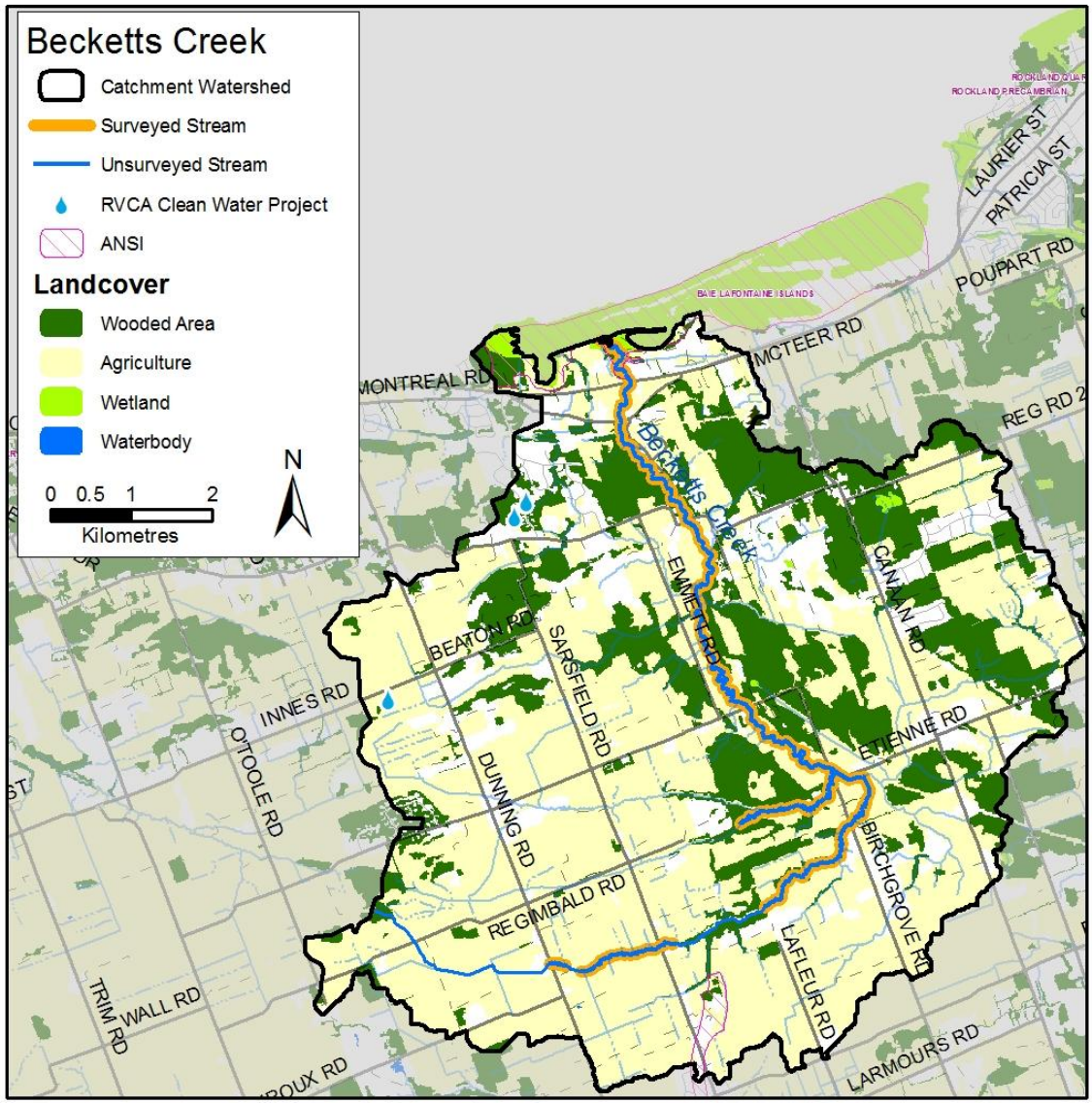
# Appendix C – Rideau Valley Conservation Authority's City Stream Watch Reports

- City Stream Watch Becketts Creek 2011 Summary Report
- City Stream Watch Becketts Creek 2017 Catchment Report

# Becketts Creek 2011 Summary Report

| | |
|---|---|
| **Area** | 59 square kilometres, 1.39% of the Rideau River watershed |
| **Land Use** | 59.62% agriculture<br>5.54% urban<br>23.24% forest<br>10.74% rural land-use<br>0.01 % waterbody<br>0.59% wetlands<br>0.26% unclassified |
| **Surficial Geology** | 64% clay,<br>7% diamicton<br>6% gravel<br>2% organic deposits<br>5% bedrock<br>22% sand |
| **Watercourse Length and Type** | *Total length*: 28 km<br>*Watercourse type*:<br>99% natural<br>1% channelized<br>*Flow type*: 100% permanent |
| **Invasive Species** | There were 6 invasive species observed along Becketts Creek |
| **Fish Community** | 25 fish species were sampled in 2011. Game fish present include largemouth bass, Northern pike, brown bullhead, walleye, black crappie, silver redhorse, shorthead redhorse, yellow bullhead and yellow perch. |
| **Species at Risk** | Species at risk known to be present in the Becketts Creek subwatershed include snapping turtle, bobolink and butternut. |




## Vegetation Cover

| Types | Hectares | % of Cover |
|---|---|---|
| Wetlands | 34.9 | 2.5 |
| Wooded areas | 1273.2 | 90.5 |
| Hedgerow | 13.3 | 0.9 |
| Plantation | 85.2 | 6.1 |
| **TOTAL COVER** | | **100%** |

## Wooded Area

| Size Category | Number of Woodlots | % of Woodlots |
|---|---|---|
| <1 ha | 251 | 97.7 |
| 1-9 ha | 6 | 2.3 |
| 10-30 ha | 0 | 0 |
| >30 ha | 0 | 0 |

## Wetland Cover

0.59% of the watershed is wetland. Wetlands make up 2.5% of the vegetation cover.

The Rideau Valley Conservation Authority, in partnership with six other agencies in Ottawa (City of Ottawa, Heron Park Community Association, Ottawa Flyfishers Society, Ottawa South Community Association, Rideau Roundtable and National Defense HQ – Fish and Game Club) initiated the City Stream Watch program in 2003.

# Becketts Creek 2011 Summary Report

The Becketts Creek subwatershed drains approximately 59 square kilometres of land. Becketts Creek is 28 kilometres in length and begins south of Sarsfield and has several tributaries and agricultural drains emptying into it. The creek flows north, just east of the town of Cumberland, crossing Rural Road 174 before its confluence with the Ottawa River. Land use in the subwatershed is mainly agricultural and rural, and there is a significant waterfall approximately three kilometres upstream of the mouth. Portions of Becketts Creek and various tributaries have municipal drain status. In 2011, 136 sections along the main branch of Becketts Creek were surveyed, in addition to 22 sections surveyed on an additional branch of Becketts. The areas along the main branch that were not surveyed were areas where the program did not have permission to access. The following is a summary of the 158 macro-stream assessment forms completed by technicians and volunteers.

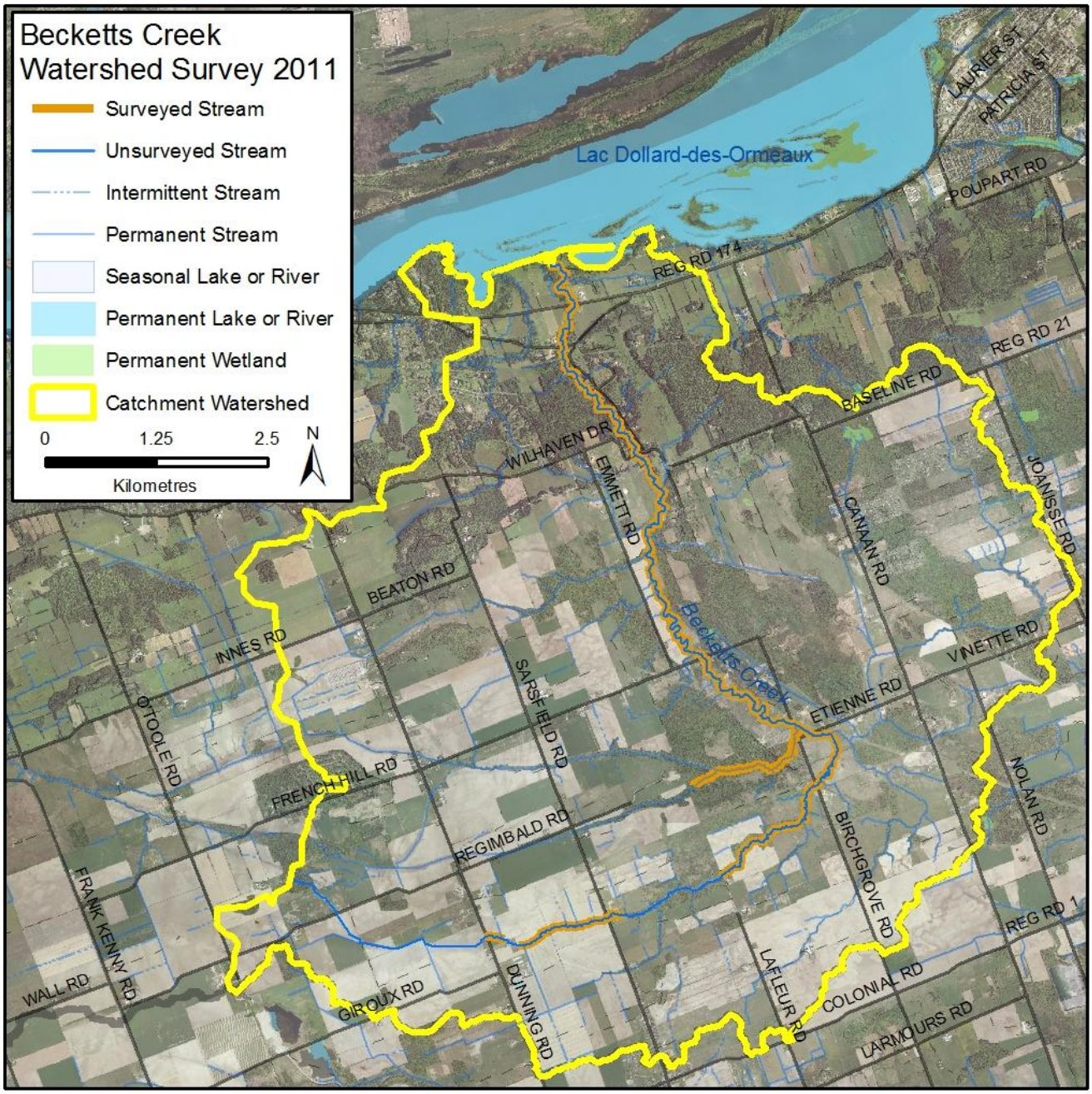



**Figure 1. Air photo of Becketts Creek Subwatershed and Surveyed Area**

# Becketts Creek 2011 Summary Report

## Anthropogenic Alterations to Becketts Creek

Figure 2 illustrates the classes of anthropogenic alterations observed along Becketts Creek. Of the 158 sections sampled, 57 percent of the stream remained without any human alteration. Sections considered natural, but with some anthropogenic changes made up nine percent of the sections sampled, and 20 percent accounted for sections that were considered "altered" but still had natural features. Fourteen percent of the sampled areas were "highly altered" with few natural portions. Areas that were listed as "altered" or "highly altered" were associated with road crossings, culverts, stormwater inputs, channelized sections or areas that had little or no buffer and little aquatic or wildlife habitat.

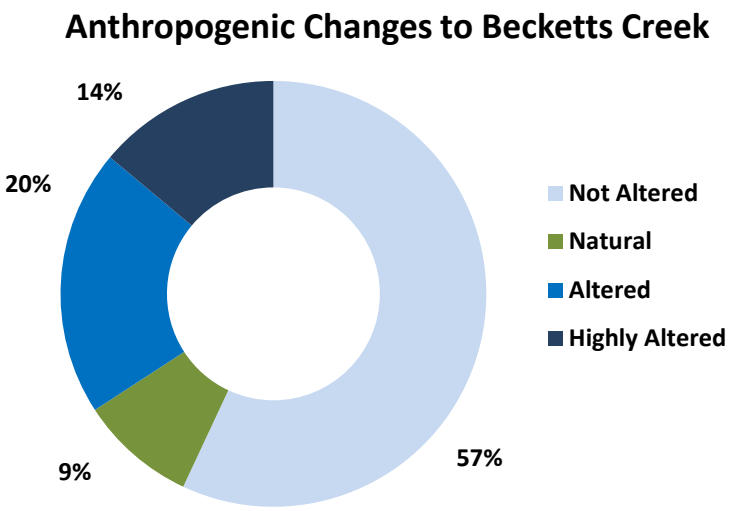



Figure 2. Classes of Anthropogenic Alterations Occurring along Becketts Creek

Photo of an anthropogenic alteration along Becketts Creek

## Land Use Adjacent to Becketts Creek

Figure 3 demonstrates 11 different land uses identified along the banks adjacent to Becketts Creek. Surrounding land use is considered from the beginning to end of the survey section (100 metres) and up to 100 metres on each side of the creek. Land use outside of this area is not considered for they surveys but is nonetheless part of the subwatershed and will influence the creek. Natural areas made up 71 percent of the stream, characterized by forest, scrubland and meadow. The other major land use was agricultural. There were several areas adjacent to the creek where forest was being cleared and tile drains were being installed; this will have a future influence on the creek but is not reflected in the 2011 data. The remaining land use consisted of residential, pasture, abandoned agriculture, infrastructure, industrial/commercial and other. "Other" was where the banks of the Ottawa River were adjacent to the stream.

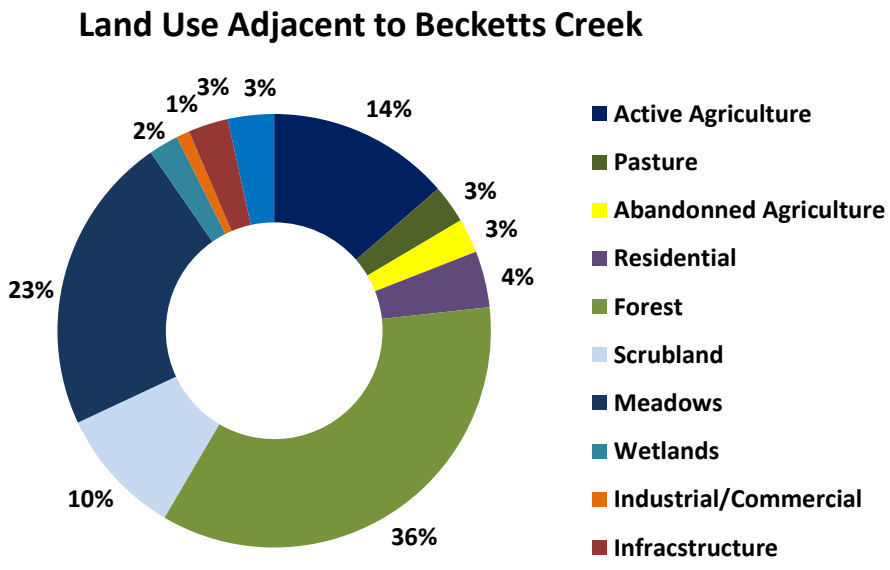



Figure 3. Land Use Identified Along Becketts Creek

An example of land use observed along Becketts Creek, meadow and forest

# Becketts Creek 2011 Summary Report

## Channel Type

Streams are naturally meandering systems and move over time, and there are varying degrees of sinuosity (curviness), depending on the creek. However, in the past, humans have altered creeks and channelized areas, which can be quite detrimental to stream function and health. Only one percent of Becketts Creek was considered channelized.

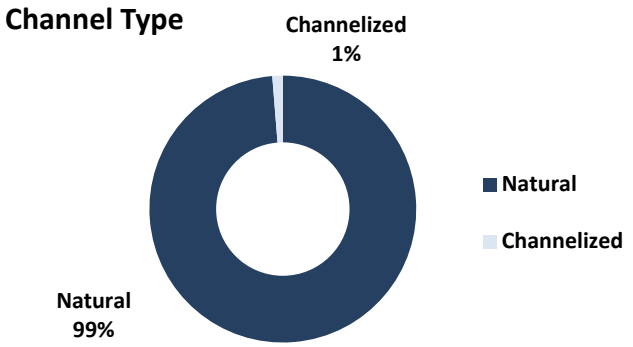



**Figure 4. Channel Type Observed Along Becketts Creek**

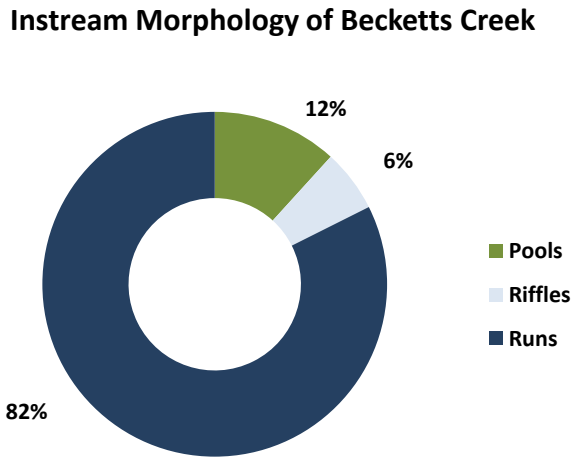



**Figure 5. Instream Morphology of Becketts Creek**

## Instream Morphology

Pools and riffles are important features for fish habitat. Riffles are areas of agitated water, and they contribute higher dissolved oxygen to the stream and act as spawning substrate for some species of fish, such as walleye. Pools provide shelter for fish and can provide refuge in the summer if water levels drop and water temperature in the creek increases. Pools also provide important over-wintering areas for fish. Runs are usually moderately shallow, with unagitated water surfaces, and areas where the thalweg (deepest part of the channel) is in the center of the channel. Becketts Creek is fairly uniform; eighty-two percent consists of runs with 12 percent pools and six percent riffles, illustrated in Figure 5. One of the major riffles along the stream is a series of waterfalls.

## Instream Substrate

Diverse substrate is important for fish and benthic invertebrate habitat because some species will only occupy certain types of substrate and will only reproduce on certain types of substrate. Boulders create instream cover and back eddies for large fish to hide and/or rest out of the current, and cobble provides important over wintering and/or spawning habitat for small or juvenile fish. Other substrates also provide instream habitat for fish and invertebrates. A variety of substrate can be found instream along Becketts Creek, although 58 percent observed was clay. Other types of substrate that occurred in smaller proportions include gravel, sand, cobble, boulder, muck, silt, detritus and bedrock.

