Carp A 2015 Summary Report

Monitoring Activity in the City of Ottawa

In 2012, Mississippi Valley Conservation Authority (MVCA) and the Friends of the Carp River (FCR) collaborated to undertake a broad scale assessment of potential restoration and stewardship opportunities along the Carp River and to test the implementation of a citizen science based volunteer monitoring program. The following year, with funding from Shell Canada, MVCA initiated a pilot City Stream Watch Program which uses a combination of detailed monitoring, education and outreach, and targeted rehabilitation to improve the overall understanding of and guardianship over the health of the watershed. Volunteer "citizen scientists" are trained to collect technical information on creek conditions. Volunteers also participate in special stewardship initiatives that include shoreline planting, fish habitat enhancement projects, stream clean-up 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 fresh water streams
- To use the information collected to encourage community driven restoration projects

Since 2013, the first year of our City Stream Watch Program, MVCA staff and volunteers have surveyed more than 200 sections of Poole Creek, Carp Creek, Huntley Creek, Watts Creek, Corkery Creek and an Unnamed Tributary of the Carp River near the carp airport. This information has fed into the planning of 13 riparian planting sites and 4 habitat improvements in Poole Creek and the Carp River and an invasive species removal event along Carp Creek.

This year (2015), 3 riparian plantings, an invasive species removal and more than 50 sections of stream were surveyed.

MVCA will continue to expand the City Stream Watch Program by implementing a six year monitoring and reporting rotation on a number of main tributaries within the City.

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

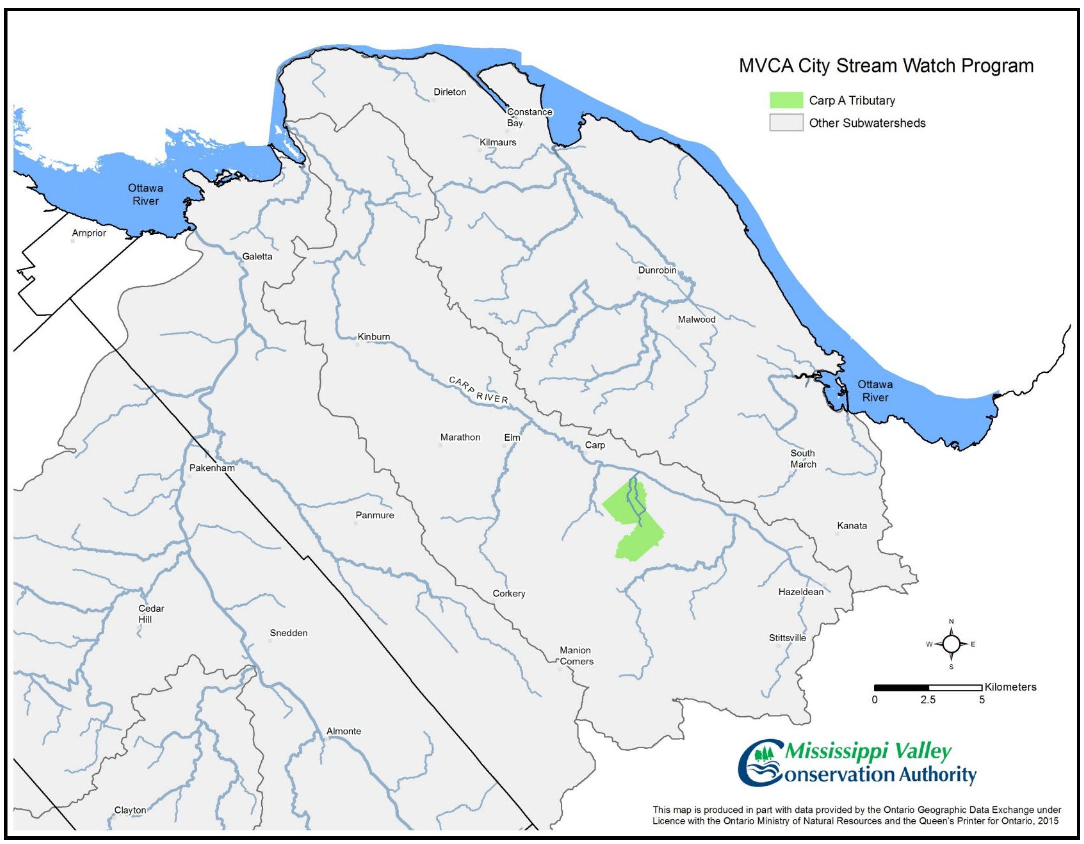


Figure 1: *MVCA's City Stream Watch Area Highlighting the Location of the Carp A Subwatershed*

Carp A Tributary

Located in the west end of the City of Ottawa, the unnamed tributary of the Carp A subwatershed is one of the smaller tributaries of the Carp River. For simplicity's sake, in this report, we refer to this unnamed tributary as the 'Carp A tributary' or 'Carp A'. It has a length of just 3.2 kilometers (km) and drains an area of 5.7 square kilometers (km^2).

Carp A's headwaters originate in a quarry - the 'McGee Pit' - located just south of William Mooney Rd and west of Carp Rd. From there it flows north through the Carp Airport property, crosses Carp Rd then March Rd and finally enters the Carp River just north of March rd and west of Donald B. Munro Dr.

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

Table 1: Subwatershed Features	
Area	5.7 square kilometers
Land Use	42.5% agriculture 14.4% aggregate sites 10.1% wooded area 18.8% rural land-use 8.2% wetlands 3.3% roads 2.7% water
Surficial Geology	26.2% clay 0.5% diamicton 0% organic deposits 0.8% bedrock 66.9% sand 5.6% gravel
Watercourse Length and Type	*Total Length:* 3.2 kilometers *Watercourse Type:* 98.2% natural 1.8% channelized *Flow Type:* 100% permanent
Fish	Creek Chub

