Carp Creek
2017 Catchment Report

Monitoring Activity in the City of Ottawa

The City Stream Watch program (CSW) is an in-depth survey of a watercourse where data is collected by wading through the stream and taking detailed observations every 100 meters (m). In 2013, MVCA joined the working group and adopted the program. Since implementing the CSW program MVCA staff and volunteers have surveyed more than 470 sections across 10 watercourses. This information has fed into the planning of 13 riparian planting sites, 4 habitat improvements, stream garbage pick-ups in Poole Creek and the Carp River, and invasive species removal events.

The City Stream Watch Program has three broad goals:

- To provide long-term documentation of the aquatic and riparian conditions in our watershed
- To enhance public awareness about the condition and value of freshwater streams through volunteer engagement and the creation of catchment reports
- To use the information collected to encourage community driven restoration projects

When possible, each CSW assessment is enhanced with the application of other monitoring programs such as benthic biomonitoring, fish community sampling and assessing headwater drainage features.

Seasonal weather conditions were very wet in 2017 with sustained high water conditions for most of the season. This hampered field surveys as sections would become too deep or fast for wading. However, with the perseverance of the crew and the volunteers, 117 sections in two catchments were assessed.

Figure 1 shows the location of the Carp Creek subwatershed within MVCA's City Stream Watch program area.

2017 marks the first return to streams previously surveyed and where possible this report will reflect on the differences found since our last visit to these waterways.

Given the atypical conditions, all assessments were subject to the effects of high water and may not reflect the overall health of the systems.

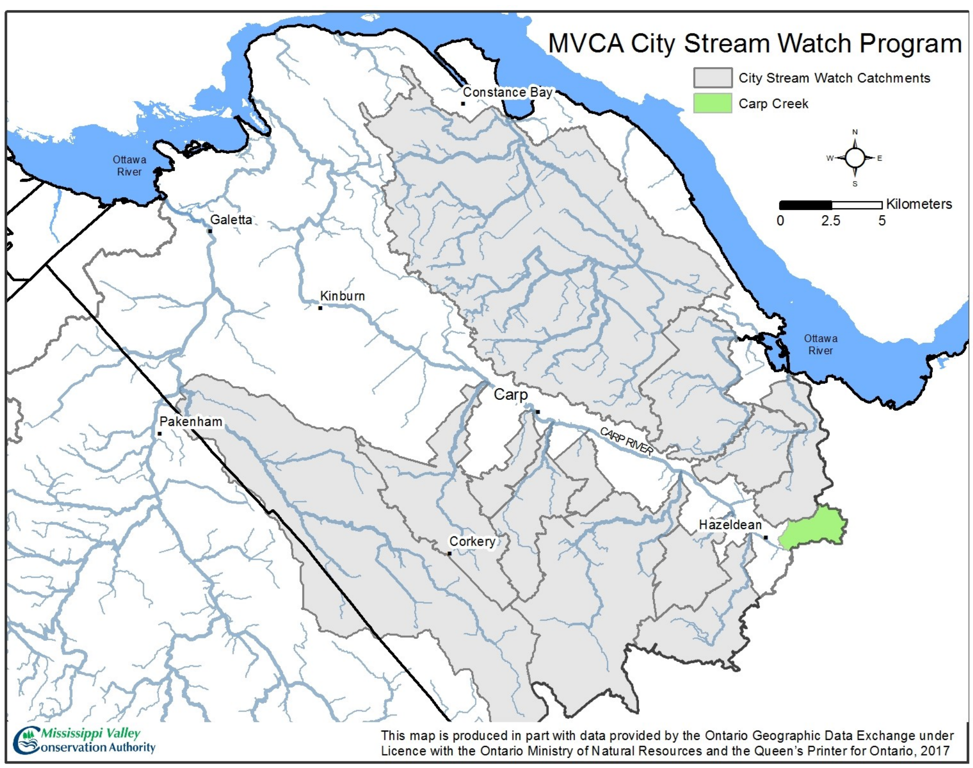


Figure 1: MVCA's City Stream Watch area highlighting the location of the Carp Creek subwatershed.

Carp Creek

Located in the west end of the City of Ottawa, Carp Creek is one of eight major tributaries of the Carp River. It has a length of 2.17 kilometers (km) and drains an area of 4.35 square kilometers (km^2).

Carp Creek's headwaters originate in the Provincially Significant Stony Swamp Wetland Complex located south of Robertson Road and east of Eagleson Road. It flows south west through a City park corridor in Glen Cairn outletting into the Carp River west of Terry Fox Drive.

Table 1 presents a summary of some key features of the Carp Creek subwatershed.

Table 1: Subwatershed Features	
Area	4.35 Square Kilometers
	1.7% of the Carp River Watershed
Length	2.17 Kilometers
Type	100% Permanent
	Thermal: Cool Water Habitat
	67% Natural
	33% Channelized
Land Use	0.6% Agriculture
	0% Aggregate sites
	54% Urban land-use
	9.1% Wooded area
	0% Rural land-use
	10.7% Wetlands
	4.8% Grassland
	21% Roads
Surficial Geology	34.4% Clay
	15.5% Diamicton
	19.2% Organic deposits
	22.5% Bedrock
	0% Sand
	8.5% Gravel

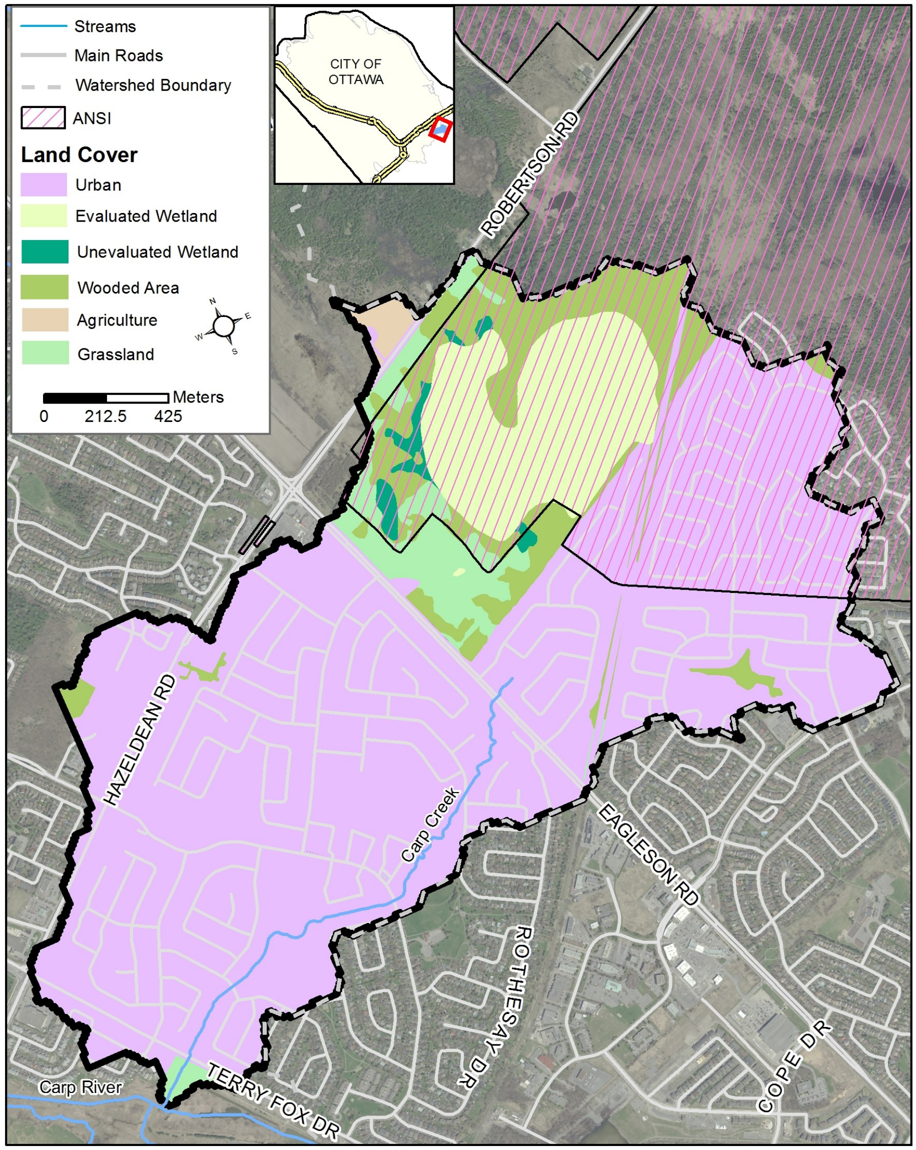


Figure 2: *Land Use in the Carp Creek subwatershed.*

The Carp Creek Subwatershed

As seen in Figure 2, the Carp Creek subwatershed is predominantly urban residential development with the remaining areas being composed of wetland and grassland habitat in the National Capital Commission's Greenbelt. As a general overview, Carp Creek begins at the outlet of a storm pipe, flows through a City of Ottawa park corridor neighboured by residential areas, three schools, two playgrounds and a community centre.

The creek provides a natural corridor and habitat for a range of aquatic and terrestrial species. It also plays an important role for the community as a place to walk, play, and educate.

