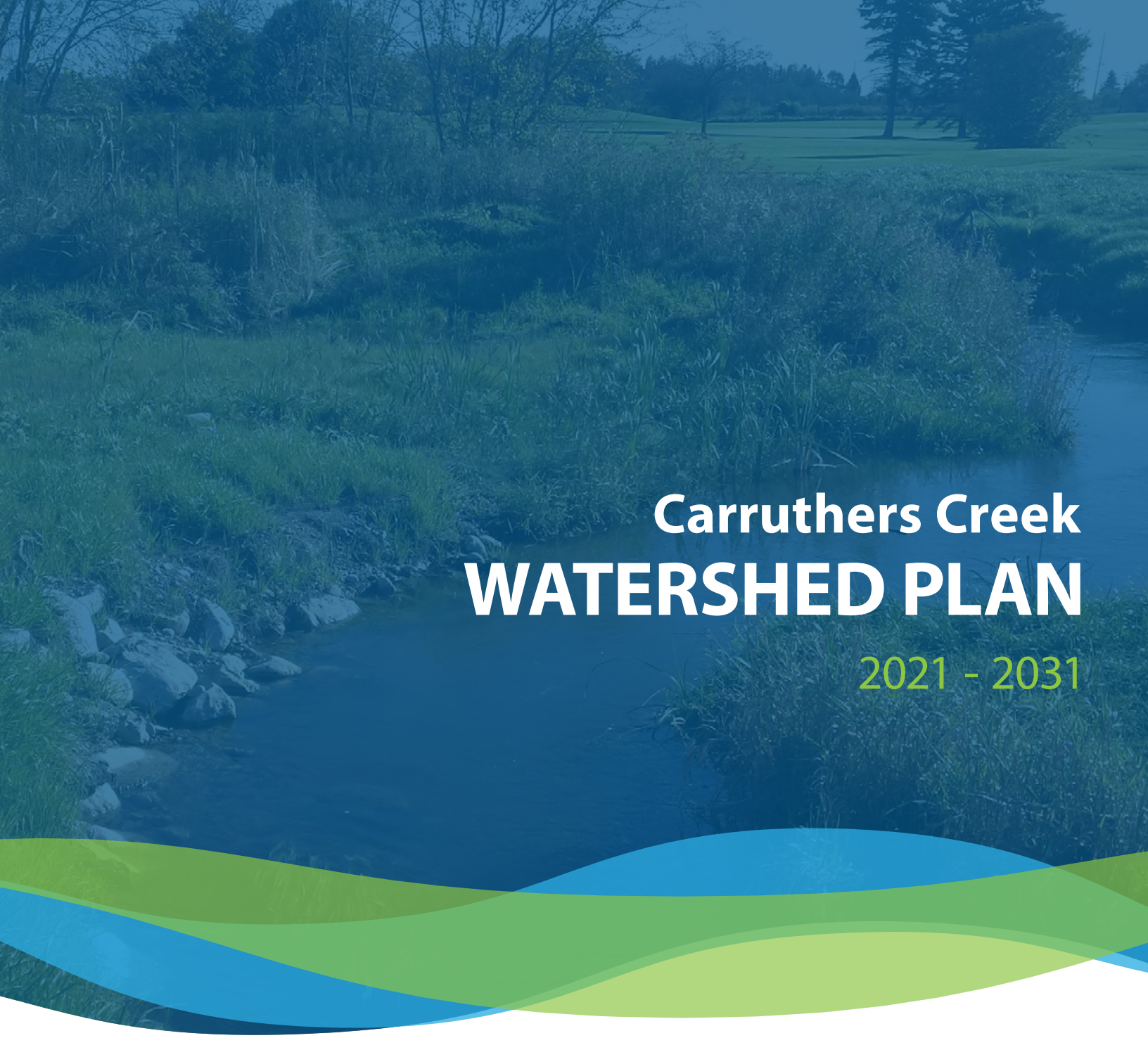
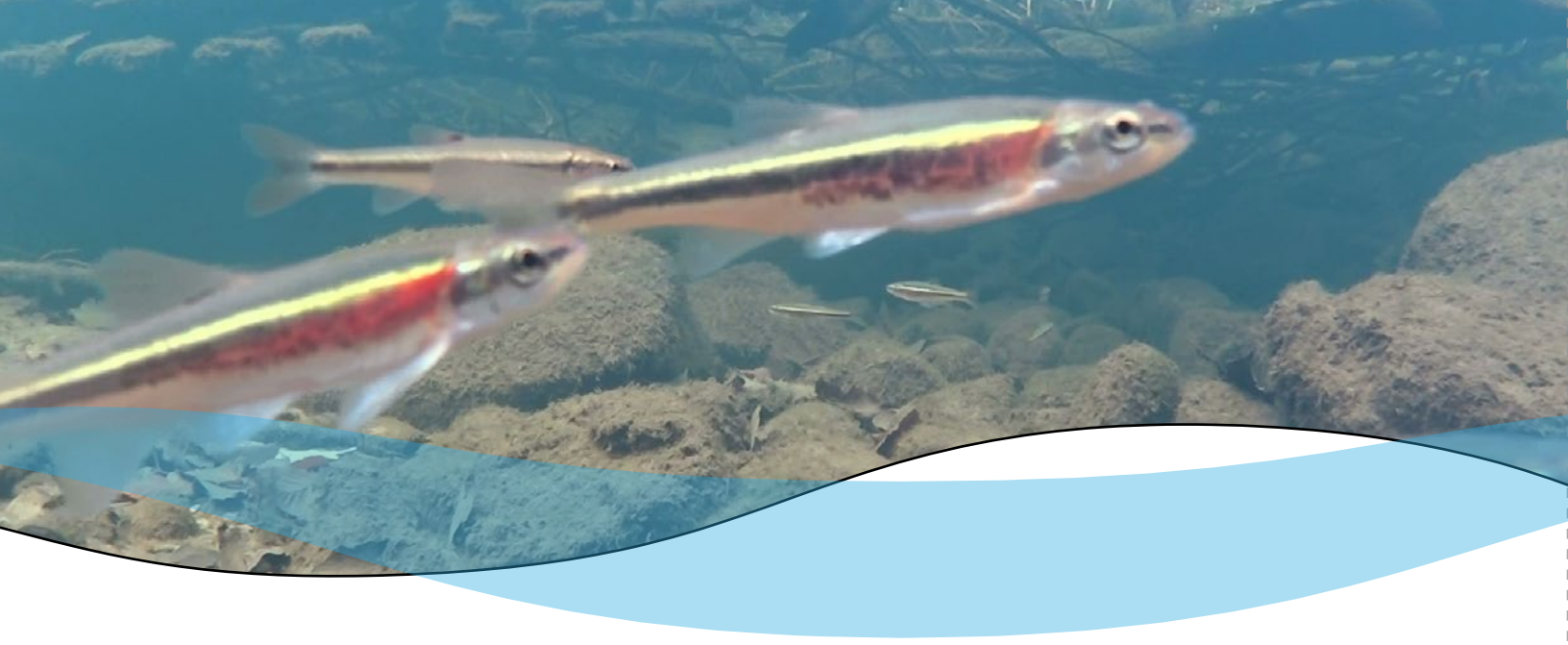


# Carruthers Creek
# WATERSHED PLAN
## 2021 - 2031

Developed in collaboration with
the **Town of Ajax** and **City of Pickering**

DURHAM REGION

Toronto and Region Conservation Authority



# Executive Summary

A watershed is an area that is drained by a river and its tributaries. Healthy watersheds provide numerous ecosystem services: from sustaining drinking water, supporting biodiversity, reducing flood and erosion hazards, protecting the quality and quantity of water, and replenishing aquifers. Due to the importance of healthy watersheds, they merit collaborative efforts to ensure their long-term sustainability.

The purpose of a watershed plan is to understand the current conditions of the watershed, and identify measures to protect, enhance, and restore the health of the watershed. Watershed planning integrates natural systems into land use and infrastructure decision-making by identifying natural features to protect and by recommending how to mitigate impacts from land use and infrastructure development on natural systems. Ontario's provincial planning framework recognizes that watershed planning is important to informing land use and infrastructure planning decisions.

The development of this watershed plan has been a collaborative effort between the Toronto and Region Conservation Authority (TRCA), the Region of Durham, the Town of Ajax, and the City of Pickering. Additional stakeholders and members of the public have been involved throughout the watershed planning process.

Carruthers Creek is a small watershed that crosses rural and urban lands, including portions of the provincial Greenbelt, before entering Lake Ontario. Urbanization and the impacts of climate change will continue to stress the health and resiliency of the watershed. Watershed planning is a means to identify opportunities to mitigate and adapt to potential changes in watershed health arising from land use and infrastructure development patterns.

## The development of the Carruthers Creek Watershed Plan was a multi-year process that consisted of:

1. Watershed characterization, which involves the identification of current conditions in the watershed.

**The key issues with Carruthers Creek were identified to be:**

- The aquatic ecosystem is sensitive and near the level of land use development it can sustain long-term (without additional and improved mitigation).
- There is not enough natural cover, or good quality habitat, needed to maintain ecosystem resilience (i.e. capacity to respond to change) due to changing land use patterns and climate change.
- Water quality is impaired (i.e. degraded), requiring improvements to stormwater management.
- The flow of water through the watershed is out of balance from natural conditions resulting in flooding and erosion issues.

2. Understanding future conditions through the analysis of potential land use scenarios. Three potential future scenarios were compared to 2015 land use conditions as part of the Carruthers Creek watershed planning process.

- **Scenario 1 (+OP)** – assumes all lands south of the Greenbelt are developed as planned in approved Official Plans up to the year 2031.
- **Scenario 2 (+NHS)** – assumes the same development as scenario 1 but includes the proposed enhanced Natural Heritage System (includes natural features and areas, such as forests, meadows, wetlands, and potential natural cover enhancement areas).
- **Scenario 3 (+Potential Urban)** – assumes post-2031 development in the headwaters of Carruthers Creek outside the proposed enhanced Natural Heritage System.

These three potential future scenarios help determine how the watershed would react to these potential land use changes, which can help inform future land use and infrastructure planning decisions. In other words, would these potential changes have a positive, neutral, or negative effect on the health of the Carruthers Creek watershed? Scenario analysis does not result in decisions about the type and configuration of land uses. Instead, scenario analysis helps to inform decisions through the municipal planning process (e.g. Official Plans, secondary plans).

3. The development of a management framework to provide recommendations on how to protect, enhance, and restore the watershed. The management framework consists of goals, objectives, indicators, and management recommendations. This management framework is designed to address existing issues in the watershed and mitigate impacts from potential future land uses, while recommending appropriate actions to protect, enhance, and restore the watershed. Decisions on the configuration of future growth and land use throughout the watershed are the purview of the applicable municipality (e.g. Region of Durham for decisions such as settlement area boundary expansions and local municipalities for site-specific decisions). The management framework is focused on:

   - Achieving more sustainable land use and infrastructure development patterns through the use of low impact development and green infrastructure policies, improved stormwater management, managing the risks of flooding and erosion, and implementing agricultural best management practices.
   - Protecting, enhancing, and restoring the Water Resource System and improving aquatic habitat connectivity.
   - Protecting, enhancing, and restoring the Natural Heritage System and increasing urban forest cover.

4. A monitoring and evaluation program to track implementation progress and ensure mechanisms are in place to adjust approaches as needed. The indicators identified as part of the management framework will help determine if actions taken in the watershed are having the desired benefit. Adaptive management will be used to adjust the management framework as needed.

Through the implementation of the Carruthers Creek Watershed Plan, TRCA and its municipal partners can improve the health of the watershed and ensure integrated long-term planning for land use and infrastructure decision-making. Protecting, enhancing, and restoring the natural systems within the watershed; accompanied by sustainable land use and infrastructure planning of redevelopments and future growth is essential for a healthy Carruthers Creek watershed.

**FIGURE 1:**
**Understanding a Watershed**

## WHAT IS A WATERSHED?

An area that is drained by a river and its tributaries. Wherever you are right now, you are in a watershed.

## WATERSHEDS DELIVER IMPORTANT BENEFITS

**Human** – provide safe drinking water and food, and help to reduce flooding and erosion.

**Economic** – produce energy, and supply water for agriculture, industry and homes.

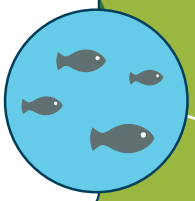
**Environment** – promote a healthy water cycle, and provide vital habitat for wildlife and plants.

### What is the Natural Heritage System?

Consists of natural features and areas, including wetlands, forests, meadows and valleylands, that are needed to maintain biodiversity and healthy ecosystems.

### What is the Water Resource System?

Consists of groundwater and surface water features and areas, including streams, lakes, groundwater recharge areas and springs, needed to sustain healthy aquatic and terrestrial ecosystems, and human water supply.



### What causes Flooding?

Rivers naturally flood with heavy rain or snowmelt, but flooding can become a problem when buildings and other structures are placed in flood plains. Climate change and urbanization can make flooding worse.

### How can salt impact a watershed?

Chlorides can contaminate drinking water and negatively affect the health of aquatic species.

### What is stormwater?

Rain and melting snow rushes off roofs, sidewalks and parking lots into pipes and pours into streams and lakes. Without proper stormwater control and treatment, flooding and erosion can increase, waterways can become polluted and local ecosystems can be damaged.

## How can agriculture impact a watershed?

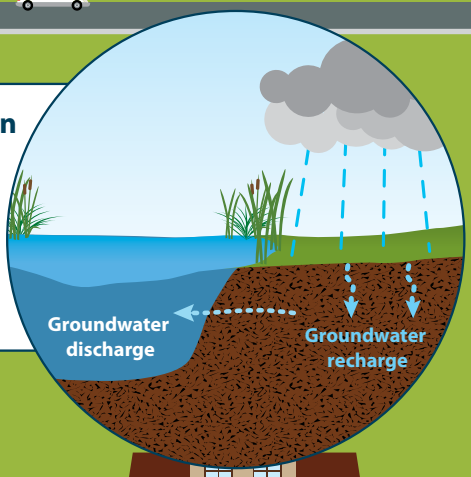
Agricultural areas provide valuable greenspace and reduce stormwater, since precipitation can penetrate the soil. On the other hand, agricultural fields can release harmful contaminants into waterways as excess nutrients (e.g. phosphorous) and pesticides. Soil erosion from fields can increase the amount of sediment in waterways negatively affecting aquatic ecosystems.

## How can urbanization impact a watershed?

Since impervious surfaces (roads, buildings, parking lots) prevent water from penetrating into soil, stormwater runoff can carry contaminants into waterways and increase the likelihood of flooding. Infrastructure and land use development can degrade habitat, reducing the quality and quantity of natural systems and their connectivity.

## Surface and Groundwater Interaction

Rain and melting snow penetrate the soil in permeable areas draining into an aquifer (i.e. groundwater recharge areas). That groundwater can then discharge at springs into streams, wetlands or other surface water features.




## Benefits of the Urban Forest

All trees in a city collectively help to remove pollutants from air and water, reduce stormwater runoff, cool communities, save energy, and improve human health and well-being.

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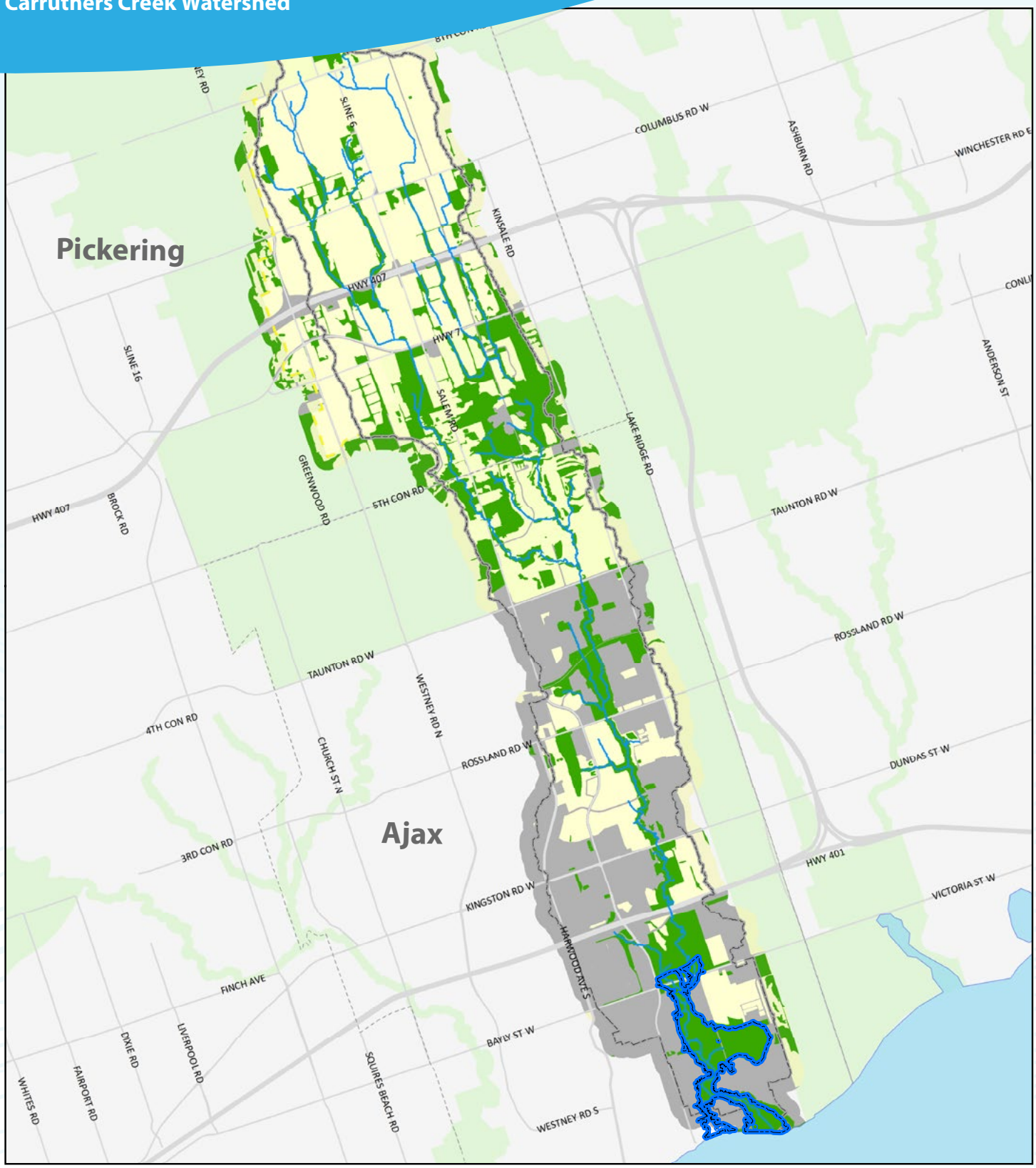
## ACRONYMS

| | |
|---|---|
| **ANSI** | Areas of Natural and Scientific Interest |
| **CCME** | Canadian Council of Ministers of the Environment |
| **CTC** | Credit Valley, Toronto and Region and Central Lake Ontario |
| **DFO** | Department of Fisheries and Oceans |
| **ESGRAs** | Ecologically Significant Groundwater Recharge Areas |
| **FBI** | Family Biotic Index |
| **FVC** | Flood Vulnerable Cluster |
| **GIS** | Geographic Information System |
| **Growth Plan** | Growth Plan for the Greater Golden Horseshoe, 2019 |
| **GTA** | Greater Toronto Area |
| **IBI** | Index of Biotic Integrity |
| **IRP** | Integrated Restoration Prioritization |
| **LAM** | Landscape Analysis Model |
| **MECP** | Ministry of the Environment, Conservation and Parks |
| **MNRF** | Ministry of Natural Resources and Forestry |
| **NHS** | Natural Heritage System |
| **PPS** | Provincial Policy Statement |
| **PWQO** | Provincial Water Quality Objectives |
| **ROP** | Regional Official Plan |
| **TRCA** | Toronto and Region Conservation Authority |
| **TSS** | Total Suspended Solids |
| **WRS** | Water Resource System |

## Indigenous Land Acknowledgement

**As we strive to develop a comprehensive watershed plan for the Carruthers Creek watershed, Toronto and Region Conservation Authority (TRCA) acknowledges that this watershed planning was undertaken within the traditional territory and treaty lands of the Anishinaabeg of the Williams Treaty First Nations, and the traditional territory of the Huron-Wendat Nation. As stewards of land and water resources within the Greater Toronto Area (GTA), TRCA appreciates and recognizes the history and diversity of the land, as well as our shared values and interests and is respectful of working in this territory.**

**FIGURE 2:**
**Carruthers Creek Watershed**

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**Carruthers Creek Watershed Plan: 2015 Land Use Conditions**

0 0.5 1 2 3 KM

- Municipal Boundary
- Watercourse

**Land Use**

- Natural
- Rural
- Urban

- Flood Vulnerable Cluster
- Greenbelt Boundary
- Carruthers Creek Watershed Boundary
- Carruthers Creek Watershed Plan Study Area

# 1. Introduction and Background

Carruthers Creek is a small, yet important watershed that crosses rural and urban areas before entering Lake Ontario. This watershed plan represents a collaborative effort to determine the current state of the watershed, assess potential future land use scenarios, and determine an appropriate management framework to ensure the long-term sustainability and resiliency of the watershed.

See **Figure 2** for a map of the Carruthers Creek watershed and its land use conditions as of 2015. This watershed plan has a ten-year time frame. However, regular monitoring and evaluation, including adaptive management, will ensure that the watershed plan is updated, or refined, as needed on an ongoing basis.

### Vision for the Carruthers Creek watershed:

Carruthers Creek watershed is a healthy and resilient natural system that is managed through partnerships to balance resource protection with human activity. Sound science and best management practices will protect and restore ecosystem functions, protect watershed residents from natural hazards like flooding, and maintain our natural heritage and water resources for present and future generations.

## 1.1 RATIONALE AND POLICY BASIS

Watershed planning is important because it helps to understand the current conditions of the watershed (i.e. watershed characterization), and identify measures to protect, enhance, and restore the health of a watershed. Watershed plans provide a comprehensive understanding of the ecological forms and functions of the various features and areas that comprise the water resource and natural heritage systems. Additionally, watershed planning helps to inform how land use and infrastructure planning influence and affect the natural ecology of the watershed.

This subsection will explain the provincial policy basis for watershed planning and the roles of municipalities and TRCA in implementing that policy framework.

### Provincial Watershed Planning Policy Basis

Ontario's planning policy framework recognizes the importance of watershed planning to inform land use and infrastructure decision-making. The key policy driver for watershed planning is applicable provincial policy direction in the Provincial Policy Statement, 2020 (PPS) and provincial plans such as the Growth Plan for the Greater Golden Horseshoe, 2020 (Growth Plan) and the Greenbelt Plan, 2017 (Greenbelt Plan)[1].

PPS policies encourage a coordinated approach to planning that recognizes the watershed as the ecologically meaningful scale for integrated and long-term planning. The PPS also directs the protection, improvement or restoration of the quality and quantity of water by minimizing potential negative impacts. Growth Plan and Greenbelt Plan policies require watershed planning to be undertaken to support the protection, enhancement or restoration of the quality and quantity of water within a watershed[2].

Furthermore, watershed planning is to be used to identify the Water Resource System (WRS), inform decisions on allocation of growth and planning for water, wastewater, and stormwater infrastructure[3].