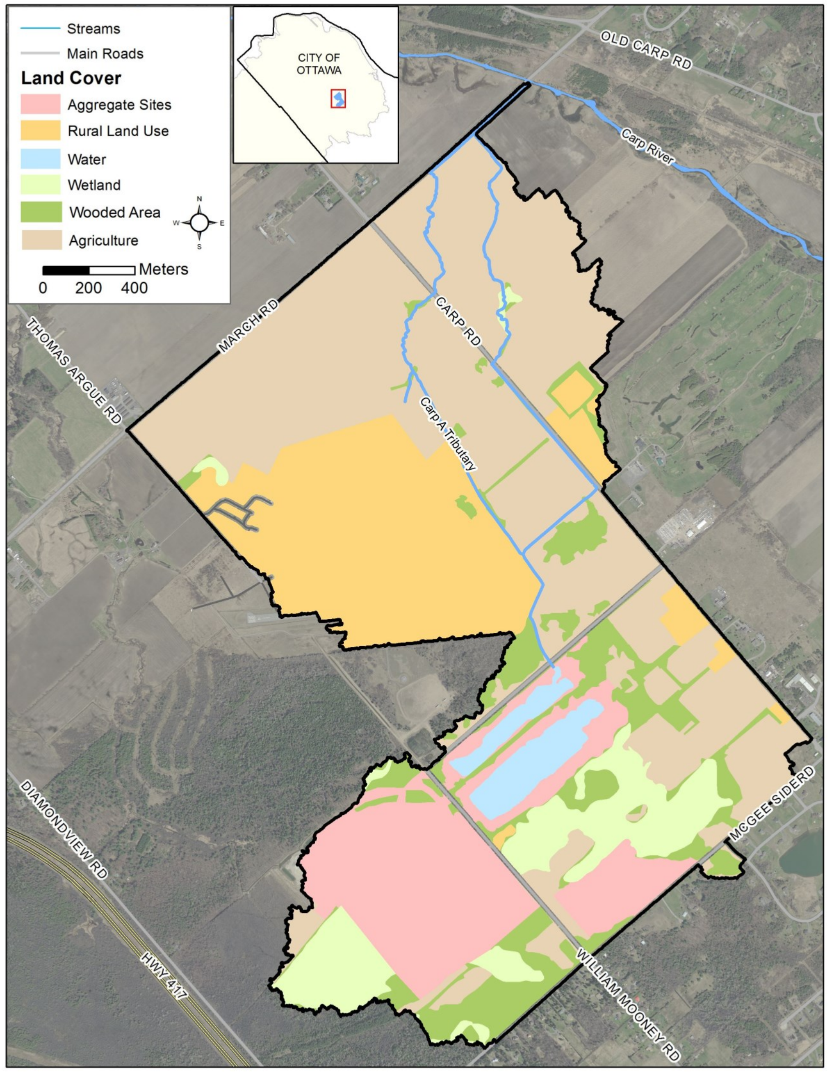


Figure 2: *Land Use in the Carp A subwatershed*

The Carp A Subwatershed

As shown in Figure 2, the Carp A subwatershed is dominated by agriculture and rural land use. Concentrated largely in the north and east, agriculture makes up 42.5% of the watershed. The large section of rural land use in the west accounts for 18.8% of the watershed and consists largely of the open fields and runways of the Carp airport. The remaining area consists of aggregate sites (14.4%), wooded area (10.1%), wetlands (8.2%), roads (3.3%) and water (2.7%).

Crossing through areas of heavy agriculture and aggregate should have a large influence on the health of the Carp A tributary. It will be exposed to influxes of fertilizer and other chemicals and with a minimal vegetated buffer these contaminants will enter the stream quickly and in large quantities. This will in turn have an impact on the larger Carp River into which it outlets.

Monitoring in Carp A

In 2015, permission was granted to survey the 14 sections of the Carp A tributary shown in Figure 3, which cover approximately 1.5 km of the main creek. The portions of the creek that were not sampled represent mostly areas where permission was not granted.

This report presents a summary of the observations made along the 14 sampled sections.

While the 14 sample sites provide a good representation of the overall condition of Carp A it should be noted that a significant section at the upstream end of the creek was not sampled but nonetheless provides an additional diversity of habitat and valuable natural functions.

Methodology

The macro stream assessment is completed using a protocol that divides the entire length of the creek into 100 metre (m) sections. Starting at the downstream end, a monitoring crew wades the creek and completes a detailed assessment at the end of each 100 m 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.

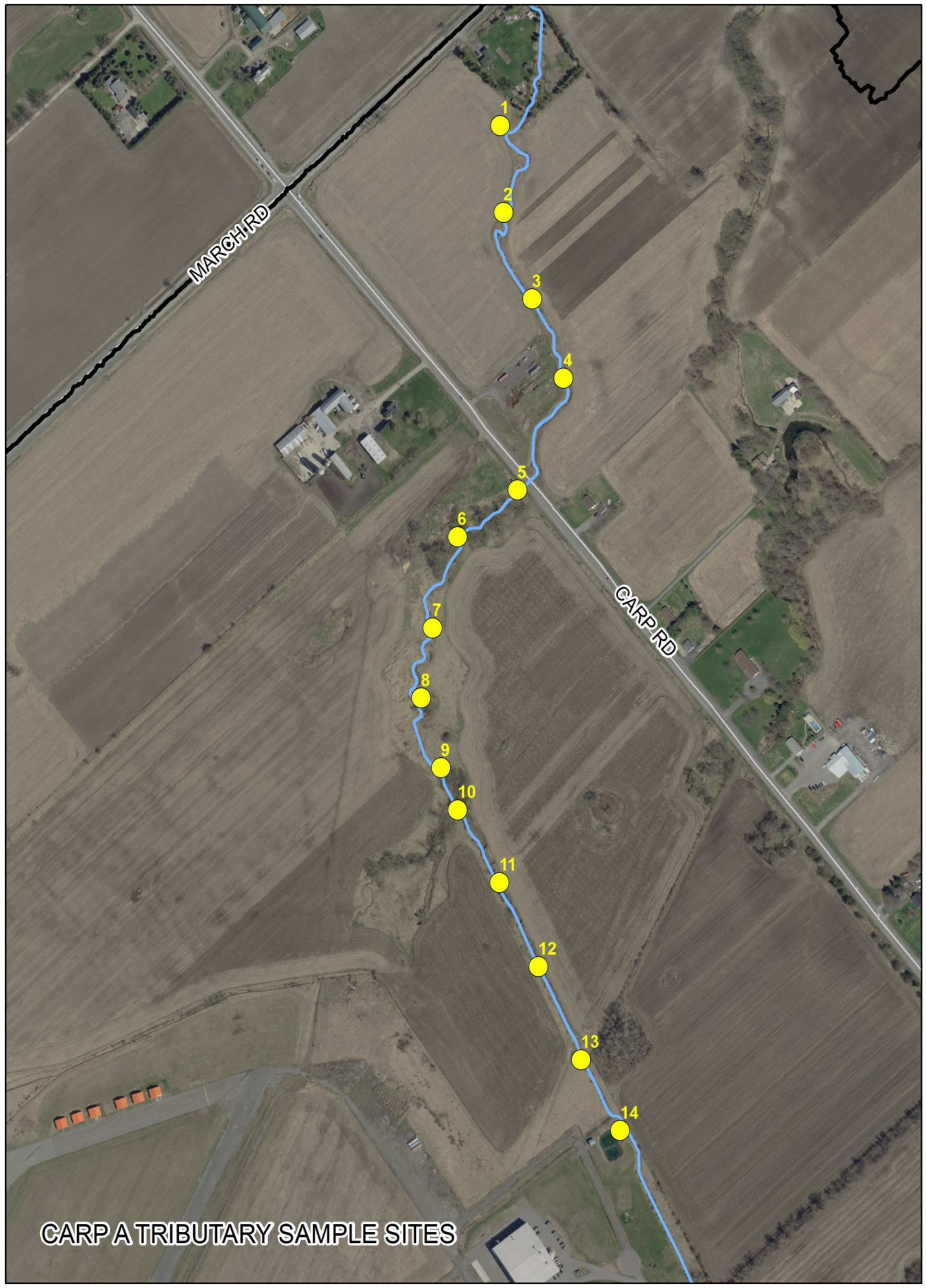


Figure 3: *Map depicting the Carp A monitoring sites.*

Table 2: Carp A Assessment Facts			
	Minimum	**Maximum**	**Average**
Air Temperature (°C)	19	29	24
Water Temperature (°C)	14.4	20.2	16.8
Stream Width (m)	0.21	3.1	0.9
Stream Depth (m)	0.03	0.82	0.16

Table 2 lays out some of the characteristics of Carp A. This creek flows mostly through cultivated clay plains, resulting in a stream morphology that is narrow and shallow. The surveyed sections had an average stream width of 0.9 meters and an average depth of only 0.16 m (Table 2). When this monitoring took place, the average air temperature was around 24°C and water temperature was 17°C.