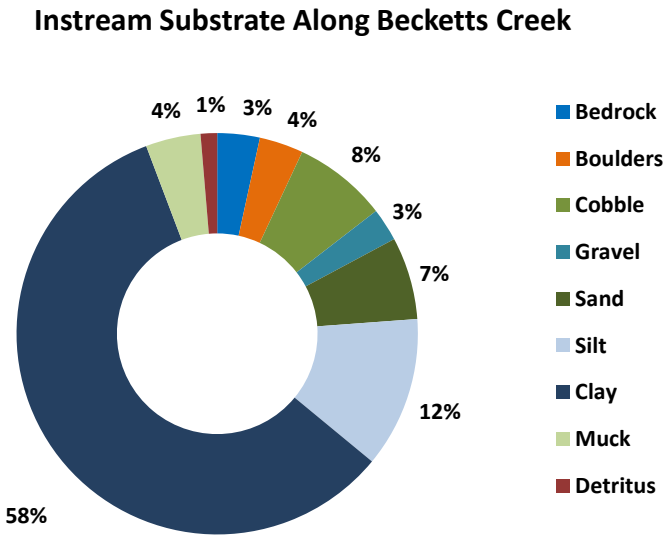



**Figure 6. Types on Instream Substrate Along Becketts Creek**

# Becketts Creek 2011 Summary Report

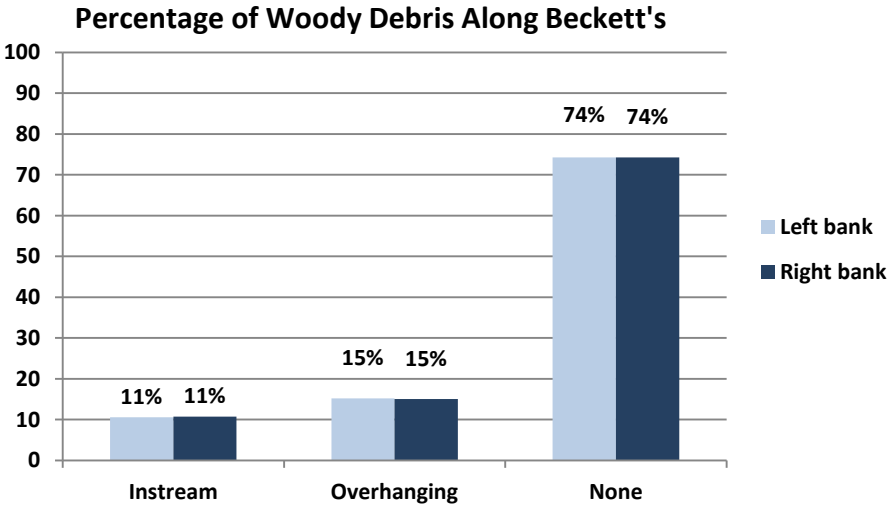



Figure 7. Amount of Woody Debris Observed Along Becketts Creek

Instream woody debris (logs, branches) is important for fish and benthic habitat, by providing refuge and feeding areas. Overhanging branches and trees provide a food source, nutrients and shade. The majority of Becketts Creek has a low percentage of instream woody debris and few overhanging branches and trees. Seventy-four percent of the left bank and right bank have no instream woody debris.

Photo of woody debris in Becketts Creek

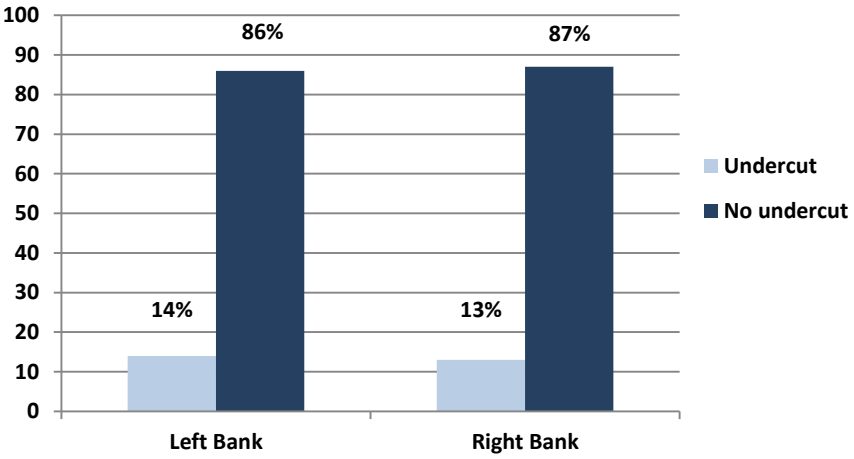



Figure 8. Amount of Undercut Banks Along Becketts Creek

Undercut banks are a normal and natural part of stream function. The overhanging banks provide excellent refuge areas for fish. On Becketts Creek, only 14 percent of the left bank and 13 percent of the right bank was undercut.

Photo of shaded area along Becketts Creek

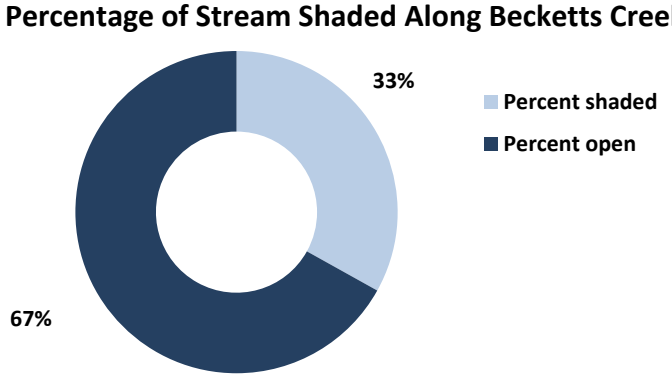



Figure 9. Overall Shading Along Becketts Creek

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. Along Becketts Creek, only 33 percent was shaded. Sixty-seven percent was considered open.

# Becketts Creek 2011 Summary Report

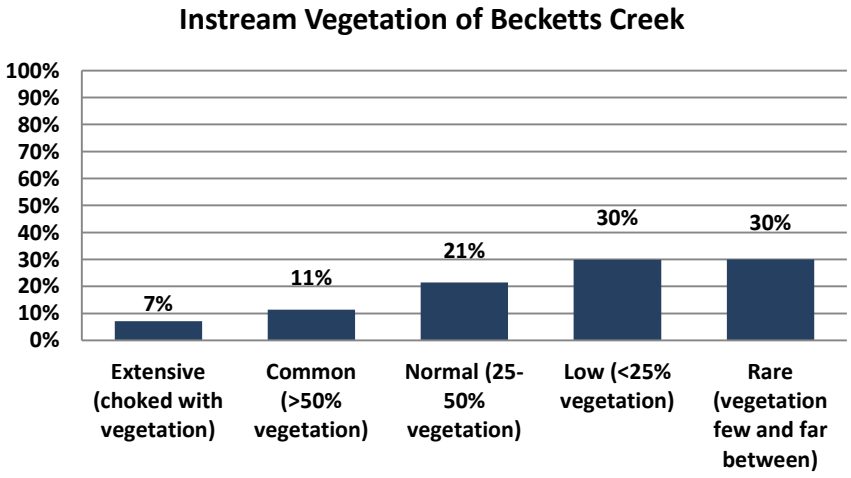



Figure 10. Amount of Instream Vegetation in Becketts Creek

## Amount of Instream Vegetation

Instream vegetation is an important factor for a healthy stream ecosystem. Vegetation helps to remove contaminants from the water, contributes oxygen to the stream, and provides habitat for fish and wildlife. However, too much vegetation can be detrimental. Figure 10 demonstrates the frequency of instream vegetation in Becketts Creek. Becketts Creek did not have a healthy level or variety of instream vegetation for most of its length; only 32 percent was considered to have common or normal levels, and in these areas. Sixty percent of the stream was considered to have low or rare levels and seven percent of the surveyed areas had extensive levels (choked with vegetation). Over 50 percent of the instream substrate was clay, in which it would be difficult for instream vegetation to grow. In addition, flashy water level fluctuations could make it challenging for instream vegetation to establish itself.

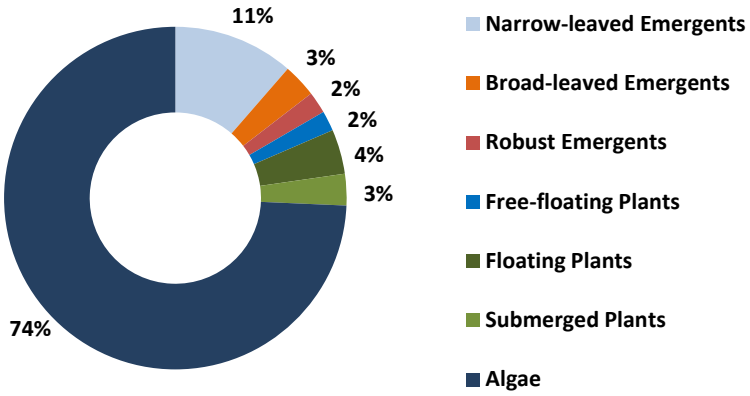



Figure 11. Types of Instream Vegetation in Becketts Creek

## Types of Instream Vegetation

The majority of Becketts Creek did not have a healthy diversity of instream vegetation. Seventy-four percent of sections surveyed consisted of algae. Narrow-leaved emergents made up 11 percent of the vegetation, and other types, such as broad-leaved, robust, free-floating, floating and submergent accounted for the remaining 14 percent.

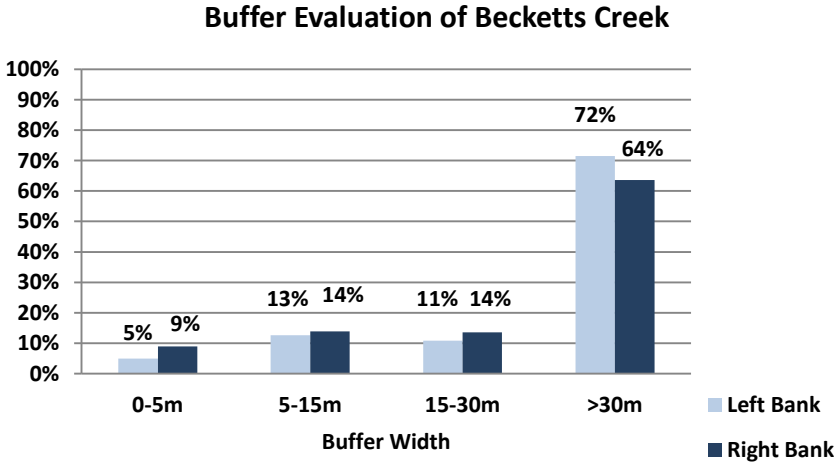



Figure 12. Buffer Evaluation of Becketts Creek

## Buffer Evaluation

Natural buffers between watercourses and human alterations are extremely important for filtering excess nutrients running into the creek, infiltrating rainwater, maintaining bank stability and providing wildlife habitat. Natural shorelines also shade the creek, helping maintain baseflow levels and keeping water temperatures cool. According to the document *How Much Habitat Is Enough* (Environment Canada, 2004), it is recommended that a stream have a minimum of 30 metres of riparian area or more (the more the better). Figure 12 demonstrates the buffer conditions of the left and right banks separately. Along Becketts Creek, five to nine percent had a buffer of zero to five metres and 13 to 14 percent had a buffer of 5 to 15 metres. Eleven to 14 percent had a buffer of 15 to 30 metres. Over 60 percent of the buffer on Becketts Creek meets the recommendations from the Environment Canada document.

# Becketts Creek 2011 Summary Report

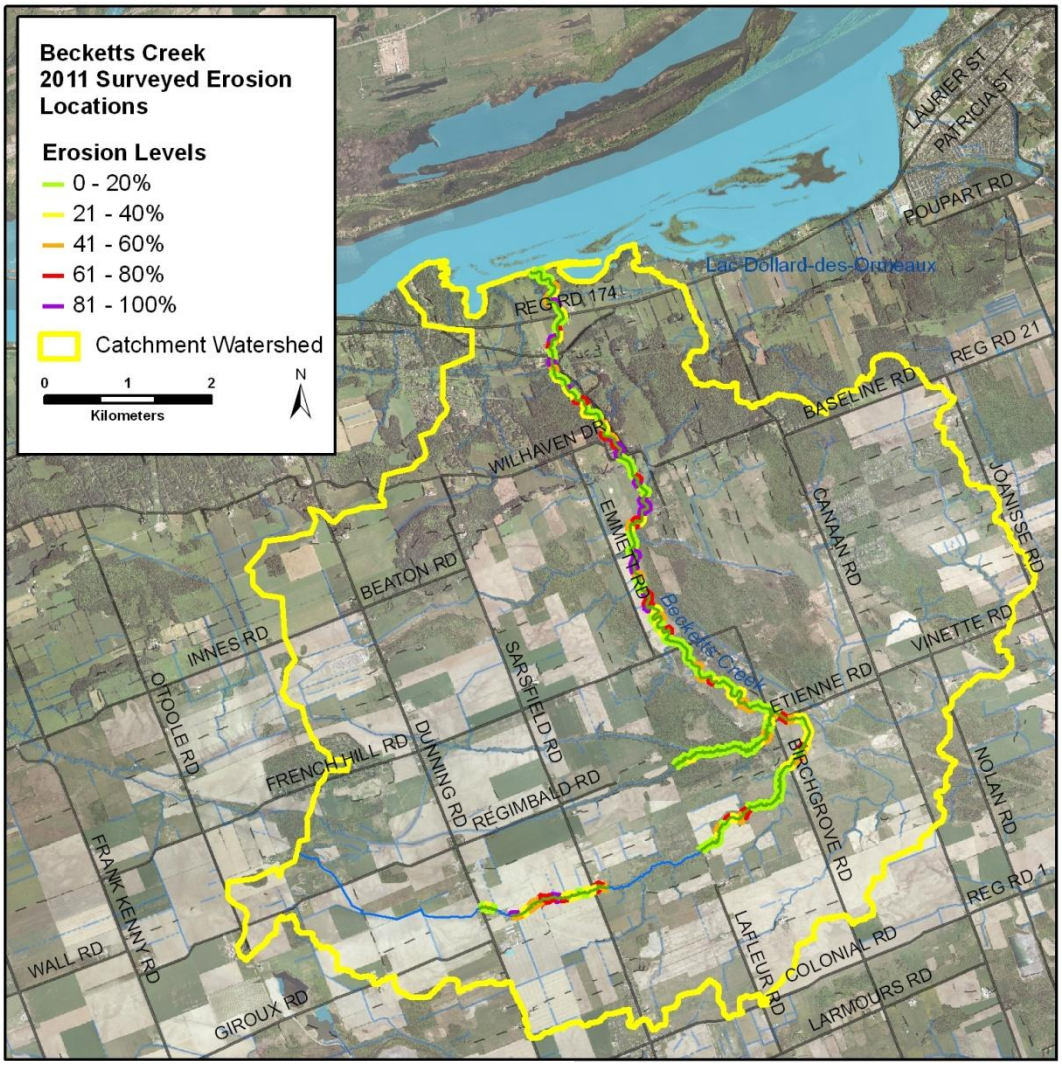



**Figure 13. Left and Right Bank Stability of Becketts Creek**

## Erosion

Erosion is a normal, important stream process and may not affect actual bank stability; however, excessive erosion and deposition of sediment within a stream can have detrimental effects to important fish and wildlife habitat. Bank stability indicates how much soil has eroded from the bank into the stream. Poor bank stability can greatly contribute to the amount of sediment carried in a waterbody as well as loss of bank vegetation due to bank failure, resulting in trees falling into the stream and the removal of aquatic plants, which provide habitat. City Stream Watch recorded bank stability separately for left and right banks to obtain greater detail on the areas experiencing erosion. For Becketts Creek, stability was the same for both banks, although areas of erosion differed. Figure 13 shows the areas of erosion along Becketts Creek. Sixty-six percent was considered stable and thirty-three percent considered stable.

## Wildlife

The diversity of fish and wildlife populations can be an indicator of water quality and overall stream health. Table 1 is a summary of all wildlife observed during stream surveys.

| Wildlife | Observed |
|---|---|
| **Birds** | terns, killdeer, sandpiper spp., red-winged blackbirds, ducks, orioles, robins, great blue heron, mallards, grey catbird, crow, goldfinch, alder flycatcher, hawk, Canada geese, belted kingfisher, pileated woodpecker, chickadees, grackle, bluejay, mourning dove, wild turkeys, white-throated sparrow, hummingbird, warbler, song sparrow, green herons, nuthatch, turkey vultures, hairy woodpecker |
| **Mammals** | muskrat, chipmunk, deer tracks, mice, raccoon tracks, squirrels, beavers, vole, river otter, animal slides/paths, rat, red squirrel |
| **Reptiles/Amphibians** | turtle, leopard frog, green frog, bullfrog, tadpoles, American toad, painted turtle, wood frog, Eastern red slider (exotic species) |
| **Aquatic Insects** | whirlygig beetles, waterboatmen, waterstriders, caddisflies, nematodes, gastropods, oligichaeta, crayfish, *hemipteran spp., coleoptera spp,* isopods, mayflies |
| **Other** | cabbage whites, mosquitoes, clam shells, Eastern tiger swallowtails, horseflies, deerflies, ebony jewelwings, damselflies, dragonflies, bumblebees, ladybugs, leeches, spiders, cicada, crickets, centipedes, caterpillars, hornets, assassin bug, wasps, argiope spiders |

**Table 1. Wildlife Observed Along Becketts Creek**

# Becketts Creek 2011 Summary Report

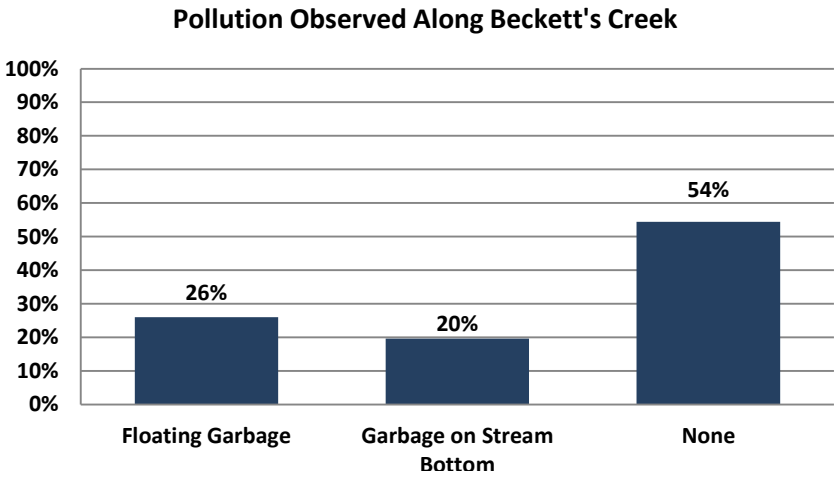



**Figure 14. Frequency of Pollution/Garbage Occurring in Becketts Creek**

## Pollution/Garbage

Figure 14 demonstrates the incidence of pollution/garbage in Becketts Creek. Pollution and garbage in the stream is assessed visually and noted for each section where it is observed. Fifty-four percent of sections surveyed did not have any garbage. Twenty-six percent had floating garbage and 20 percent had garbage on the stream bottom, although it was not observed in large quantities. No observations of oil and gas trails or unusual colouration of the channel were made. The most common type of garbage observed were plastic items (wrappers, cups, bottles, etc.). Other types of garbage observed included tires, metal rebar, styrofoam, aluminum cans, glass, plywood, garbage can, shovel, pool, CD packaging, asphalt, car, cardboard, copper wire, buckets, propane tanks, paint cans, old oil drums, aluminum siding, appliances, beach balls, bicycle, sled, plastic sheeting and tarps.