Provincial policies also recognize the importance of protecting, enhancing, and restoring the Natural Heritage System (NHS) to maintain long-term ecological and hydrologic functions of the features and areas[4], and demonstrating that there will be no negative impacts from development and site alteration. The integrated nature and importance of the natural heritage and water resource systems is discussed in greater detail in **Section 2**.

[1]There are other geographically specific provincial plans that do not apply to the Carruthers Creek watershed (e.g. Lake Simcoe Protection Plan, Oak Ridges Moraine Conservation Plan and Niagara Escarpment Plan).

[2]Growth Plan policy 4.2.1.1 and Greenbelt Plan policy 3.2.3.2.

[3]Growth Plan policy 4.2.1.3 and Greenbelt Plan policies 3.2.3.3 and 3.2.3.4.

[4]Natural Heritage System policies for the Growth Plan are 4.2.2 and the Greenbelt Plan are 3.2.2.

Municipalities are required to conform to the PPS and applicable provincial plans through the municipal planning process and when updating their Official Plans. This Carruthers Creek Watershed Plan identifies management recommendations necessary to demonstrate conformity with provincial policies related to watershed planning. By implementing the recommendations included in this watershed plan, municipalities will be able to demonstrate how the features and areas that comprise the natural heritage and water resource systems, as well as water quality and quantity, will be protected, enhanced, and restored.

Ontario's *Clean Water Act, 2006* is designed to protect existing and future sources of drinking water. Under the *Clean Water Act, 2006*, source protection plans were developed by source protection committees representing municipal, Indigenous, public, and business interests. The Credit Valley – Toronto and Region – Central Lake Ontario (CTC) Source Protection Plan applies in the Carruthers Creek watershed. The CTC Source Protection Plan is a strategy and suite of policies developed by residents, businesses, and the municipalities, which outlines how water quality and quantity for municipal drinking water systems, not including private well owners, will be protected. The CTC Source Protection Plan includes its own set of policies and compliance mechanisms, in accordance with the *Clean Water Act, 2006*, that are not repeated in this watershed plan. The management recommendations identified in this watershed plan complement the requirements of the applicable source protection plan by including the need to protect water resources, which will support safe drinking water regardless of source (i.e. municipal and private systems).

## Reducing Natural Cover Losses in the Carruthers Creek Watershed

There have been losses and impacts to natural cover in the watershed, including parts of the Greenbelt. These changes have continued since the enactment of the *Greenbelt Act, 2005*

### POLICY FRAMEWORK

As discussed in this section, the Greenbelt Plan is one part of Ontario's land use planning framework. One vital policy tool for maintaining natural cover in both the Growth Plan and the Greenbelt Plan is the NHS policies. Once a NHS is designated in a municipal Official Plan, any development or site alteration must meet certain policy requirements in the applicable provincial plan.

Observed land use changes within the Carruthers Creek portion of the Greenbelt include fill sites, road widenings, land clearing on existing lots, farming and non-farm business operations, and vehicle and other storage.

### MOVING FORWARD

This watershed plan identifies recommendations to strengthen municipal policies to protect the NHS, in accordance with provincial policy, and identifies opportunities for restoration programs.

If community members are concerned about any development, large scale tree cutting or fill activities, please contact your local municipality, Region of Durham, or conservation authority for assistance.

Ontario's provincial planning policies recognize the importance of the Great Lakes[5]. Carruthers Creek flows into Lake Ontario. The series of Great Lakes agreements, legislation and policies set binational, national, and provincial commitments to protect and restore the Great Lakes. This watershed plan is intended to improve the conditions within the Carruthers Creek watershed, thereby reducing negative impacts to Lake Ontario from this single watershed.

## Role of Municipalities

Within the Greater Golden Horseshoe, most municipalities in Ontario are organized into two-tier systems. Upper-tier municipalities, such as the Region of Durham, are comprised of several lower-tier municipalities. The role of regional government is to address issues and concerns that apply to broader geographic areas, crossing the borders of lower-tier municipalities.

For land use planning, regional government's primary planning tool is a Regional Official Plan (ROP). The ROP implements the requirements of any relevant provincial legislation, provincial plans, and the PPS. Area municipalities develop their own, more detailed Official Plans (and may include more detailed secondary plans, Part II Plans, or tertiary plans as the case may be), as well as implementing zoning by-laws. While the ROP is required to implement provincial policy, area municipal planning tools are required to conform with both regional and provincial policy.

Municipalities are granted decision-making powers through the *Municipal Act* and *Planning Act*. Watershed planning helps municipalities to make informed decisions on where and how to grow, while identifying opportunities to improve natural watershed conditions (e.g. restoration opportunities).

## Role of TRCA

Conservation authorities were established and granted responsibilities under the *Conservation Authorities Act*. Conservation authorities play an important role in land use planning and environmental protection processes in partnership with municipalities, but are not the decision-makers in land use and infrastructure planning. Conservation authorities deliver programs and services related to natural hazard protection and management (i.e. flooding), conservation and management of conservation authority lands, drinking water source protection (as prescribed under the *Clean Water Act, 2006*), and conserving natural resources. Through its watershed expertise, TRCA, in partnership with the Region of Durham, Town of Ajax, and City of Pickering, has developed this watershed plan to help inform land use and infrastructure planning decisions.

[5]The PPS identifies the importance of considering the priorities identified in various agreements related to the protection or restoration of the Great Lakes – St. Lawrence River Basin. The Growth Plan and Greenbelt Plan require the consideration of the Great Lakes Strategy and the Great Lakes Protection Act, 2015, and any applicable Great Lakes agreements as part of watershed planning.

## 1.2 LOCAL CONTEXT AND CONSIDERATIONS

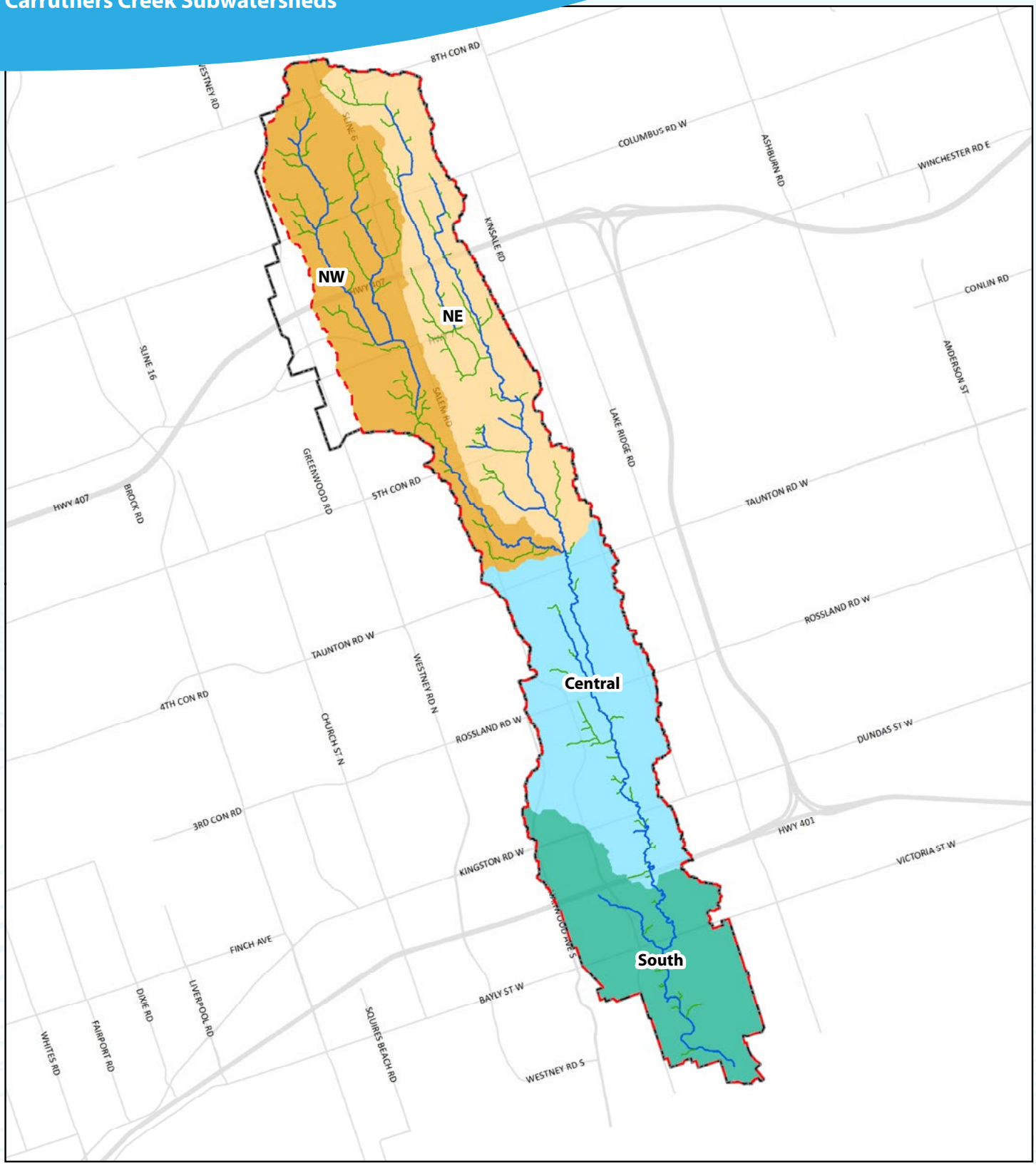
Carruthers Creek is a relatively small watershed with a drainage area of approximately 38 $km^2$, ranging from 2-3 km in width and 18 km in length, and occurs within the South Slope and glacial Lake Iroquois physiographic regions. It is the easternmost watershed in TRCA's jurisdiction and is bordered by the Duffins Creek watershed to the west and the Lynde Creek watershed in the east. The watershed has approximately 41,000 residents and is located entirely within the Region of Durham. Carruthers Creek's headwaters form to the south of the Oak Ridges Moraine, in the City of Pickering, and the creek enters Lake Ontario in the Town of Ajax. The watershed is mainly rural north of Highway 7 and urbanized south of Taunton Road to the lakeshore. From Highway 7 south to Taunton Road, most lands are in the protected countryside designation of the provincial Greenbelt Plan.

Carruthers Creek watershed consists of four subwatersheds, for the purposes of this watershed plan. Subwatersheds are defined as areas drained by a tributary, or portion of the stream, and are a more geographically specific scale than watersheds. Some of the technical analyses conducted as part of this watershed planning process used the four subwatersheds identified in **Figure 3** to evaluate the conditions of the watershed from a more refined geographic location.

The previous 2003 Duffins and Carruthers Creek Watershed Plan evaluated existing watershed conditions and identified recommendations to protect, restore, and enhance the natural systems and water quality of Carruthers Creek. The issues identified in the 2003 plan are still prevalent in the Carruthers Creek watershed, such as the need to protect and restore natural areas, improve stormwater management, and address water quality concerns. Since 2003, the Carruthers Creek watershed has undergone significant changes associated with urbanization and the impacts of climate change (See **Section 3**) for more information. Since many of the issues identified in the previous watershed plan are still occurring, an updated watershed plan using the latest advancements in watershed science, monitoring programs, and computer modelling was necessary.

Periodic reviews of watershed plans are an integral component of the watershed planning process and allow for adaptive management to incorporate new scientific approaches and to address emerging initiatives. This watershed plan update is also more reflective of current provincial policies around watershed planning, which have evolved since the 2003 plan. At the request of the Region of Durham, a small section of lands in the East Duffins Creek subwatershed, which are immediately adjacent to Carruthers Creek watershed and outside of the provincial Greenbelt, were included in the study area to provide a more complete analysis of lands in the area. However, only watershed planning processes that occur at the regional, rather than the watershed scale, were assessed (i.e. NHS planning and groundwater modelling), as these processes extend beyond the watershed boundary.

**FIGURE 3:**
**Carruthers Creek Subwatersheds**

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**Carruthers Creek Watershed Plan: Subwatersheds**

0 0.5 1 2 3 KM

**Subwatershed Boundary**
- Central
- NE
- NW
- South
- Intermittent Streams
- Permanent Streams
- Carruthers Watershed Boundary
- Carruthers Watershed Plan Study Area

The development of this Carruthers Creek Watershed Plan was a multi-year process completed in the following sequence:

- Field work on existing watershed conditions **(2015-2016)**
- Watershed characterization technical reports completed **(2017)** – See **Section 3** for the results of watershed characterization
- Potential future scenarios modelling and analysis undertaken **(2018)**
- Scenario analysis technical reports completed **(2019)** – See **Section 4** for information on the potential future scenarios and results
- Water Resource and Natural Heritage Systems identified **(2019)** – See **Section 2** for more information on these systems
- Management framework for Carruthers Creek developed **(2019)** – See **Section 5** for the Carruthers Creek management framework
- Draft Carruthers Creek Watershed Plan released for public review (**2020**)

## 1.3 PARTNERS AND STAKEHOLDERS

In 2015, the Region of Durham engaged TRCA to develop a watershed plan for Carruthers Creek. The key partners involved in the process to develop this watershed plan are TRCA, the Region of Durham, the Town of Ajax, and the City of Pickering.

Throughout the multi-year process discussed in **Subsection 1.2**, TRCA engaged the Mississaugas of Scugog Island, stakeholders, and the public to raise awareness of the watershed, planning process and solicit feedback on components of this watershed plan. Stakeholders engaged include watershed residents, landowners, farmers, developers, golf course operators, and environmental non-governmental organizations.

Stakeholders were engaged at various points during this watershed planning process, as follows:

### LATE 2015 – LATE 2017

Promoted and raised awareness of the watershed planning process for Carruthers Creek through reports and presentations to Councils and Committees of the Region of Durham, Town of Ajax, and City of Pickering.

### LATE 2017 – EARLY 2019

Continued to raise awareness of the watershed planning process for Carruthers Creek and gathered feedback from the public on a vision for the watershed plan. This was completed by launching an interactive website and hosting information booths at various events across the watershed.

### MID 2019 – LATE 2019

Gathered feedback on the draft management framework for the Carruthers Creek Watershed Plan from partners and stakeholders. Two public open houses were held in October 2019.

### EARLY 2020 - MID 2021

The draft Carruthers Creek Watershed Plan was released for public review in March 2020. Two virtual open houses were held in February 2021. The public review comment period closed March 19, 2021.

Feedback received from partners and stakeholders was invaluable in the development of this watershed plan. The Carruthers Creek Watershed Plan reflects the diversity of issues and concerns raised throughout the planning process and represents a realistic and manageable plan to improve the overall health of the Carruthers Creek watershed.

All the partners and stakeholders engaged as part of this process play a key role in the effective implementation of the management recommendations identified in **Section 5**.

# 2. Water Resource and Natural Heritage Systems

The aquatic and terrestrial features and areas that maintain the ecological integrity of a watershed consist of two integrated systems, the WRS and NHS. Together, these two systems provide essential ecosystem services, including water storage and filtration, cleaner air, support to biodiversity and habitats, carbon storage, as well as resiliency to climate change. Maintaining extensive, connected and high-quality ecological and hydrological features and areas of both systems is essential for the long-term health and sustainability of Carruthers Creek,  as shown in **Figure 1**.

As mentioned in **Subsection 1.1**, identifying and protecting both systems is a key policy requirement in the Growth Plan and Greenbelt Plan.

The features and areas that comprise both systems are explained in **Table 1** below.

**TABLE 1:**
Description of the Water Resource System and Natural Heritage System

| Water Resource System | Natural Heritage System |
|---|---|
| A system consisting of groundwater features and areas and surface water features (including shoreline areas), and hydrologic functions, which provide the water resources necessary to sustain healthy aquatic and terrestrial ecosystems and human water consumption. | A system made up of natural heritage features and areas, and linkages identified to provide connectivity (at the regional or site level) and support natural processes which are necessary to maintain biological and geological diversity, natural functions, viable populations of indigenous species, and ecosystems. |
| The WRS consists of:<br>**Key Hydrologic Areas**<br>• Significant Groundwater Recharge Areas (including Ecologically Significant Groundwater Recharge Areas)<br>• Highly Vulnerable Aquifers<br>• Significant Surface Water Contribution Areas<br><br>**Key Hydrologic Features**<br>• Permanent Streams<br>• Intermittent Streams<br>• Inland Lakes and their Littoral Zones<br>• Seepage Areas and Springs<br>• Wetlands* | The NHS consists of:<br>• Significant Wetlands*<br>• Significant Coastal Wetlands<br>• Other Coastal Wetlands in Ecoregions 5E, 6E and 7E<br>• Fish habitat*<br>• Significant Woodlands<br>• Significant Valleylands in Ecoregions 6E and 7E (excluding islands in Lake Huron and the St. Mary's River)<br>• Habitat of Endangered Species and Threatened Species<br>• Significant Wildlife Habitat<br>• Significant Areas of Natural and Scientific Interest (ANSIs)<br>• Sand barrens, savannahs, tallgrass prairies and alvars<br>• Federal or provincial parks, and conservation reserves |

***Notes:**
Wetlands are important features in both systems. For the purposes of mapping in **Section 7**, wetlands are shown separately in **Map 1A** for the WRS and included as natural cover in **Map 2** for the NHS. Fish habitat in the NHS overlaps with features and areas in the WRS.

The majority of these terms are defined in the Growth Plan, 2020. Some, but not all definitions, have been included in the Glossary (**Section 8**) of this watershed plan.

Not all of the NHS features or areas identified in this table are part of the proposed enhanced NHS for Carruthers Creek, since some of these features do not exist in this watershed (e.g. sand barrens, savannahs, etc.), or are not distinguished specifically from natural cover areas (e.g. significant woodlands and significant wildlife habitat).

Due to the importance of both systems, the protection, enhancement, and restoration of the WRS and NHS are goals of this watershed plan (**Section 5**).

See **Section 7** for maps of the WRS and the recommended NHS.

## How the WRS was delineated?

The key hydrologic areas and key hydrologic features that comprise the WRS were delineated using various techniques and methodologies.

Highly Vulnerable Aquifers and Significant Groundwater Recharge Areas were determined through Technical Rules established under the *Clean Water Act, 2006* for the purposes of regional source water protection planning. Ecologically Significant Groundwater Recharge Areas (ESGRAs) were determined using a model developed by the Oak Ridges Moraine Groundwater Program to optimize the protection of groundwater dependent ecosystems. The model results for ESGRAs were assessed to minimize the land area covered by these key hydrologic areas while maintaining a high degree of hydrological function protection for these ecosystems. Significant Surface Water Contribution Areas include many of the intermittent streams in the headwaters (northern portion) of Carruthers Creek.

Each of the five key hydrologic features were delineated using a combination of satellite imagery, ArcHydro GIS, and field site verification.

The WRS provides habitat for aquatic life (e.g. fish). The conditions of aquatic habitat in Carruthers Creek were assessed as part of this watershed planning process.

## How the NHS was delineated?

The components of the NHS were delineated using a robust methodology that incorporated ecological models (e.g. Landscape Analysis Model), information from satellite imagery, monitoring data, field site verification, and expert based knowledge.

The components of the NHS were identified for their ecological value as existing and potential natural cover (i.e. areas targeted for restoration and enhancement), to:

- Increase natural cover (e.g. forests, wetlands, meadows, etc.) quantity and quality by improving habitat size, shape, and connectivity in and around existing natural areas, as well as in areas for potential restoration
- Protect and restore species and vegetation communities by incorporating diverse habitat types, mitigating the impacts of urban development, and improving the ecological connectivity across the watershed
- Incorporate natural system vulnerabilities to climate change in planning processes to build a more resilient NHS

## Protecting the WRS and NHS

As mentioned in **Subsection 1.2**, provincial policies recognize the importance of protecting the WRS and NHS. Municipalities are required to demonstrate how these systems will be protected. Through its technical and scientific expertise, TRCA delineated both systems as part of this watershed planning process.

For the recommended NHS, the areas identified as potential natural cover (enhancement areas) should be restored to maintain the long-term resiliency and sustainability of terrestrial ecosystems, in addition to protecting the existing natural cover. TRCA's *Terrestrial Natural Heritage System Strategy* has a minimum target of 30% natural cover across the entire jurisdiction, while recognizing there will be variability among TRCA's nine watersheds due to existing land uses. The Carruthers Creek watershed is currently below that target (see **Subsection 3.3** for more information).

The management framework (**Section 5**) of this watershed plan, recognizes that land use and/or infrastructure decisions may impact, or occur, within the WRS or NHS, and establishes recommendations to avoid these features and areas, mitigate impacts, or when impacts are unavoidable, provide for ecosystem compensation. Municipalities are responsible for designating a NHS that is consistent with provincial policies and informed by the goals and objectives of this watershed plan.

# 3. Existing Watershed Conditions

Watershed characterization is a vital part of watershed planning, which helps to determine the current conditions of the watershed. As part of this watershed plan, TRCA produced technical reports on different components of the watershed, which are summarized in this section.

## 3.1 CONTEXT AND BACKGROUND

Since the previous watershed plan is from 2003, the existing conditions of the watershed were evaluated using more recent data and science. TRCA produced eight peer-reviewed technical reports as part of watershed characterization. These technical reports helped determine the current state of the watershed, as discussed in **Subsection 3.3**

Watershed characterization includes the following topics (see full technical reports listed in **Section 9**):

### Aquatic Crossing and Barrier Assessment

Involved the assessment of existing structures in Carruthers Creek that represent barriers to fish passage, such as perched culverts and online ponds.

### Aquatic Habitat and Community Characterization

Involved the assessment of aquatic habitat conditions, stream temperature, fish community richness and composition, and benthic invertebrate richness and composition.

### Fluvial Geomorphology

Involved the assessment of the creek's flow and sediment movement processes, drainage patterns, and potential erosion risks.

### Headwater Drainage Features

Involved the assessment of small streams in the upper portions of the watershed that may not flow year-round (i.e. intermittent and ephemeral). These features provide hydrologic and ecological functions to maintain downstream watershed conditions.

### Hydrogeology

Involved the assessment of groundwater conditions within the watershed, such as groundwater recharge and discharge, and groundwater flow and quality.

### Surface Water Quality Characterization

Involved the assessment of current and past water quality conditions to determine trends and factors influencing water quality.

### Terrestrial Natural Heritage

Involved the assessment of natural cover, terrestrial habitat, and species across the watershed.

### Water Quantity Characterization

Involved the assessment of the volume, velocity, spatial distribution, and timing of water moving through the stream network (i.e. streamflow).

## 3.2 HISTORICAL AND CURRENT LAND USES

Ongoing urbanization in the GTA continues to convert natural and agricultural lands to other uses. This is true in the Carruthers Creek watershed as well. In 1999, the watershed consisted of 28% natural cover, 53% agricultural lands, and 12% urban area[6]. As of 2015, natural cover had dropped to 25% and agricultural lands to 34%. Urban land use increased to approximately 37% during that time period. See **Figure 2** for a map of 2015 land use conditions. This historical context is important for characterizing the current conditions of the watershed as it helps to understand the rate of change within the watershed and provides a useful benchmark for comparison.

## 3.3 CURRENT STATE OF THE WATERSHED

Based on the technical assessments conducted as part of watershed characterization (discussed in **Subsection 3.1**), there are four key issues in Carruthers Creek:

1 **WATER RESOURCE SYSTEM:** the aquatic ecosystem is sensitive and near the level of land use development it can sustain long-term (without additional and improved mitigation).

The current state of the WRS includes assessments of headwater drainage features, fish communities, in-stream barriers to fish movement and groundwater recharge areas, which support discharge to aquatic habitats.

The analysis of the small stream features north of Highway 7 (i.e. headwater drainage features), showed that 67% of the features have been altered (i.e. reducing hydrologic connectivity and increasing surface runoff) in some way by human activities, primarily through tile drainage.

