Stillwater Creek 2023 Catchment Report

Catchment Features	
Area	23.48 square kilometers 0.55% of the Rideau Valley watershed
Land Use	15.43% agriculture 16.24% settlement 35.35% forest 7.75% meadow 4.11% transportation 15.38% wetlands
Surficial Geology	34.68% clay 14.30% organic deposits 1.87% sand 11.88% diamicton 2.36% gravel 34.90% Paleozoic bedrock
Watercourse Type	2023 thermal conditions **coolwarm** to **coldcool**
Invasive Species	Sixteen invasive species were identified in 2023: bull thistle, common buckthorn, curly-leaved pondweed, dog strangling vine, Eurasian water-milfoil, European frog-bit, flowering rush, garlic mustard, glossy buckthorn, Himalayan balsam, Japanese knotweed, Manitoba maple, non-native honeysuckles, Norway maple, purple loosestrife, wild parsnip
Fish Community	Thirty-four fish species have been observed from 2009 to 2023; game species included: black crappie, bluegill, brown bullhead, burbot, largemouth bass, longnose gar, northern pike, pumpkinseed, rock bass, white sucker, yellow perch

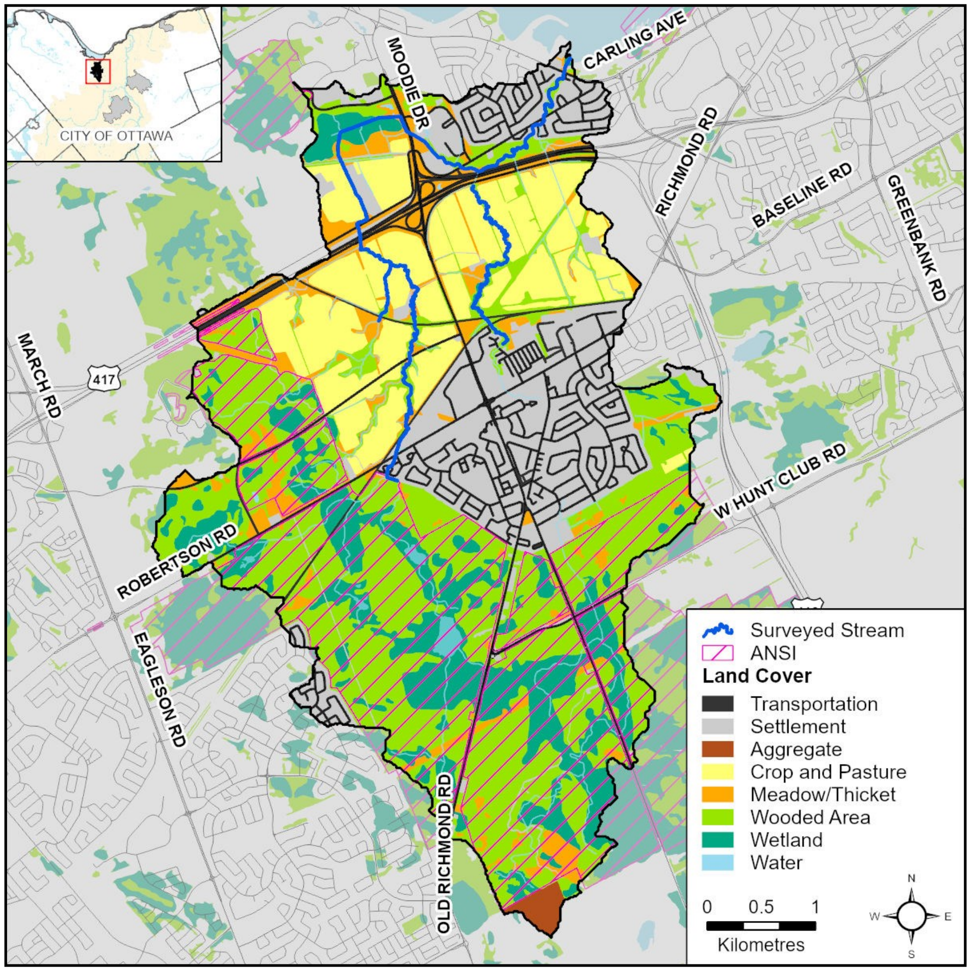


Figure 1 Land cover in the Stillwater Creek catchment

Woodlot Analysis		
Size Category	**Number of Woodlots**	**Percent of Woodlots**
1 Hectare	32	35.96%
1 to <10 Ha	39	43.82%
10 to <30 Ha	13	14.61%
>30 Ha	5	5.62%
Total Cover	**89**	**100%**

Vegetation Cover		
Type	**Hectares**	**Percent of Cover**
Wooded Areas:	**830.03**	**69.68%**
Hedgerow	13.31	1.12%
Plantation	1.71	20.39%
Regenerative	37.79	3.17%
Treed	758.54	63.67%
Wetlands*	**361.25**	**30.32%**
Total Cover	**1964.84**	**100%**

*Includes treed swamps

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 2023 collaborative.

Introduction

The headwaters of Stillwater Creek begin in the National Capital Commission's (NCC) Stony Swamp. Stony Swamp is almost 2000 hectares in size, and is a mix of woodland, wetland and regenerating fields. Over 700 plant species have been recorded in the conservation area. From Stony Swamp, Stillwater Creek runs through a heavily channelized and impacted area adjacent to Roberston Road. The creek returns to its natural morphology downstream of Robertson Road until the Highway 417 crossing. It then becomes channelized again, as it runs through the Wesley Clover Park on Corkstown Road. The creek flows through another large wetland before the Moodie Drive crossing, and from there runs parallel between Highway 417 and Corkstown Road until it turns north flowing through residential neighborhoods before emptying into the Ottawa River between the Nepean Sailing Club and Andrew Haydon Park.

Although large sections of Stillwater Creek are quite natural, it still has many impacts, including urbanization and agricultural pressures which have contributed to diminished water quality, loss of riparian cover/aquatic habitat, and shoreline destabilization (RVCA, 2015). The section of Stillwater Creek that flows between Corkstown Road and Highway 417 was designated a Life Science Site by the Ontario Ministry of Natural Resources containing regionally uncommon and regionally significant species (Ecoplans, DRAFT, 2009). Construction of a transitway expansion is underway in the area between Corkstown Road and Highway 417 which may cause impacts to this significant reach of Stillwater Creek, appropriate measures should be taken to ensure this area is not negatively impacted by future developments.

In 2023, 108 sections (10.8 km) of Stillwater Creek were surveyed as part of the City Stream Watch monitoring activities. The following is a summary of observations made by staff and volunteers.

Mouth of Stillwater Creek at the Ottawa River

Wetland habitat on Stillwater Creek upstream of Moodie Drive

Stillwater 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 of 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 Stillwater Creek. Buffers greater than 30 meters were present along 39 percent of the left bank and 41 percent of the right bank. A 15 to 30 meter buffer was present along 19 percent of the left bank and 22 percent of the right bank. A five meter buffer or less was present along 15 percent of the left bank and 13 percent of the right bank. The buffer width evaluation on the sections surveyed of Stillwater Creek are below the recommended guidelines from Environment and Climate Change Canada.

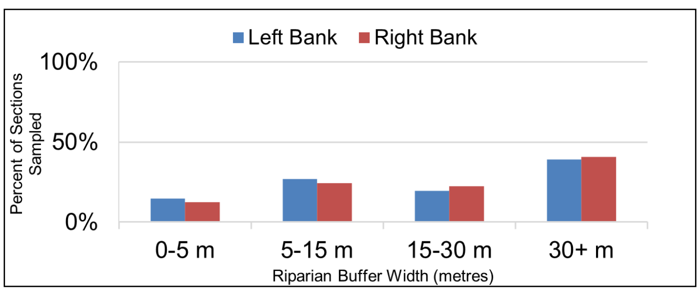


Figure 2 Vegetated buffer width along Stillwater Creek

Vegetated buffer greater than 30 meters in width along Stillwater Creek upstream of Timm Drive

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.

Stillwater Creek surveyed riparian zones were almost an even mix of natural and altered riparian buffers. Fifty-five percent of both banks had dominant natural riparian vegetative communities. Alterations to the riparian buffer accounted for 34 percent of the right bank and 30 percent on the left bank; highly altered conditions were observed on 19 percent of the right bank and 23 percent of the left bank. These alterations were associated with infrastructure such as roadways and piping.

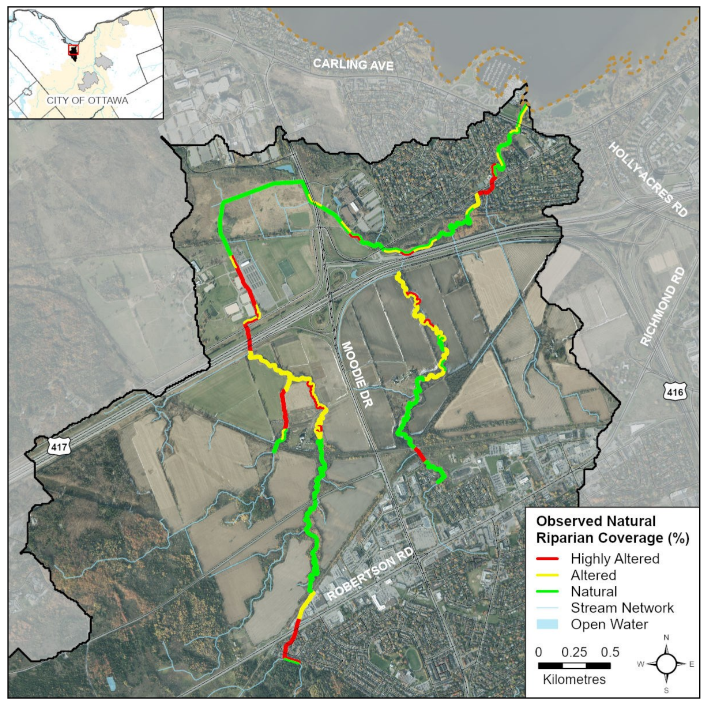


Figure 3 Riparian buffer alterations in Stillwater Creek

Roadway infrastructure on Corkstown Road along Stillwater Creek

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.

Meadow and scrubland were present in 81 percent and 85 percent of the sections surveyed, being the most common land use observed. Wetlands were present in 32 percent of the surveyed areas, and forest was present in 76 percent of sections.

Aside from the natural areas, the most common land use in the catchment was active agriculture with 54 percent of the sections containing cropped fields that are being actively farmed. Infrastructure, such as roads, bridges and culverts was observed in 40 percent of sections, while commercial land use was observed in 10 percent of sections. Recreational land use was also observed in 18 percent of sections.

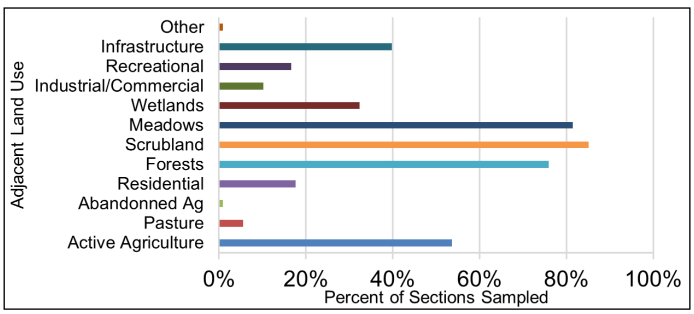


Figure 4 Adjacent land use 100 meters from each shoreline and percentage of presence along Stillwater Creek

Section along Stillwater Creek with forest, meadow and infrastructure along HWY 417

Stillwater 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 108 sections surveyed in the Stillwater Creek catchment, with 22 sections remaining without any human alteration. Of the areas surveyed, 40 sections fell in the classification of natural. Natural sections had a riparian buffer greater than 15 meters in width and natural shorelines.

Thirty sections were classified as altered. They contained straightened sections and riparian buffers of five to 15 meters in width. Shoreline alterations included concrete bridges and culverts.

Sixteen of the surveyed sections were highly altered with the riparian buffers being less than five meters in width. Shoreline alterations were found on most of the sections including rip rap and storm water outlets were present at road crossings. These sections were mostly found near road and highway infrastructure.

