Barrhaven Creek
2022 Catchment Report

Catchment Features

Area	7.2 square kilometres 0.17% of the Rideau Valley watershed
Land Use	11.3% agriculture 5.2% forest 8.5% rural 2.2% meadow 71.8% urban 0.6% waterbody 0.4% wetlands
Surficial Geology	67.0% clay 1.3% Paleozoic bedrock 31.2% diamicton 0.5% gravel
Thermal Regime	**Cool-warmwater**
Invasive Species	Six invasive species were observed in 2022: common buckthorn, dog strangling vine, flowering rush, glossy buckthorn, Manitoba maple and Norway maple
Fish Community	Twenty-five fish species have been observed in Barrhaven Creek from 2007 to 2022; game fish species include: black crappie, bluegill, common carp, largemouth bass, northern pike, pumpkinseed, rock bass, smallmouth bass, walleye, white sucker and yellow perch

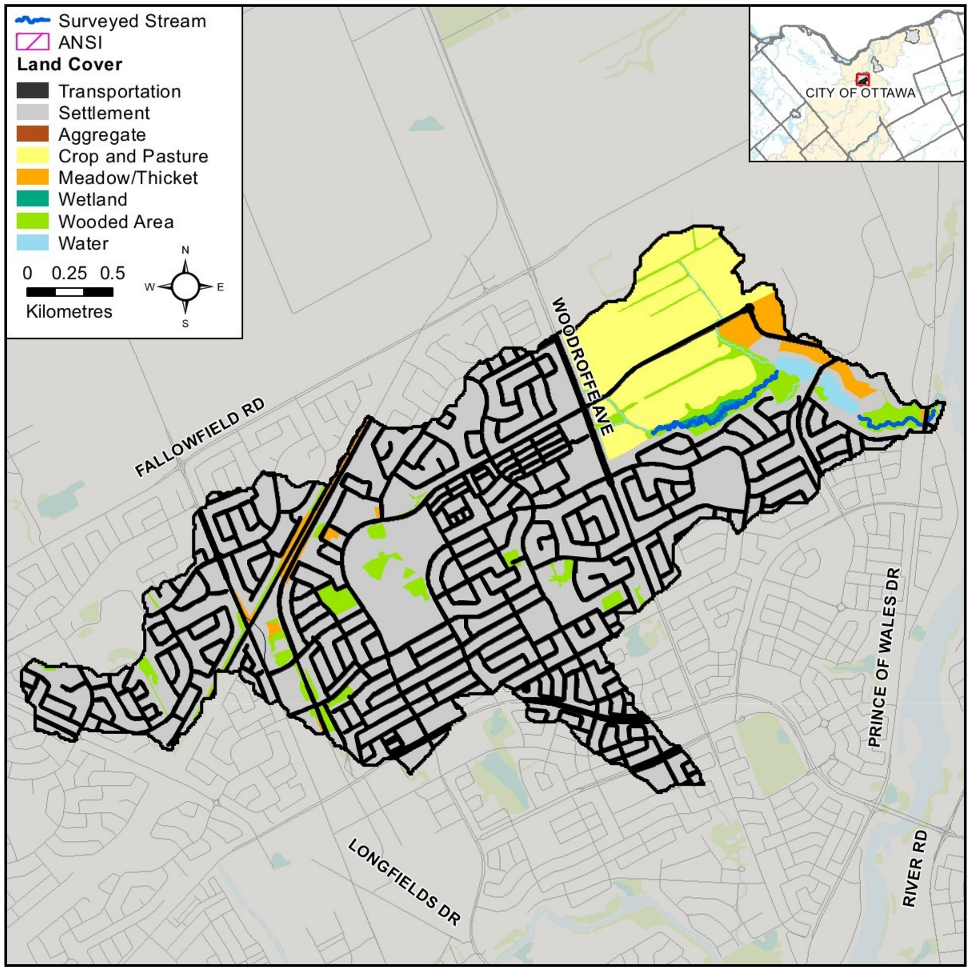


Figure 1 Land cover in the Barrhaven Creek catchment

Wetland Cover

0.4% of the watershed are unevaluated wetlands

Vegetation Cover

Type	Hectares	Percent of Cover
Wooded Areas:	**37.24**	**93.7%**
Hedgerow	3.53	8.9%
Regenerative	0.87	2.2%
Treed	32.83	82.6%
Wetlands*	**2.51**	**6.3%**
Total Cover	**39.75**	**100%**

*Includes treed swamps

Woodlot Analysis

Size Category	Number of Woodlots	Percent of Woodlots
<1 Hectare	27	77.1%
1 to <10 Ha	8	22.9%
10 to <30 Ha	0	0%
>30 Ha	0	0%
Total Cover	**35**	**100%**

The Rideau Valley Conservation Authority in partnership with the City of Ottawa, National Capital Commission, Ottawa Flyfishers Society, Canadian Forces Ottawa Fish and Game Club, Ottawa Stewardship Council, Rideau Roundtable, South Nation Conservation and Mississippi Valley Conservation Authority form the City Stream Watch 2022 collaborative.

Introduction

The headwaters of Barrhaven Creek begin at Woodroffe Avenue and flow east through a large two-celled stormwater management pond, before crossing Prince of Wales Drive and entering the Rideau River. The headwaters of Barrhaven Creek historically began near Greenbank Road but they have since been lost to urban development.

The Clarke Bellinger Stormwater Control Facility is an online facility upstream of Prince of Wales drive treating stormwater runoff from the Longfields/ Davidson Height communities, as well as other Barrhaven neighbourhoods north of the CN railway line and northeast of the Walter Baker Recreation Complex. Operation of the stormwater management facility moderates flow of stormwater from the upstream urban area to prevent accelerated erosion along Barrhaven Creek. West of Woodroffe Avenue the creek and a northern tributary flow through National Capital Commission-owned agricultural lands before entering a well defined valley (Sachs Woods). The only remaining natural channels are between Woodroffe Avenue and the upper end of the stormwater facility and between the lower end of the facility to the creek's confluence with the Rideau River. Most of the vegetation in the headwaters of the catchment was cleared years ago for agricultural purposes, aside from the banks of the creek itself. The shoreline of the remaining portions of Barrhaven creek are primarily wooded, consisting of a mix of deciduous tree species.

Barrhaven Creek was previously surveyed in 2015 under the City Stream Watch program. In 2022, 16 sections (1.6 km) of Barrhaven Creek were surveyed as part of the City Stream Watch monitoring activities. The following is a summary of observations made by staff and volunteers along those 16 sections.

Clarke Bellinger Stormwater Facility located on Barrhaven Creek.

A typical section of Barrhaven Creek.

Barrhaven Creek Overbank Zone

Riparian Buffer Width Evaluation

The riparian buffer is the adjacent land area surrounding a stream or river. Naturally vegetated buffers are important to protect the health of streams and watersheds. Natural shorelines provide buffering capacity for contaminants and nutrients that would otherwise run off freely into aquatic systems. Well established shoreline plant communities will hold soil particles in place, preventing erosion, and will also provide the stream with shading and cover. Environment and Climate Change Canada recommends a guideline of 30 meters of natural vegetation on both sides of the stream for at least 75 percent of the stream length (Environment Canada, 2013).

Figure 2 demonstrates buffer conditions along the left and right banks of the surveyed sections of Barrhaven Creek. Buffers greater than 30 meters were present along 86 percent of the left bank and 80 percent of the right bank. A 15 to 30 meter buffer was present along eight percent of the left bank and thirteen percent of the right bank. A 5 to 15 meter buffer was present along six percent of the left bank and eight percent of the right bank. A five meter buffer or less was not observed along the creek. The buffer width evaluation on the sections surveyed of Barrhaven creek are below recommended guidelines primarily along the right bank.

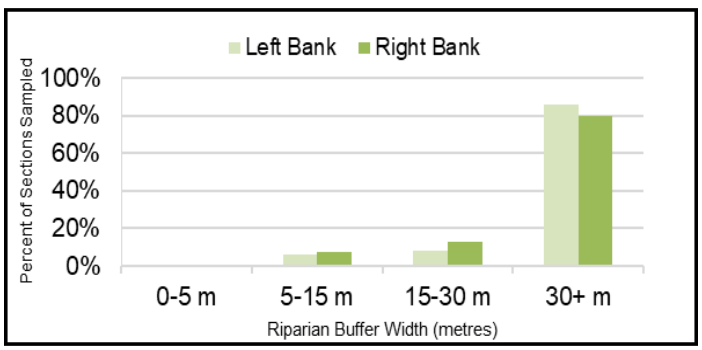


Figure 2 Vegetated buffer width along Barrhaven Creek.

Vegetated buffer greater than 30 meters in width along Barrhaven Creek at the extreme headwaters.

Riparian Buffer Alterations

Alterations within the riparian buffer were assessed within three distinct shoreline zones (0-5 m, 5-15 m, 15-30 m), and evaluated based on the dominant vegetative community and/or land cover type. The evaluation of anthropogenic alterations to the natural riparian cover are shown in Figure 3.

Barrhaven Creek surveyed riparian zones were primarily natural, with 81 percent of the right bank and 94 percent of the left bank having dominant natural riparian vegetative communities. Alterations to the riparian buffer accounted for 13 percent of the right bank; highly altered conditions were observed on six percent of each the right and left banks. These alterations were associated with infrastructure including roadways and agricultural land uses.

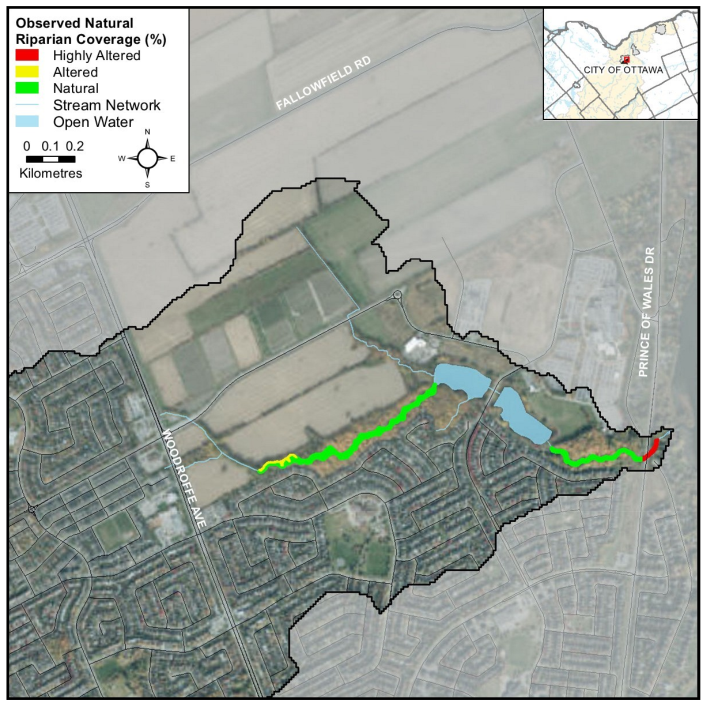


Figure 3 Riparian buffer alterations on Barrhaven Creek.

Barrhaven Creek buffer conditions where it flows into the Rideau River looking upstream.

Adjacent Land Use

Surrounding land use is considered from the beginning to the end of the survey section (100 m) and up to 100 meters on each side of the creek. Land use outside of this area is not considered for the surveys but is nonetheless part of the subwatershed and will influence the creek. Figure 4 shows the percent of surveyed sections that contain each type of land use.

Forest was present in 94 percent and scrubland was present in 13 percent of the sections surveyed. Within the riparian zone, meadow was present in six percent of sections, while wetlands were also found in six percent of sections at the confluence with the Rideau.

