# Cranberry Creek 2019 Catchment Report

| Catchment Features | |
|---|---|
| **Area** | 52.01 square kilometres<br>1.23% of the Rideau Valley watershed |
| **Land Use** | 29.17% agriculture<br>2.31% urban<br>34.93% forest<br>3.91% meadow<br>3.72% rural<br>0.02% waterbody<br>25.95% wetlands |
| **Surficial Geology** | 24.37% clay<br>20.61% diamicton<br>0.66% gravel<br>29.19% organic deposits<br>7.05% Paleozoic bedrock<br>18.12% sand |
| **Watercourse Type** | 2019 thermal conditions<br>**Cool-warm water** and **warmwater** |
| **Invasive Species** | Seven invasive species were identified in 2019: common carp, common and glossy buckthorn, curly leaf pondweed, European frog-bit, Manitoba maple, non-native *Phragmites*, purple loosestrife |
| **Fish Community** | Twenty-two species of fish have been observed from 2007-2019. Game fish species include: black crappie, bluegill, brown bullhead, largemouth bass, northern pike, pumpkinseed, rock bass, walleye, white sucker and yellow perch |

| Wetland Cover |
|---|
| **25.95% of the watershed are wetlands** |
| 9.17% are unevaluated wetlands |
| 16.79% are evaluated wetlands |

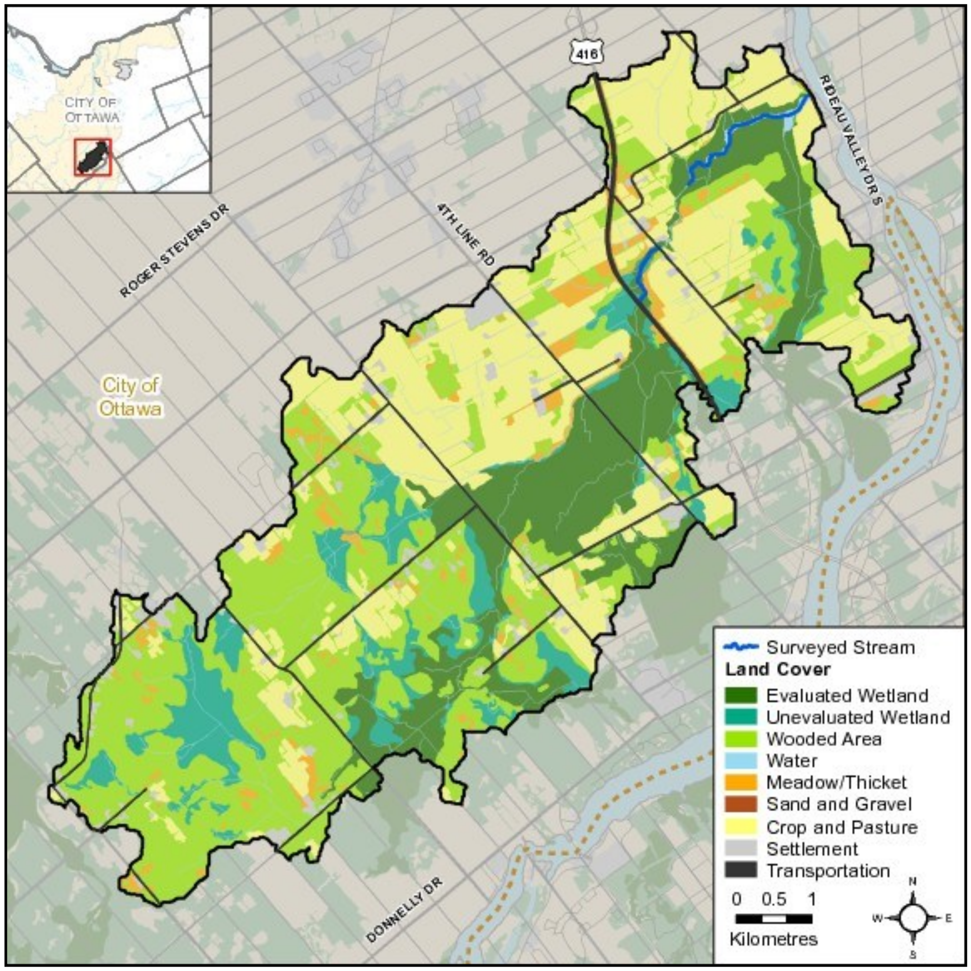



**Figure 1** Land cover in the Cranberry Creek catchment

| Vegetation Cover | | |
|---|---|---|
| **Type** | **Hectares** | **Percent of Cover** |
| **Wooded Areas:** | **1817** | **57.37%** |
| Hedgerow | 13.32 | 0.42% |
| Plantation | 91.74 | 2.90% |
| Treed | 1711.49 | 54.05% |
| **Wetlands*** | **1350** | **42.63%** |
| **Total Cover** | **3166** | **100%** |

*Includes treed swamps

| Woodlot Analysis | | |
|---|---|---|
| **Size Category** | **Number of Woodlots** | **Percent of Woodlots** |
| 1 Hectare | 90 | 51.72% |
| 1 to <10 Ha | 57 | 32.76% |
| 10 to <30 Ha | 15 | 8.62% |
| >30 Ha | 12 | 6.90% |
| **Total Cover** | **67** | **100%** |

The Rideau Valley Conservation Authority in partnership with the City of Ottawa, National Capital Commission, Ottawa Flyfishers Society, Canadian Forces Ottawa Fish and Game Club, Ottawa Stewardship Council, Rideau Roundtable, South Nation Conservation and Mississippi Valley Conservation Authority form the City Stream Watch 2019 collaborative.

## *Introduction*

Cranberry Creek is a tributary of the Rideau River located in the south end of the City of Ottawa. The approximately 19 kilometer stream flows from its headwaters west of Malakoff Road to its confluence with the Rideau River in Kars. The catchment of Cranberry Creek measures 52 square kilometers, comprised of mainly wetland, forest, and agricultural/ rural land uses.

In 2019 the City Stream Watch program surveyed 27 sections (2.7 km) of the main stem of Cranberry Creek. Areas of the creek surveyed included lower reaches with recreational boating access. The surveyed sections of the main branch include portions from the mouth in Kars to highway 416. Fourteen sites were sampled for fish community composition and data from three temperature loggers was collected at there of these sites. Sixteen headwater drainage feature sites were assessed in the spring and in the summer. The following is a summary of our observations and assessment.


## Low Water Conditions

After a cool and wet spring with significant flooding in certain areas, especially along the Ottawa River; hot dry weather with localized rainfall characterized the summer and early fall of 2019. In August, the climate stations in the watershed measured rainfall at 80 percent under normal levels for that time of year, passing the threshold for low water status. As of August 15, minor low water status in the Rideau Valley watershed was announced by the Rideau Valley Conservation Authority under the Ontario Low Water Response Program (RVCA, 2019). Water levels in lakes and large rivers were close to average for summer conditions however smaller creeks and streams, including headwater drainage features and wetlands, became dry under these drought conditions.

Several significant rainfall events in the last two weeks of October ended the drought conditions. The average 90-day rainfall measured were well above the 80 percent of normal for the time of year. As of October 30, the Rideau Valley watershed status retuned to normal water levels (RVCA, 2019).  Water levels in the smaller rivers and streams across the watershed were restored from their prior below normal dry conditions.

## *Cranberry 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 Cranberry Creek. Buffers greater than 30 meters were present along 89 percent of the left bank and 99 percent of the right bank. A 15 to 30 meter buffer was present along 10 percent of the left bank. A five meter buffer or less was present along one percent of the left bank and one percent of the right bank. The buffer width evaluation on the sections surveyed of Cranberry are within guidelines. Improvements can be made in the agricultural areas were buffers were less than 30 meters.

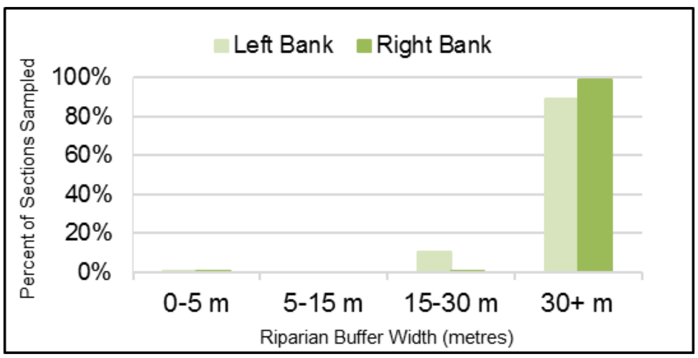



**Figure 2** Vegetated buffer width along Cranberry Creek

Vegetated buffer greater than 30 meters in width along Cranberry Creek in Kars

**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.

Cranberry Creek surveyed riparian zones were primarily natural, with 93 percent of the right and left banks having dominant natural riparian vegetative communities. Alterations to the riparian buffer accounted for two percent of the right and left banks. These alterations were associated with infrastructure including roadways and agricultural land uses.

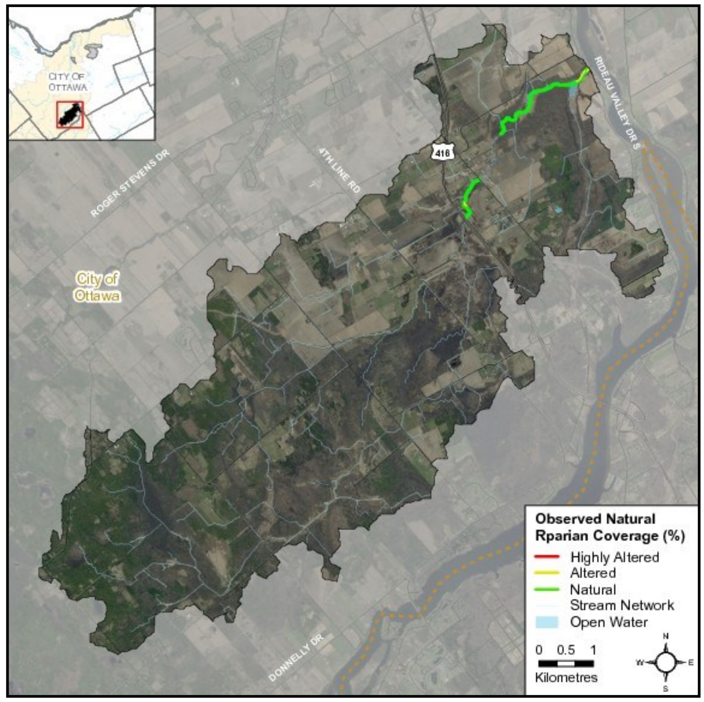



**Figure 3** Riparian buffer alterations in Cranberry Creek

Roadway infrastructure on First Line Road along Cranberry 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 river. 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.

Wetlands and forest were present in 96 percent and 81 percent of the sections surveyed, being the most common land use observed. Scrubland was present in 67 percent of the surveyed areas, and meadow was present in 37 percent of sections.

Aside from the natural areas, the most common land use in the catchment was agricultural, with seven percent of the sections containing active agriculture. Other uses observed included four percent of surveyed areas with infrastructure (such as roads); and residential areas observed in four percent of the adjacent lands.