## Invasive Species

Invasive species can have major impacts on streams and species diversity. Invasive species are one of the largest threats to ecosystems throughout Ontario and can outcompete native species, having negative effects on local wildlife, fish and plant populations. Costs to control and mitigate damage from invasive species can be quite high; it is estimated that spending from 16 invasive species amounts to between $13.3 and $34.5 billion (Government of Canada, 2004), and over 180 non-native species have been found in the Great Lakes area, with a new species arriving in the Great Lakes on average of every six to nine months (Government of Canada, 1999). These species originate from other countries and are introduced through global shipping containers, ship ballast water, pet trades, aquarium and horticultural activities, the live bait industry, recreational boats, fishing gear and more (OMNR, 2008). In Becketts Creek, invasive species were observed in 82 percent of the surveyed sections, and often more than one species was present in the same area. The five species observed were purple loosestrife (*Lythrum salicaria*), Manitoba maple (*Acer negundo*), garlic mustard (*Alliaria petiolata*), wild parsnip (*Pastinaca sativa*) and flowering rush (*Butomus umbellatus*). Out of the five species, garlic mustard and flowering rush are of greatest concern. Garlic mustard interferes with the relationship between tree roots and the soil, affecting the growth of the trees, making it problematic in natural areas. It spreads aggressively and needs constant pulling for several years in order to control. Flowering rush will spread rapidly and can form dense colonies, outcompeting other native aquatic plants.

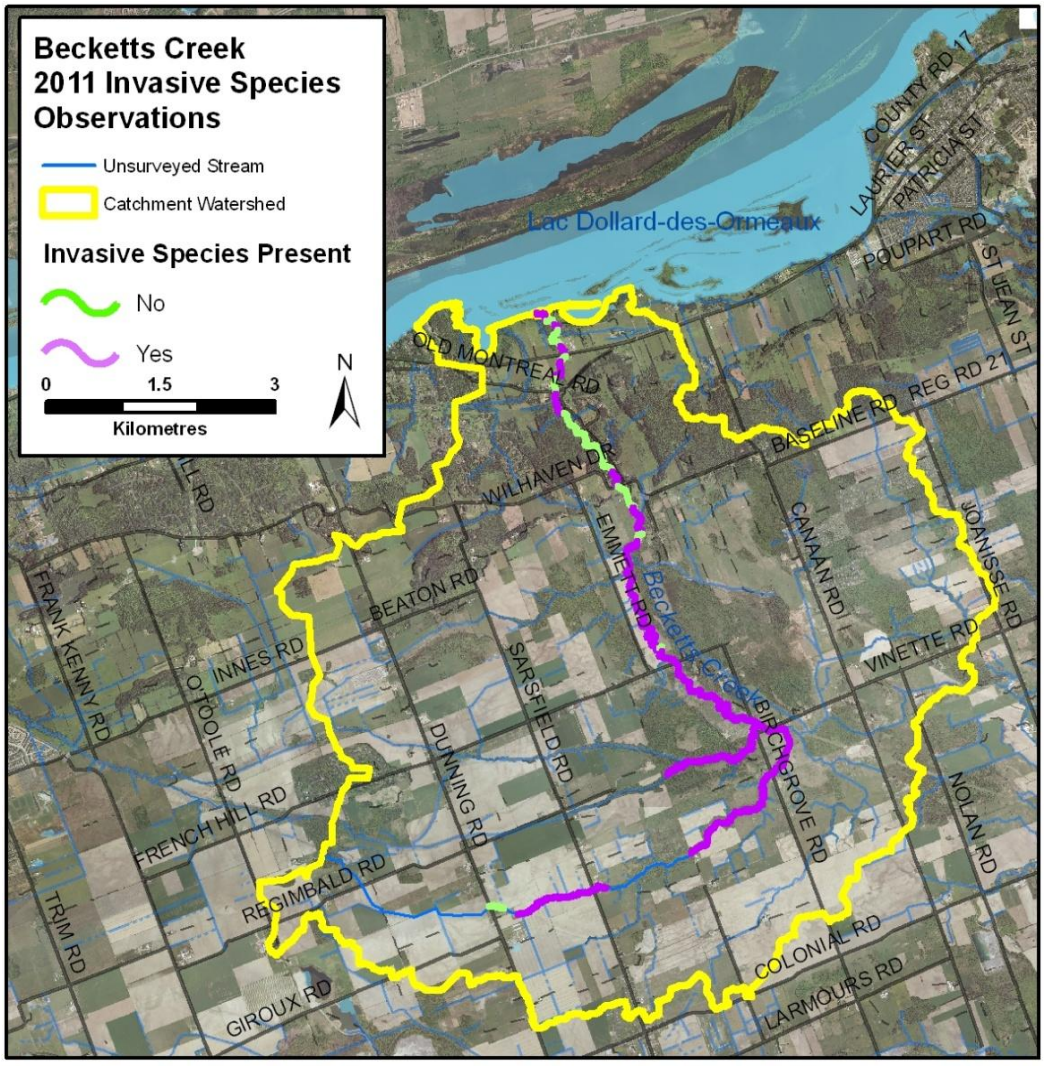



**Figure 15. Locations of Invasive Species Along Surveyed Sections of Becketts Creek**

# Becketts Creek 2011 Summary Report

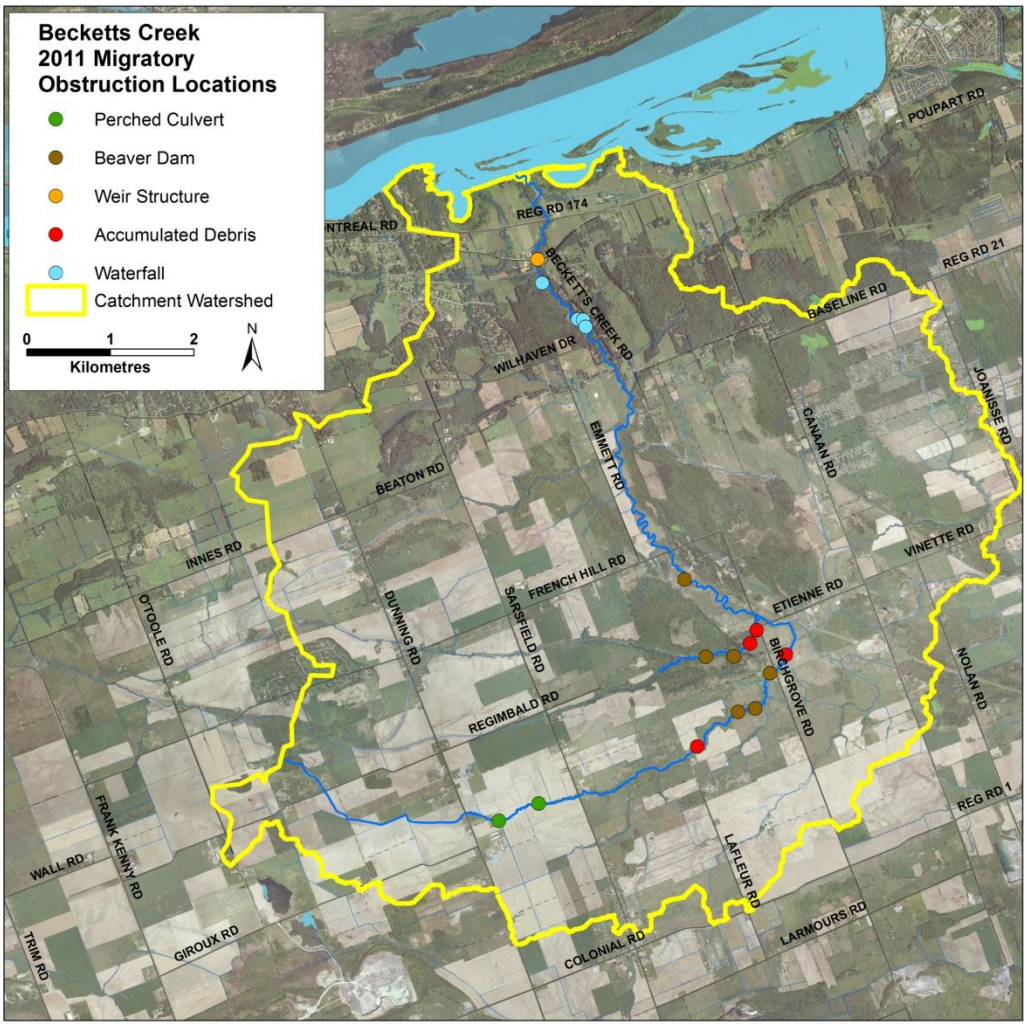



**Figure 16. Location of Migratory Obstructions to Fish Passage Along Becketts Creek**

## Migratory Obstructions

It is important to know locations of migratory obstructions because these can prevent fish from accessing important spawning and rearing habitat. Migratory obstructions can be natural or manmade, and they can be permanent or seasonal. Several migratory obstructions to fish passage were observed along Becketts Creek. There are a series of waterfalls located upstream of Old Montreal Road. These are natural barriers that fish would not be able pass over. Other migratory obstructions include one weir (under Old Montreal Road), four beaver dams, two perched culverts and 11 locations of accumulated woody debris. Often, woody debris floating downstream can get caught on fallen trees or branches and build up, possibly creating a seasonal migration barrier. The water levels in 2011 were extremely low, and the accumulated debris may not have been an obstruction in other years with normal water levels. In some sections, low water levels created barriers but are not included on the map because this was due to low water conditions.

## Thermal Classification

Temperature is an important parameter in streams as it influences many aspects of physical, chemical and biological health. Many factors can influence fluctuations in stream temperature such as:

- Springs (groundwater and surface water interaction)
- Tributaries
- Precipitation runoff
- Discharge pipes
- Stream shading from riparian vegetation

The greatest factor of fluctuating temperature is solar radiation and runoff from developed areas. Typically, streams with large amounts of riparian canopy cover will yield lower temperatures while areas with no trees may be warmer. The method for temperature classification is taken from Stoneman and Jones, which is an accepted method by both Ministry of Natural Resources and Department of Fisheries and Oceans for assigning thermal classification. Classification is based on temperature data for each stream, taken at 4:00pm, anywhere between July 1 and August 31, on days where maximum air temperature exceeds 24.5°C and the previous two or three days have had similar temperatures. Although dataloggers are set to record temperatures between April and October, only the days that meet the temperature requirements are used in classification. The water temperature is used along with the maximum temperature of those days to classify as warmwater, coolwater or cold water.

Another important methodology of temperature classification is through fish community data. Fish have different temperature requirements, and these are also considered when classifying the stream. For example, if a species is recorded in a stream that requires cold water, there could be cold water inputs influencing that stream, at that location.

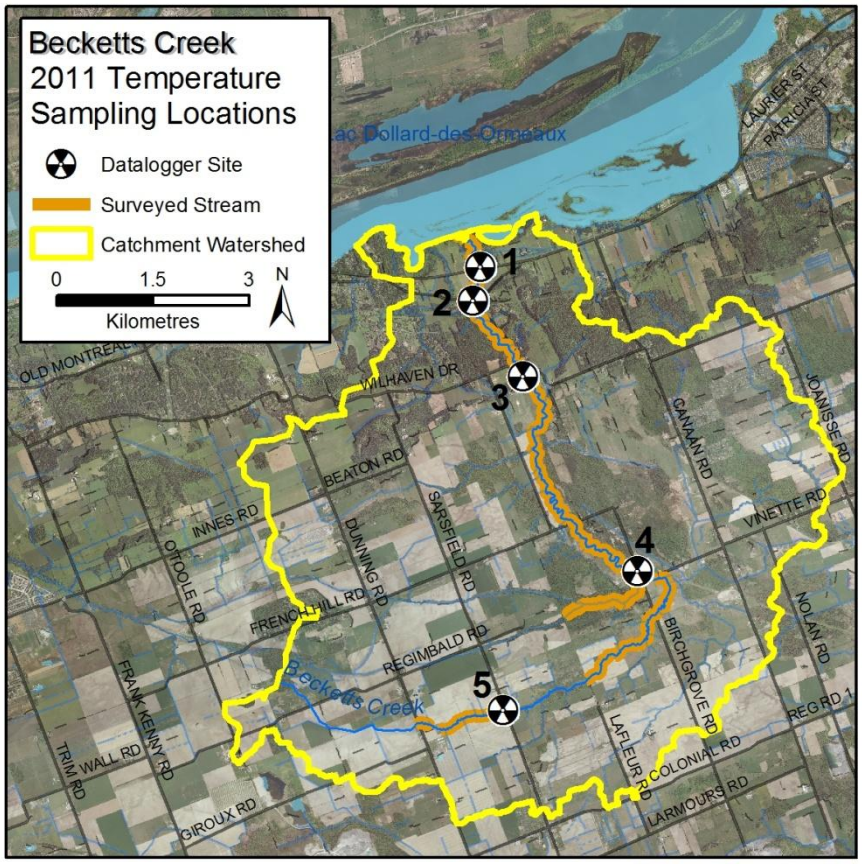



Figure 17. Temperature Datalogger Locations Along Becketts Creek

Five temperature dataloggers were deployed in Becketts Creek to give a representative sample of how temperature fluctuates and differs along the stream. The dataloggers were installed in April and retrieved in late September. Dataloggers are either secured to blocks on the bottom of a stream or attached to rebar secured to the bottom. The datalogger at site five was missing, but the other four were retrieved.

**RVCA staff installing a temperature probe on Becketts**

When analyzed on the nomograph (figure 18), it appears that Becketts Creek is a warmwater system. All temperature dataloggers were within that range, aside from datalogger 4 on one day.

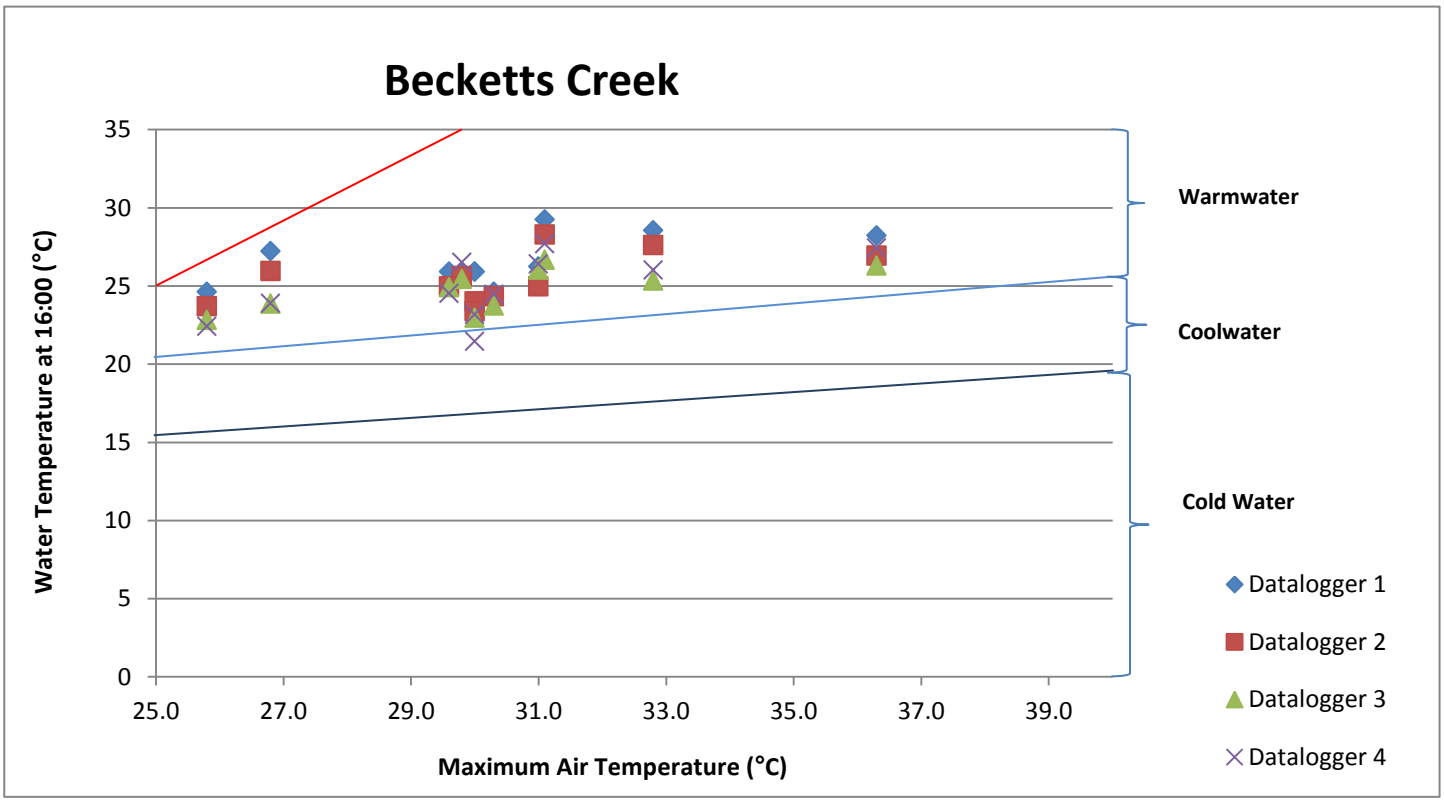



Figure 18. Temperature Data from Becketts Creek

# Becketts Creek 2011 Summary Report

| Month | Range | DO (mg/L) | DO (%) | Conductivity (µs/cm) | pH |
|---|---|---|---|---|---|
| May | low | 7.15 | 76 | 275 | 7.63 |
| | high | 10.3 | 95 | 573 | 8.5 |
| June | low | 7.65 | 85 | 322 | 7.89 |
| | high | 10.52 | 102 | 603 | 8.43 |
| July | low | 3.14 | 38 | 322 | 7.66 |
| | high | 12.69 | 145 | 792 | 8.2 |
| August | low | 3.18 | 33 | 603 | 7.81 |
| | high | 11.62 | 133 | 890 | 8.5 |

**Table 2. Maximum and minimum Levels of Dissolved Oxygen, Conductivity and pH in Becketts Creek during 2011 surveys**

## Water Chemistry

During surveys, a YSI probe was used to collect values on dissolved oxygen, conductivity and pH. In 2011, RVCA issued a Level 1 Drought for the watershed, beginning September 26, 2011 and ending January 10, 2012. Low water levels were observed during monitoring. Drought conditions would have had an effect on the parameters below. The 2011 data is summarized in Table 2.