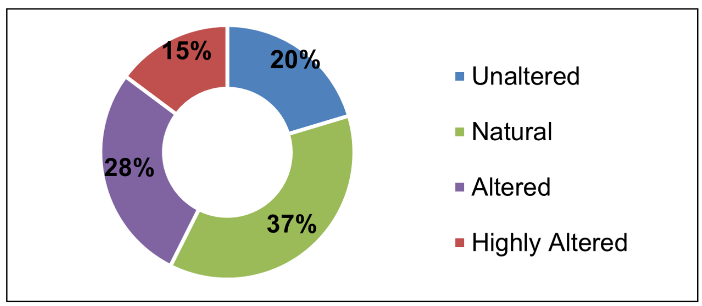


Figure 5 Anthropogenic alterations along Stillwater Creek

One of many natural sections of Stillwater Creek near Corkstown Road

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 significant erosion was observed across the surveyed portions. Bank instability was observed in 57 percent of the left bank and 56 percent of the right bank of the sections surveyed.

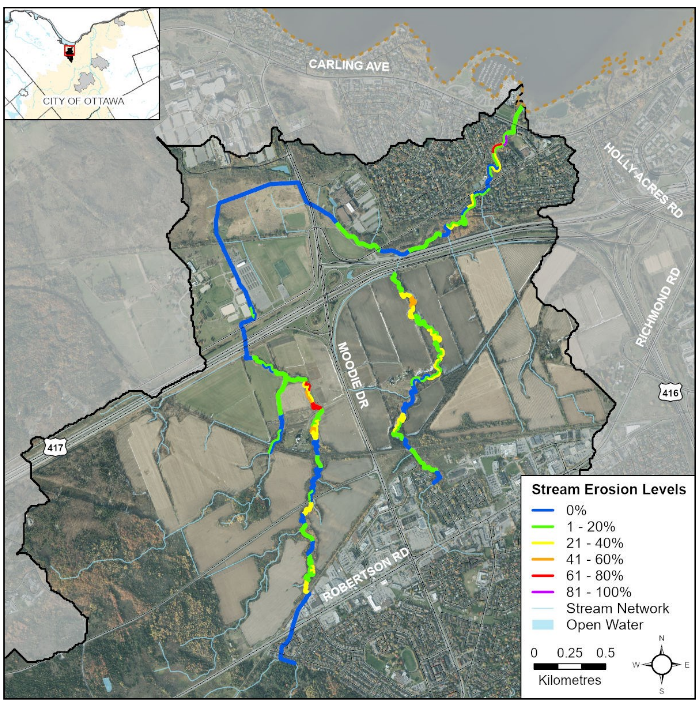


Figure 6 Erosion levels along Stillwater Creek

Bank erosion along Stillwater Creek upstream of HWY 417

Undercut Stream Banks

Stream bank undercuts can provide excellent cover habitat for aquatic life, however excessive levels can be an indication of unstable shoreline conditions. Bank undercut was 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 Stillwater Creek. Along the left bank, 58 percent of sections had undercut banks; and the right bank had 59 percent of sections with undercut banks.

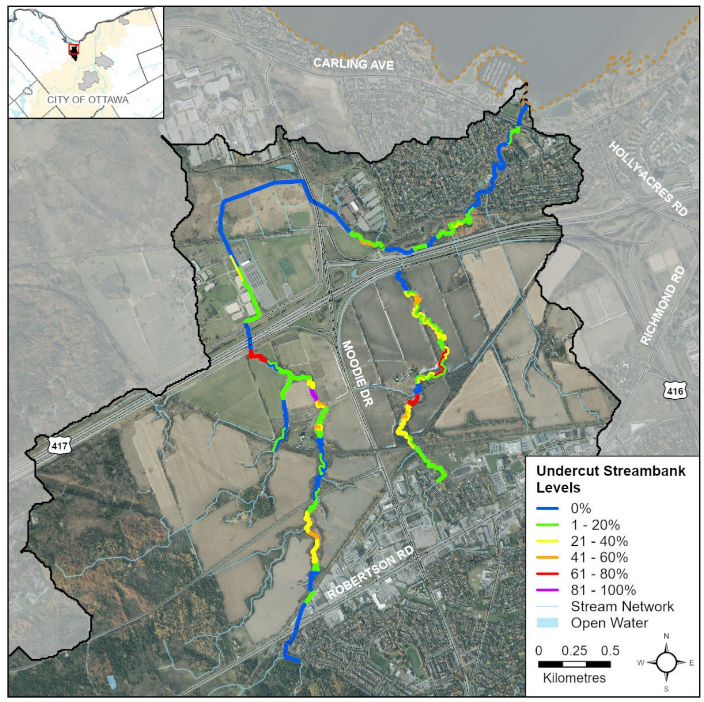


Figure 7 Undercut stream banks along Stillwater Creek

Undercut banks along Stillwater Creek upstream of Timm Drive

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. Thirty-five sections had a shade cover of 61 to 80 percent. There were 20 sections with a shade cover of 81 to 100 percent. Fourteen sections had 41 to 60 percent shade cover and 21 sections had 21 to 40 percent shade coverage. There were no sections with zero shade coverage and the final 18 sections had 1 to 20 percent coverage.

Figure 9 shows the distribution of these shading levels as a percentage of sections surveyed along Stillwater Creek.

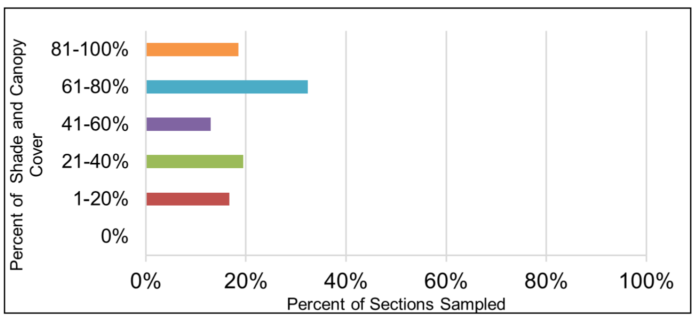


Figure 8 Stream shading along Stillwater Creek

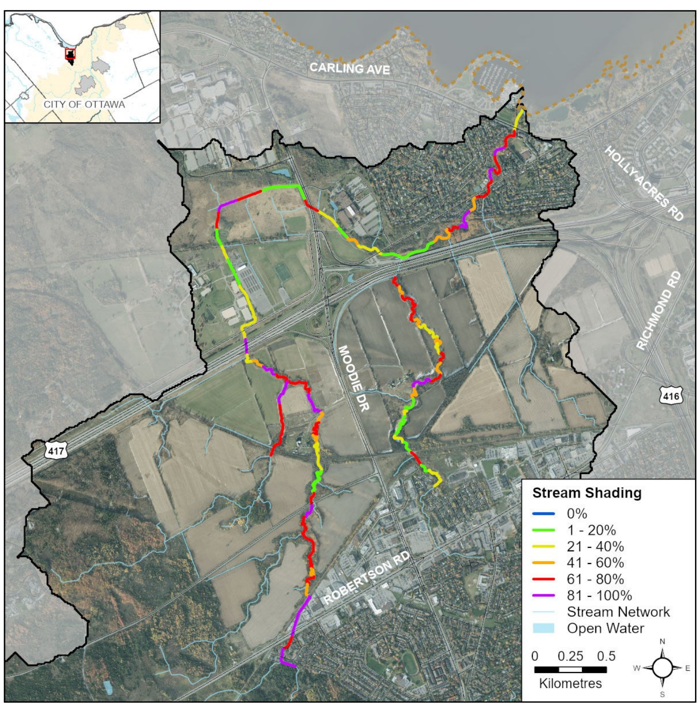


Figure 9 Stream shading along Stillwater Creek

A mix of trees and plants comprised the majority of shading. Overhanging plants, mainly grasses, robust and broad leaved emergent plants, were seen in 90 percent of the left banks and 89 percent of the right banks.

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 Stillwater Creek. Of the surveyed portions, 82 percent of the sections had overhanging trees and branches on the left bank, and 81 percent of the sections had overhanging trees on the right bank.

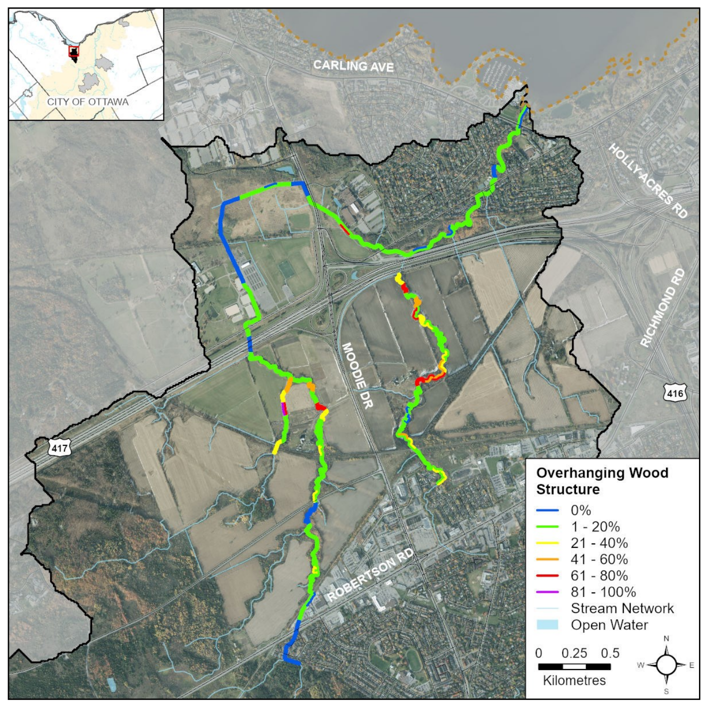


Figure 10 Overhanging trees and branches along Stillwater Creek

Overhanging plants, such as grasses, contribute most of the shading along Stillwater Creek

Stillwater Creek Instream Aquatic 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: six percent had no complexity; 10 percent had a score of one; 26 percent scored two; and 35 percent scored three. Twenty-one percent of the sections surveyed scored four for habitat complexity.

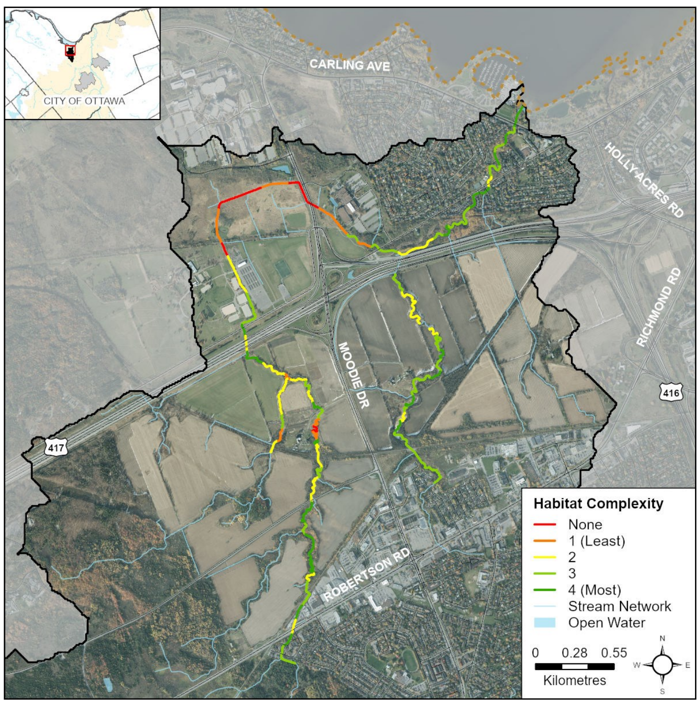


Figure 11 Instream habitat complexity along Stillwater Creek

Section of Stillwater Creek with complex habitat features including boulders, gravel and instream wood structure

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 along Stillwater Creek was observed to be fairly heterogeneous in 69 percent of sections surveyed, and homogeneous in the remaining 31 percent. Figure 12 shows the substrate types observed. As a heterogeneous system, a mix of all substrate types were recorded in the sections surveyed. Clay and cobble were the most dominant and were recorded in 81 and 78 percent of sections, respectively.

Figure 13 shows the dominant substrate types along the creek. From the assessed areas, clay was the dominant substrate type in 36 percent of sections surveyed, silt in 31 percent and cobble was dominant in 16 percent of the sections.