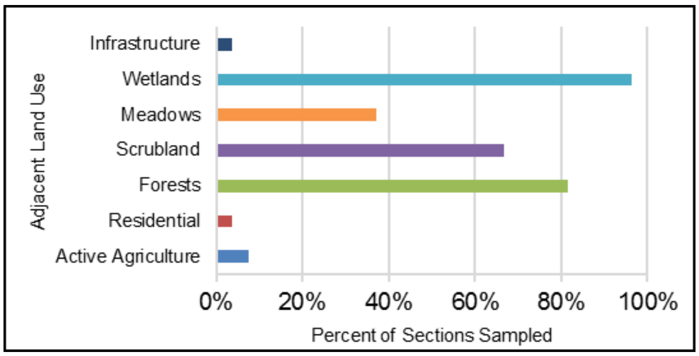



**Figure 4** Adjacent land use 100 meters from each shoreline and percentage of presence along Cranberry Creek

Section along Cranberry Creek with wetland, scrubland, residential and infrastructure land uses upstream of First Line Rd

## ***Cranberry 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 29 sections surveyed in the Cranberry Creek catchment, with 16 sections remaining without any human alteration. Of the areas surveyed, six sections fell in the classification of natural. Natural sections had a riparian buffer greater than 15 meters in width and natural shorelines.

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

Two of the sections surveyed were highly altered. The riparian buffers were less than five meters in width, shoreline alterations were found on most of the sections including rip rap and more than two storm water outlets were present at road crossings.

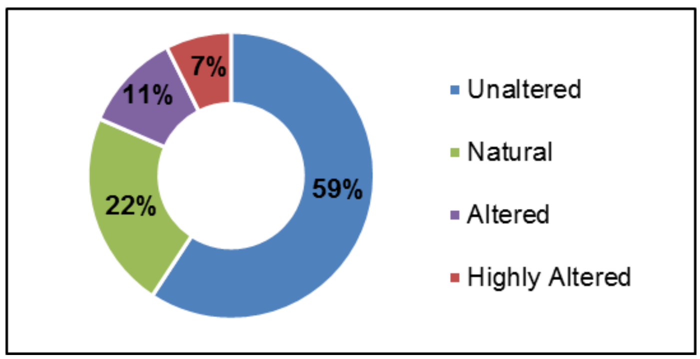



**Figure 5** Anthropogenic alterations along Cranberry Creek

One of many unaltered sections of Cranberry Creek east of Highway 416

## 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, severe undercutting, slumping or scour and potential failed erosion measures (rip rap, gabion baskets, etc.). Figure 6 shows limited erosion was observed across the surveyed portions of the creek. Bank instability was observed in four percent of the left bank and none of the right bank of sections surveyed.

Cranberry Creek is a stream emerging from wetlands, and retains riverine wetland conditions throughout. This type of system has flood storage through hydric soils and a well connected floodplain area which results in lower erosion levels.

## 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 Cranberry Creek. This is a result of the natural wetland hydrology and organic bank composition of the creek.

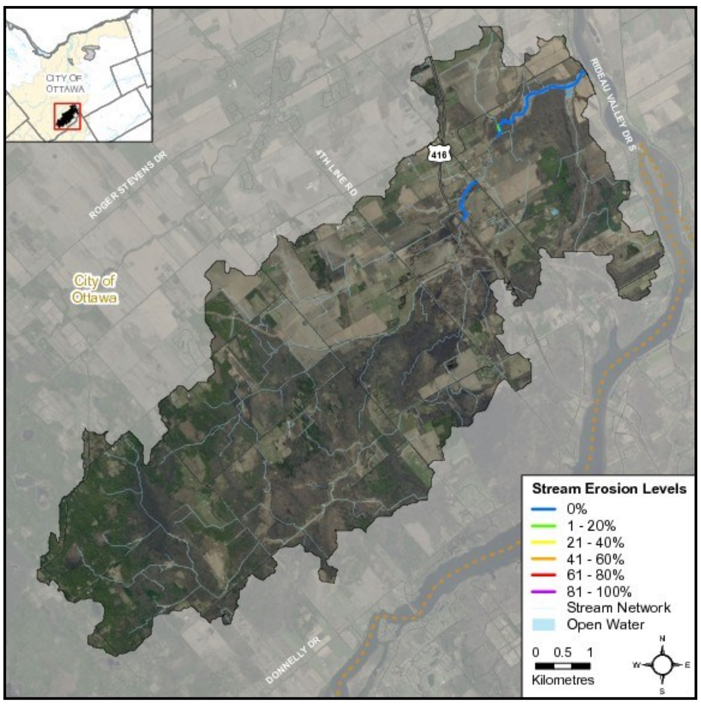



**Figure 6** Erosion levels along Cranberry Creek

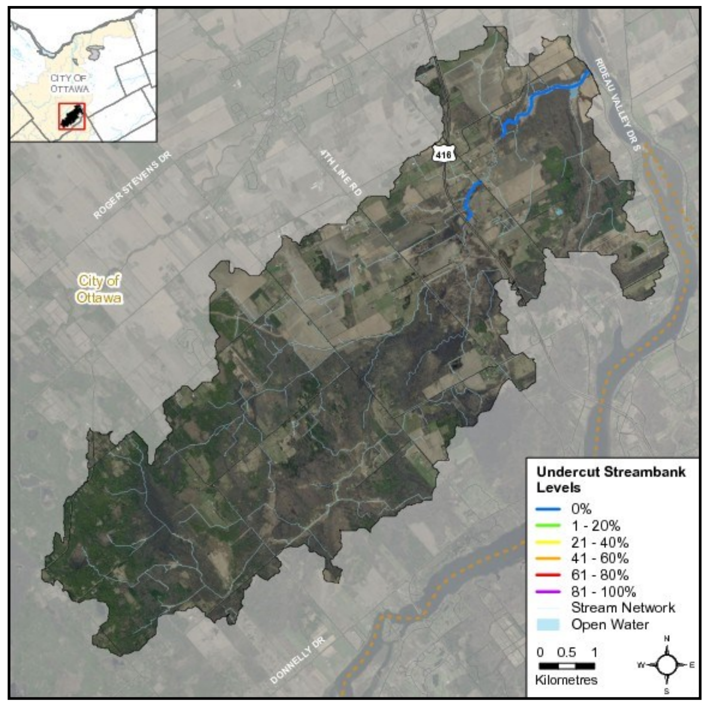



**Figure 7** Undercut stream banks along Cranberry Creek

Rip rap used as an control measure at a road crossing in Kars along Cranberry Creek

Stable banks with aquatic macrophytes along Cranberry Creek, a riverine wetland east of the highway 416

### Stream Shading

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

Figure 8 shows the percentage of sections surveyed with various levels of stream shading. The majority of sections, 17 of them, had a shade cover of one to 20 percent. The highest shading observed of 21 to 40 percent was observed in two of the sections. No cover was observed in eight of the sections. Figure 9 shows the distribution of these shading levels as a percentage of sections surveyed along Cranberry Creek.

A mix of trees and plants comprised the majority of shading. Overhanging plants, mainly robust or broad leaved emergent plants and rushes, were observed in 78 percent of the left banks and 67 percent of the right banks.

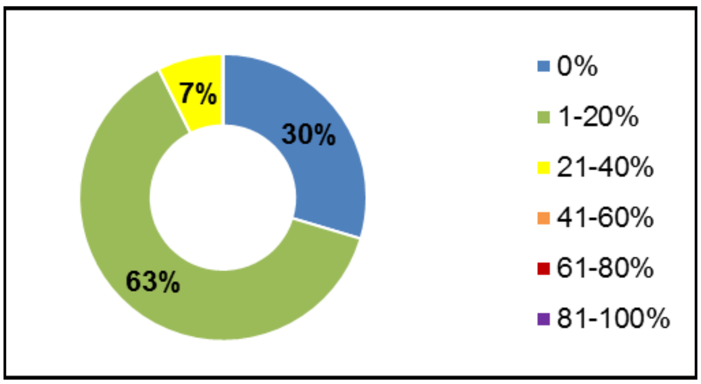



**Figure 8** Stream shading along Cranberry Creek

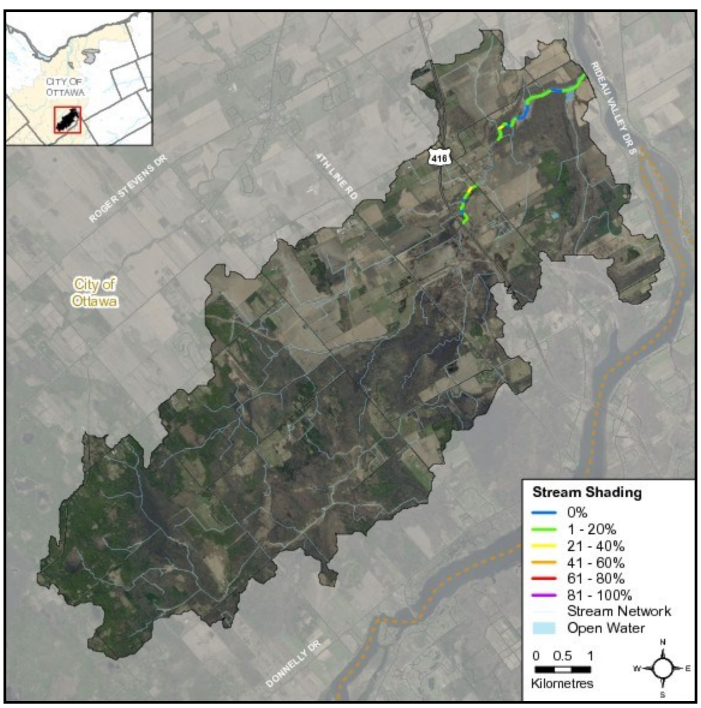



**Figure 9** Stream shading along Cranberry Creek

### 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 Cranberry Creek. Of the surveyed portions, 19 percent of the sections had overhanging trees and branches on the left bank, and 15 percent of the sections had overhanging trees on the right bank.

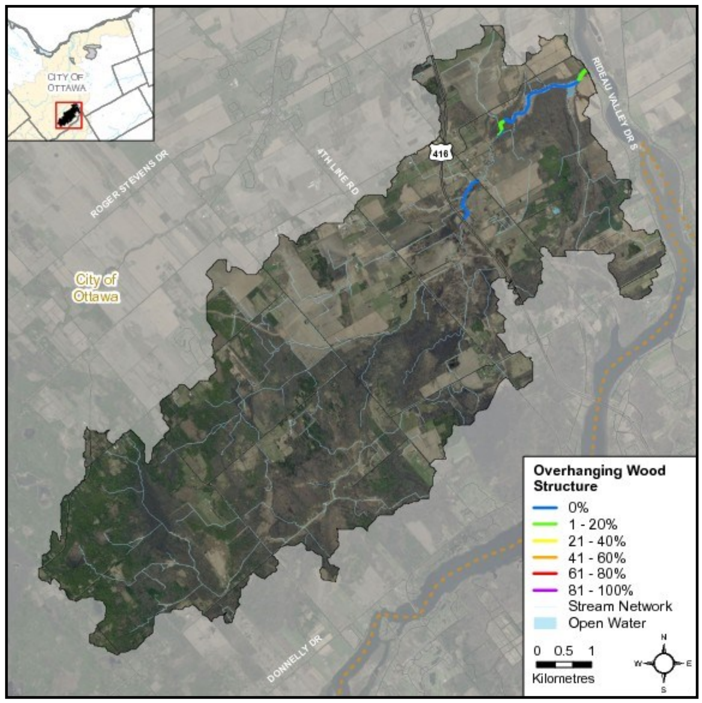



**Figure 10** Overhanging trees and branches along Cranberry Creek

Overhanging trees and branches on a tributary of Cranberry Creek east of Highway 416

## *Cranberry 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, morphological 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: 41 percent had no complexity; 52 percent had a score of one; four percent scored two; and four percent scored three. None of the sections surveyed scored four for habitat complexity.