**Dissolved Oxygen**: A measure of the amount of oxygen dissolved into a medium, such as water. The lowest acceptable concentration of dissolved oxygen is 6.0 mg/L for early stages of warmwater fish and 9.5mg/L for cold water fish (CCME, 1999). A saturation value of 90% or above is considered healthy (WOW, 2004).

**Conductivity:** The ability of a substance to transfer electricity. This measure is influenced by the presence of dissolved salts and other ions in the stream.

**pH**: A measure of relative acidity or alkalinity, ranging from 1 (most acidic) to 14 (most alkaline/basic) , with 7 occupying a neutral point.

## Fish Sampling

A total of eleven sites between the mouth and the headwaters of Becketts Creek were sampled for fish between May and July. The two sites near the confluence of the Ottawa River were sampled once for a five day period in June using large fyke nets. The other eight sites were sampled one to three times between May and July, using a variety of sampling equipment, including windemere traps, a seine net and an electrofisher. The fish sampling sites are shown in Figures 19, 20 and 21. Habitat and spawning information on the species captured are listed in Table 3.

### Species Legend

BlCra - black crappie
Blueg - bluegill
BnMin - bluntnose minnow
BrBul - brown bullhead
BrSti - brook stickleback
CA_MI - *Cyrpinid spp.*
CoCar - common carp
Coshi - common shiner
CrChu - creek chub
GoShi - golden shiner
Logpe - logperch
NoPik - Northern pike
Pumpk - pumpkinseed
RhiSp - *Rhinichthys spp.*
RoBas - rock bass
ShRed - shorthead redhorse
SiRed - silver redhorse
TaMad - tadpole madtom
Walle - walleye
WhSuc - white sucker
YeBul - yellow bullhead
YePer - yellow perch

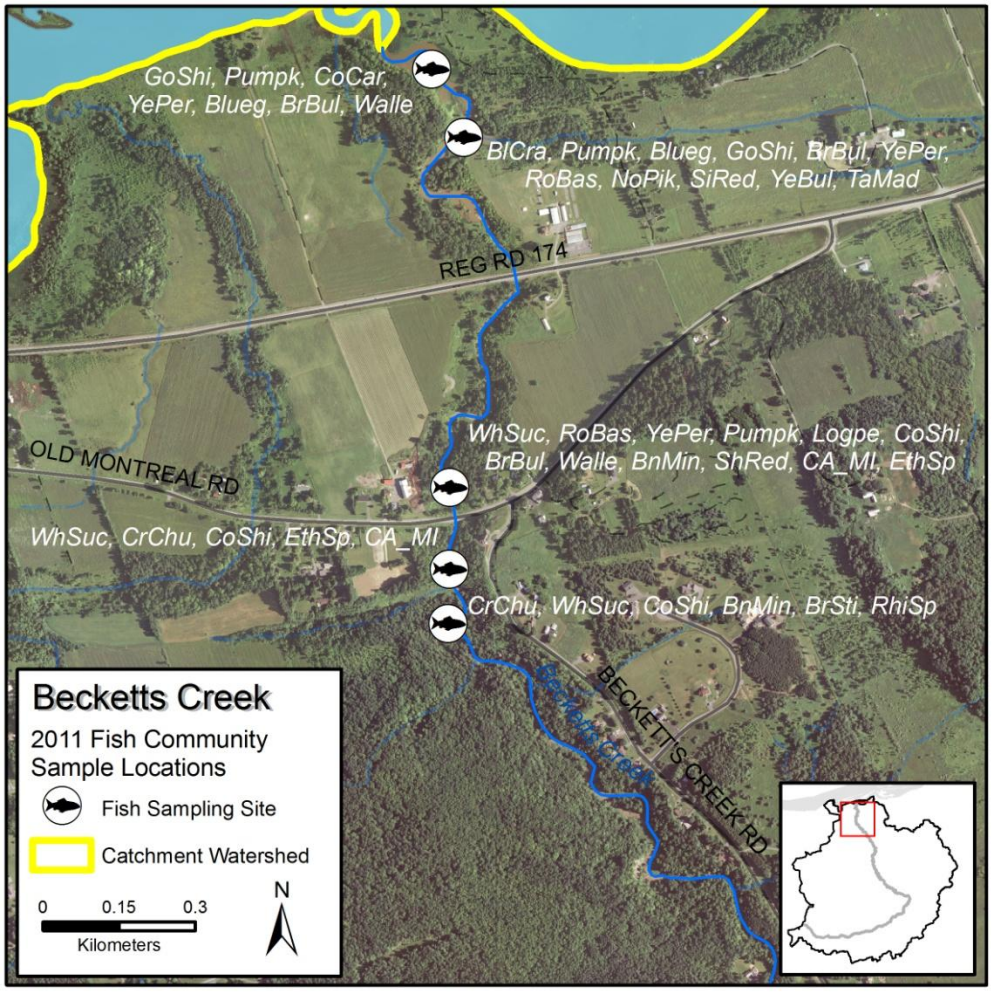
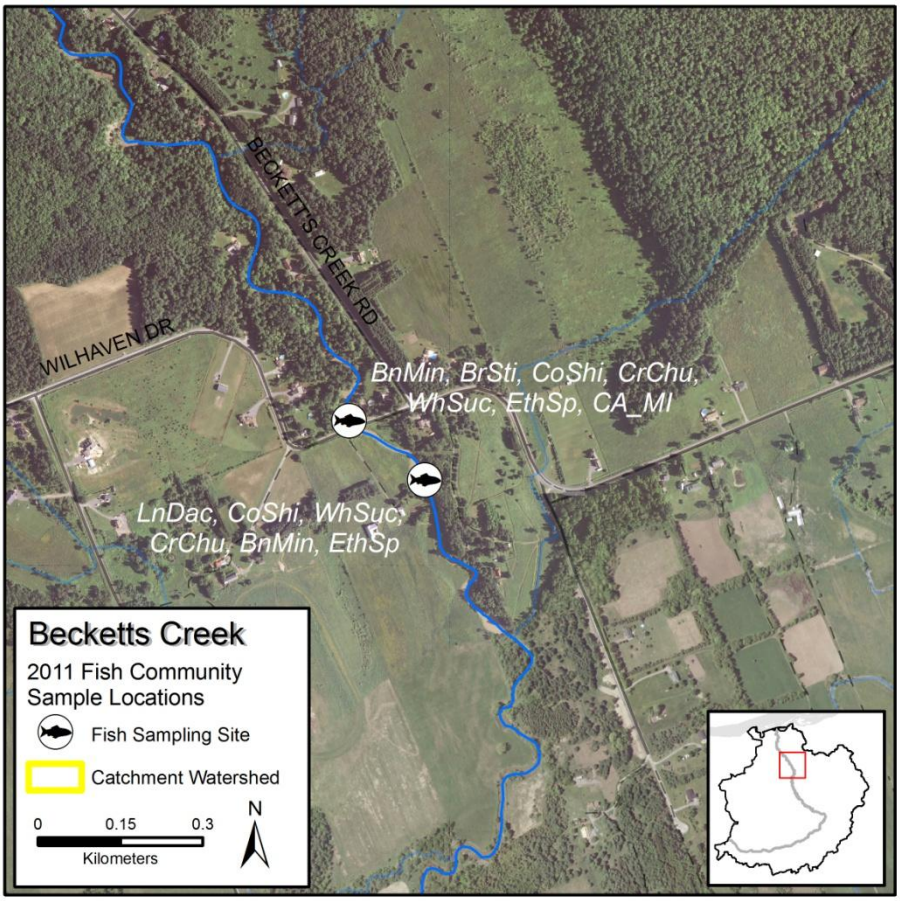
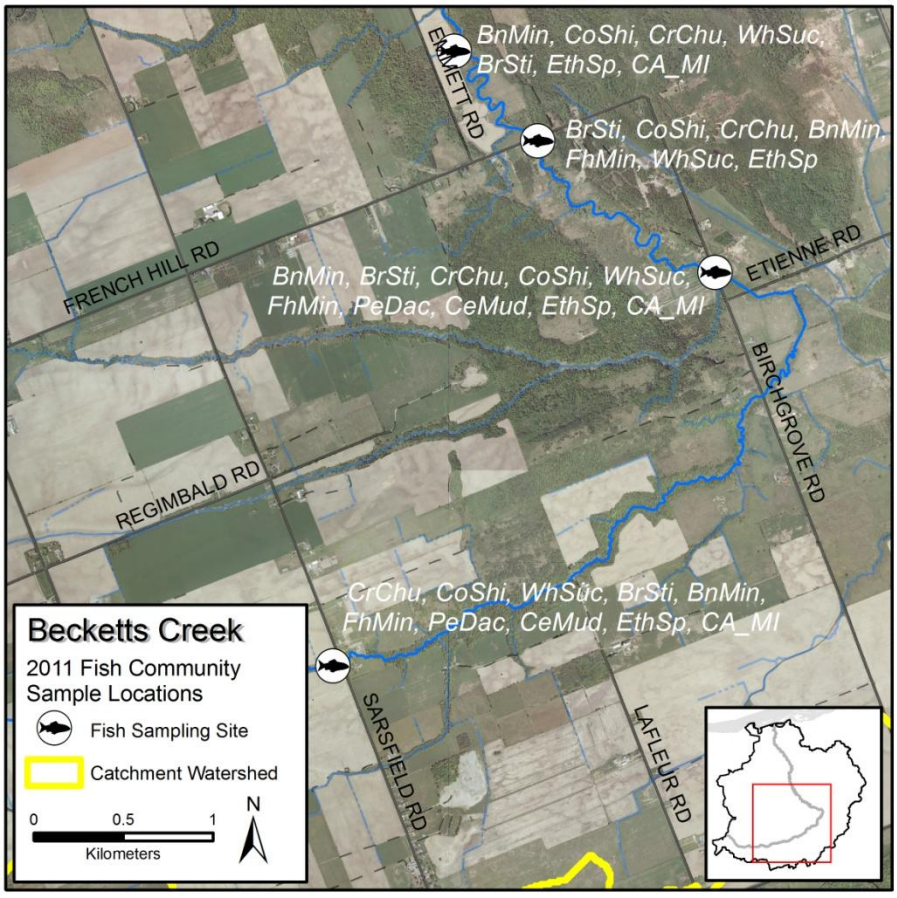



**Figure 19. Locations and of Fish Sampling and Species Recorded on Becketts Creek**

# Becketts Creek 2011 Summary Report




**Figures 20 &21. Locations and of Fish Sampling and Species Recorded on Becketts Creek**

### Species Legend

BnMin - bluntnose minnow
BrSti - brook stickleback
CA_MI - *Cyrpinid spp.*
CeMud - central mudminnow
Coshi - common shiner
CrChu - creek chub
EthSp - *Etheostoma spp.*
FhMin - fathead minnow
LnDac - longnose dace
PeDac - pearl dace
WhSuc - white sucker

## Fish Community Summary

A total of twenty-seven different fish species were collected. All fish were live released back to the stream after fish sampling. *Etheostoma spp.* indicates that either Johnny darters or tessellated darters were captured. To differentiate between those species, the fish must be removed from the system and brought back to lab; to avoid this, they are only identified to genus level. Minnow species that were caught but too small to identify are classified as *Cyprinid spp*. One dace species was captured that was too small to identify between blacknose and longnose dace, and is labeled *Rhinichthys spp*. Eight volunteers spent a total of 42 hours fish sampling on Becketts Creek.

**Volunteers and CSW staff bringing in the seine net**

# Becketts Creek 2011 Summary Report

| Species Name | Latin Name | General Habitat | Spawning Period | Spawning Temp (°C) |
|---|---|---|---|---|
| black crappie | *Pomoxis nigromaculatus* | bays, ponds, lakes or calm rivers with abundant aquatic vegetation | spring | 16-26 |
| bluegill | *Lepomis macrochirus* | ponds, lakes or calm rivers and streams with heavy aquatic vegetation | spring | 19-27 |
| bluntnose minnow | *Pimephales notatus* | bottoms of shallow lakes or ponds or gravelly streams with little aquatic vegetation | spring | 20-28 |
| brook stickleback | *Culaea inconstans* | spring-fed ponds or cold streams with heavy aquatic vegetation or wetland areas of lakes | spring | 8-19 |
| brown bullhead | *Ameiurus nebulosus* | bottom of shallow, warmwater bays, lakes or ponds and larger slow-moving rivers with abundant aquatic vegetation | late spring/ early summer | 14-29 |
| central mudminnow | *Umbra limi* | ponds or pools in streams with heavy aquatic vegetation and organic substrate | spring | ~13 |
| common carp | *Cyprinus carpio* | shallow, calm, warm rivers or lakes with heavy aquatic vegetation | spring | 17-28 |
| common shiner | *Luxilus comutus* | prefers streams or shorelines of clear lakes | spring | 14-28 |
| creek chub | *Semotilus atromaculatus* | prefers small creeks or shorelines of small lakes | spring | 13-27 |
| fathead minnow | *Pimephales promelas* | calm ponds or flowing streams | spring | 16-29 |
| golden shiner | *Notemigonus crysoleucas* | clear, still areas in shallower, larger watercourses with abundant aquatic vegetation | spring | 20-27 |
| logperch | *Percina caprodes* | lakes, rivers or streams with sand, gravel or cobble substrate | late spring/ early summer | 10-15 |
| longnose dace | *Rhinichthys cataractae* | riffle areas of clear, small streams or lakes with gravel or boulder substrate | spring | 11-24 |
| Northern pike | *Esox lucius* | calm, warm rivers or bays with heavy aquatic vegetation | spring | 2-18 |
| pearl dace | *Margariscus margarita* | beaver ponds or cool headwater creeks, ponds or small lakes | spring | 17-18 |
| pumpkinseed | *Lepomis gibbosus* | bays, lakes, ponds or calm streams with abundant submergent vegetation | spring to summer | 13-29 |
| rock bass | *Ambloplites rupestris* | rocky areas of shorelines along lakes or warm water reaches of streams | May to July | 14-24 |
| shorthead redhorse | *Moxostoma macrolepidotum* | shallower, clear lakes or rivers with sand or gravel bottom | spring | 11-21 |
| silver redhorse | *Moxostoma anisurum* | lakes but prefers calm streams with large, deep pools | spring | 13 |
| tadpole madtom | *Noturus gyrinus* | calm, clear ponds, streams, shallow lakes with soft bottoms and heavy aquatic vegetation | spring/ summer | n/a |
| walleye | *Sander vitreus* | shallow, large lakes or turbid rivers or creeks with some type of instream structure (logs, vegetation) | spring | 4-12 |
| white sucker | *Catostomus commersonii* | warmer, shallow bays, lakes or large tributaries | spring | 6-23 |
| yellow bullhead | *Ameiurus natalis* | slow-moving streams or shallow, clear bays of lakes or ponds with heavy aquatic vegetation | spring | n/a |
| yellow perch | *Perca flavescens* | warm or cool ponds, lakes or rivers with moderate levels of aquatic vegetation | spring | 7-22 |

**Table 3. Species List with Habitat and Spawning Requirements for Becketts Creek Fish Community**

## Fish Species Status, Trophic and Reproductive Guilds and Sensitivity to Sediment/Turbidity – Becketts Creek

Table 4 was generated by taking the fish community structure of Becketts Creek and classifying the fishery type, Species at Risk status, thermal classification, trophic guild (feeding preference) and their sensitivity to sediment and turbidity for reproduction, feeding, and respiration. Ten game fish species were captured between sites one and three. Upstream of site five is a significant waterfall, am gamefish would not be able to migrate past this. According to Cudmore-Vokey and Minns (2002), most species within Becketts Creek are significant to the baitfish fisheries aside from ten species that are significant to the recreational industry and two that are significant to the commercial industry. The fish community structure consists of 12 cool water species, eight warm water species and four cool/warm species. No species at risk fish were captured. All species captured in Becketts Creek had low to medium sensitivity to turbidity for reproduction. Most species had a low to medium sensitivity to turbidity for feeding, aside from black crappie, Northern pike, rock bass, walleye and yellow perch, that have a high sensitivity. For respiration, most species had high or unknown sensitivity to turbidity except for brown bullhead, central mudminnow, golden shiner and Northern pike.