Monitoring in Carp Creek

In 2017, permission was granted to survey 21 sections of Carp Creek, shown on Figure 3, which cover approximately 2.1 km of the main creek.

This report presents a summary of the observations made along the 21 sampled sections.

Table 2 shows some basic assessment measurements for Carp Creek. The surveyed sections had an average stream width of 3.7m and an average depth of 0.21m.

Flows were generally low with an average hydraulic head of 3mm indicating low surface water velocities.

Figure 3: *Map depicting the Carp Creek monitoring sites.*

Methodology

The macro stream assessment is completed using a protocol that divides the entire length of the creek into 100 meter (m) sections. Starting at the downstream end, a monitoring crew wades the creek and completes a detailed assessment at the end of each 100 meter section. If a section of the creek is un-wadeable, that section is bypassed and the assessment is continued once the creek becomes wadeable again. The parameters that are assessed include general land use, in-stream morphology, human alterations, water chemistry, plant life, and other features presented in this report.

The 2017 sampling was made more robust with the deployment of a temperature logger as well as performing an electrofishing survey.

Table 2: Carp Creek Assessment

	Minimum	Maximum	Average
Stream Width (m)	1.3	10.7	3.7
Stream Depth (m)	0.05	0.49	0.21
Hydraulic Head (mm)	0	30	3

General Land Use Adjacent to Carp Creek

General land use along each surveyed section of Carp Creek is considered from the beginning to the end of each survey section (100 m) and extending outward 100 m on each side of the creek. Land use outside of this area is not included in the surveys but is nonetheless part of the subwatershed and will influence the creek (Castelle et al, 1994).

The categories of land use include infrastructure, active agriculture, pasture, abandoned agricultural fields, residential, forests, scrubland, meadow, and wetland. Figure 4 shows the overall percent of land use that was observed adjacent to Carp Creek.

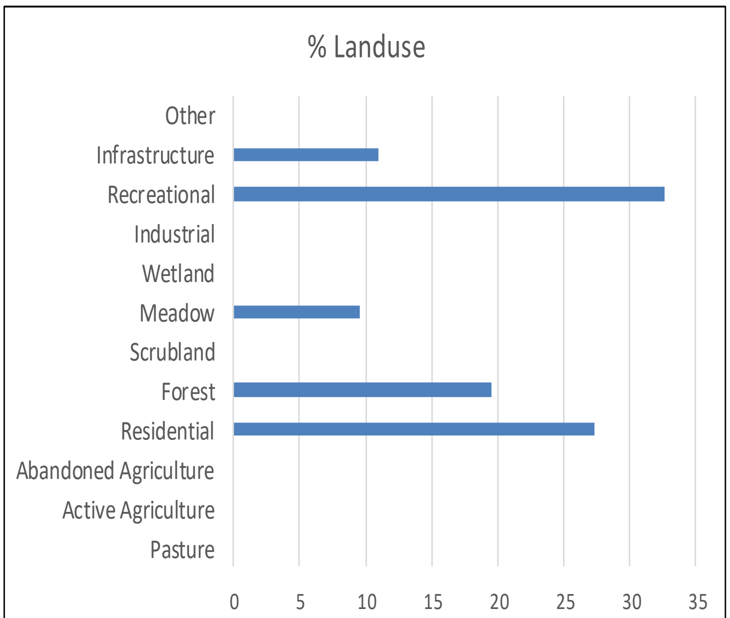


Figure 4: *Land use alongside Carp Creek.*

Of the eleven categories, active agriculture, pasture, abandoned agriculture, industrial, wetland and scrubland were not found to be present. At 33%, recreational represents the most prominent category of adjacent land use followed by residential at 27%, and forest at 20%.

As described on page 2, the land use in the overall subwatershed area is dominated by urban land use surrounding a corridor of park space designed around Carp Creek. This is reflected well in the percentages seen in Figure 4. In particular we see a high percentage of recreational, forest and meadow. These natural features of the park corridor are broken up with 5 road crossings and three pedestrian bridge structures represented by the 11% infrastructure shown in Figure 4.

Human Alterations to Carp Creek

In this assessment, human alterations refer to artificial changes to the actual channel of the watercourse either by straightening or relocation. Such alterations can be made in streams and rivers for many reasons including to accommodate development, such as road crossings and culverts, to make more land available for agriculture, to allow navigation of large boats, and to minimize natural erosion caused by the meandering pattern of flowing water. As seen in Figure 5, 0% of Carp Creek was found to be completely unaltered, 67% was natural (with minor alterations), 24% was altered (with considerable human impact) and 9% of the surveyed sections were considered highly altered.

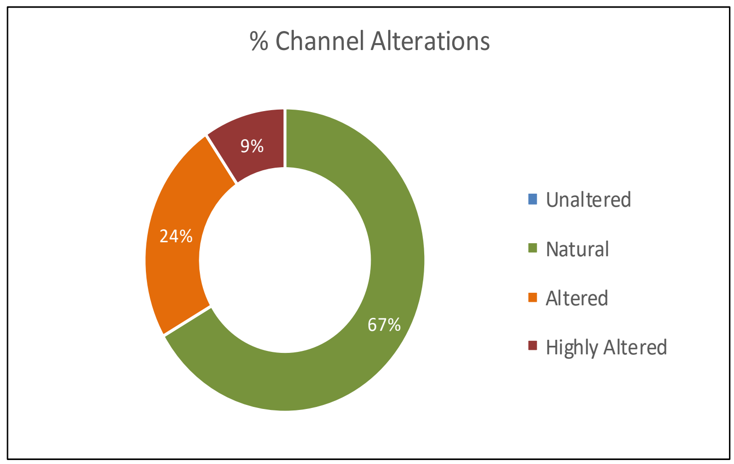


Figure 5: *Extent of human alterations to Carp Creek.*

It is beneficial to the overall health of the system that so much of the creek is natural and has not been channelized. There are also large sections that have significant alterations. In particular, the areas near road crossings and the reach in Rickey Place Park where some erosion stabilization work occurred a few years ago.

Riparian Buffer along Carp Creek

The riparian buffer refers to the amount of vegetated area along the edges of the stream banks. It can consist of a variety of vegetation types including trees, shrubs, grasses and other plants. Vegetated buffers are important for protecting water quality and creating healthy aquatic habitats. They intercept sediments and contaminants as well as protect the stream banks against erosion. Buffers also improve habitat for aquatic species by shading and cooling the water and providing protection for birds and other wildlife that need to be near water for feeding or rearing young. Riparian buffers along the creek corridor also provide a natural area for wildlife movement and dispersal. While it is not the only factor affecting stream health, studies assessing adjacent land use largely show a positive relationship between buffer size and stream health (Stanfield and Kilgour, 2012).

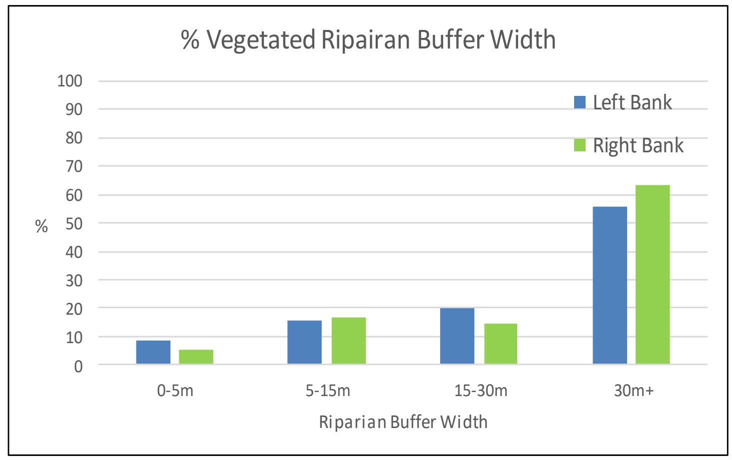


Figure 6: *Riparian buffer widths along Carp Creek.*

Environment Canada's Guideline: *How Much Habitat is Enough?* recommends a minimum 30 m wide vegetated buffer along at least 75% of the length of both sides of a watercourse. Therefore, for this assessment, we record the width of the riparian buffer within 30 m of either side of the watercourse. As summarized in Figure 6, we found that the sections of Carp Creek that were surveyed have a relatively good riparian buffer. Results show that 77% of the left and right bank has a buffer width greater than 15 meters, and 7% of sections have a buffer of 5 m or less.

Figure 7 shows the differences in riparian buffer widths along Carp Creek. The best buffers were seen along the surveyed sections in the north where the stream flows through a forested area. Through the middle section, the creek flows through recreational park land with mowed grass adjacent to the meadow riparian buffer. The 0-5m riparian buffer classifications are in an area with a wide road crossing and an area where residential yards back onto the creek. Encouraging reduced mowing in the residential area would be a simple way of improving the buffer width in that reach.