### Tile Drainage

Tile drainage is a common and important land management practice in many agricultural parts of Ontario. Tile drains are corrugated plastic tubing, clay or concrete drains installed beneath the surface of fields to drain excess water from the crop root zone.

Working with the agricultural community is important to identify opportunities to mitigate the potential impacts of tile drainage.

Consult the Ontario Ministry of Agriculture, Food and Rural Affairs, or the Ontario Soil and Crop Improvement Association for more information.

[6]Additional land use categories such as water, recreational, golf courses, cemeteries, and hydro corridors make up the remaining percentages not included in the categories of natural, agricultural, and urban land uses.

Currently, the fish communities within the watershed are dominated by cool-water native species. Redside Dace, an endangered species, is currently found within the watershed.

Urbanization results in impervious land cover (i.e. pavement, or areas where water cannot penetrate the ground). Imperviousness can increase the severity and duration of peak flows during storm events, cause erosion and sedimentation, and increase stream temperatures, which impacts aquatic habitat for all species. Some areas of the watershed are impacted by poor water quality, which negatively impacts the aquatic ecosystem (see key issue number three, water quality for more information).

Existing in-stream barriers to fish movement associated with development and infrastructure adversely impacts the aquatic system in Carruthers Creek by limiting access to feeding and spawning areas, increasing water temperature, and affecting sediment transport. In-stream structures that act as barriers to fish passage include dams, weirs, road and rail crossings, and some culverts.

From a groundwater perspective, there are three aquifer systems present in the watershed. These aquifer systems include the Oak Ridges Moraine / Mackinaw Interstadial, Thorncliffe, and Scarborough aquifer complexes. Long-term groundwater quality information for specific sites within the Carruthers Creek watershed are unavailable, but there have been a number of studies conducted in adjacent watersheds to provide an indication of background groundwater quality. The available information from Duffins Creek and Rouge River indicate elevated levels of nitrates and chlorides in groundwater attributed to road salts and fertilizer use. Healthy groundwater systems are essential for safe drinking water (e.g. particularly from rural private wells), commercial agricultural activities, and to support aquatic ecosystems.

### 2 NATURAL HERITAGE SYSTEM: there is not enough natural cover, or good quality habitat, needed to maintain ecosystem resilience (i.e. capacity to respond to change) due to changing land use patterns and climate change.

As of 2015, approximately 25% of the watershed consisted of natural cover. Approximately 9% of that natural cover is forest, 7% wetland, 4% successional (transitioning to forest), and 3% meadow [7]. Current habitat conditions are overall poor in terms of patch size, shape, and influences from surrounding land uses.

In addition to this assessment of natural cover within the watershed, TRCA also conducted terrestrial inventories of plants and animals. These inventories found 845 vascular plant species, of which only 57% are native species. These results indicate a significant presence of invasive species, such as dog-strangling vine, garlic mustard, and common buckthorn. The inventory also identified 153 flora species of regional conservation concern including four species that have not been found anywhere else in TRCA's jurisdiction. Inventories documented a total of 133 breeding vertebrate fauna species over the past decade comprised of 106 breeding birds, 18 mammals, and 9 herpetofauna (i.e. reptiles and amphibians).

The urban forest within the Carruthers Creek watershed contains 94 types of woody plant species, with over 270 varieties. Maples make up the most common type of tree within the watershed. In 2017, approximately 23% of the watershed consisted of tree and shrub canopy.

[7]The remaining natural cover percentages are around, or less than, one percent, consisting of water, hydro corridors, and beach/bluff.

**FIGURE 4:**
**Comparing Urban Forest and Natural Cover**


## Difference between urban forest and natural cover

The term **urban forest** is used to describe the trees and woody shrubs located on all private and public property within a watershed, including urbanized spaces (e.g. along roads) and in forests. The percentage of urban forest within a watershed is determined by the area covered by the canopies of all trees and shrubs.

Natural cover, expressed in hectares, or as a percentage of the overall watershed area, is the area of the watershed covered by natural habitats including forests, meadows, and wetlands.

Natural cover includes habitats with varying degrees of trees and shrubs. Meadows for example are open habitats that do not contain trees. Although meadows, and other non-treed habitats, are natural cover, they are not part of the urban forest. Similarly, the urban forest includes trees located within built portions of the watershed, outside of natural habitats. For these reasons, the amount of natural cover and the amount of urban forest in a watershed will not be equal as is the case of the Carruthers Creek watershed.

See **Figure 4** for a visual representation of this explanation.

**3 WATER QUALITY:** is impaired within the watershed, requiring improvements to stormwater management.

The headwaters of Carruthers Creek contain elevated concentrations of total phosphorus, phosphate, total ammonia, *E. coli*, total suspended solids (TSS), turbidity, and some trace metals. These elevated concentrations in the headwaters were likely influenced by agricultural practices and the construction of Highway 407. Just upstream of urban development, concentrations were reduced for most parameters, except chloride. Chloride levels regularly exceeded the threshold for the protection of aquatic life in the reaches of Carruthers Creek with urban influences. Additionally, increased concentrations of total ammonia, nitrite, phosphate, turbidity, and trace metals are often observed downstream of the urban area. As expected, the concentrations of many water quality parameters were elevated during high flow conditions that occur during storm runoff and wet weather.

Prior to the 1980s, stormwater management focused solely on flood control (stormwater quantity). Modern stormwater management provides a higher level of protection for the environment, property, and residents by incorporating mitigation provisions for water quality, erosion, and water balance in addition to water quantity control. The Carruthers Creek watershed has various levels of stormwater control that are indicative of the age of development and the prevailing stormwater management practices at the time.

**4 NATURAL HAZARDS:** the flow of water through the watershed is out of balance and there are flooding and erosion issues.

Urbanization converts formerly pervious surfaces (e.g. forests, meadows, agricultural lands) to impervious surfaces (e.g. roads, parking lots, rooftops). From 1999 to present day, the increase in urban cover has greatly altered the natural water balance. In addition, existing agricultural lands located in the headwaters of the watershed are extensively tile drained. Several sites with erosion issues were identified as part of the fluvial geomorphic assessment.

During storm events, the increase in surface runoff associated with impervious surfaces can result in excessive riverine flooding and stream erosion. Currently, a Flood Vulnerable Cluster (FVC) exists in the lower part of the Carruthers Creek watershed in the Town of Ajax (see **Figure 2** or **5** for the location of this FVC). There have been both historical and recent flooding events in the Carruthers Creek watershed due to extreme precipitation events.

These four key issues provide the basis for the management framework of this watershed plan, discussed in **Section 5**.

**Table 2** summarizes benchmarks for the four key watershed issues previously discussed. The benchmarks are important reference points for understanding how watershed conditions can change over time to evaluate success of this watershed plan. **Table 2** also identifies guidelines (or rating scales) to show the ideal state of that particular watershed component. The guidelines (or rating scales) are informed by relevant TRCA strategies, provincial or federal guidance, and established conservation science. The scenario analysis, described in **Subsection 4.3**, summarizes how the watershed will respond to potential future scenarios in comparison to the benchmarks. **Section 6** uses indicators to evaluate the success of implementation through a watershed monitoring program. The indicators identified in **Section 6** will track watershed conditions relative to the benchmarks discussed in **Table 2**. Where a monitoring station is referenced in **Table 2**, see **Figure 7** for the location of that monitoring station within the watershed.

**TABLE 2:**
Current Watershed Conditions Benchmarks

<table>
<tr><th>Key Watershed Issues</th><th>Sub-Issue</th><th>Benchmarks</th><th>Guideline or Rating Scale (if applicable)</th></tr>
<tr><td rowspan="5">WATER RESOURCE SYSTEM</td><td>Aquatic Health</td><td>Family Biotic Index (FBI)[8]– rating of fairly poor and poor across Carruthers Creek:<br>• Poor = 6.59 (Average from 2013 – 2017 at monitoring station Aquatic 1)<br>• Fairly poor = 6.19 (Average from 2013 - 2017 at monitoring station Aquatic 2)<br>• Fairly poor = 6.07 (Average from 2013 - 2017 at monitoring station Aquatic 3)<br><br>Index of Biotic Integrity (IBI)[9]:<br>• Rating of poor at three sites (2015)<br>• Rating of fair at two sites (2015)<br>• Rating of good at six sites (2015)</td><td>Rating scale for FBI:<table><tr><th>Value</th><th>Rating</th></tr><tr><td>0 – 3.75</td><td>Excellent</td></tr><tr><td>3.76 – 4.25</td><td>Very good</td></tr><tr><td>4.26 – 5.00</td><td>Good</td></tr><tr><td>5.01 – 5.75</td><td>Fair</td></tr><tr><td>5.76 – 6.50</td><td>Fairly poor</td></tr><tr><td>6.51 – 7.25</td><td>Poor</td></tr><tr><td>7.26 – 10</td><td>Very poor</td></tr></table><br>Rating scale for IBI:<table><tr><th>Value</th><th>Rating</th></tr><tr><td>≥ 38</td><td>Very good</td></tr><tr><td>28 – 37.9</td><td>Good</td></tr><tr><td>20 – 27.9</td><td>Fair</td></tr><tr><td>≤20</td><td>Poor</td></tr></table></td></tr>
<tr><td>Riparian corridor (30 m buffer around streams)</td><td>Within the riparian corridor natural cover is 49%</td><td>75% of stream length is naturally vegetated</td></tr>
<tr><td>Streamflow (surface water)</td><td>Carruthers Creek at Achilles Road had an average total volume of 1.14 x $10^7$ $m^3$ over the 2008 – 2016 period. This corresponds to a discharge rate of 0.360 $m^3/s$ when averaged on an annual basis</td><td>Not applicable (should not vary significantly from natural fluctuations year to year)</td></tr>
<tr><td>Groundwater Recharge</td><td>Average recharge rate is estimated at 118 mm/year</td><td>Not applicable (should not decrease significantly from natural rates)</td></tr>
<tr><td>Groundwater Discharge</td><td>Average discharge rate is estimated at 130 mm/year</td><td>Not applicable (should not decrease significantly from natural rates)</td></tr>
</table>

[8]The Family Biotic Index is often used to assess the quality of water in rivers and is a scale for showing the quality of an environment by indicating the types of organisms present in it.

[9]The Index of Biotic Integrity measures a chosen set of metrics (in this case number of fish species, presence of sensitive fish species, abundance and food chain classifications) to assign a rating of very good to poor.

<table>
<tr><th>Key Watershed Issues</th><th>Sub-Issue</th><th>Benchmarks</th><th>Guideline or Rating Scale<br>(if applicable)</th></tr>
<tr><td rowspan="5">NATURAL HERITAGE SYSTEM</td><td>Natural cover</td><td>Approximately 25% total natural cover, consisting of 9% forest, 7% wetland, 4% successional (transitioning to forest), and 3% meadow</td><td>Minimum 30% natural cover.<br><br>TRCA recommended NHS for Carruthers Creek: 36% natural cover; 16% forest, 7% wetland, 13% other (primarily successional forest and meadow)</td></tr>
<tr><td>Habitat quality</td><td>Evaluated using Landscape Analysis Model (LAM), which assigns a score based on total number of habitat patches, patch size, patch shape, and influences from surrounding land uses. Overall patch quality in the Carruthers Creek watershed was found to be ‘poor’</td><td>Rating scale:<table><tr><th>Patch Score</th><th>Quality Condition</th></tr><tr><td>13 – 15</td><td>Excellent</td></tr><tr><td>11 – 12</td><td>Good</td></tr><tr><td>9 – 10</td><td>Fair</td></tr><tr><td>6 – 8</td><td>Poor</td></tr><tr><td>0 – 5</td><td>Very poor</td></tr></table></td></tr>
<tr><td>Animal (i.e. fauna) species of concern</td><td>North of Taunton Road = 39<br><br>South of Taunton Road = 56</td><td>Not applicable (ideally maintained or improved)</td></tr>
<tr><td>Number and area of sensitive vegetation communities</td><td>Entire watershed number = 43<br><br>Area = approximately 54 hectares</td><td>Not applicable (ideally maintained or improved)</td></tr>
<tr><td>Tree and Shrub Canopy (urban forest)</td><td>Approximately 23% tree and shrub canopy for the entire watershed (2017)</td><td>Not applicable (targets to be established through management recommendation 3.3.2)</td></tr>
<tr><td rowspan="2">WATER QUALITY (SURFACE)<br><br>Water quality benchmarks are based on average concentration of 17 water quality samples collected monthly from June 2015 to May 2016.</td><td>Chlorides</td><td>• 183 mg/L at monitoring station Water Quality 1<br>• 72 mg/L at monitoring station Water Quality 2<br>• 35 mg/L at a no longer active monitoring station that was located west of Salem Road at Hwy 7</td><td>The long-term water quality guideline for the protection of aquatic life (CCME) for chlorides is 120 mg/L</td></tr>
<tr><td>Total suspended solids</td><td>• 20 mg/L at monitoring station Water Quality 1<br>• 11 mg/L at monitoring station Water Quality 2<br>• 59 mg/L at a no longer active monitoring station that was located west of Salem Road at Hwy 7</td><td>CCME water quality guideline for TSS is based on increases over background levels. Monitoring results show large fluctuations in TSS in Carruthers Creek.</td></tr>
</table>

| Key Watershed Issues | Sub-Issue | Benchmarks | Guideline or Rating Scale (if applicable) |
|---|---|---|---|
| **WATER QUALITY (SURFACE)** cont'd | *E. coli* | • 706 CFU/100 ml at monitoring station Water Quality 1<br>• 517 CFU/100 ml at monitoring station Water Quality 2<br>• 475 CFU/100 ml at a no longer active monitoring station that was located west of Salem Road at Hwy 7 | CFU – Colony Forming Units. Provincial Water Quality Objective (PWQO) for E. coli is 100 CFU/100 ml. Averages for Carruthers Creek exceed this guideline |
| | Total phosphorus | • 0.044 mg/L at monitoring station Water Quality 1<br>• 0.031 mg/L at monitoring station Water Quality 2<br>• 0.091 mg/L at a no longer active monitoring station that was located west of Salem Road at Hwy 7 | PWQO to avoid excessive plant growth in river and stream concentrations below 0.03 mg/L. Averages for Carruthers Creek exceed this guideline |
| | Stormwater management[10] | As of 2003, approximately 64% of the developed portion of the watershed has stormwater controls that meet TRCA criteria. Of the remaining percentages, 29% have no stormwater controls and 7% have water quantity control only | Established by municipalities, in collaboration with TRCA, through stormwater master planning and secondary planning |
| **NATURAL HAZARDS** | Peak flows (flooding) | Regional Storm (i.e. Hurricane Hazel)<br>• 71.61 $m^3/s$ at Taunton Road<br>• 140.52 $m^3/s$ at Shoal Point Road<br><br>5-year Storm (i.e. 1 in 5 probability of flow being exceeded in any one year)<br>• 7.27 $m^3/s$ at Taunton Road<br>• 11.00 $m^3/s$ at Shoal Point Road | Not applicable (peak flows should not increase) |
| | Flood vulnerable roads and structures | Metres of impassable road length affected:<br>• Average annual = 91 m<br>• Regulatory flood event = 2,532 m<br><br>Number of households affected:<br>• Average annual = 1<br>• Regulatory flood event = 89 | Not applicable (ideally a reduction in vulnerable roads and structures) |

**Notes:** See **Section 6** for map and description of monitoring station locations referenced in this table. Other surface water quality parameters were characterized as part of TRCA's technical analysis, but only parameters of concern are included in this table.

[10]For the purposes of determining the current state of the watershed, stormwater management has been grouped with water quality. However, inadequate stormwater management can also increase the frequency and duration of flooding (i.e. natural hazards) and impact aquatic habitat (i.e. WRS).

# 4. Future Watershed Conditions

An important part of watershed planning is assessing future conditions based on potential future land use scenarios. The results of watershed characterization discussed in **Section 3** were used to inform the potential future land use scenarios discussed in this section. TRCA produced peer-reviewed technical reports on different components of the watershed as part of scenario analysis, which are referenced in **Section 9**.

## 4.1 FUTURE STRESSORS

To determine what land use scenarios to assess requires identifying potential future stressors on a watershed. For Carruthers Creek, urbanization continues to drive land use change, converting natural and agricultural areas to residential, commercial, and industrial lands. This urbanization impacts the health of a watershed largely through the loss of natural cover and increase in impermeable surfaces, which alter the hydrologic regime. Despite some positive watershed management efforts to date in Carruthers Creek, the watershed exhibits signs of stress due to the impacts of urbanization and climate change. By 2051, the population of the Region of Durham is expected to nearly double from 682,000 to 1.3 million. Some of that growth will certainly be in the Carruthers Creek watershed.

Climate change is expected to increase precipitation, annual average temperatures and the frequency of extreme weather events, which will impact watersheds within the Region of Durham. Some of the implications of a changing climate include localized flooding, violent storm damage, changes to ecosystem composition, and changes to agricultural conditions and production.

These stressors were evaluated as part of assessing future watershed conditions. The management framework in **Section 5** of this watershed plan recognizes these stressors by identifying recommendations to mitigate potential future watershed impacts.

## 4.2 FUTURE SCENARIOS

An effective way to assess how a watershed will respond to potential future change is to develop, analyze, and compare several alternate scenarios, each reflecting a different composition of possible land use conditions. In this way, land use scenario analysis is used as a tool to compare how possible future land uses might add to existing pressures on the natural system, and how these pressures might affect watershed health. Land use scenario analysis is a technical exercise that is typically undertaken when developing watershed plans to ensure management recommendations are based on the best available science. The results help guide the development of management recommendations and support municipalities in land use and infrastructure planning decision-making.

### Climate Change

Climate change was incorporated into the scenario analysis for various technical components of this watershed planning process, where possible. For example, the terrestrial impact assessment completed as part of the NHS planning specifically incorporated climate change vulnerabilities as one of its criteria for determining priority NHS sites. The impacts of future climate change were factored into potential stresses on the aquatic system as part of that technical assessment. Additionally, hydrologic modelling completed as part of this watershed planning process incorporates storm events considered to be more frequent under climate change scenarios.

The management framework recognizes the importance of climate change by prioritizing the protection of the WRS and NHS, which can, if properly protected and restored, improve climate adaptation and increase ecosystem resilience. The use of green infrastructure and low impact development combined with improvements to stormwater infrastructure are also important management recommendations to adapt to a changing climate.

TRCA, the Region of Durham, Town of Ajax, and City of Pickering all recognize the challenge of climate change and have various strategies and action plans to address this challenge, in addition to the recommendations identified in this watershed plan (e.g. *Durham Community Climate Adaptation Plan* and *Durham Community Climate Change Local Action Plan*).

**Note:**
Climate change projections to 2100 for TRCA's jurisdiction and the Region of Durham are available through their respective open data portals.

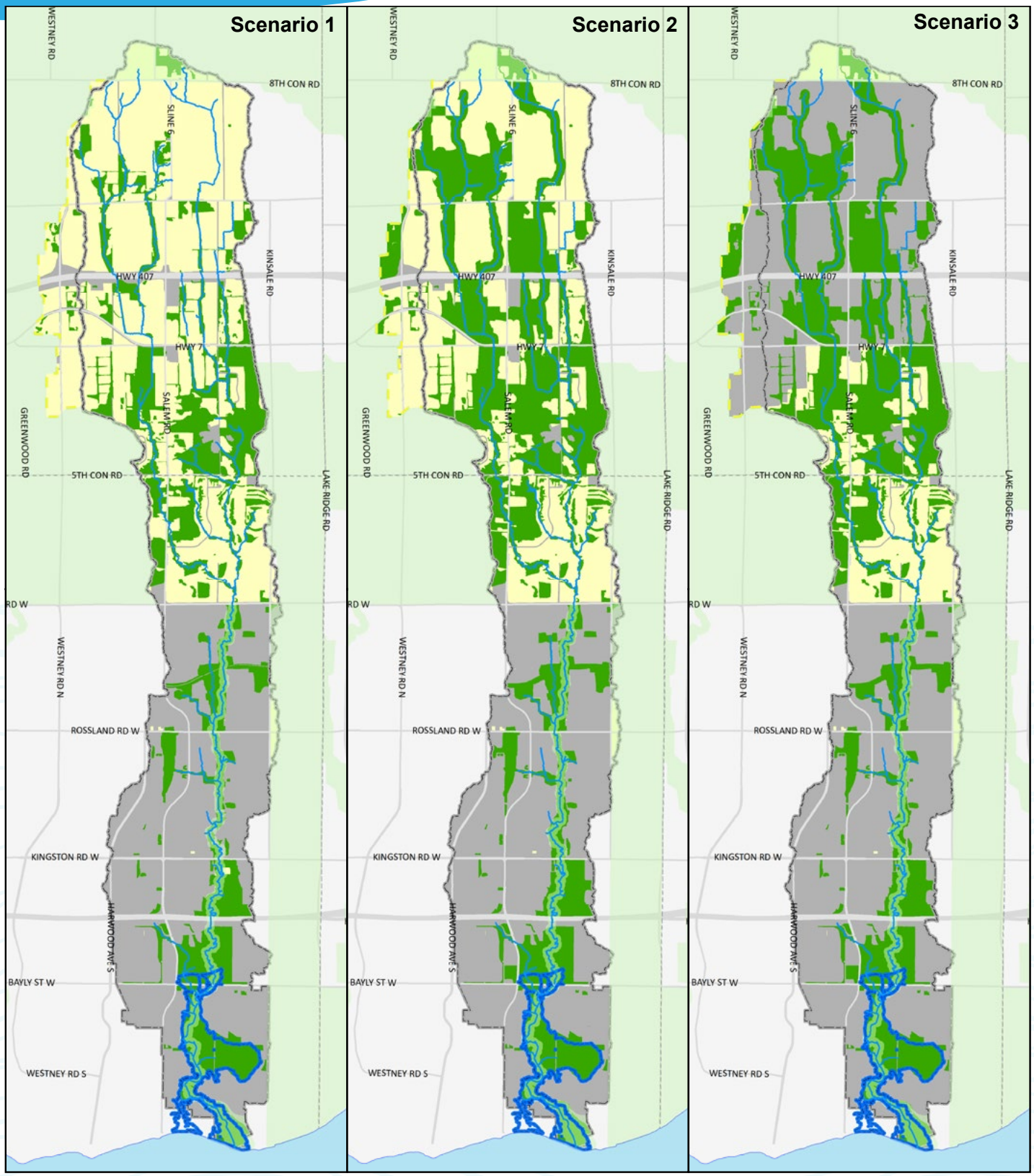
Three potential future land use scenarios were developed and analyzed as part of this watershed planning process to assess possible changes and impacts in both the built and natural environments. The year 2015 was used as the baseline for this watershed planning process due to the availability of data sets at the initiation of this project. It is worth noting that since 2015 was used as the baseline for scenario analysis, potential impacts from the extension of Highway 407 (completed in 2016) through the headwaters of Carruthers Creek can only be assumed. Ongoing monitoring of the Carruthers Creek watershed will help determine any potential changes to overall watershed health arising from the construction of this highway infrastructure.