General Land Use Adjacent to Carp A

General land use along each surveyed section of Carp A 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).

For this survey, eleven categories of land use were applied: residential, forest, meadow, wetland, recreational, industrial, abandoned farm fields, active agriculture, pasture, scrubland and infrastructure. Figure 4 shows the overall percent of land use that was observed adjacent to Carp A. Of the eleven categories, pasture, abandoned agriculture, residential, and forest were not found to be present. Active agriculture, meadow, and scrubland represented the largest land uses at 47%, 33%, and 11%, respectively.

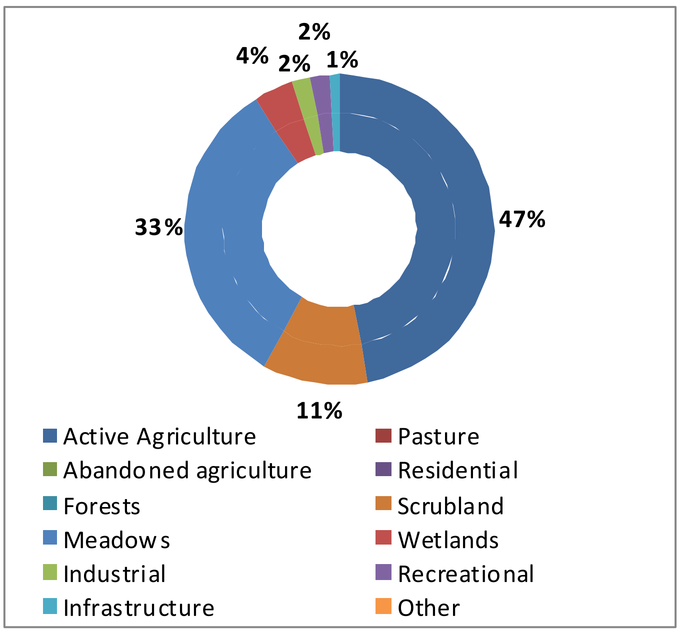


Figure 4: *Land use alongside Carp A.*

As described on page 2, the predominant land uses in the subwatershed area, especially immediately beside the tributary, are agriculture and rural land use. This is corroborated by the high agriculture percentage seen in Figure 4. It is a result of the underlying geology of clay and sand, that this area is so conducive to farming.

Human Alterations to Carp A

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, 71% of Carp A was found to be altered (with considerable human impact), while 29% was considered highly altered. No sections that were surveyed were found to be unaltered or natural.

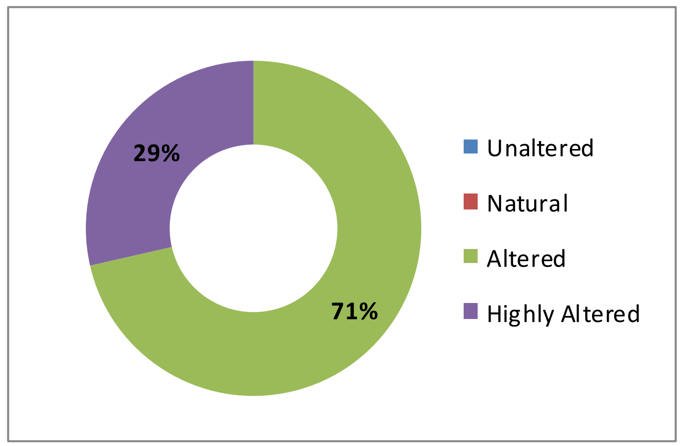


Figure 5: *Extent of human alterations to Carp A.*

As previously described, Carp A runs through mostly active agricultural land and this is what causes the high level of alteration; most areas were either channelized along a farm field or had very steep slopes and a narrow buffer to allow for larger farm fields. This is not a positive attribute of the Carp A tributary and will decrease the overall health of the stream.

Riparian Buffer along Carp A Tributary

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 the riparian buffer 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). 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.

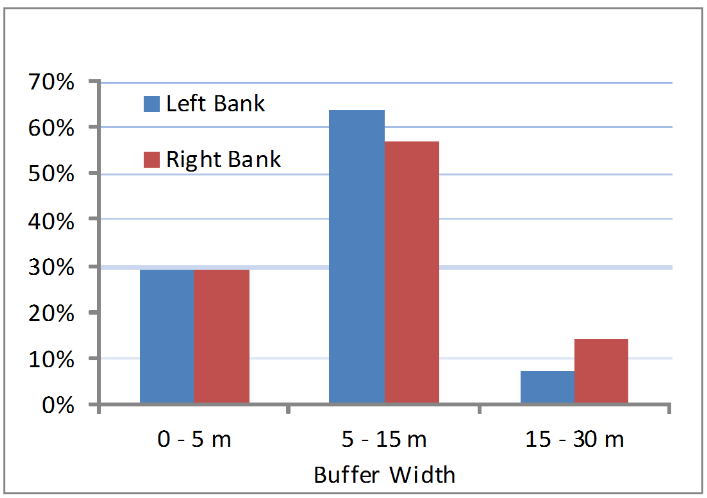


Figure 6: *Left and right bank riparian buffer widths along Carp A.*

As summarized in Figure 6, we found that the sections of Carp A that were surveyed had a relatively poor riparian buffer. Results show that 64% of the left bank and 57% of the right bank have between 5—15 meters of buffer, and 29% of both banks have only a 0—5 meter buffer.

Unfortunately, this combination of adjacent agricultural land and a small riparian buffer is a common occurrence. Active agriculture can cause excess phosphate and nitrate in rain water runoff, and scarce vegetation limits the filtering of this runoff before it reaches the water.