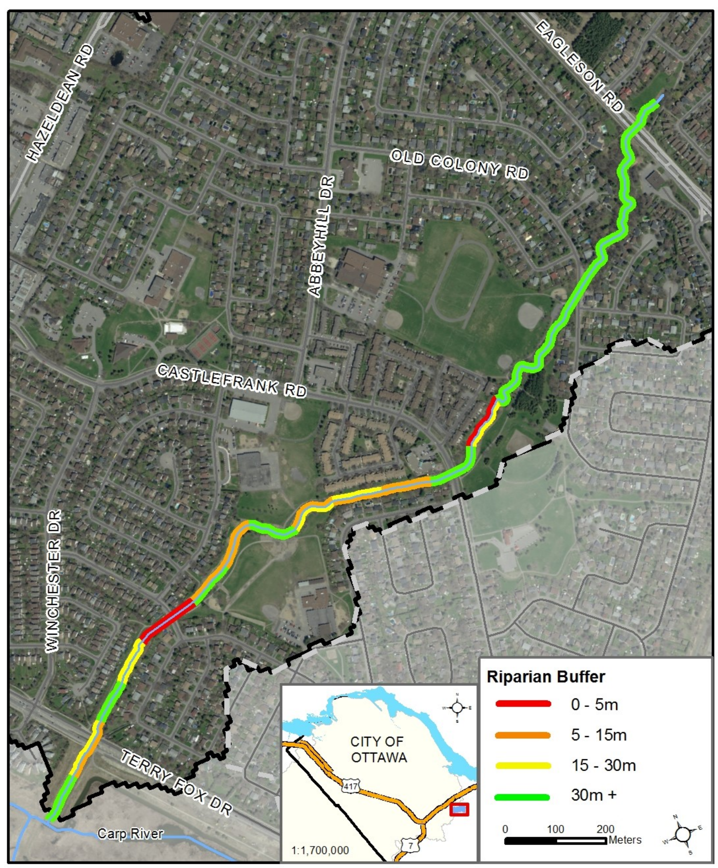


Figure 7: *Vegetated buffer width along Carp Creek.*

Overhanging Trees and Branches

Overhanging branches and trees, a byproduct of a good riparian buffer, provide crucial nutrients, in the form of coarse particulate organic matter (leaves, insects, seeds etc.), to small streams (Vannote et al. 1980). This organic matter is broken down and eaten by aquatic insects, phytoplankton and zooplankton, which are important prey items of fish and wildlife. Overhanging branches also provide stream shading, and fallen logs create excellent habitat for fish.

Overall, Carp Creek has a measurable lack of overhanging trees and branches, as seen in Figure 8. In the lower half of the reach this reflects the surrounding natural vegetative community, where the creek passes through areas dominated by tall grasses with a sparse distribution of shoreline trees. In the upper reaches downstream of Eagleson Road the Creek does pass through a forested area, but even here there are large openings in the canopy.

Figure 9 shows the data quantified as the percent of creek sections classified according to the various amounts of overhanging trees and branches. For example, 33% of the 21 surveyed stream sections on the left bank were classified as having zero overhanging trees and branches. 79% of the surveyed stream was found to have less than 40% overhanging branches.

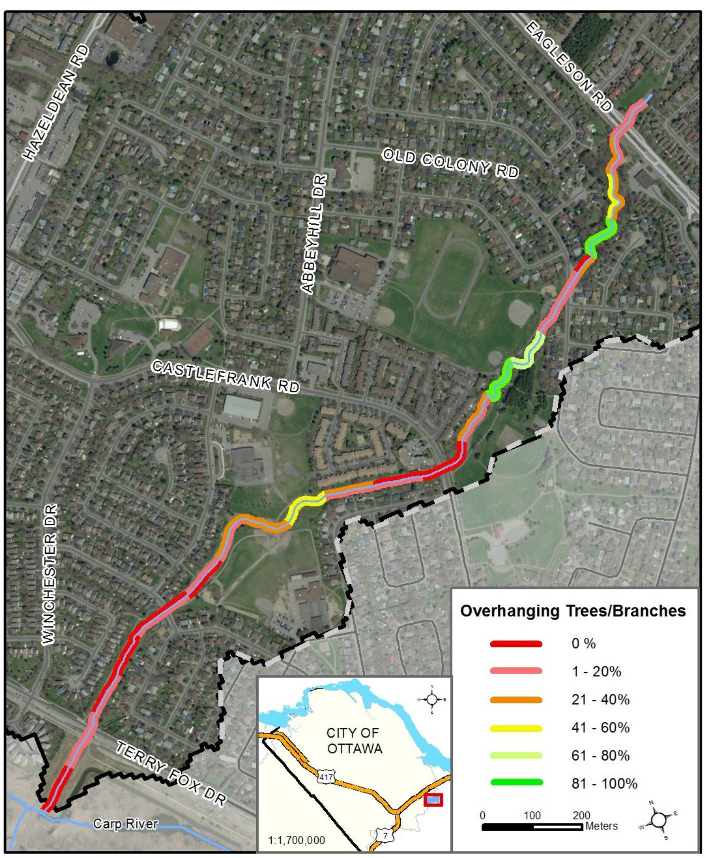


Figure 8: *Overhanging trees and branches along Carp Creek.*

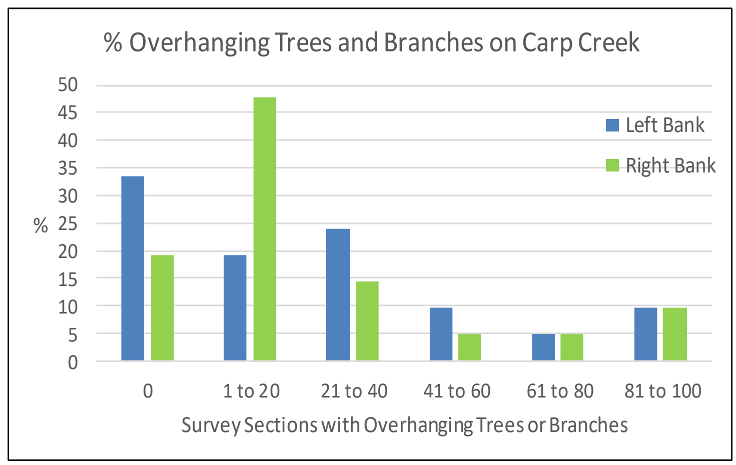
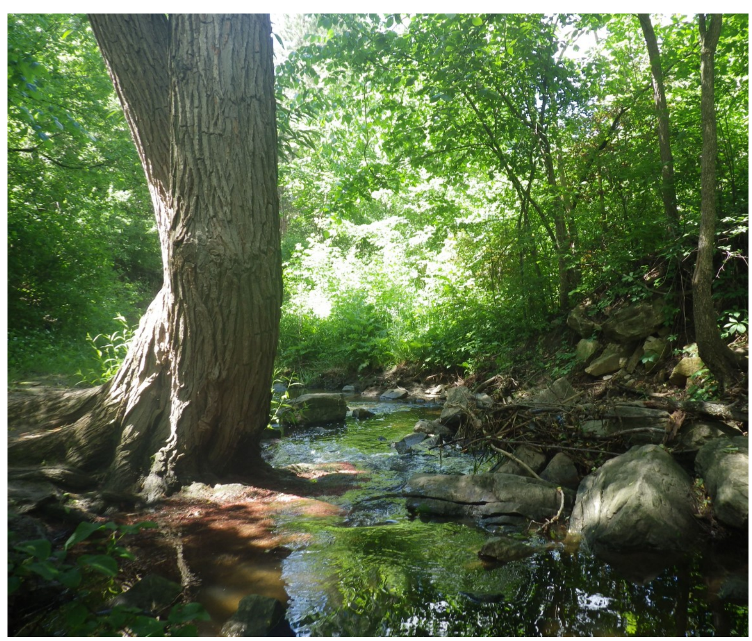
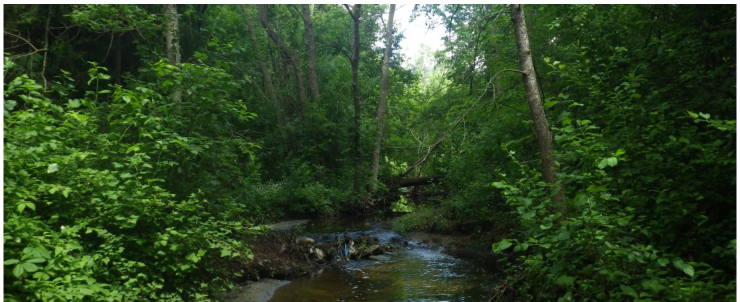
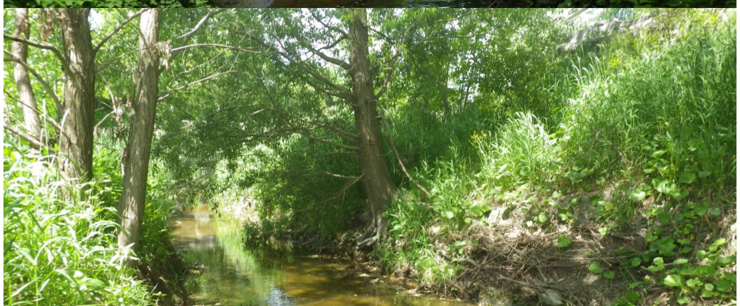
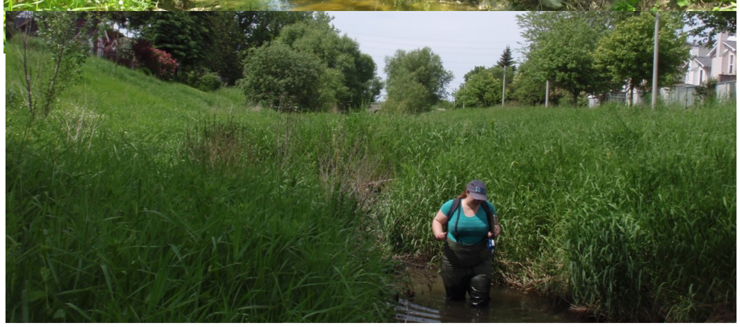


Figure 9: *Percentage of each surveyed section of Carp Creek with overhanging trees and branches.*



Stream Shading

Shade is important in moderating stream temperature, contributing to food supply and helping with nutrient reduction within a stream. Grasses, shrubs and trees can all provide shading to a stream, with trees providing more full coverage and grasses providing much needed shade directly along the edges where shading from trees may not be available.