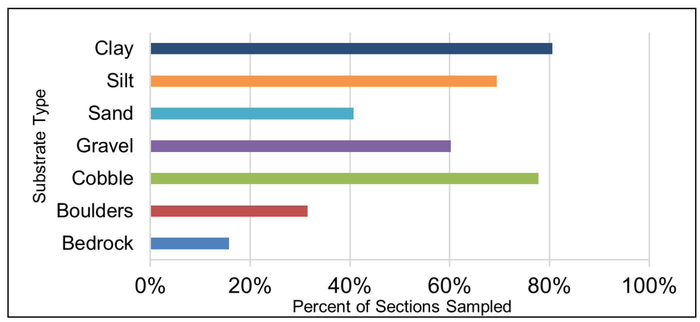


Figure 12 Instream substrate along Stillwater Creek

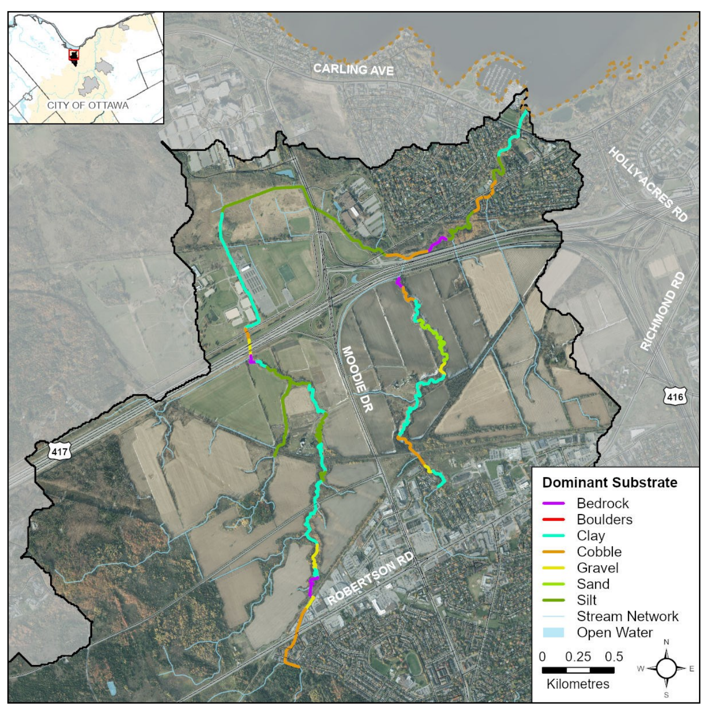


Figure 13 Dominant instream substrate along Stillwater Creek

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 Stillwater Creek are dominated by run habitat, with some riffles and pools; 50 percent of sections contained pools, 47 percent of sections contained riffles and 99 percent contained runs. Figure 15 shows the locations of sections surveyed which contained riffle habitat and the extent of presence within each section.

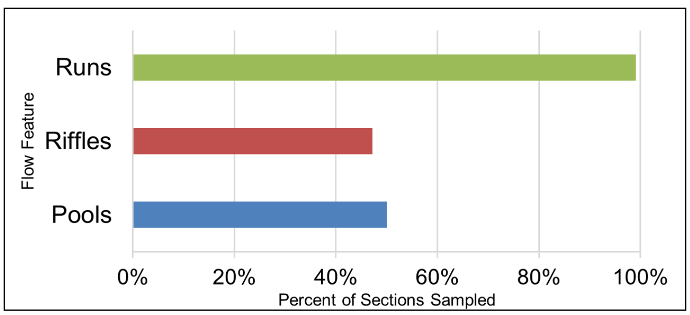


Figure 14 Instream morphology along Stillwater Creek

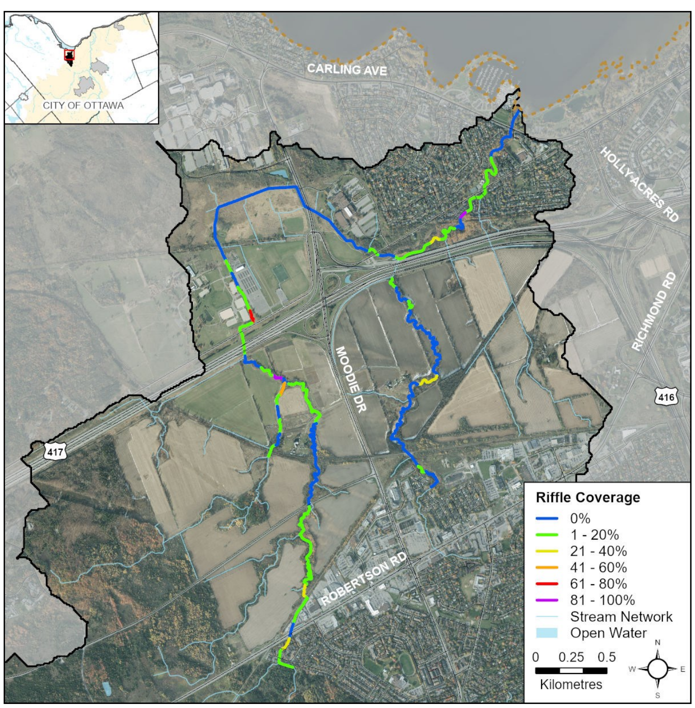


Figure 15 Riffle habitat locations along Stillwater Creek

Instream Wood Structure

Figure 16 shows that a large portion of Stillwater 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, by providing refuge and feeding areas. Excessive amounts can result in temporary seasonal migration barriers.

Instream wood structures found along Stillwater Creek are important for fish and wildlife habitat (above), some can become seasonal migration barriers (below)

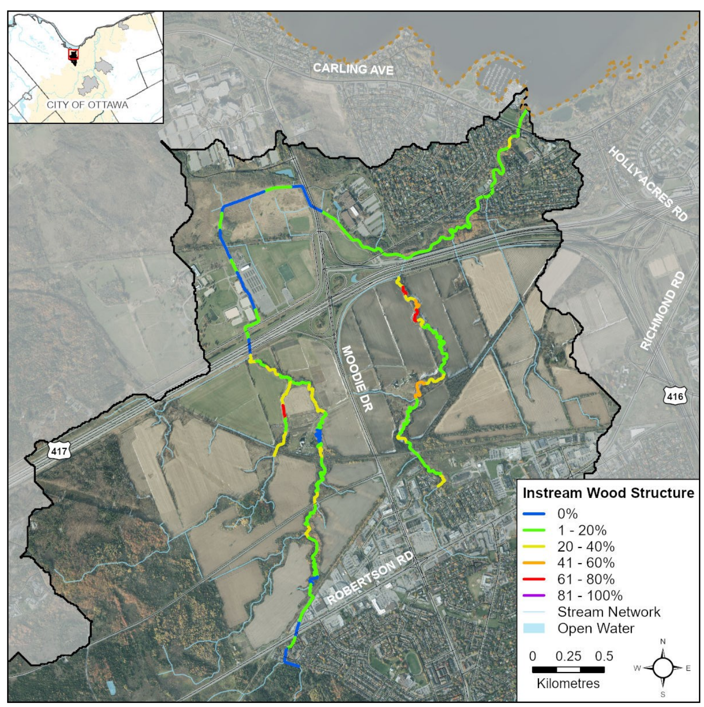


Figure 16 Instream wood structures along Stillwater Creek

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 Stillwater Creek. Vegetation types included: submerged vegetation present in 62 percent of sections; narrow-leaved emergent vegetation in 46 percent; free-floating in 17 percent; floating plants in 10 percent; robust emergent in 18 percent; algae in 60 percent; broad-leaved emergent in 14 percent of sections.

Figure 18 shows Stillwater Creek had limited instream vegetation and no vegetation was dominant in the system. Submerged plants dominated nine percent of sections; narrow-leaved emergents were dominant in three percent and algae was dominant in one percent.

Instream Vegetation Abundance

The abundance of instream vegetation is also crucial for aquatic ecosystem health. Lack of vegetation, 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. 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 this extensive mode of growth.

Abundance of vegetation is classified by the amount of vegetation present along each section. Levels of vegetation are categorized based on the extent of coverage of a section from none and sparse to an entire section choked with vegetation. As seen in Figure 19, 31 percent of sections along Stillwater Creek had low levels of vegetation, 12 percent had normal, 27 percent had common and 13 percent had extensive vegetation. Rare abundance was observed in 42 percent of sections surveyed and no vegetation was found along 95 percent of sections.

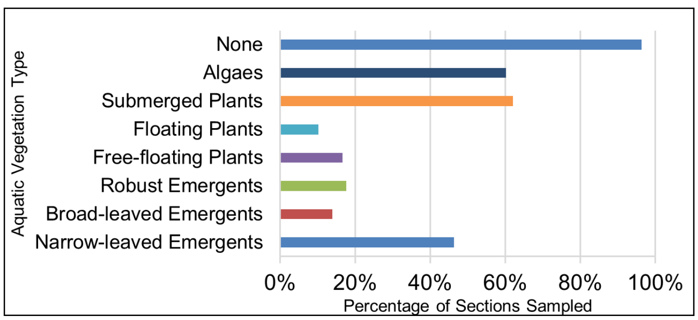


Figure 17 Aquatic vegetation presence along Stillwater Creek

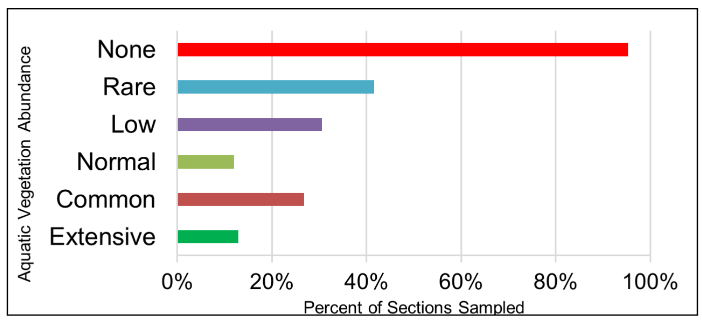


Figure 19 Instream vegetation abundance along Stillwater Creek

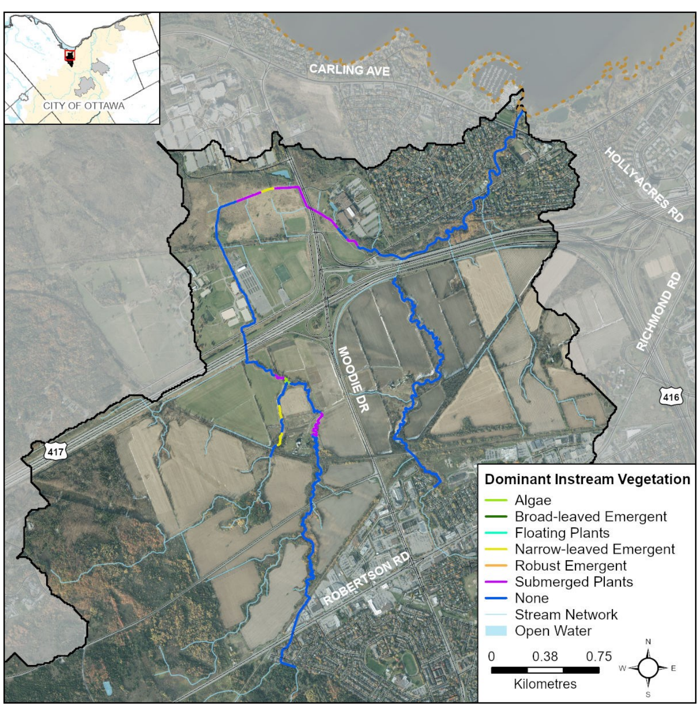


Figure 18 Dominant instream vegetation in Stillwater Creek

Long leaf pond weed is a type of submerged vegetation observed along Stillwater Creek

Stillwater 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.

Invasive species were observed in 97 percent of sections surveyed along Stillwater Creek, Figure 20 shows the diversity of species observed per section surveyed.

