mapped watercourse segments: 522

Table 72 Gull River Tertiary Watershed Wetlands, Woodlands, and Areas of Natural and Scientific Interest (ANSIs)

Parameter	Value
Total Tertiary Watershed Area[1]	**142 km^2**
Wetlands	
Provincially Significant Wetland	2 km^2 (1.2%)
Non-Provincially Significant Wetland	0 km^2 (0.0%)
Unevaluated Wetland	43 km^2 (30.4%)
Total Wetland Area	45 km^2 (32%)
Wetland Types (% of mapped wetlands)	
Bog	0.10%
Fen	0.08%
Marsh	14.49%
Open Water	0.82%
Swamp	76.84%
Unknown	7.67%
Woodlands	
Total Wooded Area	**110 km^2 (77%)**

Parameter	Value
Areas of Natural and Scientific Interest (ANSIs)	
Provincially Significant ANSI (Life Science)	0
Regionally Significant ANSI (Life Science)	0
Provincially Significant ANSI (Earth Science)	0
Regionally Significant ANSI (Earth Science)	0
Total Number of Candidate and Confirmed ANSIs	**0**

Corresponds to the total area of the watershed overlapping with County boundaries

7 Kawartha Lakes Tertiary Watershed Characterization

7.1 Physical Environment

7.1.1 Climate

Historical climate stations within the Kawartha Lakes tertiary watershed have been summarized at the quaternary scale to illustrate spatial coverage across the broader tertiary area, as shown in Figure 7. Table 73 provides additional details about each station, including period of record, time interval, and data type. The data from these stations are now over 31 years old, and not representative of current conditions. Additionally, these stations recorded daily data which does not provide the frequency needed for detailed hydrologic analysis. As such the best available, closest climate station should be used to provide the most accurate representation for the area. Otonabee tertiary watershed is the only watershed within the study area with active climate stations, making them the best available data for the Kawartha Lake River Tertiary watershed at the time of this study, see Section 4.1.1.

Table 73 Climate Monitoring Gauges and Sources within Kawartha Lakes Watershed

Quaternary Watershed	Source	Station Name	Station ID	Time Interval	Period of Record	Years of Data	Data Type	Lat.	Long.	Status
Goose Lake - Burnt River	Environment Canada	KINMOUNT	6164198	Daily	1897-1950	35	Precipitation	44.767	-78.083	Inactive
Eels Creek	Environment Canada	APSLEY	6160297	Daily	1922-1957	4	Precipitation	44.583	-78.517	Inactive
Pigeon Lake - Gannon Narrows	Environment Canada	BOBCAYGEON	6160822	Daily	1981-1985	19	Precipitation, Temperature	44.567	-78.217	Inactive
Stony Lake - Katchewanooka Lake	Environment Canada	BURLEIGH FALLS	6161050	Daily	1975-1994	28	Precipitation	44.383	-78.45	Inactive
Burleigh Falls Dam - Lower Buckhorn Lake	Environment Canada	ENNISMORE	6162328	Daily	1882-1910	116	Precipitation, Temperature	44.467	-78.233	Inactive
Stony Lake - Katchewanooka Lake	Environment Canada	LAKEFIELD	6164297	Daily	1874-1990	4	Precipitation, Temperature	44.55	-78.1	Inactive
Stony Lake - Katchewanooka Lake	Environment Canada	STONY LAKE SANDOR FARM	6168070	Daily	1962-1966	35	Precipitation	44.767	-78.083	Inactive

The period of record starts as early as 1882 and as recent as 1994. Since the data from these climate stations are older than 30 years, the data are not suitable for continuous simulation and frequency analysis, which is recommended for detailed studies at the subwatershed stage.

Since there are no active climate stations in the Kawartha Lakes Tertiary Watershed within Peterborough County, the Precipitation Surface in Map 5 of the *Conceptual Water Budget – Trent River Watershed* Report was considered to provide an approximate annual precipitation range for this tertiary watershed (2007). Map 5 demonstrated an annual precipitation range within the Kawartha Lakes Tertiary Watershed of 862 - 1026 mm/year based on data from 2006 and earlier (2007). Higher annual precipitation is observed in the north and northwest area of the tertiary watershed.

7.1.2 Physiography and Slopes

The physiographic regions within the Kawartha Lakes Tertiary Watershed is composed of Algonquin Highlands, Dummer Moraines, Georgian Bay Fringe, and Peterborough Drumlin Fields. As seen in Table 74, Georgian Bay Fringe is most predominant, making up 55% of the watershed. The Drummer Moraines region encompassed all of Bobcaygeon River quaternary watershed, and Peterborough Drumlin Field region covers all of Omemee Dam - Pigeon River quaternary watershed. The remaining quaternary watersheds are composed of mix of physiographic regions. A summary of the physiographic regions within each quaternary watershed is shown in Figure 8 and Table 74.

Table 74 Physiographic Regions within the Kawartha Lake Tertiary Watershed

Quaternary Watershed	Area of Quaternary Watershed (km^2)	Proportion within Tertiary Watershed (%)	Physiography Region (%)			
			Algonquin Highlands	Dummer Moraines	Georgian Bay Fringe	Peterborough Drumlin Field
Bobcaygeon River	7	0	-	100	-	-
Burleigh Falls Dam - Lower Buckhorn Lake	286	14	-	58	2	41
Deer Bay Creek	164	8	<1	2	98	-
Eels Creek	250	12	36	<1	64	-
Mississagua River	365	18	<1	5	94	-
Nogies Creek	180	9	-	25	75	-
Omemee Dam - Pigeon River	9	0	-	-	-	100
Pigeon Lake - Gannon Narrows	356	18	-	35	57	8
Stony Lake - Katchewanooka Lake	391	19	24	34	23	19

-: a particular physiography region is not present within the quaternary watershed (no data reported)

A description of the physiographic regions within the Kawartha Lakes Tertiary Watershed is provided in Section 3.3.2.

Kawartha Lake tertiary watershed contains some closed depressions located around the west and southwest boarder. There are three areas with hummocky terrain in the north (1) and south (2) areas of the watershed (Figure 8).

The result of the DEM slope analysis found that the Kawartha Lakes Watershed has a maximum ground surface elevation of 430 masl in Eels Creek quaternary watershed and a minimum elevation of 215 masl in the Stony Lake - Katchewanooka Lake quaternary watershed, represented in Figure 9.

Table 75 summarizes the distribution of ground slopes by the gentle, moderate, and steep categories. The majority of the watershed (50%) is classified as having moderate slopes. Moderate slopes also make up a significant portion (45%) of the overall watershed while steep slopes only classify 4% of the watershed. The high portion of medium and steep slopes can be attributed to the large portion of bare rock ridges and shallow till and shallow till and rock ridges which make up the tertiary watershed. The Omemee Dam - Pigeon River quaternary watershed consists of the highest percent of steep (12%) and moderate slopes (70%) for the Tertiary Watershed. This quaternary watershed is located in a drumlin field which would account for the increased moderate and steep slopes, though the area only makes up a very small portion of the tertiary watershed. Bobcaygeon River quaternary watershed contains the highest percent of gentle slopes (72%) within the Tertiary Watershed. The quaternary watershed is located in an area mainly composed of till plains and Pigeon Lake, which would account for the gentle slopes.

Table 75 Surface Slope Distribution within the Kawartha Lake Tertiary Watershed

Quaternary Watershed	Area of Quaternary Watershed (km^2)	Proportion within Tertiary Watershed (%)	Surface Slope Distribution (%)		
			Gentle Slope (0-2%)	Moderate Slope (2-10%)	Steep Slope (>10%)
Bobcaygeon River	7	0	72	28	0
Burleigh Falls Dam - Lower Buckhorn Lake	286	14	64	35	1
Deer Bay Creek	164	8	27	63	10
Eels Creek	250	12	35	59	6
Mississagua River	365	18	36	58	7
Nogies Creek	180	9	42	54	4
Omemee Dam - Pigeon River	9	0	18	70	12
Pigeon Lake - Gannon Narrows	356	18	50	47	3
Stony Lake - Katchewanooka Lake	391	19	52	45	3
Average for Kawartha Lake Tertiary Watershed			**45**	**50**	**4**

Based on the Hemson (2022) report, the Lakefield future growth area falls within this watershed. Table 76 provides a rough summary of the slope distribution within this potential development areas.

Table 76 Surface Slope Distribution within the Designated Future Development Land in County of Peterborough

Settlement (Future Development Lands)	Total area of Settlement (km2)	Area within Tertiary Watershed (km2)	Surface Slope Distribution (%)		
			Gentle Slope (0-2%)	Moderate Slope (2-10%)	Steep Slope (>10%)
Lakefield	2	0.2	26	67	5

The Lakefield Development makes up a very small area within the Kawartha Lakes Tertiary Watershed. It is characterized by moderate slopes (67%). This differs slightly from the surface slope distribution for the overall tertiary watershed with more moderate slopes, less gentle slopes, and slightly more steep slopes.

7.1.3 Surficial Geology

The surficial geology of the Kawartha Lakes Tertiary Watershed consists of 13 distinct geologic units (1, 2, 3, 4, 5a, 5b, 5c, 6, 7, 8a, 9c, 19, and 20), as depicted in Figure 10 and Table 5.

Comprehensive information on surficial geology, along with detailed descriptions of individual surficial geological units, is provided in Section 3.3.3.

7.1.4 Bedrock Geology and Bedrock Topography

As illustrated in Figure 11, the bedrock geology of the Kawartha Lakes Tertiary watershed is primarily comprised of seven distinct geological units: 44 to 49 and 54a. The description of each bedrock geology unit is summarized in Table 6.

The elevation of the bedrock surface approximately ranges from over 395 masl in the northeastern part of the Kawartha Lakes Tertiary Watershed to 240 masl near the southern boundary. Furthermore, lower bedrock surface elevations have been documented across the central to southern regions of the Kawartha Lakes Tertiary watershed, primarily associated with the regional lake systems. Overall, the bedrock surface generally dips towards the south (ORMGP 2022).

Bedrock thalwegs are present throughout the Kawartha Lakes Tertiary Watershed (Figure 11), while tunnel channel thalwegs are notably absent. The bedrock thalwegs generally trend in all various directions, but many follow a northeast-southwest or north-south orientation. They broadly aligning with the courses of existing rivers, wetlands, and lakes. These features are characterized by deepened valleys that correspond with the pathways of contemporary rivers, lakes, and wetlands, suggesting a strong geomorphic relationship between bedrock structure and surface hydrology.

Comprehensive information on bedrock geology and bedrock topography applicable to the County, along with detailed descriptions of each bedrock geological unit, is provided in Section 3.3.4.

7.1.5 Soils

Figure 13 illustrates the spatial distribution of the various drainage classes and surficial soils within the Trent River – Crowe River Watershed, while Table 77 outlines their respective proportions. Table 77 summarizes the drainage potential classifications.

Table 77 Soil Drainage within the Trent River - Crowe River Watershed

Quaternary Watershed	% of Quaternary Watershed within Tertiary	Area of Quaternary Watershed (km^2)	Soil Drainage Distribution (%)			
			Unknown	High	Medium	Low
Bobcaygeon River	0	7	<1	68	-	32
Burleigh Falls Dam - Lower Buckhorn Lake	14	286	<1	58	3	39
Deer Bay Creek	8	164	-	80	1	19
Eels Creek	12	250	<1	78	3	19
Mississagua River	18	365	<1	75	4	21
Nogies Creek	9	180	<1	77	8	15
Omemee Dam - Pigeon River	0	9	2	91	-	7
Pigeon Lake - Gannon Narrows	18	356	-	56	13	31
Stony Lake - Katchewanooka Lake	19	391	<1	69	2	28
Average for Kawartha Lake Tertiary Watershed			**<1**	**69**	**5**	**26**

-: a particular soil drainage class is not reported within the quaternary watershed (no data reported)
Unknown is comprised of not applicable, variable, and unknown draining soil
High is comprised of very rapid, rapidly, moderately well, and well draining soil
Medium is comprised of imperfectly draining soil
Low is comprised of poorly and very poorly draining soil

According to the broader classification system used for this study, it was determined that all quaternary watersheds within the study area are predominantly composed of soils with high drainage potential (69%). Soil with low drainage potential made up 26% of the watershed, with the majority being very poor.

7.2 Land Use

Land use within the Kawartha Lake Tertiary Watershed is classified as open space/ natural area (75%), and waterbodies (15%). The other land use types make up a very small portion of this watershed at 4% or less (Table 78).

Urban land coverage is 4% of land use within the Tertiary Watershed. The Lakefield settlement is classified as a future growth area for the county, see refer to Table 79. The distribution of these land use classes is shown in Figure 6.

Table 78 Simplified Land Use Distribution for Kawartha Lake Watershed

Quaternary Watershed	Proportion of Tertiary Watershed (%)	Area (km²)	Land Use Distribution (%) within each Quaternary Watershed						
			Agricultural	Industrial	Open Space/ Natural Area	Unknown	Urban	Waterbodies	Wetland
Bobcaygeon River	0.34	6.89	0	4	86	3	7	0	0
Burleigh Falls Dam - Lower Buckhorn Lake	14.24	285.82	6	2	51	6	8	26	2
Deer Bay Creek	8.16	163.69	0	0	89	3	1	13	0
Eels Creek	12.45	249.94	0	0	90	2	3	7	0
Mississagua River	18.2	365.39	0	1	84	2	2	15	0
Nogies Creek	8.98	180.26	0	3	83	3	2	9	1
Omemee Dam - Pigeon River	0.42	8.5	49	0	50	1	0	0	0
Pigeon Lake - Gannon Narrows	17.72	355.75	0	2	76	2	4	15	2
Stony Lake - Katchewanooka Lake	19.49	391.14	4	3	67	3	5	16	4
Average for Kawartha Lake			**2**	**2**	**75**	**3**	**4**	**15**	**2**

The land use classifications have been simplified from the Official Plan designations to form more concise understand of the land use.

Table 12 summarizes which OP designations make up each land use.

Table 79 Areas of Future Growth Settlements in Kawartha Lake Watershed

Settlement (Future development lands)	Total area of settlement (km^2)	Area within tertiary watershed (km^2)
Lakefield	2	0.2

7.3 Water Resources

7.3.1 Surface Drainage

Kawartha Lakes tertiary watershed accounts for 48% of the County (Figure 4). Of the broader watershed, 2007 km^2 or 65% of the total watershed area is within the County (Table 10). Within the County, the watershed falls partially under the jurisdiction of two Conservation Authorities: Kawartha Conservation to the west and Otonabee Conservation to the south. Much of the watershed is outside the jurisdiction of any Conservation Authority and is regulated by the MNR Districts of Bancroft and Peterborough.

There are 9 quaternary watersheds and currently there are 10 currently identified (Conservation Authority defined) subwatersheds (Table 80). The largest quaternary watershed within the County is Stony Lake – Katchewanooka Lake with a drainage area of 391 km^2 representing 19% of the tertiary watershed area. The smallest watersheds within the County are Bobcaygeon River, and Omemee Dam – Pigeon River each representing less than 1% of the tertiary watershed within the study area (Table 74).

The Kawartha Lakes watershed receives water from the Gull River watershed through the Fenlon River west of the County boundary. The watershed outlets into the Otonabee River watershed through the Otonabee River (Figure 14a).

Table 80 Drainage Area and Subwatersheds within the Kawartha Lakes Tertiary Watershed

Quaternary Watershed Name	Area of Quaternary Watershed (km^2)	% within Tertiary (1)	Subwatersheds (% within the quaternary watershed) (2)
Bobcaygeon River	7	0	Martin Creek North (72%), Pigeon Lake Tributaries (13%), Nogies Creek (6%), Sturgeon Lake Tributaries (8%)
Burleigh Falls Dam - Lower Buckhorn Lake	286	14	Buckhorn/ Lovesick Lake (34%), Chemong/Pigeon Lake (37%)
Deer Bay Creek	164	8	NI
Eels Creek	250	12	NI
Mississagua River	365	18	NI
Nogies Creek	180	9	Nogies Creek (95%)
Omemee Dam - Pigeon River	9	0	Pigeon River (58%), Fleetwood Creek (39%)

Quaternary Watershed Name	Area of Quaternary Watershed (km^2)	% within Tertiary (1)	Subwatersheds (% within the quaternary watershed) (2)
Pigeon Lake - Gannon Narrows	356	18	NI
Stony Lake - Katchewanooka Lake	391	19	Clear/ Stony Lake (24%), Katchewanooka Lake (21%)

Notes:
(1) Based on areas within the County
(2) The delineation for each subwatersheds was provided by each Conservation Authority, it should be noted that they do not share the same scale.
NI: No subwatersheds identified at this time.

Within the tertiary watershed, there are two distinct physiographic regions. For the northern quaternary watersheds, consisting of Deer Bay Creek, Eels Creek, Mississagua River, and Nogies Creek, with watercourses originating primarily from Georgian Bay Fringe. For the southern quaternary watersheds, watercourses originate in the Peterborough Drumlin Fields, Algonquin Highlands, and Dummer Moraines (see Section 3.3.2 for further details).

This tertiary watershed notably contains several lakes that make up the chain of lakes known as the Kawartha Lakes. These lakes include Pigeon Lake, Buckhorn Lake, Chemong Lake, Stoney Lake, and Clear Lake (Figure 14a, 14b, and 14e).

7.3.1.1 Drainage Network Characteristics

An overview of key morphometric attributes of each quaternary watershed situated within the portion of the Kawartha Lakes watershed that falls within the County is provided in Table 81.

The southern and northwestern portions of the watershed consist of more permeable surficial geology classes. The northeastern and central north of the watershed are comprised predominantly of surficial bedrock that can naturally limit infiltration resulting in a greater need for surface water storage and conveyance (See Section 6.4.2 for physiography information). The topography northeastern portion of the watershed includes many depressions which, combined with the impermeability has resulted in an extensive drainage network. The quaternary watershed for Bobcaygeon River is limited within the County, with no mapped watercourses, resulting in no calculated drainage density. Future studies will need to confirm the presence/absence of surface water features throughout the study area, as current mapping does not provide a fulsome characterization.

Burleigh Falls Dam – Lower Buckhorn Lake and Omemee Dam – Pigeon River have the lowest drainage densities (0.60 and 0.67 km/km^2 respectively) of the quaternary watersheds (Table 81). The drainage density of Omemee Dam – Pigeon River is low because the small drainage area (9 km^2) is in the headwaters of the watershed and therefore contains very few watercourses (Figure 14c). The drainage density of Burleigh Falls Dam – Lower Buckhorn Lake is low because of the large lakes (26% of the watershed area) throughout the watershed resulting in very short watercourses before draining into the lakes (Figure 14b). Eels Creek has an area of 250 km^2 and 452 km of watercourses resulting in the highest drainage density of the quaternary watersheds at 1.81 km/km^2 (Table 81). Waterbodies are not included in the calculation of total watercourse length and therefore do not factor into drainage density calculations. This is noted as many waterbodies result from the operation of dams and locks that may have previously existed as watercourses. The exclusion of these waterbodies results in a lower drainage density relative to other watersheds.

The total area of waterbodies for the tertiary watersheds is roughly 19%. Burleigh Falls Dam – Lower Buckhorn Lake and Nogies Creek have the highest proportions of waterbody area at 26% and 25% respectively (Table 81). Bobcaygeon River and Omemee Dam – Pigeon River each have less than 1 km^2 of waterbody area and each have <2 km of shoreline perimeter (Table 81). It is clear from a cursory review of available satellite imagery in Omemee Dam – Pigeon River shows that there are two manmade ponds that are not included in the waterbodies mapping. Mississagua River watershed contains the longest total shoreline perimeter at 1,121 km, the longest shoreline perimeter of the quaternary watersheds by at least 300 km (Table 81).