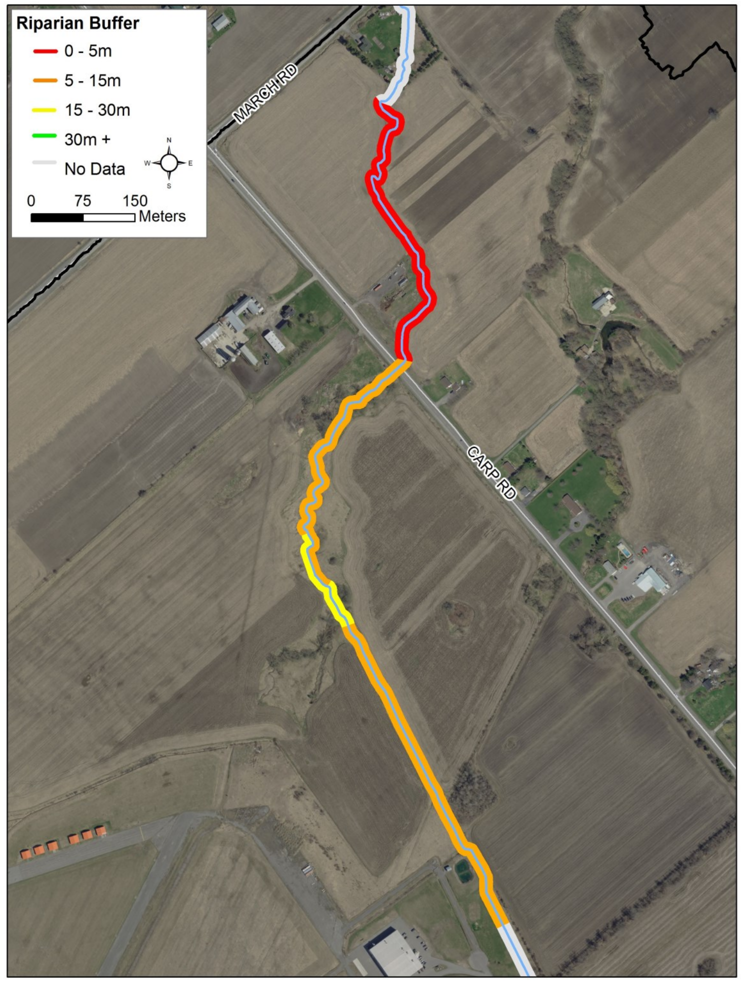


Figure 7: *Riparian buffer width along the Carp A tributary.*

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.

Changes in the amount of overhanging branches and trees along Carp A can be seen in Figure 8. Overall, Carp A has a measurable lack of overhanging trees and branches, showing overhanging vegetation between 1 and 60% along its length. In most sections the vegetation consists largely of long grasses with the occasional solitary willow tree. A small section just southwest of Carp Rd has a larger stand of dense trees but it quickly reverts back to overhanging grasses.

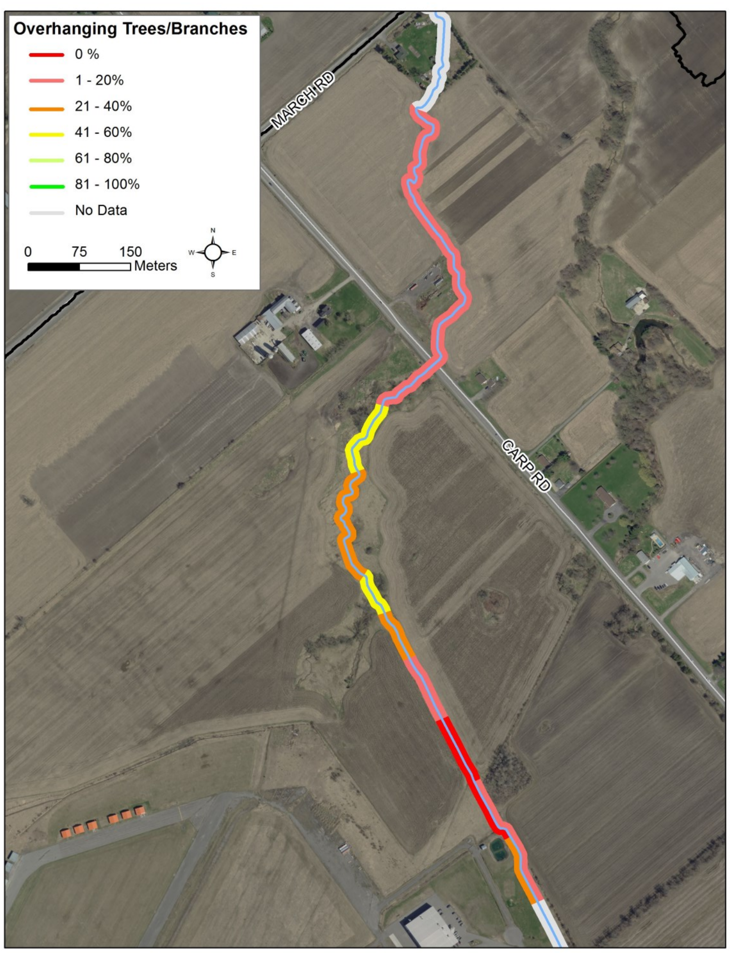


Figure 8: *Overhanging vegetation along Carp A.*

Figure 9 shows the data quantified as the percent of creek sections classified according to the various amounts of overhanging trees and branches. Of the 14 surveyed stream sections, 57% of the left bank and 43% of the right bank were classified as having 1 to 20% overhanging trees and branches. No sections had over 60%.

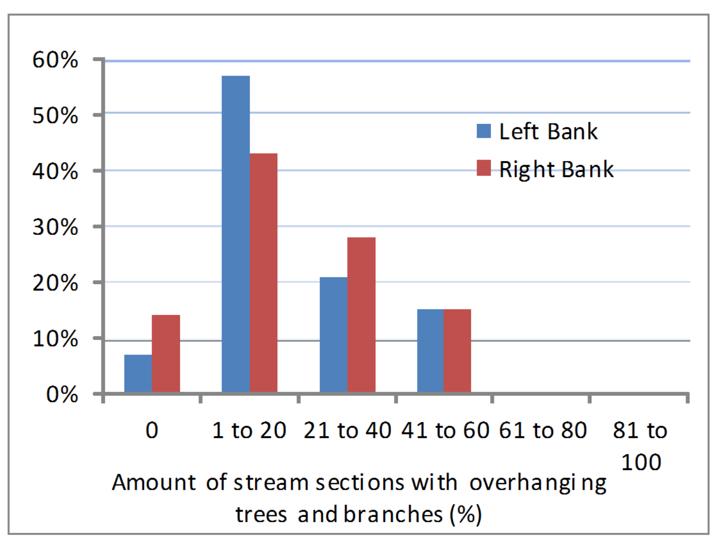


Figure 9: *Percentages of left and right bank with varying degrees of overhanging trees and branches along Carp A.*

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 A. In general the creek is reasonably well shaded, but mostly by long grasses rather than large trees. There are two notable sections of large willow trees just south of Carp Rd. These areas provide more constant shading along with nutrient input from organic matter. All other sections were heavily dominated by long grasses.

Figure 11 shows the data quantified as the percent of creek sections classified according to the various levels of shading. For example, 21% of the 14 stream sections that were surveyed, were classified as having 1 to 20% shading along the entire section. Furthermore, 37% of sections had 41 to 60% shading, 14% had 61 to 80% shading, and 7% had 81 to 100% shading.

While these numbers indicate relatively good shore cover along the creek, much of it was produced by long grasses on a steep bank rather than large overhanging trees. While the grasses provide some cooling to the stream, they do not have the extensive root systems needed to stabilize such extreme bank slopes.