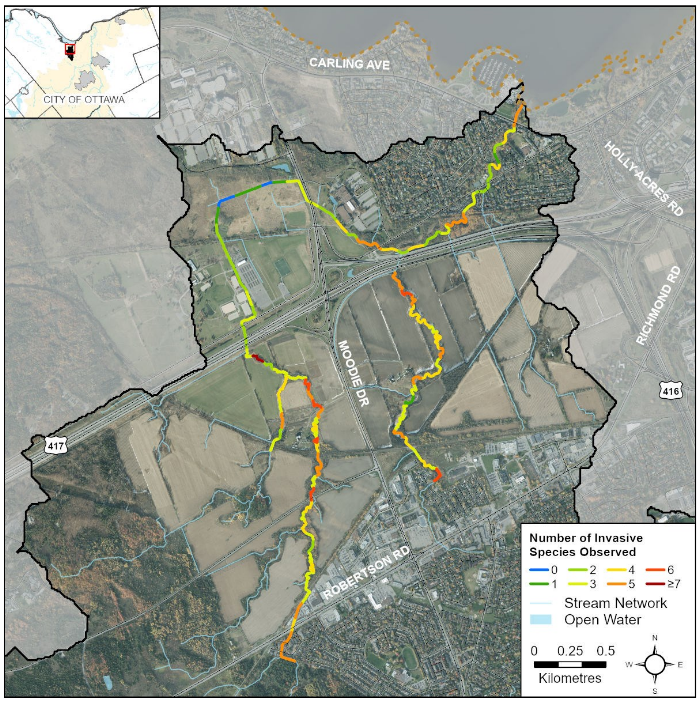


Figure 20 Invasive species diversity along Stillwater Creek

Himalayan balsam was prevalent in the upper reaches of Stillwater Creek

The following are a list of species observed in 2023 in the surveyed portions of Stillwater Creek:

- bull thistle *(Cirsium vulgare)*
- common buckthorn (*Rhamnus cathartica*)
- curly-leaved pondweed (*Potamogeton crispus*)
- dog strangling vine (*Vincetoxicum rossicum)*
- Eurasian water-milfoil (*Myriophyllum spicatum*)
- European frog-bit (*Hydrocharis morsus-ranae*)
- flowering rush (*Butomus umbellatus*)
- garlic mustard *(Alliaria petiolate)*
- glossy buckthorn (*Rhamnus frangula*)
- Himalayan balsam (*Impatiens glandulifera*)
- Japanese knotweed *(Reynoutria japonica)*
- Manitoba maple (*Acer negundo*)
- non-native honeysuckles (*Lonicera spp.)*
- Norway Maple (*Acer platanoides*)
- poison/wild parsnip (*Pastinaca sativa*)
- purple loosestrife (*Lythrum salicaria*)

To report and find information about invasive species visit

http://www.invadingspecies.com

Managed by the Ontario Federation of Anglers and Hunters

One of the many large Himalayan balsam plants found along Stillwater Creek

Pollution

Figure 21 shows where pollution was observed along Stillwater Creek. The levels of garbage found in the main portion of the stream were moderately high, with 62 percent of sections surveyed containing garbage. Garbage on the stream bottom was found in 38 percent of sections surveyed. Floating garbage was observed in 44 percent of sections. In the upper reaches, the numbers of shopping carts found was particularly concerning. A cleanup was held at the end of August to help remove some of them from the creek.

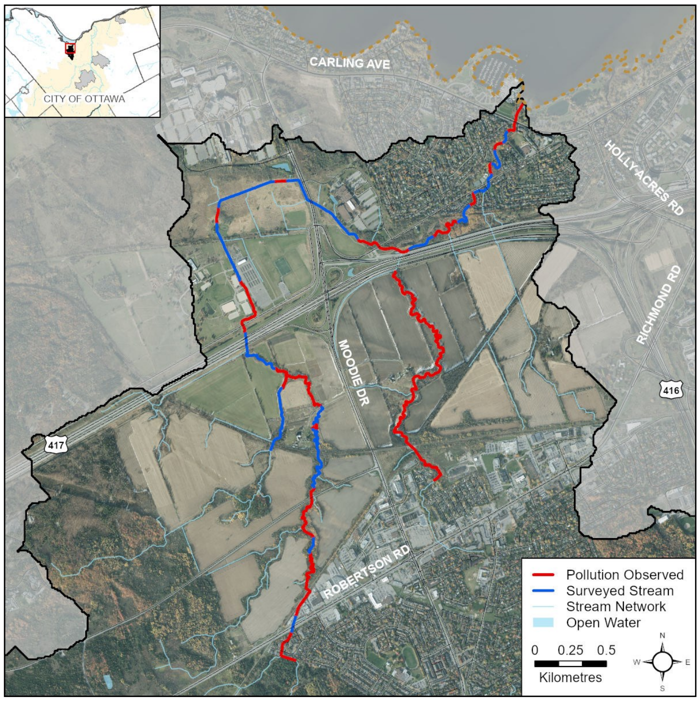


Figure 21 Pollution observed along Stillwater Creek

Shopping cart embedded in the bank of Stillwater Creek

Wildlife

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

Table 1 Wildlife observations along Stillwater Creek

Birds	American crow, American goldfinch, American robin, barn swallow, black-capped chickadee, blue jay, Canada goose, cedar waxwing, common grackle, great blue heron, great egret, green heron, grey catbird, mallard, marsh wren, Northern cardinal, Northern flicker, red-winged blackbird, ruby-throated hummingbird, song sparrow, yellow-throated warbler, yellow warbler
Reptiles & Amphibians	American bullfrog, American toad, four-toed salamander, gray treefrog, green frog, northern leopard frog, wood frog
Mammals	American beaver, coyote tracks, Eastern chipmunk, Eastern meadow vole, groundhog, raccoon tracks, red squirrel, white-tailed deer
Aquatic Insects & Benthic Invertebrates	crane fly, freshwater leech, giant water bug, water strider
Other	amber snail, bumblebee, cabbage moth, common bluet, dog-day cicada, fishing spider, green darner, Halloween pennant, honeybee, monarch butterfly, twelve-spotted skimmer, viceroy butterfly

Great egret observed along Stillwater Creek

Stillwater 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. The parameters monitored are: air and water temperature, pH, conductivity, dissolved oxygen concentration and saturation.

RVCA staff collecting water chemistry measurements with a multiparameter YSI probe

Dissolved Oxygen

Dissolved oxygen is essential for a healthy aquatic ecosystem, 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 Stillwater Creek. The two dashed lines depicted represent the Canadian water quality guidelines. Most of the surveyed portions were found to have oxygen levels within the Canadian water quality guidelines. Lower levels of dissolved oxygen were observed in wetland and agricultural areas along the system. This is typical for wetland habitats as a result of high biological oxygen demand. Average concentration levels across the system were 7.5 mg/L.

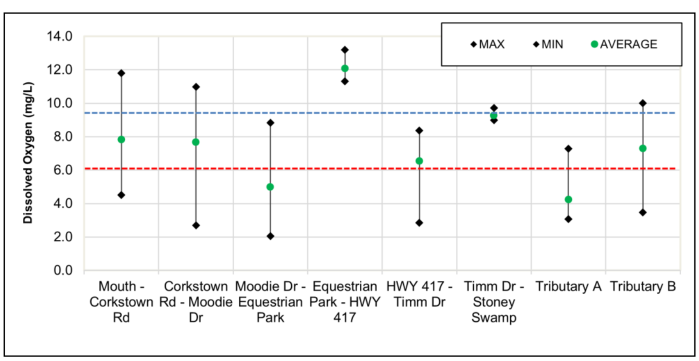


Figure 22 Dissolved oxygen ranges along surveyed sections of Stillwater Creek

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. 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 Stillwater Creek. Average conductivity level was measured at 986.4 µS/cm. Conductivity levels are lower in areas approaching headwater reaches. Higher levels were observed in the sections closer to road infrastructure and the confluence with the Ottawa River.

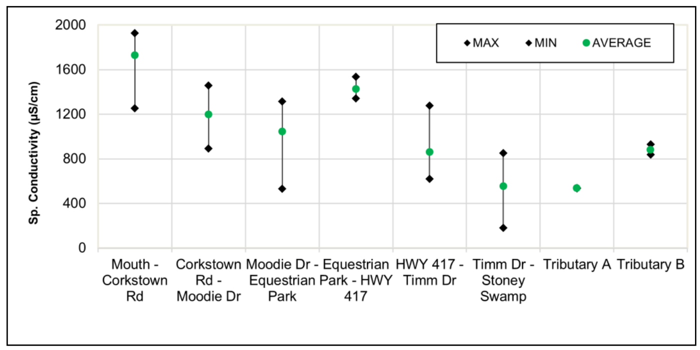


Figure 23 Specific Conductivity ranges along surveyed sections of Stillwater Creek

pH

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

Figure 24 shows most pH levels in Stillwater Creek meet the PWQO, depicted by the dashed lines. The lowest pH measured was below these standards, however this occurred in the upper wetland habitat where pH is typically lower due to the natural organic acids. Average levels across the system were pH 7.86.

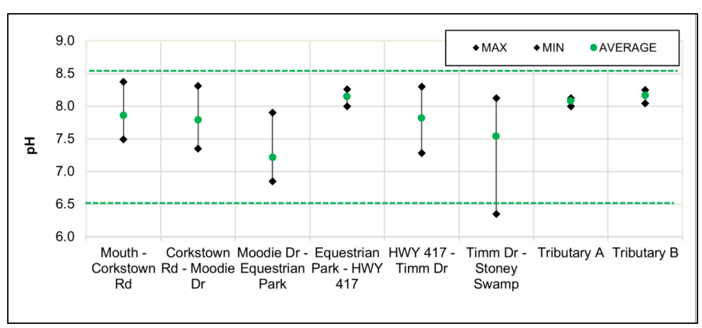


Figure 24 pH ranges along surveyed sections of Stillwater Creek

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.

Section on Stillwater Creek west of Moodie Drive with **impaired** oxygen conditions (Dissolved oxygen levels of 2.85mg/L and 31.5 % saturation)

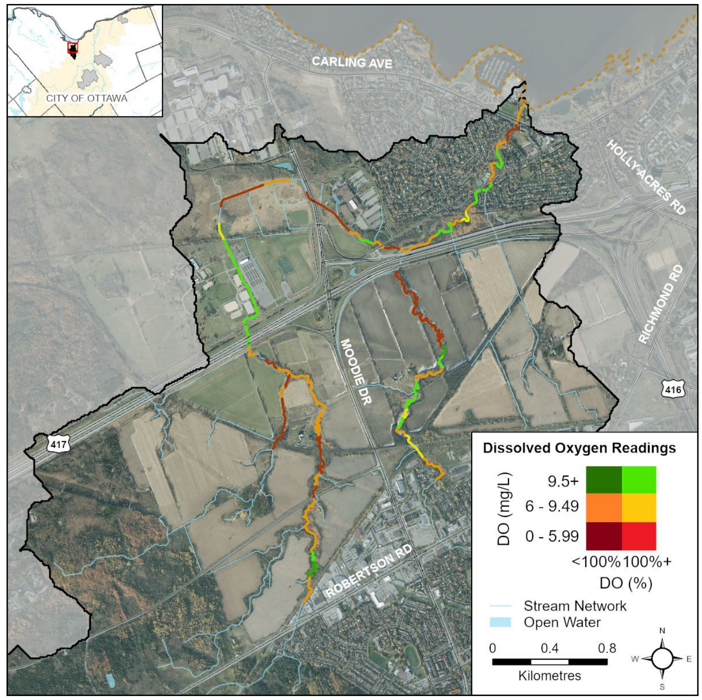


Figure 25 Bivariate assessment of dissolved oxygen concentration (mg/L) and saturation (%) along Stillwater Creek

Figure 25 shows the oxygen conditions across the areas that were surveyed in 2023. Dissolved oxygen conditions in Stillwater Creek were sufficient to sustain warm-water biota in areas downstream of HWY 417, downstream of where the creek crosses Corkstown Road and in the upper reaches of both branches. Sections shown in dark red Figure 25, had significant levels of impairment both in concentration and percent saturation. These areas had wetland features that have naturally lower oxygen levels. There were also sections with low oxygen in agricultural areas with limited shading or riffle habitat. An increase in shading conditions, through riparian planting of trees and shrubs can potentially help cool conditions and possibly increase levels of dissolved oxygen.

Section on Stillwater Creek near Vanier Road with **optimal** oxygen conditions for warm-water biota (Dissolved oxygen levels of 9.69 mg/L and 103.4 % 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 as well as commercial and 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 Stillwater Creek (986.4 µS/cm) were above guidelines (500 µS/cm) used for the Canadian Environmental Performance Index (Environment Canada 2011).

Figure 26 shows relative specific conductivity levels in Stillwater Creek. Normal levels were maintained for most of the surveyed portions. There were pockets of moderately elevated sections in areas with urban or agricultural influences. A few of the sections near the mouth exhibited highly elevated conductivity levels. Here, there is a strong influence from stormwater, which brings an increase of negative ions into the system.