Figure 10 shows the variability in the amount of stream shading along different sections of Carp Creek. We can see that the shading is extremely variable. This is due to the diversity of riparian vegetation along the creek, with large sections of tall grasses and open park land in the downstream areas, with more trees as you move upstream. With the exception of crossings, the area between Eagleson Road and Clarence Maheral Park is forested providing the creek with greater than 81% shade in its upper reach. The variability in shade can be seen in the three photographs to the left.

Figure 11 shows the data quantified as the percent of creek sections classified according to the various levels of shading. With 5% at zero shading, 29% at 1 to 20 percent, and 14% at 21 to 40 percent, 48% of the surveyed stream has less than 41% shading. The area of highest shading was in the thickly forested area downstream of Eagleson Road shown in bright green in Figure 10.

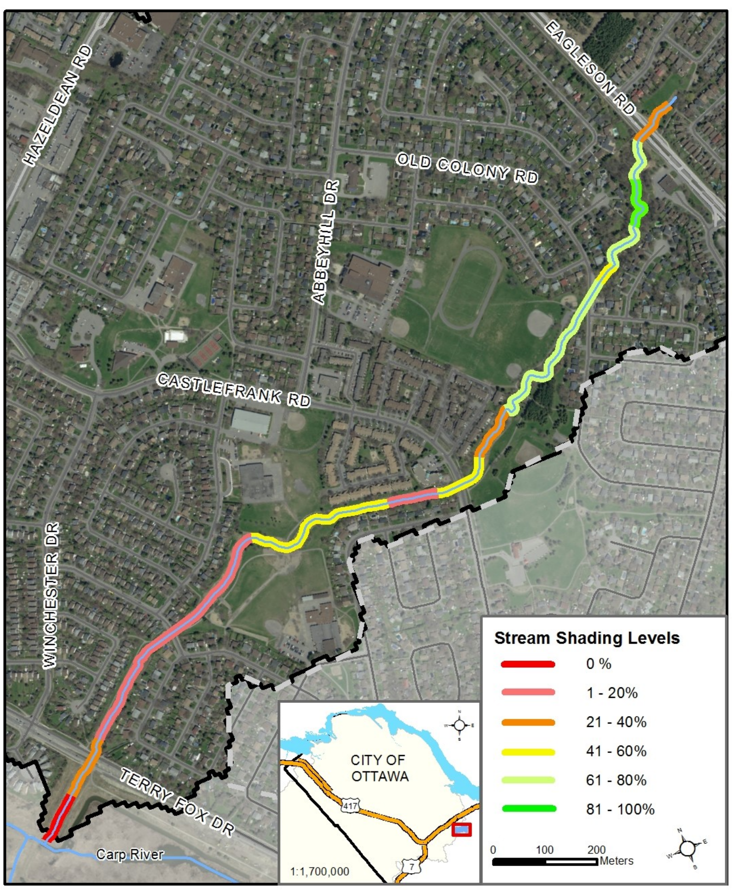


Figure 10: *Stream Shading along Carp Creek.*

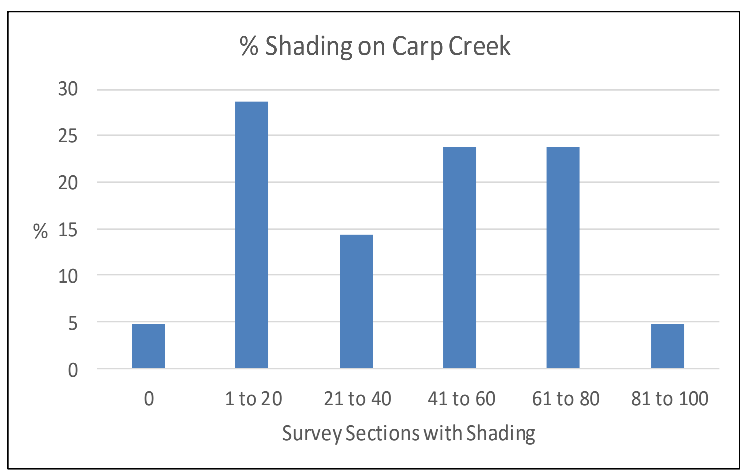


Figure 11: *Shading along Carp Creek.*

Erosion and Streambank Undercutting

Rivers and streams are dynamic hydrologic systems, which are constantly changing in response to changes in the watershed. Streambank erosion is a natural process that can produce beneficial outcomes by helping to regulate flow and shape a variety of habitat features. When the natural rate of erosion is accelerated or changed through human activities, such as stream straightening and over-clearing of catchment and stream bank vegetation, the system is thrown off balance. The acceleration of the natural erosion process can lead to stream channel instability, land loss, sedimentation, habitat loss and other adverse effects that negatively impact water quality and important fish and wildlife habitat.

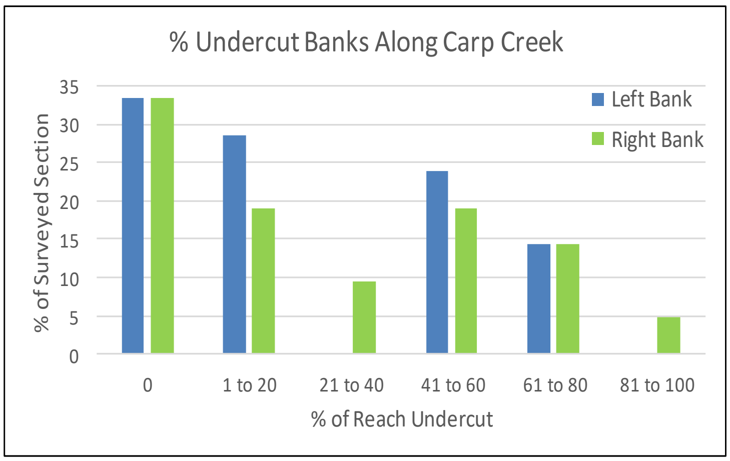


Figure 12: *Undercut stream banks along Carp Creek.*

Erosion also has the ability to create undercut stream banks. While some undercutting of stream banks can be a normal stream function and can provide excellent refuge for fish, too much undercutting can become harmful if it results in instability, erosion and sedimentation.

Figure 12 shows the percentage of undercut stream banks along each surveyed section of Carp Creek. Overall, the sections of Carp Creek that were surveyed were found to have very little undercutting, most with either less than 20% or with no undercutting at all. The areas that have moderate undercutting may provide suitable fish habitat if they are stable.

There are a number of reaches in Carp Creek that are demonstrating bank erosion beyond undercutting. These contribute sediment to the downstream reaches potentially clogging spawning areas or flows through culverts. MVCA and the City of Ottawa are discussing possibilities for restoration in some of these areas.

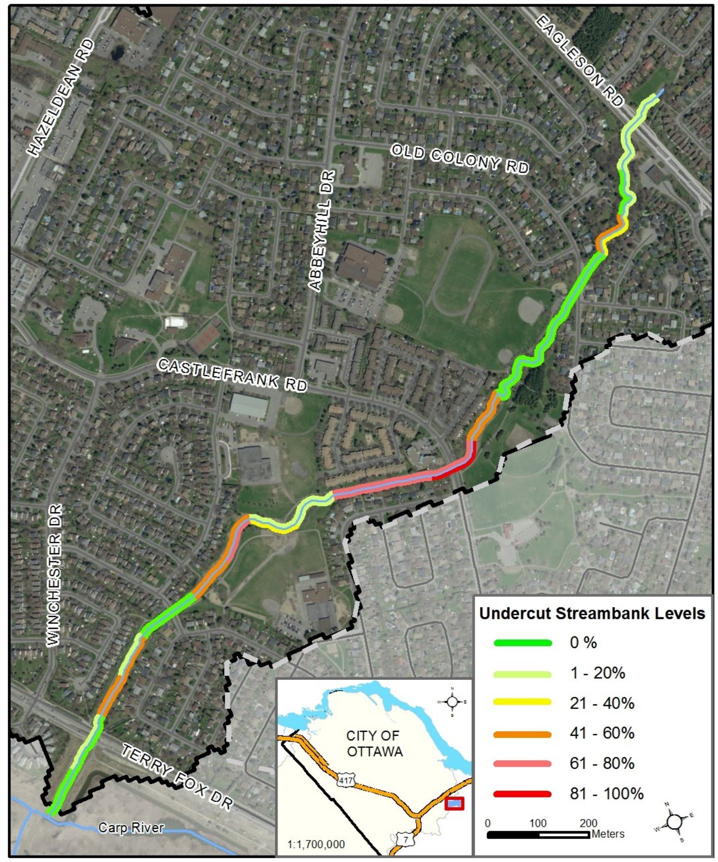


Figure13: *Map of undercut banks along Carp Creek.*

In-stream Substrate

In-stream substrate describes the composition of the bed of the watercourse. A diversity of substrates is important for fish and benthic invertebrates because some species have specific habitat requirements and will only reproduce on certain types of substrate. A healthy stream will generally have a large variety of substrate types which will support a greater diversity of organisms.