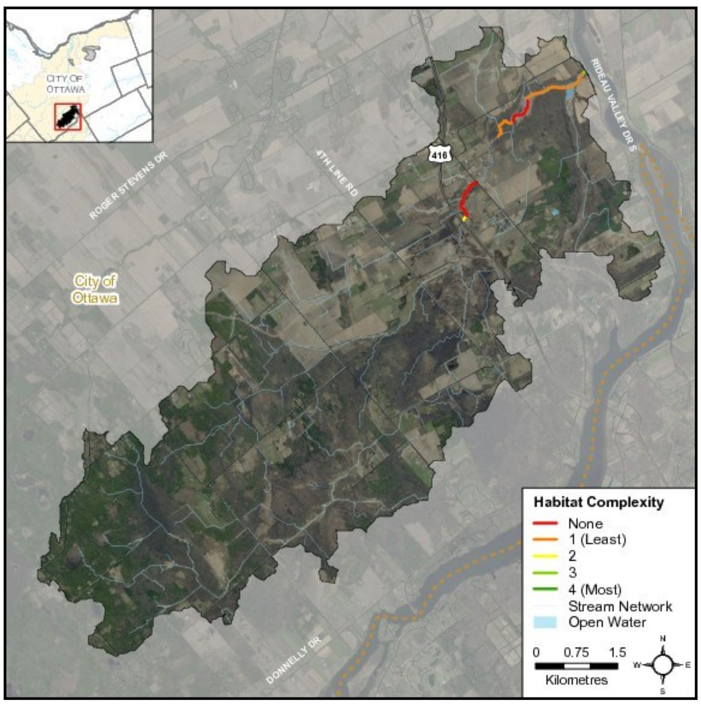



**Figure 11** Instream habitat complexity along Cranberry Creek

Section of Cranberry Creek featuring cobble 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 Cranberry Creek was observed to be fairly homogenous in 89 percent of sections surveyed, and heterogenous in the remaining eleven percent. Figure 12 shows the substrate types observed in the sections surveyed of Cranberry Creek. It is a system dominated by silt, with 100 percent of sections containing this type of substrate. It also has clay and sand areas, along with areas with gravel, cobble and boulders.

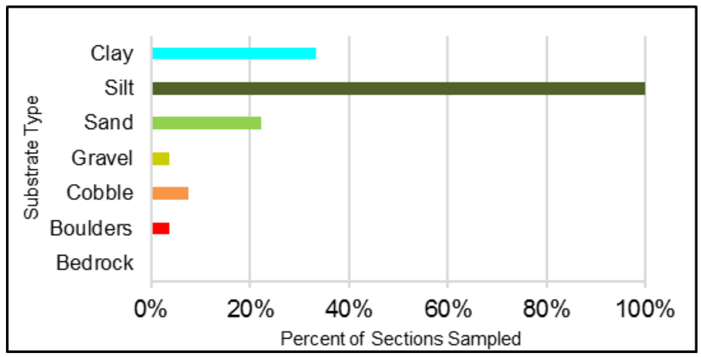



**Figure 12** Instream substrate along Cranberry Creek

Figure 13 shows the dominant substrate types along the creek. From the areas that were assessed, silt was the dominant substrate type in 100 percent of sections surveyed, which is typical for riverine wetlands.

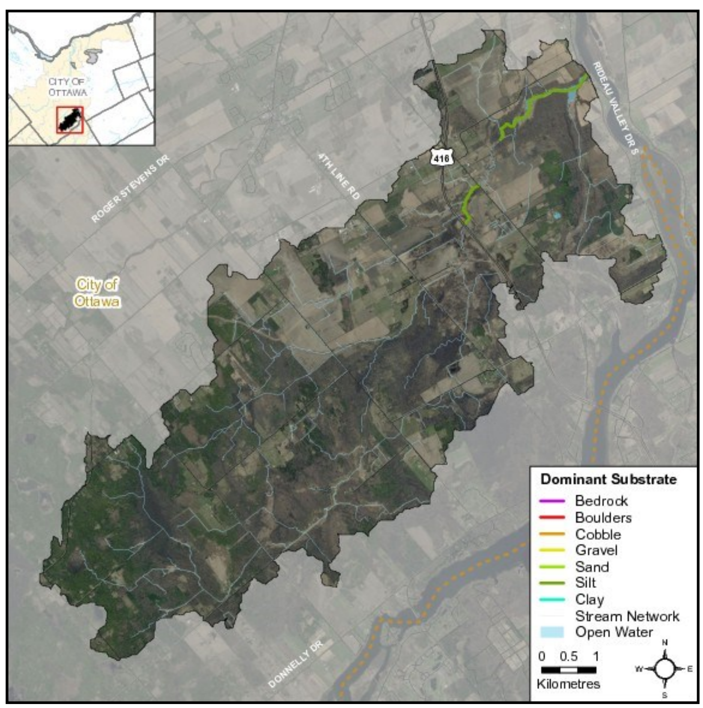



**Figure 13** Dominant instream substrate along Cranberry Creek

### 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 diverse 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 Cranberry Creek has limited diversity of morphological conditions, suitable for a variety of aquatic species and life stages; 41 percent of sections contained pools, and 100 percent contained runs.

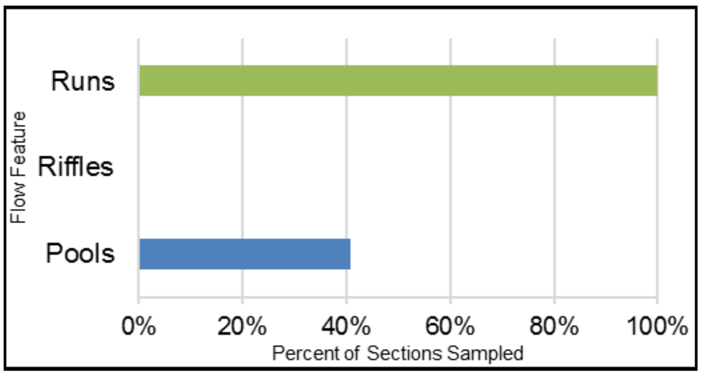



**Figure 14** Instream morphology along Cranberry Creek

Cranberry Creek is dominated by riverine wetland conditions which results in a high percentage of run and pool habitats

### Instream Wood Structure

Figure 15 shows that a portion of Cranberry 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 Cranberry Creek are important for fish and wildlife habitat

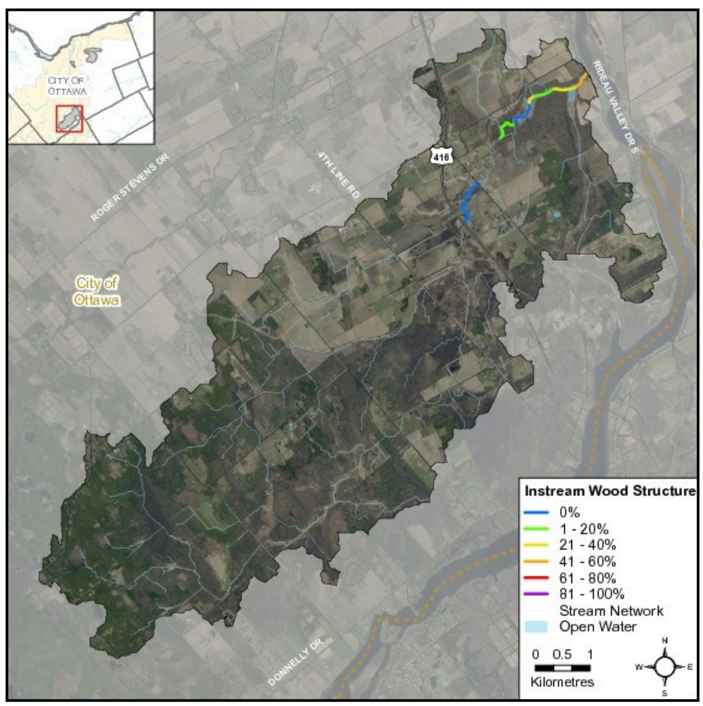



**Figure 15** Instream wood structures along Cranberry Creek

### 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 16 shows the aquatic vegetation community structure. Four types commonly present along Cranberry Creek were submerged vegetation present in all sections; robust emergent vegetation present in 78 percent; algae present in 74 percent; and free floating plants present in 70 percent of sections surveyed.

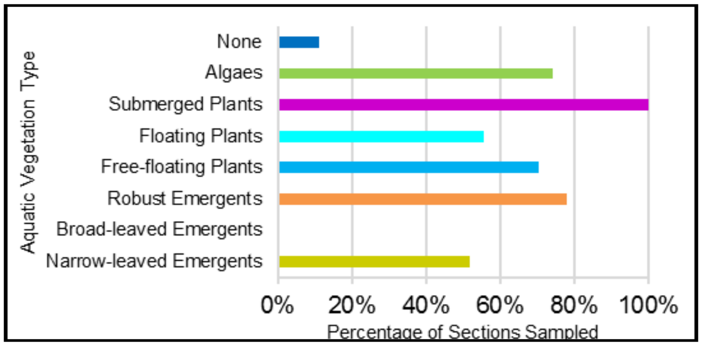



**Figure 16** Aquatic vegetation presence along Cranberry Creek

Figure 17 shows Cranberry Creek has a large diversity of instream aquatic vegetation, with the majority of sections containing submerged vegetation as the dominant type. Algae was dominant in 19 percent of sections; and robust emergent plants in four percent of sections.

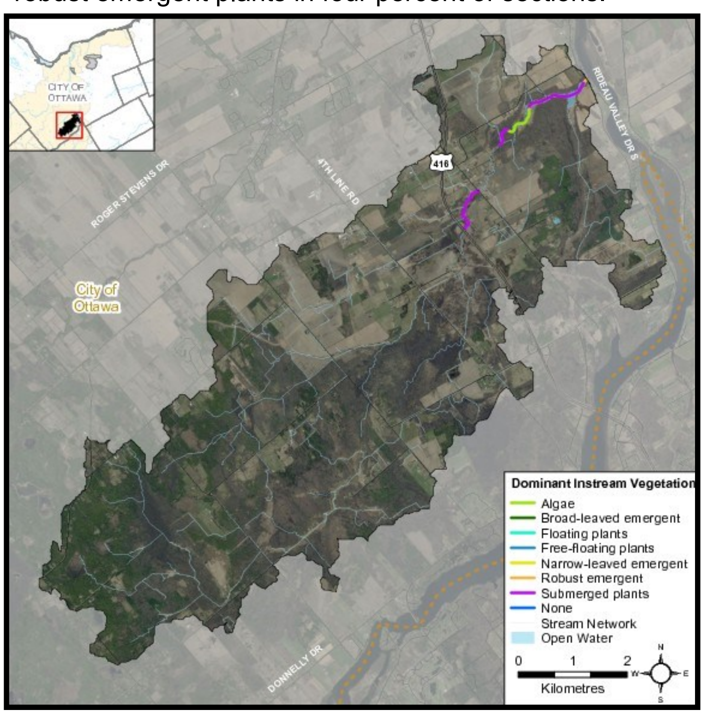



**Figure 17** Dominant instream vegetation in Cranberry Creek

### 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 leads 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 18, 81 percent of sections along Cranberry Creek had common levels of vegetation in part, 22 percent had normal, and 22 percent had extensive vegetation. Low abundance levels were observed in seven percent of sections surveyed and four percent had rare abundance. No vegetation was found along 11 percent of sections surveyed.