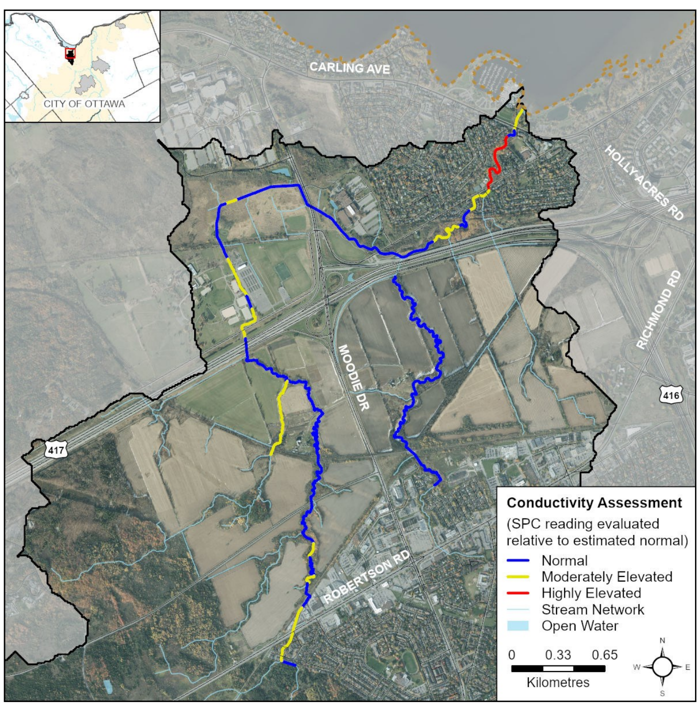


Figure 26 Relative specific conductivity levels along Stillwater Creek

Groundwater

Groundwater discharge areas can influence stream temperature, contribute nutrients, and provide important stream habitat for fish and other biota. During stream surveys and HDF assessments, indicators of groundwater discharge were noted when observed (Figure 27). Indicators included: springs/seeps, watercress, iron staining, significant temperature changes and rainbow mineral film.

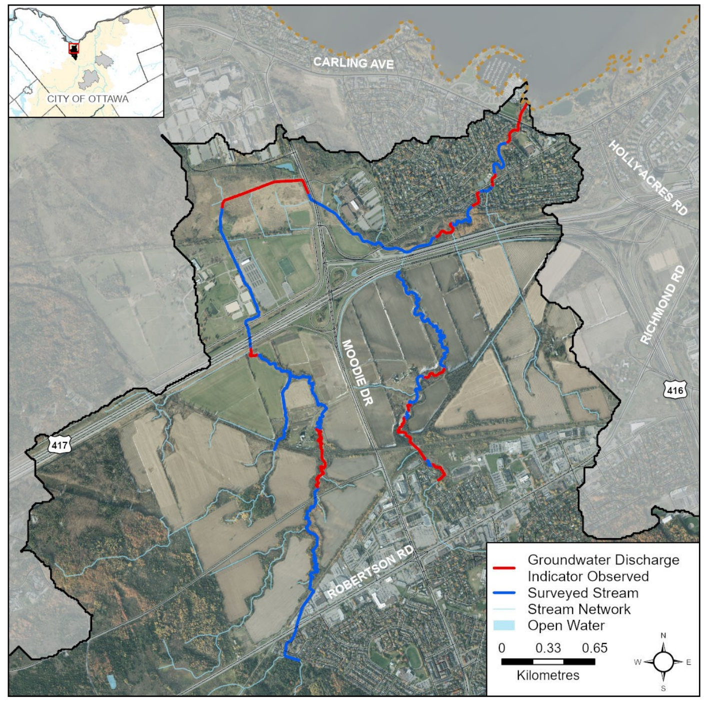


Figure 27 Groundwater indicators observed in the Stillwater Creek catchment

Watercress, an indicator of groundwater, observed in the upper reaches of Stillwater Creek

Stillwater 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 Stillwater Creek, six temperature loggers were placed in April and retrieved in early November.

Figure 28 shows where thermal sampling sites were located. Due to instrument malfunction, some points were not recorded on the logger placed upstream of Moodie Drive. Analysis of data from six loggers (using the Stoneman and Jones, 1996, method adapted by Chu et al., 2009), indicated Stillwater Creek was classified as **coolwarm** to **coldcool** water. Figures 29 and 30 show a comparison between 2015 and 2023. Fish species observed in that area have thermal preferences from cool to warm as indicated by Cocker at al. (2001).

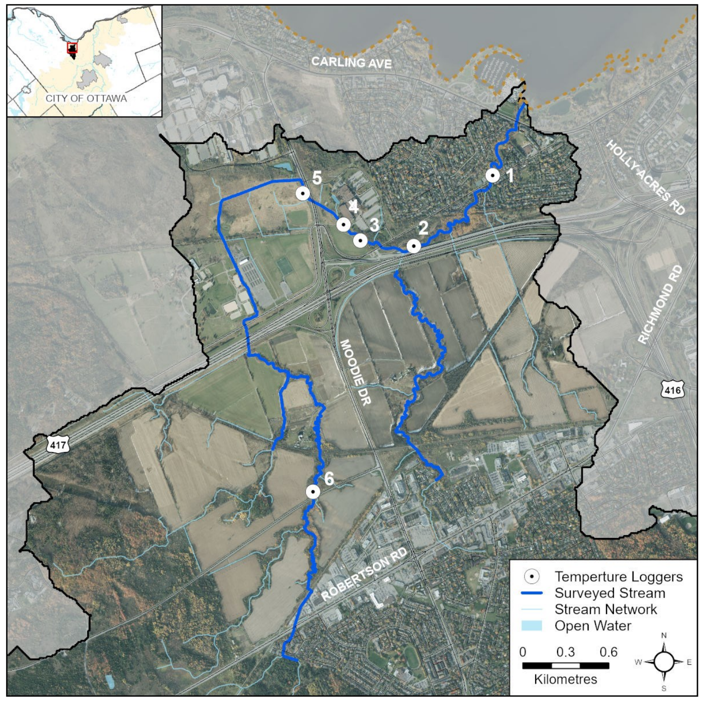


Figure 28 Temperature logger locations on Stillwater Creek

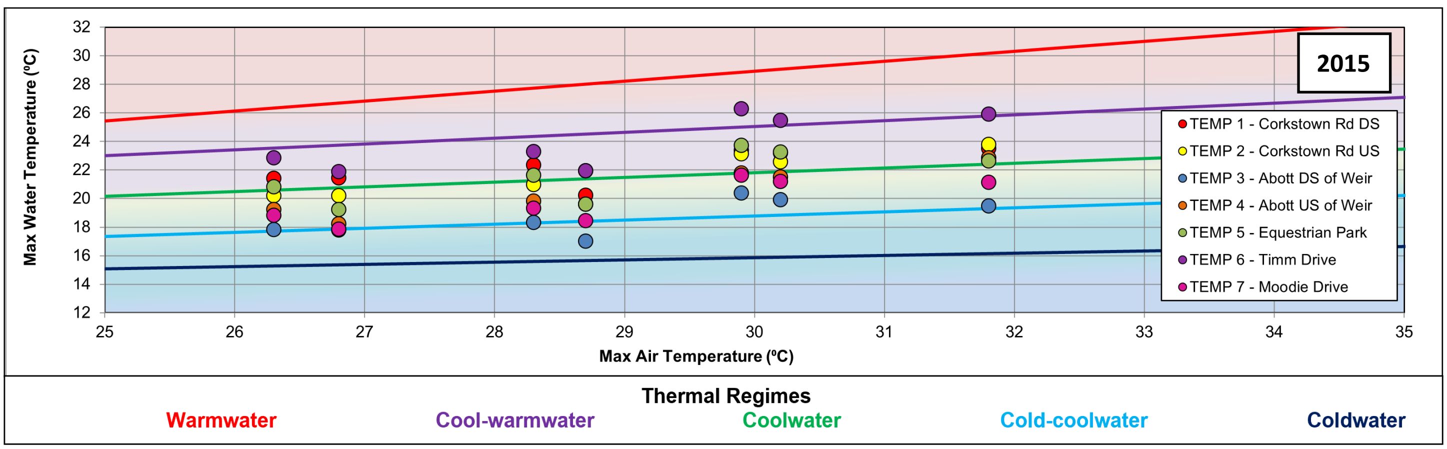


Figure 29 Thermal Classification for Stillwater Creek with the five thermal regimes adapted from Stoneman and Jones (1996) by Chu et al. (2009): **coolwarm** to **coolwater** on Stillwater Creek in 2015

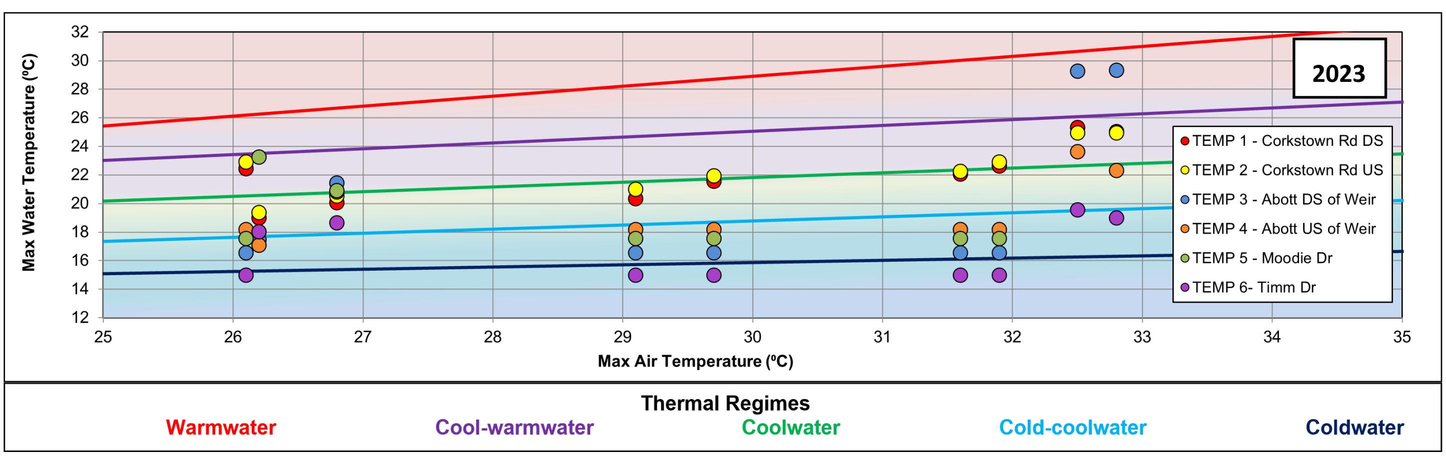


Figure 30 Thermal Classification for Stillwater Creek with the five thermal regimes adapted from Stoneman and Jones (1996) by Chu et al. (2009): **coolwarm** to **coldcool** on Stillwater Creek in 2023

Stillwater Creek Fish Community

Fish Community Summary

Eight fish sampling sites were evaluated between May and July 2023. Five site locations were sampled with the use of a backpack electrofishing unit, and three sites were sampled with a bag seine net.

Nineteen species were captured in 2023, they are listed in Table 2 along with their thermal classification preferences (Coker et al., 2001) and MNR species codes. Stillwater Creek had a mixed fish community ranging from cold to warm water species.
The sampling locations where these species were observed, as well as RVCA historical sites, 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 Stillwater Creek refer to page 23 of this report.