Table 81 Morphometric Characteristics of the Quaternary Watersheds within the Kawartha Lakes Watershed

Quaternary Watershed	Area (km^2)	% Tertiary Watershed Area	Watercourse Length (km)	Drainage Density (km/km^2)	Waterbody Area (km^2)	% Waterbody Area	Shoreline Perimeter (km)
Bobcaygeon River	7	<1	0	-	<1	<1	2
Burleigh Falls Dam - Lower Buckhorn Lake	286	14	173	0.60	75	26	403
Deer Bay Creek	164	8	271	1.65	33	20	728
Eels Creek	250	12	452	1.81	43	17	442
Mississagua River	366	18	405	1.11	65	18	1121
Nogies Creek	180	9	217	1.21	46	25	428
Omemee Dam - Pigeon River	9	<1	6	0.67	<1	<1	1
Pigeon Lake - Gannon Narrows	356	18	409	1.15	49	14	717
Stony Lake - Katchewanooka Lake	391	19	440	1.12	65	17	748

7.3.1.2 Drainage Network Alterations

As noted in the introduction of Section 3.2.1 HDF mapping was not available the Kawartha Lakes Watershed and so the alteration to HDFs has not been characterized.

A cursory review of the watercourse mapping and available aerial imagery shows limited evidence of drainage network alteration within the Kawartha Lakes watershed south of the Kawartha Lakes.

The southwestern portion of the Kawartha Lakes watershed is partly agricultural while the remainder of the watershed is predominantly “parks and conservation” and “rural” (non-agricultural) land uses that are not associated with significant drainage network alterations (See Section 3.4.6 for land use information). The Algonquin Highlands Provincial Park comprises most of the Deer Bay Creek watershed and a large portion of the Mississagua River watershed. Alterations within the Kawartha Lakes watershed are more likely to be subtle in the form of roadside drainage and ditches, and realignment or piping in agricultural lands.

The Kawartha Lakes watershed forms part of the Trent-Severn Waterway, where water impoundment plays a significant role. Four quaternary watersheds contain dams or locks, directly influencing flow regimes. The remaining five quaternary watersheds are indirectly affected as tributaries to the altered systems. One key factor is water impoundment through dams and locks, which can affect flow patterns, lake levels, sediment transport, and erosion. This is especially relevant given the watershed’s connection to the Trent Severn Waterway, and extend through directly impacted or indirectly impacted (upstream/downstream) systems.

7.3.1.3 Drainage Network Conditions and Processes

Information was not available to specifically characterize erosion and deposition within the Kawartha Lakes watershed. This is the type of information that can help inform the impact assessments related to change within a watershed. Further investigations into the fluvial processes of the watershed are recommended for future subwatershed studies, should development areas be proposed in the watershed.

7.3.1.4 Streamflow Data

The Kawartha Lake Tertiary Watershed has two discontinued stream flow gauges located at Eels Creek and Mississagua River. A summary identifying the data type, method of collection, period of record and time intervals for each station was prepared to assess the quality of the data source for future modelling exercises and identify any gaps accordingly. This information is summarized on Figure 7 and Table 82. These data are over 30 years old and may not be representative of current conditions.

Kawartha Conservation has twenty-two water monitoring stations within the Kawartha Lake Tertiary Watershed, however, no operational status was provided at the time of this study. Kawartha Conservation has an additional twenty-two water monitoring stations downstream of the study area. This information is also summarized on Figure 7.

7.3.2 Hydrogeology

An introduction to the hydrogeological setting is provided in Section 3.4.5.

This section outlines the datasets and tools used to develop the hydrogeological characterization of the Kawartha Lakes Tertiary Watershed. Key inputs include hydrostratigraphic data, Provincial Groundwater Monitoring Network (PGMN) wells, groundwater recharge and discharge areas, groundwater use information, and source water protection reports.

Table 82 Water Monitoring Gauges and Sources within Kawartha Lakes Watershed

Quaternary Watershed	Station Name	ID	Time Interval	Period of Record	Data Type	Gross Drainage (km^2)	Active or Discontinued	Current Operation Schedule	Lat	Long
Eels Creek	EELS CREEK BELOW APSLEY	02HH001	Daily	1967-1993	Flow	241	Discontinued	N/A	44.64167	-78.1353
Mississauga River	MISSISSAGUA RIVER BELOW MISSISSAGUA LAKE	02HH002	Daily	1972-1993	Flow	326	Discontinued	N/A	44.675	-78.3458

7.3.2.1 Hydrostratigraphy

Table 83 lists the hydrostratigraphic units identified in the Kawartha Lakes Tertiary Watershed using the cross-section tool and isopach maps on the ORPGP portal (2022).

Comprehensive information on hydrostratigraphy, along with detailed descriptions of each hydrostratigraphy unit, is provided in Section 3.4.4.1.

Table 83 Hydrostratigraphic Units within the Kawartha Lakes Tertiary watershed in Peterborough County

Quaternary Watershed	Present in Tertiary Watershed (Yes / No)								
	Glaciolacustrine/Fluvial/ Recent Deposits	Oak Ridges Aquifer Complex	Upper New Market Till	Inter-Newmarket Sediment	Lower Newmarket Till	Thorncliffe Formation	Sunnybrook Drift	Scarborough Formation	Bedrock
Bobcaygeon River	Yes	No	Yes	Yes	No	No	No	No	Yes
Burleigh Falls Dam - Lower Buckhorn Lake	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Deer Bay Creek	Yes	No	Yes	Yes	No	Yes	No	No	Yes
Eels Creek	Yes	No	Yes	Yes	No	Yes	No	No	Yes
Mississauga River	Yes	No	Yes	No	No	Yes	No	No	Yes
Nogies Creek	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
Omemee Dam - Pigeon River	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Pigeon Lake - Gannon Narrows	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes
Stony Lake - Katchewanooka Lake	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Data Source: (ORMGP 2022)

The greatest coverage of surficial sediments is in the southern portion of the watersheds, while bedrock is exposed at surface in most areas in the northern portions. Most Quaternary watershed consistently feature Glaciolacustrine/Fluvial/Recent Deposits and Upper Newmarket Till. In contrast, the Oak Ridges Aquifer Complex is absent in most Quaternary watersheds, with the Oak Ridges Aquifer Complex only appearing in the Omemee Dam, Pigeon River Quaternary watershed. Deeper aquifer units, such as the Thorncliffe Formation, are generally present across all Quaternary Watersheds. However, exceptions include the absence of the Thorncliffe Formation in Bobcaygeon River, and limited occurrence of the Scarborough Formation in specific areas, namely Burleigh Falls Dam, Lower Buckhorn Lake, and Stony Lake, Katchewanooka Lake where bedrock is present at surface. These spatial variations suggest localized hydrogeological complexity and highlight zones with potential for aquifer development.

7.3.2.2 Provincial Groundwater Monitoring Network Wells

There are four PGMN locations within the Kawartha Lakes Tertiary Watershed (Figure 22). The characteristics of each established PGMN well are summarized in Table 84.

Table 84 Overview of PGMN Wells within the Kawartha Lakes Tertiary Watershed in Peterborough County

PGMN Well ID	Quaternary Watershed	Township	Ground Surface Elevation (masl)	Total Well Depth (m bgs)	Screen Interval or Open Hole Interval (m bgs)	Completion Aquifer	Groundwater Level Monitoring Program Range (Years)	Groundwater Levels within the Monitoring Program Range (masl)
W0000193-1	Burleigh Falls Dam – Lower Buckhorn Lake	Smith	284.54	64	Open Hole Interval: 6.1 - 64.0	Bedrock (Limestone / Granite)	November 14, 2002, to October 24, 2016	263.74-272.16
W0000197-1	Stony Lake – Katchewanooka Lake	Smith	259.09	12.12	Open Hole Interval: 3.7 - 12.12	Bedrock (Limestone)	November 14, 2002, to December 12, 2012	257.85-259.29
W0000495-1	Nogies Creek	Galway-cavendish And Harvey	324.35	25.15	Open Hole Interval: 6 - 25.2	Bedrock (Granite)	April 26, 2012, to October 25, 2016	227.25-228.85
W0000496-1	Pigeon Lake – Gannon Narrows	Galway-cavendish And Harvey	253.35	36.75	Open Hole Interval: 6 - 36.8	Bedrock (Granite)	May 29, 2012, to October 26, 2016	257.26-259.07

m bgs – metres below ground surface
masl – metres above sea level
PGMN – Provincial Groundwater Monitoring Network
Data Source: (MECP 2023; ORMGP 2022)

Four PGMN wells located across Smith and Galway-Cavendish and Harvey Townships monitor groundwater in bedrock aquifers (limestone and granite). Well depths range from ~12 m to 64 m below ground surface, with open hole intervals spanning most of the well depth. Ground surface elevations vary from ~253 m to 324 m above sea level. The groundwater levels range from ~227 m to 272 m above sea level, influenced by local geology, limestone and granite, and topography. This data supports long-term assessment of bedrock aquifer conditions in the region.

It is recommended that future quaternary watershed plans incorporate more comprehensive assessments of groundwater levels, alongside systematic seasonal monitoring, to effectively capture temporal variations and support informed water resource management and monitoring the effects of land use change.

7.3.2.3 Groundwater Recharge Area

The mean annual groundwater recharge rates from the CANWET Model (TCC 2008) for the Kawartha Lakes Tertiary Watershed is 120 mm/year and the SGRAs mapped from TCC (2009) are illustrated in Figures 19a to 19f. The basis for the recharge estimates is provided in Section 3.4.4.3.

Across the Kawartha Lakes Tertiary Watershed recharge rates show variation reflecting differences in hydrological dynamics, geological, and land-use characteristics. Recharge rates range from 40 mm to 165 mm per year, indicating moderate levels of groundwater replenishment.

The highest recharge rates from the CANWET Model and highest density of SGRAs are typically found in Quaternary watersheds with the higher proportion of coarser grained granular deposits (i.e., sands and gravels), including Eels Creek, Mississauga River, Nogies Creek and Pigeon Lake - Gannon Narrows. The lower recharge rate (40 to 60 mm/year) Quaternary Watersheds include Burleigh Falls Dam - Lower Buckhorn Lake and Stony Lake - Katchewanooka Lake, more dominated and fine-grained deposits such as the glacial till dominated and are found in the downstream (southwest) portions of the Kawartha Lake Tertiary Watershed.

Implementation of infiltration based Low Impact Development is more feasible in higher recharge areas and is likely required as part of development to maintain downgradient groundwater discharge function. Approximately 25% Kawartha Lakes Tertiary Watershed have lower recharge rates (40 to 60 mm/year) which may provide implementational challenges to infiltration-based methodologies.

7.3.2.4 Groundwater Discharge Area

The groundwater discharge areas within the Kawartha Lakes Tertiary Watershed are well-aligned with streams, water bodies and wetlands, as illustrated in Figures 20a to 20f. The method used to map discharge areas is presented in section 3.4.4.4. Table 85 summarizes the mean depth to the water table for the Kawartha Lakes Tertiary Watershed.

Table 85 Summary of Mean Depth to Water Table Rate within the Kawartha Lakes Tertiary Watershed in Peterborough County

Quaternary Watershed	% of Quaternary Watershed Within Tertiary	Area of Quaternary Watershed (km^2)	Mean Depth to Water Table (m bgs)
Bobcaygeon River	0	7	7
Burleigh Falls Dam - Lower Buckhorn Lake	14	286	5
Deer Bay Creek	8	164	9
Eels Creek	12	250	9
Mississagua River	18	365	8
Nogies Creek	9	180	6
Omemee Dam - Pigeon River	0	9	20
Pigeon Lake - Gannon Narrows	18	356	5
Stony Lake - Katchewanooka Lake	19	391	6

Source: (ORMGP 2022)
m bgs – metres below ground surface

Among the nine Quaternary Watersheds, the mean depth to the water table ranges from approximately 5 m bgs at the Burleigh Falls Dam, Lower Buckhorn Lake and Pigeon Lake, Gannon Narrows to 20 m bgs at the Omemee Dam, – Pigeon River. Most watersheds fall within the 5–9-metre range, indicating relatively accessible groundwater that could be responsive to surface recharge and seasonal variations. These shallow depths are typical of areas with permeable soils and active hydrological cycles, making them important zones for water resource management and ecological health. In contrast, Omemee Dam – Pigeon River has the deepest mean water table at 20 m bgs, which may suggest deeper aquifers or geological barriers that restrict vertical water movement.

Typically, a shallow water table is associated with streams, water bodies, and wetlands, while a deeper water table is found in areas with higher ground surfaces, such as the Drumlins and hummocky terrain, which are distributed across the Omemee Damn – Pigeon River Quaternary Watershed.

However, the variation in depth underscores the need for site-specific strategies when planning for water extraction, land use, or environmental protection.

7.3.2.5 Groundwater Users

The groundwater users for the Kawartha Lakes Tertiary Watershed have been presented in Figures 21a to 21f and summarized in Table 86.

Table 86 has categorized wells into three types for this study: 1) municipal wells, 2) overburden completion, and 3) bedrock completion.

Table 86 Summary of Groundwater Users within the Kawartha Lakes Tertiary Watershed in Peterborough County

Quaternary Watershed	% of Quaternary Watershed within Tertiary	Area of Quaternary Watershed within the County (km²)	Water Well Record Type – Number of wells within each Quaternary Watershed			Water Well Record Type - (%) within each Quaternary watershed		
			Municipal Well	Quaternary Completion	Bedrock Completion	Municipal Well	Quaternary Completion	Bedrock Completion
Bobcaygeon River	0.34	6.89	0	5	26	0	16	84
Burleigh Falls Dam - Lower Buckhorn Lake	14.24	285.82	16	1482	4469	<1	25	75
Deer Bay Creek	8.16	163.69	0	8	90	0	8	92
Eels Creek	12.45	249.94	3	79	562	<1	12	87
Mississagua River	18.20	365.39	0	30	283	0	10	90
Nogies Creek	8.98	180.26	0	52	306	0	15	85
Omemee Dam - Pigeon River	0.42	8.50	0	56	5	0	92	8
Pigeon Lake - Gannon Narrows	17.72	355.75	4	246	1863	<1	12	88
Stony Lake - Katchewanooka Lake	19.49	391.14	3	448	2056	<1	18	82
Average for Kawartha Lake Tertiary Watershed						<1	15	85

Data Source: (ORMGP 2022)

Groundwater use within the Kawartha Lake Tertiary Watershed is dominated by private wells, with only a limited number of municipal wells recorded across the Quaternary watersheds. Municipal wells are present in a few locations, such as Burleigh Falls Dam – Lower Buckhorn Lake (16 wells) and smaller numbers in Eels Creek, Pigeon Lake – Gannon Narrows, and Stony Lake – Katchewanooka Lake. However, compared to the large number of private wells, municipal wells represent only a very small share of groundwater use.

The majority of wells in this watershed are completed in bedrock aquifers. For example, in the Deer Bay Creek watershed, 92% of wells are completed in bedrock, while in the Mississagua River watershed, 90% of wells are bedrock completions. This trend is consistent across the region, with bedrock completions typically accounting for between 82% and 92% of wells, while Quaternary completions generally make up less than 20%. On average, 85% of wells across the Kawartha Lake Tertiary Watershed are completed in bedrock, compared to just 15% in Quaternary deposits.

Although private wells dominate in all Quaternary watersheds, the scale of use varies considerably. For example, Burleigh Falls Dam – Lower Buckhorn Lake contains thousands of private wells, whereas smaller watersheds such as Bobcaygeon River or Omemee Dam – Pigeon River have only a few dozen wells. Overall, groundwater use in the Kawartha Lake Tertiary Watershed reflects a widespread dependence on bedrock aquifers, with municipal supplies playing only a minor role.

Furthermore, information on the groundwater users is provided in Section 3.4.5.

7.3.2.6 Source Water Protection

The Kawartha Lakes Tertiary Watershed is encompassed by three Source Protection Areas: Otonabee-Peterborough, Crowe Valley, and Kawartha-Haliburton, with the majority of its area lying within the Otonabee-Peterborough Source Protection Area.

Wellhead Protection Areas

There are WHPAs located within the Kawartha Lakes Tertiary Watershed. The WHPAs' locations and descriptions are presented in Figures 21a to 21f.

The municipal residential groundwater supply systems within the Kawartha Lakes Tertiary Watershed. include:

- Alpine Village – two groundwater supply water wells
- Buckhorn Lake Estates in the Municipality of Trent Lakes - one groundwater supply water wells

Comprehensive information on the WHPAs is provided in Section 3.4.5.

Highly Vulnerable Aquifers

The Kawartha Lakes Tertiary Watershed is predominantly situated within designated HVAs, as illustrated in Figures 21a to 21f.

The extensive presence of HVAs within the Tertiary Watershed underscores the critical importance of implementing robust land use regulations, comprehensive source water protection strategies, and proactive environmental planning to preserve groundwater quality and ensure a sustainable supply throughout the Kawartha Lakes Tertiary Watershed.

Comprehensive information on the HVAs is provided in Section 3.3.4.5.

Significant Groundwater Recharge Areas

The distribution of Significant Groundwater Recharge Areas (SGRAs) within the Kawartha Lakes Tertiary Watershed is dispersed across the region and illustrated in Figures 19a to 19f.

It illustrates a strong hydrogeological linkage between SGRAs, and wetlands within the Kawartha Lakes Tertiary Watershed, highlighting a critical ecological and hydrological connection that supports overall watershed health and resilience.

Similar to HVAs, potential policy applications for SGRAs align with the Provincial Planning Statement and the relevant municipal official plans. In areas designated as SGRAs, it is recommended that recharge rates be maintained when development or site alterations are proposed in addition to recharge areas that have lower recharge rates but are linked to sensitive wetland and stream features.

Comprehensive information on the SGRAs is provided in Section 3.4.6.3.

Intake Protection Zones (IPZs)

As shown in Figures 21a to 21f, IPZs cover areas around Lakefield and the connected water bodies upstream, as well as portions of the river corridor running south through Peterborough.

Comprehensive information on the IPZs is provided in Section 3.4.6.4.

7.3.3 Water Quality

7.3.3.1 Surface Water Quality

The Otonabee Conservation and Kawartha Conservation conduct ongoing surface water quality monitoring throughout its watershed, collecting samples from numerous sites. The resulting data inform evaluations of both surface water conditions and broader watershed health, with key insights presented in the Watershed Report Card (Otonabee Conservation 2023b, KRCA 2023). Table 87 presents the 2023 surface water quality evaluations for subwatersheds within the Kawartha Lakes Tertiary Watershed.

According to the 2023 Watershed Report Cards (Otonabee Conservation 2023b, KRCA 2023), the Otonabee Conservation received an overall grade of B, indicating generally good surface water quality across the region and the Kawartha Conservation received an overall grade of C, indicating fair surface water quality across the region.

The Watershed Report Cards provide a more generalized analysis compared to the detailed evaluations in Conservation's annual water quality reports. Future quaternary watershed plans should aim for more comprehensive assessments.

Additional information on the surface water quality is provided in Section 3.3.4.6.