Figure 16 summarizes the different types of substrate which make up the bed of Carp Creek.

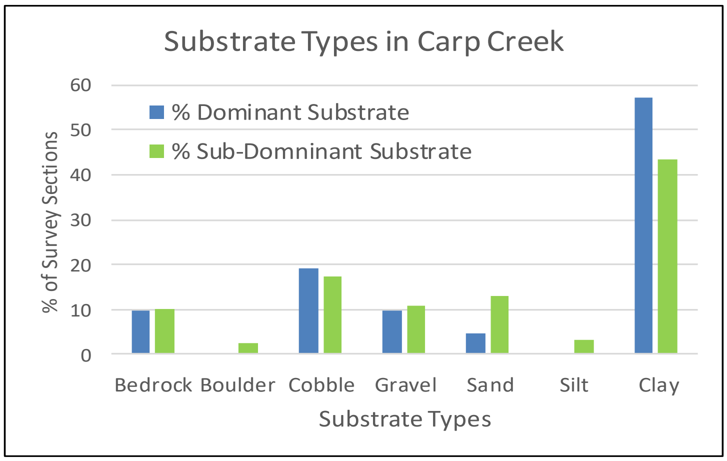


***Figure 16:** Percentages of in-stream substrate types in Carp Creek.*

Carp Creek is composed of high percentages of clay, cobble and gravel, with smaller percentages of bedrock and sand. Cobble, which makes up 19% of the dominant and 17% of the sub-dominant in-stream substrate, provides spawning habitat for fish and invertebrates. It also provides habitat for benthic invertebrates (organisms that live on the bottom of a water body or in the sediment) that are a key food source for many fish and wildlife species. Boulders, which make up 2% of Carp Creek's sub-dominant in-stream substrate, will create cover and back eddies for larger fish to hide and to rest out of the current.

Cobble and Boulder Habitat

As discussed, cobble and boulders both provide important fish habitat. Figure 17 shows the sections of Carp Creek where cobble and boulders were found to either be present or not present on the stream bed and shows that the creek has a healthy distribution of cobble and boulder substrate.

***Figure 17:** Cobble and boulder habitat along Carp Creek.*

Habitat Complexity

Habitat complexity is a measure of the overall diversity of habitat types and features within a stream. Streams with high habitat diversity support a greater variety of species niches, and therefore contribute to a greater potential for species diversity. Factors such as substrate, flow conditions, and cover material all provide crucial habitat functions for aquatic life.

The habitat complexity score seen in Figure 14 below is based on the presence or absence of gravel, cobble, or boulder substrates as well as the presence of woody material in each surveyed reach of Carp Creek. The presence of one of the variables carries a score of 1. A reach with all four features receives a score of 4 or high habitat complexity.

Only 4 of the 21 reaches received a score of 1 or less. This is likely due to the proximity of major road crossings and engineering of the channel altering the instream habitat and availability of woody debris.

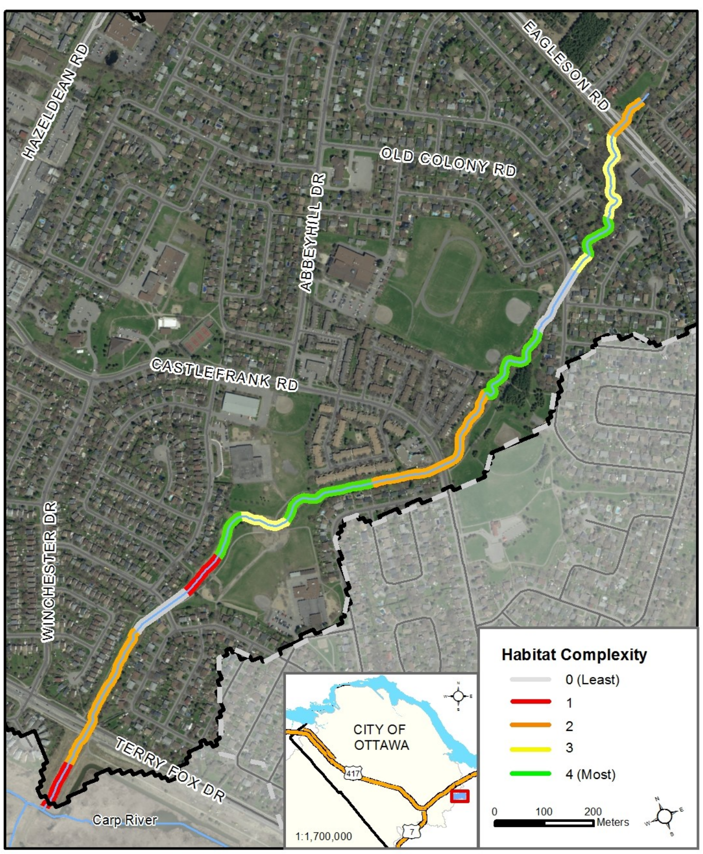


Figure 14: *Habitat Complexity results for Carp Creek.*

In-stream Morphology

In-stream morphology is categorized as pools, riffles, and runs. Pools and riffles are both particularly important for fish habitat. Pools, which are deeper and usually slower flowing sections in the stream, provide shelter for fish, especially when water levels drop or when water temperatures increase. Riffles are sections of agitated and fast moving water that add dissolved oxygen to the stream and provide spawning habitat for some species of fish. Runs are areas along a creek that are typically shallow and have un-agitated water surfaces. The in-stream morphology for Carp Creek can be seen in Figure 15.

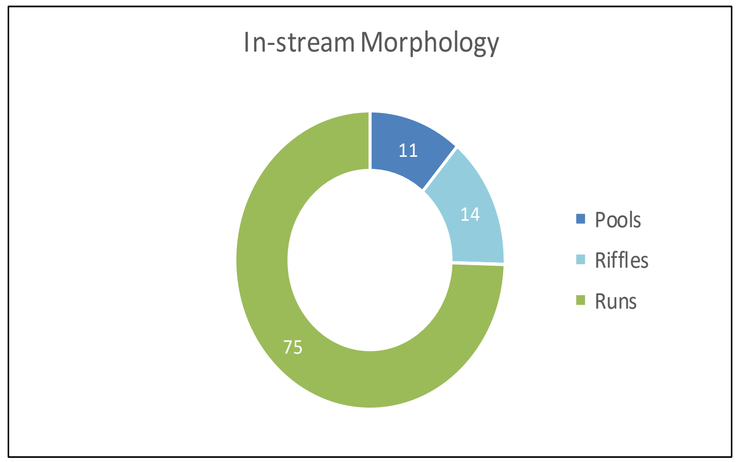


Figure 15: *In-stream morphology along Carp Creek.*

It is beneficial for the health of the ecosystem if there is a variety of these in-stream features, to allow oxygen to flow through the creek, to provide habitat, and to have a well-connected watercourse. As seen in Figure 14, Carp Creek was found to consist of 75% runs, 14% riffles and 11% pools. Stewardship efforts could be focused at creating more in-stream pool/riffle sequences to enhance fish habitat.

In-Stream Vegetation

A well-balanced amount and suitable variety of in-stream vegetation is important for a healthy stream ecosystem. Aquatic plants provide habitat for fish and wildlife, contribute oxygen to the stream, and help to remove contaminants from the water. However, too much in-stream vegetation can be detrimental and can signify an unhealthy stream. Certain types of vegetation, such as algae, can also be indicative of poor stream health, as it is often seen in streams with high nitrogen and phosphorus inputs (from runoff or wastewater).

Types of In-stream Vegetation

There are many factors that can influence the presence of aquatic plants, some of which include the substrate type, increases in air and water temperature, and the time of year the assessment was completed. As seen in Figure 18, the in-stream vegetation that was observed in each surveyed section was divided by type into eight categories; narrow-leaved emergent, broad-leaved emergent, robust emergent, free floating plants, floating plants, submerged plants, algae and no plants. Only floating plants were absent from Carp Creek.