**TABLE 3:**
Potential Future Land Use Scenarios

| | |
|---|---|
| **Scenario 1 (+Official Plan)** | This scenario assumes that all lands south of the Greenbelt are developed up to 2031 based on approved Official Plans. This scenario included municipally designated NHS's that were part of Official Plans.<br><br>This scenario provides insight into how watershed conditions will likely change as approved Official Plans are implemented. |
| **Scenario 2 (+NHS)** | This scenario assumes the same development as Scenario 1 but includes the enhanced NHS (i.e. potential natural cover).<br><br>New and updated information from natural heritage science and practice was incorporated to identify potential areas for natural cover that would improve ecosystem functions and services in the future.<br><br>This scenario provides insights into how watershed conditions will likely change with increased consideration of additional natural cover. |
| **Scenario 3 (+Potential Urban)** | This scenario assumes post-2031 development in the headwaters of Carruthers Creek (north of the Greenbelt), outside the enhanced NHS.<br><br>This scenario made general assumptions on the types of land uses associated with typical urbanization. It did not make assumptions on the levels of stormwater management controls or other mitigation measures (e.g. green infrastructure) that may accompany urban development. This level of analysis would be done during subsequent planning stages when detailed land use configurations are known.<br><br>This scenario provides insights into how watershed conditions will likely change if potential full growth is approved in the watershed. |

See **Figure 5** for representative maps of each scenario.

## FIGURE 5:
## Future Scenarios Mapping




Toronto and Region Conservation Authority

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Date: September 2019
Created by: TRCA Information Services/Information Technologies
Disclaimer:
The Data used to create this map was compiled from a variety sources and dates. The TRCA takes no responsibility for errors or omissions in the data and retains the right to make changes and corrections at anytime without notice. For further information about the data on this map, please contact the TRCA GIS Department. (416) 661-6600.

**Carruthers Creek Watershed Plan: Future Scenarios 1-3**

0 0.5 1 2 3 KM

- Municipal Boundary
- Watercourse

**Land Use**

- Natural
- Rural
- Urban
- Flood Vulnerable Cluster
- Greenbelt Boundary
- Carruthers Creek Watershed Boundary
- Carruthers Creek Watershed Plan Study Area

## 4.3 SCENARIO ANALYSIS

As part of this watershed planning process, key components of watershed health were assessed using the previously discussed three future scenarios.

The results of these scenario analyses were used to:

1. Understand the implications of each scenario on overall watershed health and integrity.

2. Develop the management framework for this Carruthers Creek Watershed Plan, which can be used to inform land use and infrastructure decisions.

It is important to note that scenario analysis does not result in decisions about the type and configuration of land uses. Instead, scenario analysis helps to inform decisions through the municipal planning process (e.g. Official Plans).

It is the responsibility of the applicable municipality to determine the ultimate land use configuration for any future changes within the watershed.

Appropriate mitigation strategies are developed during the detailed planning stages for new developments once the scope of any future land use change is known. These mitigation strategies include assessments of the appropriate levels of stormwater controls, the use of green infrastructure to maintain natural water balance as much as possible, and opportunities for ecological restoration.

**Table 4** explains the implications of the three potential future scenarios for each of the key watershed issues as identified in **Subsection 3.3**. Based on the technical assessments completed as part of this watershed planning process, **Table 4** identifies whether the watershed responds positively (conditions improve), neutrally (conditions remain the same), or negatively (conditions deteriorate) to the potential future scenario in comparison to the identified benchmark.

The colour coding in **Table 4** indicates the severity of how the watershed component reacts:

**GREEN UP ARROW: >+5% change**
indicates watershed conditions improve from a hydrologic or ecological perspective

**EQUAL SIGN: 0 to +5% or 0 to -5% change**
indicates a roughly equal comparison from a hydrologic or ecological perspective

**YELLOW DOWN ARROW: -6% to -10% change**
indicates watershed conditions deteriorate from a hydrologic or ecological perspective

**PURPLE DOWN ARROW: >-10% change**
indicates watershed conditions significantly deteriorate from a hydrologic or ecological perspective

The changes identified in **Table 4** are calculated by comparing scenario 1 to the current conditions, whereas scenarios 2 and 3 are compared to scenario 1. Since scenario 1 represents the currently approved Official Plan, it represents a future scenario that will occur, therefore it is more realistic to compare scenarios 2 and 3 to scenario 1. Some of the scenario analysis technical reports referenced in **Section 9** compare the three future scenarios to current conditions. The numbers identified in **Table 4** have been adapted accordingly to compare scenarios 2 and 3 to scenario 1.

**TABLE 4:**
Scenario Analysis Implications

## WATER RESOURCE SYSTEM

**Includes:** the features and areas of the WRS, including aquatic habitat, and their functions. Percent change is based on changes to impervious cover mentioned under aquatic health. Impervious cover is a critical measure of various factors[11] that impact aquatic health.

See **Figure 9** in **Section 7** for an illustration of subwatershed quality.

| CURRENT CONDITIONS (From subsection 3.3[12]) | SCENARIO 1 (+OP) (Compared to Current Conditions) | SCENARIO 2 (+NHS) (Compared to Scenario 1) | SCENARIO 3 (+POTENTIAL URBAN) (Compared to Scenario 1) |
|---|---|---|---|
| % change → | ↓ -6% | = +1% | ↓ -12% |
| **Aquatic Health** | | | |
| **Subwatershed quality:** NW and NE good – fair; central and south fair – poor<br><br>Impervious cover at 24% across the watershed | **Subwatershed quality:** no change from current conditions<br><br>Impervious cover at 30% across the watershed | **Subwatershed quality:** NW shows improvement to good<br><br>Impervious cover at 29% across the watershed | **Subwatershed quality:** all four have fair – poor conditions<br><br>Impervious cover at 42% across the watershed |
| **Riparian corridor (30 m buffer along streams)** | | | |
| 49% natural cover along the corridor | 50% natural cover along the corridor | 65% natural cover along the corridor | 65% natural cover along the corridor |
| **Streamflow (average surface water discharge)** | | | |
| 0.52 $m^3/s$ | 0.53 $m^3/s$ | 0.53 $m^3/s$ | 0.56 $m^3/s$ |
| **Groundwater discharge (average rate)** | | | |
| 201 mm/year | 197 mm/year | 201 mm/year | 194 mm/year |
| **Groundwater recharge (average rate)** | | | |
| 152 mm/year | 147 mm/year | 152 mm/year | 141 mm/year |

[11]These factors include channel stability, water quality, stream biodiversity, and natural flow. See the Aquatic Impact Assessment technical report for more information.

[12]The numbers for streamflow, groundwater discharge, and recharge are different in **Table 4** from **Table 2** due to models used for the scenario analysis.

## NATURAL HERITAGE SYSTEM

**Includes:** the the features and areas of the NHS, including terrestrial habitat and their functions. Percent change is based on an equally weighted average of the total natural cover and habitat quality values.

| CURRENT CONDITIONS (From subsection 3.3) | SCENARIO 1 (+OP) (Compared to Current Conditions) | SCENARIO 2 (+NHS) (Compared to Scenario 1) | SCENARIO 3 (+POTENTIAL URBAN) (Compared to Scenario 1) |
|---|---|---|---|
| % change → | = 0% | ↑ +7% | ↑[13] +6% |
| **Total natural cover** | | | |
| 25% natural cover | 25% natural cover | 36% natural cover | 36% natural cover |
| **Habitat quality (average LAM[14] score)** | | | |
| 7.6 | 7.5 | 7.9 | 7.6 |
| **Habitat connectivity (regional at watershed-scale)[15]** | | | |
| 28% | 28% | 45% | 45% |
| **Climate vulnerabilities (average of five high vulnerabilities indicators)[16]** | | | |
| 51% | 51% | 55% | 55% |

[13]While habitat quantity (as represented by natural cover) increases under scenario 3 relative to scenario 1, the habitat quality results require a caveat. LAM scores are an equally rated average of patch size, shape, and matrix influence. Under scenario 2, the matrix influence score increases threefold from scenario 1, indicating improved habitat quality. Under scenario 3, the matrix influence score decreases, indicating decrease in habitat quality. So, while patch size and shape increase under scenarios 2 and 3, scenario 3 negatively affects the matrix influence of habitat quality.

[14]These LAM scores, known as Landscape Analysis Model, combines the metrics of patch size (larger patches support larger populations), patch shape (habitat fragmentation) and matrix influence (influence of surrounding land uses). A LAM score of 6 – 8 = poor. See the Terrestrial Impact Assessment technical report for more information.

[15]Habitat connectivity values represent the percentage of area for connectivity priorities that overlap with the proposed enhanced NHS. Improved connectivity has benefits for habitat quantity and quality. In other words, higher percentages indicate more habitat connectivity corridors.

[16]The average high vulnerability indicators are ground surface temperature, climate sensitive community, habitat patch quality, soil drainage, and wetlands. The climate vulnerabilities values represent the percentage of climate vulnerable features represented in the proposed enhanced NHS. A higher percentage indicates more habitat included in the system, and therefore, if protected, improved resiliency to climate change.

## WATER QUALITY[17]

Focused on parameters of concern associated with urbanization and agricultural land uses. Amounts are based on a comparison of 2005 to 2015 average flow.

| CURRENT CONDITIONS (From subsection 3.3) | SCENARIO 1 (+OP) (Compared to Current Conditions) | SCENARIO 2 (+NHS) (Compared to Scenario 1) | SCENARIO 3 (+POTENTIAL URBAN) (Compared to Scenario 1) |
|---|---|---|---|
| % change → | It is difficult to draw a conclusion on the percent change for water quality solely. As mentioned in the WRS row of this table, water quality is one of the factors considered under the impacts of impervious cover. Of the parameters of concern identified in Table 2, TSS and total phosphorus were assessed as part of scenario analysis. | | |
| **Total Suspended Solids[18]** | | | |
| 4,602 tonnes | 4,674 tonnes | 4,641 tonnes | 4,939 tonnes |
| **Total Phosphorus[19]** | | | |
| 9,843 tonnes | 9,864 tonnes | 9,295 tonnes | 8,602 tonnes |

[17]Stream water quality in urbanized watersheds is generally degraded by increased turbidity, nutrients, metals, *E. coli*, and other contaminants due to more impervious surfaces and increased runoff. See the Aquatic Impact Assessment technical report for more information.

[18]**Table 2** in **Subsection 3.3** identified TSS readings at three monitoring stations in mg/L. For the purposes of scenario analysis, TSS was measured in tonnes at the outlet of the watershed (i.e. where it drains into Lake Ontario).

[19]**Table 2** in **Subsection 3.3** identified total phosphorus readings at three monitoring stations in mg/L. For the purposes of scenario analysis, total phosphorus was measured in tonnes at the outlet of the watershed (i.e. where it drains into Lake Ontario).

## NATURAL HAZARDS
(Flooding and Erosion)

Focused on flood modelling as measured by peak flows[20]. Percent change is based on the Regional Storm (i.e. Hurricane Hazel) at two points in the watershed. The Regional Storm for TRCA's jurisdiction is based on a historical storm of record, Hurricane Hazel. Design storms are based on statistical analysis of rainfall over a period of record. Hurricane Hazel is a 12-hour event with 212 mm of rainfall, which assumes completely saturated soils.

| CURRENT CONDITIONS (From subsection 3.3) | SCENARIO 1 (+OP) (Compared to Current Conditions) | SCENARIO 2 (+NHS) (Compared to Scenario 1) | SCENARIO 3 (+POTENTIAL URBAN)[21] (Compared to Scenario 1) |
|---|---|---|---|
| % change at Taunton Road → | = +2% | = +2% | ↓ -113% |
| % change at Shoal Point Road | ↓ -6% | = +2% | ↓ -41% |
| **Regional Storm (i.e. Hurricane Hazel)** | | | |
| 71.61 $m^3/s$ at Taunton Road | 69.90 $m^3/s$ at Taunton Road | 68.59 $m^3/s$ at Taunton Road | 148.84 $m^3/s$ at Taunton Road |
| 140.52 $m^3/s$ at Shoal Point Road | 149.50 $m^3/s$ at Shoal Point Road | 147.19 $m^3/s$ at Shoal Point Road | 210.63 $m^3/s$ at Shoal Point Road |
| **5-year Storm (i.e. 1 in 5 probability of flow being exceeded in any one year)[22]** | | | |
| 7.27 $m^3/s$ at Taunton Road | 7.18 $m^3/s$ at Taunton Road | 6.58 $m^3/s$ at Taunton Road | 6.80 $m^3/s$ at Taunton Road |
| 11.00 $m^3/s$ at Shoal Point Road | 11.71 $m^3/s$ at Shoal Point Road | 11.11 $m^3/s$ at Shoal Point Road | 11.83 $m^3/s$ at Shoal Point Road |

[20]Peak flows are the maximum rate of discharge during the period of runoff caused by a storm. Potential erosion issues were not assessed. However, erosion is likely to be worse with increased peak flows.

[21]All existing stormwater management facilities were removed from the model to account for the system failing or being at capacity during a Regional Storm event.

[22]The 5-year event uses a 60.07 mm rainfall event over a 24-hour period, which assumes an average (normal) soil condition.

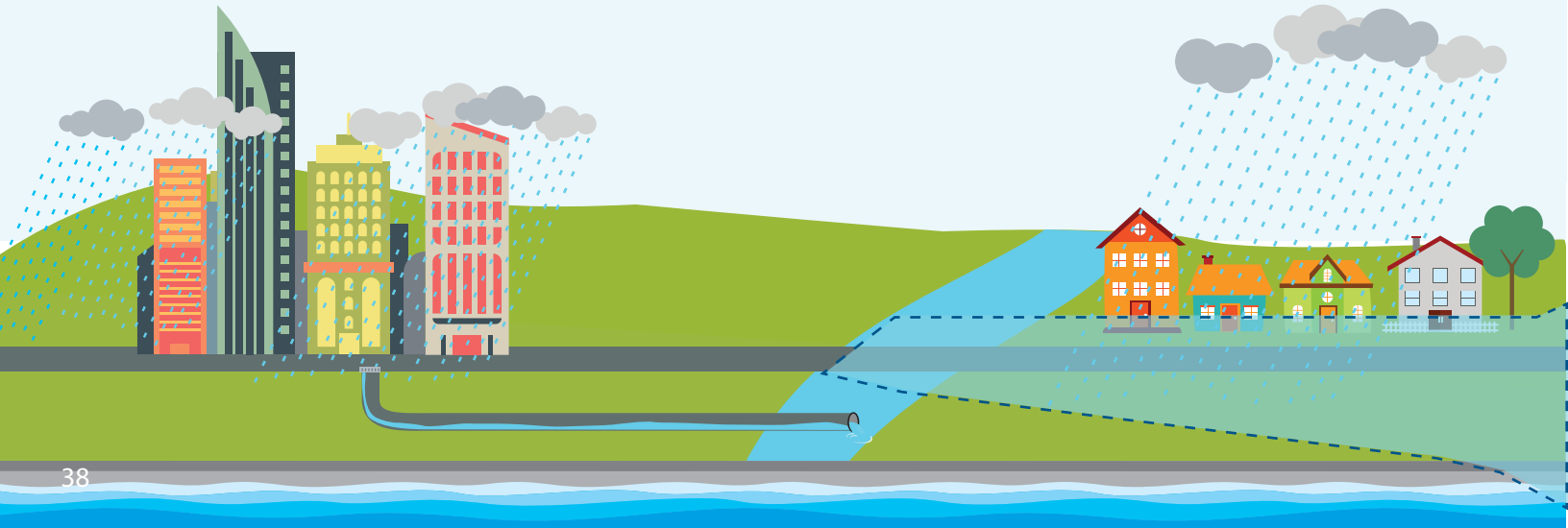


**Table 4** illustrates expected changes to watershed conditions based on available information and assessments conducted as part of this watershed planning process. The management framework in **Section 5** identifies what is necessary to protect, enhance, and restore watershed conditions. It also identifies management recommendations to encourage more sustainable land uses.

## Summary of implications:

| | Scenario 1 | Scenario 2 | Scenario 3 |
|---|---|---|---|
| **WATER RESOURCE SYSTEM** | Aquatic conditions remain relatively poor, similar to existing conditions, and there is an increase in impervious cover across the watershed. | One of the four subwatersheds shows improved aquatic conditions. | All four subwatersheds have fair-poor aquatic conditions, likely resulting in the loss of Redside Dace, a listed endangered species. |
| **NATURAL HERITAGE SYSTEM** | Natural cover and habitat quality remain similar to current conditions. | Natural cover increases and habitat quality improves. | Natural cover increases, but habitat quality does not improve by as much as scenario 2. |
| **WATER QUALITY** | Slight increases in both total suspended solids and total phosphorus. | Total phosphorus and total suspended solids decrease. | Total suspended solids increase, total phosphorus decreases. |
| **NATURAL HAZARDS** | Peak flows do not significantly change from current conditions (i.e. increases and decreases at Taunton and Shoal Point Roads under the Regional and 5-year storm events). | Peak flows decrease slightly at Taunton and Shoal Point Roads under the Regional and 5-year storm events. | Peak flows significantly increase at Taunton and Shoal Point Roads under the Regional and 5-year storms; more so for the former. |

## What does this mean?

These results demonstrate the importance of ensuring that land use and infrastructure planning decisions are made to minimize and mitigate impacts to the watershed regardless of potential future land use configurations. The management framework in Section 5 outlines the goals, objectives, indicators, and management recommendations necessary to ensure the long-term health and sustainability of the watershed.

The results of this scenario analysis emphasize the importance of protecting, enhancing, and restoring the WRS (**Subsection 5.2**) and NHS (**Subsection 5.3**).

In addition to the summary of implications, it is important to recognize the following:

- Limiting impervious cover in any potential future growth areas, or through redevelopments, provides significant benefits to aquatic biodiversity. Federal guidance recommends urbanizing watersheds maintain less than 10% impervious land cover, while already degraded urban systems should not exceed a second threshold of 25% to 30%. Scenario 1 shows impervious cover reaching this 30% threshold with only a marginal improvement to 29% under Scenario 2. See **Figure 9** in **Section 7** for more information.
- Increasing natural cover and improving habitat quality has noticeable benefits for the watershed (e.g. improvements to aquatic conditions and slight reductions of peak flows).
- Ecological restoration and improvements to land use practices (e.g. increased use of green infrastructure and improved stormwater management) could address existing water quality issues.
- The existing flooding and erosions issues can be mitigated through improved land uses (e.g. green infrastructure) and infrastructure (e.g. stormwater management) as outlined in the management recommendations of **Subsection 5.1**. In the event of future development in the headwaters of Carruthers Creek, it will be vital to develop mitigation strategies to limit the impacts of further urbanization by implementing the management recommendations outlined in **Subsection 5.4**.

The management framework is designed to address existing issues and the implications of these scenarios by accounting for new developments, redevelopments, and prioritizing the importance of protecting, enhancing, and restoring both the WRS and NHS.


# 5. Management Framework

The management framework for the Carruthers Creek Watershed Plan represents what needs to be done to protect, enhance, and restore watershed health[23]. The management framework consists of goals, objectives, indicators, and management recommendations.

TRCA developed this management framework in collaboration with its municipal partners and refined it based on feedback from stakeholders and the public.

The goals, objectives, and management recommendations were developed to address the issues identified through watershed characterization and account for potential different future land use scenarios. Many of the management recommendations are expected to mitigate many of the potential impacts associated with potential land use changes, as identified through the scenario analysis.

Each of the goals are complementary, with no one goal being more important than another. To fully realize the vision for Carruthers Creek will require the implementation of each goal area. Management recommendations were grouped under the most appropriate objective and are also listed in no particular order.

Any recommendations contained in the scenario analysis technical reports are consolidated in this management framework. Refer to the technical reports for detailed methodologies and findings beyond what was summarized in **Sections 3** and **4**. This watershed plan is the final source for goals, objectives, indicators, and management recommendations related to Carruthers Creek. Readers are encouraged to refer to the technical reports for more detailed implementation suggestions.

[23]As mentioned in **Subsection 1.1**, the CTC Source Protection Plan also applies in the Carruthers Creek watershed and includes policies to protect drinking water. Implementation of this Source Protection Plan is required under the *Clean Water Act, 2006*. Consideration of Great Lakes agreements and legislation is also important for effective watershed management. These requirements are in addition to, and complementary of, the management framework identified in this watershed plan.

**TABLE 5:**
Management Framework Explanation

| Management Framework Components | Description |
|---|---|
| **GOALS** | Represent the outcomes to achieve. |
| **OBJECTIVES** | Are the specific statements about desired results, or steps to be undertaken, to achieve the goal. |
| **INDICATORS** | Explain how progress on implementing the objective is going to be tracked or measured. Some indicators are compared to the benchmarks identified in **Table 2**. Other indicators are about reporting on implementation progress as it relates to policies, best practices, or infrastructure improvements and do not have an associated benchmark in **Table 2**. Where applicable, the guidelines identified in **Table 2** can be used as a measure to achieve. |
| **MANAGEMENT RECOMMENDATIONS** | Specifically explain what should be done to accomplish the relevant objective. |

The management framework consists of three goals, nine objectives, and 11 indicators (see **Figure 6**). The management recommendations for each goal area are described in **Subsections 5.1 – 5.3**.

The management recommendations apply to the entire watershed, identifying opportunities to improve conditions in the developed portion of the watershed and the types of studies and best practices that should be utilized for any potential future development, or redevelopment. **Subsection 5.4** summarizes recommendations that would specifically apply to any potential Settlement Area Boundary Expansion in the headwaters of Carruthers Creek.

**FIGURE 6:**
**Overview of Management Framework**

## GOAL 1

### Land Use

Achieve sustainable land use and infrastructure development patterns to protect, enhance, and restore water quality and maintain stable water balance.

**OBJECTIVE 1**
Minimize the impacts of land uses through sustainability policies and the use of low impact development and green infrastructure.

**Indicators:**
Report on implementation of sustainable development policies/standards.

**OBJECTIVE 2**
Install and upgrade stormwater infrastructure using best available technologies to reduce runoff; resulting in improved water balance and water quality.

**Indicators:**
Report on the status of stormwater management.

**OBJECTIVE 3**
Manage the risks of natural hazards through appropriate mitigation measures and restoration.

**Indicators:**
Reduce number of flood vulnerable structures and roads.

**OBJECTIVE 4**
Encourage the use of agricultural best management practices to minimize agricultural runoff and improve rural land stewardship.

**Indicators:**
Work with the agricultural community to track implementation of best management practices.

## GOAL 2

### Water Resource System

Protect, enhance, and restore the areas and features that make up the Water Resource System (including aquatic habitat) for ecosytem resilience and sustainabilty.

**OBJECTIVE 1**
Implement appropriate policies and programs that protect, enhance, and restore the areas and features that comprise the Water Resource System.

**Indicator:**
Appropriate policy designations are in place for the Water Resourse System.

**OBJECTIVE 2**
Promote aquatic habitat connectivity to faciltate native fish movement throughout the watershed.

**Indicator:**
Maintain, or improve, aquatic health rankings.

## GOAL 3

### Natural Heritage System

Protect, enhance, and restore the Natural Heritage System and urban forest within the watershed to improve ecosystem resilience and sustainability.

**OBJECTIVE 1**
Improve the quality and quantity of the Natural Heritage System across the watershed through ecosystem protection, enhancement, and restoration, and implementation of relevant policies.

**Indicators:**
Increase total natural cover in the watershed.

Appropriate policy designations are in place for the Natural Heritage System.

**OBJECTIVE 2**
Ensure habitat exists for native terrestrial species to thrive throughout the watershed.

**Indicators:**
Maintain, or increase, the number and area of species and vegetation communities of concern.

**OBJECTIVE 3**
Increase the urban forest cover within the developed portion of the watershed to improve social and environmental well-being.

**Indicator:**
Increase total tree canopy in the watershed.

## 5.1 LAND USE / INFRASTRUCTURE GOAL

### GOAL 1

**Achieve sustainable land use and infrastructure development patterns to protect, enhance, and restore water quality and maintain stable water balance.**

This goal area focuses on the policy, land use, and infrastructure planning processes that influence the health of the watershed. The management recommendations are numbered to correspond with their applicable goal and objective.