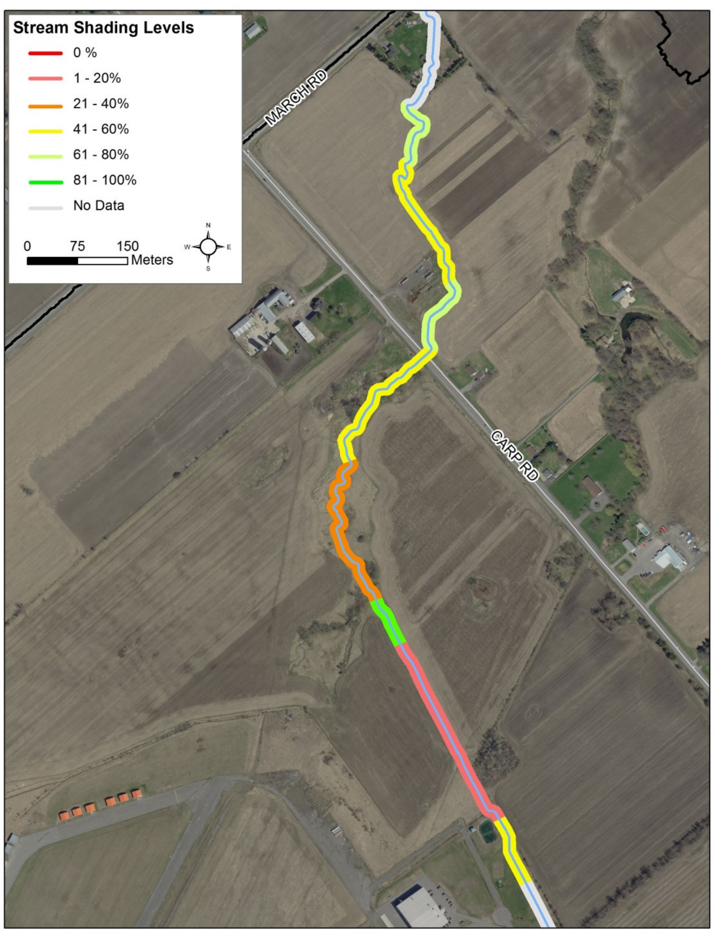


Figure 10: *Stream shading along Carp A.*

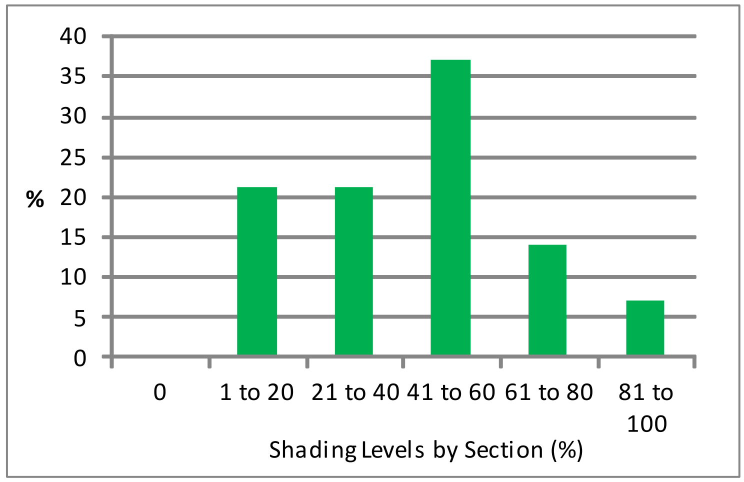


Figure 11: *Percentage of each surveyed section shaded along Carp A Tributary.*

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.

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 is resulting in instability, erosion and sedimentation.

Figure 12 shows the amount of streambank undercutting along the Carp A tributary. We can see that there were sections of heavy undercutting (between 81 and 100%) as well as areas of very little undercutting (1 to 20%). The areas of heavy undercutting may be a result of a lack of shoreline vegetation whose roots serve to stabilize the soil. Whenever there is an influx of water, from rain or drainage from the adjacent farm fields, the flow of water will increase and without adequate stabilization, will erode the shoreline.

As evidence to this point, there is a notable parallel between the areas of less undercutting seen in Figure 12 and the areas with greater riparian buffer seen in Figure 7.

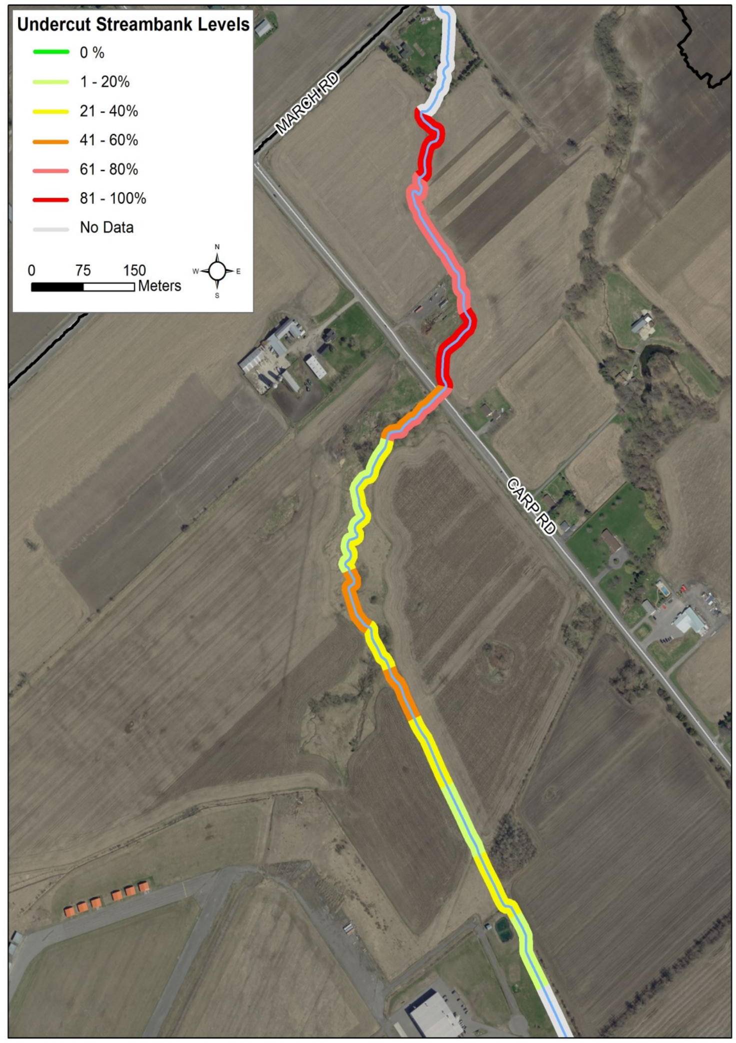


Figure 12: *Undercut banks along the Carp A tributary.*

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 of 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.

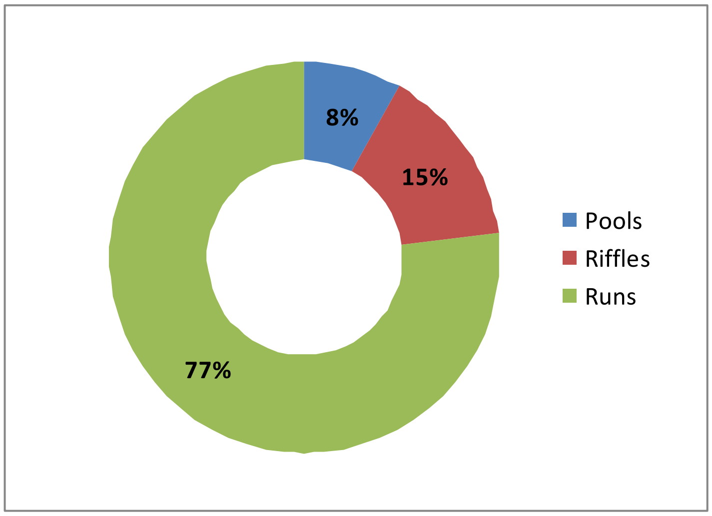


Figure 13: *In-stream morphology along Carp A.*

It is beneficial for the health of the ecosystem if there is a variety of pools, riffles and runs. This allows oxygen to flow through the creek, provides habitat, and generally results in a well-connected watercourse.