Table 2 Fish species observed in Stillwater Creek in 2023

Species	Thermal Class	MNR Species Code
banded killifish *Fundulus diphanus*	**Cool**	BaKil
blacknose dace *Rhinichthys atratulus*	**Cool**	BnDac
bluntnose minnow *Pimephales notatus*	**Warm**	BnMin
brook stickleback *Culaea inconstans*	**Cool**	BrSti
central mudminnow *Umbra limi*	**Cool**	CeMud
creek chub *Semotilus atromaculatus*	**Cool**	CrChu
emerald shiner Notropis atherinoides	**Cool**	EmShi
fathead minnow Pimephales promelas	**Warm**	FhMin
johnny/tessalated darter *Etheostoma spp.*	**Cool**	EthSp
logperch *Percina caprodes*	**Cool-warm**	LoPer
northern redbelly dace *Chrosomus eos*	**Cool-warm**	NRDac
longnose dace *Rhinichthys cataractae*	**Cool**	LnDac
longnose gar *Lepisosteus osseus*	**Warm**	LnGar
mottled sculpin *Cottus bairdii*	**Cold**	MoScu
northern redbelly dace *Chrosomus eos*	**Cool-warm**	NRDac
pumpkinseed *Lepomis gibbosus*	**Warm**	Pumpk
rock bass *Ambloplites rupestris*	**Cool**	RoBas
white sucker *Catostomus commersonii*	**Cool**	WhSuc
yellow perch *Perca flavescens*	**Cool**	YePer
Total Species		**19**

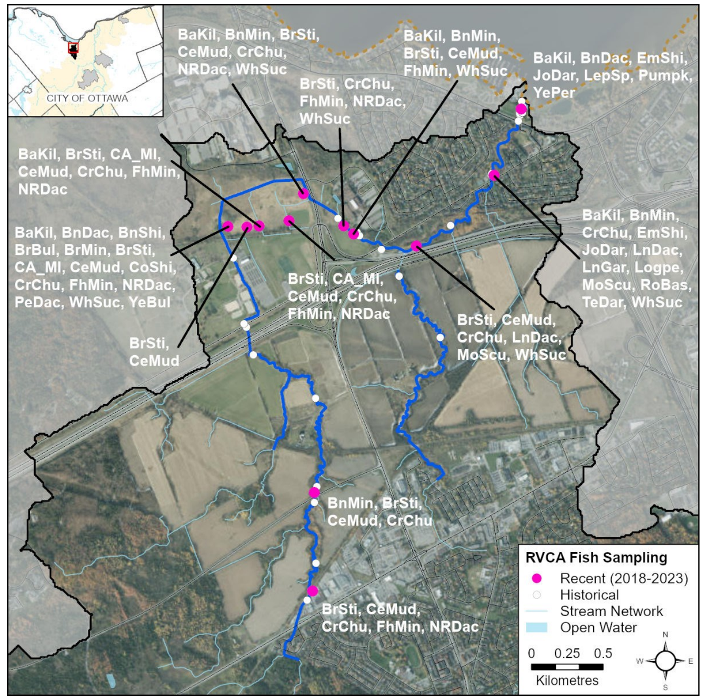


Figure 31 Stillwater Creek fish sampling locations and fish species observations from 2015-2023

Fish community sampling by electrofishing (above) and a longnose gar (below) observed in Stillwater Creek

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 migratory obstructions observed along the surveyed portions of Stillwater Creek. The migratory obstructions observed during stream surveys in 2023 are shown in Figure 32. Most of these were debris dams which can become migratory obstructions when water levels are low. Two perched culverts were noted, both of which were located where the creek flows west of Moodie Drive. There were also a few grade barriers present; most being naturally occurring.

Perched culverts create fish migratory obstructions and loss of aquatic habitat and seasonal grounds for many fish species

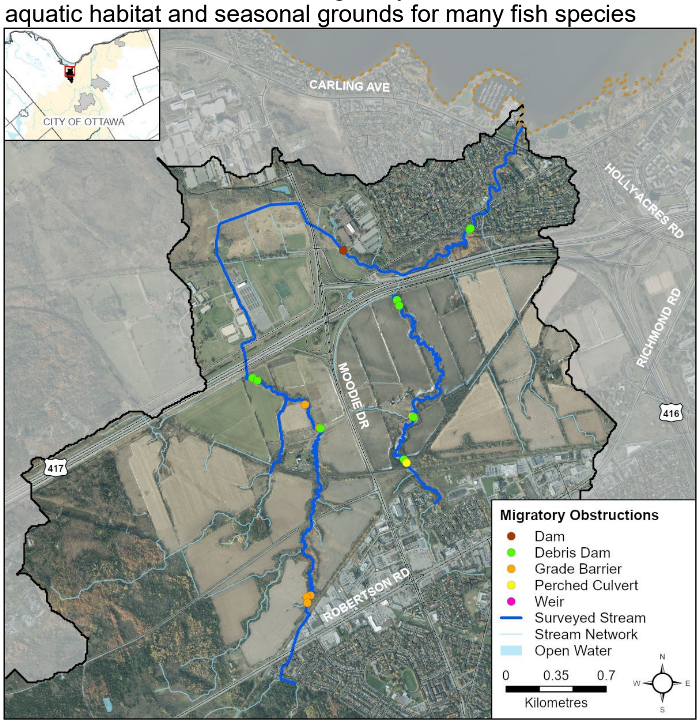


Figure 32 Locations of migratory obstructions along Stillwater Creek

Beaver Dams

Beaver dams create natural changes in the environment. Some of the benefits include providing habitat for wildlife, flood control, and silt retention. Additional benefits come from bacterial decomposition of wood material used in the dams which removes excess nutrient and toxins. Beaver dams may be seasonal potential barriers to fish migration.

In 2023 a total of 16 beaver dams were identified on the surveyed portions of Stillwater Creek and are shown in Figure 33. Additionally, two beaver lodges were noted as well. Due to the proximity to the Stoney Swamp Wetland Complex, it is not uncommon to see increased beaver activity near wetlands.

An active beaver dam blocking the culvert under the railway east of Moodie Drive

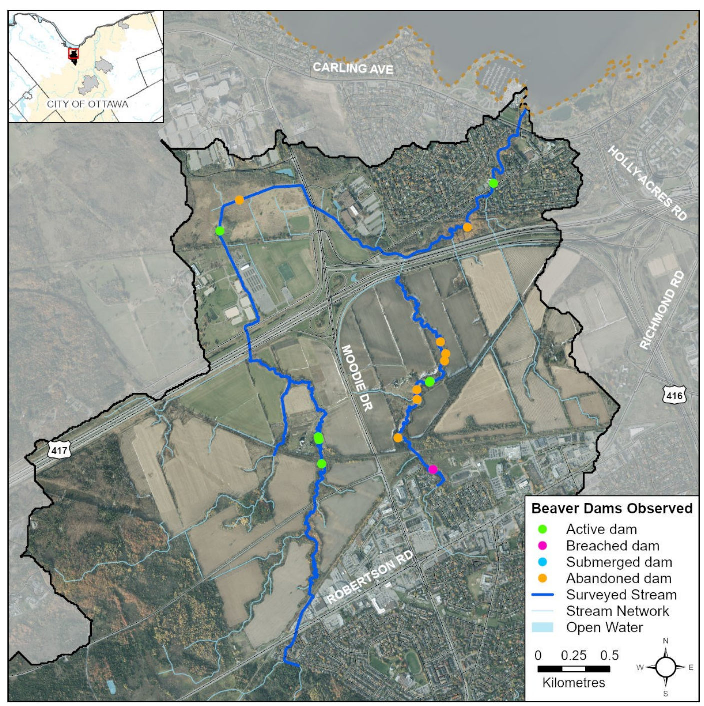


Figure 33 Locations of beaver dams along Stillwater Creek

Headwater Drainage Feature Assessment

Headwater drainage features (HDF) represent the origin from which water enters a watershed. These are small depressions, stream and wetland features that capture flows from groundwater discharge, rain and snow melt water and transport it to larger streams and rivers. In their natural state, they provide (OSAP, 2017):

- flood mitigation as water storage capacity
- water purification and groundwater discharge
- seasonal and permanent habitat refuge for fish, including spawning and nursery areas
- wildlife migration corridors/breeding areas
- storage and conveyance of sediment, nutrients and food sources for fish and wildlife

Headwaters Sampling

RVCA is working with other Conservation Authorities and the Ministry of Natural Resources and Forestry to implement the protocol with the goal of providing standard datasets to support science development and monitoring of headwater drainage features.

Features were evaluated as per the Ontario Stream Assessment Protocol (OSAP, 2017). This protocol measures zero, first and second order headwater drainage features. It is a rapid assessment method characterizing the amount of water, sediment transport, and storage capacity within headwater drainage features. In 2023 a total of 15 HDF sites were assessed in the Stillwater Creek Catchment (Figure 34).

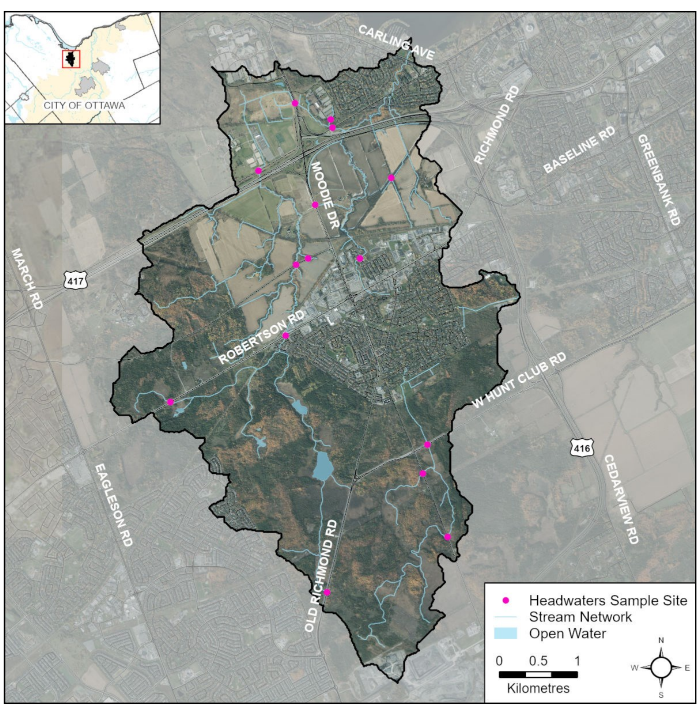


Figure 34 Location of headwater drainage feature sampling sites in the Stillwater Creek catchment

Feature Type

The headwater sampling protocol assesses the feature type in order to understand the function of each feature. The evaluation includes the following classifications: defined natural channel, channelized or constrained, multi-thread, no defined feature, tiled, wetland, swale, roadside ditch and pond outlet. By assessing the values associated with the headwater drainage features in the catchment area we can understand the ecosystem services that they provide to the watershed in the form of hydrology, sediment transport, and aquatic and terrestrial functions.

Figure 35 shows the feature type of the primary feature at the sampling locations. The majority of the features sampled were natural features with five wetland features and five defined natural channels. Five features were channelized, which occurred mostly in agricultural areas.

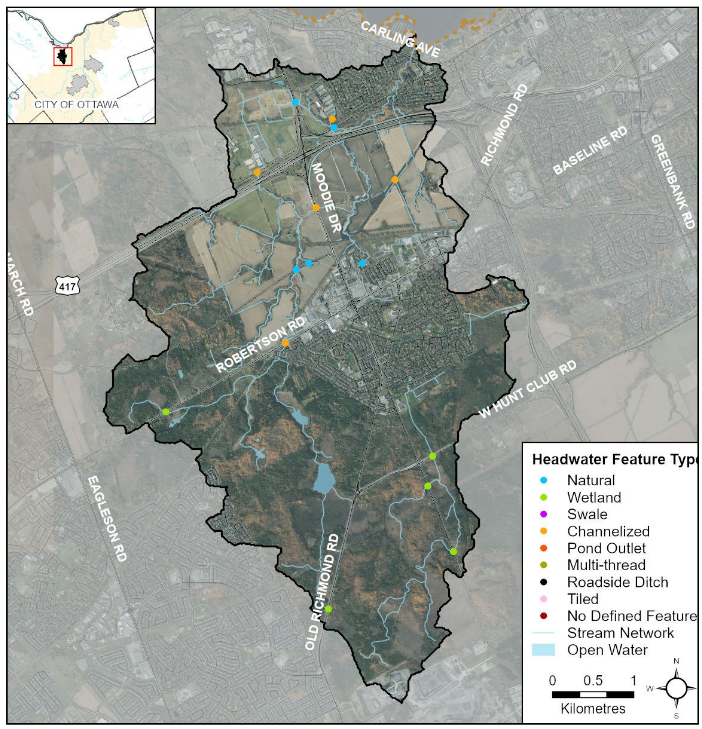


Figure 35 Map of Stillwater Creek catchment headwater drainage feature types

A wetland headwater feature near Hunt Club Road within the Stillwater Creek catchment

Headwater Feature Flow

Flow conditions in headwater features can be variable throughout the year in response to yearly seasonal weather conditions. This protocol targets features that are perennial or intermittent. Intermittent flow conditions are those where water typically flows at least six months of the year. Perennial systems flow year round. Sites were observed in the spring and summer; flow conditions were compared. Flow conditions in the Stillwater Creek catchment area are shown in Figure 36.