**TABLE 6:**
Land Use Management Recommendations

| Land Use Objective | Management Recommendations |
|---|---|
| **LAND USE OBJECTIVE 1**<br><br>Minimize the impacts of land uses through sustainability policies and the use of low impact development and green infrastructure. | **1.1.1**<br>Lower-tier municipalities, in collaboration with the Region of Durham and TRCA, to adopt green development policies, or standards, and require new developments, and redevelopments, to utilize low impact development and green infrastructure techniques to limit the impacts of increased impervious cover. The following shall apply to any municipal policies, or standards, in particular within ESGRAs, as identified on **Map 1B**<br>a. new developments shall minimize impervious cover and strive to achieve 90$^{th}$ percentile volume control of annual rainfall<br>b. redevelopments shall minimize impervious cover and strive to achieve 75$^{th}$ percentile volume control of annual rainfall |
| | **1.1.2**<br>The Region of Durham and lower-tier municipalities, in collaboration with TRCA, to develop mechanisms to track and report on implementation of sustainable development practices to assess the effectiveness of policies and standards. |
| | **1.1.3**<br>If it is determined that a Settlement Area Boundary Expansion is required in the headwaters of Carruthers Creek, the Region of Durham, in collaboration with the lower-tier municipalities and TRCA, will identify, based on consensus between the identified parties, the subsequent planning processes and further studies and assessments, that would be required to implement any such expansion. These requirements should be reflected as policies within the Regional Official Plan and include the requirement for the preparation of a secondary plan and a subwatershed plan (or equivalent), which would be supported by, at a minimum, the following studies, assessments, and further considerations:<br>a. a hydraulic assessment<br>b. how natural hazards will be assessed and mitigated (i.e. the risk of flooding and erosion will not increase)<br>c. how the Natural Heritage System and Water Resource System will be protected, enhanced, and restored<br>d. how water quality and quantity will be protected<br>e. how flood mitigation solutions will be funded, including identification of the responsible parties for providing the funding. This includes the cost of any necessary studies, engineering design, and actual construction/maintenance of flood mitigation works |

| Land Use Objective | Management Recommendations |
|---|---|
| **LAND USE OBJECTIVE 1**<br><br>cont'd | **1.1.4**<br>During planning for transportation infrastructure improvement projects, or new projects, the Region of Durham and lower-tier municipalities to implement best management practices for design, expansions and widenings in accordance with TRCA's *Crossing Guideline for Valley and Stream Corridors*, and ensure consistent policies and standards are in place to facilitate hydraulic function (e.g. prevent flooding) and ecological connectivity (e.g. wildlife passage). See **Map 3** for priority crossings. |
| | **1.1.5**<br>Lower-tier municipalities to improve the management of excess soils and prevent fill deposition that is incompatible with the soils and hydrology of the area by:<br>a. ensuring adequate policies and bylaws are in place to manage excess soil<br>b. improving compliance and enforcement of policies through collaboration between TRCA and municipalities<br>c. conducting education and outreach on:<br>i. the importance of proper soil management<br>ii. existing regulatory requirements<br>iii. regulatory responsibilities of various agencies, including who to contact with concerns<br>d. collaborating with agencies and other levels of government, including the Region of Durham, to ensure infrastructure projects that generate, or receive excess soil follow best management practices |
| | **1.1.6**<br>The Region of Durham and lower-tier municipalities, in collaboration with other levels of government and TRCA, to work to reduce the amount of chlorides entering the watershed by:<br>a. continuing to implement best management practices for winter de-icing procedures on public property<br>b. continuing education and outreach on salt management for private property |
| | **1.1.7**<br>TRCA, in collaboration with the Town of Ajax, to identify and promote opportunities for sustainable community retrofits in priority planting neighbourhoods (See **Map 8**). |

| Land Use Objective | Management Recommendations |
|---|---|
| **LAND USE OBJECTIVE 2**<br><br>Install and upgrade stormwater infrastructure using best available technologies to reduce runoff; resulting in improved water balance and water quality. | **1.2.1**<br>Lower-tier municipalities, in collaboration with the Region of Durham and TRCA, through stormwater master planning continue to:<br>a. employ best management practices for stormwater management and consistent design criteria to manage runoff quantity and quality<br>b. consider stormwater funding options for cost recovery and to reduce impervious surfaces in the watershed<br>c. examine opportunities to retrofit outdated stormwater infrastructure and install stormwater controls in areas without controls through long-term planning and investment strategies<br>d. refine existing policies to ensure modern stormwater controls are required<br>e. adaptively manage stormwater infrastructure through operation maintenance schedules and procedures |
| | **1.2.2**<br>Lower-tier municipalities, in collaboration with the Region of Durham and TRCA, to develop mechanisms to track the status and effectiveness of stormwater management infrastructure. |
| | **1.2.3**<br>Lower-tier municipalities to explore opportunities to enhance stormwater management in neighbourhoods with outdated or no stormwater facilities by retrofitting infrastructure to meet modern stormwater design criteria, as much as possible, given site characteristics. |
| | **1.2.4**<br>For new developments, lower-tier municipalities to require hydrologic analysis and erosion threshold assessments downstream of potential stormwater management facilities that need to demonstrate no negative, or adverse, downstream impacts, prior to municipal approvals. |
| **LAND USE OBJECTIVE 3**<br><br>Manage the risks of natural hazards through appropriate mitigation measures and restoration. | **1.3.1**<br>TRCA, in collaboration with lower-tier municipalities, to prioritize the restoration of the erosion hazard sites identified on **Map 4**. Additional channel restoration, or increased stream bank protection may be required as preventative measures in areas downstream of new developments. |
| | **1.3.2**<br>The Region of Durham and lower-tier municipalities, in collaboration with TRCA, to identify potential hazard risks to sewer and existing road infrastructure associated with in-stream creek erosion and implement strategies to eliminate identified risks. |

| Land Use Objective | Management Recommendations |
|---|---|
| **LAND USE OBJECTIVE 3**<br><br>cont'd | **1.3.3**<br>Implement appropriate flood mitigation measures for the Flood Vulnerable Cluster in the Town of Ajax, which could involve:<br>a. reopening, or initiating, a new environmental assessment to provide a more comprehensive list of alternatives to offset impacts associated with potential development in the headwaters<br>b. the application of regional control in the headwaters of Carruthers Creek, if developed, and required by the updated flood modelling (see management recommendation 1.3.5) |
| | **1.3.4**<br>TRCA, in collaboration with the Region of Durham and lower-tier municipalities, to educate property owners in high flood risk areas about proper lot level practices (e.g. removing hydraulic impairments). |
| | **1.3.5**<br>TRCA will continue to complete comprehensive flood plain mapping based on routinely updated hydraulic models and updated land use information to inform municipal planning decisions. Regulatory flood plain mapping is updated based on approved land uses. |
| **LAND USE OBJECTIVE 4**<br><br>Encourage the use of agricultural best management practices to minimize agricultural runoff and improve rural land stewardship. | **1.4.1**<br>In collaboration with the agricultural community and provincial ministries, TRCA, the Region of Durham and lower-tier municipalities to identify opportunities to expand best management practices that reduce agricultural runoff and improve water management, such as:<br>a. use cover crops and / or leave crop residue<br>b. adopt no till farm practices during non-growing season<br>c. conduct soil testing for nutrients and adjust fertilizer application rates, if required |
| | **1.4.2**<br>In collaboration with the agricultural community, rural land owners, and provincial ministries, TRCA, the Region of Durham, and lower-tier municipalities to identify opportunities to improve rural land stewardship best management practices through:<br>a. natural buffers between agricultural lands and natural and / or water resource features and areas<br>b. implementation of Environmental Farm Plans and other rural land stewardship programs (e.g. TRCA's Rural Clean Water Programs)<br>c. education / outreach about the benefits of utilizing best management practices to improve habitat (e.g. meadows for sensitive bird species) |

## 5.2 WATER RESOURCE SYSTEM GOAL

### GOAL 2

**Protect, enhance, and restore the areas and features that make up the Water Resource System (including aquatic habitat) for ecosystem resilience and sustainability.**

This goal area focuses on ensuring policies are in place for the long-term protection of the WRS and undertaking priority restoration initiatives to benefit the long-term resiliency of the WRS. The WRS is presented in **Map 1A** and **Map 1B**. The areas and features that comprise the WRS are to be protected in accordance with the recommendations laid out in this subsection.

**TABLE 7:**
WRS Management Recommendations

| WRS Objective | Management Recommendations |
|---|---|
| **WRS OBJECTIVE 1**<br><br>Implement appropriate policies and programs that protect, enhance, and restore the areas and features that comprise the Water Resource System. | **2.1.1**<br>The Region of Durham and lower-tier municipalities, in collaboration with TRCA, to ensure the protection of the Water Resource System (**Map 1A** and **Map 1B**) and its functions, by:<br>a. updating Official Plans and zoning bylaws to protect the Water Resource System<br>b. assessing existing standards and guidelines for land use and infrastructure development to ensure they reflect current provincial policy direction to protect, enhance, and restore the quality and quantity of water<br>c. avoiding development near key hydrologic features through the establishment of appropriate buffers<br>d. requiring the implementation of appropriate mitigation measures where avoidance of key hydrologic areas is not possible, in order to maintain hydrologic functions |
| | **2.1.2**<br>TRCA, in collaboration with the Region of Durham and lower-tier municipalities, to routinely update mapping data layers for all components of the Water Resource System as new information becomes available. |

| WRS Objective | Management Recommendations |
|---|---|
| **WRS OBJECTIVE 1**<br><br>cont'd | **2.1.3**<br>TRCA, in collaboration with the Region of Durham and lower-tier municipalities, to prioritize the restoration of the aquatic sites identified on **Map 4**, which have been selected for contributing to the following:<br>a. enhancing habitat quality and watershed connectivity<br>b. ensuring biodiversity persists<br>c. improving watershed resiliency to climate change |
| | **2.1.4**<br>If it is determined that a Settlement Area Boundary Expansion is required in the headwaters of Carruthers Creek, the City of Pickering, in collaboration with the Region of Durham, Town of Ajax, and TRCA, prior to approvals of a secondary plan, to demonstrate through a subwatershed plan (or equivalent) that:<br>a. key hydrologic features will be protected and hydrologic functions maintained<br>b. where avoidance of key hydrologic areas is not possible, appropriate mitigation measures are to be implemented to maintain downstream hydrologic functions<br>c. there will be no negative or adverse downstream effects, such as increased flooding, erosion, or deteriorated water quality through a hydraulic analysis (to quantify and map depth and extent of impacts) and other relevant modelling |
| **WRS OBJECTIVE 2**<br><br>Promote aquatic habitat connectivity to facilitate native fish movement throughout the watershed. | **2.2.1**<br>TRCA, in collaboration with the Region of Durham and lower-tier municipalities and landowners, to remove the six priority barriers to fish movement identified in **Map 5** |
| | **2.2.2**<br>TRCA, through its application review function, to identify and implement avoidance, conservation, design, and mitigation measures for the protection and / or recovery of native aquatic species, including Redside Dace and its habitat. For activities that affect Redside Dace habitat, consult the *Guidance for Development Activities in Redside Dace Protected Habitat* (MNRF 2016), MECP and DFO to determine requirements under species at risk legislation. |

## 5.3 NATURAL HERITAGE SYSTEM GOAL

### GOAL 3

**Protect, enhance, and restore the Natural Heritage System and urban forest within the watershed to improve ecosystem resilience and sustainability.**

This goal area focuses on improving the quality and quantity of natural systems throughout the watershed. The proposed enhanced NHS identified on **Map 2** is recommended by TRCA to achieve this goal. It will be up to municipalities to adopt a NHS that is consistent with provincial policy and informed by the goals and objectives of the CCWP. The proposed enhanced NHS includes areas with existing natural cover and areas that are targeted to be potential natural cover through restoration. Refinements to the recommended NHS may be considered assuming the scientific analysis is consistent with the goals and objectives of the CCWP. The recommended NHS is designed to move towards the minimum target for natural cover in an urban and urbanizing watershed as established in TRCA's *Terrestrial Natural Heritage System Strategy* (2007) and *How Much Habitat is Enough?* (Environment and Climate Change Canada, 2013). Assuming that the identified potential natural cover areas are restored, the recommended NHS achieves approximately 36% natural cover across the watershed, including approximately 25% forests and successional forests and 7% wetlands, consistent with the minimum targets. A large amount of the land recommended for potential natural cover occurs in the headwaters of Carruthers Creek. If development proceeds in this area, it will be essential to restore and protect (i.e. through securement) an amount of land consistent with the recommended NHS.

To appropriately implement a NHS will require updates to municipal Official Plans, which can then guide future land use decisions to avoid development in the municipally adopted NHS, mitigate any impacts or, where impacts are unavoidable, provide ecosystem compensation. The management recommendations related to the NHS in this subsection are consistent with TRCA's protection hierarchy of avoid, minimize, mitigate, and as a last resort compensate.

Urban forests provide valuable terrestrial habitat, help manage stormwater, provide clean air, and other socio-economic benefits (e.g. regulates local temperatures, improves personal well-being). Including urban forestry under this NHS goal recognizes the integrated nature of natural areas (i.e. NHS) and the ecological value of additional natural cover in parks, on streets, or private property (i.e. urban forests).

**TABLE 8:**
NHS Management Recommendations

| NHS Objective | Management Recommendations |
|---|---|
| **NHS OBJECTIVE 1**<br><br>Improve the quality and quantity of the Natural Heritage System across the watershed through ecosystem protection, enhancement, and restoration, and implementation of relevant policies. | **3.1.1**<br>The Region of Durham, as part of its Municipal Comprehensive Review, to ensure the protection, enhancement, and restoration of a Natural Heritage System consistent with the goals and objectives of this watershed plan (**Map 2** for recommended NHS) by:<br>a. including existing natural cover areas identified in **Map 2** in the Regional Official Plan<br>b. providing direction to lower-tier municipalities to include policies in their Official Plans to protect, enhance and restore existing natural cover areas as identified in **Map 2**<br>c. recognizing the potential natural cover areas identified in **Map 2** in the Regional Official Plan and providing direction to lower-tier municipalities to include any relevant policies in their Official Plans to enhance and restore potential natural cover areas<br>d. avoiding infrastructure development (i.e. buildings and structures) and minimizing infrastructure linear feature crossings, in a municipally designated enhanced Natural Heritage System<br>e. providing direction to lower-tier municipalities on the establishment of minimum vegetation protection zones along natural heritage features, with the ability of the minimum vegetation protection zone to be confirmed through an appropriate environmental study |
| | **3.1.2**<br>Lower-tier municipalities, in collaboration with TRCA, to ensure the protection, enhancement, and restoration of a Natural Heritage System consistent with the goals and objectives of this watershed plan (**Map 2**), including the target of achieving 36% natural cover across the watershed, by:<br>a. designating in their Official Plans, at a minimum, existing natural cover as identified in **Map 2**<br>b. including policies in their Official Plans to identify enhancement and restoration opportunities for potential natural cover areas as identified in **Map 2**<br>c. assessing existing standards and guidelines for land use and infrastructure development to ensure they reflect current provincial policy direction to maintain, restore, or enhance the municipally designated Natural Heritage System |

| NHS Objective | Management Recommendations |
|---|---|
| **NHS OBJECTIVE 1**<br><br>cont'd | **3.1.2 (cont'd)**<br>d. avoiding infrastructure development (i.e. buildings and structures) and minimizing infrastructure linear feature crossings, in a municipally designated enhanced Natural Heritage System<br>e. adopting municipal policies for ecosystem compensation that meet or exceed TRCA's *Guideline for Determining Ecosystem Compensation*, where development in a municipally designated enhanced Natural Heritage System is unavoidable<br>f. applying a minimum vegetation protection zone along natural heritage features at the boundary of a municipally designated enhanced Natural Heritage System. A minimum 30 metre vegetation protection zone is recommended, unless otherwise determined through an appropriate environmental study<br>g. requiring development and site alterations be designed and approved to prevent encroachment into a municipally designated enhanced Natural Heritage System |
| | **3.1.3**<br>TRCA, in collaboration with the Region of Durham and lower-tier municipalities, to prioritize the restoration of the terrestrial sites identified on **Map 4**, which have been selected for contributing to the following:<br>a. increasing habitat quantity<br>b. enhancing habitat quality and connectivity<br>c. ensuring biodiversity persists<br>d. adapting for climate vulnerabilities |
| | **3.1.4**<br>TRCA, in collaboration with the Region of Durham and lower-tier municipalities, to explore opportunities to secure the sites identified on **Map 6** for ecological protection and to increase public land ownership and connectivity along the main channel of Carruthers Creek south of Taunton Road. |

| NHS Objective | Management Recommendations |
|---|---|
| **NHS OBJECTIVE 1**<br><br>cont'd | **3.1.5**<br>TRCA, the Region of Durham and lower-tier municipalities to regularly update their trail guidelines and standards for consistency, and to ensure that any new, or modifications to existing trails, use best practices, such as prioritizing the use of boardwalks in sensitive areas (e.g. wetlands), and implementing methods to ensure trail users stay on marked trails (e.g. signage, barriers to humans and dogs, but not other species, and limited access during breeding season). |
| | **3.1.6**<br>TRCA, in collaboration with the Region of Durham and lower-tier municipalities, to minimize impacts to the municipally designated Natural Heritage System from any active recreation and human activity by:<br>a. ensuring proper trail management and signage<br>b. providing education and outreach on the importance of the municipally designated Natural Heritage System<br>c. promoting community stewardship to maintain and monitor the municipally designated Natural Heritage System for improper trail usage (e.g. off-trail compaction and erosion), illegal dumping and invasive species, while encouraging community restoration programs (e.g. tree plantings) |
| | **3.1.7**<br>Wetland water balance studies that demonstrate how the hydrological function of the wetland is to be protected will be undertaken by the landowner for any potential future growth in the areas identified on **Map 7**, or other areas identified during subwatershed planning, prior to applicable planning approvals. |
| **NHS OBJECTIVE 2**<br><br>Ensure habitat exists for native terrestrial species to thrive throughout the watershed. | **3.2.1**<br>The Region of Durham, lower-tier municipalities, TRCA, landowners, and other agencies will collaborate to manage problematic invasive species. |
| | **3.2.2**<br>TRCA will continue to work with landowners to restore meadow habitat areas in support of open country bird species at risk, in accordance with the terrestrial restoration priorities identified on **Map 4** |

| NHS Objective | Management Recommendations |
|---|---|
| **NHS OBJECTIVE 3**<br><br>Increase the urban forest cover within the developed portion of the watershed to improve social and environmental well-being. | **3.3.1**<br>Lower-tier municipalities, in collaboration with the Region of Durham and TRCA, to update existing urban forest studies and consolidate them into a comprehensive study that:<br>a. accounts for all public and private lands<br>b. develops targets for public and private lands for inclusion in an urban forest strategy<br>c. develops indicators for the quality and quantity of the urban forest for inclusion in an urban forest strategy |
| | **3.3.2**<br>The Region of Durham and lower-tier municipalities, in collaboration with TRCA, to develop a comprehensive urban forest strategy that:<br>a. enhances tree and soil conservation in accordance with *Preserving and Restoring Healthy Soil: Best Practices for Urban Construction* at any new development, or redevelopment, (e.g. Carruthers Creek Business Area), and on regional property (e.g. along Taunton Road) as depicted on **Map 8**<br>b. focuses urban forest tree planting programs in the Town of Ajax as depicted on **Map 8**<br>c. encourages an urban forest with diverse and native (or non-invasive) tree species and class sizes<br>d. ensures consistent policies and bylaws for tree conservation on public and private lands<br>e. explores opportunities to increase the capacity of the Region of Durham to implement an Urban Forest Strategy consistent with this management recommendation<br>f. encourages participation in knowledge-sharing and collaboration through the Regional Public Works Commissioners of Ontario's Urban Forestry Sub-working Group and Ontario's Municipal Arborist and Urban Foresters Association<br>g. includes urban forest targets for existing developed areas and any future development as part of the strategy |

## 5.4 CARRUTHERS CREEK HEADWATERS MANAGEMENT

There are several management recommendations that refer to potential future studies, subwatershed planning, or potential development in the headwaters of Carruthers Creek. The headwaters that could potentially have development in the future are the lands outside of the Greenbelt north of Highway 7. At the moment, these lands are not designated as part of the settlement area of the City of Pickering in their Official Plan, or the Region of Durham's urban area boundary. For any future development to occur, a Settlement Area Boundary Expansion, in compliance with the Growth Plan, would need to occur. The following management recommendations speak to what would be required based on provincial policy and the recommendations in this watershed plan. These management recommendations were already discussed under their relevant goal, but are repeated here as they are specific to the headwaters of Carruthers Creek. Should a decision be made to proceed with a Settlement Area Boundary Expansion, the full suite of management recommendations in **Subsections 5.1 – 5.3** would apply to that area.