As shown in Figure 13, runs are by far the most common feature in Carp A at 77%. There is a measurable lack of pools and riffles (8 and 15%).

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.

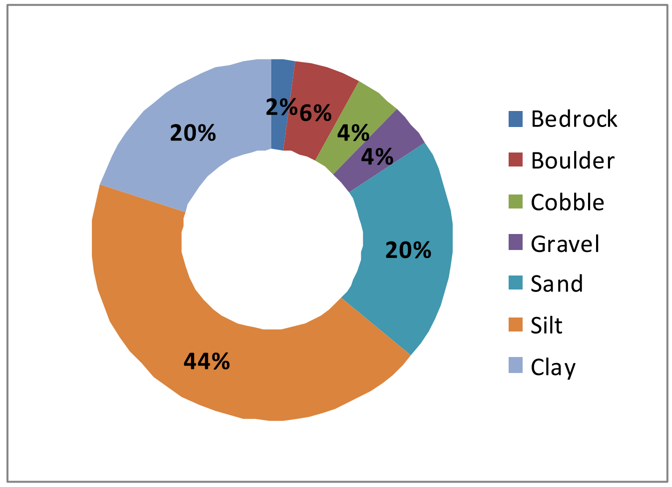


Figure 14: *Percentages of in-stream substrate types in Carp A*

Figure 14 summarizes the different types of substrate which make up the bed of Carp A.

Carp A is composed almost entirely of silt, sand, and clay, with 44%, 20%, and 20%, respectively. While these fine substrates play an important role in some respects—providing nutrients for fish and bottom-dwellers— the overwhelming abundance is unhealthy for the stream. This is most likely caused by the lack of a good riparian buffer to control the influx of sediment. A larger proportion of boulder and cobble would help by providing spawning areas for fish and benthic species, and by adding more heterogeneity to the morphology of the stream.

Cobble and Boulder Habitat

As discussed, cobble and boulders provide important fish habitat. Figure 15 shows the sections of Carp A where cobble and boulders were found to either be present or not present on the stream bed and shows that there are some sections that contain small amounts of boulders or both boulders and cobble.

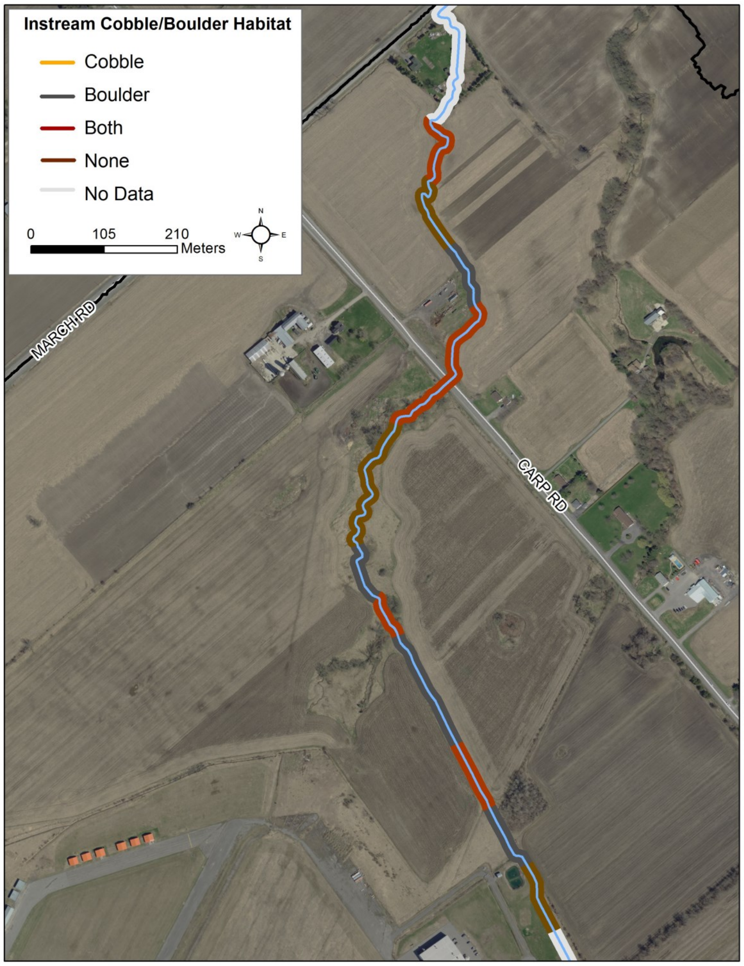


Figure 15: *In-stream cobble and boulder habitat in Carp A.*

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. 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.

As shown in Figure 16, only three of these categories were present in the Carp A tributary. Narrow-leaved emergents constituted 6%, robust emergent 15%, and no plants 79%. Clearly there is a lack of vegetation in the stream.

Amount of In-stream Vegetation

The *amount* of in-stream vegetation can also have an effect on stream health. Figure 17 displays the abundance of in-

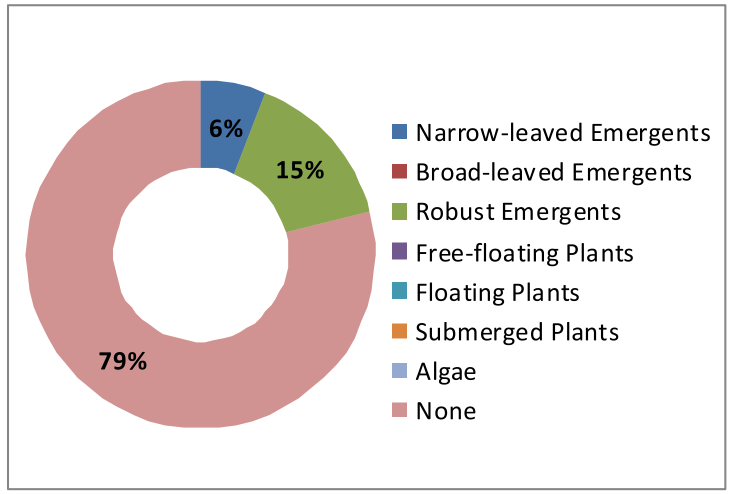


Figure 16: *Percentages of In-stream vegetation in Carp A.*

stream vegetation along Carp A. This is measured according to six categories: 'Extensive' (choked with vegetation), 'Common' (>50% vegetation), 'Normal' (25-50%), 'Low' (<25%), 'Rare' (very few plants), and 'None'.