Aside from the natural areas, the most common land use in the catchment was residential with 94 percent of the surveyed sections. Infrastructure was observed in 81 percent of the sections containing roads, bridges and culverts. Active agriculture was observed in 63 percent of the surveyed sections along Barrhaven Creek. The remaining six percent of land use was attributed to recreational in the form of pathways associated with the stormwater management facility.

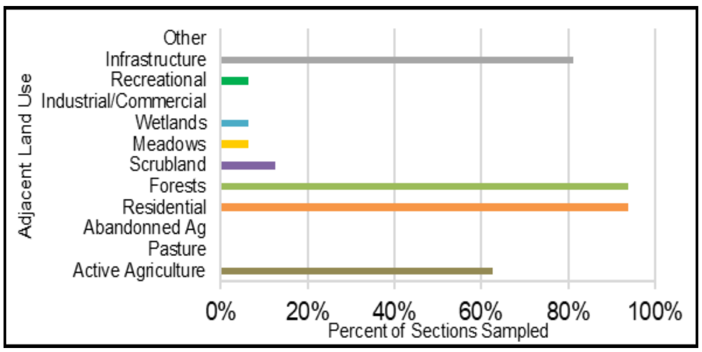


Figure 4 Adjacent land use 100 meters from each shoreline and percentage of presence along Barrhaven Creek.

Barrhaven Creek Shoreline Zone

Anthropogenic Alterations

Stream alterations were classified based on specific functional criteria associated with potential human influences on the riparian buffer, shoreline state, flow conditions and channel structure.

Figure 5 shows the level of anthropogenic alterations for the 16 sections surveyed in the Barrhaven Creek catchment, with only three sections remaining without any human alteration. Of the areas surveyed, 12 sections fell in the classification of natural. Natural sections had a riparian buffer greater than 15 meters in width and naturally vegetated shorelines.

No sections were classified as altered.

One of the surveyed sections was highly altered. The riparian buffers were less than five meters in width, and the section was channelized. This section was located adjacent to road infrastructure.

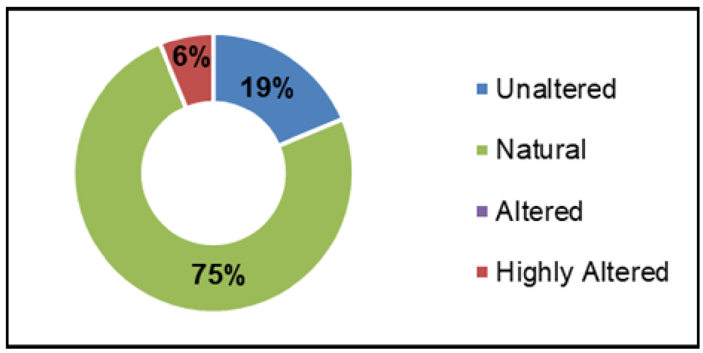


Figure 5 Anthropogenic alterations along Barrhaven Creek.

Section along Barrhaven Creek with scrubland and forested buffer zones.

Channelized section of Barrhaven Creek under Prince of Wales Drive.

Erosion

Stream erosion is the process by which water erodes and transports sediments, resulting in dynamic flows and diverse habitat conditions. Excessive erosion can result in drastic environmental changes, as habitat conditions, water quality and aquatic life are all negatively affected. Bank stability was assessed as the extent of each section with “unstable” shoreline conditions. These conditions are defined by the presence of significant exposed soils/roots, minimal bank vegetation, undercutting, slumping or scour and potential failed erosion measures (rip rap, gabion baskets, etc.).

Figure 6 shows the location and levels of erosion that were observed across the surveyed portions. Bank instability was observed in 69 percent of the left bank and 81 percent of the right bank of the sections surveyed.

Undercut Stream Banks

A stream bank undercut is a bank that rises vertically or overhangs the stream or creek. Stream bank undercuts can provide excellent cover habitat for aquatic organisms, including fish and benthic invertebrates. However, excessive or deep undercuts can be an indication of unstable shoreline conditions and may result in bank failure or collapse. Bank undercuts were assessed as the extent of each surveyed section with overhanging bank cover present.

Figure 7 shows where undercut banks were present and to what extent each section contained them in Barrhaven Creek. Along the left bank, 31 percent of sections had undercut banks; while the right bank had 44 percent of sections with undercut banks.

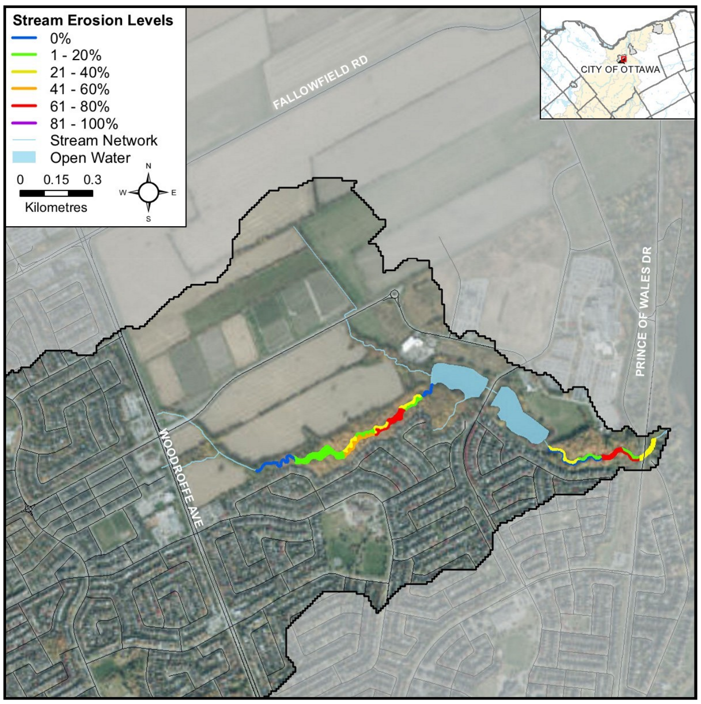


Figure 6 Erosion levels along Barrhaven Creek.

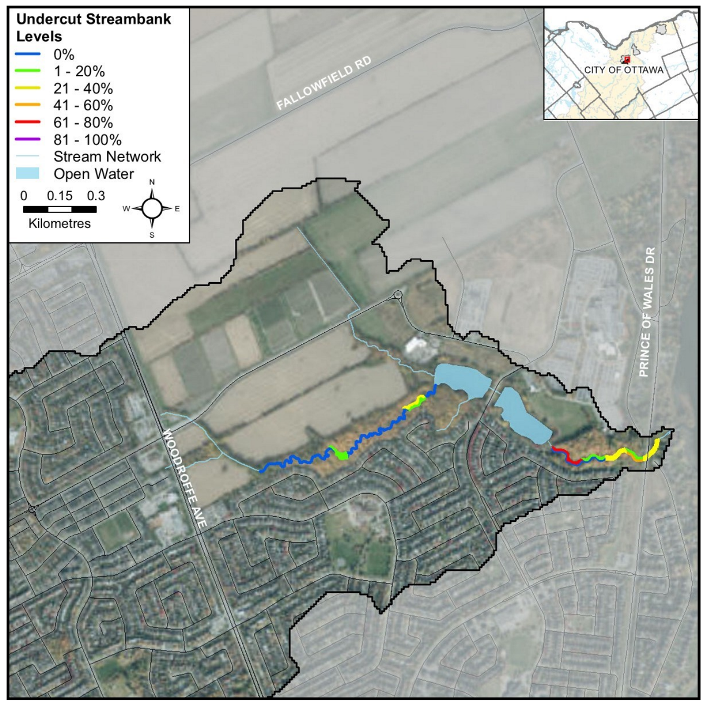


Figure 7 Undercut stream banks along Barrhaven Creek.

Bank erosion observed along Barrhaven Creek downstream of the stormwater pond.

Undercut banks west of Prince of Wales Drive along Barrhaven Creek.

Stream Shading

Grasses, shrubs and trees all contribute towards shading a stream. Shade is important in moderating stream temperature, contributing to food supply and helping with nutrient reduction within a stream. Stream cover is assessed as the total coverage area in each section that is shaded by overhanging trees/grasses and tree canopy, at greater than one meter above the water surface.

Figure 8 shows the percentage of sections surveyed with various levels of stream shading. The majority of sections, 12 of them, had a shade cover of 81 to 100 percent. Two sections had 61 to 80 percent and two had 41-60 percent shade cover conditions observed. Figure 9 shows the distribution of these shading levels as a percentage of sections surveyed along Barrhaven Creek.

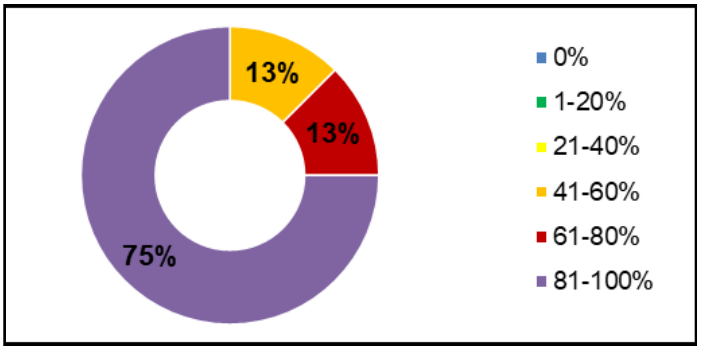


Figure 8 Stream shading levels along Barrhaven Creek.

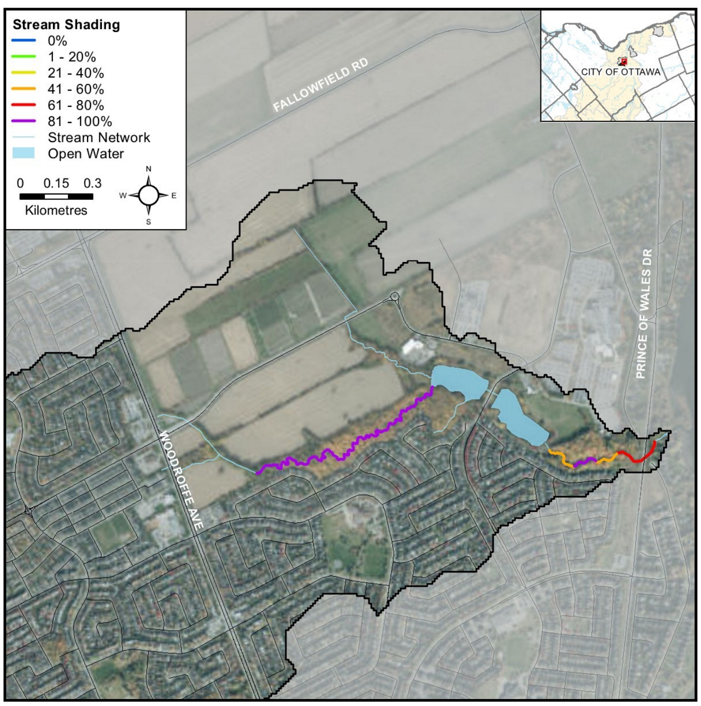


Figure 9 Stream shading along Barrhaven Creek.

The overall mix of trees and plants comprised the majority of the shading. Overhanging plants, mainly grasses, robust and broad leaved emergent plants provided shade in 25 percent of the left bank and 31 percent of the right bank.

Overhanging Trees and Branches

Trees and branches that are less than one meter from the surface of the water are defined as overhanging. Overhanging branches and trees provide a food source, nutrients and shade which helps to moderate instream water temperatures.