Intermittent headwater drainage feature with spring and summer conditions near Corkstown Road

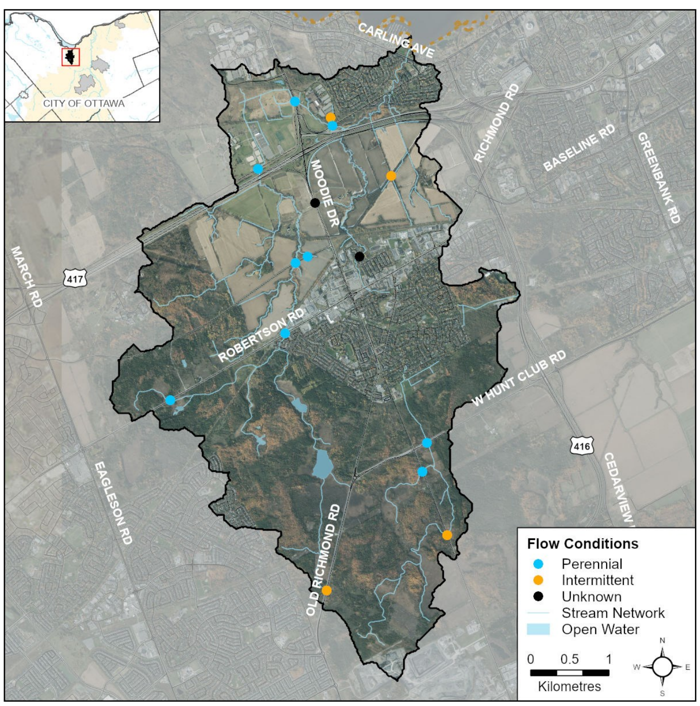


Figure 36 Headwater drainage feature flow conditions in the Stillwater Creek catchment

Feature Channel Modifications

Channel modifications can influence HDF conditions and function. Modifications that were of focus included dredging (and historical channel straightening), hardening (e.g. rip-rap, armourstone, gabion baskets) or on-line ponds.

Figure 37 shows channel modifications observed in Stillwater Creek headwater drainage features. Modifications in this catchment for its headwater drainage features are channel hardening with rip rap, gabion baskets or armour stone along with channel straightening.

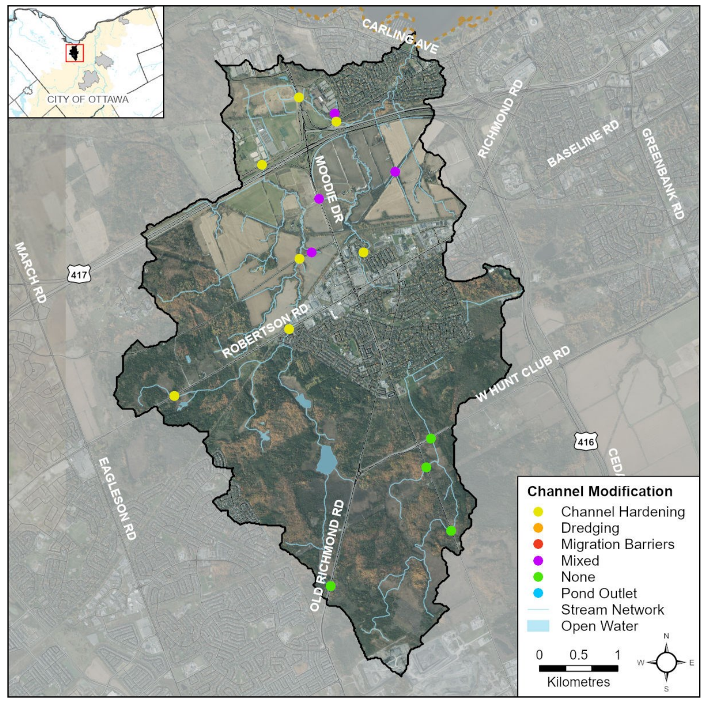


Figure 37 Headwater drainage feature channel modifications in the Stillwater Creek catchment

An example of the use of armourstone on a headwater drainage feature on Robertson Road

Headwater Feature Vegetation

Headwater feature vegetation evaluates the type of vegetation that is found within the drainage feature. The type of vegetation within the channel influences the aquatic and terrestrial ecosystem values that the feature provides. For some types of headwater features the vegetation within the feature plays an important role in flow, sediment movement and provides wildlife habitat. The following classifications are evaluated: none, lawn, wetland, meadow, scrubland and forest.

Figure 38 depicts the dominant vegetation observed at the sampled sites in the Stillwater Creek catchment. Six features were dominated by wetland vegetation. The remaining features had no vegetation in the spring. In these instances, flows and sediment transport are unmitigated by the lack of vegetation.

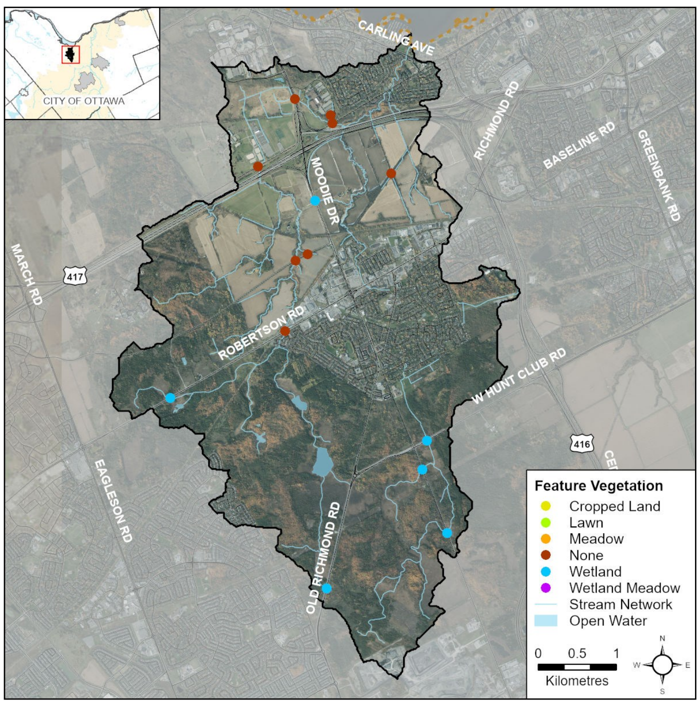


Figure 38 Headwater drainage in feature vegetation in the Stillwater Creek catchment

Headwater feature with no instream vegetation off of Timm Road

Headwater Feature Riparian Vegetation

Headwater riparian vegetation evaluates the type of vegetation that is found along the adjacent lands of a headwater drainage feature. The type of vegetation within the riparian corridor influences the aquatic and terrestrial ecosystem values that the feature provides to the watershed.

Figure 39 shows the type of riparian vegetation observed at the sampled headwater sites in the Stillwater Creek catchment. They are grouped as natural, and other riparian zones which have anthropogenic influences from agricultural areas, residential areas as well as road infrastructure.

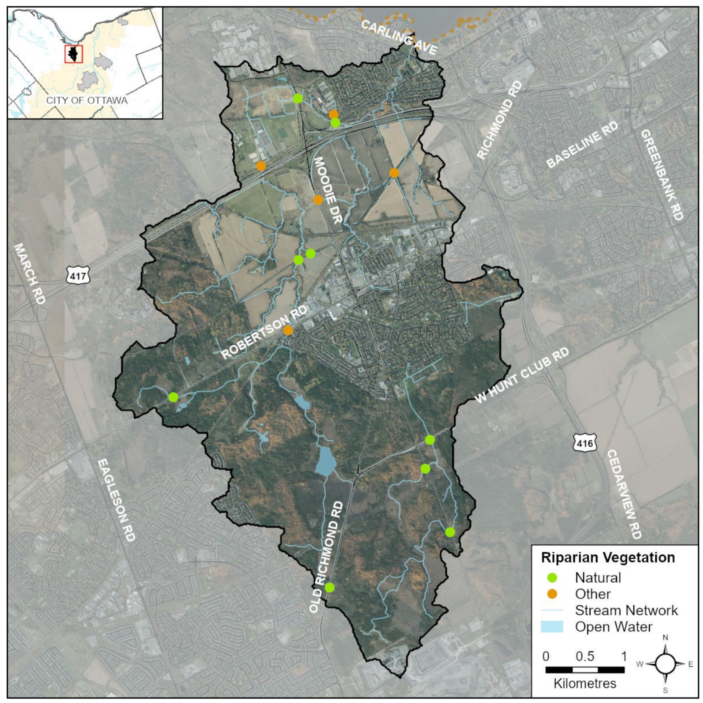


Figure 39 Riparian vegetation types along headwater drainage features in the Stillwater Creek catchment

Headwater drainage feature with natural meadow, scrubland and forest riparian vegetation off of Timm Road

Headwater Feature Sediment Deposition

Assessing the amount of recent sediment deposition in a channel provides an index of the degree to which the feature could be transporting sediment downstream (OSAP, 2017). Sediment transport is a natural process, however, excessive sedimentation can be indicative of higher erosion than a natural system can accommodate. High sediment deposition can indicate the need for further assessment and potential implementation of best management practices.

From the features assessed, sediment deposition ranged from none to moderate. Ten features had evidence of minimal deposition levels. Three features had moderate amounts of deposition. Figure 40 shows the levels of sediment deposition observed in headwater features within the Stillwater Creek catchment.

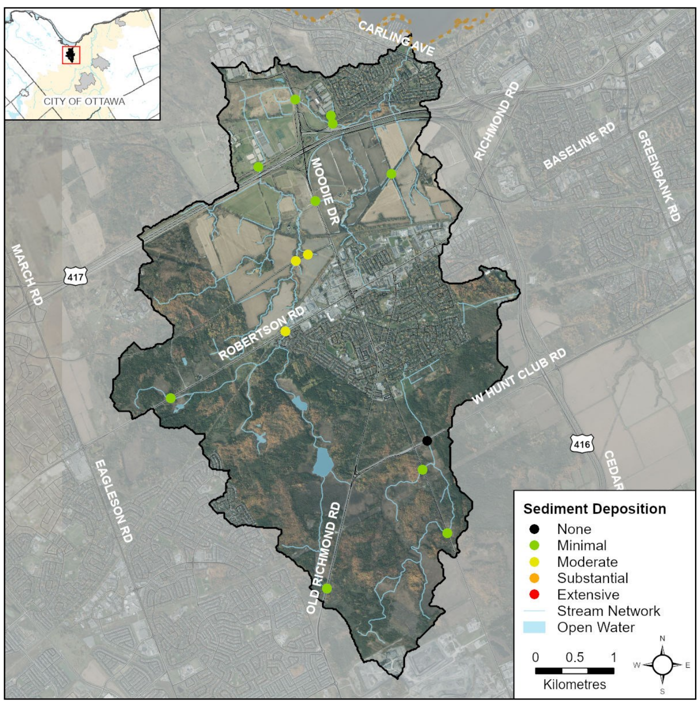


Figure 40 Headwater drainage feature sediment deposition in the Stillwater Creek catchment

Moderate sediment deposition observed in a headwater drainage feature on Timm Road

Headwater Feature Upstream Roughness

Feature roughness is a relative measure of the amount of material within the feature that diffuses flows (OSAP, 2023). Materials on the channel bottom that provide roughness include vegetation, wood material as well as boulders and cobble substrates. Roughness can reduce erosion downstream of the feature, as well as providing important habitat to a variety of aquatic organisms, and producing food sources.

This parameter is categorized depending on the amount of roughness coverage in a channel: minimal (less than 10 %), moderate (10-40 %), high (40-60 %), and extreme (more than 60 %). In the Stillwater Creek catchment, roughness ranged from minimal to extreme. Due to the presence of wetlands in the headwaters of Stillwater Creek, several headwater drainage features exhibited extreme roughness as seen in Figure 41.