Overall the creek was found to have very low amounts of in-stream vegetation for most of its length. More than half of the surveyed sections had no vegetation, while another 24% were categorized as having 'Rare' vegetation.

Low in-stream vegetation levels in Carp A are likely due to very shallow water depths and extensive shading from grasses and steep banks. These together create conditions that limit plant growth.

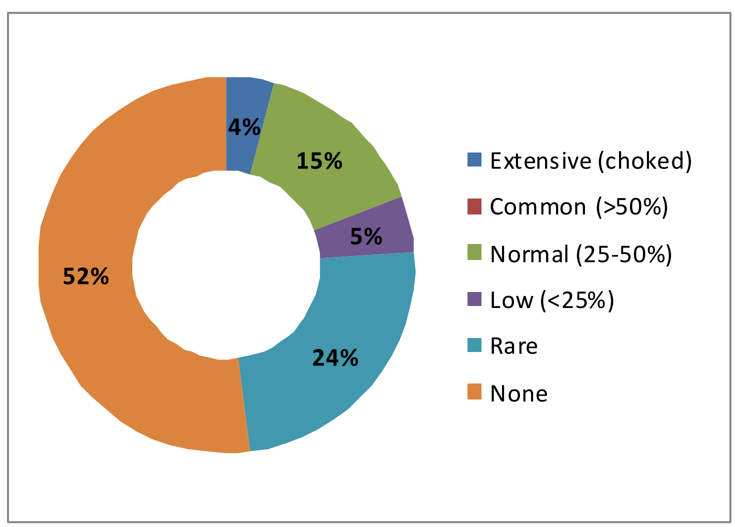


Figure 17: *Percentage of In-stream vegetation abundance in Carp A.*

Wildlife Observed

There were many species of wildlife observed during this assessment of Carp A. Various land bird species including finches, red-winged blackbirds and a kingfisher were seen as well as a mallard. Mammal tracks from deer and raccoons were seen along with sightings of many green and leopard frogs. Finally many insects were seen, namely water striders, mosquitoes and flies.

Water Chemistry and Quality

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

Dissolved oxygen measures the amount of available oxygen within the water that is accessible to aquatic life. 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 6.0mg/L (milligrams/liter) for warm water ecosystems and 9.5 mg/L for cold water ecosystems. The average amount of dissolved oxygen in Carp A is 8.07 mg/L making it acceptable for warm water species, but below the requirements for cold water species.

Table 3: Carp A Water Quality Data

	Minimum	Maximum	Average
pH	7.04	8.54	8.08
Dissolved Oxygen (mg/L)	4.44	9.42	8.07
Conductivity (µS/cm)	499	789	645

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 saltiness in the water. Factors that can change the conductivity of freshwater include geology, 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 salt in and around 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 µS/cm (microSiemens/centimeter). The United States Environmental Protection Agency note that streams supporting good mixed fisheries generally fall between 150 and 500 µS/cm. The average conductivity of Carp A is 645 µS/cm, putting it higher than the ideal range. This is probably a result of high chemical input and 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. The average pH of Carp A is 8.08, a nearly neutral condition, which is good for many species of fish to thrive.

Thermal Classification

Temperature is an important parameter in streams as it influences many aspects of physical, chemical and biological health. Figure 18 shows where one temperature logger was deployed in Carp A from April to late October 2015 to give a representative sample of how water temperature fluctuates.

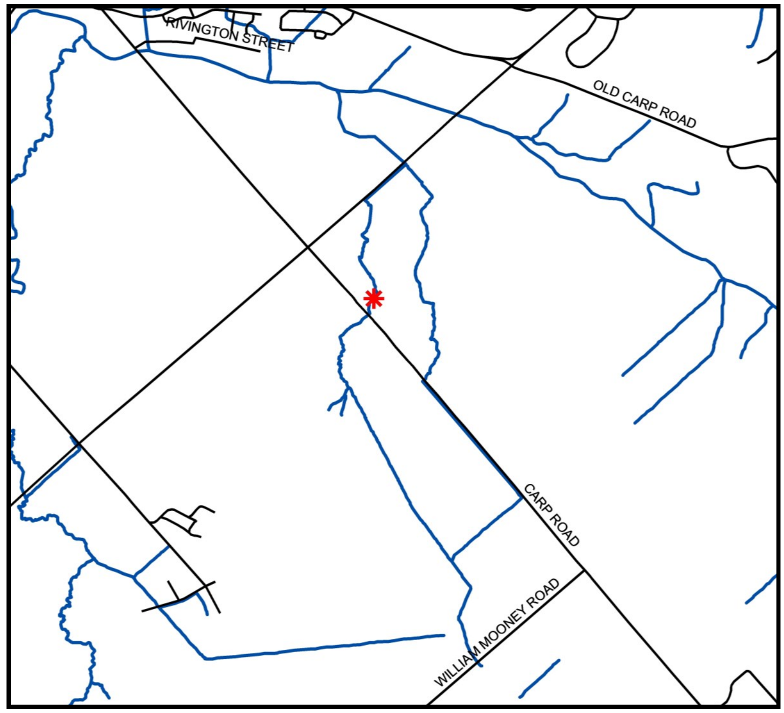


Figure 18: *Location of the temperature logger in Carp A.*

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, and cold water. Figure 19 shows the thermal classification of Corkery Creek.

Analysis of the data indicates that Carp A should be classified as cool to cool-warm water. This is initially surprising as the Carp A Tributary is a very narrow and shallow watercourse which could be easily heated by the sun. However, with closer inspection we find that our logger was placed in a location following heavy shading of the stream which may have contributed to the cooler temperatures. We can also speculate that the creek is being fed by groundwater springs or cool discharge pipes.