Figure 10 shows the presence and percentage within each section of overhanging trees and branches that were observed along Barrhaven Creek. All 100 percent of the sections had overhanging trees and branches on the left bank and right banks. This is due to the high percentage of forested conditions along the riparian zone of Barrhaven Creek.

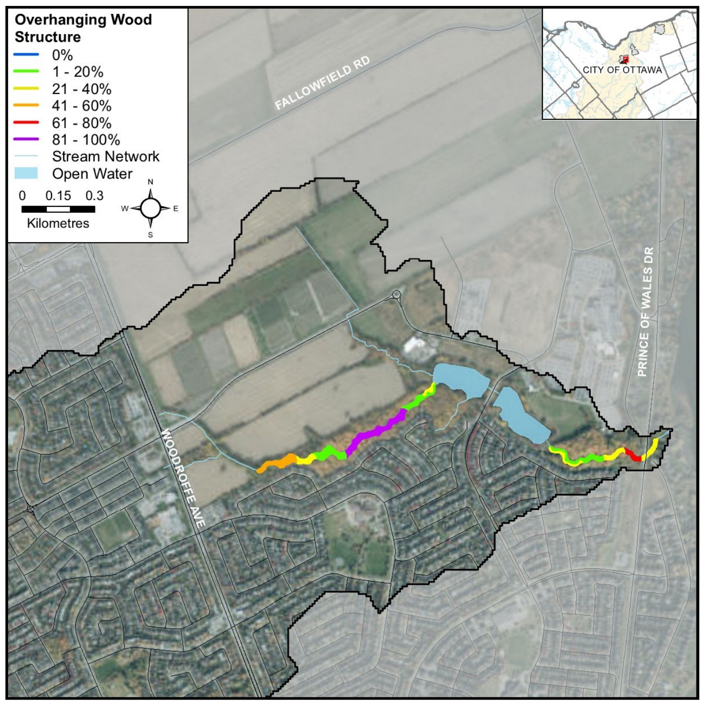


Figure 10 Overhanging trees and branches along Barrhaven Creek.

Overhanging trees and shrubs provided shade and cooling stream temperatures along Barrhaven Creek.

Barrhaven Creek Instream Habitat

Habitat Complexity

Habitat complexity is a measure of the diversity of habitat types and features within a stream. Streams with high habitat complexity support a greater variety of species niches, and therefore contribute to greater diversity. Factors such as substrate, morphologic conditions (pools, riffles) and cover material (vegetation, wood structure, etc.) all provide crucial habitat to aquatic life. Habitat complexity is assessed based on the presence of boulder, cobble and gravel substrates, as well as the presence of instream wood structure. A higher score shows greater complexity where a variety of species can be supported. Figure 11 shows habitat complexity of the sections surveyed: 44 percent had a score of one; 38 percent scored two; and 19 percent scored three. No sections surveyed scored zero or four for habitat complexity.

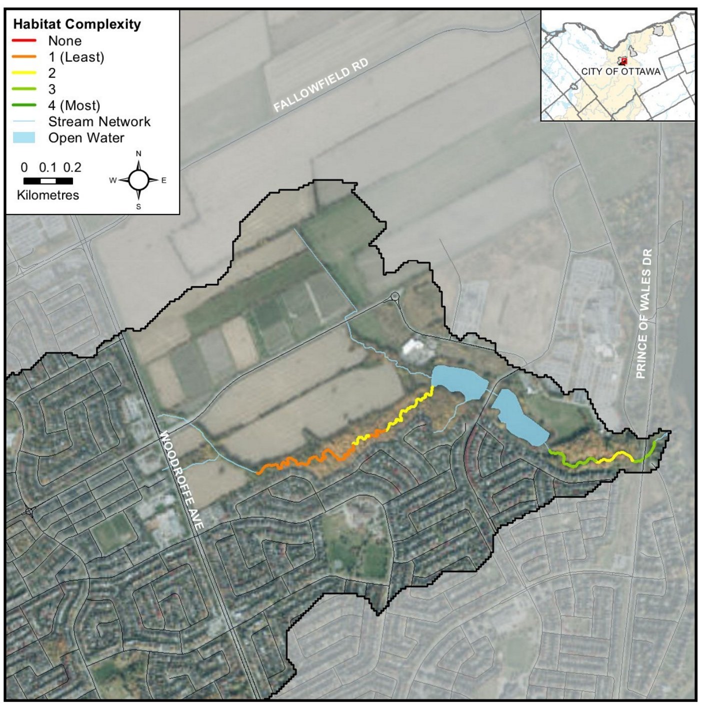


Figure 11 Instream habitat complexity along Barrhaven Creek.

Section of Barrhaven Creek with complex habitat features including boulders, cobble and instream vegetation.

Instream Substrate

Diverse substrate is important for fish and benthic invertebrate habitat because some species have specific substrate requirements and for example will only reproduce on certain types of substrate. The absence of diverse substrate types may limit the diversity of species within a stream.

Substrate complexity was observed to be fairly heterogenous in 62 percent of the sections surveyed, and homogenous in the remaining 38 percent. Figure 12 shows the substrate types and percent of sections they were observed in.

Figure 13 shows the dominant substrate types along the creek. From the assessed areas the dominant substrate type was clay at 44 percent, followed by silt at 38 percent of sections surveyed.

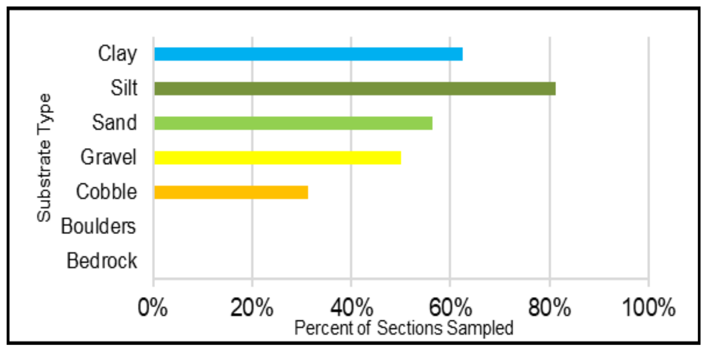


Figure 12 Instream substrate along Barrhaven Creek.

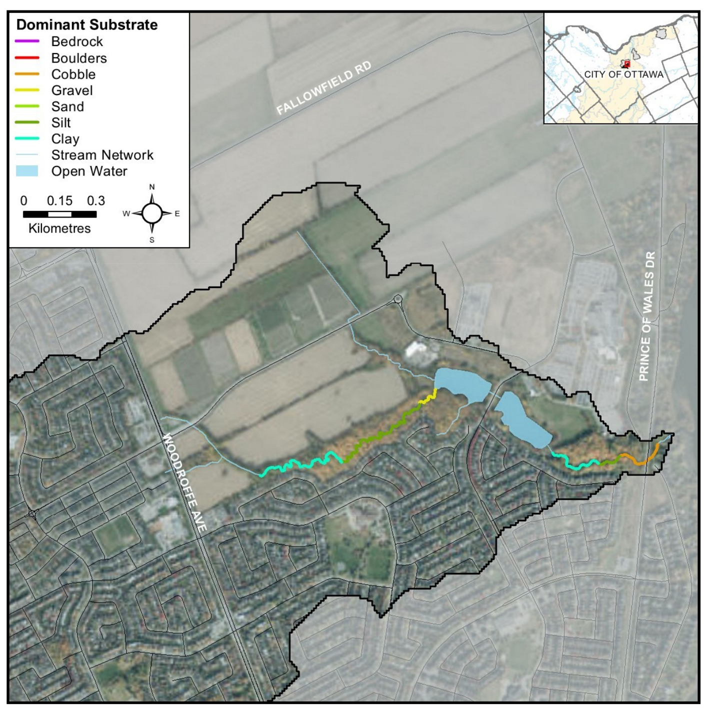


Figure 13 Dominant instream substrates along Barrhaven Creek.

Instream Morphology

Pools and riffles are important habitat features for aquatic life. Riffles are fast flowing areas characterized by agitation and overturn of the water surface. Riffles thereby play a crucial role in contributing to dissolved oxygen conditions and directly support spawning for some fish species. They are also areas that support increased benthic invertebrate populations which are an important food source for many aquatic species. Pools are characterized by minimal flows, with relatively deep water and winter and summer refuge habitat for aquatic species. Runs are moderately shallow, with unagitated surfaces of water and areas where the thalweg (deepest part of the channel) is in the center of the channel.

Figure 14 shows that the surveyed portions of Barrhaven Creek have a high diversity of morphological conditions, suitable for a variety of aquatic species and life stages; 69 percent of sections contained pools, 69 percent of sections contained riffles and 81 percent contained runs.

Figure 15 shows the locations of sections surveyed which contained riffle habitat.

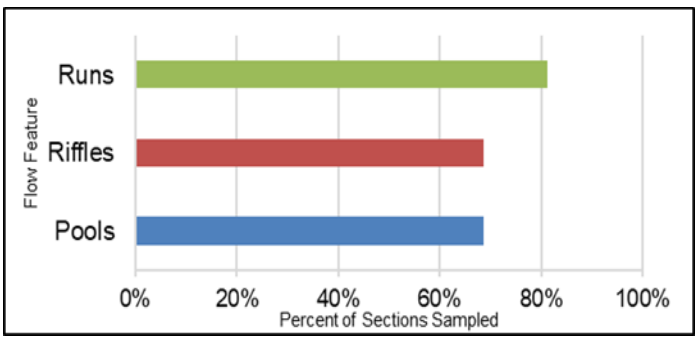


Figure 14 Instream morphology along Barrhaven Creek.

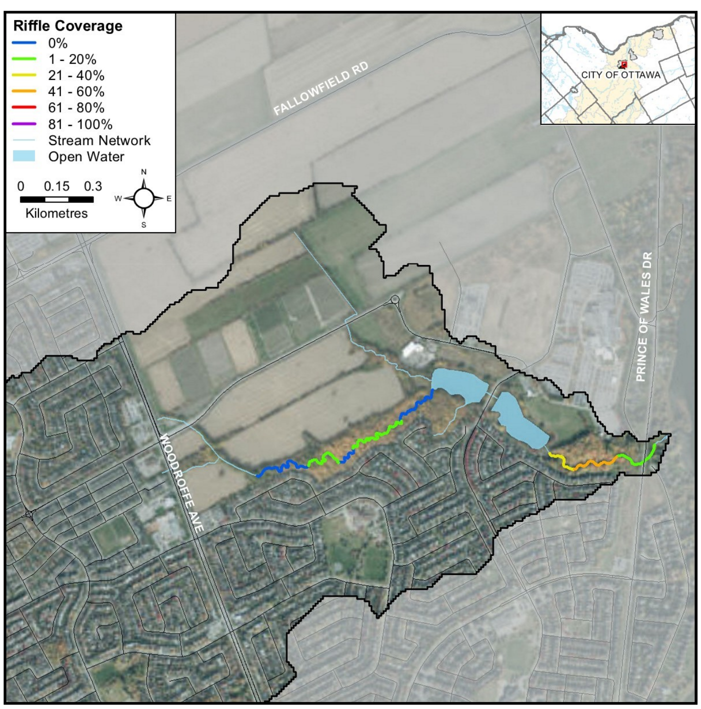


Figure 15 Riffle habitat locations along Barrhaven Creek.

Instream Wood Structure

Figure 16 shows that a large portion of Barrhaven Creek had moderate levels of instream wood structure in the form of branches and trees. Instream wood structure is important for fish and wildlife habitat since it provides refuge and feeding areas. However, excessive amounts can result in temporary seasonal migration barriers. The May 2022 wind storm resulted in a number of trees being downed into Barrhaven Creek.