| MNR Code | Common Name | Scientific Name | Fishery Type | Status | Thermal Class | Trophic Guild | Sensitivity to Sediment/Turbidity | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Reproduction | Feeding | Respiration |
| 319 | black crappie | *Pomoxis nigromaculatus* | recreational | none | cool | Insectivore/ piscivore | L | H | unknown |
| 314 | bluegill | *Lepomis macrochirus* | recreational | none | cool/ warm | insectivore | L | M | unknown |
| 208 | bluntnose minnow | *Pimephales notatus* | bait | none | warm | omnivore | L | M | unknown |
| 281 | brook stickleback | *Culaea inconstans* | bait | none | cool | insectivore | L | M | unknown |
| 233 | brown bullhead | *Ameiurus nebulosus* | recreational/ limited commercial | none | warm | insectivore | L | L | L |
| 141 | central mudminnow | *Umbra limi* | bait | none | cool/ warm | insectivore/ omnivore | M | M | L |
| 186 | common carp | *Cyprinus carpio* | recreational | none | warm | omnivore | M | L | unknown |
| 198 | common shiner | *Luxilus comutus* | bait | none | cool | insectivore | M | M | unknown |
| 212 | creek chub | *Semotilus atromaculatus* | bait | none | cool | insectivore/ generalist | M | M | H |
| 209 | fathead minnow | *Pimephales promelas* | bait | none | warm | omnivore | L | L | unknown |
| 194 | golden shiner | *Notemigonus crysoleucas* | bait | none | cool/ warm | omnivore | M | M | L |
| 342 | logperch | *Percina caprodes* | bait | none | cool | insectivore | M | M | H |
| 211 | longnose dace | *Rhinichthys cataractae* | bait | none | cool | insectivore | M | M | H |
| 131 | Northern pike | *Esox Lucius* | recreational | none | cool | piscivore | M | H | L |
| 214 | pearl dace | *Margariscus margarita* | bait | none | cool | insectivore | M | M | H |
| 313 | pumpkinseed | *Lepomis gibbosus* | recreational | none | cool/ warm | insectivore | L | M | unknown |
| 311 | rock bass | *Ambloplites rupestris* | recreational | none | warm | insectivore | L | H | unknown |

| MNR Code | Common Name | Scientific Name | Fishery Type | Status | Thermal Class | Trophic Guild | Sensitivity to Sediment/Turbidity | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Reproduction | Feeding | Respiration |
| 171 | shorthead redhorse | *Moxostoma macrolepidotum* | | none | cool | insectivore | M | L | H |
| 168 | silver redhorse | *Moxostoma anisurum* | | none | warm | insectivore | M | L | H |
| 236 | tadpole madtom | *Noturus gyrinus* | limited recreational | none | warm | insectivore | M | L | unknown |
| 334 | walleye | *Sander vitreus* | recreational/ commercial | none | cool | piscivore | M | H | H |
| 163 | white sucker | *Catostomus commersonii* | | none | cool | insectivore/ omnivore | M | L | H |
| 232 | yellow bullhead | *Ameiurus natalis* | recreational | none | warm | insectivore | L | L | unknown |
| 331 | yellow perch | *Perca flavescens* | recreational | none | cool | insectivore/ piscivore | M | H | unknown |

**Table 4. Summary of Status, Sensitivity and Classification for Fish Community in Becketts Creek**

**Large fyke net set at the mouth of Becketts Creek**

**Juvenile shorthead redhorse**

## Comparison of Becketts Creek Between 2006 and 2011

The following tables provide a comparison of Becketts Creek between the 2006 and 2011 survey years. Different sections were surveyed in 2011 and 2006; therefore, a comparison has only been made for the applicable sections.

| Anthropogenic Alterations | 2006 | 2011 |
|---|---|---|
| None | 77 | 55 |
| "Natural" conditions with minor human alterations | 19 | 13 |
| "Altered" with considerable human impact but significant natural portions | 3 | 19 |
| "Highly altered" by humans with few natural portions | 2 | 13 |

**Table 5. Comparison of Anthropogenic Alterations Between 2006 and 2011**

Between 2006 and 2011, anthropogenic alterations along Becketts Creek have increased. Part of the change is likely related to a difference in the macro stream protocol used. In 2010, anthropogenic alterations were further defined, which would have caused some land uses to shift categories. Most of the alterations along Becketts Creek can be attributed to its reduced buffer between the creek and human influence, which occurs in many areas that were surveyed. Other areas classified as altered include road crossings, shoreline armouring and tile drains. During 2011 surveys, active buffer removals in some areas were observed.

# Becketts Creek 2011 Summary Report

| Bank Stability | 2006 (%) | 2011 (%) |
|---|---|---|
| Stable | 57 | 66LB, 65RB |
| Unstable | 43 | 34LB, 35RB |

**Table 6. Comparison of Bank Stability Between 2006 and 2011**

Stability along Becketts Creek has improved between 2006 and 2011, although there were still areas where minor and major erosion was observed. In some instances, eroding slopes can slump into the stream, lessening the slope and becoming more stable over time.

| Levels of Instream Vegetation | 2006 | 2011 |
|---|---|---|
| Extensive | 2 | 3 |
| Common | 9 | 10 |
| Normal | 35 | 24 |
| Low | 38 | 34 |
| Rare | 16 | 29 |
| None | n/a | 0 |

**Table 7. Comparison of Instream Vegetation Levels Between 2006 and 2011**

Levels of vegetation have increased slightly in the extensive and common categories and by 13 percent in the rare category. The percentage of vegetation levels in the normal and low categories have decreased. The category "none" was added in 2006, although on all sites surveyed there was some level of vegetation observed.

| Pollution/Garbage | 2006 | 2011 |
|---|---|---|
| None | 66 | 73 |
| Floating garbage | 14 | 13 |
| Garbage on stream bottom | 19 | 15 |
| Oil or gas trails | 0 | 0 |
| Unusual colouration | n/a | 0 |

**Table 8. Comparison of Pollution/Garbage Levels Between 2006 and 2011**

The amount of garbage on Becketts Creek has decreased in the compared areas. In 2006, 66 percent of the sections surveyed were garbage free, and in 2011, it increased by seven percent. In 2006, one percent had oil and gas trails, but it was not in the compared section. In 2011, a lot of garbage occurred outside the compared areas, and therefore, is not reflected in the comparison but is still an issue.

**Photo of yellow perch**

| Fish Species | 2007 | 2011 |
|---|---|---|
| black crappie | | X |
| blacknose dace | X | |
| bluegill | | X |
| bluntnose minnow | X | X |
| brook stickleback | X | X |
| brown bullhead | X | X |
| central mudminnow | X | X |
| common carp | | X |
| common shiner | X | X |
| creek chub | X | X |
| *Cyrpinid spp.* | | X |
| *Etheostoma spp.* | X | X |
| fathead minnow | X | X |
| golden shiner | | X |
| largemouth bass | X | |
| logperch | X | X |
| longnose dace | X | X |
| Northern pike | | X |
| Northern redbelly dace | X | |
| pearl dace | | X |
| pumpkinseed | X | X |
| *Rhinichthys spp.* | | X |
| rock bass | X | X |
| shorthead redhorse | | X |
| silver redhorse | | X |
| tadpole madtom | | X |
| walleye | | X |
| white sucker | X | X |
| yellow bullhead | | X |
| yellow perch | | X |
| **Total** | **16** | **27** |

**Table 9. Comparison of Fish Species Between 2007 and 2011**

# Becketts Creek 2011 Summary Report

Fish sampling was conducted along Becketts Creek in 2007 and 2011. In 2007, two sites were surveyed with a seine net, concentrated at the Old Montreal Road and French Hill road crossings. Sixteen species were caught. In 2011, eleven sites were sampled using a variety of methods (large fyke net, seine net, electrofisher, windemere traps). These sites were spread out between the mouth and the headwaters, and a total of 27 species were captured. The increase in species caught can be contributed to increased sampling effort and a greater variety of sampling equipment, allowing staff to sample all different types of habitat.

**Photo of a tadpole madtom**

The following table highlights past monitoring and restoration efforts that have been carried out in the Becketts Creek subwatershed.

## Highlight of Monitoring and/or Restoration Work

| Year | Accomplishment | Description |
|---|---|---|
| **2006** | 116 macro stream surveys were completed on Becketts Creek by City Stream Watch staff and volunteers. | A total of 101 volunteer hours were spent carrying out stream habitat surveys on Becketts Creek. |
| **2007** | Two sites sampled for fish by City Stream Watch staff and volunteers; a total of 17 fish species were captured. | Seven volunteers spent a total of 21 hours assisting with seine netting. All fish were released live back into the creek. |
| **2011** | 158 macro stream surveys were completed on Becketts Creek by City Stream Watch staff and volunteers | 31 volunteers spent a total of 254.5 hours carrying out stream habitat surveys on Becketts Creek and a branch of Becketts Creek. |
| **2011** | 11 sites along Becketts Creek were sampled by City Stream Watch staff and volunteers; a total of 25 fish species were captured. | 8 volunteers spent a total of 42 hours assisting with seine netting. All fish were released live back into the creek. |
| **ongoing** | RVCA Stewardship projects. | Three Rural Clean Water projects have been carried out in the Becketts Creek subwatershed. |

**Table 10. Monitoring and Restoration Highlights in the Becketts Creek subwatershed**

**Left photo: a bioengineering and buffer enhancement opportunity, right photo: a car sunk in Becketts Creek**

Based on data collected by City Stream Watch staff and volunteers, a variety of projects have been identified along Becketts Creek to help improve environmental conditions. Figure 22 illustrates the potential instream projects, and Figure 23 illustrates the potential shoreline restoration projects. Table 11 summarizes the numbers and details of the projects identified on both maps.

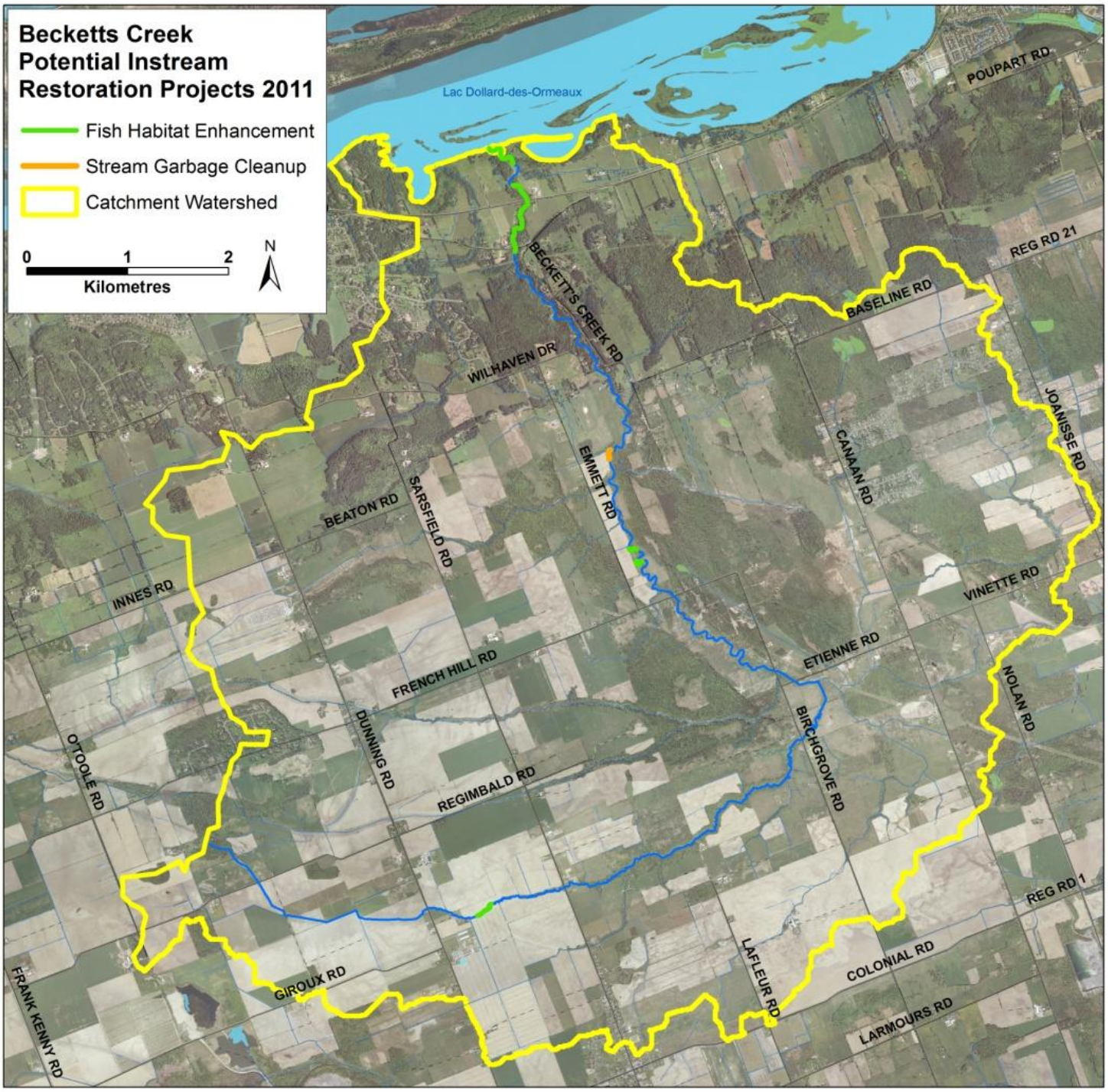



**Figure 22. Map of Potential Instream Projects Along Becketts Creek**

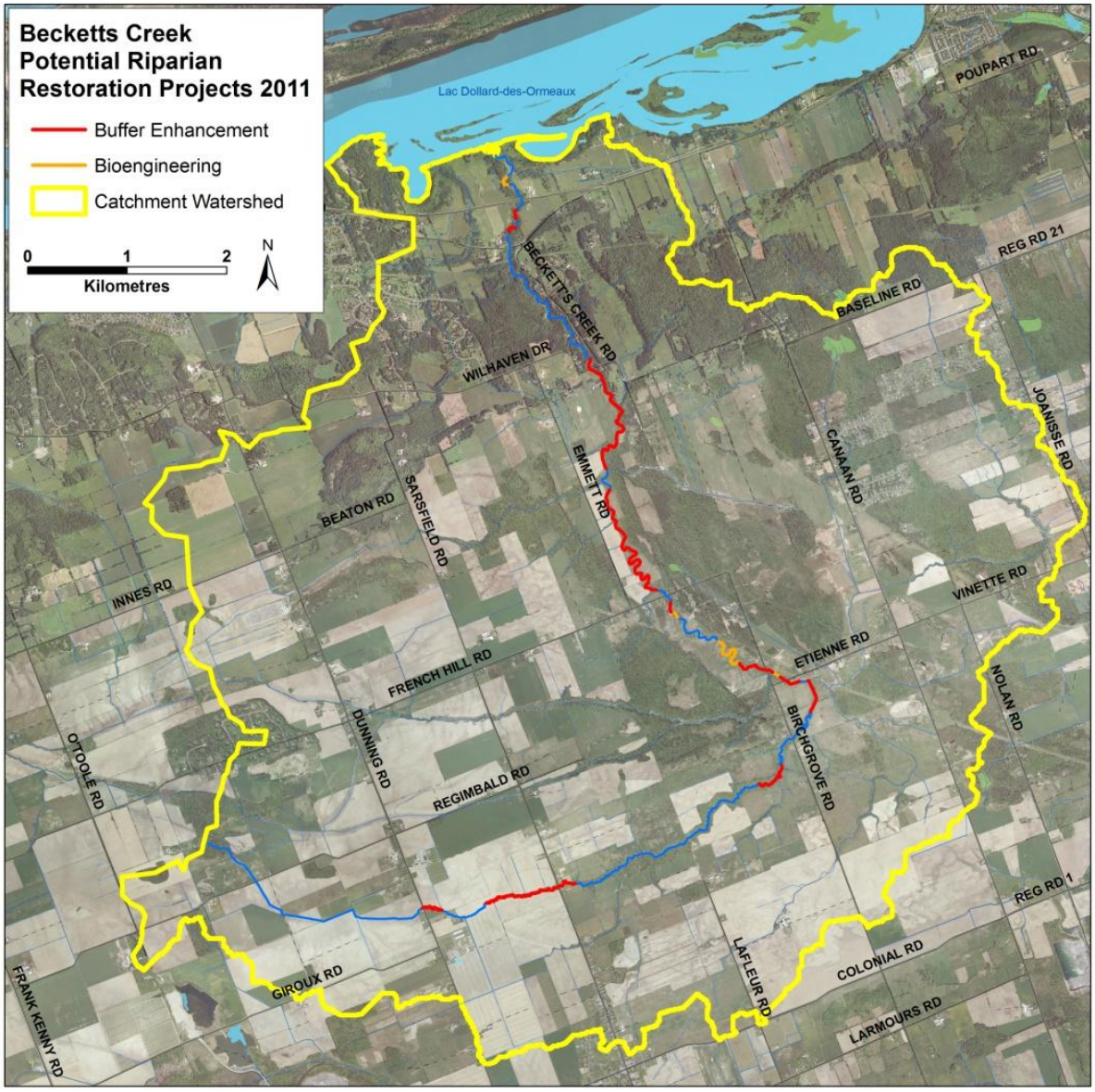



**Figure 23. Map of Potential Shoreline Projects Along Becketts Creek**

## Local Actions for Improvement of Becketts Creek

| Type of Project | Description |
|---|---|
| Riparian Planting/Buffer Enhancement | Riparian plantings and buffer improvements with native species have been identified for 10 sites, for a total of 6.2km of stream |
| Bioengineering | Areas in need of bioengineering (natural erosion control) have been identified for 8 sites, for a total of 1.6km of stream |
| Fish Habitat Enhancement | 5 sites have been identified for fish habitat improvements, for a total of 1.3km of stream; these sites include creating riffles, instream structure (root wads, etc.), enhancing walleye spawning and enhancing spawning for muskellunge and Northern pike. |
| Stream Garbage Cleanup | There has been one site identified for a stream garbage cleanup between Wilhaven and French Hill Road; it is an old car and machinery would be required for removal |
| Invasive Species Removal | 5 invasive species observed were purple loosestrife (Lythrum salicaria), Manitoba maple (Acer negundo), garlic mustard (Alliaria petiolata), wild parsnip (Pastinaca sativa) and flowering rush (Butomus umbellatus). If you see a suspected invasive species, you can report it to the Ontario Federation of Anglers and Hunters **invading species hotline: 1-800-563-7711** |

**Table 11. Potential Rehabilitation Projects in the Becketts Creek subwatershed**



For information on the overall 2011 City Stream Watch Program and the volunteer activities, please refer to the City Stream Watch Summary report, 2011. To view the macrostream protocol used, please see the City Stream Watch website: http://www.rvca.ca/programs/streamwatch/index.html

## REFERENCES


1. Canadian Wildlife Service (CWS), Environment Canada. 2004. *How Much Habitat Is Enough?* Retrieved from: http://www.ec.gc.ca/EnviroZine/english/issues/64/feature2_e.cfm
2. Cudmore-Vokey, Becky and Minns, C.K. 2002. *Reproductive Ecology and Vegetation Association Databases of Lake Ontario Fishes*.
3. Ontario Ministry of Natural Resources. 2008. *Field Guide to Aquatic Invasive Species.*
4. Rideau Valley Conservation Authority (RVCA). 2006. *City Stream Watch Annual Report*. Manotick, ON: Grant Nichols
5. Rideau Valley Conservation Authority (RVCA). 2007. *City Stream Watch Annual Report*. Manotick, ON: Grant Nichols
6. Stoneman, C.L. and M.L. Jones. 1996. *A Simple Method to Evaluate the Thermal Stability of Trout Streams*.