Table 87 Summary of Surface Water Quality within the Kawartha Lakes Tertiary Watershed in Peterborough County

Quaternary Watershed (5)	Subwatersheds (% within the Quaternary Watershed) (1)	Surface Water Quality Grade (2)	2023 Watershed Report Card Summary (3)
Bobcaygeon River	Martin Creek North (72%), Pigeon Lake Tributaries (13%), Nogies Creek (6%), Sturgeon Lake Tributaries (8%)	A (Excellent) – Sturgeon Lake Tributaries Insufficient Data - Martin Creek North, Pigeon Lake Tributaries, and Nogies Creek	• Overall C Grade for the Kawartha Conservation. • Overall B Grade for the Otonabee Conservation. • Insufficient Data – Changes in monitoring objectives have resulted in many subwatersheds lacking sufficient data to meet the criteria of the Watershed Report Card scoring system.
Burleigh Falls Dam - Lower Buckhorn Lake	Buckhorn/ Lovesick Lake (34%), Chemong/Pigeon Lake (37%)	B (Good)	
Deer Bay Creek	NI	NI	
Eels Creek	NI	NI	
Mississagua River	NI	NI	
Nogies Creek	Nogies Creek (95%)	Insufficient Data	
Omemee Dam - Pigeon River	Pigeon River (58%), Fleetwood Creek (39%)	Insufficient Data	
Pigeon Lake - Gannon Narrows	NI	Insufficient Data	
Stony Lake - Katchewanooka Lake	Clear/ Stony Lake (24%), Katchewanooka Lake (21%)	B (Good)	

Notes:
(1) The delineation for each subwatershed was provided by each Conservation Authority. The boundaries of the subwatersheds created by Conservation Authorities differ from the OMNRF watershed boundaries.
(2) Three indicators were utilized to evaluate the quality of surface water: phosphorus, *E. Coli* (fecal indicator bacteria) and benthic macroinvertebrates. Phosphorus, a nutrient found both naturally and through human activities, can lead to algae blooms, excessive plant growth, and reduced oxygen levels when present in high concentrations. In contrast, benthic macroinvertebrates, due to their varying sensitivities to water quality, are reliable indicators of the long-term health of aquatic environments. *E. Coli* may come from leaky septic tanks, overloaded sewage treatment plants, agricultural runoff or even high numbers of waterfowl such as Canada geese.
(3) Sources: KRCA 2023; Otonabee Conservation 2023b.
NI: No subwatersheds identified at this time.
The northern portion of the Kawartha Lakes Tertiary Watershed is not regulated by a Conservation Authority, and local subwatersheds are not available.

7.3.3.2 Ground Water Quality

The Otonabee Conservation and Kawartha Conservation conduct ongoing groundwater quality monitoring throughout their watershed, collecting samples from numerous sites. The data obtained from these sites are used to assess groundwater conditions and inform evaluations of overall watershed health, with key insights presented in the Watershed Report Cards (Otonabee Conservation 2023b, KRCA 2023).

According to the 2023 Watershed Report Card, groundwater quality in the Otonabee Conservation and Kawartha Conservation was evaluated through the analysis of key chemical indicators, including nitrate, nitrite and chloride—substances that, at elevated levels, may pose risks to human health. As reported in the 2023 Watershed Report Cards (Otonabee Conservation 2023b, KRCA 2023), concentrations of these parameters at the monitoring sites remained within the acceptable limits defined by the Ontario Drinking Water Quality Standards and the Canadian Water Quality Guidelines during the monitoring period from 2017 to 2021.

The Watershed Report Cards provide a more generalized analysis compared to the detailed evaluations in the Conservation Authority's annual water quality reports. Future quaternary watershed plans should aim for more comprehensive assessments.

7.4 Natural Hazards

Detail on the types of natural hazards, associated setbacks, and applicable agencies or regulators are included in Section 3.5. The following summarizes the results for the Kawartha Lakes tertiary watershed.

Mapping of the natural hazards can be found in Figures 11, 18, and 23.

Table 88 Natural Hazards within the Kawartha Lakes Tertiary Watershed by Quaternary Watershed

Quaternary Watershed	% of the Watershed Within the Tertiary Watershed	Area of Quaternary Watershed (km^2)	Natural Hazard					
			Known Karst (%)	Inferred Karst (%)	Potential Karst (%)	Floodplain Area (km^2)	Regulated Top of Slope Area (km^2)	Meander Belt Area (km^2)
Bobcaygeon River	0.34	6.89	0	17	40	-	0.37	-
Burleigh Falls Dam - Lower Buckhorn Lake	14.24	285.82	1	3	41	<1	-	-
Deer Bay Creek	8.16	163.69	0	1	2	-	-	-
Eels Creek	12.45	249.94	0	<1	<1	-	-	-
Mississagua River	18.20	365.39	0	2	1	-	-	-
Nogies Creek	8.98	180.26	9	2	7	2	45.74	-

Quaternary Watershed	% of the Watershed Within the Tertiary Watershed	Area of Quaternary Watershed (km^2)	Natural Hazard					
			Known Karst (%)	Inferred Karst (%)	Potential Karst (%)	Floodplain Area (km^2)	Regulated Top of Slope Area (km^2)	Meander Belt Area (km^2)
Omemee Dam - Pigeon River	0.42	8.50	0	0	0	-	2.28	-
Pigeon Lake - Gannon Narrows	17.72	355.75	8	5	14	1	1.32	-
Stony Lake - Katchewanooka Lake	19.49	391.14	0	7	16	2	-	-

The karst landscapes are illustrated in Figure 11 and detailed in Table 88. Known karst areas are present in Nogies Creek (9%), Pigeon Lake–Gannon Narrows (8%), and Burleigh Falls Dam–Lower Buckhorn Lake (1%). Inferred karst occurs at low percentages in most watersheds, ranging from <1% to 17%, with the highest value in Bobcaygeon River (17%). Potential karst is most extensive in Burleigh Falls Dam–Lower Buckhorn Lake (41%), followed by Stony Lake–Katchewanooka Lake (16%), Nogies Creek (7%), and Pigeon Lake–Gannon Narrows (14%), while the other watersheds have very limited potential karst.

Overall, the highest karst sensitivity occurs in Nogies Creek, Pigeon Lake–Gannon Narrows, and Burleigh Falls Dam–Lower Buckhorn Lake, where combined known, inferred, and potential karst features could affect land stability and groundwater protection. Land use planning in these areas should prioritize conservation of natural areas and other low-intensity uses, while directing higher-intensity development toward areas with low or no karst hazard, ensuring that floodplain and slope risks are also considered.

Of the erosion hazards, meander belt mapping has not been delineated and provided for the watercourses of the Kawartha Lakes watersheds within the Study Area. This is a notable gap that should be addressed to inform subwatershed studies and development in and around watercourses.

Regulated slope mapping was provided by Kawartha Conservation for their jurisdiction within the watershed, which does not fully align with the tertiary and quaternary watershed boundaries used for this characterization. This mapping was provided for Bobcaygeon River, Nogies Creek, Omemee Dam – Pigeon River, and Pigeon Lake – Gannon Narrows. The Pigeon Lake – Gannon Narrows quaternary watershed is only partly regulated by Kawartha Conservation and so the area of regulated top of slope reported in Table 88 significantly underestimate the proportion of land area with steep slopes. Regulated slope mapping does not include metadata to detail the components of the hazard delineation (i.e. stable slopes, toe erosion, other allowances). Further studies are required to confirm existing regulated slope mapping, and to extend erosion hazard mapping (meander belt and stable top of slope) throughout the study area, as development or other construction is anticipated.

With respect to the delineated floodplains, the largest proportion of floodplain areas (>0.09% total area) is found in Stoney Lake and Nogies Creek quaternary watersheds. All other quaternary watersheds in the Kawartha Lakes Tertiary Watershed have a portion of floodplain areas less than or equal to 0.04%. This information should be used to inform subwatershed studies to identify potential constraints to development for potential growth areas and to inform planning.

7.5 Aquatic and Terrestrial Features

To provide a high-level characterization of the aquatic features within the Kawartha Lakes tertiary watershed, Table 89 presents a summary of the lakes, rivers, creeks, fish habitat, and thermal regime information available from background sources. Similarly, a high-level analysis of terrestrial features within the tertiary watershed is presented in Table 90.

Table 89 Kawartha Lakes Tertiary Watershed Aquatic Feature Characterization

Lakes	Clear Lake, Pigeon Lake, Bald Lake Narrows, Sandy Lake, Duck Pond, Big Duck Pond, Moore Lake, Chemong Lake, Higgins Lake, Clanricarde Lake, Little Anstruther Lake, Pencil Lake, Serpentine Lake, North Rathbun Lake, Rathbun Lake, Picard Lake, Sucker Lake, Beaver Lake, Wolf Lake, Gold Lake, Crab Lake, Sugarbush Lake, Mississagua Lake, Hemlock Lake, Golborne Lake, Cox Lake, Long Lake, Hansa Lake, Little Long Lake, Cloudy Lake, Bolger Lake, Bass Lake, Concession Lake, Compass Lake, Loucks Lake, De Gaulle Lake, Buzzard Lake, Pilot Lake, Little Spinster Lake, St. Charles Lake, Little Silver Lake, Lavery Lake, Vixen Lake, Spinster Lake, Stoplog Lake, Turtle Lake, Volturno Lake, Nogen Pond, Church Lake, Big Cedar Lake, Little Bald Lake, Triangle Lake, Apsley Lake, Little Sugarbush Lake, Lower Buckhorn Lake, Lovesick Lake, McGee Lake, Alder Lake, Loom Lake, Mountain Lake, Tamarack Lake, Big Bald Lake, Bow Lake, Udra Lake, Elm Lake, Upper Chemong Lake, Apsley Lake, Lower Apsley Lake, Loon Call Lake, McGinnis Lake, Jack Lake, Anstruther Lake, Galloway Lake, North Pencil Lake, Copper Lake, Poplar Lake, Crane Lake, Eels Lake, Lower Monmouth Lake, Nogies Lake, Horseshoe Lake, Egg Lake, Agate Lake, Minnow Lake, Crystal Lake, Ties Lake, Julian Lake, Bottle Lake, Alder Lake, Fair Lake, Sparkler Lake, Shark Lake, Cavendish Lake, Red Lake, Buckhorn Lake, Greens Lake, St. Croix Lake, Cold Lake, Catchacoma Lake, Cherry Lake, Fairy Lake, Little Jack Lake, Harrington Narrows, Gannon Narrows, Katchewanooka Lake, Stony Lake, Racoon Lake
Rivers	Miskwaa Ziibi, Mississagua River, Indian River, Otonabee River
Creeks	Anstruther Creek, Eels Creek, Stony Creek, Nogies Creek, Deer Bay Creek, Bottle Creek, Loom Creek, Miller Creek, Sandy Creek, Cloudy Creek, Bear Creek, Lavery Creek, Fleetwood Creek, Julia Creek, Nogies Creek, Sandy Creek, Rathbun Creek
Fish Species	Alewife, Black Crappie, Blackchin Shiner, , Blacknose Shiner, Bluegill, Bluntnose Minnow, Brassy Minnow, Brook Stickleback, Brook Trout, Brown Bullhead, Burbot, Central Mudminnow, Channel Catfish, Common Carp, Common Shiner, Creek Chub, Emerald Shiner, Fallfish, Fathead Minnow, Finescale Dace, Golden Shiner, Greater Redhorse, Hornyhead Chub, Iowa Darter, Lake Trout, Lake Whitefish, Largemouth Bass, Logperch, Longnose Dace, Mottled Sculpin, Muskellunge, Northern Pearl Dace, Northern Pike, Northern Redbelly Dace, Pumpkinseed, Rock Bass, Sauger, Smallmouth Bass, Spottail Shiner, Walleye, Western Blacknose Dace, White Sucker, Yellow Perch

Fish Activity Areas	White Sucker, Lake Trout, Muskellunge, Walleye, Smallmouth Bass, and Largemouth Bass Spawning Areas
Thermal Regime (1)	Warm: 76% Cool: 2% Cold: 2% Unknown: 20%

Note:
(1) Total mapped watercourse segments: 1085

Table 90 Kawartha Lakes Tertiary Watershed Wetlands, Woodlands, and Areas of Natural and Scientific Interest (ANSIs)

Parameter	Value
Total Tertiary Watershed Area[1]	**2,007 km^2**
Wetlands	
Provincially Significant Wetland	50 km^2 (2.5%)
Non-Provincially Significant Wetland	6 km^2 (0.3%)
Unevaluated Wetland	305 km^2 (15.2%)
Total Wetland Area	361 km^2 (18%)
Wetland Types (% of mapped wetlands)	
Bog	0.29%
Fen	0.42%
Marsh	15.81%
Open Water	1.26%
Swamp	63.80%
Unknown	18.43%
Woodlands	
Total Wooded Area	**1,259 km^2 (63%)**
Areas of Natural and Scientific Interest (ANSIs)	
Provincially Significant ANSI (Life Science)	2
Regionally Significant ANSI (Life Science)	7
Provincially Significant ANSI (Earth Science)	3
Regionally Significant ANSI (Earth Science)	2
Total Number of Candidate and Confirmed ANSIs	**14**

Note:
(1) Corresponds to the total area of the watershed overlapping with County boundaries

8 North Lake Ontario Shoreline Tertiary Watershed Characterization

8.1 Physical Environment

8.1.1 Climate

The North Lake Ontario Shoreline Tertiary Watershed does not contain any climate stations. For future studies the best available closest climate station should be used to provide the most accurate representation for the area. Otonabee tertiary watershed is the only watershed within the County with active climate stations, making them the best available data for the North Lake Ontario Shoreline River Tertiary watershed at the time of this study, see Section 4.1.1.

Since there are no climate stations in the North Lake Ontario Shoreline Tertiary Watershed within Peterborough County, the Precipitation Surface in Map 5 of the *Conceptual Water Budget – Trent River Watershed* Report was considered to provide an approximate annual precipitation range for this tertiary watershed (2007). Map 5 demonstrated an annual precipitation range within the North Lake Ontario Shoreline Tertiary Watershed of 961- 1,026 mm/year based on data from 2006 and earlier (2007).

8.1.2 Physiography and Slopes

The physiography within the North Lake Ontario Shoreline Tertiary Watershed is entirely composed of the Oak Ridge Moraines physiographic region, as seen in Table 91. A summary of the physiographic regions within each quaternary watershed is shown in Figure 8.

Table 91 Physiographic Regions within the North Lake Ontario Shoreline Tertiary Watershed

Quaternary Watershed	Area of quaternary watershed (km^2)	Proportion within Tertiary Watershed (%)	Physiography Region (%)
			Oak Ridges Moraine
Ganaraska River	6	100	100

A description of the physiographic regions within the North Lake Ontario Shoreline Tertiary Watershed is provided in Appendix B.

The North Lake Ontario Shoreline Tertiary Watershed contains Hummocky Terrain over almost the entire portion of the watershed within the study area. There are also a few areas with closed depressions. These physiographic features are depicted in Figure 8.

As the result of the DTM Quaternary scale slope assessment, the ground surface elevation within the North Lake Ontario Shoreline watershed ranges from a minimum elevation of 260 masl to a maximum of about 350 masl in the Ganaraska River quaternary watershed. A summary of the topographic mapping is shown in Figure 9.

Within the North Lake Ontario Shoreline Tertiary Watershed, gentle, moderate, and steep slope categories were used to describe the distribution of surface slopes, as noted and summarized in Table 92. The majority of the watershed (68%) is classified as having moderate slopes. Gentle slopes make up 22% of the watershed followed by 10% of the watershed classified as steep slopes. The large portion of moderate slopes can be attributed to the Kame Moraines land feature which makes up the entirely of the quaternary watershed.

Table 92 Surface Slope Distribution within the North Lake Ontario Shoreline Watershed

Quaternary Watershed	Area of Quaternary Watershed (km2)	Proportion within Tertiary Watershed (%)	Surface Slope Distribution (%)		
			Gentle Slope (0-2%)	Moderate Slope (2-10%)	Steep Slope (>10%)
Ganaraska River	6	100	22	68	10
Average for North Lake Ontario Shoreline Tertiary Watershed			22	68	10

8.1.3 Surficial Geology

The surficial geology of the North Lake Ontario Shoreline Tertiary Watershed consists of 8 distinct geologic units (5b, 6, 7, 8a, 9c, 12, 17, and 19) as depicted in Figure 10 and Table 13.

Comprehensive information on surficial geology, along with detailed descriptions of individual surficial geological units, is provided in Section 3.3.3.

8.1.4 Bedrock Geology and Bedrock Topography

As illustrated in Figure 11, the bedrock geology of the North Lake Ontario Shoreline Tertiary watershed is primarily comprised of Paleozoic sedimentary rocks (Unit 54a).

The elevation of the bedrock surface approximately ranges from over 162 masl in the southeast of the North Lake Ontario Shoreline Tertiary Watershed (near the County of Northumberland boundary) to 183 masl near the northwest and western boundary (approaching the Municipality of Durham; Figure 11). The bedrock surface generally dips towards the southeast (ORMGP 2022).

Additionally, bedrock thalwegs and tunnel channel thalwegs are notably absent within the North Lake Ontario Shoreline Tertiary Watershed (Figure 11).

Comprehensive information on bedrock geology and bedrock topography applicable to the study area, along with detailed descriptions of each bedrock geological unit, is provided in Section 3.3.4.

8.1.5 Soils

Soil data summarized by drainage potential, were completed for the North Lake Ontario Shoreline Tertiary Watershed. Figure 13 illustrates the spatial distribution of the various drainage classes and surficial soils within North Lake Ontario Shoreline Watershed, while Table 93 outlines their respective proportions. Table 93 summarizes the drainage potential classifications.

Table 93 Soil Drainage within the North Lake Ontario Shoreline Watershed

Quaternary Watershed	% of Quaternary Watershed within Tertiary	Area of Quaternary Watershed (km^2)	Soil Drainage Distribution (%)			
			Unknown	High	Medium	Low
Ganaraska River	100	6	<1	100	-	-
Average for North Lake Ontario Shoreline Tertiary Watershed			**<1**	**100**	**-**	**-**

-: a particular soil drainage class is not reported within the quaternary watershed (no data reported)
Unknown is comprised of not applicable, variable, and unknown draining soil
High is comprised of very rapid, rapidly, moderately well, and well draining soil
Medium is comprised of imperfectly draining soil
Low is comprised of poorly and very poorly draining soil

According to the broader classification system used for this study, it was determined that the Ganaraska River quaternary watershed within the tertiary watershed is predominantly composed of soils with high drainage potential. The quaternary watershed is primarily composed of rapid draining soil (91%) and has some very rapid (4%) and well draining soil (4%). There is no soil classified as medium or low drainage.

8.2 Land Use

Analysis of land use was completed for the North Lake Ontario Shoreline Tertiary Watershed. As demonstrated in Table 94, the proposed land use distribution across the tertiary watershed is represented by majority open space (98%). The other land use types make up a very small portion of this watershed (1% or less). No urban development is currently planned for this area. The distribution of these land use classes is shown in Figure 6.

Table 94 Simplified Land Use Distribution for North Lake Ontario Shoreline Watershed

Quaternary Watershed	Proportion of Tertiary Watershed (%)	Area (km^2)	Land Use Distribution (%) within each Quaternary Watershed						
			Agricultural	Industrial	Open Space/ Natural Area	Unknown	Urban	Waterbodies	Wetland
Ganaraska River	100	6	0	0	99	1	0	0	0
Average for North Lake Ontario Shoreline Watershed			**0**	**0**	**98**	**1**	**0**	**0**	**0**

The land use classifications have been simplified from the Official Plan designations to form more concise understand of the land use.

Table 12 summarizes which OP designations make up each land use.

8.3 Water Resource System

8.3.1 Surface Drainage

The North Lake Ontario Shoreline watershed is located on the southwestern boundary of the Study Area, accounting for less than 1% of the total County surface area (Figure 4; Table 95). Within the tertiary watershed in the County, there is a single quaternary watershed, Ganaraska River. The streams and rivers of the watersheds, originate in the Oak Ridges Moraine (see Section 3.3.2 for further details). 6 km^2 or <1% of the total watershed area is within the County boundary (Table 10). The North Lake Ontario Shoreline watershed originates on the Oak Ridges Moraine and outlets into Lake Ontario south of the County (Figure 14c). The watershed within the County is within the jurisdiction of the Ganaraska Conservation.