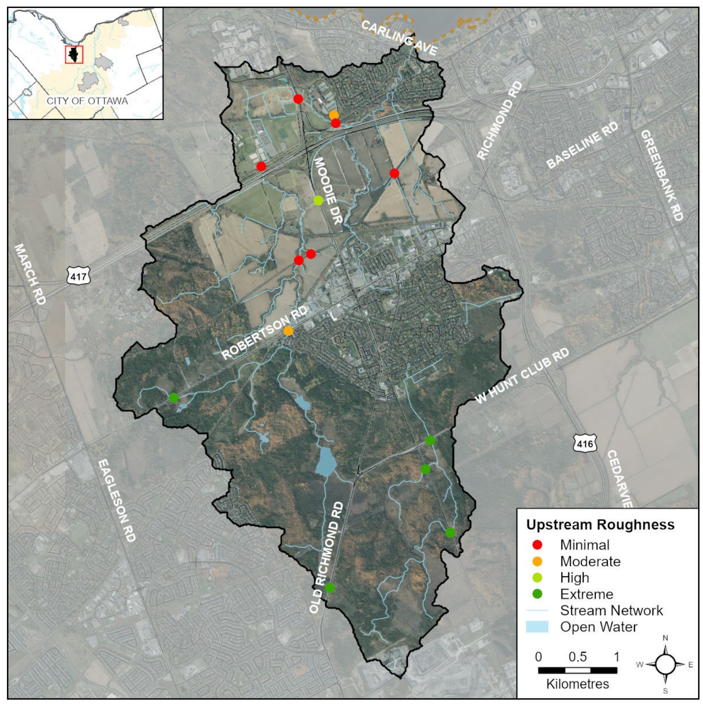


Figure 41 Headwater drainage feature roughness in the Stillwater Creek catchment

Extreme roughness in wetland headwater drainage feature on Moodie Drive

Stream Comparison Between 2009, 2015 and 2023

The following tables provide a comparison of observations on Stillwater Creek between the 2009, 2015 and 2023 survey years (RVCA 2009, RVCA 2015). Monitoring protocols since 2009 have been modified and enhanced, only certain data from that year can be compared to later 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 2023.

Table 3 Water chemistry comparison (2009/2015/2023)

Water Chemistry (2013/2023)				
Year	**Parameter**	**Unit**	**Average**	**STND Error**
2009	pH	-	7.94	±0.29
2015	pH	-	7.86	±0.079
2023	pH	-	7.86	±0.084
2009	Sp. Conductivity	us/cm	906.7	±41.51
2015	Sp. Conductivity	us/cm	1657	±49.38
2023	Sp. Conductivity	us/cm	986.4	±36.74
2009	Dissolved Oxygen	mg/L	9.3	±0.52
2015	Dissolved Oxygen	mg/L	8.2	±0.22
2023	Dissolved Oxygen	mg/L	7.5	±0.31
2009	Water Temperature	ºC	16.8	±0.71
2015	Water Temperature	ºC	18.1	±0.28
2023	Water Temperature	ºC	18.9	±0.26
2009	Standardized Stream Temperature[1]	ºC Water / 1ºC Air	0.77	±0.42
2015	Standardized Stream Temperature[1]	ºC Water / 1ºC Air	0.73	±0.30
2023	Standardized Stream Temperature[1]	ºC Water / 1ºC Air	0.69	±0.32

[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

The average pH in 2023 was the same as in 2015 and specific conductivity decreased from 2015 by 670 µS/cm to levels similar to 2009. These slight changes may reflect seasonal variability. Average dissolved oxygen levels appear to be lowering over time. These changes can also be attributed to seasonal conditions and warmer temperatures which are less conducive to the stream's ability to hold more oxygen.

Average summer water temperatures ranges are increasing over time from cooler water in 2009 (16.8°C) to warmer values in 2023 (18.9°C). 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, standardized stream temperature factors were calculated and summarized in Table 3. This factor has lowered over time from 0.77 for every degree of air in 2009, to 0.73 in 2015 and 0.69 in 2023.

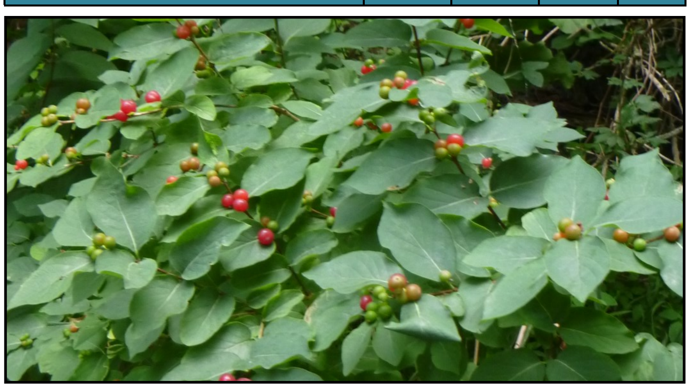
A staff member collecting water chemistry in Stillwater Creek

Invasive Species

The percentage of sections surveyed where invasive species were observed had a small increase of three percent. (Table 4) This number was already at a high of 94 percent in 2015. Most invasive species previously reported had an increase in the number of sections they were observed in. Some species have also decreased, including flowering rush, Japanese knotweed, Manitoba maple, purple loosestrife and yellow iris. These species are likely still present in strong numbers, but may have been noted less in the surveys than in 2015. There are also species that were not previously reported, including curly-leaved pondweed, dog strangling vine and bull thistle.

Table 4 Invasive species presence (% of sections) observed in 2015 and 2023 (NR are species that were not reported in that

Invasive Species	2009	2015	2023	+/-
bull thistle	NR	NR	11%	▲
common buckthorn	4%	58%	81%	▲
curly-leaved pondweed	NR	NR	2%	▲
dog strangling vine	NR	NR	1%	▲
Eurasian water-milfoil	3%	NR	6%	▲
flowering rush	NR	20%	2%	▼
garlic mustard	3%	6%	11%	▲
glossy buckthorn	NR	7%	21%	▲
Himalayan balsam	NR	22%	31%	▲
Japanese knotweed	NR	2%	1%	▼
Manitoba maple	NR	50%	49%	▼
non-native honeysuckles	1%	3%	34%	▲
Norway maple	NR	NR	1%	▲
poison/wild parsnip	3%	13%	29%	▲
purple loosestrife	57%	65%	56%	▼
yellow iris	NR	1%	NR	▼
Total percent of sections invaded	**77%**	**94%**	**97%**	▲



Recorded observations of non-native honeysuckles has increased significantly in 2023

Instream Aquatic Vegetation

Table 6 shows increases in instream aquatic vegetation from 2009-2023. Narrow-leaved emergent plants (e.g. sedges), submerged plants (e.g. pondweed) and algae had significant increases of 30 percent or higher. In some cases, drastic increases can be associated with different seasonal plant emergence or seasonal variances in temperature and precipitation.

Table 5 Instream aquatic vegetation (presence in % of sections) comparison between 2009-2023

Instream Vegetation	2009	2015	2023	+/-
narrow-leaved emergent plants	24%	10%	46%	▲
broad-leaved emergent plants	2%	4%	14%	▲
robust emergent plants	1%	5%	18%	▲
free-floating plants	1%	1%	17%	▲
floating plants	1%	2%	10%	▲
submerged plants	16%	13%	62%	▲
algae	47%	28%	60%	▲

Section of Stillwater Creek with narrow-leaved emergent plants, submergent plants, robust emergent plants, free floating plants and algae downstream of Corkstown Road.

Fish Community

Fish sampling was carried out by the City Stream Watch program in 2009, 2015 and 2023 to evaluate fish community composition in Stillwater Creek (see Table 6). In total, 34 species have been observed in Stillwater Creek. In 2009, 20 fish species were captured at four sites; in 2015, 29 species were observed in ten sites; and 19 species were observed in eight sites in 2023. Sample locations in 2023 were similar to those sampled in 2015.

The majority of species observed in 2023 had been captured in previous years, with the blacknose dace and the longnose gar as new observations.

Table 6 Comparison of fish species caught between 2009-2023

Species	2009	2015	2023
banded killifish *Fundulus diphanus*	X	X	X
black crappie *Pomoxis nigromaculatus*		X	
blackchin shiner *Notropis heterodon*		X	
blacknose dace *Rhinichthys atratulus*			X
blacknose shiner *Rhinichthys atratulus*		X	
bluegill *Lepomis macrochirus*		X	
bluntnose minnow *Pimephales notatus*	X	X	X
brassy minnow *Hybognathus hankinsoni*	X	X	
brook stickleback *Culaea inconstans*	X	X	X
brown bullhead *Ameiurus nebulosus*		X	
burbot *Lota lota*	X		
central mudminnow *Umbra limi*		X	X
common shiner *Luxilus cornutus*	X	X	
creek chub *Semotilus atromaculatus*	X	X	X
emerald shiner *Notropis atherinoides*	X	X	X
fathead minnow Pimephales promelas	X	X	X
finescale dace *Chrosomus neogaeus*	X		
golden shiner *Notemigonus crysoleucas*		X	
johnny/tessalated darter *Etheostoma spp.*	X	X	X

Species (continued)	2009	2015	2023
largemouth bass *Micropterus salmoides*		X	
logperch *Percina caprodes*	X	X	X
longnose dace *Rhinichthys cataractae*	X	X	X
longnose gar *Lepisosteus osseus*			X
mottled sculpin *Cottus bairdii*	X	X	X
muskellunge *Esox masquinongy*		X	
northern pearl dace *Margariscus nachtriebi*	X	X	
northern pike *Esox lucius*		X	
northern redbelly dace *Chrosomus eos*	X	X	X
pumpkinseed *Lepomis gibbosus*	X	X	X
rock bass *Ambloplites rupestris*		X	X
spotfin shiner *Cyprinella siloptera*		X	
spottail shiner *Notropis hudsonius*	X		
white sucker *Catostomus commersonii*	X	X	X
yellow perch *Perca flavescens*	X	X	X
Total Species 34			

Yellow perch, a coolwater species, were observed in Stillwater Creek in all three sample years.

Monitoring and Restoration

Monitoring on Stillwater Creek

Table 7 highlights recent and past monitoring that has been done on Stillwater Creek by the Rideau Valley Conservation Authority's City Stream Watch program. Monitoring activities and efforts have changed over the years.

Table 7 City Stream Watch monitoring on Stillwater Creek

Accomplishment	Year	Description
City Stream Watch Stream Monitoring	2009	7.9 km of stream was surveyed
	2015	10 km of stream was surveyed
	2023	10.8 km of stream was surveyed
City Stream Watch Fish Sampling	2009	four fish community sites were sampled
	2015	ten fish community sites were sampled
	2023	eight fish community sites were sampled
City Stream Watch Thermal Classification	2009	four temperature probes were deployed
	2015	seven temperature probes were deployed
	2023	six temperature probes were deployed
Headwater Drainage Feature Assessment	2015	thirteen headwater drainage feature sites were sampled in the catchment
	2023	fifteen headwater drainage feature sites were sampled in the catchment

RVCA staff working to remove shopping carts from the upper reaches of Stillwater Creek

Potential Riparian Restoration Opportunities

Riparian restoration opportunities include potential enhancement through riparian planting. Opportunities were identified along Stillwater Creek surveyed areas (Figure 42).

Riparian Planting

Various riparian areas of Stillwater Creek can benefit from planting to increase plant diversity. Many sections had riparian buffers of low plant diversity. Additional planting would increase shading, enhance wildlife habitat, prevent soil erosion and mitigate negative impacts from runoff and anthropogenic input.

Area of Stillwater Creek west of Moodie Drive that would benefit from riparian planting

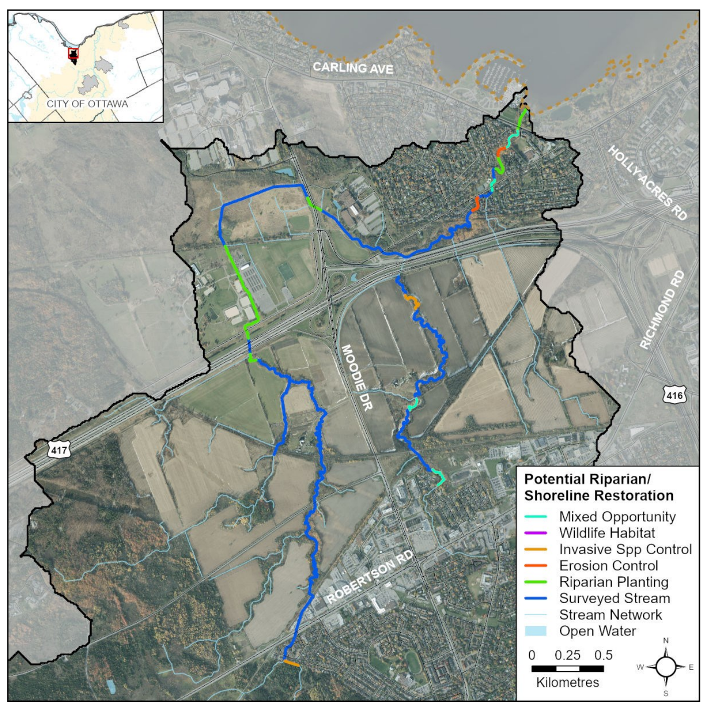


Figure 42 Potential riparian/shoreline restoration opportunities along Stillwater Creek



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For more information on the 2023 City Stream Watch Program and the volunteer activities, please refer to the City Stream Watch 2023 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