## 2011 City Stream Watch Sponsors


**A very large and sincere thank you to our 2011 program sponsors:**
**Community Fisheries and Wildlife Involvement Program, Ministry of Natural Resources**
**Science and Technology Internship, Natural Resources Canada**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# Becketts Creek 2017 Catchment Report

| Watershed Features | |
|---|---|
| **Area** | 59.8 Square kilometres<br>1.41% of the Rideau Valley watershed |
| **Land Use** | 55.28% agriculture<br>4.59% urban<br>7.73% rural<br>24.81% forest<br>3.87% meadow<br>0.16% water body<br>3.55% wetland |
| **Surficial Geology** | 64.16% clay<br>7.01% diamicton<br>0.64% gravel<br>1.70% organic deposits<br>5.07% Paleozoic bedrock<br>21.43% sand |
| **Watercourse Type** | 2017 thermal conditions<br>cool-warm water system |
| **Invasive Species** | Ten invasive species were identified in 2017: banded mystery snail, common and glossy buckthorn, flowering rush, garlic mustard, non-native honey suckle, Japanese knotweed, Manitoba maple, periwinkle, purple loosestrife, and wild/ poison parsnip. |
| **Fish Community** | 31 species of fish observed from 2006-2017. Game fish species present include: black crappie, brown and yellow bullhead, largemouth and smallmouth bass, northern pike, rock bass, silver and shorthead redhorse, walleye, white sucker and yellow perch. |
| **Wetland Catchment Cover** | |
| 0.56% evaluated wetland | |
| 3.00% unevaluated wetland | |

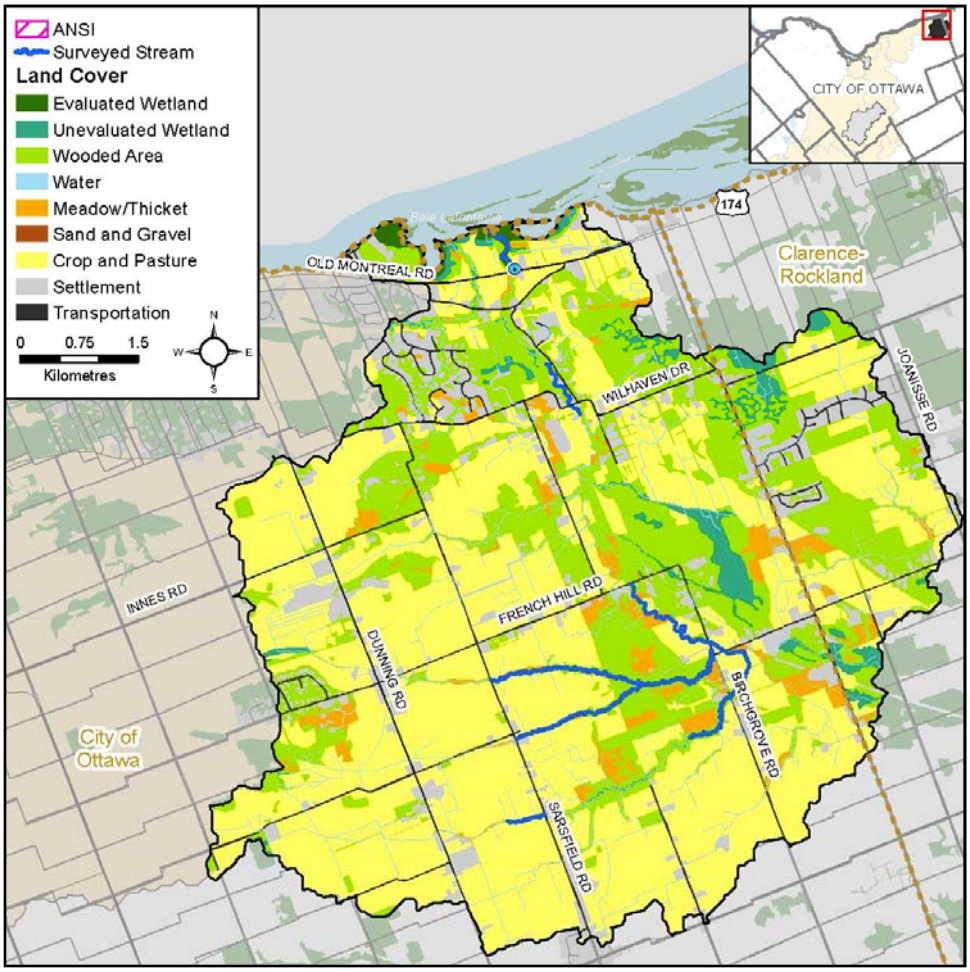



**Figure 1** Land cover in the Becketts Creek catchment

Confluence of Becketts Creek on to the Ottawa River

The Rideau Valley Conservation Authority, in partnership with six other agencies in Ottawa: City of Ottawa, Ottawa Flyfishers Society, Ottawa Stewardship Council, Rideau Roundtable, Canadian Forces Fish and Game Club, and the National Capital Commission form the 2017 City Stream Watch Collaborative.

## Flood Conditions - Rideau Valley Watershed


### *Flood Warning Conditions*

Heavy rains throughout the summer and into the fall made 2017 the wettest year in Ottawa in recorded history. This year we observed prolonged and significant flooding in parts of the Ottawa River Watershed. RVCA monitors certain areas along the Ottawa River, by mid-April the first flood message was sent and by May 1st the message was upgraded to a Flood Warning.

The Ottawa River peaked on May 7th with a record flow of 5769 cubic meters per second, making it a 1:50 year flood event (RVCA, 2017). The confluence of Becketts Creek with the Ottawa River is situated in Cumberland where flooding was experienced this spring affecting many homes in the area. This year was quite a contrast to 2016, when the city experienced moderate to severe drought conditions throughout most of the year.


Flooded road section in the Stevens Creek catchment near the Rideau River

Flooded section of Pinecrest Creek near the Ottawa River

Flooded agricultural field in the Becketts Creek catchment

## *Introduction*

Becketts Creek is a tributary of the Ottawa River located in the East end of the City of Ottawa. The 28 kilometer stream flows from the southern portion of Sarsfield to its confluence into the River at Baie Lafontaine in Cumberland. Adjacent to the confluence there is also a 184 hectare migratory bird sanctuary.

The sub-watershed of Becketts Creek drains 59.8 square kilometers of land, comprised of mainly forest, agricultural and rural land uses. The vegetation cover is comprised of 87.47 percent wooded areas and 12.53 percent wetland; of the woodlots in the catchment, 55 percent are less than one hectare in size, 40 percent are one to 30 hectares, and five percent have an area over 30 hectares. The majority of the headwaters of this catchment are influenced by agricultural land use. This system is fed mostly by agricultural drains, and portions of itself and many of its tributaries are designated municipal drains.

In 2017 the City Stream Watch program surveyed 130 sections (13 km) of the main stem and branches of Becketts Creek; eight sites were sampled for fish community composition; five temperature loggers were deployed; and 61 headwater drainage feature sites were assessed. Areas that were not surveyed lacked private property access permission. The surveyed sections of the main branch include portions from the mouth to Old Montreal Road, sections near the crossing at Wilhaven Drive, from French Hill Road past Birchgrove Road, and from Sarsfield Road to Dunning Road. Two branches were also surveyed from Birchgrove Road to Sarsfield Road. The following report summarizes findings of the areas surveyed.

## *Becketts Creek Overbank Zone*

### Riparian Buffer Width Evaluation

The riparian buffer is the adjacent land area surrounding a stream or river. Naturally vegetated buffers are very important to protect the overall 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 Becketts Creek. Buffers greater than 30 meters were present along 71 percent of the left bank and 76 percent of the right bank. A 15 to 30 meter buffer was present along 14 percent of the left bank and 11 percent of the right bank; five to 15 meter buffers were observed along eight percent of the left bank and six percent of the right bank. A five meter buffer or less was present along seven percent of the left banks and five percent of the right bank.

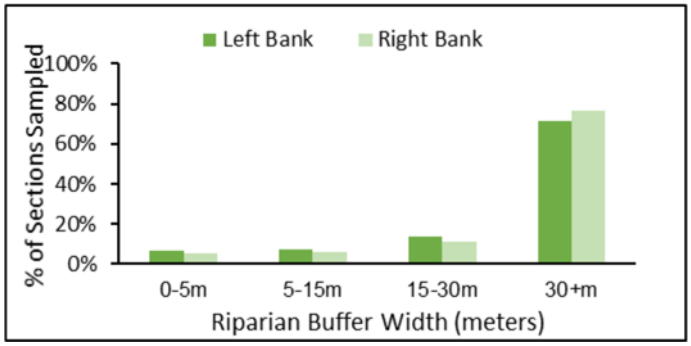



**Figure 2** Vegetated buffer width along Becketts Creek

Improvements of buffer are needed, particularly in the agricultural areas and near roadway intersections where buffers are lower than the recommended guidelines.

### 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 percentage of anthropogenic alterations to the natural riparian cover are shown in Figure 3. Becketts Creek riparian zones are mostly natural vegetative communities, with alterations associated with municipal infrastructure, including roadways, and agricultural land uses.

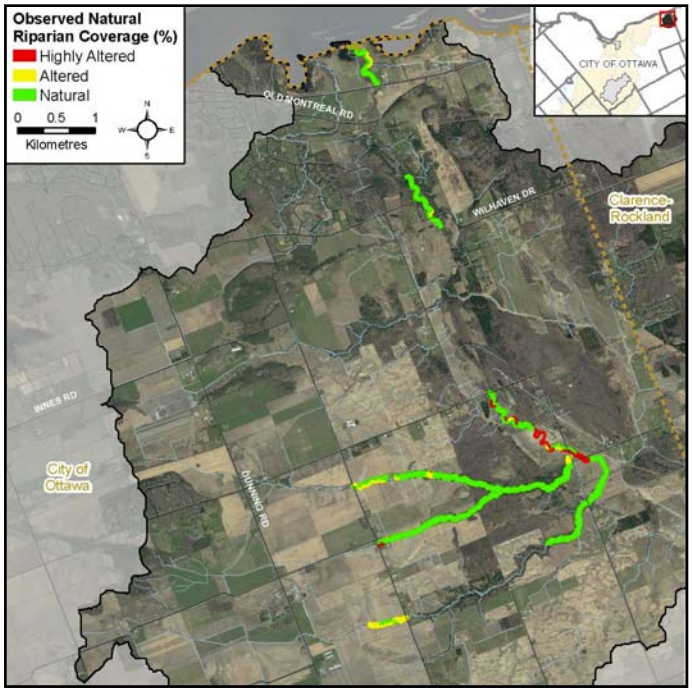



**Figure 3** Riparian buffer alterations in Becketts Creek

### Adjacent Land Use

Surrounding land use is considered from the beginning to end the 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.

Meadows and forest were present in 80 percent and 82 percent of the sections surveyed, being the most common land use found. Scrubland was present in 52 percent of the surveyed areas, and wetland was present in five percent of sections.

Aside from the natural areas, the most common land use in the catchment was agricultural, with 49 percent of the sections containing active agriculture, eight percent abandoned agriculture and 14 percent of the sections had pasture land present. Other uses observed included 18 percent of surveyed areas with infrastructure (such as roads); residential areas were observed in 14 percent; and industrial or commercial use was identified in two percent of the adjacent lands.

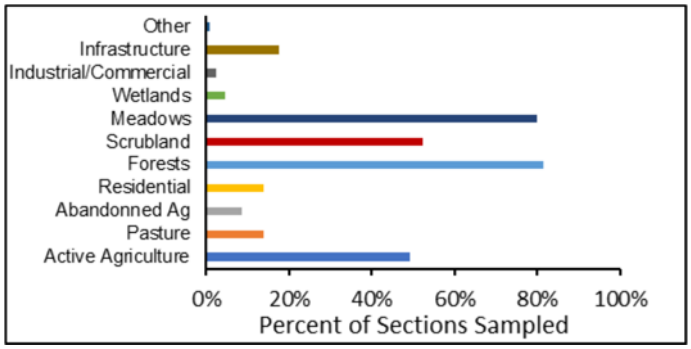



**Figure 4** Adjacent land use 100 m from each shoreline and percentage of presence along Becketts Creek

Road crossing altering riparian zones along Becketts Creek

## ***Becketts Creek Shoreline Zone***

### Anthropogenic Alterations

Stream alterations are classified based on specific functional criteria associated with the flow conditions, the riparian buffer and potential human influences.

Figure 5 shows the level of anthropogenic alterations for the 130 sections surveyed in Becketts Creek, with 63 percent remaining without any human alteration. Of the sections surveyed, 25 percent fall in the classification of natural. Natural sections have not been straightened or diverted, have a riparian buffer greater than 15 meters, contain few lawns, ornamental gardens, beaches, rip rap or constructed wooden structures.

Altered sections account for five percent of surveyed areas, they may contain diverted or straightened sections and riparian buffers of five to 15 meters. Shoreline alterations also include concrete. One or two storm water outlets could also be present.

Highly altered sections (7% of sections) have the highest proportion of alterations. Including riparian buffers less than five meters, shoreline alterations are found on most of the section, and portions of the stream may flow through culverts.

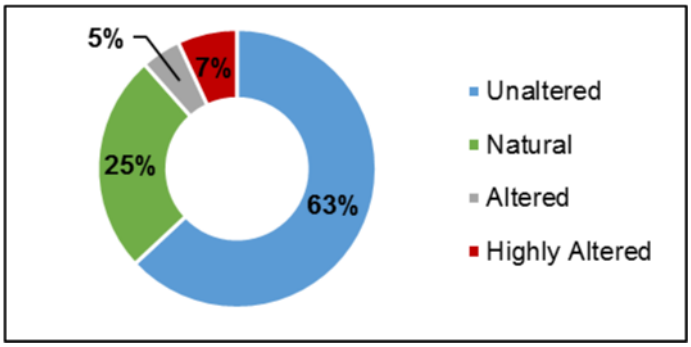



**Figure 5** Anthropogenic alterations along Becketts Creek

A highly altered stream section flowing through a culvert

## 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 overall 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 the levels of stream erosion observed across the surveyed portions of Becketts Creek.

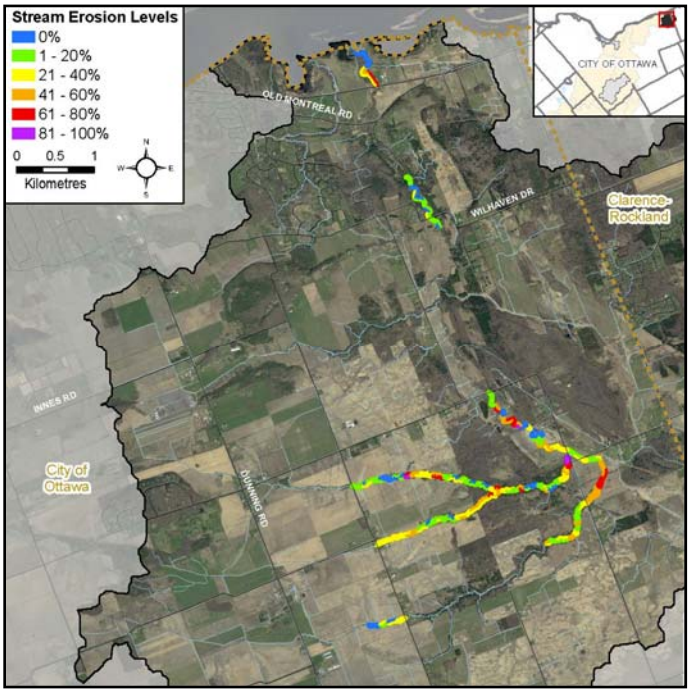



**Figure 6** Erosion levels along Becketts Creek

Bank destabilization along a steep slope of Becketts Creek

Near the mouth and in many other reaches of Becketts Creek, the system is dominated by steep forested slopes and leda clay that makes them unstable. In the upper reaches of the system, certain agricultural areas have unstable banks with exposed soils, lack of vegetation and undercutting.

Stream bank erosion with visible soils and lack of vegetation

## 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 overall extent of each surveyed section with overhanging bank cover present.

Figure 7 shows that undercut banks were present in the majority of the sections surveyed in Becketts Creek, 84 percent of the sections had undercutting in the left bank and 80 percent of the right bank.

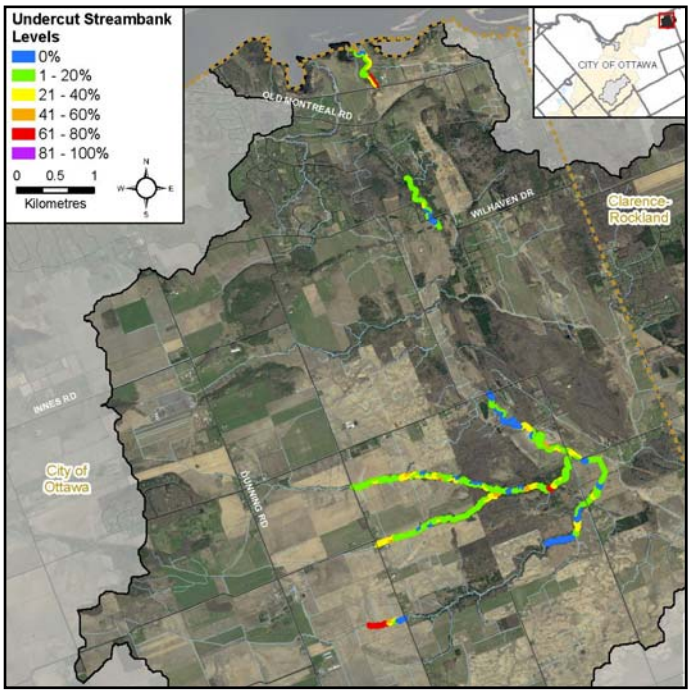



**Figure 7** Undercut stream banks along Becketts Creek

### Stream Shading

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

Figure 8 shows the percentage of sections surveyed with various levels stream shading. The majority of sections (33%) had a shade cover of 61 to 80 percent. The highest shading of 81 to 100 percent was observed in eight percent of the sections. Cover of 41 to 60 percent was present in 18 percent of the sections and 19 percent of the sections had 21 to 40 percent coverage. Minimal shading of one to 20 percent was observed in 18 percent of sections and no cover was observed only in two percent of the sections. Figure 9 shows the distribution of these shading levels along Becketts Creek.

A mix of trees and grasses comprised the majority of shading. Overhanging plants, mainly grasses predominant in agricultural areas were seen in 86 percent of the left bank and 85 percent of the right bank.