Table 95 Drainage Area and Subwatersheds within the North Lake Ontario Shoreline Tertiary Watershed

Quaternary Watershed Name	Area of quaternary watershed (km^2)	% within Tertiary [(1)]	Subwatersheds (% within the Quaternary Watershed) [(2)]
Ganaraska River	6	100	Ganaraska River Watershed (96%)

Notes:
(1) Based on areas within the county
(2) The delineation for each subwatersheds was provided by each Conservation Authority, it should be noted that they do not share the same scale.

8.3.1.1 Drainage Network Characteristics

An overview of key morphometric attributes of each quaternary watershed situated within the portion of the North Lake Ontario Shoreline watershed that falls within the County is provided in Table 96.

The Ganaraska River watershed has a total watercourse length of 4 km and a drainage density of 0.60 due to the watershed within the County having a small surface area and being the headwaters of the watershed (Table 96). Waterbodies are not included in the calculation of total watercourse length but are included in the total watershed area used in calculating the drainage density.

The total area of waterbodies for the tertiary watersheds is <1%. The Ganaraska River watershed has <1 km^2 of waterbody area comprising <1% of the watershed area (Table 96). The total shoreline perimeter of the small pond features within the watershed is roughly 1 km (Table 96).

Table 96 Morphometric Characteristics of the Quaternary Watersheds within the North Lake Ontario Shoreline Watershed (within the County)

Quaternary Watershed	Area (km^2)	% Tertiary Watershed Area	Watercourse Length (km)	Drainage Density (km/km^2)	Waterbody Area (km^2)	% Waterbody Area	Shoreline Perimeter (km)
Ganaraska River	6	100	4	0.60	<1	<1	1

8.3.1.2 Drainage Network Alterations

Cursory review of the watercourse mapping and available satellite imagery shows limited evidence of drainage network alteration within the North Lake Ontario Shoreline watershed. The watershed was historically farmed but was reforested starting in 1947 (Martin 2015). Historical farming could have modified smaller watercourses and headwaters through ditching, damming, and piping. The watershed is now almost entirely encompassed by the Ganaraska forest which is part of the “parks and conservation” land use that is not associated with significant drainage network alterations (See Section 3.5.6 for land use information). Alterations within the watershed are more likely to be subtle in the form of roadside drainage and ditches.

The North Lake Ontario Shoreline watershed within the County is not directly or indirectly impacted by impoundment as there are no impoundments downstream and the slopes within the watershed are generally steep (See Section 3.5.2 for slope information).

8.3.1.3 Drainage Network Conditions and Processes

Data and reporting are not available to characterize erosion and deposition within the North Lake Ontario Shoreline watershed. Such information can help understand sensitivity and impacts related to development or other construction activities. Further investigations into the fluvial processes of the watershed are recommended for detailed studies to guide development.

8.3.1.4 Streamflow Data

The North Lake Ontario Shoreline Tertiary Watershed does not contain any Water Survey Canada stream flow gauges at the time of this study.

8.3.2 Hydrogeology

An introduction to the hydrogeological setting is provided in Section 3.4.5.

This section outlines the datasets and tools used to develop the hydrogeological characterization of the North Lake Ontario Shoreline Tertiary Watershed. Key inputs include hydrostratigraphic data, Provincial Groundwater Monitoring Network (PGMN) wells, groundwater recharge and discharge areas, groundwater use information, and source water protection reports.

8.3.2.1 Hydrostratigraphy

Table 97 lists the hydrostratigraphic units identified in the North Lake Ontario Shoreline Tertiary Watershed using the cross-section tool and isopach maps on the ORMGP portal (2025b).

Comprehensive information on hydrostratigraphy, along with detailed descriptions of each hydrostratigraphy unit, is provided in Section 3.4.4.1.

Table 97 Hydrostratigraphic Units within the North Lake Ontario Shoreline Tertiary Watershed in Peterborough County

Quaternary Watershed	Present in Tertiary Watershed (Yes / No)								
	Glaciolacustrine/Fluvial/	Oak Ridges Aquifer Complex	Upper New Market Till	Inter-Newmarket Sediment	Lower Newmarket Till	Thorncliffe Formation	Sunnybrook Drift	Scarborough Formation	Bedrock
Ganaraska River	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Data Source: (ORMGP 2022)

Of the hydrostratigraphic units listed, nine are present in this watershed. The shallow aquifer unit – Oak Ridges Aquifer Complex, intermediate aquifer unit – Inter-Newmarket Till and deeper aquifer units like the Thorncliffe Formation, and Scarborough Drift are present throughout the North Lake Ontario Shoreline Tertiary watershed in Peterborough County.

The presence of the deeper units such as the Thorncliffe Formation, Sunnybrook Drift, and Scarborough Formation suggests substantial vertical stratification and groundwater storage potential. These patterns reflect a regionally continuous hydrogeological framework, critical for groundwater resource evaluation and management. These distinctions are essential for understanding groundwater flow, recharge zones, and aquifer/aquitard delineation across the region.

8.3.2.2 Provincial Groundwater Monitoring Network Wells

There are no PGMN wells within the North Lake Ontario Shoreline Tertiary Watershed in Peterborough County.

It is recommended that future quaternary watershed plans incorporate more comprehensive assessments of groundwater levels, alongside systematic seasonal monitoring, to effectively capture temporal variations and support informed water resource management.

8.3.2.3 Groundwater Recharge Area

The mean annual groundwater recharge rates from the CANWET Model (TCC 2008) for the North Lake Ontario Shoreline Tertiary Watershed is 123 mm/year and the SGRAs mapped from TCC (2009) are illustrated in Figures 19a to 19f. The basis for the recharge estimates is provided in Section 3.4.4.3.

Within the County of Peterborough, the North Lake Ontario Shoreline Tertiary Watershed and Ganaraska Quaternary Watershed is a very small portion of the overall watershed that was evaluated in the CANWET Model, and as such there is more uncertainty in the representativeness of the resulting recharge rate estimated from the model. This portion of the North Lake Ontario Shoreline Tertiary Watershed within the County is approximately 80% coarse grained granular deposits and 20% finer-grained glacial till deposits. As such, the vast majority of the Tertiary and Quaternary Watersheds are delineated as SGRA. Using the surficial geology-based approach presented in TCC (2009), the area-weighted mean annual groundwater recharge is approximately 275 mm/year, which is interpreted as a more representative estimate given the surficial geologic mapping.

Implementation of infiltration based Low Impact Development is more feasible in higher recharge areas and is likely required as part of development to maintain downgradient groundwater discharge function and/or connection to drinking water supply systems (e.g. municipal groundwater supply).

8.3.2.4 Groundwater Discharge Area

The groundwater discharge areas within the North Lake Ontario Shoreline Tertiary Watershed are well-aligned with cold streams as illustrated in Figures 20a to 20f. Table 98 summarizes the mean depth to the water table for the North Lake Ontario Shoreline Tertiary Watershed.

Table 98 Summary of Mean Depth to Water Table Rate within the North Lake Ontario Shoreline Tertiary Watershed in Peterborough County

Tertiary Watershed	Quaternary Watershed	% of Quaternary Watershed Within Tertiary	Area of Quaternary Watershed (km^2)	Mean Depth to Water Table (m bgs)
North Lake Ontario Shoreline	Ganaraska River	100	6	36

Source: (ORMGP 2025a)
m bgs – metres below ground surface

The Ganaraska River Quaternary Watershed has a mean depth to water of 36 m bgs, indicating a deep-water table, which is found in areas with high ground surfaces, such as hummocky terrain, which are distributed across the Ganaraska River Quaternary Watershed.

The depth to groundwater is important for water resource planning, especially in terms of well construction, groundwater sustainability, and vulnerability to contamination.

8.3.2.5 Groundwater Users

The groundwater users for the North Lake Ontario Shoreline Tertiary Watershed have been presented in Figures 21a to 21f and summarized in Table 99

Table 99 has been categorized wells into three types for this study: 1) municipal wells, 2) overburden completion, and 3) bedrock completion.

Table 99 Summary of Groundwater Users within the North Lake Ontario Shoreline Tertiary Watershed in Peterborough County

Quaternary Watershed	% of Quaternary Watershed within Tertiary	Area of Quaternary Watershed within the County (km^2)	Water Well Record Type – Number of wells within each Quaternary watershed			Water Well Record Type - (%) within each Quaternary watershed		
			Municipal Well	Quaternary Completion	Bedrock Completion	Municipal Well	Quaternary Completion	Bedrock Completion
Ganaraska River	100	6	0	9	1	0	90	10
Average for North Lake Ontario Shoreline Tertiary Watershed						**0**	**90**	**10**

Data Source: (ORMGP 2022)

Groundwater use within the North Lake Ontario Shoreline Tertiary Watershed is very limited, with only a small number of wells recorded in the Ganaraska River Quaternary watershed. No municipal wells are present, indicating that all groundwater reliance in this area is based on private well supplies.

Most wells in the Ganaraska River watershed are completed in Quaternary deposits, with 90% of wells drawing from unconsolidated materials and only 10% completed in bedrock. This pattern contrasts with several other tertiary watersheds in the region, where bedrock aquifers are more dominant. The data suggest that local groundwater use is strongly tied to shallow aquifer systems.

Overall, groundwater reliance in the North Lake Ontario Shoreline Tertiary Watershed is characterized by a very small number of private wells and an almost exclusive dependence on Quaternary aquifers. With no municipal wells present, groundwater use in this watershed is rural in nature and limited in scale.

Furthermore, information on the groundwater users is provided in Section 3.4.5.

8.3.2.6 Source Water Protection

The North Lake Ontario Shoreline Tertiary Watershed is located within the Ganaraska Region Source Protection Area.

Wellhead Protection Areas

Based on Figures 21a to 21f, there are no WHPAs located within the North Lake Ontario Shoreline Tertiary Watershed. Comprehensive information on the WHPAs is provided in Section 3.4.5.

Highly Vulnerable Aquifers

The majority of the North Lake Ontario Shoreline Tertiary Watershed is situated within designated HVAs, as illustrated in Figures 21a to 21f.

The extensive presence of HVAs within the Tertiary Watershed underscores the critical importance of implementing land use regulations, comprehensive source water protection strategies, and proactive environmental planning to preserve groundwater quality and ensure a sustainable supply throughout the North Lake Ontario Shoreline Tertiary Watershed.

Comprehensive information on the HVAs is provided in Section 3.4.6.2.

Significant Groundwater Recharge Areas

The SGRAs coverage for the North Lake Ontario Shoreline Tertiary Watershed is presented in Figures 19a to 19f. The predominance of sandy and gravelly soils has resulted in most of the North Lake Ontario Shoreline Tertiary Watershed being located within SGRAs. In addition, Figures 19a to 19f illustrate a strong hydrogeological linkage between SGRAs and cold-water streams within the North Lake Ontario Shoreline Tertiary Watershed, highlighting a critical ecological and hydrological connection that supports overall watershed health and resilience.

Similar to HVAs, potential policy applications for SGRAs align with the Provincial Policy Statement and the relevant municipal official plans. In areas designated as SGRAs, it is recommended that recharge rates be maintained when development or site alterations are proposed in addition to recharge areas that have lower recharge rates but are linked to sensitive wetland and stream features.

Comprehensive information on the SGRAs is provided in Section 3.4.6.3.

Intake Protection Zones (IPZs)

There are no IPZs located within the North Lake Ontario Shoreline Tertiary Watershed. Comprehensive information on the IPZs is provided in Section 3.4.6.4.

8.3.3 Water Quality

8.3.3.1 Surface Water Quality

The Ganaraska Conservation conducts ongoing surface water quality monitoring throughout its watershed, collecting samples from numerous sites. The resulting data inform evaluations of both surface water conditions and broader watershed health, with key insights presented in the

Watershed Report Card (Otonabee Conservation, 2023). Table 100 presents the 2023 surface water quality evaluations for the Ganaraska River subwatershed within the North Lake Ontario Shoreline Tertiary Watershed. According to the 2023 Watershed Report Card (Ganaraska Conservation 2023), the Ganaraska Region Conservation received an overall grade of C, indicating generally fair surface water quality across the region.

The Watershed Report Cards provide a more generalized analysis compared to the detailed evaluations in the Conservation Authority's annual water quality reports. Future quaternary watershed plans should aim for more comprehensive assessments.

Comprehensive information on the surface water quality is provided in Section 3.4.6.

Table 100 Summary of Surface Water Quality within the North Lake Ontario Shoreline Tertiary Watershed in Peterborough County

Quaternary Watershed	Subwatershed (% within the Quaternary Watershed [1])	Surface Water Quality Grade [2]	2023 Watershed Report Card Summary [3]
Ganaraska River	Ganaraska River Watershed (96%)	B - Good	• Overall C Grade for the Ganaraska Conservation. • Most watershed surface water quality remains steady since the last reporting card.

Notes:
(1) The delineation for each subwatershed was provided by each Conservation Authority; it should be noted that they do not share the same scale.
(2) Three indicators were utilized to evaluate the quality of surface water: phosphorus, chloride, and Escherichia Coli (E. coli bacteria). Phosphorus, a nutrient found both naturally and through human activities, can lead to algae blooms, excessive plant growth, and reduced oxygen levels when present in high concentrations. Chloride occurs naturally within the environment. However, anthropogenic sources of chloride enter through ecosystem via road salt. E. Coli may come from leaky septic tanks, overloaded sewage treatment plants, agricultural runoff, or even high numbers of waterfowl such as Canada geese. (Kawartha Conservation 2008; GRCA 2018; Otonabee Conservation, 2023).
(3) Source: (GRCA 2023)

8.3.3.2 Ground Water Quality

The Ganaraska Conservation conducts ongoing groundwater quality monitoring throughout its watershed, collecting samples from numerous sites. The data obtained from these sites are used to assess groundwater conditions and inform evaluations of overall watershed health, with key insights presented in the Watershed Report Card (GRCA 2023).

According to the 2023 Watershed Report Card, groundwater quality in the Ganaraska Region Watershed was evaluated through the analysis of key chemical indicators, including nitrate and chloride, substances that, at elevated levels, may pose risks to human health. As reported in the 2023 Watershed Report Card (GRCA 2023), concentrations of nitrate and chloride parameters at most monitoring sites remained within the acceptable limits defined by the Ontario Drinking Water Quality Standards and the Canadian Water Quality Guidelines during the monitoring period from 2017 to 2021.

The Watershed Report Cards provide a more generalized analysis compared to the detailed evaluations in Conservation's annual water quality reports. Future quaternary watershed plans should aim for more comprehensive assessments.

8.4 Natural Hazards

Detail on the types of natural hazards, associated setbacks, and applicable agencies or regulators are included in Section 3.5. The following summarizes the results for the North Lake Ontario tertiary watershed. Table 101 indicates that no natural hazard mapping or delineation has been provided for this watershed.

Table 101 Natural Hazards within the North Lake Ontario Shoreline Tertiary Watershed by Quaternary Watershed

Quaternary Watershed	% of the Watershed Within the Tertiary Watershed	Area of Quaternary Watershed (km^2)	Natural Hazard					
			Known Karst (%)	Inferred Karst (%)	Potential Karst (%)	Floodplain Area (km^2)	Regulated Top of Slope Area (km^2)	Meander Belt Area (km^2)
Ganaraska River	100.00	6.43	0	0	0		-	-

Figure 11 and Table 101 reveal that there is no karst topography of either classification within the tertiary watershed. From a land use perspective, this suggests that the watershed is generally suitable for development or other land uses without concern for subsurface karst instability. Standard land use planning can proceed, though other natural hazards such as floodplains, slopes, or meander belts should still be considered if present.

The delineated floodplain does not extend into the portion of the North Ontario Shoreline Tertiary watershed included in this study and presents no floodplain hazards. Ganaraska Conservation is in the process of producing updated floodplain mapping for a significant portion of its watershed including Ganaraska River and an area that drains into the western end of Rice Lake that extends into the County. This information should be confirmed and updated through future study, then used to inform subwatershed studies to identify potential constraints to development for potential growth areas and to inform planning.

8.5 Aquatic and Terrestrial Features

To provide a high-level characterization of the aquatic features within the North Lake Ontario Shoreline tertiary watershed, Table 102 presents a summary of the lakes, rivers, creeks, fish habitat, and thermal regime information available from background sources. Similarly, a high-level analysis of terrestrial features within the tertiary watershed is presented in Table 103.

Table 102 North Lake Ontario Shoreline Tertiary Watershed Aquatic Feature Characterization

Lakes	No data available.
Rivers	Ganaraska River
Creeks	No data available.
Fish Species	Atlantic Salmon, Blacknose Dace, Bluntnose Minnow, Brook Stickleback, Brook Trout, Brown Trout, Central Mudminnow, Chinook Salmon, Coho Salmon, Common Shiner, Creek Chub, Fathead Minnow, Hornyhead Chub, Mottled Sculpin, Slimy Sculpin
Fish Activity Areas	None.
Thermal Regime (1)	Cold: 100%

Note:
(1) Total mapped watercourse segments: 11

Table 103 North Lake Ontario Shoreline Tertiary Watershed Wetlands, Woodlands, and Areas of Natural and Scientific Interest (ANSIs)

Parameter	Value
Total Tertiary Watershed Area (1)	**6.43 km²**
Wetlands	
Provincially Significant Wetland	0 km² (0.0%)
Non-Provincially Significant Wetland	0 km² (0.0%)
Unevaluated Wetland	0.02 km² (0.3%)
Total Wetland Area	**0.02 km² (0.3%)**
Wetland Types (% of mapped wetlands)	
Bog	0%
Fen	0%
Marsh	0%
Open Water	0%
Swamp	100%
Unknown	0%
Woodlands	
Total Wooded Area	**6.07 km² (94%)**
Areas of Natural and Scientific Interest (ANSIs)	
Provincially Significant ANSI (Life Science)	0
Regionally Significant ANSI (Life Science)	1
Provincially Significant ANSI (Earth Science)	0
Regionally Significant ANSI (Earth Science)	0
Total Number of Candidate and Confirmed ANSIs	1

Note:
(1) Corresponds to the total area of the watershed overlapping with County boundaries

9 Conclusions

The Volume 1 Characterization report for Peterborough County's first Watershed Plan provides a synthesis, in text, tables and mapping, of a comprehensive review of relevant environmental data available at the time of this study. This information has been presented and organized by the five tertiary watersheds that overlap with the County. The Volume 1 report specifically provides:

- A summary of the background review findings and key gaps (Section 2)
- A description of the presence and distribution of various environmental features and their sensitivities across the County (Section 3), and in each of the five tertiary watersheds in the County (Section 4 through 8).

This characterization has relied on a review of existing data sources and has involved a review of the following natural and water-based system components, in alignment with the applicable provincial guidance (as outlined in Section 1.4):

- drainage systems
- surficial soils
- slopes / topography
- groundwater system and Source Water Protection
- natural hazards
- natural heritage (including aquatic / fish habitat and terrestrial features and areas)
- land uses (urban and agricultural), and
- locations for watershed monitoring (climate, streamflow, water quality and groundwater).

The technical information and findings in this Volume 1 Characterization report have directly informed the Volume 2 Planning and Management Guidance for the Watershed Plan. Volume 2 includes a vision, goals and objectives for the Watershed Plan and high-level guidance for the County related to:

- water management (quantity/quality)
- climate change considerations
- natural hazard management
- land use impact management including cumulative impacts, and
- future studies and monitoring.

This Watershed Plan will allow for a more detailed understanding of the different natural and water-based systems across Peterborough County. The information will also inform the County's Official Plan (and local area municipal Official Plans) and provide direction for the subsequent studies required to support future quaternary watershed planning and local subwatershed planning initiatives in the County.

Volume 1 provides the technical background to inform the planning and management guidance provided in Volume 2. Together, these two volumes comprise the County's first Watershed Plan.