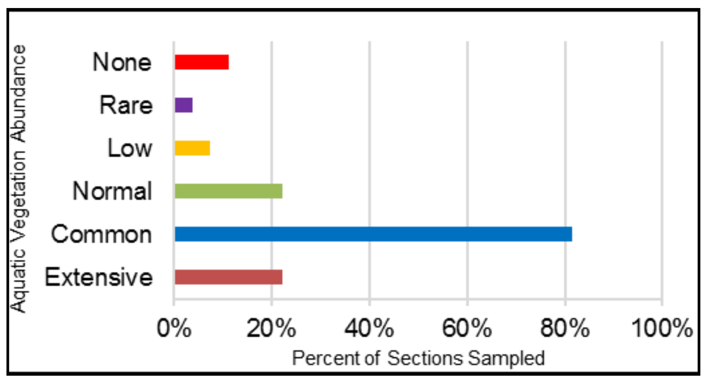



**Figure 18** Instream vegetation abundance along Cranberry Creek

Submerged vegetation and cattails are instream robust emergent vegetation typically found in wetlands observed along Cranberry Creek

## *Cranberry 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 all sections surveyed along Cranberry Creek, Figure 19 shows diversity of species observed per section surveyed.

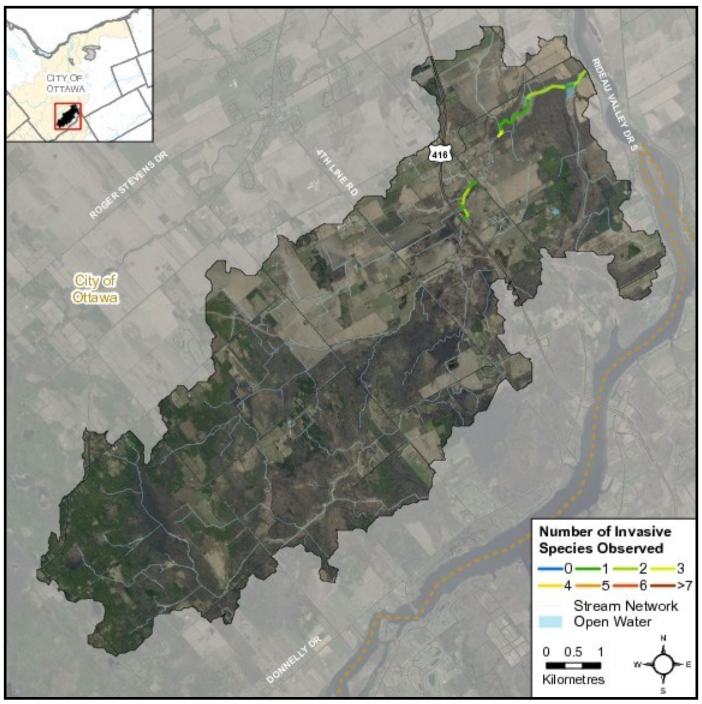



**Figure 19** Invasive species diversity along Cranberry Creek

The following are a list of species observed in 2019 in the surveyed portions of Cranberry Creek:

- common buckthorn (*Rhamnus cathartica*)
- curly-leaved pondweed (*Potamogeton crispus*)
- European frog-bit (*Hydrocharis morsus-ranae*)
- glossy buckthorn (*Rhamnus frangula*)
- Manitoba maple (*Acer negundo*)
- non-native *Phragmites* (*Phragmites australis*)
- purple loosestrife (*Lythrum salicaria*)

Invasive common buckthorn and Manitoba maple observed along the shores of Cranberry Creek near Kars

To report and find information about invasive species visit

**http://www.invadingspecies.com**

Managed by the Ontario Federation of Anglers and Hunters

### Pollution

Figure 20 shows where pollution was observed along Cranberry Creek. The levels of garbage found in the main portion of the stream were low, with 96 percent of sections surveyed containing no garbage. Four percent of sections had floating garbage and garbage on the stream bottom.

In the headwater portions of the catchment garbage was also observed.

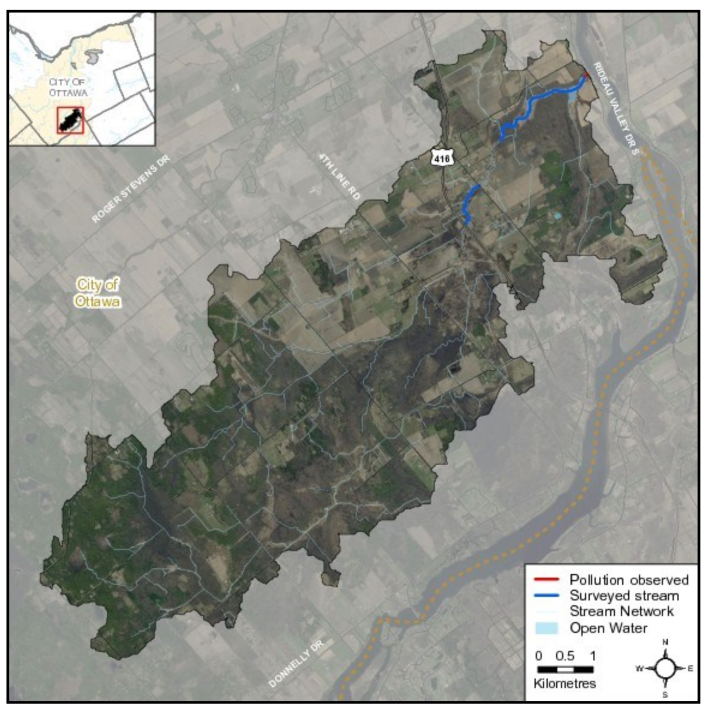



**Figure 20** Pollution observed along Cranberry Creek

**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 Cranberry Creek catchment.

Red winged black bird female guarding her nest near the confluence with the Rideau River (above) and great blue heron hunting in the headwater reaches (below) of Cranberry Creek

Leopard frog observed in the headwaters of Cranberry Creek (above) and a clubtail exoskeleton on a cattail (below)

**Table 1** Wildlife observations along Cranberry Creek in 2019

| | |
|---|---|
| **Birds** | American bittern, American crow, American goldfinch, American Robin, blue jay, common grackle, downy woodpecker, ducks, eastern kingbird, great blue heron, green heron, mallard, mourning dove, northern flicker, osprey, oriole, sandpipers, red-winged blackbird, tree swallow, turkey vulture, veery, wilson's snipe, wood duck, woodpeckers, yellow warbler |
| **Reptiles & Amphibians** | American bullfrog, eastern musk turtle, green frog, northern leopard frog, midland painted turtle |
| **Mammals** | chipmunk, eastern grey squirrel, muskrat |
| **Aquatic Insects & Benthic Invertebrates** | amphipods, caddisflies, crayfish, eastern floater, fingernail clam, gyrinid beetle, leeches, mayflies, snails, odonate larvae, water scorpion, water strider, whirligig beetle, |
| **Other** | beetles, butterflies, damselflies, dragonflies, spotted tussock moth, mosquitoes, moths, spiders, snails |

A musk turtle, a species of special concern (above) and a painted turtle (below) found in Cranberry Creek

## *Cranberry 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.

A volunteer 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 21 shows the concentration levels found in the surveyed portions of Cranberry Creek. The two dashed lines depicted represent the Canadian water quality guidelines. Most of the surveyed portions had adequate oxygen levels to support warm-water aquatic life. Levels below the Canadian water quality guideline were found adjacent to agricultural areas (sec. 8-14) and downstream of Highway 416 in wetland habitat conditions. Lower levels of dissolved oxygen are typically found in wetland habitats as a result of high biological oxygen demand. Average concentration levels across the system were 6.1 milligrams per liter.

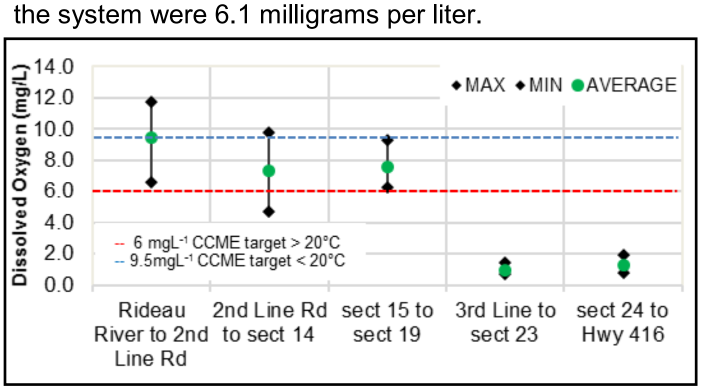



**Figure 21** Dissolved oxygen ranges along surveyed sections of Cranberry Creek

### 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. Currently there is no existing guideline for stream conductivity levels, however conductivity measurements outside of normal range across a system are good indicators of anthropogenic inputs including unmitigated discharges and storm water input.

Figure 22 shows specific conductivity levels in Cranberry Creek, the average level is depicted by the dashed line (567 µS/cm). Notable variability was observed at the mouth, (sec. 1-7) likely influenced by the Rideau River; and by drainage in agricultural zones as well as road runoff.

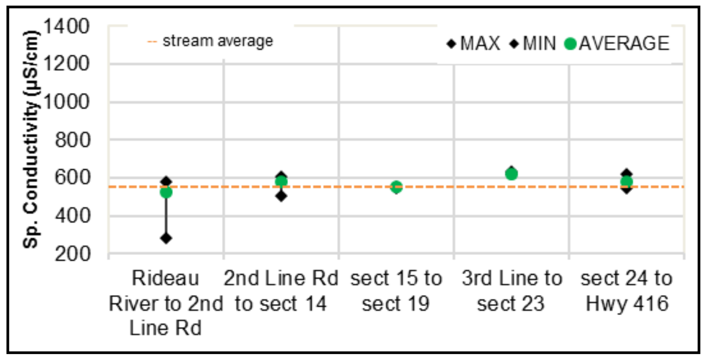



**Figure 22** Specific Conductivity ranges along surveyed sections of Cranberry Creek

### 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 23 shows Cranberry Creek had pH levels that meet the PWQO, depicted by the dashed lines. Average levels across the system were pH 7.40.

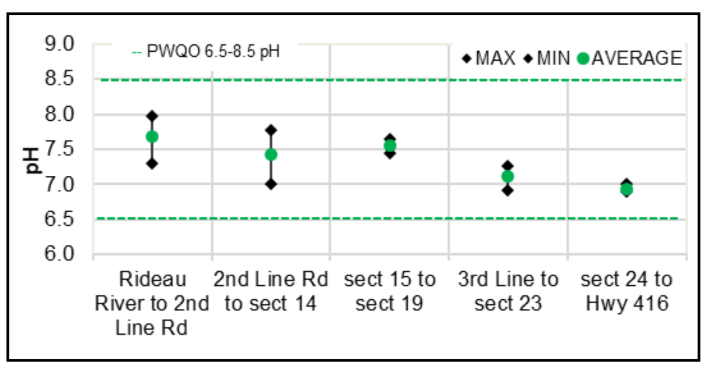



**Figure 23** pH ranges along surveyed sections of Cranberry Creek

### 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.

Site on Cranberry Creek near the Highway 416 with **impaired** oxygen conditions (Dissolved oxygen levels of 1.03 mg/L and 12.0 % saturation)

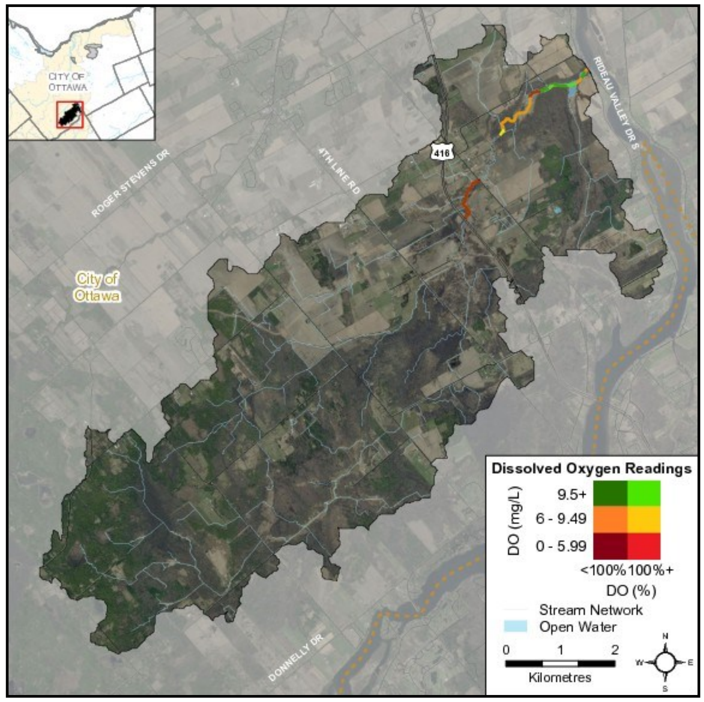



**Figure 24** Bivariate assessment of dissolved oxygen concentration (mg/L) and saturation (%) along Cranberry Creek

Figure 24 shows the oxygen conditions across the areas that were surveyed in 2019. Dissolved oxygen conditions in Cranberry Creek were sufficient to sustain cold water biota in areas near the confluence with the Rideau River. Sections in the middle reaches, had sufficient oxygen levels to sustain warmwater biota.