Instream wood structures found along Barrhaven Creek are important for fish and wildlife habitat.

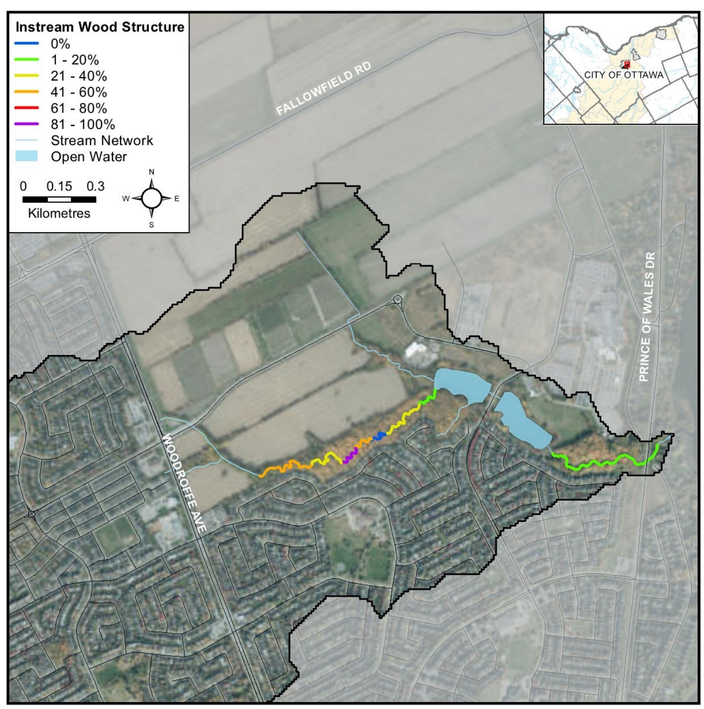


Figure 16 Instream wood structure along Barrhaven Creek.

Instream Aquatic Vegetation Type

Instream vegetation is a key component of aquatic ecosystems. It promotes stream health by:

- Providing riparian and instream habitat;
- Maintaining water quality by erosion control, nutrient cycling, and pollutant absorption;
- Stabilizing flows and reducing shoreline erosion;
- Contributing dissolved oxygen via photosynthesis;
- Moderating temperatures through shading.

Figure 17 shows the aquatic vegetation community structure along Barrhaven Creek. All sections had areas of the stream where no vegetation was present. Vegetation types in the 16 sections surveyed included: narrow-leaved emergent vegetation in eight sections; algae in three sections; broad-leaved emergent in two sections; floating, robust emergent, and submerged vegetation types were each present in one section.

Figure 18 shows the diversity of the dominant instream aquatic vegetation type by section.

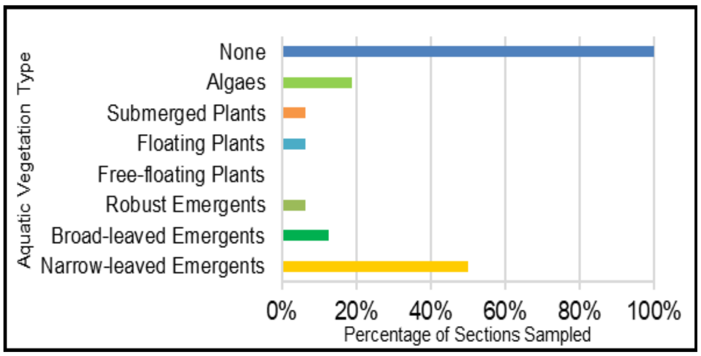


Figure 17 Aquatic vegetation presence along Barrhaven Creek.

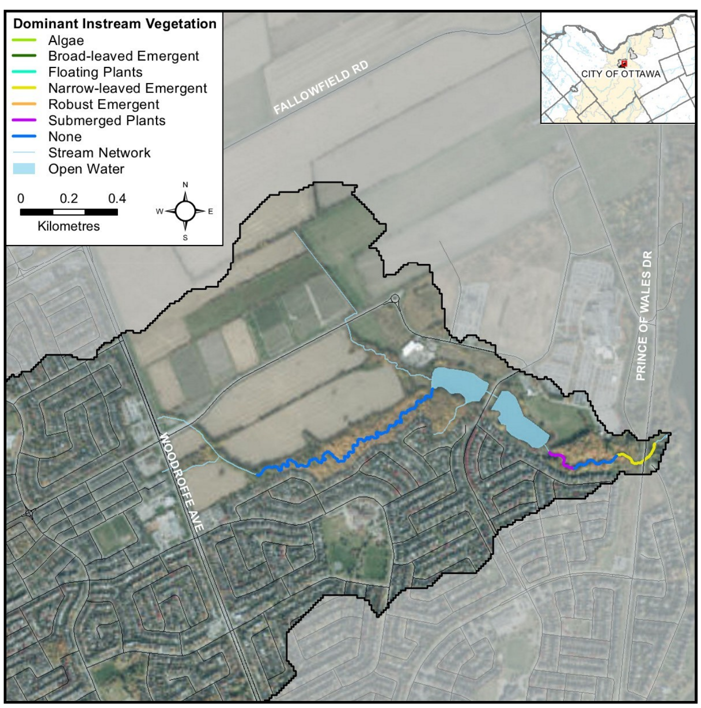


Figure 18 Dominant instream vegetation in Barrhaven Creek.

Instream Vegetation Abundance

The abundance of instream vegetation is also crucial for aquatic ecosystem health. Lack of vegetation and rare or low abundances can impair the ability of plants to contribute adequately to dissolved oxygen, provide habitat, and remove nutrients and contaminants. Extensive amounts of vegetation can also have negative impacts by lowering dissolved oxygen levels during decomposition. It can act as a physical barrier for humans and wildlife, and it can lead to a reduction in plant diversity. Invasive species in particular tend to have extensive growth.

Abundance of vegetation is classified by the amount of vegetation present along each section. The level of vegetation is categorized based on the extend of its presence in a section, from none or sparse, to parts being choked. As seen in Figure 19, 100 percent of the sections along Barrhaven Creek had locations of no vegetation, 56 percent had rare levels and 13 percent had low levels of vegetation. Normal levels of abundance were observed in only six percent of sections surveyed.

The low levels of instream vegetation found in Barrhaven Creek are likely due to substrate type and flashy flows. These characteristics impact the ability of aquatic vegetation to establish.

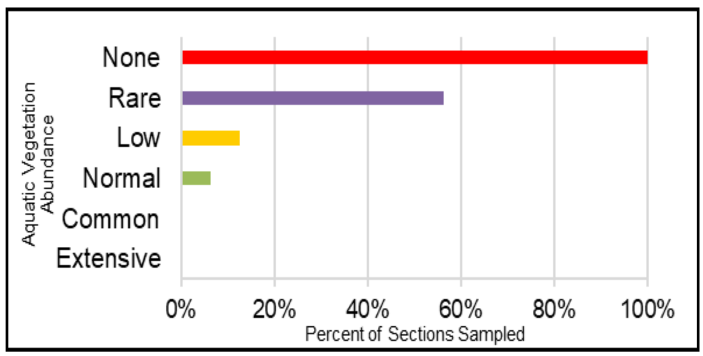


Figure 19 Instream vegetation abundance on Barrhaven Creek.

A survey section with no instream vegetation observed along Barrhaven Creek.

Barrhaven Creek Stream Health

Invasive Species

Invasive species are harmful to the environment, the economy and our society. They have high reproduction, quick establishment of dense colonies, tolerate a variety of environmental conditions and lack natural predators. They can have major implications on stream health and reduce species diversity (OMNR 2012). They can be difficult to eradicate, however it is important to continue to research, monitor and manage them. Figure 20 shows the diversity of invasive species observed per section surveyed.

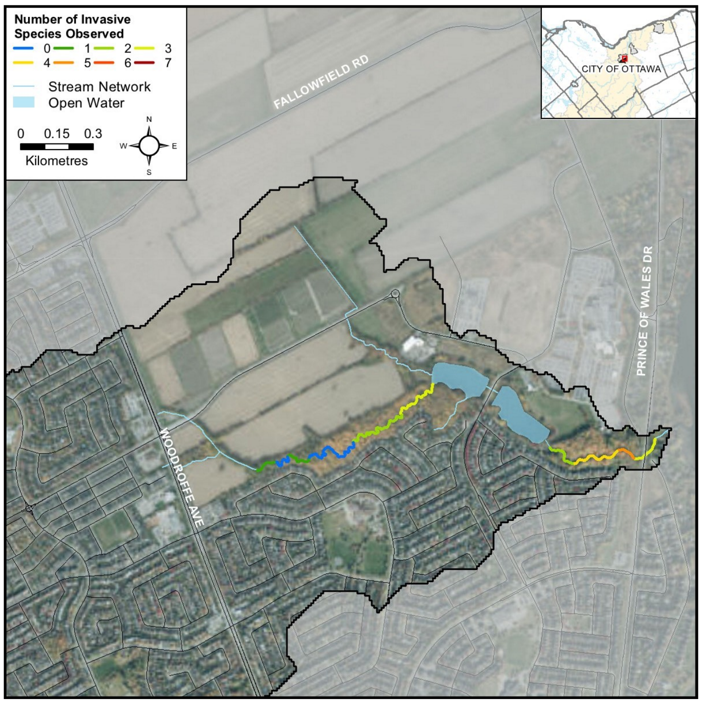


Figure 20 Invasive species diversity along Barrhaven Creek.

The following invasive species were observed in the surveyed portions of Barrhaven Creek in 2022:

- common buckthorn (*Rhamnus cathartica*)
- dog strangling vine (*Cynanchum rossicum*)
- glossy buckthorn (*Rhamnus frangula*)
- flowering rush (*Butmous umbrellatus*)
- Manitoba maple (*Acer negundo*)
- Norway maple (*Acer platanoides*)

Common buckthorn was the most observed invasive species along the riparian zone of Barrhaven Creek.

Flowering rush observed along surveyed portions of Barrhaven Creek.

To report and find information about invasive species visit:

http://www.invadingspecies.com

Managed by the Ontario Federation of Anglers and Hunters.

Pollution

Figure 21 shows where pollution was observed along Barrhaven Creek. The levels of garbage found in the main portion of the stream were high, with 88 percent of sections surveyed containing garbage. Garbage on the stream bottom was found in 69 percent of sections surveyed. Floating garbage was found within 69 percent of the surveyed sections. Garbage included plastics, automobile components, and beverage and food wrappers.

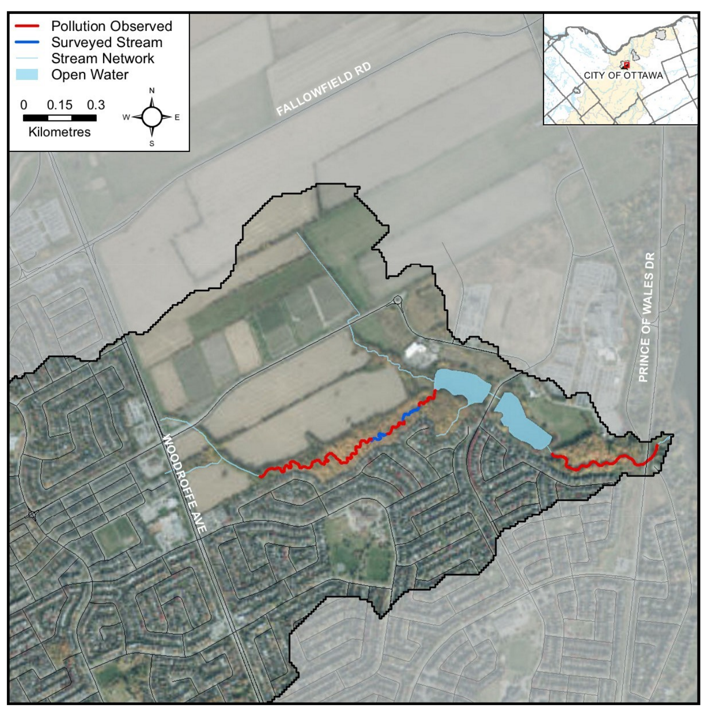


Figure 21 Pollution observed along Barrhaven Creek.