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Appendix A Background Materials Received and Reviewed

Table A1 Breakdown of Tertiary Watersheds, Quaternary Watersheds, Local Area Municipalities, and Major Towns within the Study Area

Tertiary Watershed	Quaternary Watershed	Township	Major Town
Gull River	Birchbark Lake - Irondale River	Municipality of Trent Lakes	
	Goose Lake - Burnt River	Municipality of Trent Lakes	
	Farquhar Lake - Irondale River	Municipality of Trent Lakes	
		Township of North Kawartha	
Kawartha Lakes	Nogies Creek	Municipality of Trent Lakes	
	Pigeon Lake - Gannon Narrows	Municipality of Trent Lakes	
		Selwyn Township	
	Mississagua River	Municipality of Trent Lakes	
		Township of North Kawartha	
	Eels Creek	Township of North Kawartha	Apsley
	Stony Lake - Katchewanooka Lake	Selwyn Township	
		Township of Douro-Dummer	
		Township of Havelock-Belmont-Methuen	
		Township of North Kawartha	
	Deer Bay Creek	Township of North Kawartha	
	Burleigh Falls Dam - Lower Buckhorn Lake	Municipality of Trent Lakes	Buckhorn
		Selwyn Township	Bridgenorth
	Bobcaygeon River	Municipality of Trent Lakes	
	Omeemee Dam - Pigeon River	Township of Cavan Monaghan	
North Lake Ontario Shoreline	Ganaraska River	Township of Cavan Monaghan	
Otonabee River	Lock 19 - Otonabee River	City of Peterborough	
		Township of Cavan Monaghan	
		Township of Douro-Dummer	
		Township of Otonabee-South Monaghan	
		Selwyn Township	Lakefield
	Indian River	Township of Douro-Dummer	Douro
		Township of Otonabee-South Monaghan	
	Ouse River	Township of Asphodel-Norwood	Norwood
		Township of Douro-Dummer	

Tertiary Watershed	Quaternary Watershed	Township	Major Town
		Township of Havelock-Belmont-Methuen	
		Township of Otonabee-South Monaghan	
	Hastings Lock 18 Dam - Trent River	Township of Asphodel-Norwood	
		Township of Otonabee-South Monaghan	
	Otonabee River Outlet	City of Peterborough	
		Township of Cavan Monaghan	Millbrook
		Township of Otonabee-South Monaghan	
	Cavan Creek	Township of Cavan Monaghan	
		Township of Otonabee-South Monaghan	
Trent River - Crowe River	Paudash Lake Dam - Crowe River	Township of North Kawartha	
	Chandos Lake - Crowe River	Township of North Kawartha	
	Cordova Lake Dam - Crowe River	Township of Havelock-Belmont-Methuen	
		Township of North Kawartha	
	Kasshabog Lake - North River	Township of Douro-Dummer	
		Township of Havelock-Belmont-Methuen	
	Round Lake - North River Outlet	Township of Havelock-Belmont-Methuen	
	Crowe Lake - Crowe River	Township of Havelock-Belmont-Methuen	Havelock
	Crowe Bay Dam - Trent River	Township of Asphodel-Norwood	
		Township of Havelock-Belmont-Methuen	

Appendix B Natural Heritage Species List

Fish Species Reported from Peterborough County

Species Name		Conservation Rank				Source			
Scientific Name	**Common Name**	**Provincial (S-rank)**	**Provincial (ESA)**	**National (COSEWIC)**	**National (SARA)**	**NHIC [1]**	**iNaturalist [2]**	**DFO [3]**	**LIO [4]**
Acipenseriformes									
Acipenser fulvescens pop. 3	Lake Sturgeon (Great Lakes - Upper St. Lawrence River population)	S2	END	THR		x			
Anguilliformes									
Anguilla rostrata	American Eel	S1S2	END	THR		x	x		
Atheriniformes									
Labidesthes sicculus	Brook Silverside	S4					x		x
Clupeiformes									
Alosa pseudoharengus	Alewife	SNA							x
Cypriniformes									
Campostoma anomalum	Central Stoneroller	S4					x		x
Carassius auratus	Goldfish	SNA					x		
Couesius plumbeus	Lake Chub	S5					x		
Cyprinus carpio	Common Carp	SNA					x		x
Hybognathus hankinsoni	Brassy Minnow	S5					x		x
Nocomis biguttatus	Hornyhead Chub	S4					x		x
Nocomis micropogon	River Chub	S4							x
Notemigonus crysoleucas	Golden Shiner	S5					x		x
Notropis atherinoides	Emerald Shiner	S5							x
Notropis heterodon	Blackchin Shiner	S4							x
Notropis heterolepis	Blacknose Shiner	S5					x		x
Notropis hudsonius	Spottail Shiner	S5							x
Notropis rubellus	Rosyface Shiner	S4					x		x
Notropis volucellus	Mimic Shiner	S5					x		
Chrosomus eos	Northern Redbelly Dace	S5					x		x
Chrosomus neogaeus	Finescale Dace	S5					x		x
Pimephales notatus	Bluntnose Minnow	S5					x		x
Pimephales promelas	Fathead Minnow	S5					x		x
Rhinichthys cataractae	Longnose Dace	S5					x		x
Semotilus atromaculatus	Creek Chub	S5					x		x
Semotilus corporalis	Fallfish	S4					x		x
Cyprinella spiloptera	Spotfin Shiner	S4					x		
Luxilus chrysocephalus	Striped Shiner	S4					x		
Luxilus cornutus	Common Shiner	S5					x		x
Margariscus margarita	Northern Pearl Dace	S5							x
Catostomus catostomus	Longnose Sucker	S5							x
Catostomus commersonii	White Sucker	S5					x		x
Hypentelium nigricans	Northern Hog Sucker	S4					x		
Moxostoma valenciennesi	Greater Redhorse	S3					x		x
Cyprinodontiformes									
Fundulus diaphanus	Banded Killifish	S5					x		x
Esociformes									
Umbra limi	Central Mudminnow	S5					x		x
Esox lucius	Northern Pike	S5					x		x
Esox masquinongy	Muskellunge	S4					x		x
Gadiformes									
Lota lota	Burbot	S5					x		x
Gasterosteiformes									
Culaea inconstans	Brook Stickleback	S5					x		x
Gasterosteus aculeatus	Threespine Stickleback	S4S5							x
Lepisosteiformes									
Lepisosteus osseus	Longnose Gar	S4					x		

Fish Species Reported from Peterborough County

Species Name		Conservation Rank				Source			
Scientific Name	Common Name	Provincial (S-rank)	Provincial (ESA)	National (COSEWIC)	National (SARA)	NHIC [1]	iNaturalist [2]	DFO [3]	LIO [4]
Osmeriformes									
Osmerus mordax	Rainbow Smelt	S5					x		
Perciformes									
Ambloplites rupestris	Rock Bass	S5					x		x
Lepomis gibbosus	Pumpkinseed	S5					x		x
Lepomis macrochirus	Bluegill	S5					x		x
Micropterus dolomieu	Smallmouth Bass	S5					x		x
Micropterus salmoides	Largemouth Bass	S5							x
Pomoxis nigromaculatus	Black Crappie	S4					x		x
Etheostoma exile	Iowa Darter	S5					x		x
Etheostoma nigrum	Johnny Darter	S5					x		x
Perca flavescens	Yellow Perch	S5					x		x
Percina caprodes	Logperch	S5					x		x
Sander canadensis	Sauger	S4							x
Sander vitreus vitreus	Walleye	S5							x
Neogobius melanostomus	Round Goby	SNA					x		
Lepomis peltastes	Northern Sunfish	S3	SC	SC	SC		x	x	
Salmoniformes									
Coregonus artedi	Cisco	S5					x		x
Coregonus clupeaformis	Lake Whitefish	S5					x		x
Oncorhynchus kisutch	Coho Salmon	SNA							x
Oncorhynchus tshawytscha	Chinook Salmon	SNA							x
Oncorhynchus mykiss	Rainbow Trout	SNA					x		x
Salmo trutta	Brown Trout	S5							x
Salvelinus fontinalis fontinalis	Brook Trout	S5							x
Salvelinus namaycush	Lake Trout	S5					x		x
Scorpaeniformes									
Cottus bairdii	Mottled Sculpin	S5					x		x
Cottus cognatus	Slimy Sculpin	S5					x		x
Siluriformes									
Ictalurus punctatus	Channel Catfish	S4							x
Ameiurus natalis	Yellow Bullhead	S4					x		
Ameiurus nebulosus	Brown Bullhead	S5					x		x
Total						**2**	**52**	**1**	**56**

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Bird Species Reported from Peterborough County

Species		Conservation Rank				Source		
Scientific Name	Common Name	Provincial (S-rank)	Provincial (ESA)	National (COSEWIC)	National (SARA)	NHIC [1]	OBBA [2]	iNaturalist [3]
Accipitridae	**Hawks, Kites, Eagles & Allies**							
Accipiter cooperii	Cooper's Hawk	S4					x	
Accipiter striatus	Sharp-shinned Hawk	S5					x	x
Aquila chrysaetos	Golden Eagle	S1B, S4N	END					x
Buteo jamaicensis	Red-tailed Hawk	S5					x	x
Buteo lagopus	Rough-legged Hawk	S1B/S4N						x
Buteo lineatus	Red-shouldered Hawk	S4B,S2N					x	x
Buteo platypterus	Broad-winged Hawk	S5B					x	x
Circus cyaneus	Northern Harrier	S5B, S4N					x	
Haliaeetus leucocephalus	Bald Eagle	S4					x	x
Alaudidae	**Larks**							
Eremophila alpestris	Horned Lark	S4					x	
Alcedinidae	**Kingfishers**							
Megaceryle alcyon	Belted Kingfisher	S5B, S4N					x	x
Apodidae	**Swifts**							
Chaetura pelagica	Chimney Swift	S3B	THR	THR	THR		x	x
Anatidae	**Ducks, Geese & Swans**							
Aix sponsa	Wood Duck	S5B, S3N					x	x
Anas acuta	Northern Pintail	S5B, S4N						x
Anas clypeata	Northern Shoveler	S4B, S4N, S5M					x	
Anas crecca	Green-winged Teal	S4B, S4N, S5M					x	x
Anas discors	Blue-winged Teal	S3B,S4M				x	x	
Anas platyrhynchos	Mallard	S5					x	x
Anas rubripes	American Black Duck	S4					x	x
Aythya americana	Redhead	S2B/S4N						x
Aythya marila	Great Scaup	S4B, S4N, S5M						x
Branta canadensis	Canada Goose	S5					x	x
Bucephala albeola	Bufflehead	S5						x
Bucephala clangula	Common Goldeneye	S5						x
Clangula hyemalis	Long-tailed Duck	S3B, S5N						x
Cygnus buccinator	Trumpeter Swan	S4					x	x
Cygnus olor	Mute Swan	SNA					x	x
Lophodytes cucullatus	Hooded Merganser	S5					x	x
Melanitta perspicillata	Surf Scoter	S4B/S5N						x
Mergus serrator	Red-breasted Merganser	S4B/S5N						x
Oxyura jamaicensis	Ruddy Duck	S3B, S4N, S5M						x
Anser albifrons	Greater White-fronted Goose	S3M						x
Aythya affinis	Lesser Scaup	S4B, S4N, S5M						x
Aythya collaris	Ring-necked Duck	S5B, S4N					x	x
Aythya valisineria	Canvasback	S1B, S3N, S4M						x
Branta bernicla	Brant	S4M						x
Branta leucopsis	Barnacle Goose	SNA						x
Bucephala islandica	Barrow's Goldeneye	S2N		SC	SC			x
Cygnus columbianus	Tundra Swan	S2B, S4N, S3M						x
Histrionicus histrionicus	Harlequin Duck	S2N		SC	SC			x
Melanitta americana	Black Scoter	S4						x
Mergus merganser	Common Merganser	S5					x	x
Somateria mollissima	Common Eider	S1B						x
Somateria spectabilis	King Eider	SHB, S2N						x
Ardeidae	**Herons and Bitterns**							
Ardea alba	Great Egret	S2B, S3M						x
Ardea herodias	Great Blue Heron	S4					x	x
Botaurus lentiginosus	American Bittern	S5B					x	x
Butorides virescens	Green Heron	S4B					x	x
Ixobrychus exilis	Least Bittern	S4B	THR	THR	THR	x	x	

Bird Species Reported from Peterborough County

Species		Conservation Rank				Source		
Scientific Name	Common Name	Provincial (S-rank)	Provincial (ESA)	National (COSEWIC)	National (SARA)	NHIC [1]	OBBA [2]	iNaturalist [3]
Nyctanassa violacea	Yellow-crowned Night-heron	SNA						x
Nycticorax nycticorax	Black-crowned Night-heron	S3B, S2N, S4M						x
Bombycillidae	**Waxwings**							
Bombycilla cedrorum	Cedar Waxwing	S5					x	x
Bombycilla garrulus	Bohemian Waxwing	S4B, S5N						x
Calcariidae	**Longspurs & Snow Buntings**							
Calcarius lapponicus	Lapland Longspur	S3B, S4N						x
Plectrophenax nivalis	Snow Bunting	S4N						x
Caprimulgidae	**Nightjars**							
Chordeiles minor	Common Nighthawk	S4B	SC	SC	SC	x	x	x
Antrostomus vociferus	Eastern Whip-poor-will	S4B	THR	SC	THR	x	x	x
Cardinalidae	**Cardinals, Grosbeaks & Allies**							
Cardinalis cardinalis	Northern Cardinal	S5					x	x
Passerina caerulea	Blue Grosbeak	SNA						x
Passerina cyanea	Indigo Bunting	S5B					x	x
Pheucticus ludovicianus	Rose-breasted Grosbeak	S5B					x	x
Piranga olivacea	Scarlet Tanager	S5B					x	x
Piranga rubra	Summer Tanager	S1M						x
Spiza americana	Dickcissel	S2M						x
Cathartidae	**Vultures**							
Cathartes aura	Turkey Vulture	S5B, S3N					x	x
Certhiidae	**Creepers**							
Certhia americana	Brown Creeper	S5					x	x
Charadriidae	**Plovers**							
Charadrius semipalmatus	Semipalmated Plover	S4B, S5M						x
Charadrius vociferus	Killdeer	S4B					x	x
Pluvialis dominica	American Golden-Plover	S2B, S4M						x
Pluvialis squatarola	Black-bellied Plover	S4M						x
Columbidae	**Pigeons & Doves**							
Columba livia	Rock Pigeon	SNA					x	x
Zenaida asiatica	White-winged Dove	SNA						x
Zenaida macroura	Mourning Dove	S5					x	x
Corvidae	**Crows & Jays**							
Corvus brachyrhynchos	American Crow	S5					x	x
Corvus corax	Common Raven	S5					x	x
Cyanocitta cristata	Blue Jay	S5					x	x
Perisoreus canadensis	Canada Jay	S5					x	x
Cuculidae	**Cuckoo & Anis**							
Coccyzus americanus	Yellow-billed Cuckoo	S4B					x	x
Coccyzus erythropthalmus	Black-billed Cuckoo	S4S5B					x	x
Emberizidae	**New World Sparrows & Allies**							
Ammodramus henslowii	Henslow's Sparrow	S1B	END	END	END	x		
Ammodramus savannarum	Grasshopper Sparrow	S4B	SC	SC		x	x	x
Junco hyemalis	Dark-eyed Junco	S5					x	x
Melospiza georgiana	Swamp Sparrow	S5B, S4N					x	x
Melospiza lincolnii	Lincoln's Sparrow	S5B					x	x
Melospiza melodia	Song Sparrow	S5					x	x
Passerculus sandwichensis	Savannah Sparrow	S5B, S3N					x	x
Passerella iliaca	Fox Sparrow	S5B, S3N						x
Pipilo erythrophthalmus	Eastern Towhee	S4B, S3N					x	x
Pooecetes gramineus	Vesper Sparrow	S4B					x	x
Spizella pallida	Clay-colored Sparrow	S4B					x	x
Spizella passerina	Chipping Sparrow	S5B, S3N					x	x
Zonotrichia albicollis	White-throated Sparrow	S5					x	x
Zonotrichia leucophrys	White-crowned Sparrow	S5B, S3N						x

Bird Species Reported from Peterborough County

Species		Conservation Rank				Source		
Scientific Name	Common Name	Provincial (S-rank)	Provincial (ESA)	National (COSEWIC)	National (SARA)	NHIC [1]	OBBA [2]	iNaturalist [3]
Zonotrichia querula	Harris's Sparrow	S2B		SC	SC			x
Spizella pusilla	Field Sparrow	S4B, S3N					x	x
Falconidae	**Carcaras & Falcons**							
Falco columbarius	Merlin	S5					x	x
Falco peregrinus	Peregrine Falcon	S4	SC			x	x	x
Falco sparverius	American Kestrel	S4					x	x
Fringillidae	**Finches & Allies**							
Acanthis flammea	Common Redpoll	S5						x
Coccothraustes vespertinus	Evening Grosbeak	S4	SC	SC	SC	x	x	x
Haemorhous mexicanus	House Finch	SNA					x	x
Haemorhous purpureus	Purple Finch	S5					x	x
Loxia curvirostra	Red Crossbill	S5					x	x
Loxia leucoptera	White-winged Crossbill	S5					x	x
Pinicola enucleator	Pine Grosbeak	S4B, S5N						x
Spinus pinus	Pine Siskin	S5					x	x
Spinus tritis	American Goldfinch	S5					x	
Gaviidae	**Loons**							
Gavia stellata	Red-throated Loon	S2B, S4M						x
Gavia immer	Common Loon	S5					x	x
Gruidae	**Cranes**							
Grus canadensis	Sandhill Crane	S5B, S3N					x	
Hirundinidae	**Swallows**							
Hirundo rustica	Barn Swallow	S4B	SC	SC	THR	x	x	x
Petrochelidon pyrrhonota	Cliff Swallow	S4S5B					x	x
Progne subis	Purple Martin	S3B				x	x	x
Riparia riparia	Bank Swallow	S4B	THR	THR	THR	x	x	x
Stelgidopteryx serripennis	Northern Rough-winged Swallow	S4B					x	x
Tachycineta bicolor	Tree Swallow	S4S5B					x	x
Icteridae	**New World Blackbird**							
Agelaius phoeniceus	Red-winged Blackbird	S5					x	x
Dolichonyx oryzivorus	Bobolink	S4B	THR	SC	THR	x	x	x
Euphagus carolinus	Rusty Blackbird	S4B, S3N	SC	SC	SC			x
Icterus galbula	Baltimore Oriole	S4B					x	x
Icterus spurius	Orchard Oriole	S4B					x	x
Molothrus ater	Brown-headed Cowbird	S5					x	x
Quiscalus quiscula	Common Grackle	S5					x	x
Sturnella magna	Eastern Meadowlark	S4B, S3N	THR	THR	THR	x	x	x
Laniidae	**Shrikes**							
Lanius ludovicianus	Loggerhead Shrike	S1B	END		END	x		
Laridae	**Gulls, Terns & Skimmers**							
Chlidonias niger	Black Tern	S3B, S4M	SC			x	x	x
Chroicocephalus philadelphia	Bonaparte's Gull	S5						x
Hydroprogne caspia	Caspian Tern	S3B, S5M				x		x
Larus argentatus	Herring Gull	S4B, S5N					x	
Larus delawarensis	Ring-billed Gull	S5					x	x
Larus fuscus	Lesser Black-backed Gull	S3N, S4M						x
Larus glaucoides	Iceland Gull	S4N						x
Larus hyperboreus	Glaucous Gull	S4N						x
Larus marinus	Great Black-backed Gull	S1B, S4N						x
Mimidae	**Mockingbirds, Thrashers & Allies**							
Dumetella carolinsis	Gray Catbird	S5B, S3N					x	
Mimus polyglottos	Northern Mockingbird	S4					x	x
Toxostoma rufum	Brown Thrasher	S4B					x	x
Motacillidae	**Wagtails, Longclaws & Pipits**							
Anthus rubescens	American Pipit	S4B						x