**TABLE 9:**
Headwaters Specific Management Recommendations

| | Relevant Management Recommendations | Rationale and Provincial Policy Basis |
|---|---|---|
| **1.1.3** | If it is determined that a Settlement Area Boundary Expansion is required in the headwaters of Carruthers Creek, the Region of Durham, in collaboration with the lower-tier municipalities and TRCA, will identify, based on consensus between the identified parties, the subsequent planning processes and further studies and assessments, that would be required to implement any such expansion. These requirements should be reflected as policies within the Regional Official Plan and include the requirement for the preparation of a secondary plan and a subwatershed plan (or equivalent), which would be supported by, at a minimum, the following studies, assessments, and further considerations:<br>a. a hydraulic assessment<br>b. how natural hazards will be assessed and mitigated (i.e. the risk of flooding and erosion will not increase)<br>c. how the Natural Heritage System and Water Resource System will be protected, enhanced, and restored<br>d. how water quality and quantity will be protected<br>e. how flood mitigation solutions will be funded, including identification of the responsible parties for providing the funding. This includes the cost of any necessary studies, engineering design, and actual construction/maintenance of flood mitigation works | Appropriate scoping of any subwatershed studies for potential future Settlement Area Boundary Expansions will allow those studies to build upon work completed through this watershed planning process in a collaborative fashion.<br><br>Growth Plan policies 2.2.8.3 (d) / (e) and 4.2.1.3 (c). |

| | Relevant Management Recommendations | Rationale and Provincial Policy Basis |
|---|---|---|
| **1.1.4** | During planning for transportation infrastructure improvement projects, or new projects, the Region of Durham and lower-tier municipalities to implement best management practices for design, expansions and widenings in accordance with TRCA's *Crossing Guideline for Valley and Stream Corridors*, and ensure consistent policies and standards are in place to facilitate hydraulic function (e.g. prevent flooding) and ecological connectivity (e.g. wildlife passage). See **Map 3** for priority crossings. | This management recommendation is intended to ensure hydrological and ecological connectivity by improving crossings when new transportation infrastructure is built, or existing infrastructure is upgraded.<br><br>This recommendation will help protect the integrity of the WRS and NHS, consistent with Growth Plan policies 4.2.1 and 4.2.2. |
| **1.2.4** | For new developments, lower-tier municipalities to require hydrologic analysis and erosion threshold assessments downstream of potential stormwater management facilities that need to demonstrate no negative, or adverse, downstream impacts, prior to municipal approvals. | This management recommendation is intended to identify potential changes to the functions of the WRS arising from new development.<br><br>It is consistent with Growth Plan policies related to stormwater management (3.2.7). |
| **1.3.3** | Implement appropriate flood mitigation measures for the Flood Vulnerable Cluster in the Town of Ajax, which could involve:<br>a. reopening, or initiating, a new environmental assessment to provide a more comprehensive list of alternatives to offset impacts associated with potential development in the headwaters<br>b. the application of regional control in the headwaters of Carruthers Creek, if developed and required by updated flood modelling | This management recommendation is in reference to existing flooding issues in the lower part of the Carruthers Creek watershed in the Town of Ajax. The exact nature of the flood mitigation measure will depend on whether development proceeds in the headwaters of Carruthers Creek. |

| | Relevant Management Recommendations | Rationale and Provincial Policy Basis |
|---|---|---|
| **2.1.4** | If it is determined that a Settlement Area Boundary Expansion is required in the headwaters of Carruthers Creek, the City of Pickering, in collaboration with the Region of Durham, Town of Ajax, and TRCA, prior to approvals of a secondary plan, to demonstrate through a subwatershed plan (or equivalent) that:<br>a. key hydrologic features will be protected and hydrologic functions maintained<br>b. where avoidance of key hydrologic areas is not possible, appropriate mitigation measures are to be implemented to maintain downstream hydrologic functions<br>c. there will be no negative or adverse downstream effects, such as increased flooding, erosion, or deteriorated water quality through a hydraulic analysis (to quantify and map depth and extent of impacts) and other relevant modelling | Similarly, to management recommendation 1.1.3, this management recommendation identifies what is necessary to protect the integrity of the WRS and NHS.<br><br>Growth Plan policies 2.2.8.3 (d) / (e), 4.2.1.3 (c), 4.2.2.3, and 4.2.2.6. |
| **3.1.7** | Wetland water balance studies that demonstrate how the hydrological function of the wetland is to be protected will be undertaken by the landowner for any potential future growth in the areas identified in **Map 7**, or other areas identified during subwatershed planning, prior to any planning approvals. | Wetlands are vital features to both the WRS and NHS. Any development in proximity to wetland features should demonstrate the protection of hydrologic functions.<br><br>Growth Plan policies 4.2.1.2, 4.2.1.4, and 4.2.2.3. |

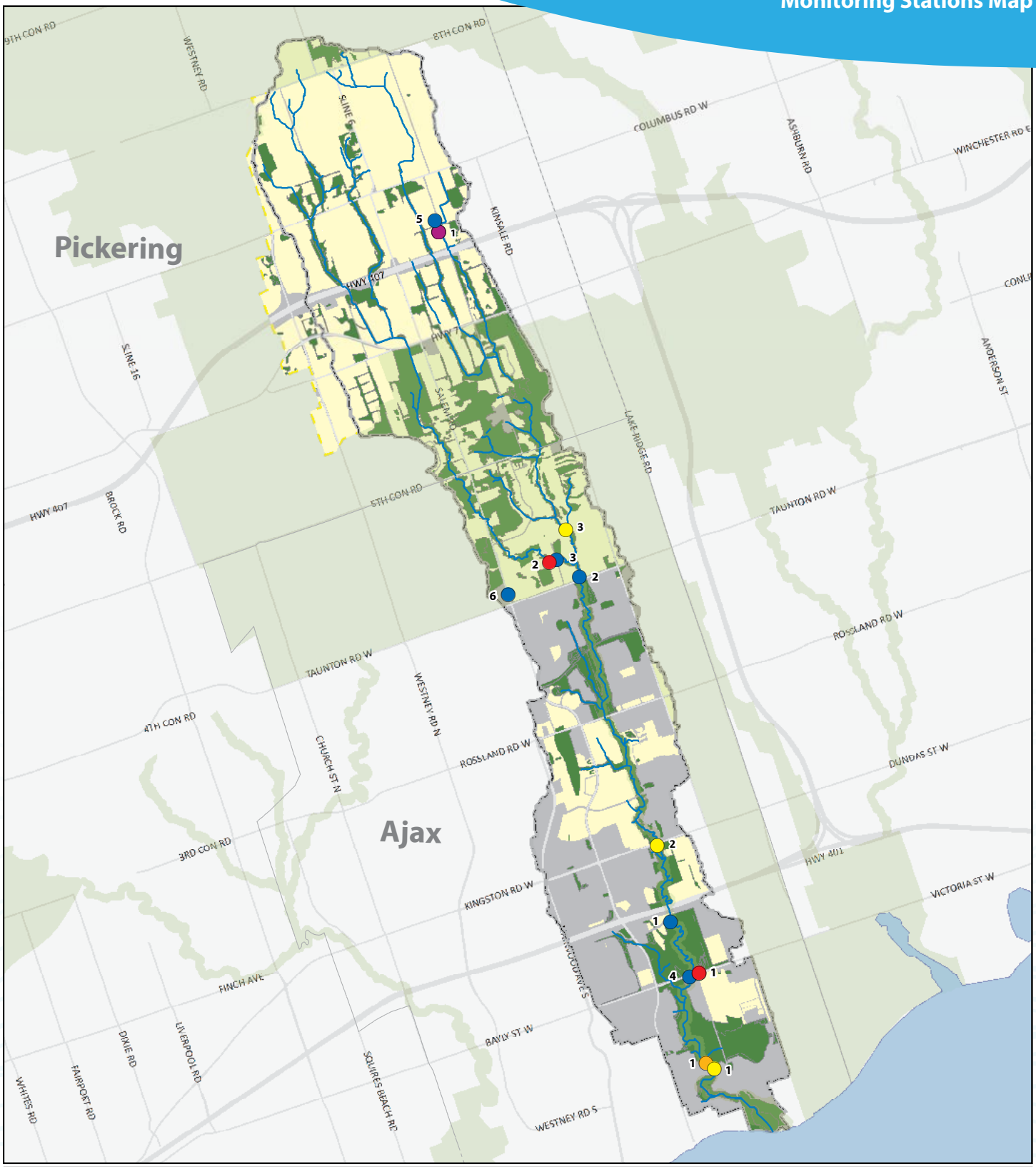
# 6. Monitoring and Evaluation

Monitoring is vital to the successful implementation of this watershed plan. Monitoring will help evaluate trends in watershed conditions and track the implementation of plan objectives. Monitoring will help determine what is working to maintain or improve conditions and what, if necessary, needs to change should conditions deteriorate.

The Carruthers Creek monitoring program is designed to evaluate both watershed health and indicators associated with objectives of this watershed plan. The monitoring stations map (**Figure 7**) identifies monitoring stations by category based on what they monitor. **Table 10** explains the Carruthers Creek monitoring program in detail. The stations identified in the monitoring stations map are cross referenced in the stations column in **Table 10** (e.g. the first station listed in the table is an aquatic station, which is the yellow number 1 on the map).

Additional monitoring stations are likely necessary to adequately track watershed health trends and the identified indicators over time. TRCA, in collaboration with its municipal partners, will identify opportunities to expand watershed monitoring with appropriate resourcing. It will be particularly important to ensure monitoring stations are collecting data in all parts of the watershed. Currently, monitoring stations are limited in the northern part of the watershed. If development occurs in the headwaters of Carruthers Creek, it may be necessary to add additional monitoring stations.

**FIGURE 7:**
**Monitoring Stations Map**

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**Carruthers Creek Watershed Plan: Monitoring Stations**

0 0.5 1 2 3 KM

- Aquatic
- Groundwater
- Terrestrial
- Water Quality
- Water Quantity

- Municipal Boundary
- Watercourse
- Greenbelt Boundary

**Land Use**

- Natural
- Rural
- Urban

- Carruthers Creek Watershed Boundary
- Carruthers Creek Watershed Plan Study

**TABLE 10:**
Carruthers Creek Monitoring Program

| Monitoring Category | Stations | Monitoring Frequency | What is monitored? | Why do we monitor it? |
|---|---|---|---|---|
| **WATER RESOURCE SYSTEM** (aquatic ecosystems) | **ID#: CC001WM** (Yellow #1 on map)<br>**ID#: CC002WM** (Yellow #2 on map)<br>**ID#: CC003WM** (Yellow #3 on map) | Every three years | Fish community, aquatic habitat, and benthic invertebrate community | **Indicator:** Maintain, or increase, aquatic health rankings.<br>Applicable to WRS Objective 2.<br>Monitoring these aquatic habitat characteristics allows for the assessments of the overall health of the aquatic ecosystem. |
| **NATURAL HERITAGE SYSTEM** (terrestrial ecosystems) | **ID#: FV-18 & FV-18_1** (Orange #1 on map) | Annually | Vegetation and forest birds | **Indicator:** Maintain, or increase, the number and area of species and vegetation communities of concern.<br>Applicable to NHS Objective 2.<br>Monitoring these terrestrial habitat characteristics helps to understand how the system is functioning and if there are changes to species composition over time.<br>**Note:** This indicator requires inventory data from across the watershed to be properly assessed. The identified monitoring stations only collect data at that particular location and therefore do not assess trends across the watershed. An inventory would need to be conducted within the next ten years to update information regarding current conditions. |

| Monitoring Category | Stations | Monitoring Frequency | What is monitored? | Why do we monitor it? |
|---|---|---|---|---|
| **SURFACE WATER QUALITY** | **ID#: 107002** (Red #1 on map) | Monthly samples | Water chemistry (e.g. nutrients), metals, bacteria, and temperature | Applicable to overall watershed health and trends to know whether water quality conditions are improving or not.<br><br>Monitoring water quality helps to understand the impacts of land uses on local water quality that ultimately flows into Lake Ontario. |
| | **ID#: CC005** (Red #2 on map) | | | |
| **SURFACE WATER QUANTITY** | **ID#: HY013** (Blue #1 on map) | Continuous water level data collected, reported in 15-minute intervals | Stream level, discharge, and temperature | Applicable to overall watershed health and trends to know whether hydrology conditions are improving or not.<br><br>Monitoring stream level, discharge and temperature helps to understand the interconnections between groundwater and surface water. This information can be used to guide the management and protection of baseflow levels to protect aquatic life and ensure sustainable human use of surface water. |
| | **ID#: HY090** (Blue #2 on map) | | | |
| | **ID#: HY089** (Blue #3 on map) | | | |
| | **ID#: WQ002** (Blue #4 on map) | Continuous water level and certain water quality data collected, reported in 15-minute intervals<br><br>Monthly grab samples for full suite of water quality parameters<br><br>Also takes event-based (i.e. heavy rainfall) water quality samples | Stream level, discharge, and temperature<br><br>Note: also measures water quality as part of Lake Ontario tributary monitoring | Applicable to overall watershed health and trends to know whether hydrology and water quality conditions are improving or not.<br><br>The primary purpose of this station is to assess nutrient loadings to Lake Ontario. |

| Monitoring Category | Stations | Monitoring Frequency | What is monitored? | Why do we monitor it? |
|---|---|---|---|---|
| | **ID#: HY121** (Blue #5 on map) | Continuous real-time (reporting every 5 minutes) | Rainfall and snowfall amount and temperature | Applicable to overall watershed health and trends to know whether hydrology conditions are improving or not.<br><br>Precipitation monitoring information assists with flood forecasting and warning, event-based sampling, and watershed planning. |
| | **ID#: HY122** (Blue #6 on map) | | | |
| **GROUNDWATER QUANTITY** | **ID#: HY121** (Purple #1 on map) | Hourly groundwater level and temperature, and monthly manual groundwater level measurements | Water level | Applicable to overall watershed health and trends to know whether hydrogeology conditions are improving or not.<br><br>Groundwater and surface water interactions are essential for a functioning WRS. Understanding groundwater conditions is vital to understanding the nature of these interactions. |

**Note:**
The following indicators are not evaluated through a particular monitoring station in Carruthers Creek, but will be periodically assessed through GIS analyses:

- Reduce number of flood vulnerable structures and flood vulnerable roads (Land Use Objective 2)
- Increase total natural cover in the watershed (NHS Objective 1)
- Increase total tree canopy in the watershed (NHS Objective 3)

The remaining indicators are qualitative (e.g. ensuring policies are in place) and will be reported on by TRCA in collaboration with its municipal partners.

## Reporting

As part of the Carruthers Creek monitoring program, TRCA, in collaboration with its municipal partners, will conduct annual reporting to communicate on the health of the watershed and plan implementation progress.

Annual reporting will help to track watershed health trends and the indicators identified as part of this watershed plan.

Some components of this watershed plan may not be reported on annually (e.g. aquatic community and terrestrial species). This is due to different monitoring frequencies for certain components (e.g. aquatic species are surveyed every three years).

## Adaptive Management

Adaptive management is a systematic process (see **Figure 8**) for continually improving practices by learning and applying updated knowledge to improve project outcomes. In the context of this watershed plan, adaptive management, in combination with the monitoring program, will allow modifications and refinements to management recommendations, and/or the monitoring program throughout the life cycle of this watershed plan. For example, if water quality continues to deteriorate, certain land use management recommendations may not be resulting in the desired outcome, requiring adjustment.

**FIGURE 8:**
**Adaptive Management Cycle**

# 7. Maps

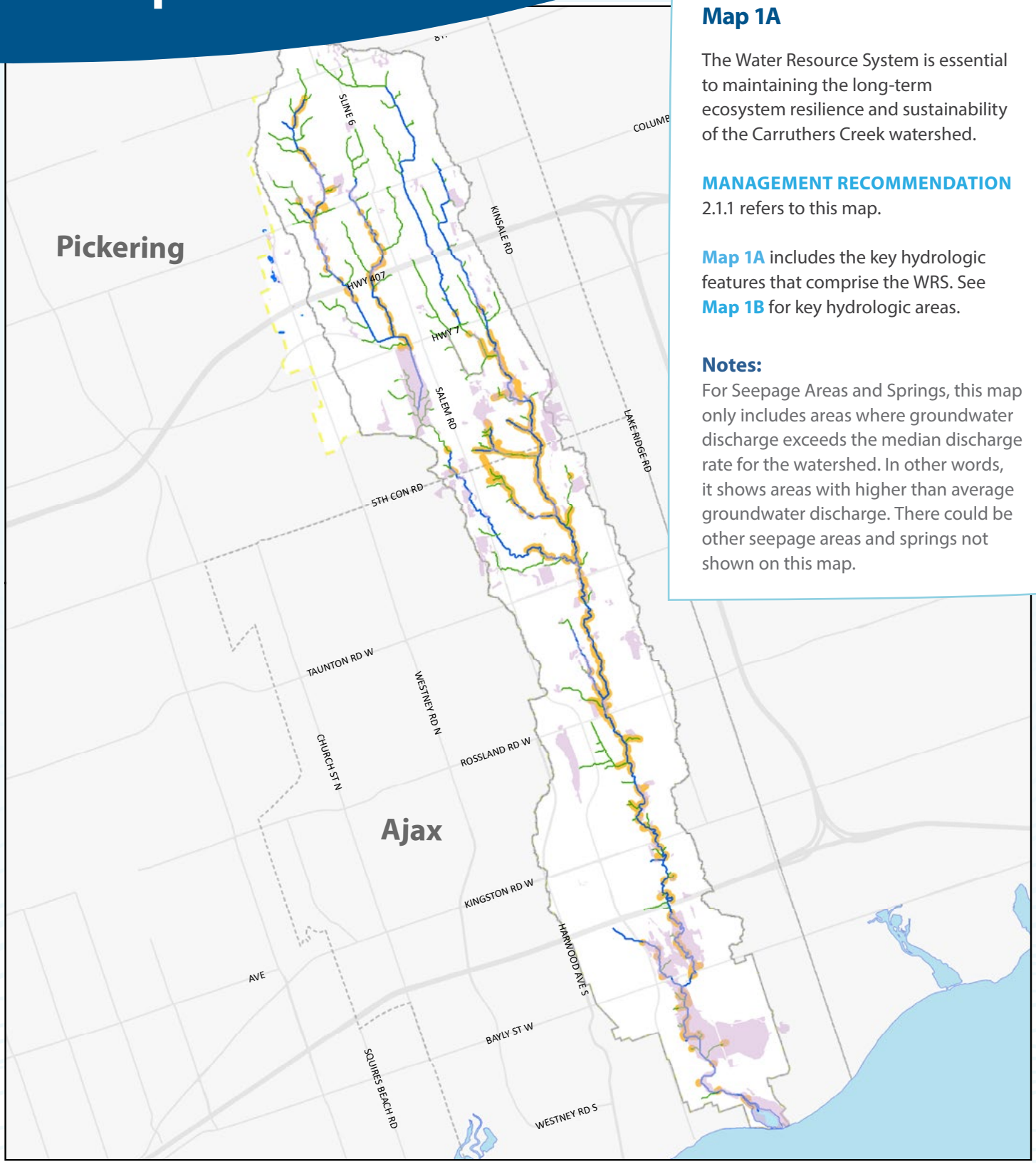
## Map 1A

The Water Resource System is essential to maintaining the long-term ecosystem resilience and sustainability of the Carruthers Creek watershed.

**MANAGEMENT RECOMMENDATION**
2.1.1 refers to this map.

**Map 1A** includes the key hydrologic features that comprise the WRS. See **Map 1B** for key hydrologic areas.

**Notes:**
For Seepage Areas and Springs, this map only includes areas where groundwater discharge exceeds the median discharge rate for the watershed. In other words, it shows areas with higher than average groundwater discharge. There could be other seepage areas and springs not shown on this map.

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**Carruthers Creek Watershed Plan: Water Resource System - Map A**

0 0.5 1 2 3 KM

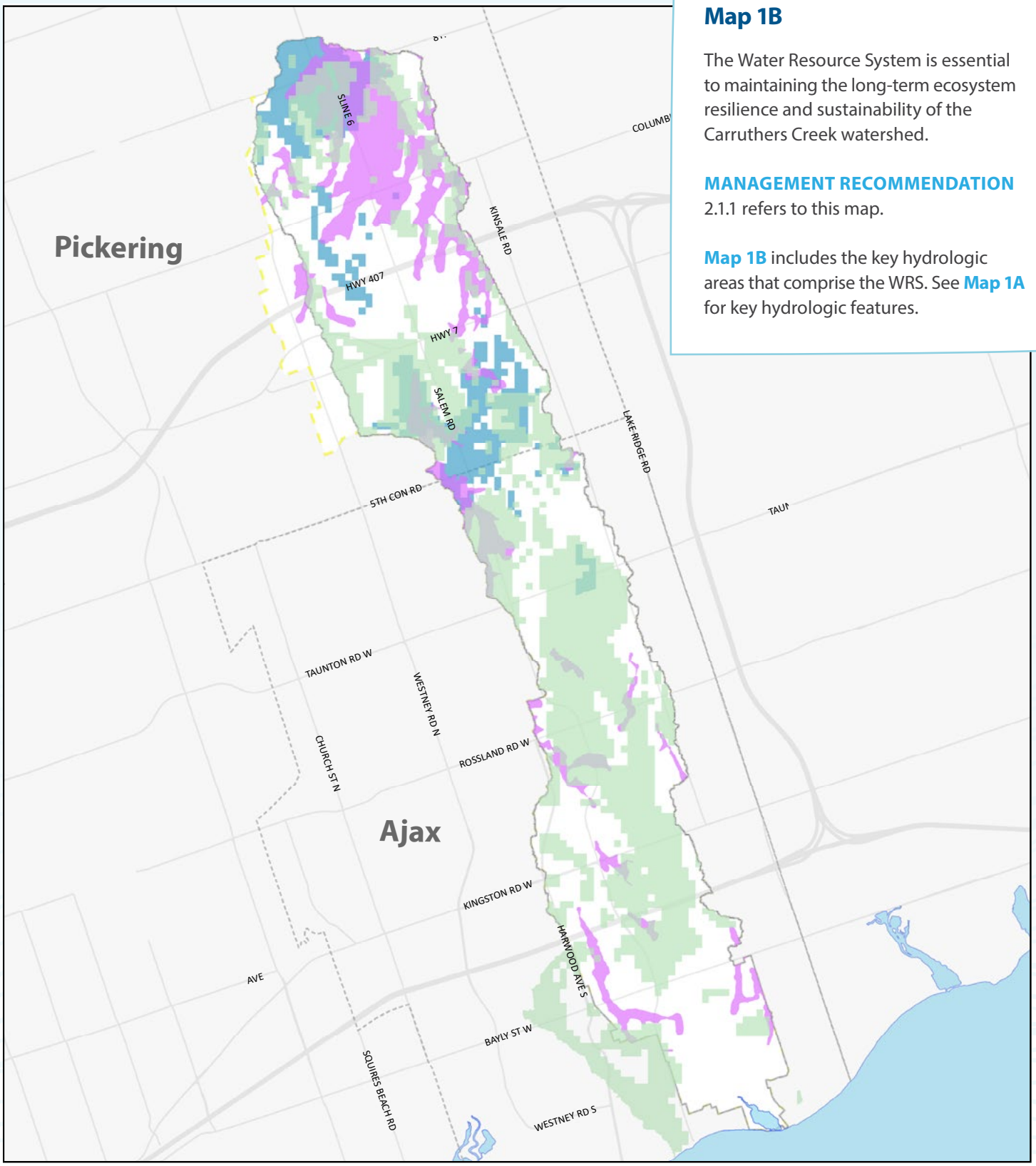
Key Hydrologic Features
- Inland Lakes
- Intermittent Streams
- Permanent Streams
- Seepage Areas and Springs
- Wetlands
- Municipal Boundary
- Carruthers Creek Watershed Boundary
- Carruthers Creek Watershed Plan Study

## Map 1B

The Water Resource System is essential to maintaining the long-term ecosystem resilience and sustainability of the Carruthers Creek watershed.