Wildlife

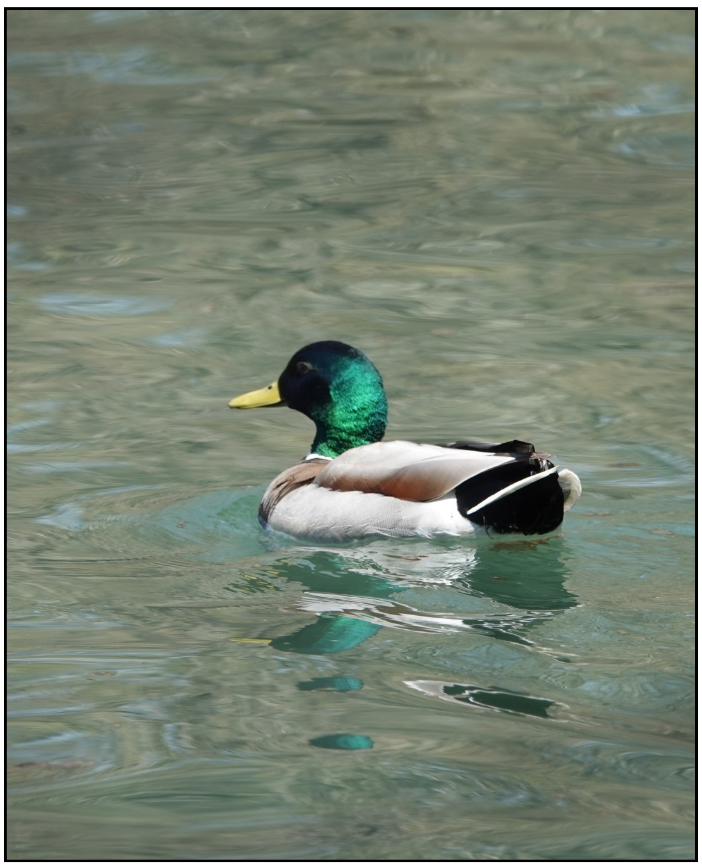
The diversity of fish and wildlife populations can be an indicator of water quality and stream health. Wildlife observations were noted during monitoring and survey activities; they do not represent an extensive evaluation of species presence along Barrhaven Creek (Table 1).

Table 1 Wildlife observations along Barrhaven Creek in 2022.

Birds	American goldfinch, American robin, Canada goose, cardinal, Cooper's hawk, crow, mallard, pileated woodpecker, song sparrow
Reptiles & Amphibians	American toad, green frog, northern leopard frog
Mammals	Eastern gray squirrel (black morph), chipmunk, raccoon tracks, red squirrel
Aquatic Insects & Benthic Invertebrates	crayfish, dragonfly larvae, damselfly larvae, isopods, snails, water striders, Unionid mussels
Other	bumblebees, damselflies, deer flies, dragonflies, mosquitoes, moths, spiders, snails

American toad (*Anaxyrus americanus*) on Barrhaven Creek.

American toad tadpoles (*Anaxyrus americanus*) observed along Barrhaven Creek.



Mallard (*Anas platyrhynchos*) observed on Barrhaven Creek.

Racoon tracks (*Procyon lotor*) observed along Barrhaven Creek.

Barrhaven Creek Water Chemistry

Water Chemistry Assessment

Water chemistry collection is done at the start and end of each 100 meter section with a multiparameter YSI probe. Monitored parameters include: air and water temperature, pH, conductivity, dissolved oxygen concentration and saturation.

Volunteer collecting water chemistry measurements with a multiparameter probe.

Dissolved Oxygen

Dissolved oxygen is essential for a healthy aquatic ecosystem, as fish and other aquatic organisms need oxygen to survive. The level of oxygen required is dependent on the particular species and life stage. The lowest acceptable concentration for the early and other life stages according to the Canadian water quality guidelines for the protection of aquatic life are: 6.0 milligrams per liter in warm-water biota and 9.5 milligrams per liter for cold-water biota (CCME 1999).

Figure 22 shows the concentration levels found in the surveyed portions of Barrhaven Creek. The two dashed lines depict the Canadian water quality guidelines. Most of the surveyed portions were found to have oxygen levels within the Canadian water quality guidelines.

Dissolved oxygen levels that are sufficient to support warm-water aquatic life were found in all sections of Barrhaven Creek (sec. 1-16). Average concentration levels across the system were 8.3 mg/L.

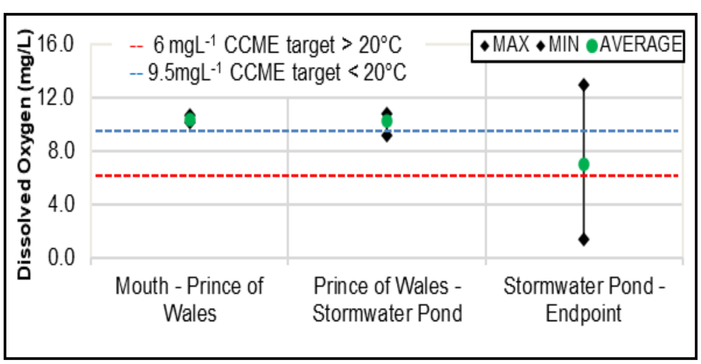


Figure 22 Dissolved oxygen ranges along surveyed sections of Barrhaven Creek: sections 1-16.

Conductivity

Conductivity is a measure of water's capacity to conduct electrical flow. This capacity is dictated by the presence of conductive ions that originate from inorganic materials and dissolved salts. Water conductivity in natural environments is typically dictated by the geology of the area, however anthropogenic inputs also have a profound effect. Currently there is no existing guideline for stream conductivity levels, however conductivity measurements outside of normal range across a system are good indicators of anthropogenic inputs including unmitigated discharges and storm water input.

Figure 23 shows specific conductivity levels in Barrhaven Creek. The average level, 893 µS/cm, is depicted by the dashed line. Conductivity levels are lower in areas approaching headwater reaches. Higher levels were observed in the sections immediately downstream of the stormwater facility and the confluence with the Rideau River (sec.1-16).

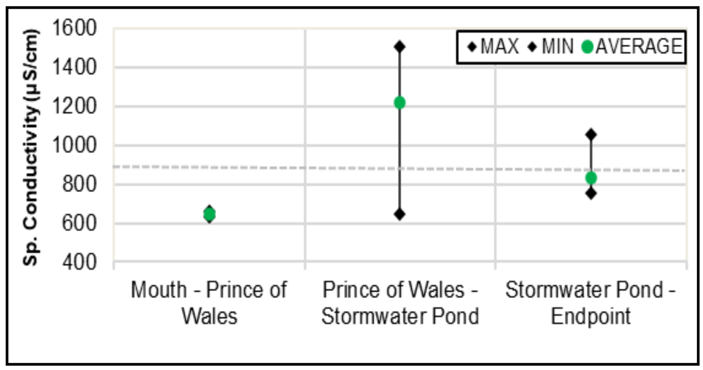


Figure 23 Specific Conductivity ranges along surveyed sections of Barrhaven Creek: sections 1-16.

pH

pH is a measure of alkalinity or acidity. This parameter is influenced by the geology of the system but it can also be influenced by anthropogenic inputs. For pH the provincial water quality objective (PWQO) recommends a range of 6.5 to 8.5 to protect aquatic life (MOEE 1994).

Figure 24 shows Barrhaven Creek had pH levels that meet the PWQO, depicted by the dashed lines. The average level across the system was pH 7.72.

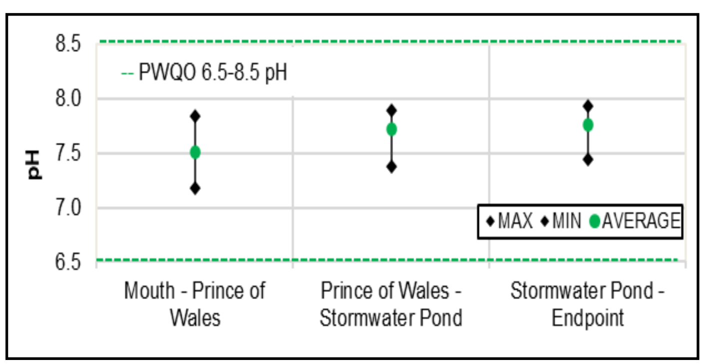


Figure 24 pH ranges along surveyed sections of Barrhaven Creek: sections 1-16.

Oxygen Saturation (%)

Oxygen saturation is measured as the ratio of dissolved oxygen relative to the maximum amount of oxygen that will dissolve based on the temperature and atmospheric pressure. Well oxygenated water will stabilize at or above 100 percent saturation, however the presence of decaying matter/pollutants can drastically reduce these levels. Oxygen input through photosynthesis has the potential to increase saturation above 100 percent to a maximum of 500 percent, depending on the productivity level of the environment. In order to represent the relationship between concentration and saturation, the measured values have been summarized into 6 classes:

1) <100% Saturation / <6.0 mg/L Concentration

Oxygen concentration and saturation are not sufficient to support aquatic life and may represent impairment.

2) >100% Saturation / <6.0 mg/L Concentration

Oxygen concentration is not sufficient to support aquatic life, however saturation levels indicate that the water has stabilized at its estimated maximum. This is indicative of higher water temperatures and stagnant flows.

3) <100% Saturation / 6.0—9.5 mg/L Concentration

Oxygen concentration is sufficient to support warm-water biota, however depletion factors are likely present and are limiting maximum saturation.

4) >100% Saturation / 6.0—9.5 mg/L Concentration

Oxygen concentration and saturation levels are optimal for warm-water biota.

5) <100% Saturation / >9.5 mg/L Concentration

Oxygen concentration is sufficient to support cold-water biota, however depletion factors are likely present and are limiting maximum saturation.

6) >100% Saturation / >9.5 mg/L Concentration

Oxygen concentration and saturation levels are optimal for warm and cold-water biota.

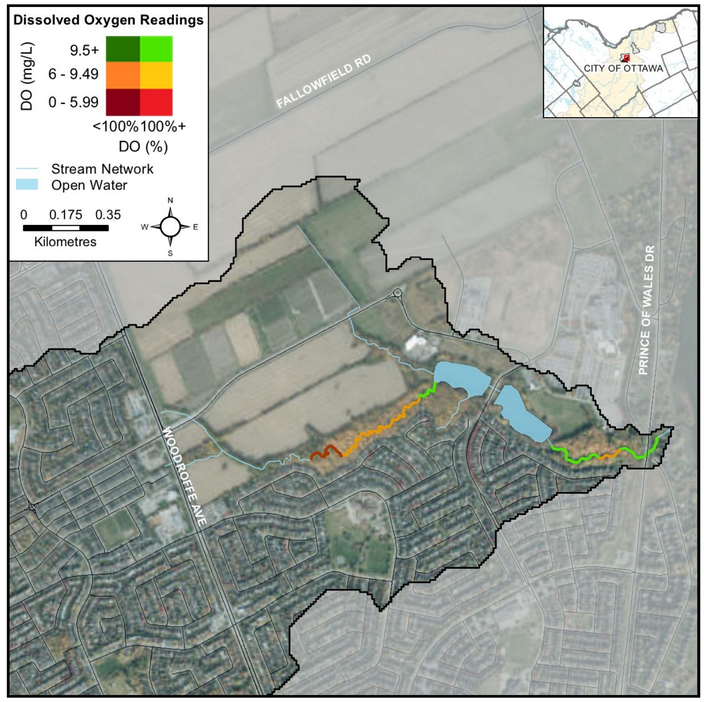


Figure 25 Bivariate assessment of dissolved oxygen concentration (mg/L) and saturation (%) along Barrhaven Creek.