Bird Species Reported from Peterborough County

Species		Conservation Rank				Source		
Scientific Name	Common Name	Provincial (S-rank)	Provincial (ESA)	National (COSEWIC)	National (SARA)	NHIC (1)	OBBA (2)	iNaturalist (3)
Pandionidae	**Osprey**							
Pandion haliaetus	Osprey	S5B					x	x
Paridae	**Chickadees and Titmice**							
Poecile atricapillus	Black-capped Chickadee	S5					x	x
Poecile hudsonicus	Boreal Chickadee	S4						x
Parulidae	**Wood Warblers**							
Cardellina canadensis	Canada Warbler	S5B	SC	SC	THR	x	x	x
Cardellina pusilla	Wilson's Warbler	S5B						x
Geothlypis philadelphia	Mourning Warbler	S5B					x	x
Geothylupis trichas	Common Yellowthroat	S5B, S3N					x	
Helmitheros vermivorum	Worm-eating Warbler	S1M						x
Mniotilta varia	Black-and-white Warbler	S5B					x	x
Oreothlypis ruficapilla	Nashville Warbler	S5B					x	
Parkesia noveboracensis	Northern Waterthrush	S5B					x	x
Seiurus aurocapilla	Ovenbird	S5B					x	x
Setophaga americana	Northern Parula	S5B					x	x
Setophaga caerulescens	Black-throated Blue Warbler	S5B					x	x
Setophaga castanea	Bay-breasted Warbler	S5B						x
Setophaga cerulea	Cerulean Warbler	S2B	THR	END	END	x	x	x
Setophaga citrina	Hooded Warbler	S4B					x	
Setophaga coronata	Yellow Rumped Warbler	S5B, S4N					x	x
Setophaga discolor	Prairie Warbler	S2B				x	x	x
Setophaga fusca	Blackburnian Warbler	S5B					x	x
Setophaga magnolia	Magnolia Warbler	S5B					x	x
Setophaga pensylvanica	Chestnut-sided warbler	S5B					x	x
Setophaga petechai	Yellow Warbler	S5B					x	
Setophaga pinus	Pine Warbler	S5B, S3N					x	x
Setophaga ruticilla	American Redstart	S5B					x	x
Setophaga striata	Blackpoll Warbler	S5B						x
Setophaga tigrina	Cape May Warbler	S5B						x
Setophaga virens	Black-throated Green Warbler	S5B					x	x
Vermivora chrysoptera	Golden-winged Warbler	S3B	SC	THR	THR	x	x	x
Vermivora cyanoptera	Blue-winged Warbler	S4B					x	x
Passeridae	**Sparrows**							
Passer domesticus	House Sparrow	SNA					x	x
Phalacrocoracidae	**Cormorants**							
Phalacrocorax auritus	Double-crested Cormorant	S5B, S4N					x	
Phasianidae	**Patridges, Grouse, Turkeys**							
Meleagris gallopavo	Wild Turkey	S5					x	x
Phasianus colchicus	Ring-necked Pheasant	SNA						x
Bonasa umbellus	Ruffed Grouse	S5					x	x
Picidae	**Woodpeckers**							
Colaptes auratus	Northern Flicker	S5					x	x
Dryocopus pileatus	Pileated Woodpecker	S5					x	x
Leuconotopicus villosus	Hairy Woodpecker	S5					x	
Melanerpes carolinus	Red-bellied Woodpecker	S5					x	x
Melanerpes erythrocephalus	Red-headed Woodpecker	S3	END	END	END	x	x	x
Picoides arcticus	Black-backed Woodpecker	S5					x	x
Picoides pubescens	Downy Woodpecker	S5					x	
Sphyrapicus varius	Yellow-bellied Sapsucker	S5B, S3N					x	x
Podicipedidae	**Grebes**							
Podiceps auritus	Horned Grebe	S1B, S3N, S4M	SC	SC				x
Podiceps grisegena	Red-necked Grebe	S3						x
Podilymbus podiceps	Pied-billed Grebe	S4B, S2N					x	x

Bird Species Reported from Peterborough County

Species		Conservation Rank				Source		
Scientific Name	Common Name	Provincial (S-rank)	Provincial (ESA)	National (COSEWIC)	National (SARA)	NHIC [1]	OBBA [2]	iNaturalist [3]
Polioptilidae	**Gnatcatchers**							
Polioptila caerulea	Blue-gray Gnatcatcher	S4B					x	x
Rallidae	**Railes, Gallinules & Coots**							
Coturnicops noveboracensis	Yellow Rail	S3B	SC	SC	SC			x
Fulica americana	American Coot	S3B, S4N				x	x	x
Gallinula chloropus	Common Gallinule	S3B				x	x	
Porzana carolina	Sora	S5B					x	x
Rallus elegans	King Rail	S1B	END	END	END	x		
Rallus limicola	Virginia Rail	S4S5B					x	x
Recurvirostridae	**Avocets and Stilts**							
Recurvirostra americana	American Avocet	S2M						x
Regulidae	**Kinglets**							
Regulus satrapa	Golden-crowned Kinglet	S5					x	x
Scolopacidae	**Sandpipers, Phalaropes &Allies**							
Actitis macularius	Spotted Sandpiper	S5B					x	x
Bartramia longicauda	Upland Sandpiper	S2B				x	x	x
Calidris alpina	Dunlin	S4B, S5M						x
Calidris bairdii	Baird's Sandpiper	S4M						x
Calidris fuscicollis	White-rumped Sandpiper	S5M						x
Calidris melanotos	Pectoral Sandpiper	S1B, S4M						x
Calidris minutilla	Least Sandpiper	S4B, S5M						x
Calidris pusilla	Semipalmated Sandpiper	S2B, S4M						x
Gallinago delicata	Wilson's Snipe	S5B					x	x
Limnodromus griseus	Short-billed Dowitcher	S3B, S4M						x
Limnodromus scolopaceus	Long-billed Dowitcher	S4M						x
Phalaropus fulicarius	Red Phalarope	S2M						x
Phalaropus lobatus	Red-necked Phalarope	S3B, S4M	SC	SC	SC			x
Phalaropus tricolor	Wilson's Phalarope	S2B, S4M						x
Scolopax minor	American Woodcock	S4B					x	x
Tringa flavipes	Lesser Yellowlegs	S3S4B, S5M	THR	THR				x
Tringa melanoleuca	Greater Yellowlegs	S4B, S5M						x
Tringa solitaria	Solitary Sandpiper	S4B, S5M						x
Sittidae	**Nutchatches**							
Sitta canadensis	Red-breasted Nuthatch	S5					x	x
Sitta carolinensis	White-breasted Nuthatch	S5					x	x
Stercorariidae	**Skuas**							
Aegolius acadicus	Northern Saw-whet Owl	S5					x	x
Asio flammeus	Short-eared Owl	S4?B, S2S3N	THR	THR	SC			x
Asio otus	Long-eared Owl	S4					x	x
Bubo virginianus	Great Horned Owl	S4					x	x
Megascops asio	Eastern Screech Owl	S4						x
Strix nebulosa	Great Gray Owl	S4						x
Strix varia	Barred Owl	S5					x	x
Surnia ulula	Northern Hawk Owl	S4						x
Sturnidae	**Starlings**							
Sturnus vulgaris	European Starling	SNA					x	x
Trochillidae	**Hummingbirds**							
Archilochus colubris	Ruby-throated Hummingbird	S5B					x	x
Troglodytidae	**Wrens**							
Cistothorus palustris	Marsh Wren	S4B, S3N					x	x
Cistothorus platensis	Sedge Wren	S4B					x	
Thyrothorus ludovicianus	Carolina Wren	S4					x	
Troglodytes aedon	House Wren	S5B					x	x
Troglodytes hiemalis	Winter Wren	S5B, S4N					x	x

Bird Species Reported from Peterborough County

Species		Conservation Rank				Source		
Scientific Name	Common Name	Provincial (S-rank)	Provincial (ESA)	National (COSEWIC)	National (SARA)	NHIC (1)	OBBA (2)	iNaturalist (3)
Turdidae	**Thrushes**							
Catharus fuscescens	Veery	S5B					x	x
Catharus guttatus	Hermit Thrush	S5B, S4N					x	x
Catharus minimus	Gray-cheeked Thrush	S4?B, S4M						x
Catharus ustulatus	Swainson's Thrush	S5B					x	x
Hylocichla mustelina	Wood Thrush	S4B	SC	THR	THR	x	x	x
Sialia sialis	Eastern Bluebird	S5B, S4N					x	x
Turdus migratorius	American Robin	S5					x	x
Tyrannidae	**Tyrant Flycatchers**							
Contopus cooperi	Olive-sided Flycatcher	S4B	SC	SC	SC	x	x	x
Contopus virens	Eastern Wood-pewee	S4B	SC	SC	SC	x	x	x
Empidonax alnorum	Alder Flycatcher	S5B					x	x
Empidonax flaviventris	Yellow-bellied Flycatcher	S5B					x	x
Empidonax minimus	Least Flycatcher	S5B					x	x
Empidonax traillii	Willow Flycatcher	S4B					x	x
Myiarchus crinitus	Great Crested Flycatcher	S5B					x	x
Pyrocephalus rubinus	Vermilion Flycatcher	SNA						x
Sayornis phoebe	Eastern Phoebe	S5B					x	x
Tyrannus tyrannus	Eastern Kingbird	S4B					x	x
Vireonidae	**Vireos**							
Vireo gilvus	Warbling Vireo	S5B					x	x
Vireo olivaceus	Red-eyed Vireo	S5B					x	x
Vireo griseus	White-eyed Vireo	S1B						x
Vireo solitarius	Blue-headed Vireo	S5B					x	x
Vireo flavifrons	Yellow-throated Vireo	S4B					x	x
Vireo philadelphicus	Philadelphia Vireo	S5B						x
Odontophoridae	**New World Quails**							
Icteria virens	Yellow-breasted Chat	S1B	END	END	END	x		
Parkesia motacilla	Louisiana Waterthrush	S2B	THR	THR	THR	x		
Total						**30**	**166**	**228**

Sources:

1 Ontario Ministry of Natural Resources and Forestry (MNRF). 2025. Make a Map: Natural Heritage Areas. Mapping application. Accessed April 2025. https://www.lioapplications.lrc.gov.on.ca/Natural_Heritage/index.html?viewer=Natural_Heritage.Natural_Heritage&locale=en-CA

2 Birds Canada et al. 2025. Ontario Breeding Bird Atlas Data Summary Tool. NatureCounts platform. Accessed April 2025. https://naturecounts.ca/nc/onatlas/findsquare.jsp

3 iNaturalist. 2025. Observations. Accessed April 2025. https://www.inaturalist.org/observations

Reptile and Amphibian Species Reported from Peterborough County

Species		Conservation Rank				Source		
Scientific Name	Common Name	Provincial (S-RANK)	Provincial (ESA)	National (COSEWIC)	National (SARA)	NHIC	ORAA	iNaturalist
Cryptodeira	**Turtles**							
Chelydra serpentina	Snapping Turtle	S4	SC	SC	SC	x	x	x
Chrysemys picta marginata	Midland Painted Turtle	S4		SC	SC	x	x	
Emydoidea blandingii	Blanding's Turtle	S3	THR	END	END	x	x	x
Graptemys geographica	Northern Map Turtle	S3	SC	SC	SC	x	x	x
Sternotherus odoratus	Eastern Musk Turtle	S3	SC	SC	SC	x	x	x
Trachemys scripta	Pond Slider	SNA						x
Trachemys scripta elegans	Red-eared Slider	SNA					x	
Squamata	**Snakes**							
Diadophis punctatus	Ring-necked Snake	S4					x	x
Heterodon platirhinos	Eastern Hog-nosed Snake	S3	THR	THR	THR		x	x
Lampropeltis triangulum	Eastern Milksnake	S4		SC	SC	x	x	x
Nerodia sipedon sipedon	Northern Watersnake	S5					x	
Opheodrys vernalis	Smooth Greensnake	S4					x	x
Plestiodon fasciatus pop. 2	Common Five-lined Skink (Southern Shield population)	S3	SC	SC	SC	x	x	x
Storeria dekayi	DeKay's Brownsnake	S5					x	x
Storeria occipitomaculata	Red-bellied snake	S5					x	x
Thamnophis saurita	Northern Ribbonsnake	S4	SC	SC	SC	x	x	x
Thamnophis sirtalis sirtalis	Eastern Gartersnake	S5					x	
Caudata	**Salamanders**							
Ambystoma laterale	Blue-spotted Salamander	S4					x	x
Ambystoma maculatum	Spotted Salamander	S4					x	x
Eurycea bislineata	Northern Two-lined Salamander	S4					x	x
Hemidactylium scutatum	Four-toed Salamander	S4					x	x
Necturus maculosus	Mudpuppy	S4					x	
Notophthalmus viridescens viridescens	Red-spotted Newt	S5					x	x
Plethodon cinereus	Eastern Red-backed Salamander	S5					x	x
Anura	**Frogs and Toads**							
Anaxyrus americanus	American Toad	S5					x	x
Hyla versicolor	Gray Treefrog	S5					x	x
Lithobates catesbeianus	American Bullfrog	S4					x	x
Lithobates clamitans	Green Frog	S5					x	x
Lithobates palustris	Pickerel Frog	S4					x	x
Lithobates pipiens	Northern Leopard Frog	S5					x	x
Lithobates septentrionalis	Mink Frog	S5					x	x
Lithobates sylvaticus	Wood Frog	S5					x	x
Pseudacris crucifer	Spring Peeper	S5					x	x
Pseudacris maculata	Boreal Chorus Frog	S5				x		x
Pseudacris trisetaria pop. 1	Western Chorus Frog (Great Lakes / St. Lawrence - Canadian Shield population)	S4		THR	THR	x	x	
Total:						**10**	**33**	**29**

Sources:

1 Ontario Ministry of Natural Resources and Forestry (MNRF). 2025. Make a Map: Natural Heritage Areas. Mapping application. Accessed April 2025. https://www.lioapplications.lrc.gov.on.ca/Natural_Heritage/index.html?viewer=Natural_Heritage.Natural_Heritage&locale=en-CA

2 Ontario Nature. April. Ontario Reptile and Amphibian Atlas. Accessed April 2025. https://www.ontarioinsects.org/herp/index.html?Sort=1&area2=squaresCounties&records=all&myZoom=5&Lat=42.95&Long=-81.01

3 iNaturalist. 2025. Observations. Accessed April 2025. https://www.inaturalist.org/observations

Mammal Species Reported from Peterborough County

Species Name		Conservation Ranking				Source		
Scientific Name	Common Name	S-RANK	ESA	COSEWIC	SARA	NHIC (1)	Ontario Mammals (2)	iNaturalist (3)
Artiodactyla	**Deer and Bison**							
Alces americanus	Moose	S5					x	
Cervus canadensis	Elk	SNA						x
Odocoileus virginianus	White-tailed Deer	S5					x	x
Carnivora	**Carnivores**							
Canis latrans	Coyote	S5					x	x
Canis sp. lupus lycaon	Eastern Wolf	S2	THR	THR	SC	x	x	
Lontra canadensis	North American River Otter	S5					x	x
Lynx canadensis	Canada Lynx	S5					x	
Lynx rufus	Bobcat	S4					x	x
Martes americana	American Marten	S5					x	x
Mephitis mephitis	Striped Skunk	S5					x	x
Mustela frenata	Long-tailed Weasel	SU					x	
Mustela nivalis	Least Weasel	SU					x	
Neogale vison	American Mink	S4					x	x
Pekania pennanti	Fisher	S5					x	x
Procyon lotor	Northern Raccoon	S5					x	x
Urocyon cinereoargenteus	Gray Fox	S1	THR	THR	THR		x	
Ursus americanus	American Black Bear	S5					x	x
Vulpes vulpes	Red Fox	S5					x	x
Chiroptera	**Bats**							
Eptesicus fuscus	Big Brown Bat	S4					x	x
Lasionycteris noctivagans	Silver-haired Bat	S4	END	END			x	x
Lasiurus borealis	Eastern Red Bat	S4	END	END			x	x
Lasiurus cinereus	Hoary Bat	S4	END	END			x	x
Myotis leibii	Eastern Small-footed Myotis	S2S3	END				x	x
Myotis lucifugus	Little Brown Myotis	S3	END	END	END		x	x
Myotis septentrionalis	Northern Myotis	S3	END	END	END		x	
Perimyotis subflavus	Tricolored Bat	S3?	END	END	END		x	x
Didelphimorphia	**Oppossums**							
Didelphis virginiana	Virginia Opossum	S4					x	x
Lagomorphia	**Rabbits and Hares**							
Lepus europaeus	European Hare	SNA					x	x
Sylvilagus floridanus	Eastern Cottontail	S5					x	x
Lepus americanus	Snowshoe Hare	S5					x	x
Rodentia	**Rodents**							
Castor canadensis	Beaver	S5					x	x
Erethizon dorsatum	Porcupine	S5					x	x
Glaucomys sabrinus	Northern Flying Squirrel	S5					x	x
Glaucomys volans	Southern Flying Squirrel	S4					x	x
Marmota monax	Woodchuck	S5					x	x
Microtus pennsylvanicus	Meadow Vole	S5					x	x
Mus musculus	House Mouse	SNA					x	x
Myodes gapperi	Southern Red-backed Vole	S5					x	
Napaeozapus insignis	Woodland Jumping Mouse	S5					x	x
Ondatra zibethicus	Muskrat	S5					x	x
Peromyscus leucopus	White-footed Mouse	S5					x	x
Peromyscus maniculatus	Deer Mouse	S5					x	x
Rattus norvegicus	Norway Rat	SNA					x	x
Sciurus carolinensis	Grey Squirrel	S5					x	x
Synaptomys cooperi	Southern Bog Lemming	S4					x	
Tamias striatus	Eastern Chipmunk	S5					x	x
Tamiasciurus hudsonicus	Red Squirrel	S5					x	x
Zapus hudsonius	Meadow Jumping Mouse	S5					x	x
Soricomorpha								
Blarina brevicauda	Northern Short-tailed Shrew	S5					x	x
Condylura cristata	Star-nosed Mole	S5					x	x
Parascalops breweri	Hairy-tailed Mole	S4						x
Sorex cinereus	Masked Shrew	S5					x	x
Sorex fumeus	Smoky Shrew	S5					x	x
Sorex hoyi	Pygmy Shrew	S4					x	x
TOTAL:						**1**	**52**	**45**

Sources:

1 Ontario Ministry of Natural Resources and Forestry (MNRF). 2025. Make a Map: Natural Heritage Areas. Mapping application. Accessed April 2025. https://www.lioapplications.lrc.gov.on.ca/Natural_Heritage/index.html?viewer=Natural_Heritage.Natural_Heritage&locale=en-CA

2 iNaturalist. 2025. Ontario Mammals. Accessed April 2025. https://www.inaturalist.org/guides/1327?view=card

3 iNaturalist. 2025. Observations. Accessed April 2025. https://www.inaturalist.org/observations