Sections shown in Figure 24 in dark red downstream from Highway 416 had levels of impairment both in concentration and percent saturation. These areas had wetland features that have naturally lower oxygen levels, however these can be further limited by extensive vegetation growth of invasive species, and anthropogenic nutrient input.

Site on Cranberry Creek near Rideau Valley Drive with **optimal** oxygen conditions (Dissolved oxygen levels of 11.71 mg/L and 115.0% 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 Cranberry Creek (567.3 µS/cm) were slightly above guidelines (500 µS/cm) used for the Canadian Environmental Performance Index (Environment Canada 2011).

Figure 25 shows relative specific conductivity levels in Cranberry Creek. Normal levels were maintained for most of the surveyed portions. Moderately elevated conditions were observed near Third Line Road. This area receives upstream wetland discharge, has road runoff influences, and adjacent agricultural land uses. All of these factors combined contributed to elevated conductivity levels.

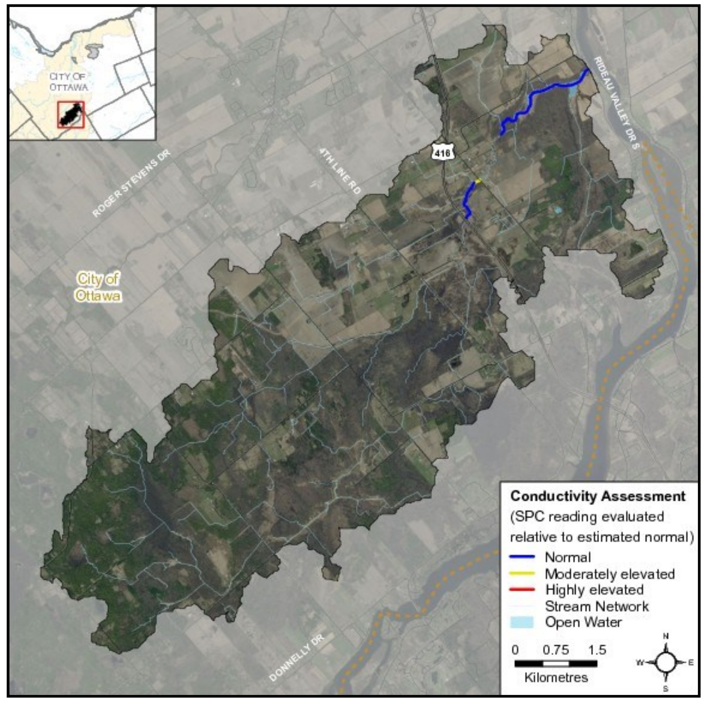



**Figure 25** Relative specific conductivity levels along Cranberry Creek

Section of Cranberry Creek at the confluence with the Rideau River has lower than average specific conductivity levels

Section of Cranberry Creek near Third Line Road with moderately elevated levels of specific conductivity

## *Cranberry 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 Cranberry Creek, four temperature loggers were placed in April and retrieved in early November.

Figure 26 shows where thermal sampling sites were located. Due to dry conditions at one site, only data from three loggers was analyzed (#1, #2, #4). Analysis of data from three loggers (using the Stoneman and Jones, 1996, method adapted by Chu et al., 2009), indicated Cranberry Creek was classified as **warm-water** at the mouth and **cool-warmwater** at Highway 416 and Malakoff Road (Figure 27). Fish species observed at all sites had thermal preferences from cool to warm as indicated by Cocker at al. (2001).

**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 28). Indicators included: springs/seeps, watercress, iron staining, significant temperature changes and rainbow mineral film.

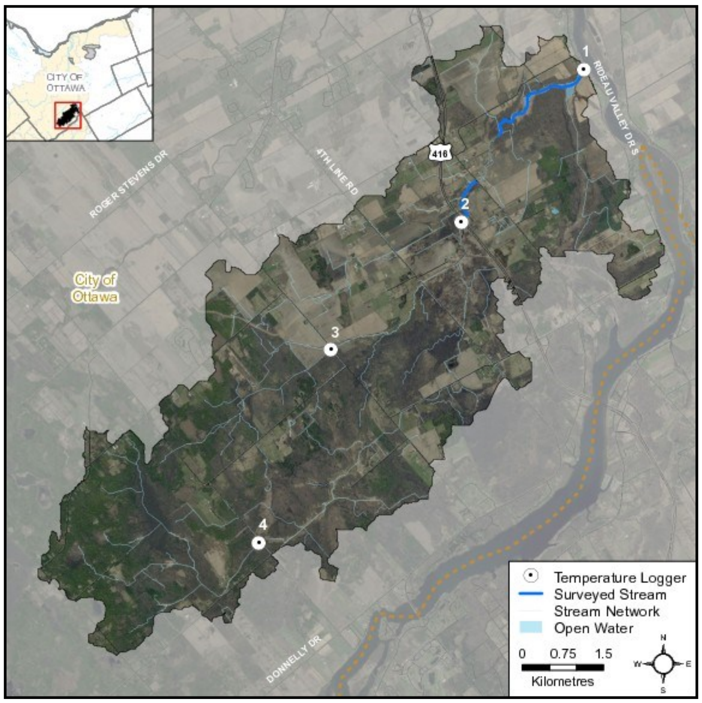



**Figure 26** Temperature logger locations on Cranberry Creek

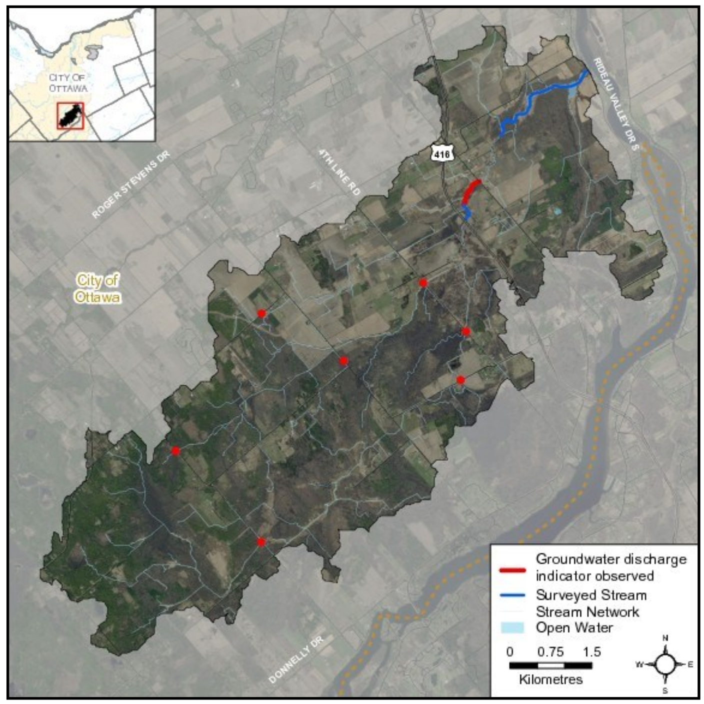



**Figure 28** Groundwater indicators observed in the Cranberry Creek catchment

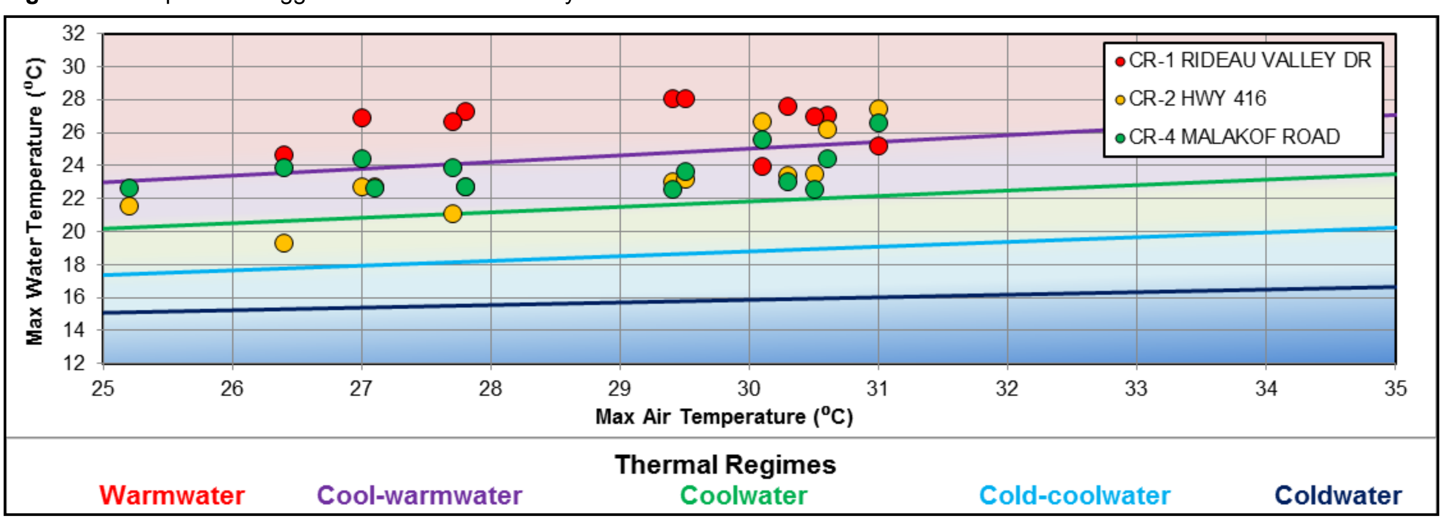



**Figure 27** Thermal Classification for Cranberry Creek with the five thermal regimes adapted from Stoneman and Jones (1996) by Chu et al. (2009): **cool-warmwater** at CR-2 and CR-4; and **warmwater** at CR-1 from sites sampled on Cranberry Creek

## *Cranberry Creek Fish Community*

### Fish Community Summary

Fourteen fish sampling sites were evaluated between May and July 2019. Four locations were sampled daily for four days with a fyke net near the confluence with the Rideau River. Six sites were sampled daily for four days with a Windemere net, located near the tributary bay on the left bank of Cranberry Creek. Four site locations were sampled with a seine net.

Eleven species were captured in 2019, they are listed in Table 2 along with their thermal classification preferences (Coker et al., 2001) and MNR species codes. Cranberry Creek had a mixed fish community ranging from cold-cool to warm water species. The sampling locations where these species were observed, as well as RVCA historical sites, are depicted in Figure 29. The codes used in the figure are the MNR codes provided in Table 2. For comparisons across sampling years and a complete list of RVCA historical fish records from Cranberry Creek refer to page 22 of this report.