Figure 25 shows the oxygen conditions across the areas that were surveyed in 2022. Dissolved oxygen conditions in Barrhaven Creek were sufficient to sustain cold-water biota in most areas from the confluence with the Rideau River to just downstream of the stormwater management facility, and up to 100m upstream of it. Most sections upstream of the facility had sufficient conditions to support warm-water biota. The most upstream portion surveyed had significant levels of impairment both in concentration and percent saturation. These areas had very shallow intermittent flow with naturally lower oxygen levels. An increase in water flows in these areas could possibly increase levels of dissolved oxygen concentration.

Section on Barrhaven Creek upstream of the stormwater management facility with **impaired** oxygen conditions (Dissolved oxygen levels of 3.97 mg/L and 39.7% saturation).

Section on Barrhaven Creek near Prince of Wales Drive with **optimal** oxygen conditions for cold-water biota (Dissolved oxygen levels of 10.65 mg/L and 111.6% saturation).

Specific Conductivity Assessment

Specific conductivity (SPC) is a standardized measure of electrical conductance, collected at or corrected to a water temperature of 25°C. SPC is directly related to the concentration of ions in water, and is influenced by the area geology and anthropogenic input as it contributes to the presence of dissolved salts, alkalis, chlorides, sulfides and carbonate compounds. The higher the concentration of these compounds, the higher the conductivity. Common sources of elevated conductivity include stormwater, agricultural inputs and commercial or industrial effluents.

In order to summarize the conditions observed, levels were evaluated as either normal, moderately elevated or highly elevated. These categories are defined by the amount of variation (standard deviation) at each section compared to the system's average.

Average levels of specific conductivity measured in the surveyed portions of Barrhaven Creek (892.7 µS/cm) exceeded guidelines (<500 µS/cm) used for the Canadian Environmental Performance Index (Environment Canada 2011).

Figure 26 shows relative specific conductivity levels in Barrhaven Creek. Normal levels were maintained for most of the surveyed portions. Moderately elevated conditions were observed approaching the stormwater management facility upstream of Prince of Wales Drive. This area is influenced by the ions concentrated in the stormwater management facility.

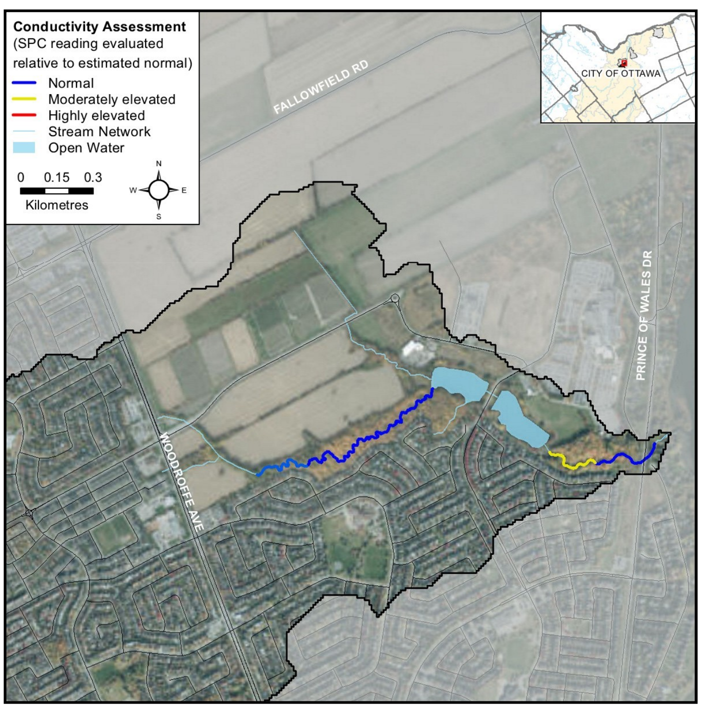


Figure 26 Relative specific conductivity levels along Barrhaven Creek.

Groundwater

Groundwater discharge areas can influence stream temperature, contribute nutrients, and provide important stream habitat for fish and other biota. During stream surveys no indicators of groundwater discharge were observed (Figure 27). Indicators typically include: springs/seeps, watercress, iron staining, significant temperature changes and rainbow mineral film.

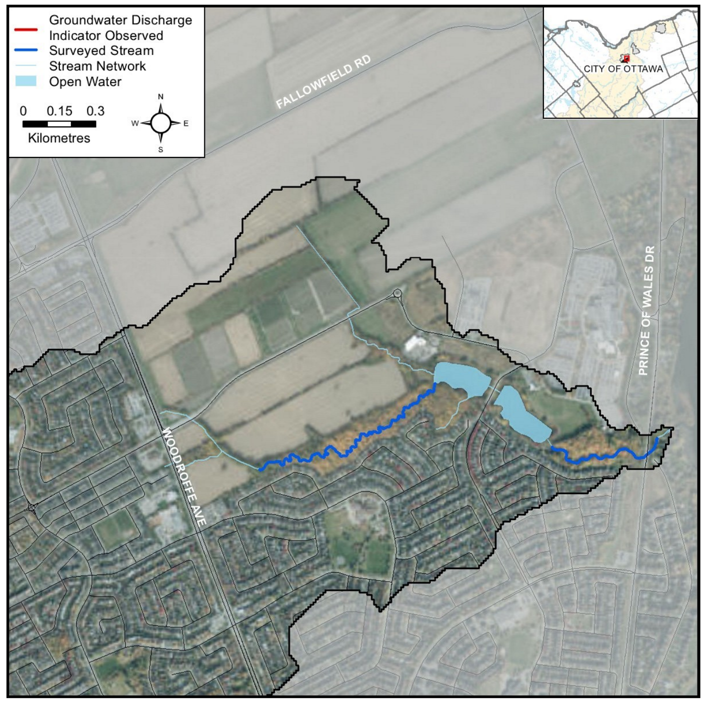


Figure 27 Groundwater indicators were not observed in the Barrhaven Creek catchment.

Section of Barrhaven Creek where previous groundwater observations were made in 2015.

Barrhaven Creek Thermal Classification

Thermal Classification

Instream water temperatures are influenced by various factors including season, time of day, precipitation, storm water run off, springs, tributaries, drains, discharge pipes, stream shading from riparian vegetation and artificial shade created by infrastructure. To monitor water temperatures in Barrhaven Creek, two temperature loggers were placed in early June and retrieved at the end of September.

Figure 28 shows where thermal sampling sites were located. Analysis from the data loggers (using the Stoneman and Jones, 1996, method adapted by Chu et al., 2009), indicate Barrhaven Creek is classified as a **coolwater** to **cool-warmwater** system in 2015, shifting to all **cool-warmwater** in 2022. Figures 29 and 30 show a comparison of thermal conditions from 2015 and 2022. The system appears to be shifting to a warmer thermal regime classification.

Fish species observed in the monitored areas have thermal preferences from cool to warmwater as indicated by Cocker at al. (2001).

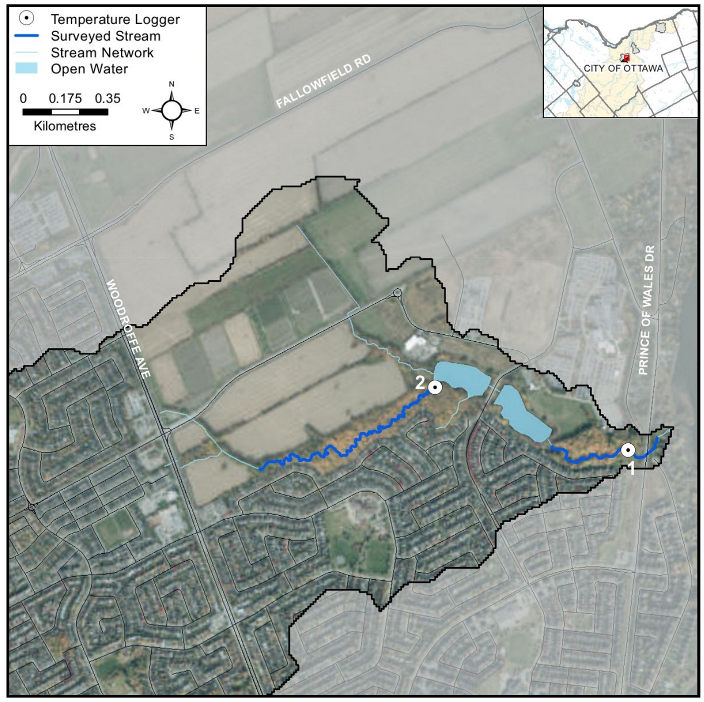


Figure 28 Temperature logger locations on Barrhaven Creek.

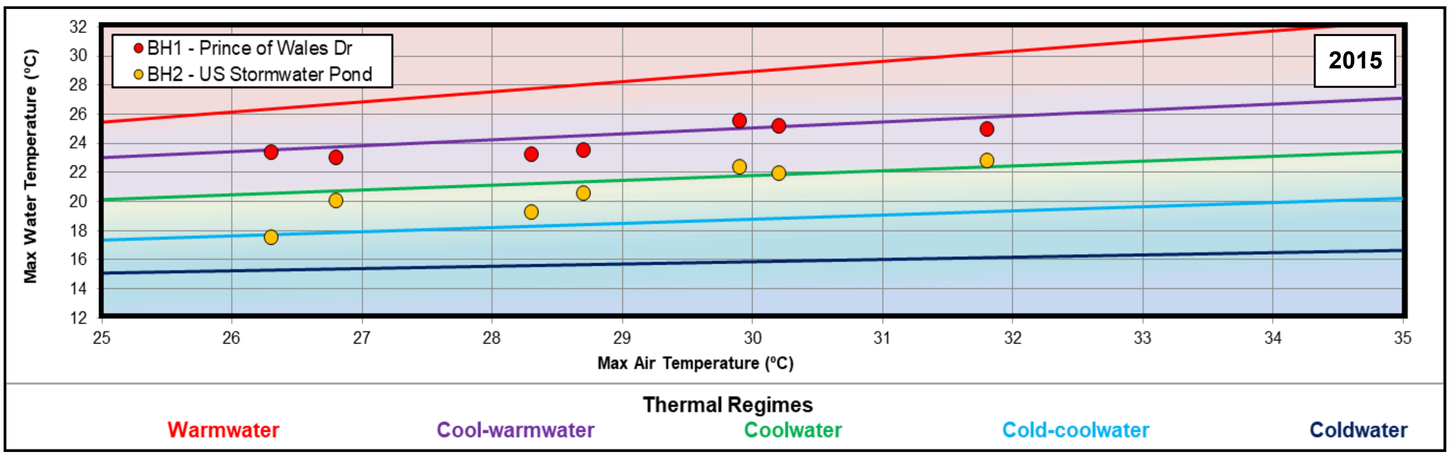


Figure 29 Thermal Classification for Barrhaven Creek with the five thermal regimes adapted from Stoneman and Jones (1996) by Chu et al. (2009): **coolwater** (BH2) and **cool-warmwater** (BH1) categories for the sites sampled on Barrhaven Creek in **2015.**