Insect Species Reported from Peterborough County

Species Name		Conservation Rank				Source			
Scientific Name	Common Name	Provincial (S-rank)	Provincial (ESA)	National (COSEWIC)	National (SARA)	NHIC [1]	Ontario Butterfly Atlas [2]	iNaturalist [3]	Ontario Moth Atlas [4]
Coleoptera	**Beetles**								
Agrilus planipennis	Emerald Ash Borer	SNA						x	
Alaus oculatus	Click Beetle	S4?						x	
Anatis labiculata	Fifteen-spotted Ladybird Beetle	S4S5						x	
Baliosus nervosus	Leaf Beetle	S5						x	
Calligrapha multipunctata	Leaf Beetle	S4S5						x	
Callimoxys sanguinicollis	Longhorned Beetle	S3				x			
Calomycterus setarius	Weevil species	SNA						x	
Carabus nemoralis	European Ground Beetle	SNA						x	
Chauliognathus pensylvanicus	Soldier Beetle	S5						x	
Chrysochus auratus	Leaf Beetle	S4S5						x	
Coccinella novemnotata	Nine-spotted Lady Beetle	S1	END	END		x			
Coccinella transversoguttata	Transverse Lady Beetle	S1	END	SC	SC	x			
Dermestes lardarius	Dermestid Beetle	SNA						x	
Dorcus parallelus	Stag Beetle	SU						x	
Glischrochilus quadrisignatus	Sap Beetle	S5						x	
Hippodamia glacialis	Ladybird Beetle	SNR						x	
Lebia viridis	Ground Beetle	SNR						x	
Lucidota atra	Glowworm	SNR						x	
Macrodactylus subspinosus	Scarab Beetle	SNR						x	
Microrhopala vittata	Leaf Beetle	SNR						x	
Necrophila americana	Carrion Beetle	S5						x	
Otiorhynchus sulcatus	Weevil species	SNR						x	
Pelidnota punctata	Scarab Beetle	SNR						x	
Polydrusus formosus	Green Immigrant Leaf Weevil							x	
Popillia japonica	Scarab Beetle	SNA						x	
Trichiotinus assimilis	Scarab Beetle	SNR						x	
Trirhabda canadensis	Leaf Beetle	SNR						x	
Typocerus velutinus	Longhorned Beetle	SNR						x	
Diptera	**Flies**								
Bombylius major	Large Bee Fly	S5?						x	
Chrysops excitans	Agitated Deer Fly	S5						x	
Coquillettidia perturbans	Cattail Mosquito	S5						x	
Exoprosopa decora	Adorned Bee Fly	S3S4						x	
Systropus macer	Thin Bee Fly	S3				x			
Ephemeroptera	**Mayflies**								
Stenonema femoratum	Red Fox Flat-headed Mayfly	S4S5						x	
Clastoptera proteus	Dogwood Spittle Bug	S5						x	
Paraphilaenus parallelus	Spittlebug	S2?				x			
Hymenoptera	**Sawflies, Wasps, Bees, and Ants**								
Agapostemon virescens	Bicoloured Sweat Bee	S5						x	
Anthidium manicatum	Wool Carder Bee	SNA						x	
Bombus fervidus	Golden Northern Bumble Bee	S3S4						x	
Bombus griseocollis	Brown-belted Bumble Bee	S5						x	
Bombus impatiens	Common Eastern Bumble Bee	S5						x	
Bombus pensylvanicus	American Bumble Bee	S3S4	SC			x		x	
Bombus terricola	Yellow-banded Bumble Bee	S3S5	SC	SC	SC	x			
Bombus vagans	Half-black Bumble Bee	S5						x	
Camponotus pennsylvanicus	Eastern Black Carpenter Ant	S5						x	
Epeolus scutellaris	Red-chested Cuckoo Nomad Bee	S3				x			
Lasius claviger	Smaller Field Ant	S4						x	
Megachile latimanus	Square-legged Leafcutter Bee	S5						x	
Myrmica rubra	European Fire Ant	SNA						x	
Xylocopa virginica	Virginia Carpenter Bee	S4S5						x	
Lepidoptera	**Butterflies and Moths**								
Achyra rantalis	Garden Webworm Moth	SNR						x	
Acronicta americana	American Dagger Moth	S5						x	

Insect Species Reported from Peterborough County

Species Name		Conservation Rank				Source			
Scientific Name	Common Name	Provincial (S-rank)	Provincial (ESA)	National (COSEWIC)	National (SARA)	NHIC [1]	Ontario Butterfly Atlas [2]	iNaturalist [3]	Ontario Moth Atlas [4]
Acronicta connecta	Connected Dagger Moth	S1?				x			
Acronicta fallax	The Green Marvel	SNR						x	
Acronicta impressa	Impressed Dagger Moth	S5						x	
Acronicta increta	Unclear Dagger Moth	SNR						x	
Acronicta lepusculina	Cottonwood Dagger Moth	S4S5						x	
Acronicta vinnula	Delightful Dagger Moth	S4?						x	
Actias luna	Luna Moth	S4							x
Aethalura intertexta	Four-barred Gray	SNR						x	
Aglais milberti	Milbert's Tortoiseshell	S5					x		
Aglossa cuprina	Grease Moth	SNR						x	
Agrotis ipsilon	Ipsilon Dart	S5						x	
Alypia octomaculata	Eight-spotted Forester Moth	S5						x	
Amblyscirtes hegon	Pepper and Salt Skipper	S4					x		
Amblyscirtes vialis	Common Roadside Skipper	S4					x	x	
Amolita fessa	Feeble Grass Moth	SNR						x	
Amorpha juglandis	Walnut Sphinx	S4?							x
Amphion floridensis	Nessus Sphinx	S4							x
Amphipyra pyramidoides	Copper Underwing	SNR						x	
Anagrapha falcifera	Celery Looper Moth	S5						x	
Anaplectoides prasina	Green Arches	S4						x	
Anathix puta	Puta Sallow	S5				x			
Anatrytone logan	Delaware Skipper	S4					x	x	
Anavitrinella pampinaria	Common Gray Moth	S4S5						x	
Ancyloxypha numitor	Least Skipper	S5					x		
Antheraea polyphemus	Polyphemus Moth	S5							x
Apamea devastator	Glassy Cutworm Moth	S5						x	
Apamea dubitans	Doubtful Apamea Moth	S5						x	
Apantesis nais	Nais Tiger Moth	SNR							x
Apantesis phalerata	Harnessed Moth	S4?						x	x
Archiearis infans	The Infant	SNR						x	
Archips argyrospila	Fruit-tree Leafroller Moth	SNR						x	
Arctia caja	Great Tiger Moth	S4?						x	x
Argyrotaenia mariana	Gray-banded Leafroller Moth	SNR						x	
Atteva aurea	Ailanthus Webworm Moth	SNR						x	
Autographa precationis	Common Looper Moth	S5						x	
Automeris io	Io Moth	S5						x	x
Baileya doubledayi	Doubleday's Baileya	SNR						x	
Baileya ophthalmica	Eyed Baileya	SNR						x	
Battus philenor	Pipevine Swallowtail	SNA					x		
Bellura obliqua	Cattail Borer Moth	SNR						x	
Bleptina caradrinalis	Bent-winged Owlet	SNR						x	
Boloria bellona	Meadow Fritillary	S5					x		
Boloria eunomia	Bog Fritillary	S5					x		
Boloria selene	Silver-bordered Fritillary	S5					x		
Caenurgina crassiuscula	Clover Looper Moth	S5						x	
Caenurgina erechtea	Forage Looper Moth	S4S5						x	
Calledapteryx dryopterata	Brown Scoopwing	S1?				x		x	
Callizzia amorata	Gray Scoopwing	SNR						x	
Callophrys augustinus	Brown Elfin	S5					x	x	
Callophrys gryneus	Juniper Hairstreak	S3				x	x		
Callophrys henrici	Henry's Elfin	S4					x	x	
Callophrys niphon	Eastern Pine Elfin	S5					x	x	
Callophrys polios	Hoary Elfin	S4					x	x	
Callosamia promethea	Promethea Moth	S4							x
Caripeta divisata	Gray Spruce Looper Moth	SNR						x	
Catabena lineolata	Five-lined Sallow	SNR						x	
Catocala blandula	Charming Underwing	S5						x	x

Insect Species Reported from Peterborough County

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Catocala briseis	Briseis Underwing Moth	S5							x
Catocala cerogama	Yellow-banded Underwing	S5							x
Catocala concumbens	Sleepy Underwing	S5							x
Catocala grynea	Woody Underwing	S5							x
Catocala ilia	Ilia Underwing	S5							x
Catocala minuta	Little Underwing	SNR							x
Catocala relicta	White Underwing Moth	S5							x
Catocala semirelicta	Semirelict Underwing	S5							x
Catocala subnata	Youthful Underwing	S3							x
Catocala ultronia	Ultronia Underwing Moth	S5							x
Catocala unijuga	Once-married Underwing	S5							x
Celastrina lucia	Northern Spring Azure	S5					x		
Celastrina neglecta	Summer Azure	S5					x		
Ceratomia undulosa	Waved Sphinx Moth	S5							x
Cercyonis pegala	Common Wood-Nymph	S5					x	x	
Cerma cora	Bird Dropping Moth	S1?				x			
Charadra deridens	The Laugher	S4?							
Chlorochlamys chloroleucaria	Blackberry Looper Moth	SNR						x	
Chlosyne harrisii	Harris's Checkerspot	S4					x	x	
Chlosyne nycteis	Silvery Checkerspot	S5					x		
Chytonix palliatricula	Cloaked Marvel	SNR						x	
Cingilia catenaria	Chain-dotted Geometer	SNR						x	
Cisseps fulvicollis	Yellow-collared Scape Moth	SNR							x
Clemensia albata	Little White Lichen Moth	SNR							x
Clostera albosigma	Sigmoid Prominent Moth	S5							x
Clostera inclusa	Angle-lined Prominent	SNR							x
Colias eurytheme	Orange Sulphur	S5					x		
Colias interior	Pink-edged Sulphur	S5					x		
Colias philodice	Clouded Sulphur	S5					x	x	
Colobochyla interpuncta	Yellow-lined Owlet	SNR				x			
Colocasia propinquilinea	Closebanded Yellowhorn	SNR						x	
Condica vecors	Dusky Groundling	SNR						x	
Copivaleria grotei	Grote's Sallow	SNR						x	
Cosmia calami	American Dun-bar	SNR						x	
Costaconvexa centrostrigaria	Bent-line Carpet	SNR						x	
Crambidia pallida	Pale Lichen Moth	SNR							x
Ctenucha virginica	Virginia Ctenucha Moth	S5							x
Cucullia asteroides	The Asteroid	S4						x	
Cucullia convexipennis	Brown-bordered Cucullia	S4						x	
Cucullia intermedia	Intemediate Cucullia	S5						x	
Cupido comyntas	Eastern Tailed Blue	S5					x	x	
Cycnia oregonensis	Oregon Cycnia	SNR							x
Cycnia tenera	Delicate Cycnia	S4						x	x
Cydia pomonella	Codling Moth	SNR						x	
Danaus plexippus	Monarch	S2N,S4B	SC	END	SC		x	x	
Darapsa choerilus	Azalea Sphinx Moth	S5						x	x
Darapsa myron	Hog Sphinx	SU							x
Dasychira basiflava	Yellow-based Tussock Moth	SNR				x			
Datana angusii	Angus's Datana	SNR							x
Datana integerrima	Walnut Caterpillar Moth	SNR				x			x
Datana ministra	Yellow-necked Caterpillar Moth	S5							x
Datana perspicua	Spotted Datana	SNR							x
Deidamia inscripta	Lettered Sphinx	SNA							x
Deltote bellicula	Bog Lithacodia	S5						x	
Desmia funeralis	Grape Leaffolder Moth	SNR						x	
Digrammia continuata	Curve-lined Angle	SNA						x	
Digrammia ocellinata	Faint-spotted angle	SNR						x	

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Drepana arcuata	Arched Hooktip Moth	S5						x	
Dryocampa rubicunda	Rosy Maple Moth	S5							x
Dypterygia rozmani	American Bird's-wing Moth	SNR				x			
Dyspteris abortivaria	The Bad-wing	SNR						x	
Eacles imperialis	Imperial Moth	S4							x
Ellida caniplaga	Linden Prominent	SNR							x
Ennomos subsignaria	Elm Spanworm Moth	S4						x	
Epargyreus clarus	Silver-spotted Skipper	S4					x		
Epiblema otiosana	Bidens Borer Moth	SNR						x	
Epiglaea apiata	Pointed Sallow	S4				x			
Erora laeta	Early Hairstreak	S2				x	x		
Erynnis baptisiae	Wild Indigo Duskywing	S4					x		
Erynnis icelus	Dreamy Duskywing	S5					x	x	
Erynnis juvenalis	Juvenal's Duskywing	S5					x	x	
Erynnis lucilius	Columbine Duskywing	S4					x	x	
Erynnis martialis	Mottled Duskywing	S2	END	END			x		
Estigmene acrea	Salt Marsh Moth	S5							x
Euchaetes egle	Milkweed Tussock Moth	S4?							x
Euchlaena johnsonaria	Johnson's Euchlaena Moth	S4						x	
Euchloe olympia	Olympia Marble	S4					x		
Eudryas grata	Beautiful Wood-nymph	SNR						x	
Eulithis gracilineata	Greater Grapevine Looper Moth	SNR				x		x	
Eulithis testata	Chevron Moth	SNR						x	
Eumorpha pandorus	Pandorus Sphinx	S4							x
Euparthenos nubilis	Locust Underwing	S4?				x			
Euphydryas phaeton	Baltimore Checkerspot	S4					x	x	
Euphyes bimacula	Two-spotted Skipper	S4					x		
Euphyes dion	Dion Skipper	S4					x	x	
Euphyes vestris	Dun Skipper	S5					x	x	
Euplexia benesimilis	American Angle Shades Moth	S4						x	
Euptoieta claudia	Variegated Fritillary	SNA					x		
Eusarca confusaria	Confused Eusarca	SNR						x	
Euthyatira pudens	Dogwood Thyatirid	S2?						x	
Eutrapela clemataria	Curve-toothed Geometer	SNR						x	
Feltia jaculifera	Dingy Cutworm Moth	S5						x	
Feniseca tarquinius	Harvester	S4					x		
Feralia comstocki	Comstock's Sallow	S5						x	
Furcula borealis	White Furcula	SNR							x
Furcula cinerea	Gray Furcula	SNR						x	x
Glaucopsyche lygdamus	Silvery Blue	S5					x		
Gluphisia septentrionis	Common Gluphisia	SNR						x	x
Habrosyne gloriosa	Glorious Habrosyne	S2S3				x			
Haematopis grataria	Chickweed Geometer	SNR						x	
Halysidota tessellaris	Banded Tussock Moth	S5						x	x
Haploa confusa	Confused Haploa	S5						x	x
Haploa contigua	The Neighbor	SNR				x			x
Haploa lecontei	LeConte's Haploa	S4?							x
Harrisimemna trisignata	Harris's Three-spot	S4						x	
Harrisina americana	Grapeleaf Skeletonizer Moth	SNR						x	
Helicoverpa zea	Corn Earworm Moth	SNR						x	
Heliomata cycladata	Common Spring Moth	SNR						x	
Hemaris aethra	a hawkmoth	S4S5						x	
Hemaris diffinis	Snowberry Clearwing Moth	S4S5							x
Hemaris gracilis	Slender Clearwing	S3							x
Hemaris thysbe	Hummingbird Clearwing	S5						x	x
Hesperia leonardus	Leonard's Skipper	S4					x		
Hesperia sassacus	Indian Skipper	S4					x	x	

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Heterocampa biundata	Wavy-lined Heterocampa	SNR							x
Heterocampa guttivitta	Saddled Prominent	SNR							x
Heterocampa obliqua	Oblique Heterocampa	SNR							x
Heterocampa umbrata	White-blotched Heterocampa	SNR							x
Homoglaea hircina	Goat Sallow	SNR						x	
Horisme intestinata	Brown Bark Carpet	SNR						x	
Hyalophora cecropia	Cecropia Moth	S5						x	x
Hydrelia albifera	Fragile White Carpet	SNR						x	
Hylephila phyleus	Fiery Skipper	SNA					x		
Hyles euphorbiae	Euphorbia Sphinx	SNA							x
Hyles gallii	Galium Sphinx	S5?						x	x
Hypena baltimoralis	Baltimore Bomolocha	SNR						x	
Hypena bijugalis	Dimorphic Bomolocha	SNR						x	
Hypena deceptalis	Deceptive Bomolocha	SNR						x	
Hypena madefactalis	Gray-edged Bomolocha	SNR						x	
Hypena manalis	Flowing-line Bomolocha	SNR				x		x	
Hypena scabra	Green Cloverworm Moth	SNR						x	
Hypenodes fractilinea	Broken-line Hypenodes	SNR				x			
Hyperaeschra georgica	Georgian Prominent	SNR							x
Hypercompe scribonia	Giant Leopard Moth	SNR						x	x
Hyphantria cunea	Fall Webworm Moth	S5						x	x
Hypoprepia fucosa	Painted Lichen Moth	S5							x
Hypoprepia miniata	Scarlet-winged Lichen Moth	S4?							x
Hyppa xylinoides	Common Hyppa	SNR						x	
Hypsopygia costalis	Clover Hayworm Moth	SNA						x	
Idia aemula	Common Idia	SNR						x	
Idia americalis	American Idia	SNR						x	
Idia lubricalis	Glossy Black Idia	SNR						x	
Ipimorpha pleonectusa	Even-lined Sallow	SNR						x	
Iridopsis larvaria	Bent-line Gray	SNR						x	
Iridopsis vellivolata	Large Purplish Gray	SNR							
Junonia coenia	Common Buckeye	SNA					x		
Lacanobia grandis	Grand Arches	S5						x	
Lacinipolia anguina	Snaky Arches	S5				x			
Lacinipolia lorea	Bridled Arches	S5						x	
Lacinipolia meditata	The Thinker	SNR				x			
Lacinipolia renigera	Bristly Cutworm Moth	S5						x	
Lambdina fiscellaria	Hemlock Looper Moth	S5						x	
Lapara bombycoides	Northern Pine Sphinx	S5							x
Lascoria ambigualis	Ambiguous Moth	SNR						x	
Lateroligia ophiogramma	Double Lobed Moth	SNA						x	
Lethe anthedon	Northern Pearly-Eye	S5					x		
Lethe appalachia	Appalachian Brown	S4					x		
Lethe eurydice	Eyed Brown	S5					x	x	
Leuconycta diphteroides	Green Leuconycta	SNR						x	
Libytheana carinenta	American Snout	SNA					x		
Limenitis archippus	Viceroy	S5					x		
Limenitis arthemis arthemis	White Admiral	S5					x		
Limenitis arthemis astyanax	Red-spotted Purple	S5					x		
Lintneria eremitus	Hermit Sphinx	S5				x		x	x
Lithophane hemina	Hemina Pinion	S4?				x			
Lochmaeus bilineata	Double-lined Prominent	SNR						x	x
Lochmaeus manteo	Variable Oakleaf Caterpillar Moth	SNR							x
Lomographa semiclarata	Bluish Spring Moth	SNR						x	
Lophocampa caryae	Hickory Tussock Moth	SNR						x	x
Lophocampa maculata	Spotted Tussock Moth	S4							x
Lycomorpha pholus	Black-and-yellow Lichen Moth	SNR				x		x	x