**Table 2** Fish species observed in Cranberry Creek in 2019

| Species | Thermal Class | MNR Species Code |
|---|---|---|
| banded killifish *Fundulus diaphanus* | **Cool** | BaKil |
| black crappie *Pomoxis nigromaculatus* | **Cool** | BlCra |
| bluegill *Lepomis macrochirus* | **Warm** | Blueg |
| bluntnose minnow *Pimephales notatus* | **Warm** | BnMin |
| brown bullhead *Ameiurus nebulosus* | **Warm** | BrBul |
| johnny/tessalated darter *Etheostoma spp.* | **Cool** | EthSp |
| golden shiner *Notemigonus crysoleucas* | **Cool** | GoShi |
| largemouth bass *Micropterus salmoides* | **Warm** | LmBas |
| pumpkinseed *Lepomis gibbosus* | **Warm** | Pumpk |
| rock bass *Ambloplites rupestris* | **Cool** | RoBass |
| yellow perch *Perca flavescens* | **Cool** | YePer |
| **Total Species** | | **11** |

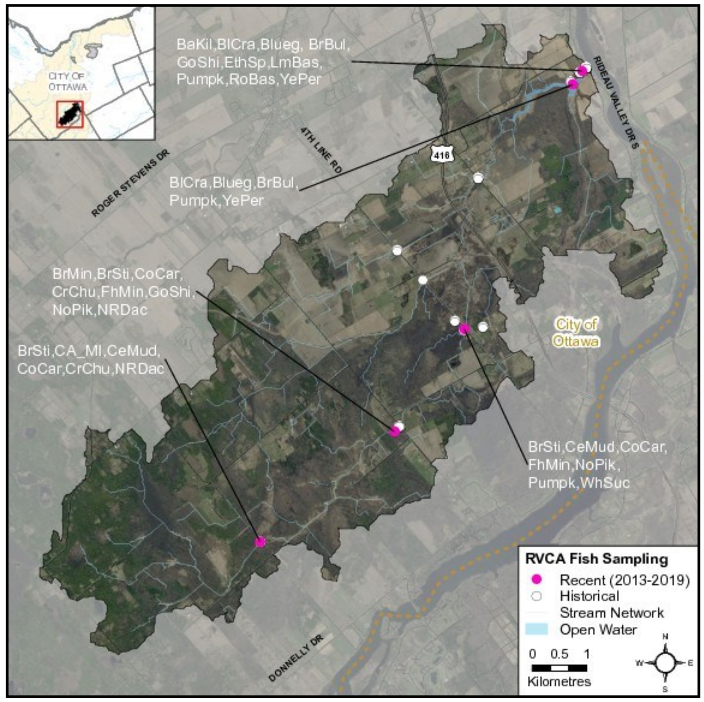



**Figure 29** Cranberry Creek fish sampling locations and fish species observations from 2013-2019

Setting a large fyke net (above) and a juvenile largemouth bass captured (below) in Cranberry Creek near Kars

Yellow Perch were prominent in Cranberry Creek near Kars

## 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 no migratory obstructions observed along the surveyed portions of Cranberry Creek. The locations of migratory obstructions observed during headwater drainage feature assessments in 2019 are shown in Figure 30.

Tiling and modifications of headwater drainage features create fish migratory obstructions, loss of aquatic habitat and spawning areas for fish species

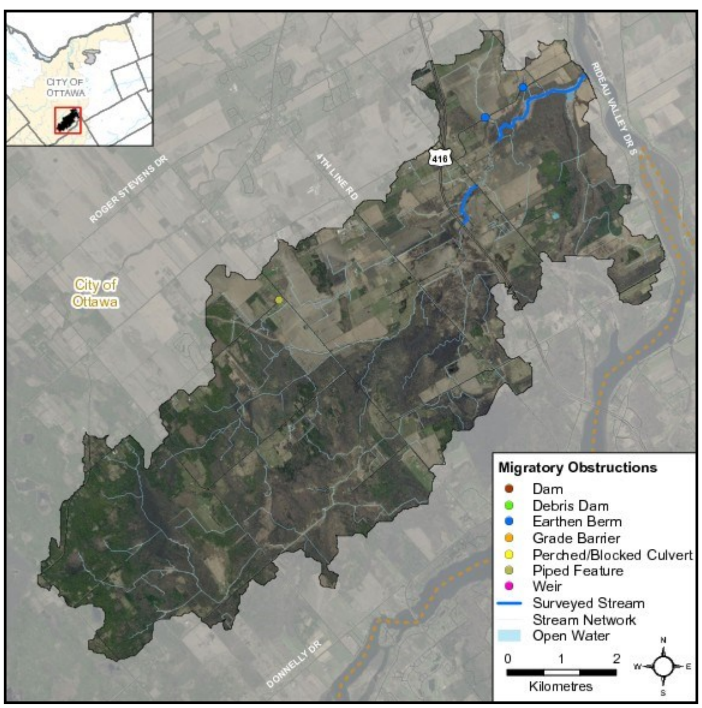



**Figure 30** Locations of migratory obstructions along Cranberry Creek catchment

## 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 barriers to fish migration.

One beaver dam was identified on the surveyed portions of Cranberry Creek in 2019 and is shown in Figure 31.

Abandoned beaver dam along Cranberry Creek

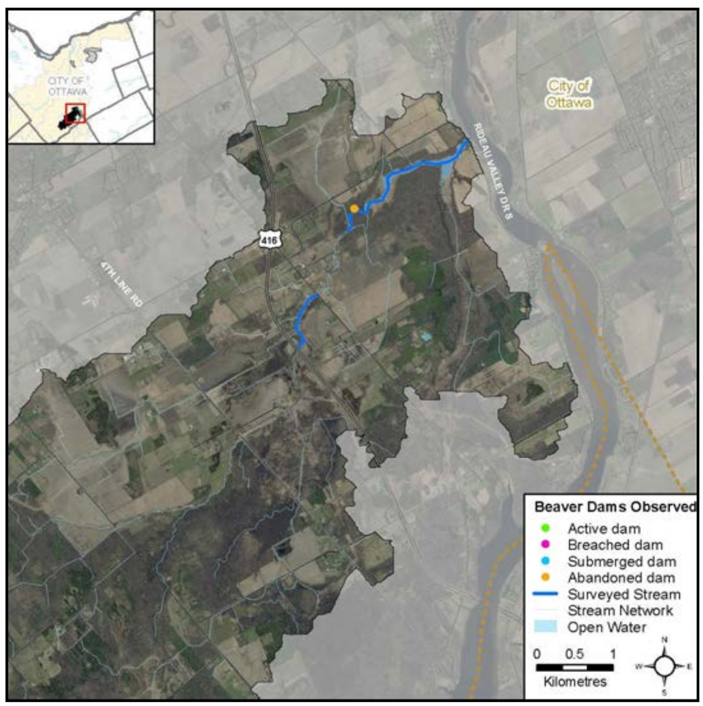



**Figure 31** Locations of beaver dams along Cranberry Creek

## *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, 2019):

- 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, 2019). 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 2019 a total of 16 HDF sites were assessed in the Cranberry Creek Catchment (Figure 32).

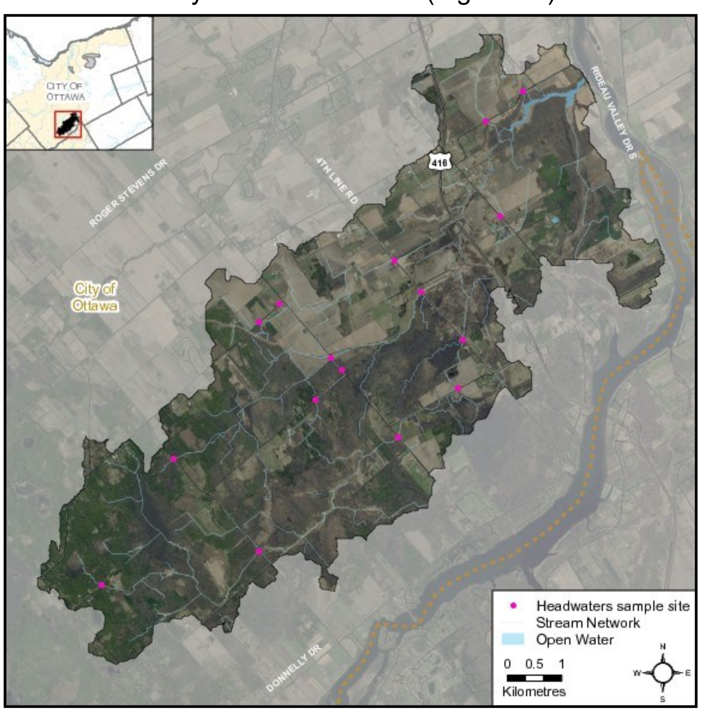



**Figure 32** Location of headwater drainage feature sampling sites in the Cranberry Creek catchment

### 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 33 shows the feature type of the primary feature at the sampling locations. Channelized features were dominant, being observed at six sites. Two features were roadside ditches, and two were tiled. The natural features present included six wetlands features.

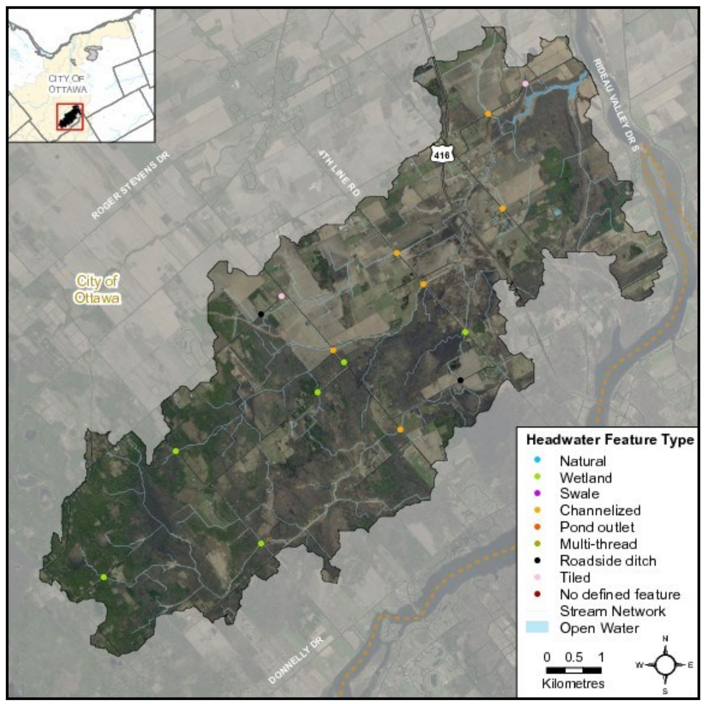



**Figure 33** Map of Cranberry Creek catchment headwater drainage feature types

Channelized headwater drainage feature on Third Line Road

### 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. Drought conditions were experienced in 2019 which influenced flow conditions in the summer.

Flow conditions in the Cranberry Creek catchment  area are shown in Figure 34.