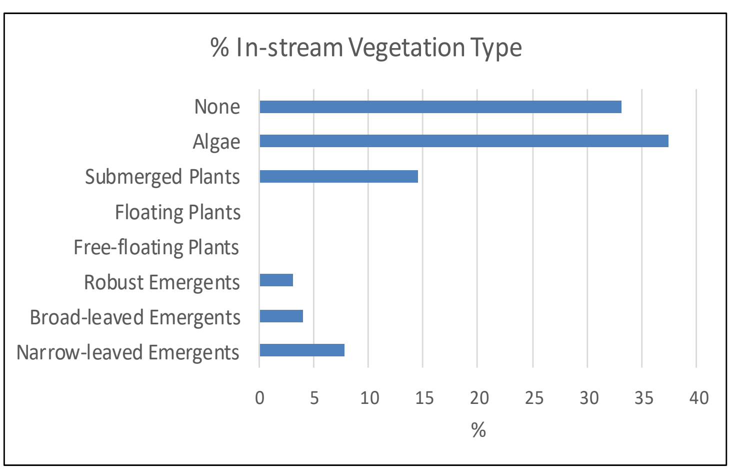


Figure 18: *Types of in-stream vegetation in Carp Creek.*

Amount of In-stream Vegetation

In-stream vegetation helps to remove contaminants from the water, contribute oxygen to the stream, provide habitat for fish and wildlife, and reduce current velocities, however too much vegetation can be detrimental. For this assessment, the amount of in-stream vegetation is measured according to five categories, ranging from "extensive", where the stream is choked with vegetation, to "rare", where there are very few plants.

Figure 19 shows the amounts of in-stream vegetation in Carp Creek. The creek was found to have a good diversity of vegetation abundance with each category being represented, except for extensive. Overall the majority of the creek (62%) creek had low vegetation amounts, with 8% low, 17% rare, and 37% no vegetation.

Low in-stream vegetation levels in Carp Creek are likely due to substrate type. For example areas that are dominated by clay (57% of the surveyed reaches) do not facilitate easy plant growth. It may also be the result of water depths or currents creating conditions that limit plant growth.

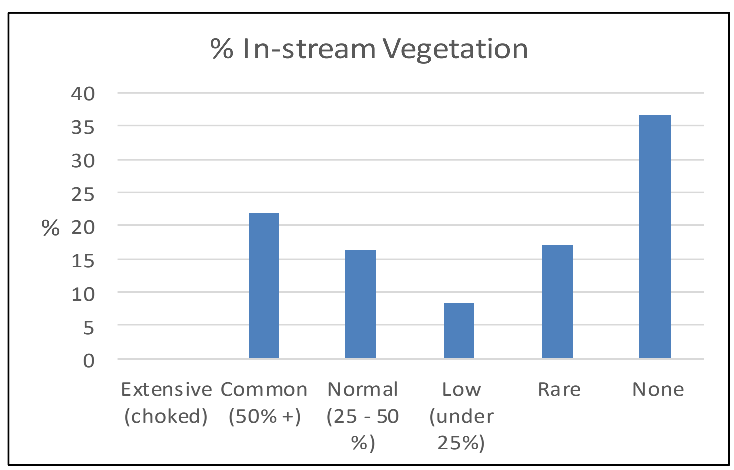


Figure 19: *Abundances of in-stream vegetation in Carp Creek.*

Water Chemistry and Quality

A YSI probe was used to collect water quality data including conductivity, pH, and dissolved oxygen at each site assessed. The maximum, minimum and average readings for each of those parameters are presented in Table 3.

Table 3: Carp Creek Water Quality Data			
	Minimum	**Maximum**	**Average**
Water Temperature (°C)	13	18.4	15.8
Specific Conductivity (µS/cm)	718	1611	1282
pH	7.26	8.19	7.91
Dissolved Oxygen Concentration (mg/L)	8.0	13.1	10.3

Conductivity is defined as the ability of water to pass an electrical current, and is an indirect measure of the saltiness of the water caused by dissolved ions. Fish cannot tolerate large increases in ion concentrations in the water. Factors that can change the conductivity of freshwater include climate change and human activity. Warmer climate conditions increase the evaporation of water, leaving existing water with higher concentrations of dissolved ions (higher conductivity). Use of road salts and fertilizers around the stream can also elevate ion levels, along with industrial and human wastewater. Because of all these factors, conductivity of a stream can fluctuate greatly with readings between 0 and 10,000 microSiemens/centimeter (µS/cm). Environment Canada (2011) sets a target of 500 µS/cm as part their Environmental Performance Water Quality Index. The average specific conductivity of Carp Creek is 1282 µS/cm, putting it above the ideal range. This can have an effect on the wildlife present.

The measurement of **pH** tells us the relative acidity or alkalinity of the creek. The scale ranges from 1 (most acidic) to 14 (most basic) and has 7 as the middle and most neutral point. A range of 6.5 to 8.5 should be maintained for the protection of aquatic life. As can be seen in Figure 20 the range of pH values found in Carp Creek stays well within this range. The average pH of Carp Creek is 7.91, a nearly neutral condition, which is good for many species of fish to thrive.

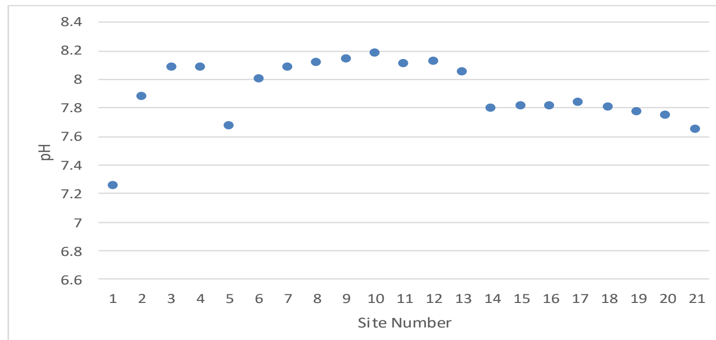


Figure 20: *pH values found along Carp Creek.*

Dissolved Oxygen Concentration measures the amount of available oxygen within the water that is accessible to wildlife. According to the Canadian Water Quality Guidelines for the Protection of Aquatic Life, the guideline value for the concentration of dissolved oxygen in freshwater for early life stages is 6.0 milligrams/liter (mg/L) for warm water ecosystems and 9.5 mg/L for cold water ecosystems. The average amount of dissolved oxygen in Carp Creek measured at - 10.3mg/L, making it healthy for warm water fish, and slightly below the requirements for cold water fish in the upper half, as seen in Figure 21.

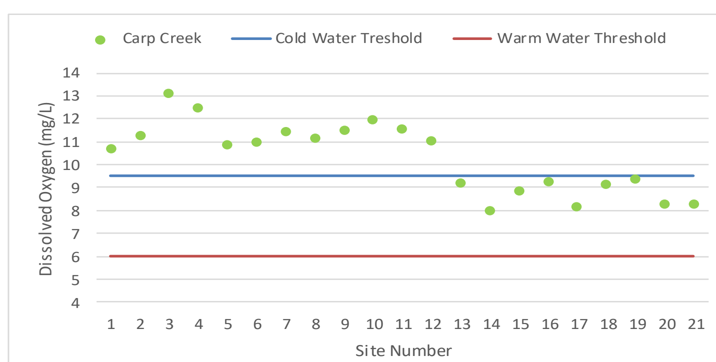


Figure 21: *Dissolved oxygen concentration results from Carp Creek.*

Dissolved 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% 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% to a maximum of 500%, depending on the productivity level of the environment.

Combining the dissolved oxygen concentrations with the saturation values provides us with 6 categories to classify the suitability of stream for supporting various aquatic organisms. With results shown in Figure 22.

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.
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.
6) >100% Saturation / >9.5 mg/L Concentration
   Oxygen concentration and saturation levels are optimal for warm and cold water biota.

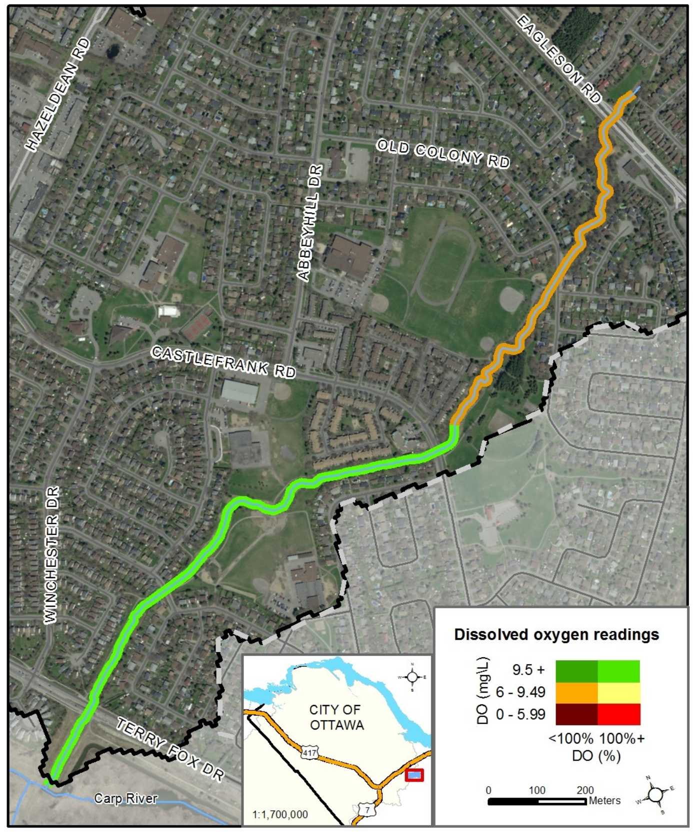


Figure 22: Dissolved Oxygen Concentration plus Saturation Results from Carp Creek.