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Lytrosis unitaria	Common Lytrosis	SNR						x	
Machimia tentoriferella	Golden-striped Leaftier Moth	SNR						x	
Macronoctua onusta	Iris Borer Moth	SNR						x	
Macrurocampa marthesia	Mottled Prominent	SNR							x
Malacosoma americana	Eastern Tent Caterpillar Moth	S5						x	x
Malacosoma disstria	Forest Tent Caterpillar Moth	S5						x	x
Maliattha concinnimacula	Red-spotted Lithacodia	SNR				x			
Maliattha synochitis	Black-dotted Lithacodia	S4?						x	
Manduca quinquemaculata	Five-spotted Sphinx Moth	S5							x
Marathyssa inficita	Dark Marathyssa	SNR						x	
Megisto cymela	Little Wood-Satyr	S5					x		
Melanchra adjuncta	Hitched Arches	S5						x	
Metalectra discalis	Common Fugus Moth	SNR				x			
Metanema determinata	Dark Metanema	SNR						x	
Metaxaglaea inulta	Unsated Sallow	S3?				x			
Morrisonia confusa	Confused Woodgrain Moth	S4						x	
Morrisonia evicta	Bicolored Woodgrain	SNR						x	
Morrisonia latex	Fluid Arches	SNR						x	
Mythimna unipuncta	Armyworm Moth	S4						x	
Nadata gibbosa	White-spotted Prominent Moth	S5							x
Nedra ramosula	Gray Half-spot	SNR						x	
Nematocampa resistaria	Horned Spanworm Moth	SNR						x	
Nephelodes minians	Bronzed Cutworm Moth	S5						x	
Nepytia canosaria	False Hemlock Looper Moth	S4						x	
Nerice bidentata	Double-toothed Prominent	SNR						x	x
Noctua pronuba	Large Yellow Underwing Moth	SNA							
Nola cilicoides	Blurry-patched Nola	SNR						x	
Nymphalis antiopa	Mourning Cloak	S5					x		
Nymphalis l-album	Compton Tortoiseshell	S5					x	x	
Ochropleura implecta	Flame-shouldered Dart	S5						x	
Odontosia elegans	Elegant Prominent	SNR							x
Oeneis chryxus	Chryxus Arctic	S5					x	x	
Ogdoconta cinereola	Common Pinkband	SNR						x	
Oligia modica	Black-banded Brocade	SNR						x	
Oligocentria lignicolor	White-streaked Prominent	SNR							x
Oligocentria semirufescens	Red-washed Prominent	SNR							x
Operophtera bruceata	Bruce Spanworm	SNR						x	
Orgyia definita	Definite Tussock Moth	SNR						x	
Orthodes cynica	Cynical Quaker	S5						x	
Orthonama obstipata	The Gem	SNR						x	
Ostrinia nubilalis	European Corn Borer Moth	SNA						x	
Pachysphinx modesta	Big Poplar Sphinx	S5							x
Palthis angulalis	Dark-spotted Palthis	SNR						x	
Palthis asopialis	Faint-spotted Palthis	SNR				x		x	
Pangrapta decoralis	Decorated Owlet	SNR				x			
Panopoda carneicosta	Brown Panopoda	SNR				x			
Panopoda rufimargo	Red-lined Panopoda	SNR				x			
Panthea acronyctoides	Black Zigzag Moth	S4?						x	
Pantographa limata	Basswood Leafroller Moth	SNR						x	
Paonias excaecata	Blinded Sphinx	S5						x	x
Paonias myops	Small-eyed Sphinx	S5							x
Papilio canadensis	Canadian Tiger Swallowtail	S5						x	
Papilio polyxenes	Black Swallowtail	S5					x	x	
Peridea angulosa	Angulose Prominent	SNR						x	x
Peridea basitriens	Oval-based Prominent	S4?							x
Peridea ferruginea	Chocolate Prominent Moth	S5						x	x
Pero honestaria	Honest Pero	SNR						x	

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Phalaenophana pyramusalis	Dark-banded Owlet	SNR						x	
Phalaenostola larentioides	Black-banded Owlet	SNR						x	
Pheosia rimosa	Black-rimmed Prominent	SNR						x	x
Phigalia titea	The Half-wing	SNR						x	
Phlogophora periculosa	Brown Angle Shades Moth	S5						x	
Pholisora catullus	Common Sootywing	S4					x		
Phragmatobia assimilans	Large Ruby Tiger Moth	SNR							x
Phragmatobia fuliginosa	Ruby Tiger Moth	S4?							x
Phyciodes batesii	Tawny Crescent	S4					x		
Phyciodes cocyta	Northern Crescent	S5					x		
Phyciodes tharos	Pearl Crescent	S4					x		
Phyllodesma americana	Lappet Moth	S5						x	x
Pieris oleracea	Mustard White	S4					x		
Pieris rapae	Cabbage White	SNA					x	x	
Pieris virginiensis	West Virginia White	S3	SC			x	x		
Plagodis alcoolaria	Hollow-spotted Plagodis	SNR						x	
Pleuroprucha insulsaria	Common Tan Wave	SNR						x	
Plusia contexta	Connected Looper Moth	SNR						x	
Plusiodonta compressipalpis	Moonseed Moth	SNR				x			
Plutella xylostella	Diamondback Moth	SNR						x	
Poanes massasoit	Mulberry Wing	S4					x		
Poanes viator	Broad-winged Skipper	S4					x	x	
Polites mystic	Long Dash Skipper	S5					x		
Polites origenes	Crossline Skipper	S4					x	x	
Polites themistocles	Tawny-edged Skipper	S5					x		
Polygonia comma	Eastern Comma	S5					x	x	
Polygonia faunus	Green Comma	S4					x		
Polygonia interrogationis	Question Mark	S5					x		
Polygonia progne	Gray Comma	S5					x	x	
Polygonia satyrus	Satyr Comma	S4					x		
Prochoerodes lineola	Large Maple Spanworm Moth	S5							
Protodeltote muscosula	Large Mossy Lithacodia	SNR							
Psyche casta	Common Bagworm Moth	SNA						x	
Pyrisitia lisa	Little Yellow	SNA					x		
Pyrrharctia isabella	Isabella Tiger Moth	S5						x	x
Raphia frater	The Brother	S4S5						x	
Satyrium acadica	Acadian Hairstreak	S4					x	x	
Satyrium calanus	Banded Hairstreak	S4					x	x	
Satyrium caryaevorus	Hickory Hairstreak	S4					x		
Satyrium edwardsii	Edwards' Hairstreak	S4					x		
Satyrium liparops	Striped Hairstreak	S5					x		
Satyrium titus	Coral Hairstreak	S5					x	x	
Schinia arcigera	Arcigera Flower Moth	SNR						x	
Schinia lynx	Lynx Flower Moth	SNR				x			
Schizura badia	Chestnut Schizura	SNR				x		x	x
Schizura concinna	Red-humped Caterpillar Moth	SNR							x
Schizura leptinoides	Black-blotched Schizura	SNR							x
Schizura unicornis	Unicorn Caterpillar Moth	SNR							x
Scoliopteryx libatrix	Herald Moth	S5						x	
Scopula cacuminaria	Frosted Tan Wave	SNR						x	
Scopula limboundata	Large Lace-border	SNR						x	
Smerinthus cerisyi	One-eyed Sphinx	S5							x
Smerinthus jamaicensis	Twin-spotted Sphinx	S5							x
Spaelotis clandestina	Clandestine Dart	S5						x	
Sphecodina abbottii	Abbott's Sphinx	S4						x	x
Sphinx canadensis	Canadian Sphinx	S5						x	x
Sphinx chersis	Great Ash Sphinx	S5						x	x

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Sphinx kalmiae	Laurel Sphinx	S5							x
Spilosoma congrua	Agreeable Tiger Moth	S4?						x	x
Spilosoma dubia	Dubious Tiger Moth	SNR							x
Spilosoma latipennis	Pink-legged Tiger Moth	SNR				x			x
Spilosoma virginica	Virginian Tiger Moth	S5							x
Spodoptera frugiperda	Fall Armyworm Moth	SNR						x	
Strymon melinus	Gray Hairstreak	S4					x	x	
Sunira bicolorago	Bicolored Sallow Moth	S5						x	
Sympistis chionanthi	Fringe-tree Sallow	SNR						x	
Thorybes pylades	Northern Cloudywing	S5					x		
Thymelicus lineola	European Skipper	SNA					x	x	
Tolype laricis	Larch Tolype	SNR						x	x
Tolype velleda	Large Tolype	SNR							x
Udea rubigalis	Celery Leaftier Moth	SNR						x	
Ulolonche culea	Sheathed Quaker	SNR				x			
Vanessa atalanta	Red Admiral	S5					x		
Vanessa cardui	Painted Lady	S5					x		
Vanessa virginiensis	American Lady	S5					x	x	
Venusia comptaria	Brown-shaded Carpet	SNR						x	
Virbia aurantiaca	Orange Holomelina	S4?				x			x
Virbia immaculata	Immaculate Holomelina	SNA							x
Virbia laeta	Joyful Holomelina	SNR							x
Virbia opella	Tawny Holomelina	SNR							x
Xanthorhoe labradorensis	Labrador Carpet	SNR						x	
Zale horrida	Horrid Zale	SNR						x	
Zale minerea	Colorful Zale	S4S5						x	
Zale undularis	Black Zale	SNR				x			
Zanclognatha cruralis	Early Zanclognatha	SNR						x	
Zanclognatha lituralis	Lettered Zanclognatha	SNR				x			
Zanclognatha pedipilalis	Grayish Zanclognatha	SNR						x	
Mantodea	**Mantises**								
Mantis religiosa	Praying Mantis	SNA						x	
Neuroptera	**Net-winged Insects**								
Chrysopa oculata	Golden-eyed Green Lacewing	S5						x	
Odonata	**Damselflies and Dragonflies**								
Aeshna canadensis	Canada Darner	S5						x	
Aeshna constricta	Lance-tipped Darner	S5						x	
Aeshna tuberculifera	Black-tipped Darner	S4						x	
Anax junius	Green Darner	S5						x	
Arigomphus villosipes	Unicorn Clubtail	S3				x			
Calopteryx maculata	Ebony Jewelwing	S5						x	
Celithemis elisa	Calico Pennant	S5						x	
Celithemis eponina	Halloween Pennant	S4						x	
Chromagrion conditum	Aurora Damsel	S5						x	
Cordulegaster obliqua	Arrowhead Spiketail	S2				x			
Cordulia shurtleffii	American Emerald	S5						x	
Dromogomphus spinosus	Black-shouldered Spinyleg	S5						x	
Enallagma aspersum	Azure Bluet	S3						x	
Enallagma boreale	Boreal Bluet	S5						x	
Enallagma civile	Familiar Bluet	S5						x	
Enallagma hageni	Hagen's Bluet	S5						x	
Epiaeschna heros	Swamp Darner	S2S3				x			
Epitheca canis	Beaverpond Baskettail	S5						x	
Epitheca cynosura	Common Baskettail	S5						x	
Erythemis simplicicollis	Eastern Pondhawk	S5						x	
Gomphaeschna furcillata	Harlequin Darner	S3				x		x	
Hagenius brevistylus	Dragonhunter	S5						x	

Insect Species Reported from Peterborough County

Species Name		Conservation Rank				Source			
Scientific Name	Common Name	Provincial (S-rank)	Provincial (ESA)	National (COSEWIC)	National (SARA)	NHIC [1]	Ontario Butterfly Atlas [2]	iNaturalist [3]	Ontario Moth Atlas [4]
Ischnura posita	Fragile Forktail	S4						x	
Ischnura verticalis	Eastern Forktail	S5						x	
Ladona julia	Chalk-fronted Corporal	S5						x	
Lestes dryas	Emerald Spreadwing	S5						x	
Lestes eurinus	Amber-winged Spreadwing	S3						x	
Leucorrhinia frigida	Frosted Whiteface	S5						x	
Leucorrhinia glacialis	Crimson-ringed Whiteface	S4						x	
Leucorrhinia hudsonica	Hudsonian Whiteface	S5						x	
Leucorrhinia intacta	Dot-tailed Whiteface	S5						x	
Leucorrhinia proxima	Belted Whiteface	S5						x	
Libellula quadrimaculata	Four-spotted Skimmer	S5						x	
Nannothemis bella	Elfin Skimmer	S4						x	
Pachydiplax longipennis	Blue Dasher	S5						x	
Perithemis tenera	Eastern Amberwing	S4						x	
Phanogomphus borealis	Beaverpond Clubtail	S3				x			
Phanogomphus exilis	Lancet Clubtail	S5						x	
Phanogomphus graslinellus	Pronghorn Clubtail	S3				x			
Phanogomphus spicatus	Dusky Clubtail	S5						x	
Plathemis lydia	Common Whitetail	S5						x	
Progomphus obscurus	Common Sanddragon	S1				x		x	
Somatochlora incurvata	Incurvate Emerald	S1				x		x	
Sympetrum internum	Cherry-faced Meadowhawk	S5						x	
Sympetrum semicinctum	Band-winged Meadowhawk	S4						x	
Sympetrum vicinum	Autumn Meadowhawk	S5						x	
Tramea lacerata	Black Saddlebags	S4						x	
Williamsonia fletcheri	Ebony Boghaunter	S2				x		x	
Orthoptera	**Grasshoppers, Katydids, Crickets, and related insects**								
Chortophaga viridifasciata	Green-striped Grasshopper	S4						x	
Conocephalus nigropleurum	Black-sided Meadow Katydid	S3S4						x	
Dissosteira carolina	Carolina Grasshopper	S4S5						x	
Gryllus pennsylvanicus	Fall Field Cricket	S5						x	
Oecanthus nigricornis	Black-horned Tree Cricket	S4						x	
Scudderia septentrionalis	Northern Bush Katydid	S3?				x			
Trichoptera	**Caddisflies**								
Nectopsyche exquisita	Exquisite Long-horned Caddisfly	S4S5						x	
Platycentropus radiatus	Shining Northern Caddisfly	S4S5						x	
Total						**56**	**85**	**310**	**112**

Sources:

1 Ontario Ministry of Natural Resources and Forestry (MNRF). 2025. Make a Map: Natural Heritage Areas. Mapping application. Accessed April 2025. https://www.lioapplications.lrc.gov.on.ca/Natural_Heritage/index.html?viewer=Natural_Heritage.Natural_Heritage&locale=en-CA

2 Macnaughton, A., Layberry, R., Cavasin, R., Edwards, B., and C. Jones. 2025. Ontario Butterfly Atlas. Accessed April 2025. https://www.ontarioinsects.org/atlas/

3 iNaturalist (iNaturalist). 2025. Observations. Accessed April 2025. https://www.inaturalist.org/observations

4 Kaposi, D., Macnaughton, A., and B. Edwards. 2025. Ontario Moth Atlas. Accessed April 2025. https://www.ontarioinsects.org/moth/index.html

Notes:

S-rank

S1 - Critically Imperiled
S2 - Imperiled
S3 - Vulnerable
S4 - Apparently Secure
S5 - Secure
SU - Unrankable
SNA - Unranked
SX - Presumed Extirpated
SH - Possibly Extirpated
S#? - Rank Uncertain

ESA

SC - Special Concern
THR - Threatened
END - Endangered
EXT - Extinct
EXP - Extirpated

Additional Notes

ESA - *Endangered Species Act*
COSEWIC - Committee on the Status of Endangered Wildlife in Canada
SARA - *Species at Risk Act*
NHIC - Natural Heritage Information Centre
DFO - Department of Fisheries and Oceans Canada
OBBA - Ontario Breeding Bird Atlas
ORAA - Ontario Reptile and Amphibian Atlas

COSEWIC

NAR - Not at Risk
SC - Special Concern
THR - Threatened
END - Endangered
EXT - Extinct
EXP - Extirpated
DD - Data Deficient

SARA Schedule

Schedule 1 - Officially protected under SARA
Schedule 2 - threatened/endangered; may be reassessed for consideration for inclusion to Schedule 1
Schedule 3 - special concern; may be reassessed for consideration for inclusion to Schedule 1

COSSARO

NAR - Not at Risk
SC - Special Concern
THR - Threatened
END - Endangered
EXP - Extirpated
DD - Data Deficient

Appendix C Physiographic Region Descriptions

Table C-1 Overview of Physiographic Regions within the County of Peterborough

Physiographic Region	Description[1]
Peterborough Drumlin Field	Most of the Otonabee Tertiary Watershed fall within the Peterborough Drumlin Field physiographic region with the City of Peterborough located in the geographical centre of the region. The Peterborough Drumlin Field is defined as distinct upland areas of rolling till plains that contains a series of well-formed drumlins in addition to many other drumlinoid hills (Chapman and Putnam 1984). Drumlins in this region are typically elongated, low-lying hills, they are composed of highly calcareous glacial till consisting of sand and gravels.
Dummer Moraines	The Dummer Moraines constitute a grouping of till moraines representing the advance of the northern ice sheet to the Kawartha Lakes area. This region is characterized primarily by till plains and coarse angular limestone fragments derived from the underlying bedrock and extends over 600 square miles. The underlying bedrock is sedimentary limestone that forms a plain. The plain has a gentle decline southward of 200 feet from 800 to 600 feet a.s.l. The limestone end at an escarpment in the north which has a height of 25 to 75 feet. There are other smaller north-facing escarpments in some places, in others, the rock face is burred below a morainic mantle.
Oak Ridges Moraine	The Oak Ridges Moraine physiographic region is part of a continuous range of rolling hills extending from the Niagara Escarpment to east of Rice Lake. The Oak Ridges Moraine consists mainly of permeable sands and gravels with some impermeable deposits of till, silt and clay. Within this physiographic region, there tends to be a lack of streams because the permeable sand and gravel that makes up the moraine, allows water to drain vertically into the Moraine, rather than along the surface. Water infiltrating the moraine is forced to move horizontally when it reaches less permeable geologic layers. The kame moraine feature is identified as having potential significance for recharge capabilities, as the removal of fine materials (i.e., clay and silt) through glacial processes has resulted in well draining soils. (Aquafor, 2020)
Algonquin Highlands	The Algonquin Highlands is a physiographic region characterized by hard Precambrian rock overlain by a thin layer of sandy glacial till of variable depth and other hard Precambrian rocks. This region takes in much of the area underlain by granite and other hard Precambrian rocks, covering an area of 15,500 square miles (9,934,000 acres). Overall, it is broadly dome shaped, the crown stands 1,600 to 1,800 feet a.s.l. sloping down to 900 feet, more or less, in the west and 600 feet in the east. Locally, the relief is rough, rounded knobs and ridges standing up usually 50 to 200 feet but with occasional ridges 500 feet high. There are frequent outcrops of bare rock, but they do not amount to more than 5% of the total area. The soils are generally shallow but thickness over the bedrock varies greatly over short distances. Also, they are stony, sandy and acid, so they are mostly submarginal for agriculture. Many of the valleys are floored with outwash sand and gravel. The frequent swamps and bogs in hollows also detract from their usefulness for farming, but they are very useful forest soils. As an exception to the foregoing, several areas have deeper till and few rock outcrops, and the surface of the till is smoothed and moulded with occasional drumlins appearing.
Georgian Bay Fringe	The Georgian Bay Fringe is a broad belt bordering Georgian Bay and is characterized by very shallow soil and bare rock knobs and ridges. It covers around 826,000 acres and covers much of Perry Sound and Muskoka and extends eastward towards northern Kawartha Lakes. The bare rock ridges were the result of past glacier activity. The resulting soil types in this area are not ideal for agriculture, farms in the region are located within narrow strips of good soil. This soil is classified by fine sand, silt, and clay loams often found in valleys.

Physiographic Region	Description[1]
Iroquois Plain	The Iroquois plain extends a distance of around 190 miles spanning from Niagara River to the Trent River valley. The conditions in the plain vary depending on location, for the purpose of this summary, the Trent Embayment will be the sub-section of focus. This sub-section was once a great bay of Lake Iroquois. There were many islands which resulted in wave-washed hillsides or boulder pavements. This sub-section contains many sand plains, deposits of stratified silt, and lacustrine deposits. The drumlin and clay flat pattern are an identifying characteristic of this sub-section. The land use in this area is predominantly general farming, specifically, meat products. The 368-foot fall from Rice Lake to the Bay of Quinte provided a number of locations for power sites. Additionally, the lacustrine deposits provided high quality agricultural land to this sub-section.
[1]: Descriptions for the physiographic regions are taken mainly from: The physiography of southern Ontario, third edition (Chapman and Putnam 1984), and Silv-Econ Ltd. (2019) report	