Intermittent headwater drainage feature with spring and summer conditions on McCordick Road

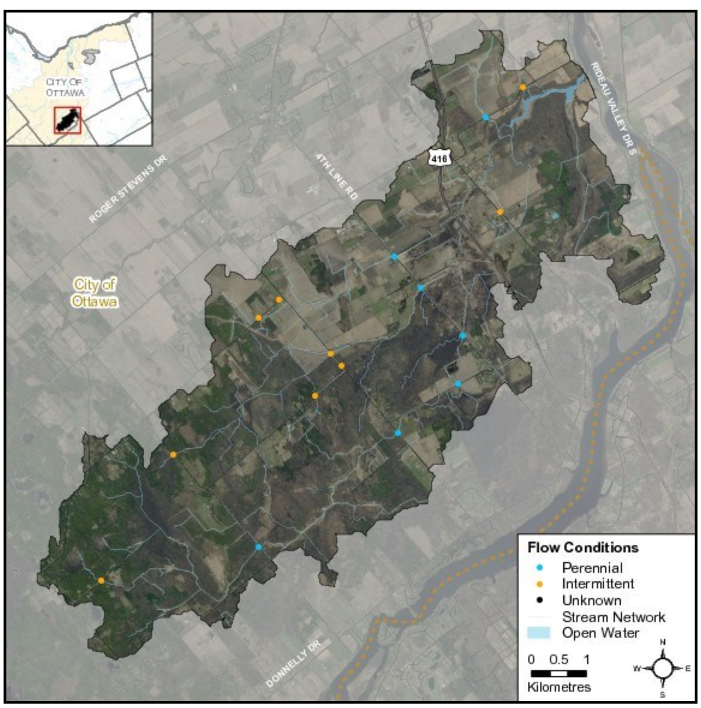



**Figure 34** Headwater drainage feature flow conditions in the Cranberry Creek catchment

### 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 35 shows channel modifications observed in Cranberry Creek headwater drainage features. Most modifications in this catchment for headwater drainage features are dredging or straightening.

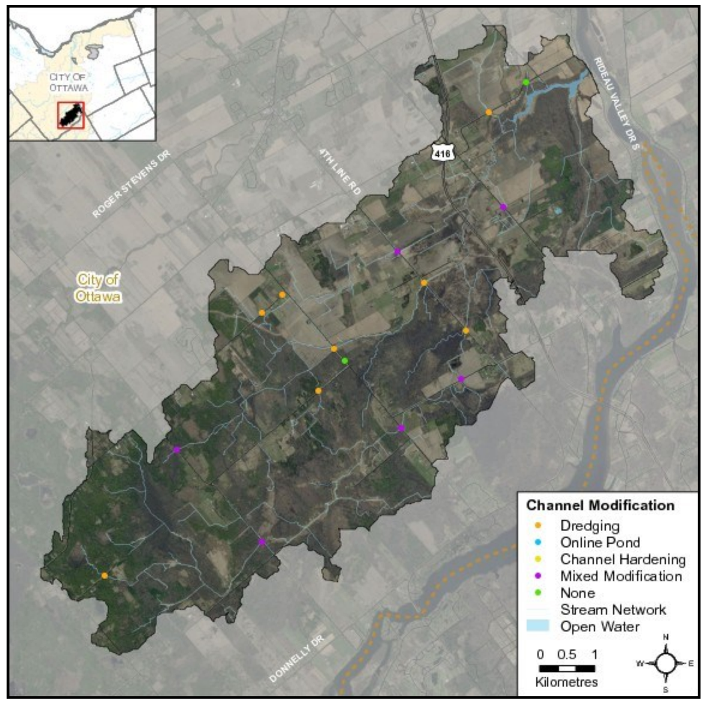



**Figure 35** Headwater drainage feature channel modifications in the Cranberry Creek catchment

An example of mixed modifications on a headwater drainage feature: dredging and channel hardening with rip rap on Fourth Line 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 36 depicts the dominant vegetation observed at the sampled sites in the Cranberry Creek catchment. Wetland vegetation, water tolerant plants, was the most common type, observed in 12 features. One feature was dominated by meadow. Three features had no vegetation in the spring time, where flows and sediment transport are unmitigated by the lack of vegetation.

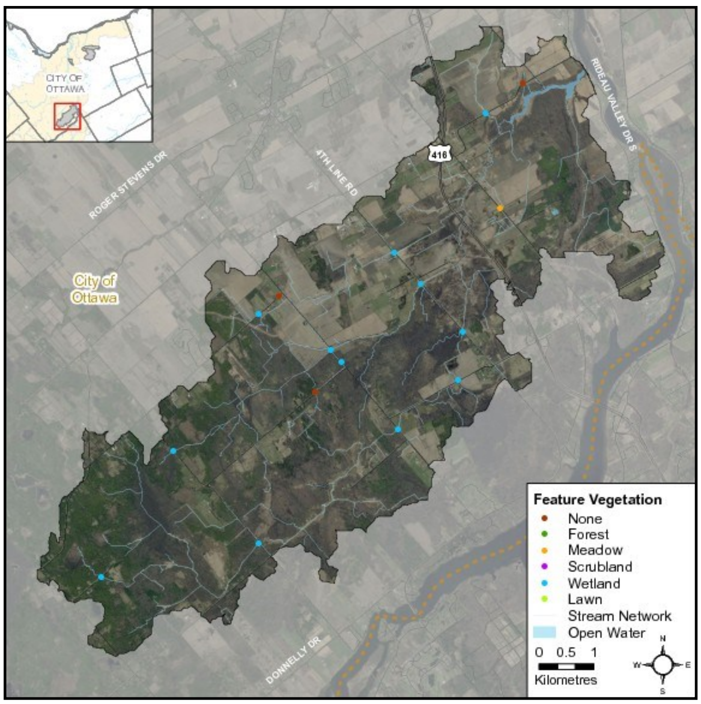



**Figure 36** Headwater drainage in feature vegetation in the Cranberry Creek catchment

Wetland feature vegetation in a headwater drainage feature on Fourth Line 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 37 shows the type of riparian vegetation observed at the sampled headwater sites in the Cranberry 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.

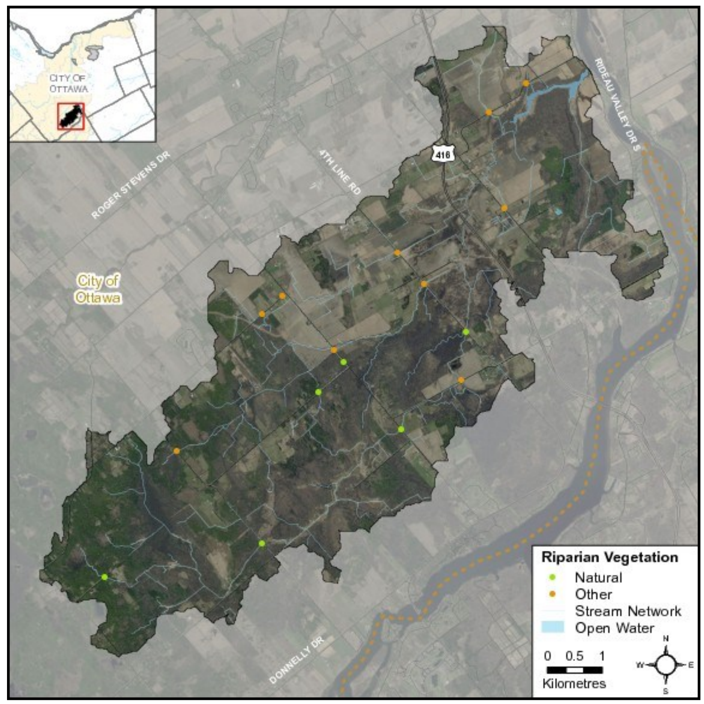



**Figure 37** Riparian vegetation types along headwater drainage features in the Cranberry Creek catchment

Headwater drainage feature with non-natural riparian vegetation on Fourth Line 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, 2019). 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 extensive. Two features had evidence of extensive deposition levels. Two features had moderate amounts of deposition, nine had minimal levels and three had no evidence of sediment deposition. Figure 38 shows the levels of sediment deposition observed in the catchment headwaters.

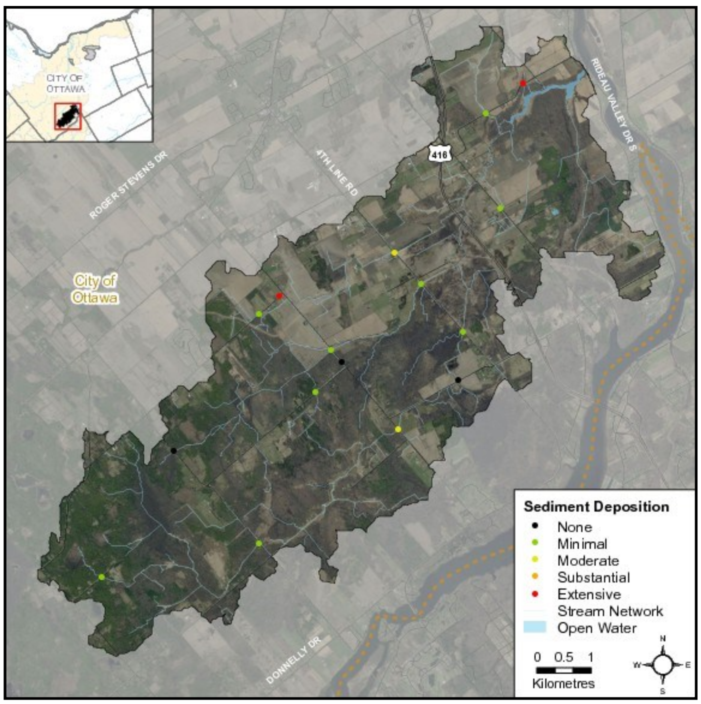



**Figure 38** Headwater drainage feature sediment deposition in the Cranberry Creek catchment

Substantial sediment deposition observed in a headwater drainage feature on Lockhead Road

### Headwater Feature Upstream Roughness

Feature roughness is a relative measure of the amount of material within the feature that diffuses flows (OSAP, 2019). 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 Cranberry Creek catchment, eight of the sites had minimal roughness, four had moderate, two had high, and two had extreme coverage. Figure 39 shows the various feature roughness across the area.

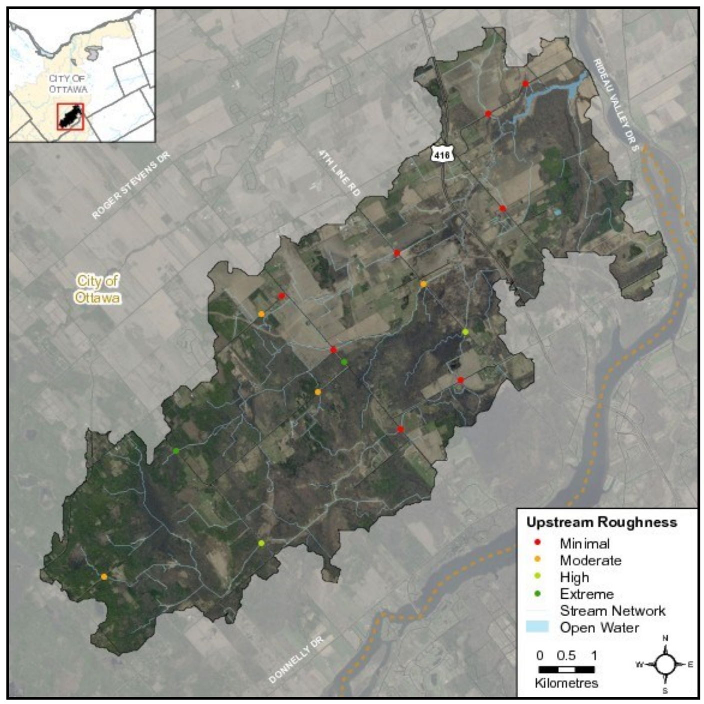



**Figure 39** Headwater drainage feature roughness in the Cranberry Creek catchment

Extreme feature roughness provided by cattails and cobble in a headwater drainage feature on Malakoff Road

## *Stream Comparison Between 2007, 2013 and 2019*

The following tables provide a comparison of observations on Cranberry Creek between the 2007, 2013 and 2019 survey years (RVCA 2007, RVCA 2013). Monitoring protocols since 2007 have been modified and enhanced, only certain data from that year can be compared to later years. In order to accurately represent current and historical information, the data was only compared for those sections which were surveyed in both 2013 and 2019. This results in changes to our summary information, averages presented in this section differ from ones in previous pages of this report. 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 2013 and 2019.