Areas of Water Quality Concern

This is a summary of areas that are potentially under stress due to one or several water chemistry factors.

In Carp Creek there were no sites outside of the expected pH range, and conductivity values were fairly good throughout with slightly higher values in the upper reaches. Dissolved oxygen was good for cold and warm water biota in the lower reaches and good for warm water biota in the upper reach. However, in the upper reaches dissolved oxygen saturation was <100%. This combined with the slightly elevated conductivity values in the upper reaches resulted in the Good score shown in Figure 23.

Figure 23: Areas of Water Quality Concern for Carp Creek.

Thermal Classification

Temperature is an important parameter in streams as it influences many aspects of physical, chemical and biological health. Figure 24 shows where the temperature datalogger was deployed in Carp Creek from May to October 2017 to give a representative sample of how water temperature fluctuates throughout the summer season.

Many factors can influence fluctuations in stream temperature, including springs, tributaries, precipitation runoff, discharge pipes and stream shading from riparian vegetation. Water temperature is used along with the maximum air temperature (using the revised Stoneman and Jones method by Cindy Chu *et al*) to classify a watercourse as either warm, cool-warm, cool, cold-cool, or cold water. Figure 25 shows the thermal classifications of Carp Creek for 2017.

Analysis of the data collected indicates that Carp Creek should be classified as a cool water stream. This is likely due to the primary sources of water flowing into Carp Creek coming from cool underground storm water pipes.

Figure 24: *Location of the temperature logger and fish sampling site on Carp Creek.*

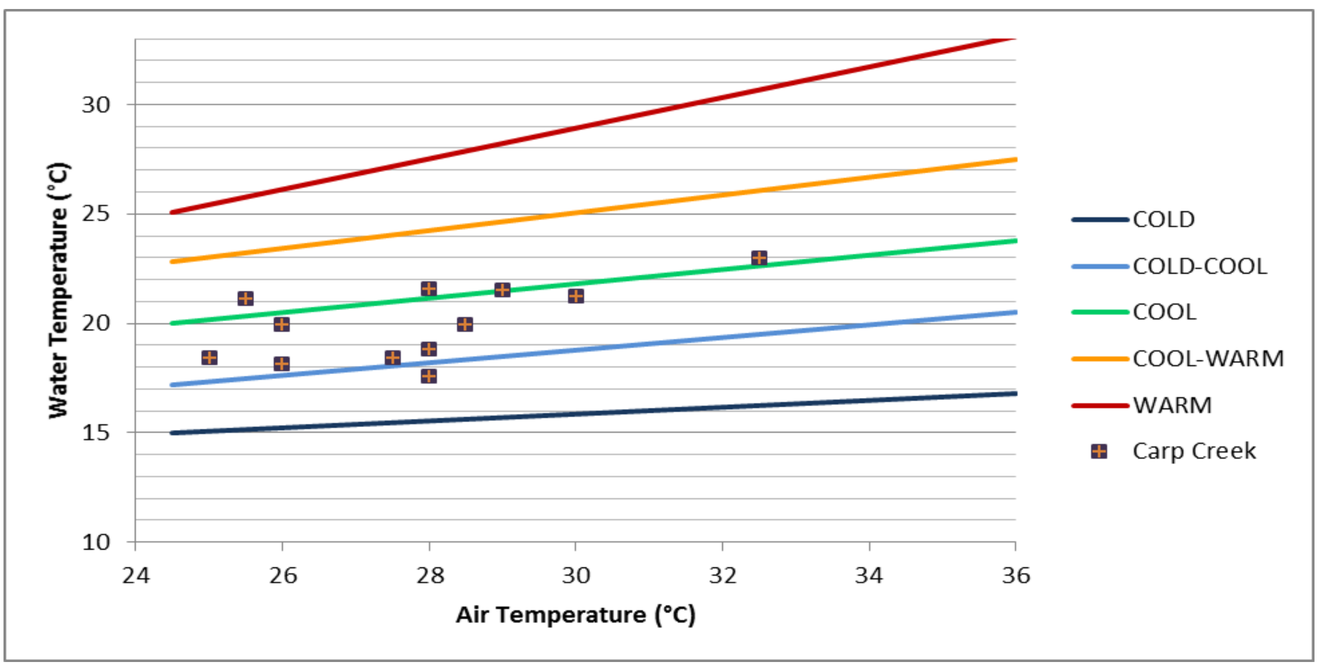
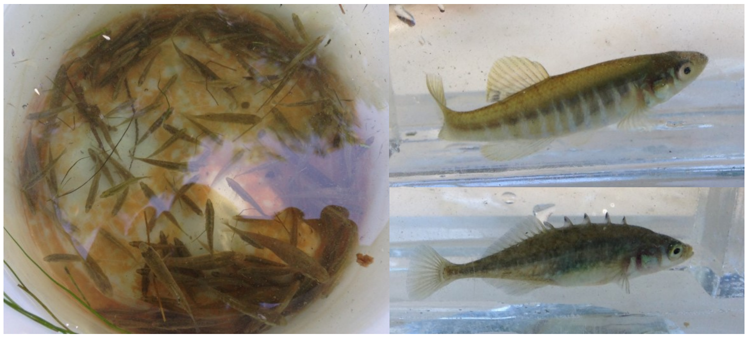


Figure 25: *Thermal classification of Carp Creek.*

Each point on the graph represents a water temperature that was taken under the following conditions:

- Sampling dates between July 1 and August 31.
- Sampling date has a maximum air temperature ≥ 24.5 °C and was preceded by two consecutive days with a maximum air temperature ≥ 24.5 °C during which time no precipitation occurred.
- Water temperature is taken at 4:00 pm



Fish Sampling

In 2017, MVCA used a method called electrofishing to sample Carp Creek's fish population just upstream of Terry Fox Drive, in the same location as our temperature probe.

We found the community to be fairly limited in species diversity, capturing only 3 species. Most fish were found hiding in the filamentous algae or in the riparian vegetation.

In 2014, an environmental consultant fished the reach that flows through Rickey Place Park and found four species of minnows, two of which are different than the ones we caught. This brings the known fish list to the six species listed below in Table 4. (Thermal classes from Coker, 2001)

Table 4: Fish Species Found In Carp Creek

Species Common Name	Thermal Class
Banded Killifish	Cool
Blacknose Dace	Cool
Brook Stickleback	Cool
Creek Chub	Cool
Fathead Minnow	Warm
Finescale Dace	Cool

Migratory Obstructions

Migratory obstructions are features in a water way that prevent fish from freely swimming up and downstream. This can effect successful migration to breeding or foraging habitats as well as restricts a fish's ability to access deeper, cooler water refuges when summer droughts come. These obstructions can be anthropogenic such as perched culverts or debris dams at road crossings, or they can be natural features such as waterfalls and beaver dams.

As seen in Figure 26, 2 blocked culverts were noted during the survey of Carp Creek.

Figure 26: *Map of migratory obstructions on Carp Creek, 2017.*

Wildlife Observed

There were many species of wildlife observed during this assessment of Carp Creek. A highlight for the crew was that a snapping turtle was spotted swimming downstream. When it caught sight of them it dove for cover.

Table 5: Carp Creek Wildlife Observed	
Birds	Duck, Red-winged Blackbird
Mammals	Raccoon, Chipmunk
Reptiles and Amphibians	Snapping Turtle, Green Frog, Tadpoles
Aquatic Insects	Dragonfly, Water Strider
Other	Crayfish, Snail, Leach, small unidentified fish






Potential Stewardship Opportunities

Naturally vegetated shorelines help reduce erosion, filter pollutants from entering the watercourse, assist in flood control and provide food and habitat for a diversity of wildlife.

Figure 27 depicts the locations identified by MVCA staff and volunteers, as areas for potential riparian restoration activities. There is occasional garbage throughout the creek with the reaches up and down stream of Castlefrank Road, and Terry Fox Drive, flagged as being in need of a clean up.

A much larger project will be to organize some reoccurring Himalayan Balsam pulls as this invasive species is found along the entire channel.

Other potential steps will be to contact landowners and community members to explore the potential for collaboration to work together on a voluntary basis to enhance their shorelines through a number of potential activities, such as increasing the unmowed areas along the shore, garbage clean ups and invasive species removal days.

Figure 27: *Areas for potential restoration projects along Carp Creek.*

Invasive Species

Invasive species are a concern as they can impact local species diversity and richness by outcompeting native species. This can result in the reduction of available food and habitat that our native plants and animals rely upon. Species such as Giant Hogweed and Wild Parsnip are also a human health concern as the sap from these plants can cause chemical burns to skin.

Figure 28 shows that although there are seven identified invasive species in the Carp Creek Corridor, they are not all found everywhere.