**MANAGEMENT RECOMMENDATION**
2.1.1 refers to this map.

**Map 1B** includes the key hydrologic areas that comprise the WRS. See **Map 1A** for key hydrologic features.

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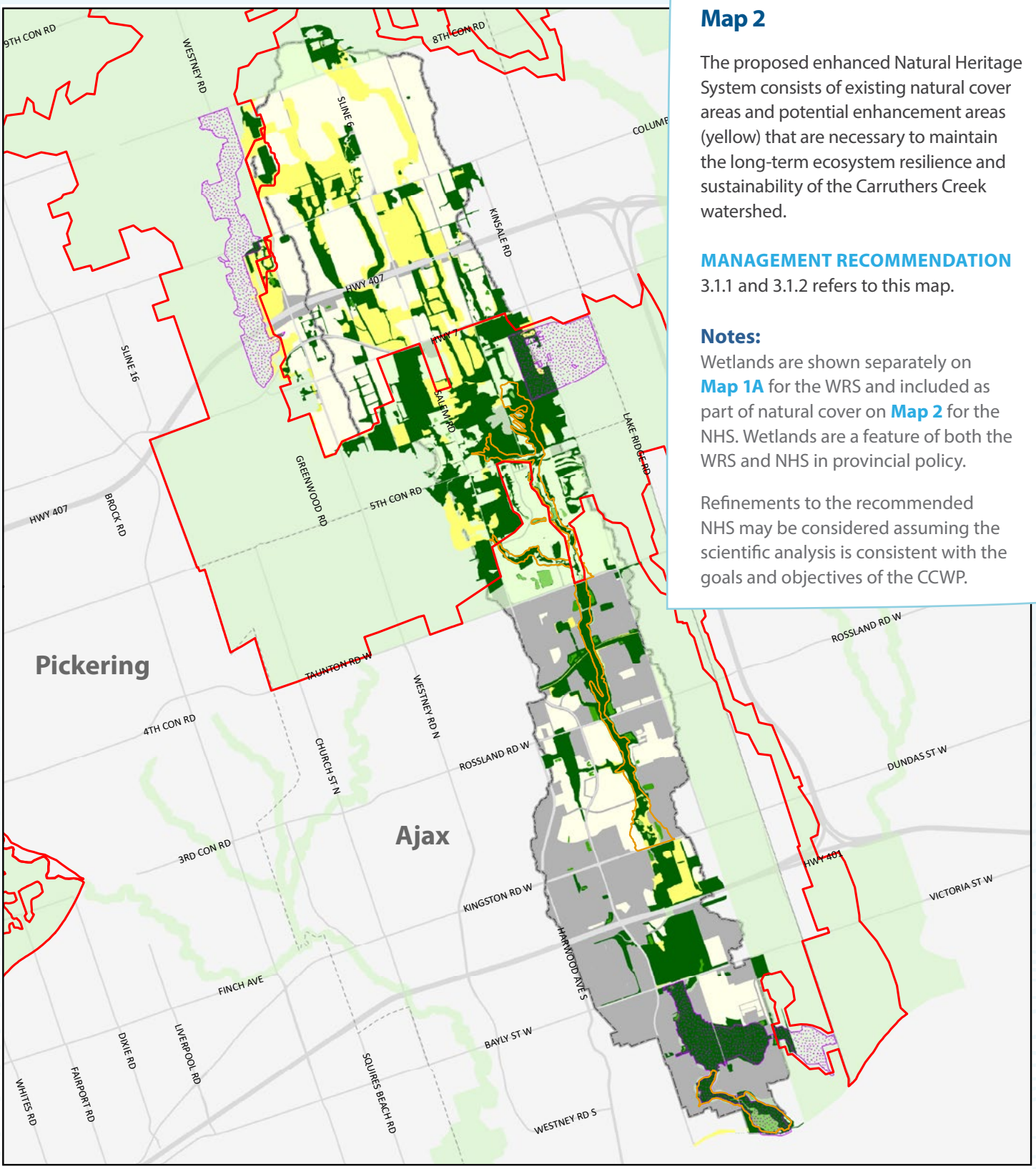
**Carruthers Creek Watershed Plan: Water Resource System - Map B**

0 0.5 1 2 3 KM

Key Hydrologic Areas
- Highly Vulnerable Aquifers
- Significant Groundwater Recharge Areas
- Ecologically Significant Groundwater Recharge Areas

- Municipal Boundary
- Carruthers Creek Watershed Boundary
- Carruthers Creek Watershed Plan Study




## Map 2

The proposed enhanced Natural Heritage System consists of existing natural cover areas and potential enhancement areas (yellow) that are necessary to maintain the long-term ecosystem resilience and sustainability of the Carruthers Creek watershed.

**MANAGEMENT RECOMMENDATION**
3.1.1 and 3.1.2 refers to this map.

**Notes:**
Wetlands are shown separately on **Map 1A** for the WRS and included as part of natural cover on **Map 2** for the NHS. Wetlands are a feature of both the WRS and NHS in provincial policy.

Refinements to the recommended NHS may be considered assuming the scientific analysis is consistent with the goals and objectives of the CCWP.

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**Carruthers Creek Watershed Plan: Enhanced Natural Heritage System**

0 0.5 1 2 3 KM

- Valleyland
- ANSI
- Natural Cover (Existing)
- Natural Cover (Potential)
- Provincial NHS
- Municipal Boundary
- Greenbelt Boundary
- Carruthers Creek Watershed Boundary
- Carruthers Creek Watershed Plan Study Area

**Land Use**
- Natural
- Rural
- Urban

## Map 3

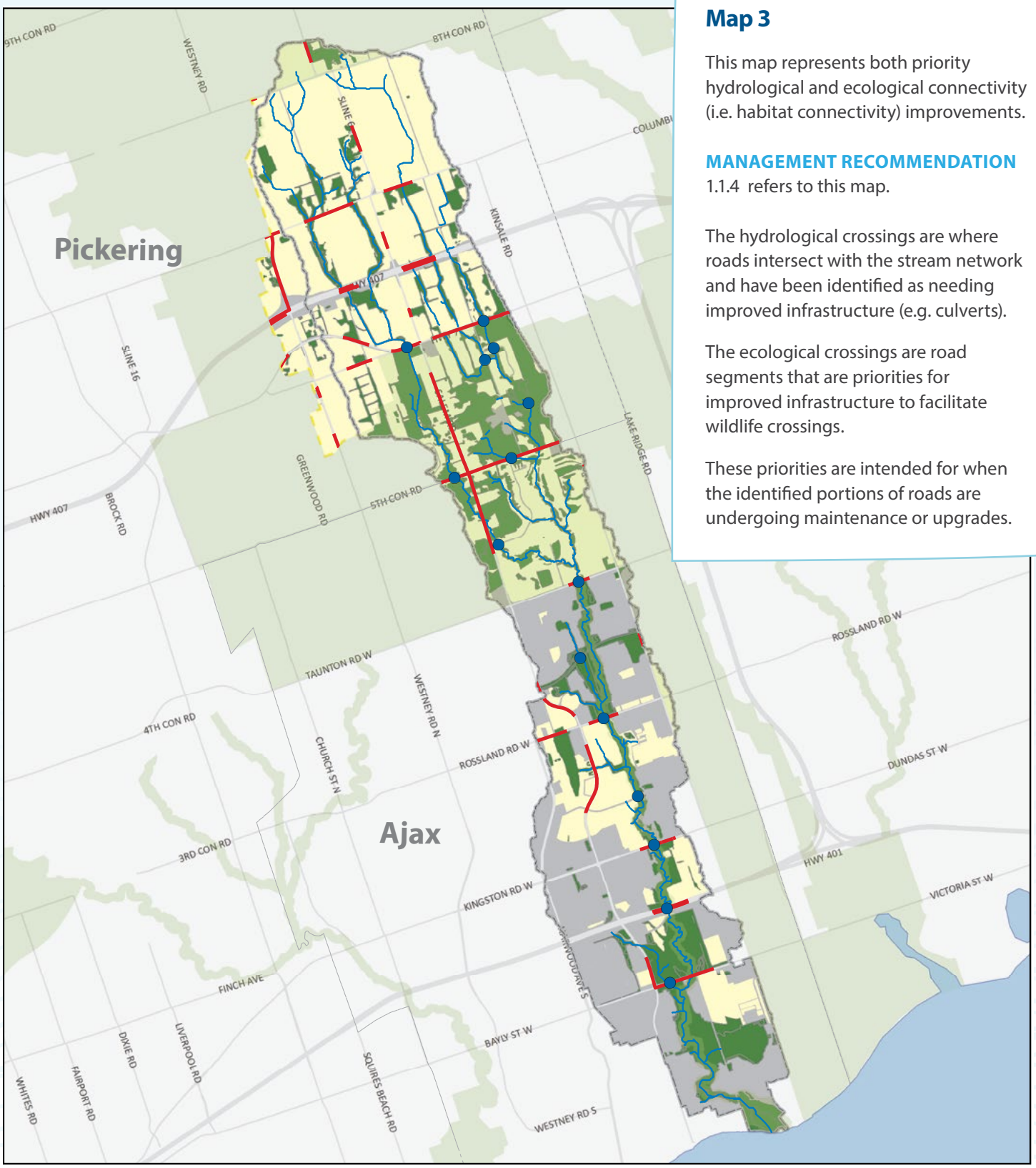
This map represents both priority hydrological and ecological connectivity (i.e. habitat connectivity) improvements.

**MANAGEMENT RECOMMENDATION**
1.1.4 refers to this map.

The hydrological crossings are where roads intersect with the stream network and have been identified as needing improved infrastructure (e.g. culverts).

The ecological crossings are road segments that are priorities for improved infrastructure to facilitate wildlife crossings.

These priorities are intended for when the identified portions of roads are undergoing maintenance or upgrades.

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**Carruthers Creek Watershed Plan: Priority Crossing Improvements**

0 0.5 1 2 3 KM

- Priority Hydrologic Crossings Improvement Areas
- Priority Ecological Connectivity Areas
- Watercourse
- Greenbelt Boundary
- Carruthers Creek Watershed Boundary
- Carruthers Creek Watershed Plan Study Area

Land Use
- Natural
- Rural
- Urban
- Municipal Boundary

Note: Priorities shown in this map are for regional roads only

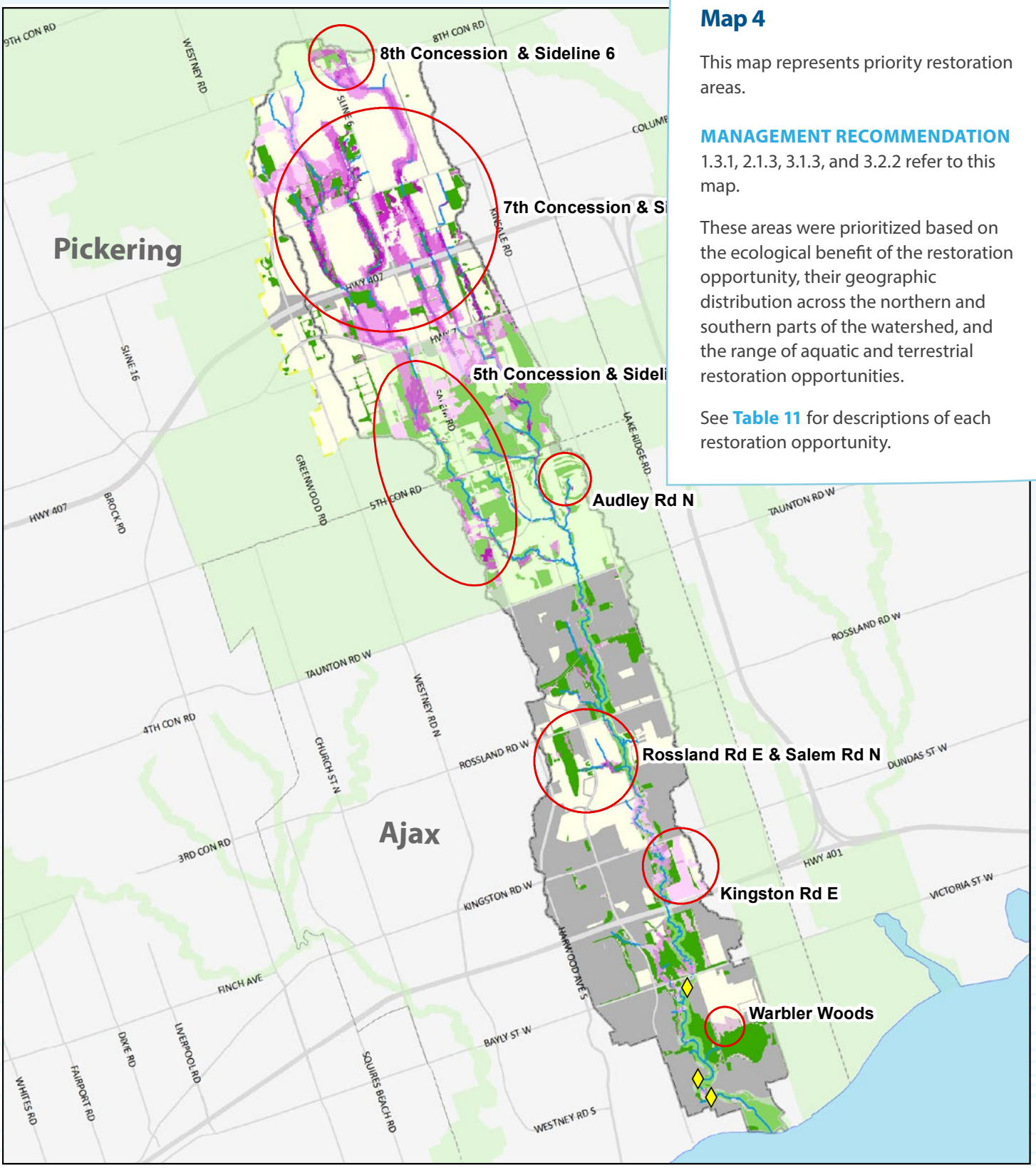
## Map 4

This map represents priority restoration areas.

**MANAGEMENT RECOMMENDATION**
1.3.1, 2.1.3, 3.1.3, and 3.2.2 refer to this map.

These areas were prioritized based on the ecological benefit of the restoration opportunity, their geographic distribution across the northern and southern parts of the watershed, and the range of aquatic and terrestrial restoration opportunities.

See **Table 11** for descriptions of each restoration opportunity.

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**Carruthers Creek Watershed Plan: Restoration Priorities**

0 0.5 1 2 3 KM

- Erosion Priority Restoration Sites
- Restoration Opportunity Priority Areas
- Municipal Boundary
- Watercourse

**Land Use**
- Natural
- Rural
- Urban

- Greenbelt Boundary
- Carruthers Creek Watershed Boundary
- Carruthers Creek Watershed Plan Study Area

**Ecological Benefit of Restoration Opportunity**
- Highest Benefit

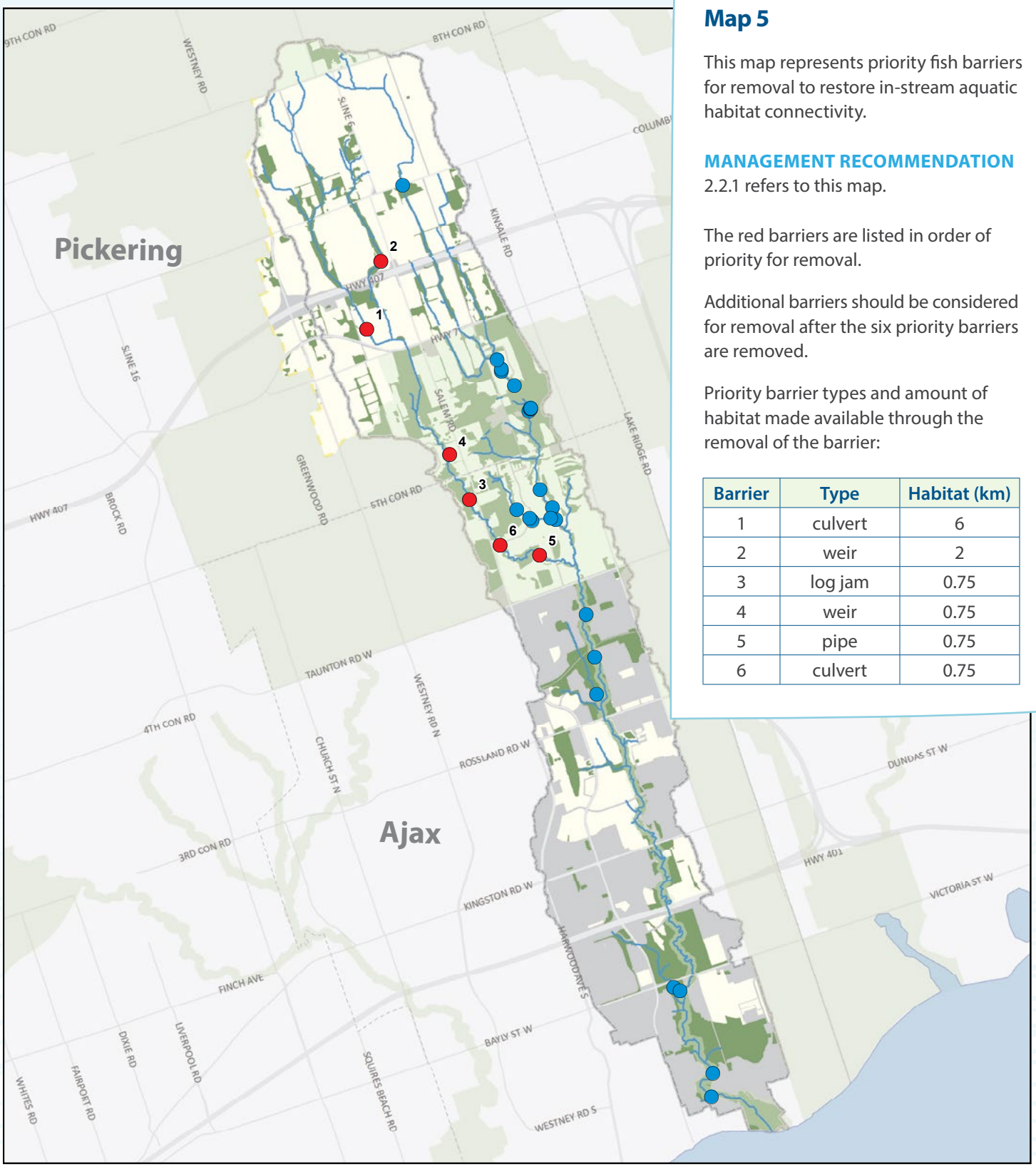
## Restoration Opportunity Planning for Carruthers Creek

Restoration opportunity planning is TRCA's current process for identifying and recording site-level information for terrestrial and aquatic restoration opportunities (e.g. wetland, riparian, forest, meadow, and stream restoration). TRCA's Integrated Restoration Prioritization (IRP) tool is used to help select priority restoration opportunities where ecological impairments exist and, if restored, could contribute most to the terrestrial natural heritage and water resource systems.

Restoration opportunities in the Carruthers Creek watershed were originally identified using desktop assessment techniques as per the restoration opportunity planning methodology. For the CCWP, a more detailed prioritization method using additional data identified the most important areas to consider for restoration. This involved combining the IRP scores with the criteria listed in management recommendations 2.1.3 for aquatic and 3.1.2 for terrestrial. TRCA then overlaid these scores with the restoration opportunity planning information to identify the highest scoring areas, which are circled in **Map 4** (Note: the Audley Road N opportunity was selected for meadow restoration potential in support of management recommendation 3.2.2).

**TABLE 11:**
Restoration Opportunity Summaries

| Location | Restoration Opportunity |
|---|---|
| **8th Concession and Sideline 6** | • Forest, wetland, stream, and riparian restoration opportunities have been identified in areas of residential and agricultural land uses.<br>• Forest restoration will help connect and expand existing forest to the north.<br>• Large-scale wetland and riparian restoration would restore headwater drainage feature functions and benefit downstream habitat. Existing land use patterns have altered streams, wetlands, and riparian areas.<br>• With agriculture as the predominant land-use, the focus of restoration should be to work with property owners to restore and maintain marginal lands that do not negatively impact agricultural use but promote best management practices and contribute to the potential enhanced natural heritage system. |
| **7th Concession and Sideline 6** | • Forest, wetland, stream, and riparian restoration opportunities were identified in this largely agricultural area.<br>• Highest priority areas include riparian corridors and around existing forest patches.<br>• Portions in the north-east and along hydro corridors of this area provide meadow restoration opportunities.<br>• Areas of wetland restoration will increase habitat diversity, contribute to the reduction of run-off, and increase water infiltration and storage. |
| **5th Concession and Sideline 6** | • Forest, wetland, riparian, and meadow restoration opportunities were identified in this priority area.<br>• Restore large area of wetland and riparian habitat in the northern portion of this area.<br>• Meadow habitat can be created along the hydro corridor running east to west in this area.<br>• Existing forests can be expanded along the proposed enhanced NHS. |
| **Audley Road North** | • Restore wetland and meadow habitat to the east of the stream, in collaboration with golf course.<br>• Meadow restoration potential in the hydro corridor to the south of the area to support habitat for sensitive species. |
| **Rossland Road East and Salem Road North** | • Restore riparian buffer to the west of the main branch of the creek and create a forest buffer between future development and the NHS.<br>• Work with developer to restore wetlands and riparian corridors and encourage the use of best management practices such as low impact development and buffers as part of any development. |
| **Kingston Road East** | • Restore riparian cover along the main channel of Carruthers Creek.<br>• Restore large wetlands to the east of this area and plant riparian and forest habitat around the wetlands.<br>• Restore ponds in flood plain north of Kingston Road East to enhance wetland habitat and connect corridor along the stream network. |
| **Kingston Road East** | • Restore wetland habitat north of existing wetland to provide a buffer between this area and potential development. |
| **Warbler Woods** | • Restore wetland habitat north of existing wetland to provide a buffer between this area and potential development. |




## Map 5

This map represents priority fish barriers for removal to restore in-stream aquatic habitat connectivity.

**MANAGEMENT RECOMMENDATION**
2.2.1 refers to this map.

The red barriers are listed in order of priority for removal.

Additional barriers should be considered for removal after the six priority barriers are removed.

Priority barrier types and amount of habitat made available through the removal of the barrier:

| Barrier | Type | Habitat (km) |
|---|---|---|
| 1 | culvert | 6 |
| 2 | weir | 2 |
| 3 | log jam | 0.75 |
| 4 | weir | 0.75 |
| 5 | pipe | 0.75 |
| 6 | culvert | 0.75 |

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**Carruthers Creek Watershed Plan: Fish Barriers**

0 0.5 1 2 3 KM

- Priority Barriers
- Other Barriers
- Municipal Boundary
- Watercourse
- Greenbelt Boundary
- Carruthers Creek Watershed Boundary
- Carruthers Creek Watershed Plan Study Area

**Land Use**

- Natural
- Rural
- Urban

## Map 6

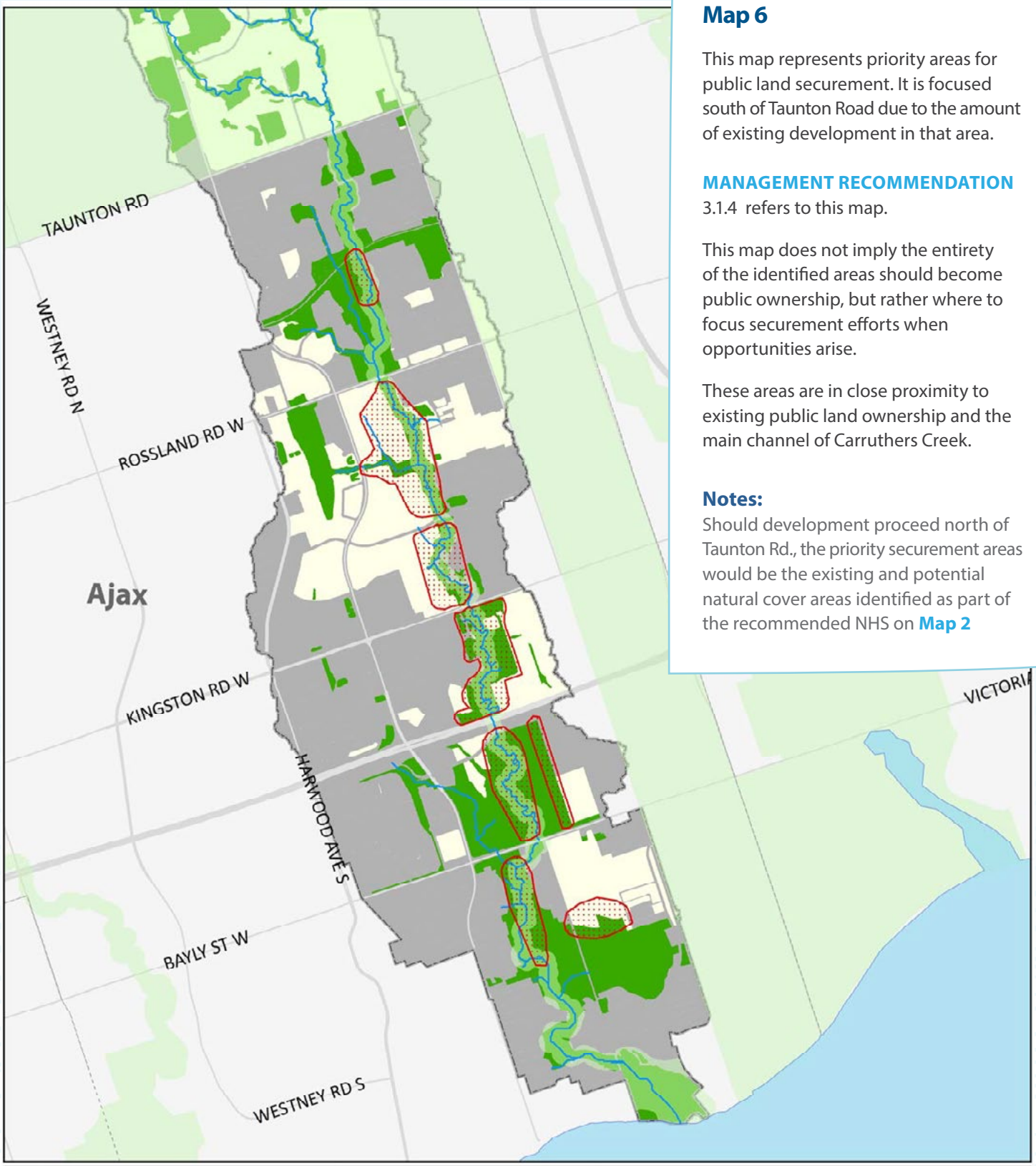
This map represents priority areas for public land securement. It is focused south of Taunton Road due to the amount of existing development in that area.