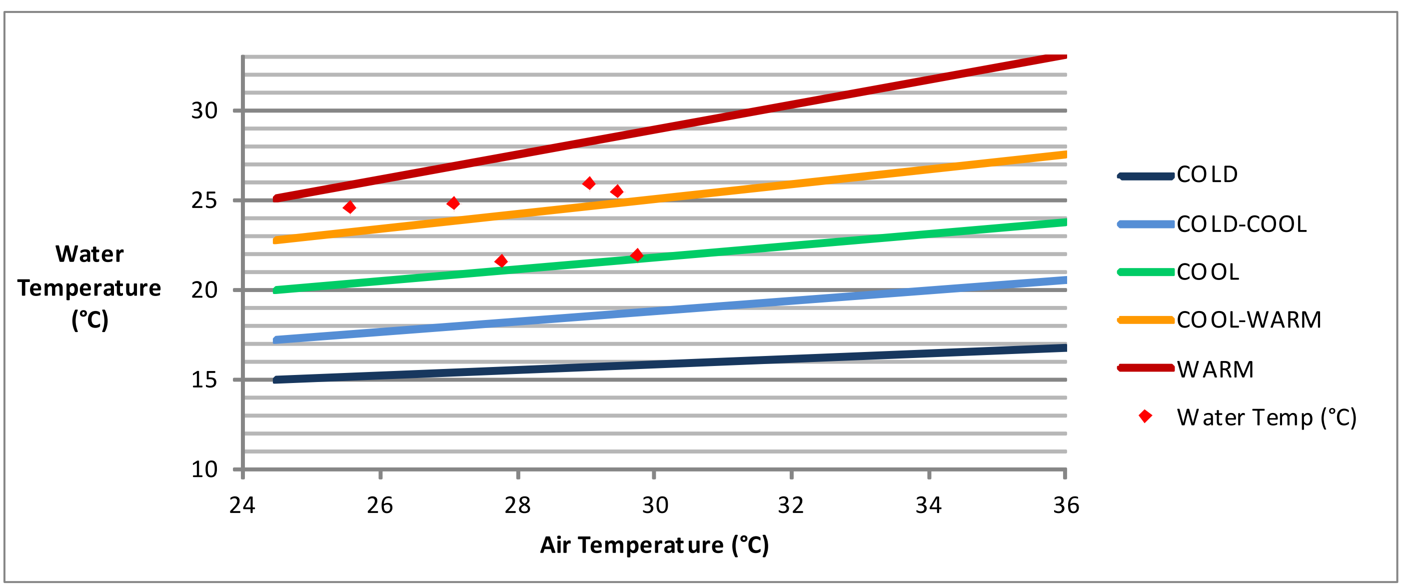


Figure 19: *Thermal Classification of Carp A based on data from one temperature logger.*

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 ^{o}C and was preceded by two consecutive days with a maximum air temperature ≥ 24.5 ^{o}C during which time no precipitation has occurred.
- Water temperature is taken at 4:00 pm

Fish Sampling

Fish sampling was performed at one site on the Carp A tributary. The thermal classifications for each species found are listed in Table 4 beside the common name of those fish species identified.

Table 4: Fish Species Found in Carp A Tributary

Species	Thermal regime	# individuals
Creek Chub	Cool	3

Potential Riparian Restoration 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 20 depicts the locations identified by MVCA staff and volunteers, as areas for potential riparian restoration activities along Carp A.

The next steps will be to approach the landowners and work with them on a voluntary basis to enhance their shorelines through a number of potential activities, such as increasing the unmowed areas along the shore or agreeing to plant and maintain native shoreline species of trees or shrubs.

Through this assessment several other key restoration opportunities were identified including one site that could benefit from a garbage clean up, another where erosion control measures could be implemented, and a large section where invasive purple loosestrife could be removed.

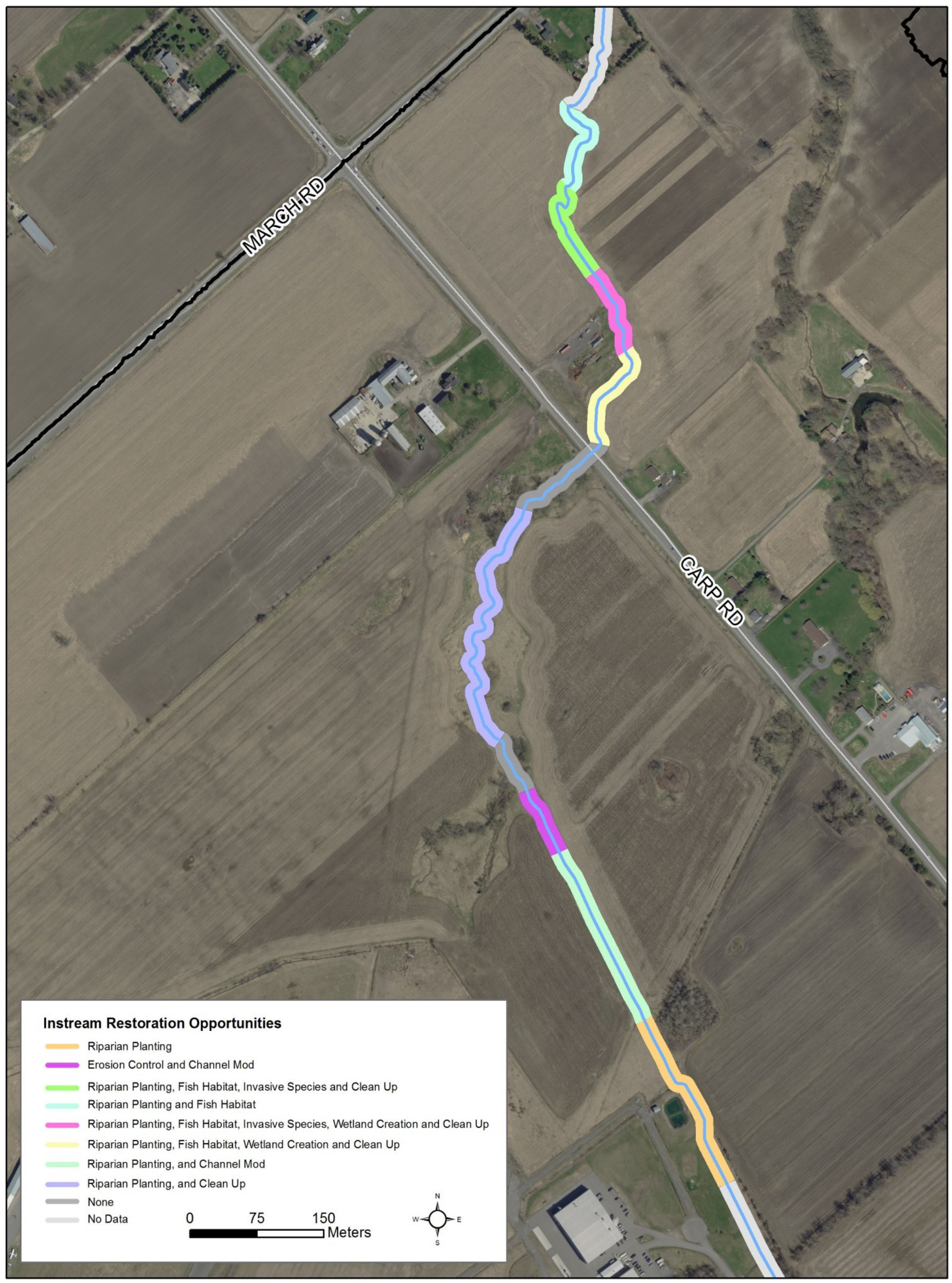


Figure 20: *Potential areas for riparian restoration projects.*

How Does This Information Get Used?

The City Stream Watch Program is an excellent monitoring program that allows MVCA to be able 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.

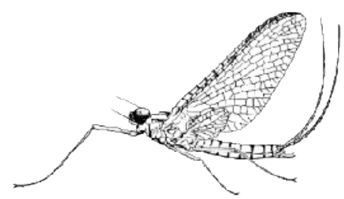
MVCA uses stream surveys to target specific areas that need restoration work. Stream garbage clean ups are carried out, blockages are removed, and shoreline planting, erosion control and habitat enhancements are organized.

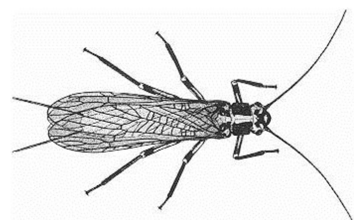
MVCA is always looking for volunteers to help with monitoring and stewardship programs!

Call 613-253-0006 ext. 272, 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/identification
* Participating in natural photography





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