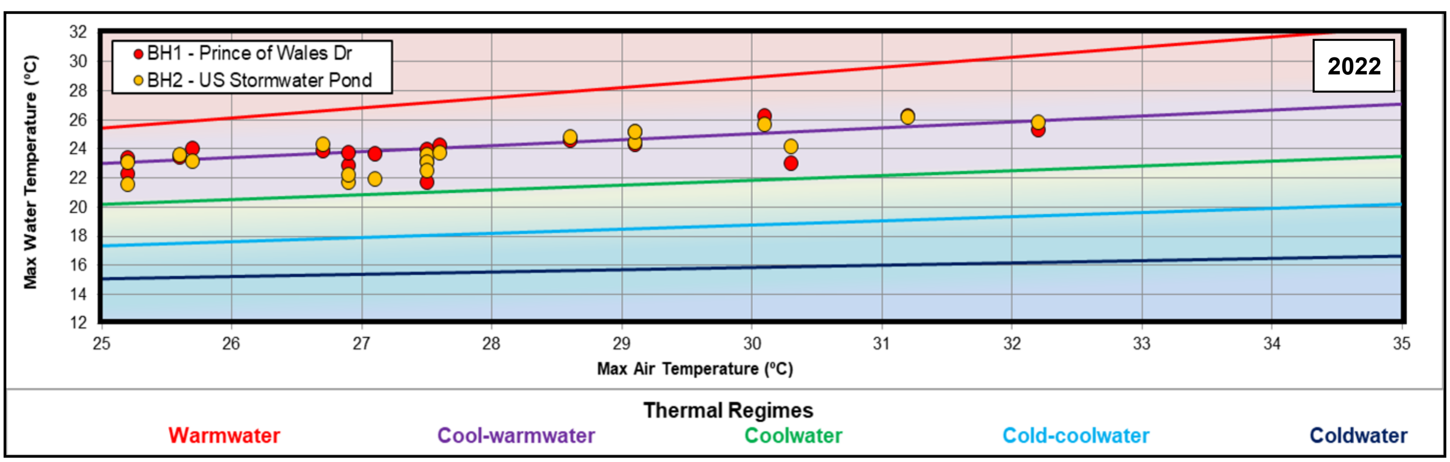


Figure 30 Thermal Classification for Barrhaven Creek with the five thermal regimes adapted from Stoneman and Jones (1996) by Chu et al. (2009): **cool-warmwater** category for the sites sampled on Barrhaven Creek in **2022.**

Barrhaven Creek Fish Community

Fish Community Summary

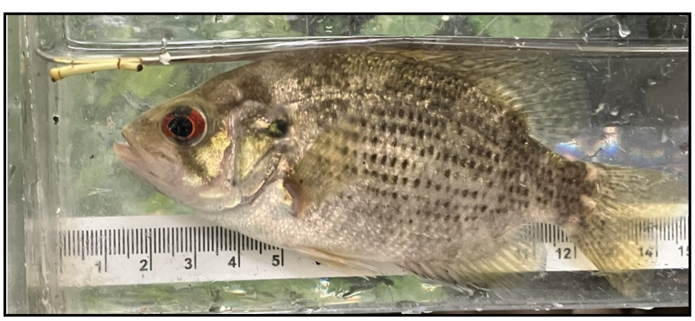
Four fish sampling sites were evaluated between June and August 2022. Three site locations were sampled with the use of a backpack electrofishing unit, and one site was sampled with a bag seine net.

Eight species were captured in 2022; they are listed in Table 2 along with their thermal classification preferences (Coker et al., 2001) and MNR species codes. Barrhaven Creek had a mixed fish community ranging from cool to warm water species.

The sampling locations where these species were observed, as well as Rideau Valley Conservation Authority (RVCA) historical sites, in white, are depicted in Figure 31. The codes used in the figure are the MNR species codes provided in Table 2. For comparisons across sampling years and a complete list of RVCA historical fish records from Barrhaven Creek refer to page 18 of this report.

Table 2 Fish species observed in Barrhaven Creek in 2022.

Species	Thermal Class	MNR Species Code
Brook stickleback *Culaea inconstans*	**Cool**	BrSti
Carps and minnows unidentified species	**Cool to Warm**	CA_MI
Creek chub *Semotilus atromaculatus*	**Cool**	CrChu
Fathead minnow Pimephales promelas	**Warm**	FhMin
Longnose dace *Rhinichthys cataractae*	**Cool**	LnDac
Northern redbelly dace *Chrosomus eos*	**Cool-warm**	NRDac
Rock bass *Ambloplites rupestris*	**Cool**	RoBas
Spotfin shiner *Cyprinella spiloptera*	**Warm**	SfShi
White sucker *Catostomus commersonii*	**Cool**	WhSuc
Total Species		**8**



Rock bass, *Ambloplites rupestris*, observed in Barrhaven Creek.

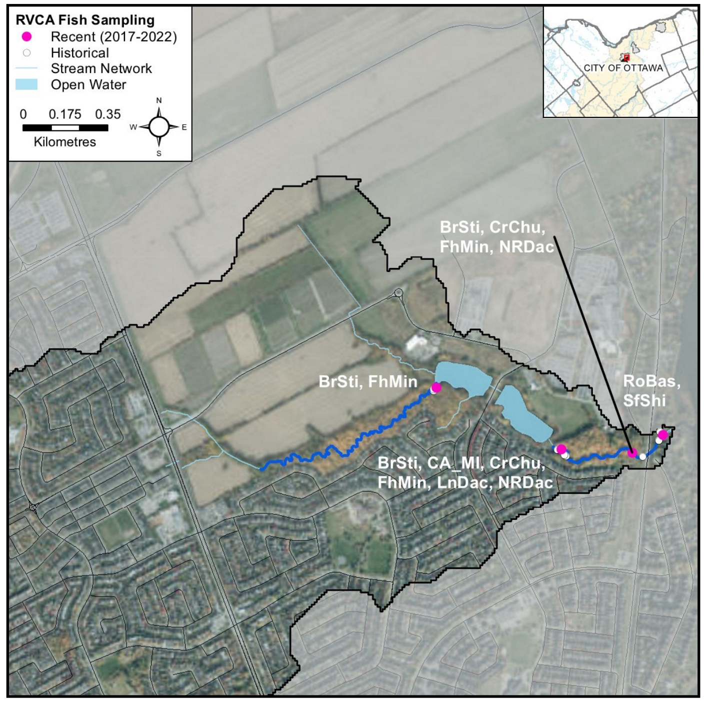
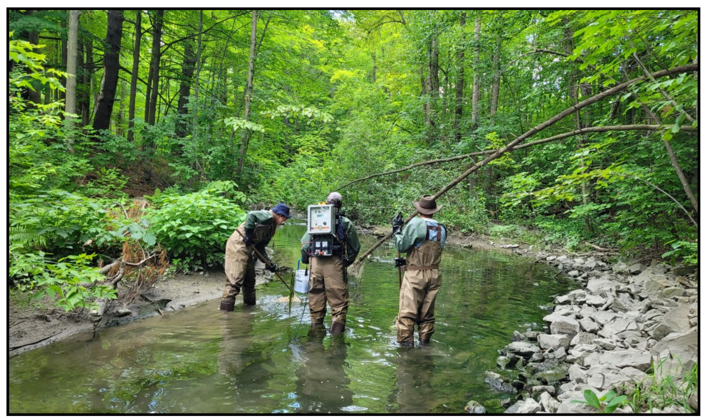


Figure 31 Barrhaven Creek fish sampling locations (historical in white, 2022 in pink) and fish species observations from 2022.



Fish community sampling by electrofishing (above); and common white suckers, *Catostomus commersonii*, observed spawning along Barrhaven Creek (below).

Migratory Obstructions

It is important to know locations of migratory obstructions because these can prevent fish from accessing important spawning and rearing habitat. Migratory obstructions can be natural or manmade, and they can be permanent or seasonal.

There were four migratory obstructions observed along the surveyed portions of Barrhaven Creek. The migratory obstructions observed are shown in Figure 32. There were two manmade obstructions, a grade barrier at Prince of Whales Drive and a weir at the stormwater management facility. The other two obstructions were natural debris jams, which were only seasonal barriers.

Debris jams in the upper reaches of Barrhaven Creek, create seasonal migratory obstructions.

Perched culverts can result in fish passage obstructions which can reduce species diversity along a watercourse.

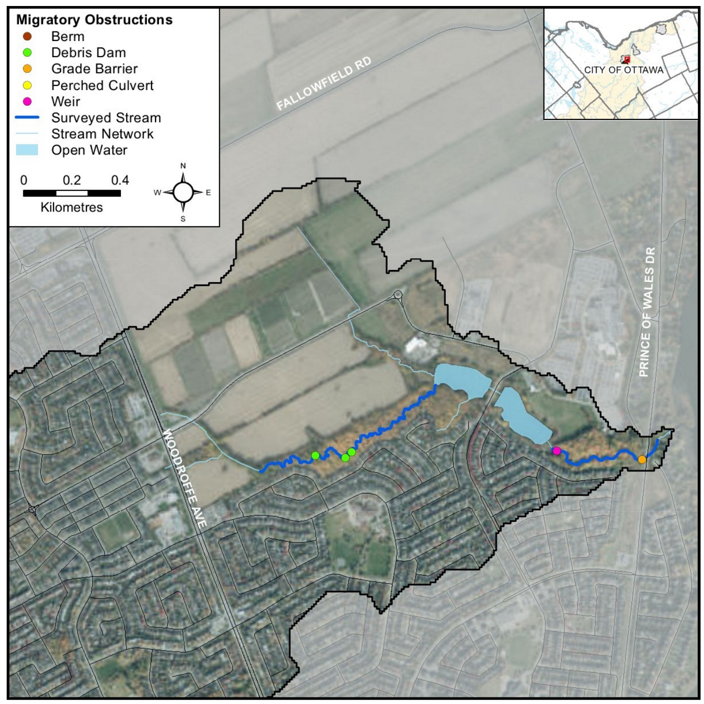


Figure 32 Locations of migratory obstructions along Barrhaven Creek.

Building structure at the stormwater management facility on Barrhaven Creek is a permanent migratory obstruction.

Beaver Dams

Beaver dams create natural changes in the environment. Some of the benefits include providing habitat for fish and wildlife, flood control, baseflow during low water conditions and sediment retention. Additional benefits come from bacterial decomposition of wood material used in the dams which removes excess nutrient and toxins. Beaver dams can in certain circumstances result in seasonal barriers to fish migration. They can also potentially put important infrastructure at risk upstream of the dam location. If this is an issue, there are dam flow device options that can be considered and potentially implemented that balance the risks to infrastructure while supporting the ecosystem created by the dam. In 2022 no beaver dams were identified along Barrhaven Creek.

Stream Comparison Between 2009, 2015 and 2022

The following tables provide a comparison of observations on Barrhaven Creek between the 2009, 2015 and 2022 survey years (RVCA, 2009; RVCA, 2015). Monitoring protocols since 2009 have been modified and enhanced, so only certain data from that year can be compared to later years. In order to accurately represent current and historical information, the data was only compared for those sections which were surveyed in all three years. This information is a comparative evaluation and doesn't represent the entirety of our assessment.

Water Chemistry

Water chemistry parameters are collected throughout all the sections surveyed in the stream. This criteria reflects the conditions and changes in the environment. Variation in these conditions can be attributed to environmental and ecological changes. Some can be in part due to natural variability within the system from various weather, seasonal, and annual conditions. Table 3 shows a comparison of these water chemistry parameters between 2009, 2015 and 2022.