**MANAGEMENT RECOMMENDATION**
3.1.4 refers to this map.

This map does not imply the entirety of the identified areas should become public ownership, but rather where to focus securement efforts when opportunities arise.

These areas are in close proximity to existing public land ownership and the main channel of Carruthers Creek.

**Notes:**
Should development proceed north of Taunton Rd., the priority securement areas would be the existing and potential natural cover areas identified as part of the recommended NHS on **Map 2**

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**Carruthers Creek Watershed Plan: Priority Securement Areas**

0 0.4 0.8 1.6 KM

- Priority Securement Areas
- Inland Lakes
- Watercourse
- Municipal Boundary
- Greenbelt Boundary
- Carruthers Creek Watershed Boundary
- Carruthers Creek Watershed Plan Study Area

**Land Use**
- Natural
- Rural
- Urban

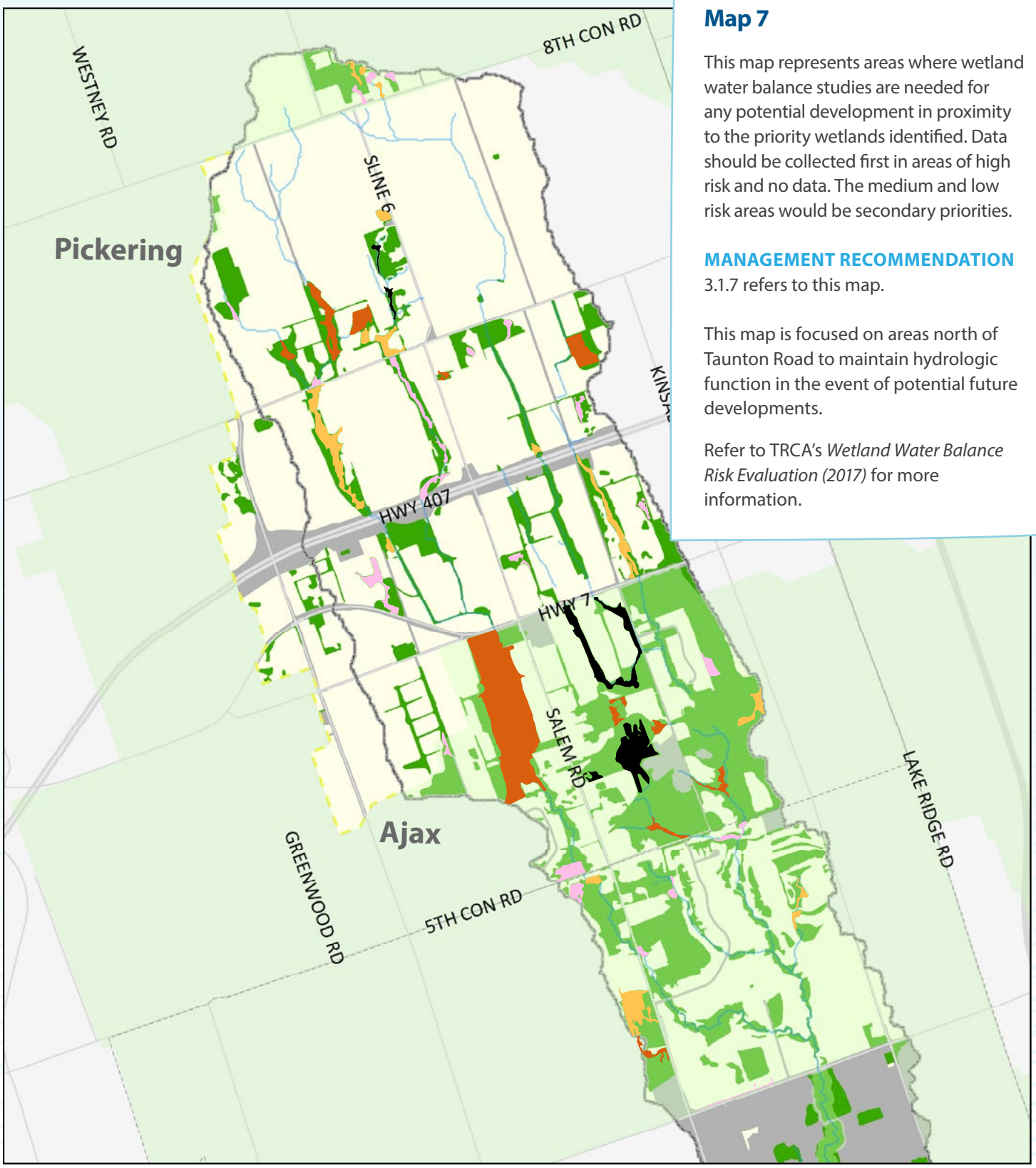
## Map 7

This map represents areas where wetland water balance studies are needed for any potential development in proximity to the priority wetlands identified. Data should be collected first in areas of high risk and no data. The medium and low risk areas would be secondary priorities.

**MANAGEMENT RECOMMENDATION**
3.1.7 refers to this map.

This map is focused on areas north of Taunton Road to maintain hydrologic function in the event of potential future developments.

Refer to TRCA's *Wetland Water Balance Risk Evaluation (2017)* for more information.

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**Carruthers Creek Watershed Plan: Wetland Water Balance Study Priorities**

0 0.5 1 KM

Wetland Priorities*
- No Data
- High
- Medium
- Low
- Municipal Boundary
- Watercourse

- Greenbelt Boundary
- Carruthers Creek Watershed Boundary
- Carruthers Creek Watershed Plan Study Area

**Land Use**
- Natural
- Rural
- Urban

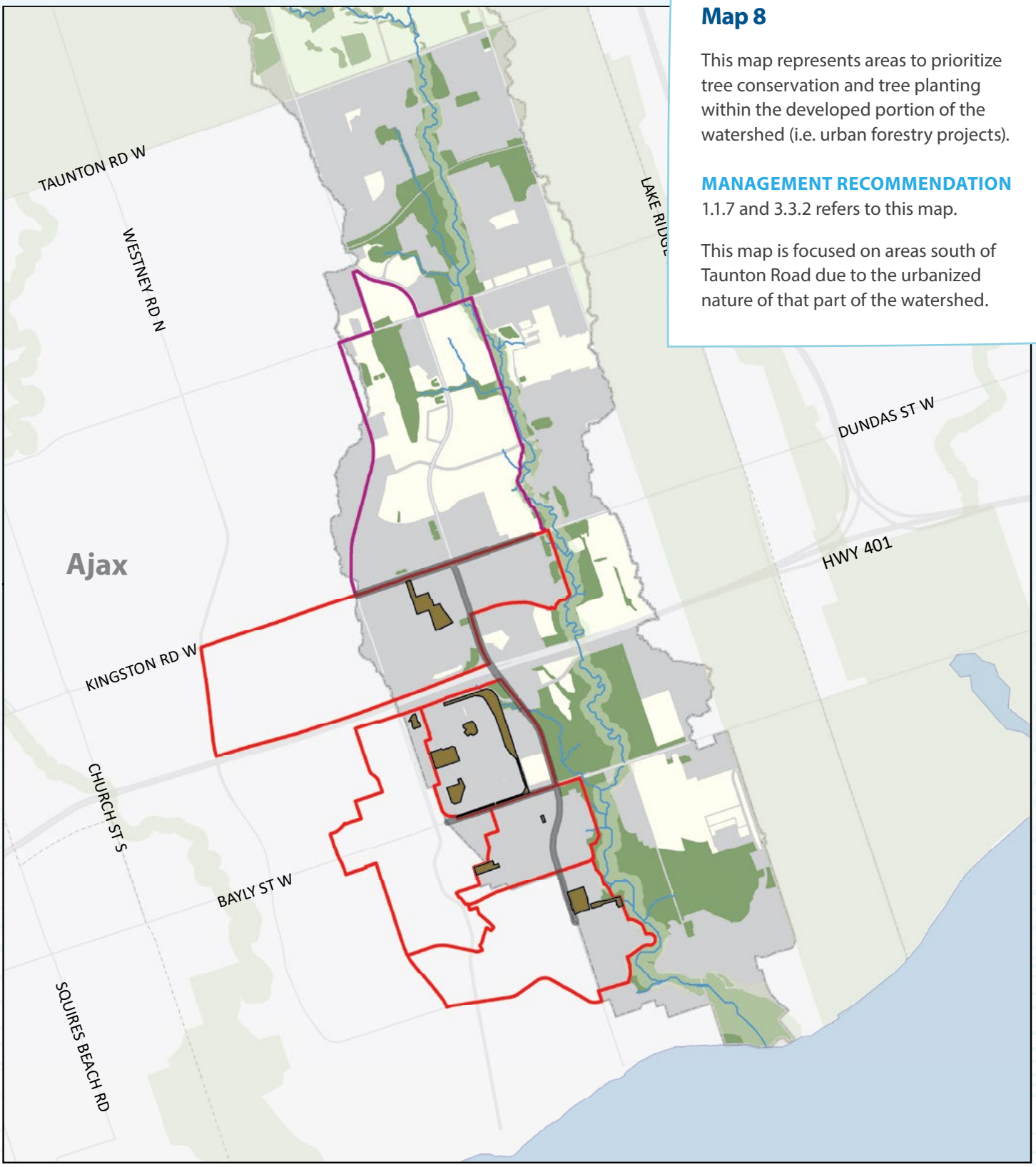
*Classifications based on TRCA Wetland Water Balance Risk Evaluation framework

## Map 8

This map represents areas to prioritize tree conservation and tree planting within the developed portion of the watershed (i.e. urban forestry projects).

**MANAGEMENT RECOMMENDATION**
1.1.7 and 3.3.2 refers to this map.

This map is focused on areas south of Taunton Road due to the urbanized nature of that part of the watershed.

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**Carruthers Creek Watershed Plan: Priority Urban Forestry Areas**

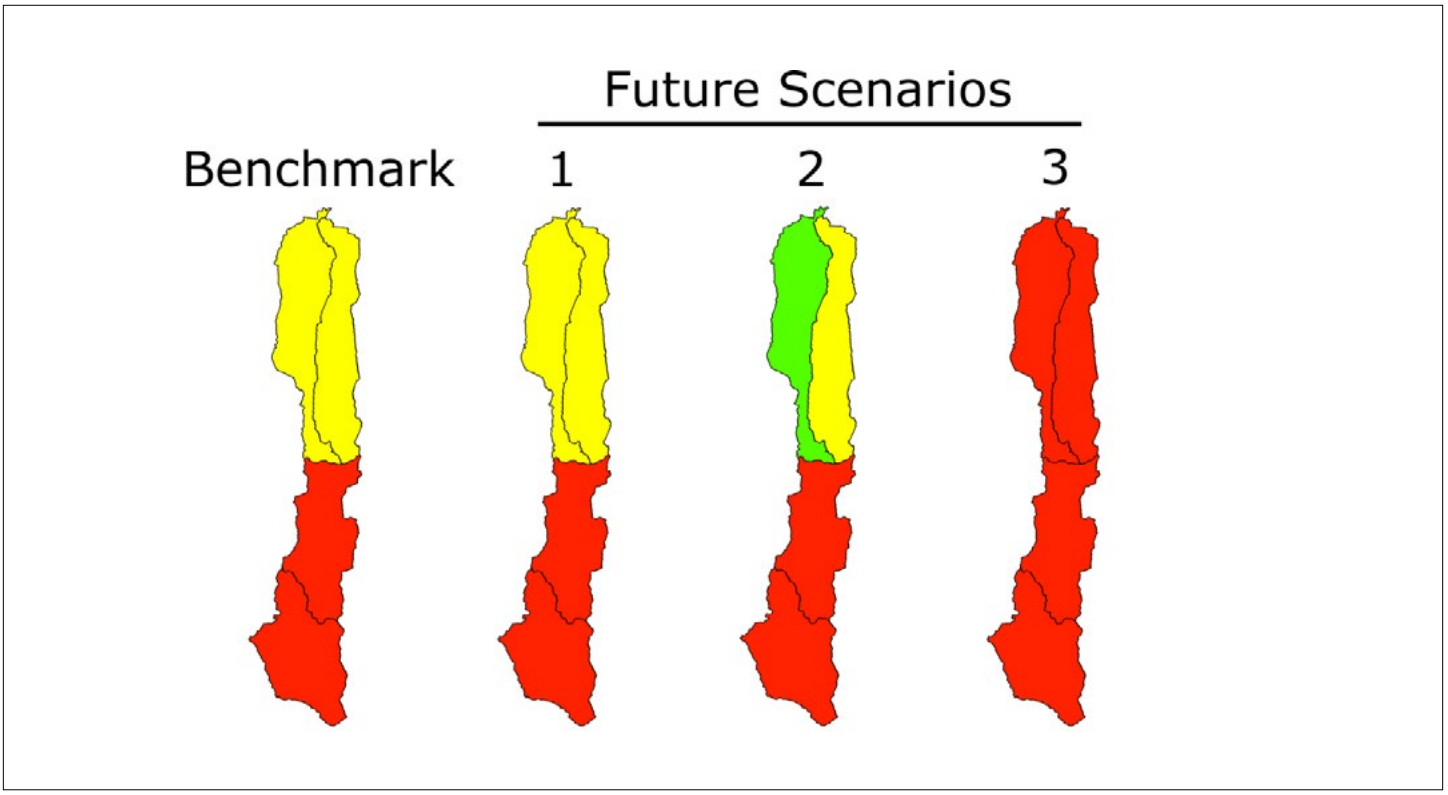
0 0.25 0.5 1 KM

- Road Priorities
- Parks in Priority Neighbourhoods
- Priority Conservation Neighbourhood
- Priority Planting Neighbourhoods
- Municipal Boundary
- Watercourse
- Greenbelt Boundary
- Carruthers Creek Watershed Boundary
- Carruthers Creek Watershed Plan Study Area

**Land Use**

- Natural
- Rural
- Urban

**FIGURE 9:**
**Subwatershed Quality Due to Changes in Impervious Cover**




## Figure 9

As discussed in **Table 4** for the aquatic health of the WRS, subwatershed quality was assessed based on impervious cover under the existing benchmark conditions and the three future scenarios. The proposed enhanced NHS benefits the aquatic ecosystem in scenario 2 where the north-west subwatershed improves from good – fair to good. The increase in impervious cover associated with scenario 3 results in all four subwatersheds degrading to fair – poor conditions, and will likely result in the loss of Redside Dace, a listed endangered species, within the Carruthers Creek watershed. Implementing the management recommendations identified in this watershed plan, especially limiting impervious cover and undertaking restoration activities will help Redside Dace habitat.

The rating scale for subwatershed quality is based on the amount of impervious cover, with:

- Good (green) = 0% to 10% imperviousness
- Good – fair (yellow) = 10% to 25% imperviousness
- Fair – poor (red) = greater than 25% imperviousness

**Notes:** the percent imperviousness identified in **Subsection 4.3** is for the entire watershed; while the subwatersheds may have different imperviousness values (e.g. Scenario 1 has 30% imperviousness across the entire watershed, whereas imperviousness by subwatershed is as follows: 10% north-west, 11% north-east, 53% central and 49% south).

See Aquatic Impact Assessment technical report for more information.

# 8. Glossary

### Aquifer
A saturated permeable geologic unit that can transmit significant quantities of groundwater under ordinary hydraulic gradients. They can be classified as confined or unconfined. In southern Ontario, aquifers are typically comprised of sand and/or gravel, or fractured limestone.

*Source: TRCA's Living City Policies, 2014*

### Biodiversity
The variability among organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species and ecosystems.

*Source: TRCA's Living City Policies, 2014*

### Ecological Integrity
Which includes hydrologic integrity, means the condition of ecosystems in which,

a. the structure, composition and function of the ecosystems are unimpaired by stresses from human activity,
b. natural ecological processes are intact and self-sustaining,
c. the ecosystems evolve naturally.

*Source: Greenbelt Plan, 2017*

### Ecosystem Services
The benefits provided by ecosystems that are critical to the environment's life support systems and that contribute to human welfare both directly and indirectly and therefore represent social and economic value.

*Source: TRCA's Living City Policies, 2014*

### Green Infrastructure
Natural and human-made elements that provide ecological and hydrologic functions and processes. Green infrastructure can include components such as natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces, and green roofs.

*Source: Growth Plan, 2020*

### Headwater Drainage Features

Ill-defined, non-permanently flowing drainage features that may not have defined beds and banks.

*Source: TRCA's Living City Policies, 2014*

### Highly Vulnerable Aquifer

Aquifers, including lands above the aquifers, on which external sources have or are likely to have a significant adverse effect.

*Source: Growth Plan, 2020*

### Hydrologic Function

The functions of the hydrologic cycle that include the occurrence, circulation, distribution and chemical and physical properties of water on the surface of the land, in the soil and underlying rocks, and in the atmosphere, and water's interaction with the environment including its relation to living things.

*Source: Growth Plan, 2020*

### Hydrogeology

A science that describes the movement of groundwater, and its interaction with water that moves on the ground surface in rivers, lakes, streams, and over land. Groundwater seeps into the ground to varying depths and collects in aquifers. Groundwater can remain stored underground for periods ranging from a few days to thousands of years.

*Source: TRCA's Living City Policies, 2014*

### Hydrology

The engineering science that analyzes the different components of the hydrologic cycle, and takes into account that the natural cycle can be altered by human and natural activities.

*Source: TRCA's Living City Policies, 2014*

### Life Science Areas of Natural and Scientific Interest (ANSIs)

An area that has been identified as having life science values related to protection, scientific study, or education; and further identified by the Ministry of Natural Resources and Forestry using evaluation procedures established by that Ministry, as amended from time to time.

*Source: Growth Plan, 2020*

## Low Impact Development

An approach to stormwater management that seeks to manage rain and other precipitation as close as possible to where it falls to mitigate the impacts of increased runoff and stormwater pollution. It typically includes a set of site design strategies and distributed, small-scale structural practices to mimic the natural hydrology to the greatest extent possible through infiltration, evapotranspiration, harvesting, filtration, and detention of stormwater. Low impact development can include, for example: bio-swales, vegetated areas at the edge of paved surfaces, permeable pavement, rain gardens, green roofs, and exfiltration systems. Low impact development often employs vegetation and soil in its design, however, that does not always have to be the case and the specific form may vary considering local conditions and community character.

*Source: Growth Plan, 2020*

## Natural Hazards *(Consisting of Erosion Hazard and Flooding Hazard)*

### EROSION HAZARD

Means the loss of land, due to human or natural processes, that poses a threat to life and property.

### FLOODING HAZARD

Means the inundation of areas adjacent to a shoreline or a river or stream system not ordinarily covered by water.

*Source: PPS, 2020*

## Natural Heritage System

A system made up of natural heritage features and areas, and linkages intended to provide connectivity (at the regional or site level) and support natural processes which are necessary to maintain biological and geological diversity, natural functions, viable populations of indigenous species, and ecosystems. The system can include key natural heritage features, key hydrologic features, federal and provincial parks and conservation reserves, other natural heritage features and areas, lands that have been restored or have the potential to be restored to a natural state, associated areas that support hydrologic functions, and working landscapes that enable ecological functions to continue.

*Source: Growth Plan, 2020*

## Negative Impacts

Means:

a. in regard to policy 1.6.6.4 and 1.6.6.5 degradation to the quality and quantity of water, sensitive surface water features and sensitive ground water features, and their related hydrologic functions, due to single, multiple or successive development.

b. in regard to policy 2.2, degradation to the quality and quantity of water, sensitive surface water features and sensitive ground water features, and their related hydrologic functions, due to single, multiple or successive development or site alteration activities;
c. in regard to fish habitat, any permanent alteration to, or destruction of fish habitat, except where, in conjunction with the appropriate authorities, it has been authorized under the Fisheries Act; and
d. in regard to other natural heritage features and areas, degradation that threatens the health and integrity of the natural features or ecological functions for which an area is identified due to single, multiple or successive development or site alteration activities.

*Source: PPS, 2020*

## Regional (flood) Control

Stormwater management control of flood flows from the regional storm event (Hurricane Hazel) to mitigate increases in flood risk associated with development (urbanization).

*Source: TRCA's Living City Policies, 2014*

## Riparian

The areas adjacent to water bodies such as streams, wetlands and shorelines. Riparian areas form transitional zones between aquatic and terrestrial ecosystems.

*Source: TRCA's Living City Policies, 2014*

## Seepage Areas and Springs

Sites of emergence of groundwater where the water table is present at the ground surface.

*Source: Growth Plan, 2020*

## Significant Groundwater Recharge Area

An area that has been identified:

a. as a significant groundwater recharge area by any public body for the purposes of implementing the PPS, 2014;
b. as a significant groundwater recharge area in the assessment report required under the Clean Water Act, 2006; or
c. as an ecologically significant groundwater recharge area delineated in a subwatershed plan or equivalent in accordance with provincial guidelines.

For the purposes of this definition, ecologically significant groundwater recharge areas are areas of land that are responsible for replenishing groundwater systems that directly support sensitive areas like cold water streams and wetlands.

*Source: Growth Plan, 2020*

## Sustainable Community Retrofits

Focus on actions in older, urban neighbourhoods by retrofitting buildings and infrastructure, regenerating habitats and urban ecology, and revitalizing a community's social fabric. TRCA's Sustainable Neighbourhood Action Program provides examples of sustainable community retrofits.

*Source: Sustainable Neighbourhood Action Program, TRCA, 2020*

## Urban Forest

All trees, shrubs and understorey plants, as well as the soils that sustain them, on public and private property within an urban setting.

*Source: TRCA's Living City Policies, 2014*

## Vegetation Protection Zone

A vegetated buffer area surrounding a key natural heritage feature or key hydrologic feature.

*Source: Growth Plan, 2020*

## Water Balance

The hydrologic cycle of precipitation, groundwater infiltration, evapotranspiration (into the atmosphere and by plant interception), and surface runoff. .

*Source: TRCA's Living City Policies, 2014*

## Water Resource System

A system consisting of ground water features and areas and surface water features (including shoreline areas), and hydrologic functions, which provide the water resources necessary to sustain healthy aquatic and terrestrial ecosystems and human water consumption. The water resource system will comprise key hydrologic features and key hydrologic areas.

*Source: Growth Plan, 2020*

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the **Town of Ajax** and **City of Pickering**

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