Average pH increased by 0.18 units from 2013 to 2019; specific conductivity decreased by 12.1 µS/cm. These slight changes may reflect seasonal variability. Average dissolved oxygen levels were found to be higher by 4.9 milligrams per liter from 2013 to 2019. These changes can also be attributed to seasonal conditions and cooler temperatures which are conducive to the stream's ability to hold more oxygen.

Average summer water temperatures range from cooler water in 2019 (17.6°C) to warmer values in 2013 (20.3° C), with 2.7 degrees centigrade of variation. In 2019 cooler temperatures than the previous reporting year are due to the different sampling seasons. Observations from 2013 were made from July to September, whereas observations in 2019 were made in June. 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. These values increased by 0.13°C for every degree of air temperature from 2013 to 2019. Near the confluence with the Rideau River, Cranberry Creek at this site was classified as cool-warm water in 2013 and as warm water in 2019 (methods from Chu et al., 2009). In the upper reaches at Highway 416 and at Malakoff Road, Cranberry creek was classified as cool water in 2013 and as cool-warm water in 2019 (methods from Chu et al., 2009). This shows that maximum summer temperatures under baseflow conditions had a warming trend from 2013 to 2019.

**Table 3** Water chemistry comparison (2013/2019)

| Water Chemistry (2013/2019) | | | | |
|---|---|---|---|---|
| **Year** | **Parameter** | **Unit** | **Average** | **STND Error** |
| 2013 | pH | - | 7.23 | ± 0.04 |
| 2019 | pH | - | 7.41 | ± 0.08 |
| 2013 | Sp. Conductivity | us/cm | 571.5 | ± 18.0 |
| 2019 | Sp. Conductivity | us/cm | 559.4 | ± 17.4 |
| 2013 | Dissolved Oxygen | mg/L | 1.9 | ± 0.23 |
| 2019 | Dissolved Oxygen | mg/L | 6.8 | ± 0.83 |
| 2013 | Water Temperature | ºC | 20.3 | ± 0.7 |
| 2019 | Water Temperature | ºC | 17.6 | ± 0.9 |
| 2013 | Standardized Stream Temperature[1] | ºC Water / 1ºC Air | 0.74 | ± 0.04 |
| 2019 | Standardized Stream Temperature[1] | ºC Water / 1ºC Air | 0.87 | ± 0.03 |

[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

### *Pollution*

Garbage accumulation on Cranberry Creek was found to decrease from 2007 to 2013 and decreased more by 2019. Frequent precipitation events in 2019 may have flushed garbage downstream. In 2019 the polluted sections contained garbage, such as plastics, packaging, glass and old fishing gear. Table 4 shows pollution levels in all three monitoring years.

**Table 4** Pollution levels (presence in % of sections surveyed) comparison between 2007-2019

| Pollution/Garbage | 2007 | 2013 | 2019 | +/- |
|---|---|---|---|---|
| floating garbage | 29% | 16% | 6% | ▼ |
| garbage on stream bottom | 0% | 4% | 6% | ▲ |
| Unusual colouration | 5% | 0% | 0% | ▼ |
| other | 24% | 12% | 0% | ▼ |
| **Total polluted sections** | **33%** | **28%** | **6%** | **▼** |

### *Instream Aquatic Vegetation*

Table 5 shows decreases in instream aquatic vegetation from 2013-2019. Robust emergent plants (e.g. cattails) and floating plants (e.g. water lilies) were present in comparable abundance in both survey years. Free-floating plants (e.g. frog-bit) and Narrow-leaved emergent plants (e.g. sedges) had lower observations in the number of sections surveyed. Declines seen in broad leaved emergent plants (e.g. arrowhead), submerged plants (e.g. pondweed) and algae are associated with different seasonal plant emergence, observations in 2013 were made later in the summer compared to 2019.

**Table 5** Instream aquatic vegetation (presence in % of sections) comparison between 2013 and 2019

| Instream Vegetation | 2013 | 2019 | +/- |
|---|---|---|---|
| narrow-leaved emergent plants | 88% | 56% | ▼ |
| broad-leaved emergent plants | 52% | 0% | ▼ |
| robust emergent plants | 92% | 94% | ▲ |
| free-floating plants | 96% | 72% | ▼ |
| floating plants | 76% | 78% | ▲ |
| submerged plants | 84% | 18% | ▼ |
| algae | 68% | 14% | ▼ |

Instream vegetation along Cranberry Creek in June 2019 (above) and in July 2013 (below) near Kars

### Fish Community

Fish sampling was carried out by the City Stream Watch program in 2007, 2013 and 2019 to evaluate fish community composition in Cranberry Creek (see Table 6). In total 22 species have been observed in Cranberry Creek. In 2007, 19 species were captured through out seven sites; and 11 species were observed in 14 sites in 2019. Sample locations in 2007 and 2013 were spread throughout Cranberry creek, sites in 2019 were concentrated near the confluence with the Rideau River.

The majority of species observed in 2019 had been captured in previous years, with the bluntnose minnow as a new observation. It is also important to note one invasive species (Scott and Crossman 1998), the common carp, was observed in 2007 and 2013 and is likely still present in 2019.

**Table 6** Comparison of fish species caught between 2007-2019

| Species | 2007 | 2013 | 2019 |
|---|---|---|---|
| banded killifish *Fundulus diaphanus* | X | X | X |
| black crappie *Pomoxis nigromaculatus* | X | X | X |
| bluegill *Lepomis macrochirus* | X | X | X |
| bluntnose minnow *Pimephales notatus* | | | X |
| brassy minnow *Hybognathus hankinsoni* | | X | |
| brook stickleback *Culaea inconstans* | X | X | |
| brown bullhead *Ameiurus nebulosus* | X | X | X |
| central mudminnow *Umbra limi* | X | X | |
| common carp *Cyprinus carpio* | X | X | |
| common shiner *Luxilus cornutus* | X | | |
| creek chub *Semotilus atromaculatus* | X | X | |
| *Etheostoma spp.* | X | X | X |
| fathead minnow *Pimephales promelas* | | X | |
| golden shiner *Notemigonus crysoleucas* | X | X | X |
| largemouth bass *Micropterus salmoides* | X | X | X |
| northern pike *Esox Lucius* | X | X | |
| northern redbelly dace *Chrosomus eos* | X | X | |
| Pumpkinseed *Lepomis gibbosus* | X | X | X |
| rock bass *Ambloplites rupestris* | X | X | X |
| walleye *Sander vitreus* | X | | |
| white sucker *Catostomus commersonii* | X | X | |
| yellow perch *Perca flavescens* | X | X | X |
| **Total Species 22** | **19** | **19** | **11** |

Black crappie have been observed in Cranberry Creek in all three sampling years

## *Monitoring and Restoration*

### Monitoring on Cranberry Creek

Table 7 highlights recent and past monitoring that has been done on Cranberry Creek by the City Stream Watch program. Monitoring activities and efforts have changed over the years.

**Table 7** City Stream Watch monitoring on Cranberry Creek

| Accomplishment | Year | Description |
|---|---|---|
| **City Stream Watch Stream Monitoring** | 2007 | 6.1 km of stream was surveyed |
| | 2013 | 4.3 km of stream was surveyed |
| | 2019 | 2.7 km of stream was surveyed |
| **City Stream Watch Fish Sampling** | 2007 | six fish community sites were sampled |
| | 2013 | eight fish community sites were sampled |
| | 2019 | fourteen fish community sites were sampled |
| **City Stream Watch Thermal Classification** | 2007 | three temperature probes were deployed from June to September |
| | 2013 | four temperature probes were deployed from April to September |
| | 2019 | three temperature probes were deployed from April to October |
| **Headwater Drainage Feature Assessment** | 2013 | 19 headwater drainage feature sites were sampled in the catchment |
| | 2019 | 16 headwater drainage feature sites were sampled in the catchment |

### Potential Riparian Restoration Opportunities

Riparian restoration opportunities include potential enhancement through riparian planting and tile outlet control. Opportunities were identified along the headwater drainage features in the Cranberry Creek catchment area (Figure 40).

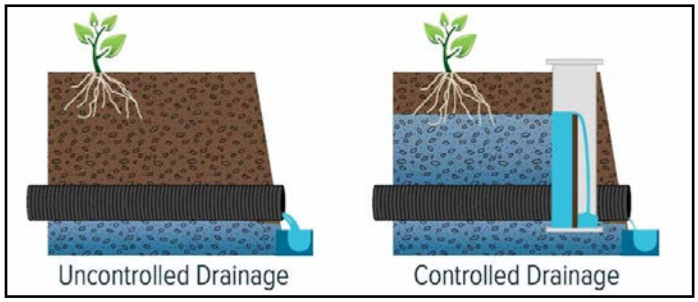
### Riparian Planting

Various riparian areas of headwater drainage features of Cranberry Creek can benefit from planting. Many sections had riparian buffers of limited size and low plant diversity. Additional planting would increase shading, enhance wildlife habitat, reduce soil erosion and mitigate negative impacts from runoff and anthropogenic input.

Headwater drainage feature in the Cranberry creek catchment that would benefit from riparian planting

### Tile Outlet Control

Due to the high agricultural land use in the Cranberry Creek catchment, many headwater areas could benefit from tile outlet control. This involves placing structures at the head of tile drains to retain water and nutrients in the field during growing season. It has been demonstrated through research that water quality and crop yields increase with the use of these structures. On average fields of corn see a three percent yield increase and soy can have up to four percent (Agriculture & Agri-food Canada, 2010).




Tile Outlet Control Schematic, image courtesy of Ontario Soil and Crop Improvement Association (above), and an aerial photo of a field with tile outlet control, photo courtesy of South Nation Conservation (below)

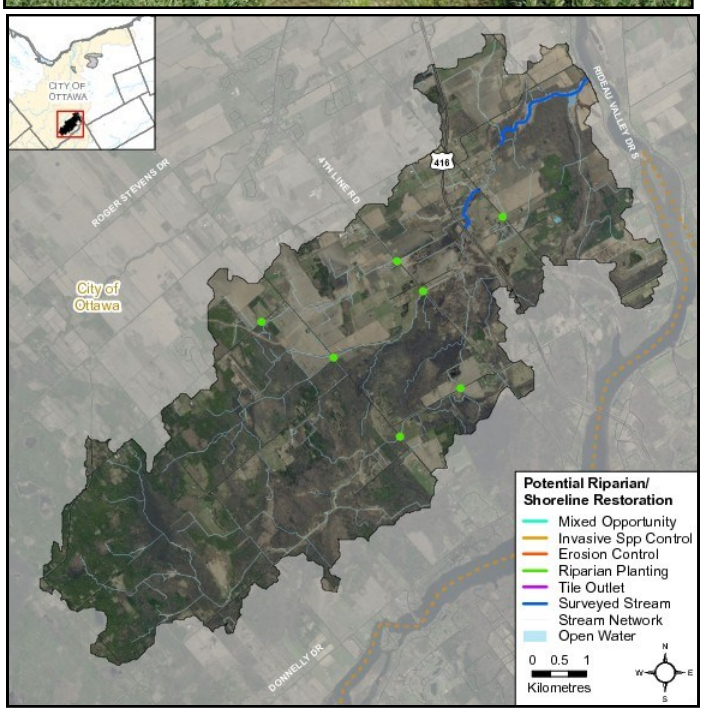



**Figure 40** Potential riparian/shoreline restoration opportunities along Cranberry Creek and its headwater reaches

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For more information on the 2019 City Stream Watch Program and the volunteer activities, please refer to the City Stream Watch 2019 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