Invasive species such as Buckthorn, Wild Parsnip, Himalayan Balsam, Purple Loosestrife and Garlic Mustard continue to grow throughout the creek corridor. This year Giant Hogweed and Dog Strangling Vine were also identified in the upper reaches during the survey.

Consistent identification and mapping of invasive species will aid in improving our understanding of these results.

For more information on identifying and reporting invasive species visit www.invadingspecies.com/ managed by the Ontario Federation of Anglers and Hunters.

Figure 28: *Identified invasive species abundance in Carp Creek.*

Carp Creek valley lands contain Wild Parsnip, Himalayan Balsam, Purple Loostrife and Garlic Mustard (Shown above, clockwise), lastly at bottom Dog Strangling Vine.

Photo Credits: Garlic Mustard Chris Evans (University of Illinois) all others Kelly Stiles (MVCA).

For information on choosing local native species as part of your gardening and landscaping choices please read the Ontario Invasive Plants Council Document "Grow Me Instead" found here: www.ontarioinvasiveplants.ca

For information about promoting pollinators with local native plant species refer to: www.pollinator.org/canada

Pollution

Pollution in the form of litter was an ongoing observation during the surveys of Carp Creek, particularly near downstream road crossings. An oily sheen was noted at the outlet. The litter was primarily smaller items such as pop bottles.

Stream Comparison Between 2013 and 2017

Water Chemistry

Water chemistry parameters are tracked throughout the entire surveyed system and reflect the general conditions of the environment. Shifts in these conditions can be indicative of general ecological changes within the environment. However due to the limited number of sampling years completed, it is difficult to determine if a change in surveyed values is part of the system's natural variability or if it is due to impairment.

F-Tests were run to compare the results from 2013 to those from 2017. As seen in Table 6, the mean results are very similar but with lower mean water levels, dissolved oxygen and conductivity readings in 2017. All the variables have smaller variance ranges in 2017 with the exception of conductivity. There was a big difference in the weather experienced between these two years with increased rainfall and increased frequency of rainfall events contributing to the observed stream conditions in 2017. It is unclear at this time if there are additional factors contributing to the recorded differences.

Shoreline Erosion Project

When MVCA last visited Carp Creek in 2013, the CSW program identified an area of significant shoreline erosion downstream of Old Colony Road, in the City of Ottawa park lands.

MVCA has engaged the engineering services of McIntosh Perry to complete a Class Environment Assessment for Remedial Flood and Erosion Control Projects to address the erosion at the site and recommend potential solutions.

A geotechnical investigation was undertaken at the base of the slope in the fall of 2017 and a report listing possible site appropriate alternatives to stabilize and protect the slope is currently being drafted. Once it is ready, a public information session will be organized before moving onto next steps.

The City of Ottawa is supporting MVCA completing this project with funding from their Water Environment Strategy.

Table 6: Comparison of Water Quality Parameters in Carp Creek

	2013 Mean Results	2013 Variance	2017 Mean Results	2017 Variance	Significant Difference?
Water Temperature (°C)	15.3	2.60	15.8	2.56	No
Water Depth (m)	0.30	0.04	0.21	0.01	Yes
pH	7.52	0.07	7.91	0.05	No
Dissolved Oxygen (mg/L)	10.70	7.69	10.32	2.38	Yes
Specific Conductivity (µS/cm)	1507	13414	1283	72280	Yes

Report Summary

The results in the table below are a summary of the highlights from each of the report sections. Although mostly in an urban setting, Carp Creek has high amounts of shoreline vegetation, cool water temperatures, and no areas of concern with a poor score. There are some sites of shoreline erosion which are leading to blocked culvert concerns. The creek also has slightly elevated conductivity results and pollution in the form of littering.

The presence of the parkland corridor provides the creek with healthy riparian buffers and shade cover. Half of the site surveyed had good aquatic habitat complexity, with only 4 sections receiving a poor score. These features combine to provide a diversity of habitats to benthic organisms, fish, and other animals that call Carp Creek home.

The largest erosion site is being evaluated for potential solutions by MVCA in partnership with the City of Ottawa. Through stewardship and education efforts with the community, gains can be made in reducing the littering and presence of invasive species.

Summary of City Stream Watch Results for Carp Creek 2017	
Sample Variable	**Carp Creek**
Number of Sections Surveyed	21
Average Stream Width (m)	3.7
Average Stream Depth (m)	0.21
Average Hydraulic Head (mm)	3
Average Water Temperature (^oC)	15.8
Average Conductivity (µS/cm)	1282
Average pH	7.91
Average Dissolved Oxygen Concentration (mg/L)	10.3
Average Dissolved Oxygen Saturation (%)	103.69
Areas of Water Quality Concern with a Poor Score	0
Dominant Adjacent Land Uses	Recreational 33%, Residential 27%
% Channel Alterations	67% Natural
% Vegetated Riparian Buffer Width (>30m)	56% Left Bank, 63% Right Bank
% Overhanging Trees & Branches >40%Section Coverage	24% Left bank, 19% Right Bank
% Stream Shading >40% Section Coverage	52%
% of Undercut Banks >60% Section Coverage	14% Left Bank, 19% Right Bank
Dominant Substrate Type	Clay 57%, Cobble 19%
Sub-Dominant Substrate Type	Clay 43%, Cobble 17%
# Sections with a Habitat Complexity Score ≥3 Variables	10
Dominant In-stream Morphology	75% Run
Dominant In-stream Vegetation Types	Algae 37%, None 33%
Dominant Amount of In-stream Vegetation	None 37%, Common 22%
Thermal Class	Cool Water
# Fish Species Found	3 of 6 Previously Recorded Species
Migratory Obstructions	2 Partially Blocked Culverts
# of Identified Invasive Species	7
Potential Stewardship Activities	Garbage Clean Ups, Invasive Species Pulls

How Does This Information Get Used?

The City Stream Watch Program is an excellent monitoring program that allows MVCA to assess the condition of subwatersheds over time. Stewardship activities in areas that need further work are completed and improve the health of the ecosystem.

MVCA uses stream surveys to target specific areas that need restoration work. Stream garbage clean ups are carried out, blockages are removed, and shoreline planting, erosion control and habitat enhancements are organized.

MVCA is always looking for volunteers to help with monitoring and stewardship programs!

Call 613-253-0006 ext. 234, if you are interested!

Volunteer projects that are carried out as a result of the City Stream Watch Program are:

* Planting trees and shrubs along the shoreline
* Removing invasive plant species
* Stream garbage clean ups
* Learning about and participating in monitoring the streams
* Learning about and participating in fish sampling, identification and wildlife identification
* Learning about and participating in benthic invertebrate sampling and identification
* Participating in natural photography

References

Brooks, A.P., Gehrke, P.C., Jansen, J.D., Abbe, T.B. " Experimental reintroduction of woody debris on the Williams river, NSW: Geomorphic and Ecological responses". *River Research and Applications.* (2004). 513-536 Online

Canada. Environment Canada. "How Much habitat is Enough? A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern". *Minister of Public Works and Government Services Canada.* (2004). Print.

Canadian Council of Ministers of the Environment. "Canadian water quality guidelines for the protection of aquatic life: Dissolved oxygen (freshwater)". *Canadian Council of Ministers of the Environment.* (1999).

Castelle A.J., Johnson, A. W., Conolly, C. "Wetland and Stream Buffer Size Requirements—A Review". *Journal of Environmental Quality.* 23 (1994): 878-882. Print.

Chu, C., Jones, N.E., Piggott, A.R. and Buttle, J.M. "Evaluation of a Simple Method to Classify the Thermal Characteristics of Streams Using a Nomogram of Daily Maximum Air and Water Temperatures." *North American Journal of Fisheries Management* 29. (2009). 1605-1619, Online.

Coker, G.A, C.B. Portt, and C.K. Minns. 2001. Morphological and Ecological Characteristics of Canadian Freshwater Fishes. Can. MS Rpt. Fish. Aquat. Sci. 2554: iv+89p.

Environment Canada, 2011. Canada's Freshwater Quality in a Global Context Indicator. Data sources and methods. ISBN: 978-1-100-17978-0 . Available online: http://publications.gc.ca/collections/collection_2011/ec/En4-144-3-2011-eng.pdf

Stanfield, L. W., Kilgour, B.W. "How Proximity of Land Use Affects Stream Fish and Habitat." *River Research and Application*. Wiley Online Library. (2012). Online.

Stanfield, L. (editor). 2017. Ontario Stream Assessment Protocol. Version 10. Section 4: Module 10. Ontario Ministry of Natural Resources. Peterborough, Ontario. 548 Pages.

Vannote, R.L., Minshall, G.W., Cummins, K.W., Sedell, J.R. and Cushing, C.E. "The River Continuum". *Canadian Journal of Fisheries and Aquatic Sciences* 37. (1980): 130-137. Print.

The City Stream Watch Collaborative is made up of: Rideau Valley Conservation Authority, Mississippi Valley Conservation Authority, South Nation Conservation Authority, The City of Ottawa, National Capital Commission, Ottawa Flyfishers Society, Ottawa Stewardship Council, Rideau Roundtable, and the Canadian Forces Fish and Game Club.