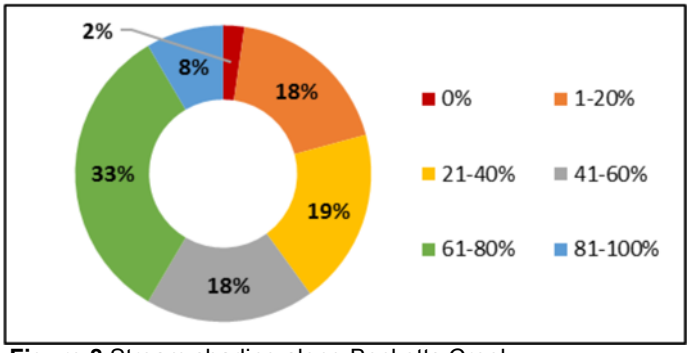



**Figure 8** Stream shading along Becketts Creek

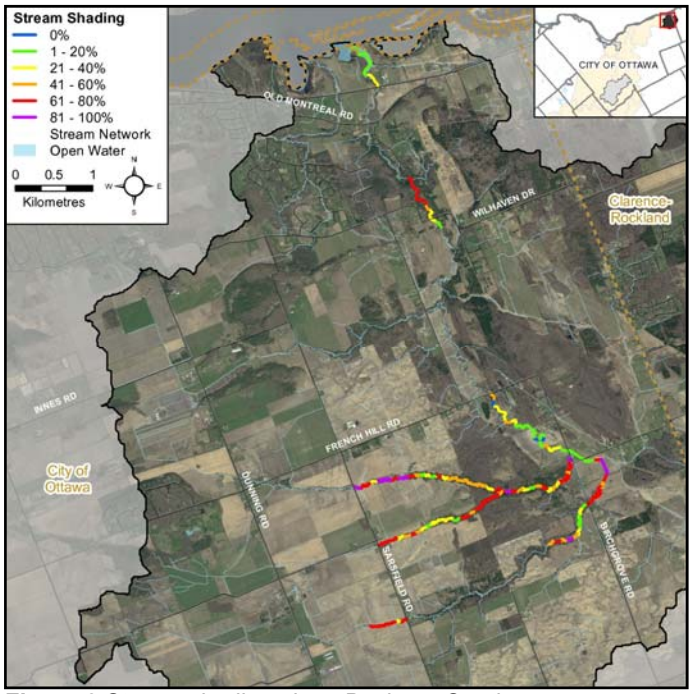



**Figure 9** Stream shading along Becketts Creek

### 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 of overhanging trees and branches that were observed along Becketts Creek. In the surveyed portions, 73 percent of the sections had overhanging trees and branches on the left bank, and 70 percent of the sections had overhanging trees on the right banks.

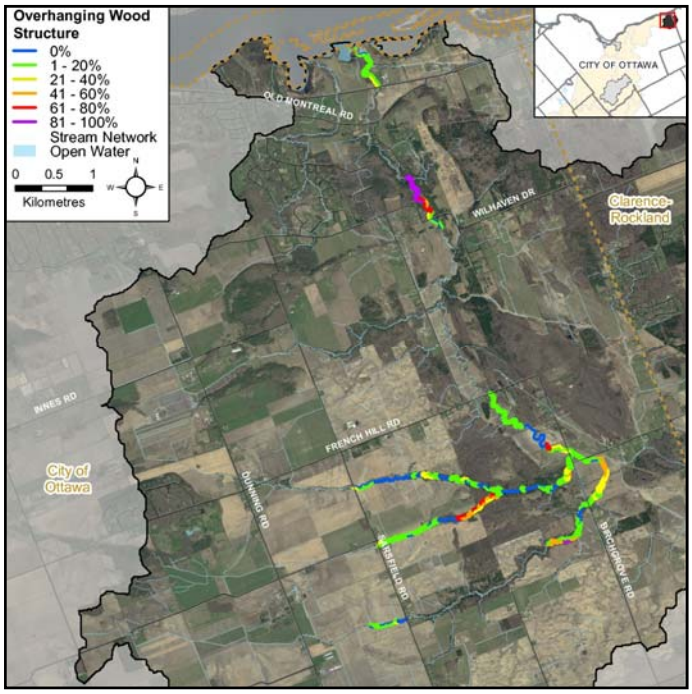



**Figure 10** Overhanging trees and branches along Becketts Creek

A natural section with overhanging trees along Becketts Creek

## ***Becketts Creek Instream Aquatic Habitat***

### Habitat Complexity

Habitat complexity is a measure of the overall 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, flow 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 woody material. A higher score shows greater complexity where a variety of species can be supported. Figure 11 shows habitat complexity of the sections surveyed: five percent had no complexity; 46 percent had a score of one; 19 percent scored two; 15 percent scored three; and 15 percent had the highest habitat diversity.

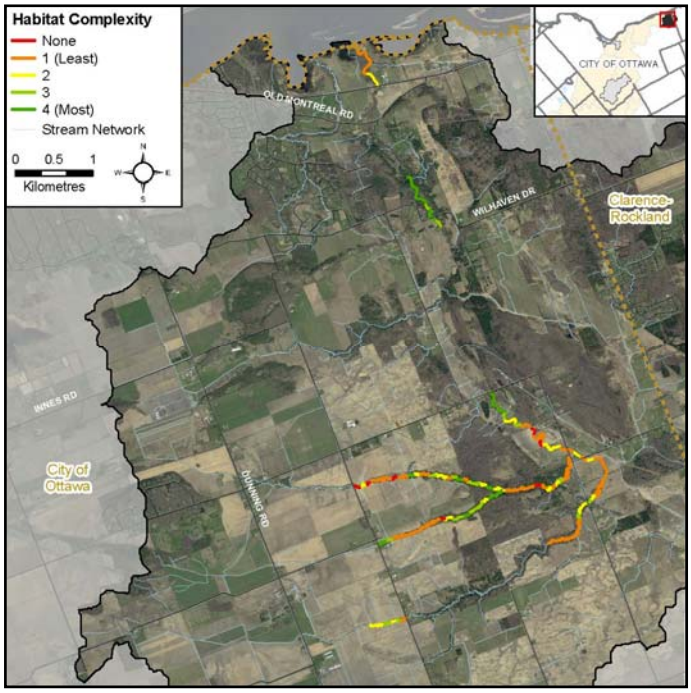



**Figure 11** Instream habitat complexity along Becketts Creek

Diverse habitat cover in Becketts Creek

### 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 overall diversity of species within a stream.

Figure 12 shows the substrates present in the sections surveyed of Becketts Creek. It is a system dominated by clay, with 88 percent of sections containing this type of substrate. It also has bedrock portions; in the locations containing waterfall systems near Old Montreal Road most bedrock portions were not surveyed due to lack of property access.

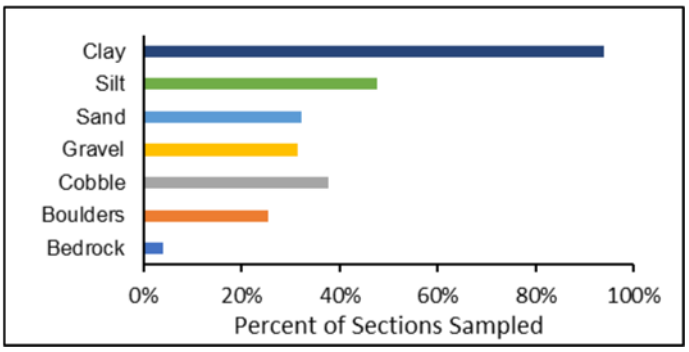



**Figure 12** Instream substrates present along Becketts Creek

Figure 13 shows the dominant substrates in the creek. From the areas that were assessed, bedrock was the dominant type in two percent of sections. Gravel and cobble were identified as dominant in eight percent of all surveyed sections; sand and silt dominated only two percent of sections.

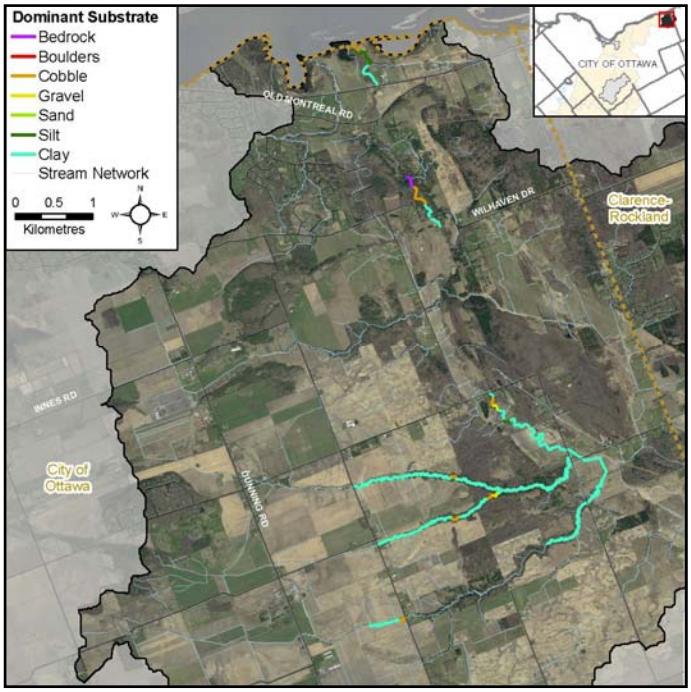



**Figure 13** Dominant instream substrates along Becketts Creek

### 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 Becketts Creek has a diversity of morphological conditions, suitable for a variety of aquatic species and life stages; 78 percent of sections contained pools, 53 percent contained riffles and the majority, 98 percent, contained runs. Figure 15 shows the locations of riffle habitat along Becketts Creek.

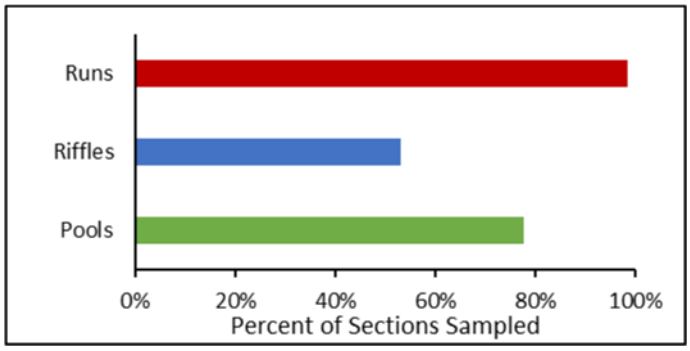



**Figure 14** Instream morphology along Becketts Creek

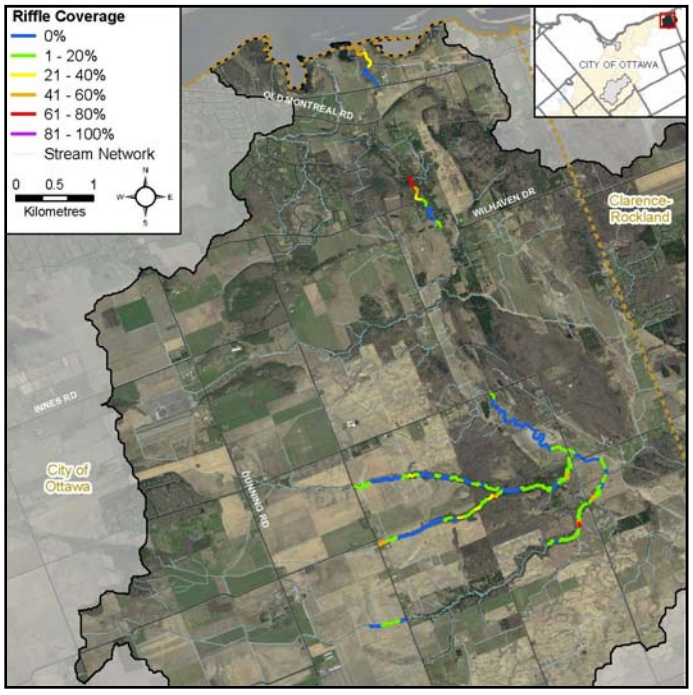



**Figure 15** Riffle habitat locations along Becketts Creek

### Instream Wood Structure

Figure 16 shows that the majority of Becketts Creek had low levels of instream woody material in the form of branches and trees. Instream wood material is important for fish and wildlife habitat, by providing refuge and feeding areas. Excessive amounts can create barriers.

Instream wood structures found along Becketts Creek

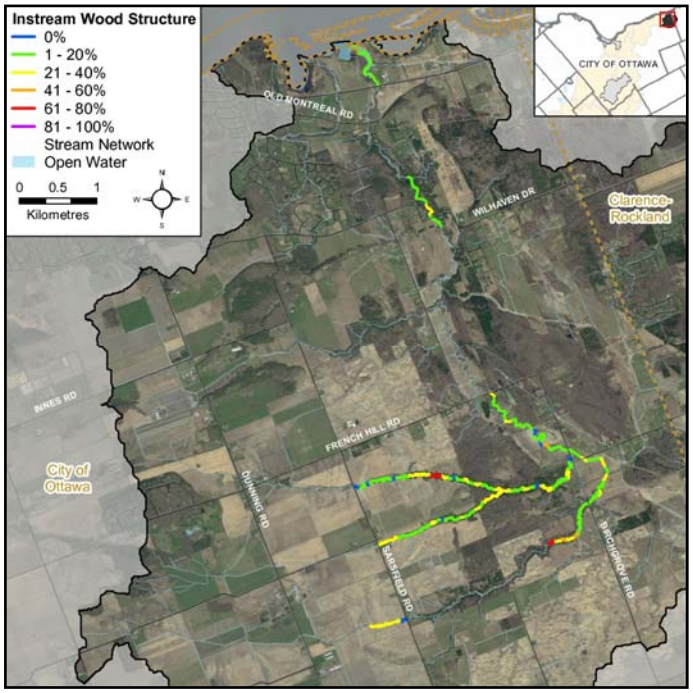



**Figure 16** Instream wood structures along Becketts Creek

### Instream Vegetation Type

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

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

Figure 17 shows the aquatic vegetation community structure. The two categories most commonly present were none, present in all sections; and narrowed leaved present in 75 percent of sections sampled.

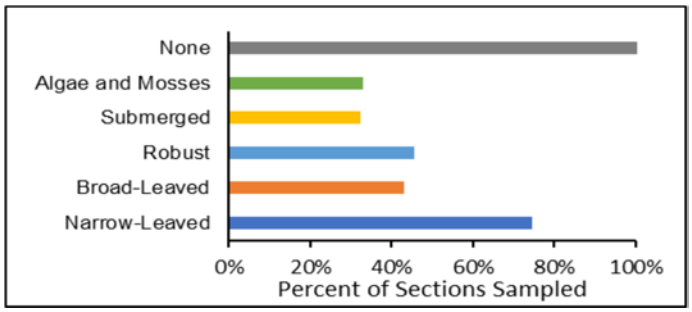



**Figure 17** Aquatic vegetation presence along Becketts Creek

Becketts Creek does not have a large diversity of instream vegetation, with 84 percent of sections having no vegetation as the dominant category (Figure 18), due to the types of substrates found such as consolidated clay or bedrock. Narrowed-leaved vegetation was dominant in six percent of sections; robust emergent plants in four percent; and algae and mosses were dominant in three percent. Broad-leaved and submerged vegetation were each dominant in two percent of sections.

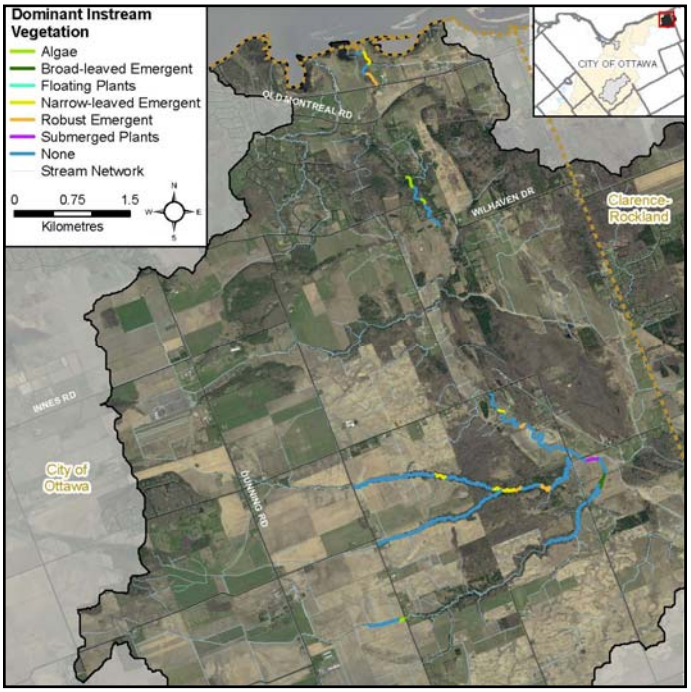



**Figure 18** Dominant instream vegetation in Becketts Creek

### Instream Vegetation Abundance

The abundance of instream vegetation is also crucial for overall 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.

As seen in Figure 19, 94 percent of Becketts Creek sections had no vegetation, 25 percent had rare vegetation, and 40 percent had low vegetation levels. Normal abundance levels were observed in 40 percent of sections surveyed and common abundance was observed in 28 percent. Only three percent of sections had extensive abundance levels.

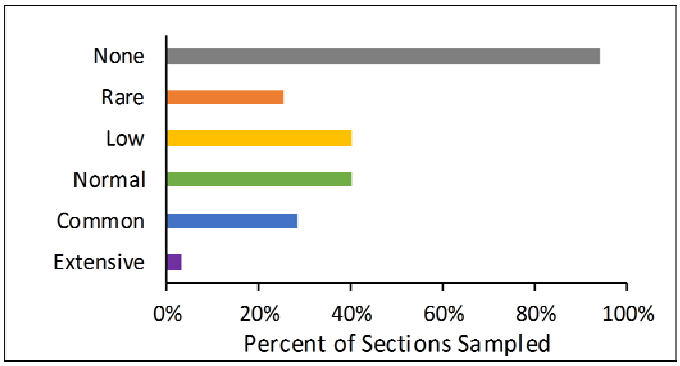



**Figure 19** Instream vegetation abundance in Becketts Creek

Instream floating yellow water lily on Becketts Creek

Section of Becketts Creek without aquatic vegetation

## ***Becketts 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 manage or eradicate, however it is important to continue to research, monitor and manage them.