Average pH decreased by 0.65 units from 2009 to 2015 and increased by 0.18 in 2022. Specific conductivity decreased from 2009 to 2015 by 23.8 µS/cm and increased by 5.5 µS/cm in 2022. Average dissolved oxygen levels were found to be significantly higher in 2009. From 2015 to 2022, dissolved oxygen levels decreased by 1.1 mg/L. These water chemistry changes, particularly from 2009, can also be attributed to seasonal conditions and cooler temperatures which are conducive to the stream's ability to have higher pH levels, more dissolved ions and increased conductivity, as well as hold more oxygen.

Table 3 Water chemistry comparison (2009, 2015 and 2022).

Water Chemistry (2009, 2015 and 2022)				
Year	**Parameter**	**Unit**	**Average**	**STND Error**
2009	pH	-	8.19	± 0.32
2015	pH	-	7.54	± 0.04
2022	pH	-	7.72	± 0.78
2009	Sp. Conductivity	us/cm	911.0	± 115.4
2015	Sp. Conductivity	us/cm	887.2	± 47.8
2022	Sp. Conductivity	us/cm	892.7	± 111.3
2009	Dissolved Oxygen	mg/L	71.2	± 12.5
2015	Dissolved Oxygen	mg/L	5.4	± 0.6
2022	Dissolved Oxygen	mg/L	4.3	± 1.1
2009	Water Temperature	ºC	12.2	± 1.9
2015	Water Temperature	ºC	18.3	± 0.4
2022	Water Temperature	ºC	16.7	± 1.6
2009	Standardized Stream Temperature[1]	ºC Water / 1ºC Air	0.83	± 0.26
2015	Standardized Stream Temperature[1]	ºC Water / 1ºC Air	0.78	± 0.16
2022	Standardized Stream Temperature[1]	ºC Water / 1ºC Air	0.86	± 0.13

[1] ***Standardized Stream Temperature:*** Temperature data is collected via logger and standardized based on the following conditions:

- Daily maximum air temperatures must exceed 24.5 ºC;
- No precipitation for 3 days preceding measurement;
- Measurements to be taken between 4:00PM - 6:00PM;
- Water temperature points collected from July 1st - September 10th;
- Logger must be deployed in flowing waters.

Average summer water temperatures range from cooler water in 2009 (12.2°C) to warmer values in 2015 (18.3° C) and 2022 (16.7°C), with 6.1 degrees centigrade of variation. In 2009 cooler temperatures than other reporting years are due to the different sampling time windows. Observations in 2009 were made in the month of April, in 2015 observations were made in May, while surveys were completed in June and July in 2022. Aside from these general temperature observations, loggers provide a detailed recording of stream thermal conditions. Standardized stream temperature assessments account for climatic factors including air temperatures and precipitation. With the data collected from temperature loggers at Prince of Wales Drive and upstream of the stormwater management facility, standardized stream temperature factors were calculated and summarized in Table 3. This factor has varied from 2009 to 2022. From 2015 to 2022, Barrhaven Creek has shifted from a coolwater to a cool-warmwater system (methods from Chu et al., 2009).

Invasive Species

The percentage of sections surveyed where invasive species were observed had an increase of two percent (Table 4). Most invasive species previously reported had an increase in the number of sections they were observed in. There are also several species that were not reported in 2022, they are likely still present but not noted at the time of the survey.

Table 4 Invasive species presence (% of sections) observed in 2015 and 2022, NR denotes not reported.

Invasive Species	2015	2022	+/-
Common buckthorn	13%	69%	▲
Dog strangling vine	NR	13%	▲
European frogbit	6%	NR	▼
Flowering rush	6%	13%	▲
Glossy buckthorn	6%	38%	▲
Honey suckle (non-native)	6%	NR	▼
Manitoba maple	40%	56%	▲
Norway maple	6%	6%	-
Total percent of sections invaded	**73%**	**75%**	▲

Pollution

Garbage accumulation along Barrhaven Creek was found to have decreased from 2009 to 2015 with a small increase observed in 2022. Overall, in 2022 less garbage was observed than in 2009 but had similar levels to 2015. In 2022 the polluted sections contained garbage such as plastics, packaging, beverage containers and vehicle parts. Table 5 shows pollution levels in all three monitoring years.

Table 5 Pollution levels (presence in % of sections surveyed) comparison between 2009-2022.

Pollution/Garbage	2009	2015	2022	+/-
Floating garbage	73%	67%	69%	▲
Garbage on stream bottom	47%	53%	69%	▲
Oil or gas trail	7%	0%	0%	▼
Total polluted sections	**100%**	**80%**	**88%**	▲

Instream Aquatic Vegetation

Table 6 shows both increases and increases in instream aquatic vegetation from 2015 to 2022. Narrow-leaved emergent plants (e.g. sedges) broad leaved emergent plants (e.g. arrowhead), robust emergent plants (e.g. cattails) and floating plants (e.g. water lilies) were present in more sections in 2022. Free-floating plants (e.g. frog-bit), submerged plants (e.g. pondweed) and algae had lower observations in the number of sections surveyed. These slight differences are likely associated with different seasonal plant emergence, observations in 2015 were made in late spring, and in 2022 in early summer.

Table 6 Instream aquatic vegetation (presence in % of sections) comparison between 2015 and 2022.

Instream Vegetation	2015	2022	+/-
Narrow-leaved emergent plants	6%	50%	▲
Broad-leaved emergent plants	1%	13%	▲
Robust emergent plants	0%	6%	▲
Free-floating plants	1%	0%	▼
Floating plants	0%	6%	▲
Submerged plants	1%	6%	▲
Algae	35%	19%	▼
None	56%	100%	▲

Fish Community

Fish sampling was carried out by the City Stream Watch program in 2009, 2015 and 2022 to evaluate fish community composition in Barrhaven Creek (see Table 7). In total 25 species have been observed in Barrhaven Creek. In 2009, 20 fish species were captured at three sites (over nine sessions); in 2015, 13 species were observed in five sites; and eight species were observed in four sites in 2022.

Although more species were captured in 2009 and 2015, the sampling efforts were greater, capturing more species diversity. This does not mean the species have disappeared, but likely reflect the difference in sampling efforts. The majority of species observed in 2022 had been captured in previous years, with the spotfin shiner as a new observation.

Table 7 Comparison of fish species caught between 2009-2022.

Species	2009	2015	2022
Black crappie *Pomoxis nigromaculatus*	X		
Bluegill *Lepomis microchirus*	X		
Bluntnose minnow *Pimephales notatus*	X		
Brassy minnow *Hybognathus hankinsoni*	X		
Brook stickleback *Culaea inconstans*	X	X	X
Carps and minnows unidentified species	X		X
Common carp *Cyprinus carpio*		X	
Common shiner *Luxilus cornutus*	X	X	
Creek chub *Semotilus atromaculatus*	X	X	X
Darter species *Etheostoma spp.*	X		
Fallfish *Semotilus corporalis*		X	
Fathead minnow Pimephales promelas	X	X	X
Finescale dace *Chrosomus neogaeus*	X		
Golden shiner *Notemigonus crysoleucas*		X	
Largemouth bass *Micropterus salmoides*	X		
Logperch *Percina caprodes*	X		
Longnose dace *Rhinichthys cataractae*		X	X
Northern pike *Esox Lucius*	X		
Northern redbelly dace *Chrosomus eos*	X	X	X
Pumpkinseed *Lepomis gibbosus*	X		
Rock bass *Ambloplites rupestris*	X	X	X
Smallmouth bass Micropterus dolomieu	X	X	
Spotfin shiner Cyprinella spiloptera			X
Walleye *Sander vitreus*	X	X	
White sucker *Catostomus commersonii*	X	X	X
Yellow perch *Perca flavescens*	X		
Total Species 25	**20**	**13**	**8**

Spotfin shiners captured in Barrhaven Creek in 2022.

Monitoring and Restoration

Monitoring on Barrhaven Creek

Table 8 highlights recent and past monitoring and restoration activities that have been completed on Barrhaven Creek by the Rideau Valley Conservation Authority's City Stream Watch program. Monitoring activities and stewardship efforts have changed over the years.

Table 8 City Stream Watch activities on Barrhaven Creek.

Accomplishment	Year	Description
City Stream Watch Stream Monitoring	2009	2 km of stream was surveyed
	2015	1.5 km of stream was surveyed
	2022	1.6 km of stream was surveyed
City Stream Watch Fish Sampling	2009	Three fish community sites were sampled
	2015	Five fish community sites were sampled
	2022	Four fish community sites were sampled
City Stream Watch Thermal Classification	2009	One temperature probe was deployed from June to September
	2015	Two temperature probes were deployed from April to September
	2022	Two temperature probes were deployed from June to September
Headwater Drainage Feature Assessment	2015	Two headwater drainage feature sites were sampled in the Barrhaven Creek catchment
City Stream Watch Garbage Cleanups	2015	Garbage was removed by volunteers from Black Rapids Creek near the stormwater management pond
	2018	Part of Clean up the Capital, volunteers collected garbage along the stormwater management pond
	2022	In a spring cleanup, volunteers removed accumulated garbage found within Barrhaven Creek

Potential Instream Restoration Opportunities

Instream restoration opportunities include potential enhancement through channel modification, fish habitat enhancement and stream garbage cleanups.

Stream Garbage Cleanups

Opportunities were identified along Barrhaven Creek near the stormwater management facility, and a garbage cleanup was completed in the summer.

Volunteers removing garbage observed during stream survey work along Barrhaven Creek.

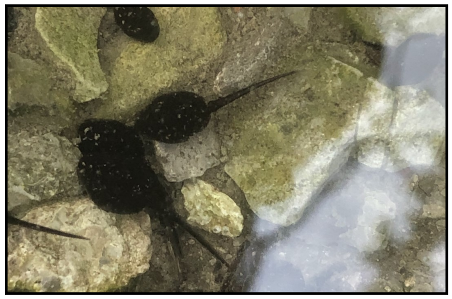
Potential Riparian Restoration Opportunities

Riparian restoration opportunities include potential enhancement through riparian planting, wildlife habitat enhancement, erosion control and invasive species management. Opportunities were not identified along Barrhaven Creek surveyed areas this year (Figure 34).

Potential future opportunities

The surveys of Barrhaven creek will enable the City Stream Watch program to monitor ongoing invasive species distribution and potential high erosion sites. Although at this time there are no recommendations for riparian restoration opportunities they may potentially be needed if there are future changes in the system. In particular high erosion areas near Prince of Wales Drive and upstream of the stormwater management facility may need attention in the future.

Section of Barrhaven Creek near Prince of Wales Drive with increased erosion levels that may require erosion mitigation measures in the future.


Barrhaven Creek photographs courtesy of: Amy McPherson, City of Ottawa 2022.

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For more information on the 2022 City Stream Watch Program and the volunteer activities, please refer to the City Stream Watch 2022 Summary Report:

https://www.rvca.ca/rvca-publications/city-stream-watch-reports

RVCA City Stream Watch would like to thank all the **volunteers** who assisted in the collection of information; as well as the many **landowners** who gave us property access to portions of the stream; and to our **City Stream Watch Collaborative members**: City of Ottawa, National Capital Commission, Ottawa Flyfishers Society, Canadian Forces Ottawa Fish and Game Club, Ottawa Stewardship Council, Rideau Roundtable, South Nation Conservation, Mississippi Valley Conservation Authority and Rideau Valley Conservation Authority.