Figure 20 shows abundance of species observed per section. Ten invasive species present in 2017 were:

- banded mystery snail (*Viviparus georgianus)*
- common & glossy buckthorn (*Rhamnus cathartica* & *R. frangula*)
- flowering rush (*Butomus umbellatus*)
- garlic mustard (*Alliaria petiolata*)
- non-native honey suckle (*Lonicer sp.*)
- Japanese knotweed (*Reynoutria japonica var. japonica*)
- Manitoba maple (*Acer negundo*)
- periwinkle (*Vinca minor*)
- poison/wild parsnip (*Pastinaca sativa*)
- purple loosestrife (*Lythrum salicaria*)

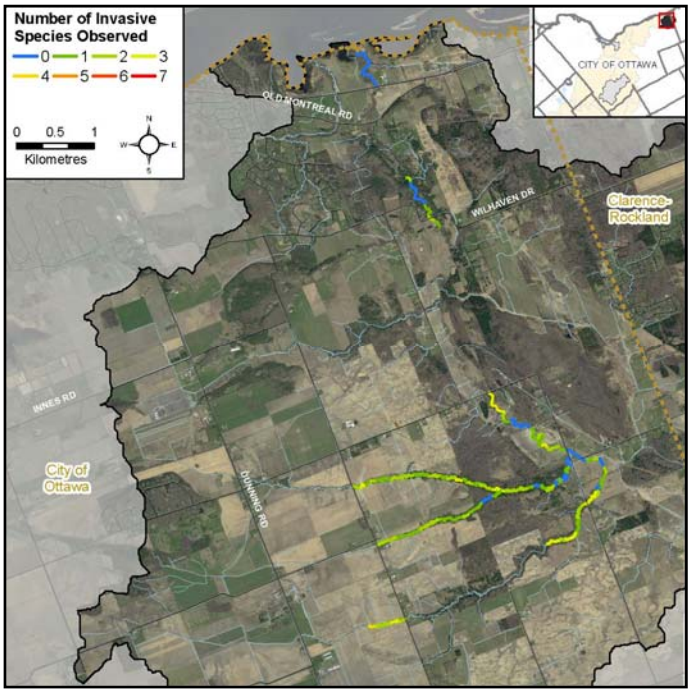



**Figure 20** invasive species abundance along Becketts Creek

Invasive Japanese knotweed along the bank of Becketts Creek

To report and find information about invasive species visit

http://www.invadingspecies.com

Managed by the Ontario Federation of Anglers and Hunters

### Pollution

Figure 21 shows the types of pollution observed in Becketts Creek. The levels of garbage found in the main portion of the stream were low, with 84 percent of sections surveyed containing no garbage. In the 16 percent of sections that were polluted, most garbage observed were styrofoam, plastics, cans, and tires.

In the headwater portions of the catchment garbage and dumping was also observed. The images below show examples of dumping and oil spills near roads.

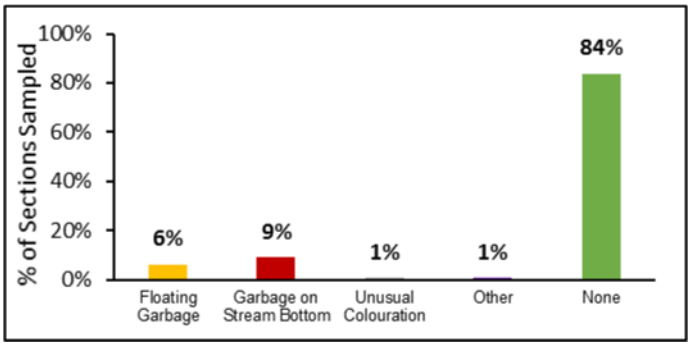



**Figure 21** Pollution observed within Becketts Creek

Pollution observed along headwater areas of Becketts Creek: metal drums and pails of unknown fluids

## Wildlife

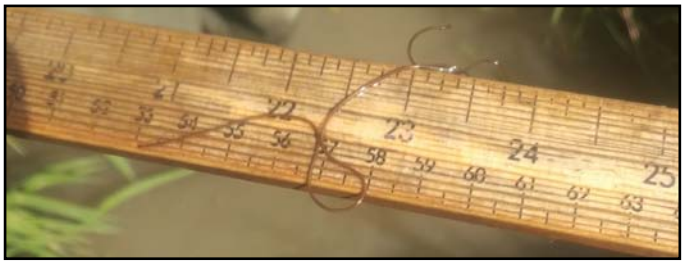
The diversity of fish and wildlife populations can be an indicator of water quality and overall stream health (Table 1). Wildlife observations are noted during standard monitoring and survey activities; they do not represent an extensive evaluation of species presence or absence in the Becketts Creek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

Wasp hive (top) and pearl dace (bottom) found along Becketts Creek

Ebony jewelwing damselflies (top) and fingernail clams (bottom) are found throughout the Becketts Creek catchment

**Table 1** Wildlife observations along Becketts Creek in 2017

| | |
|---|---|
| **Birds** | American crow, American goldfinch, American robin, black-capped chickadee, blue jay, Canada goose, common merganser, downy woodpecker, ducks, finches, gray catbird, great blue heron, mourning dove, red-winged blackbird, ruffed grouse, song sparrow, sparrows, turkey vulture, wild turkey, woodpeckers |
| **Reptiles & Amphibians** | American bullfrog, common garter snake, frogs, gray treefrog, green frog, leopard frog, painted turtle, snapping turtle, tadpoles, wood frog |
| **Mammals** | American beaver, American mink, American red squirrel, chipmunks, eastern grey squirrel, muskrat, northern river otter, raccoon tracks, white-tailed deer |
| **Aquatic Insects & Benthic Invertebrates** | aquatics sow bugs, banded mystery snail, beetles, caddisflies, crayfishes, damselflies, eastern floater, fingernail clams, mayflies, stoneflies, giant floater, horsehair worm, unionid mussels, water boatman, water strider, whirligig beetle |
| **Other** | *Argiope* spider, bees, bumblebees, butterflies, caddisflies, cicadas, crane flies, crickets, damselflies, deerflies, dragonflies, ebony jewel wing, horseflies, midges, monarch butterfly, mosquitoes, moths, mud dauber, red meadow-hawk, spiders, wasps |



Horsehair worm (above) and painted turtle basking on a log (below) in Becketts Creek

## *Becketts 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 on Becketts Creek

### Dissolved Oxygen

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

Figure 22 shows the concentration levels found in the surveyed portions of Becketts 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 in agricultural areas and at road crossings (sec. 51-63; 11-23 SB). Average levels across the system were 8.4 milligrams per liter.

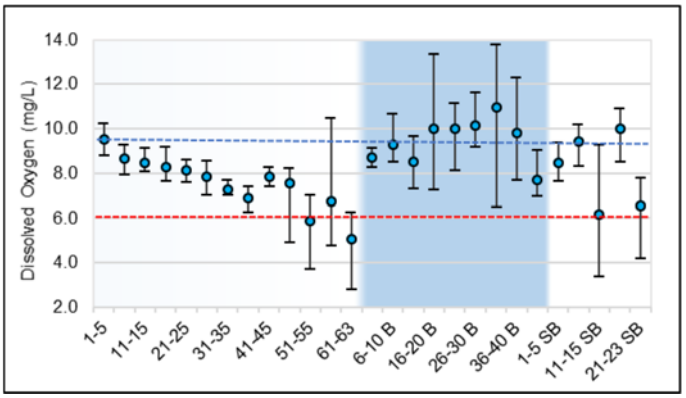



**Figure 22** Dissolved oxygen ranges in surveyed sections of Becketts Creek: 1-63 main stem, 1-44 branch (B) in blue, 1-23 south branch (SB)

### Conductivity

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

Figure 23 shows specific conductivity levels in Becketts Creek, the average level is depicted by the dashed line (720 µS/cm). Notable variability was observed at the mouth, (sec. 1-5) likely influenced by the Ottawa River; and by drainage in agricultural zones and runoff from roadway crossings (sec. 56-60, 6-10 SB, 16-20 SB).

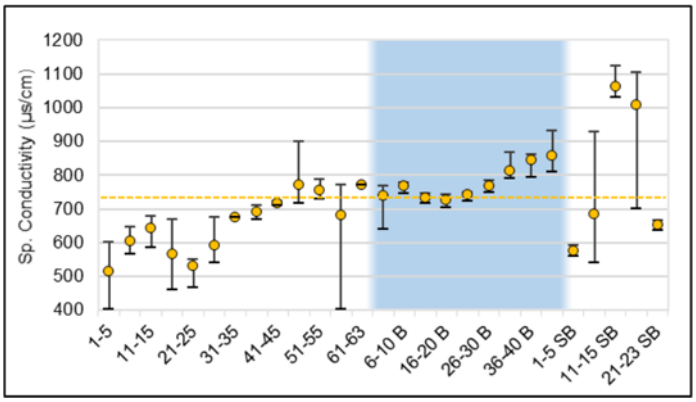



**Figure 23** Conductivity ranges in sections of Becketts Creek: 1-63 main stem, 1-44 branch (B) in blue, 1-23 south branch (SB)

### pH

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

Figure 24 shows Becketts Creek had mostly pH levels that meet the PWQO, depicted by the dashed line. Average levels across were pH 7.95; and sections above 8.5 were found in agricultural land use areas.

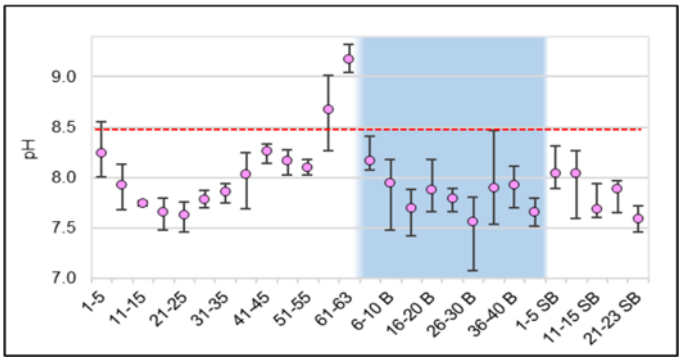



**Figure 24** pH ranges in surveyed sections of Becketts Creek: 1-63 main stem, 1-44 branch (B) in blue, 1-23 south branch (SB)

### 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 Becketts Creek with **optimal** oxygen conditions

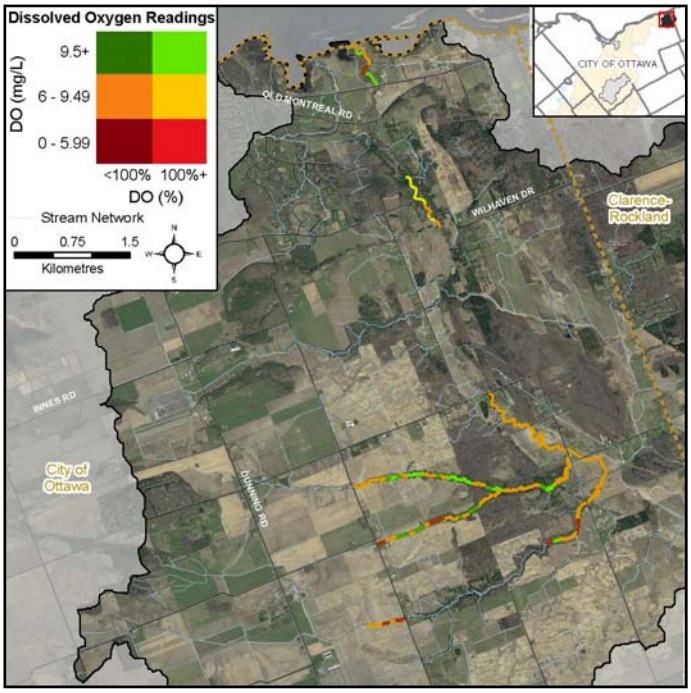



**Figure 25** Bivariate assessment of dissolved oxygen concentration (mg/L) and saturation (%) along Becketts Creek

Figure 25 shows the oxygen conditions across the areas that were surveyed in 2017. Overall dissolved oxygen conditions in Becketts Creek are sufficient to sustain warm-water biota.

There are forested areas in the headwater reaches where conditions would be optimal for warm and cold-water biota. Impairment of dissolved oxygen levels, shown in red in Figure 25, were observed near agricultural areas and road crossings.

Site on Becketts Creek with **impaired** oxygen conditions

### 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 storm water, 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 conductivity in Becketts Creek (720 µS/cm) exceed the water quality parameter (500 µS/cm) used for the Canadian Environmental Performance Index (Environment Canada 2011).

Figure 26 shows relative specific conductivity levels in Becketts Creek. Normal levels were maintained near Wilhaven Drive, and throughout many portions upstream of Birchgrove Road. Moderately elevated conditions were observed in the main stem of Becketts Creek between French Hill Road and Birchgrove Road. Highly elevated conditions were present in the South Branch portion, where there is agricultural activity. Other areas with highly elevated conditions are near the confluence with the Ottawa River, and agricultural areas East of Sarsfield Road.

Section of Becketts Creek upstream of Sarsfield Road with highly elevated conductivity levels

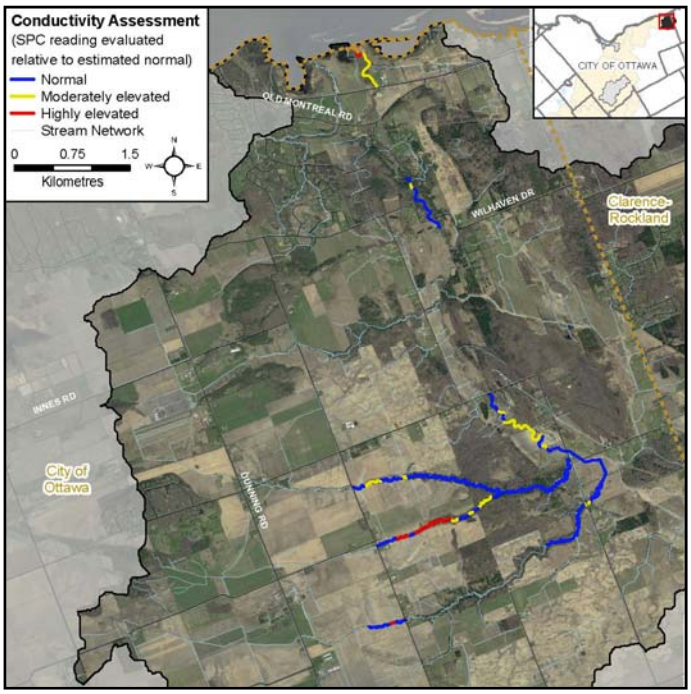



**Figure 26** Relative specific conductivity levels along Becketts Creek

Section of Becketts Creek upstream of Birchgrove Road that would benefit from buffer enhancement to improve shoreline conditions and water quality.

## *Becketts 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 Becketts Creek, five temperature loggers were placed; four were retrieved, one was missing in its location (#5), and one was compromised out of water.

Figure 27 shows where thermal sampling sites were located. Analysis of data from three loggers (using the Stoneman and Jones, 1996, method adapted by Chu et al., 2009), Becketts Creek is classified as **Cool-warm water** (Figure 28).

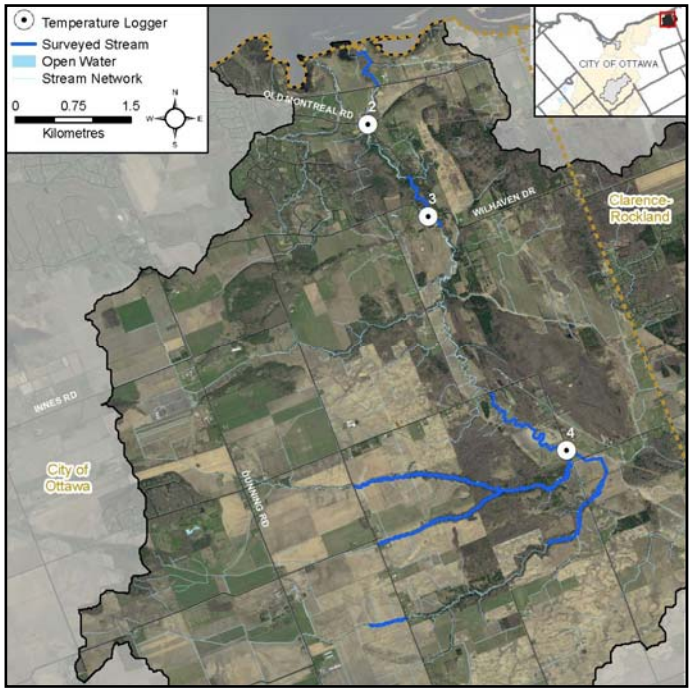



**Figure 27** Temperature logger locations on Becketts Creek

Within those three sites, cool, cool-warm water and warm water fish species were present, with fish thermal preferences 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, indicators of groundwater discharge are noted when observed. Indicators include: springs/ seeps, watercress, iron staining, significant temperature change and rainbow mineral film. Figure 29 shows areas were one or more groundwater indicators were observed during stream surveys and headwater assessments.

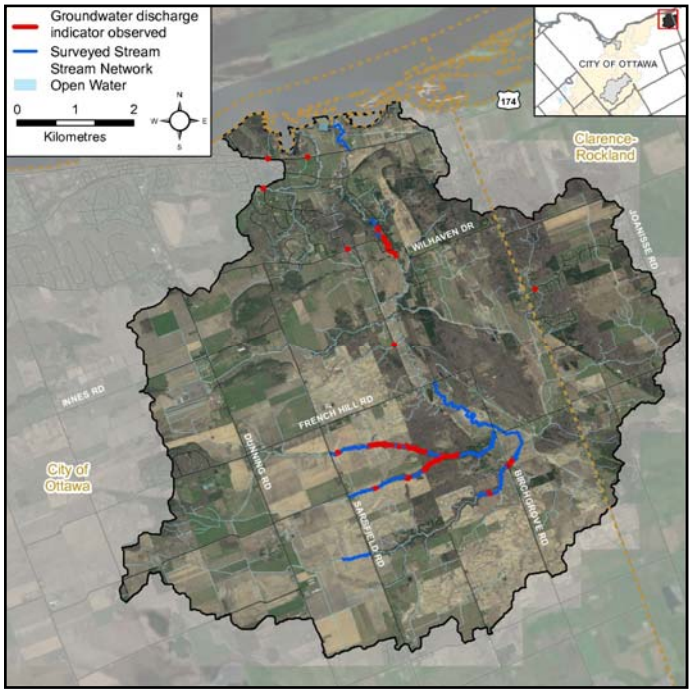



**Figure 29** Groundwater indicators observed in Becketts Creek

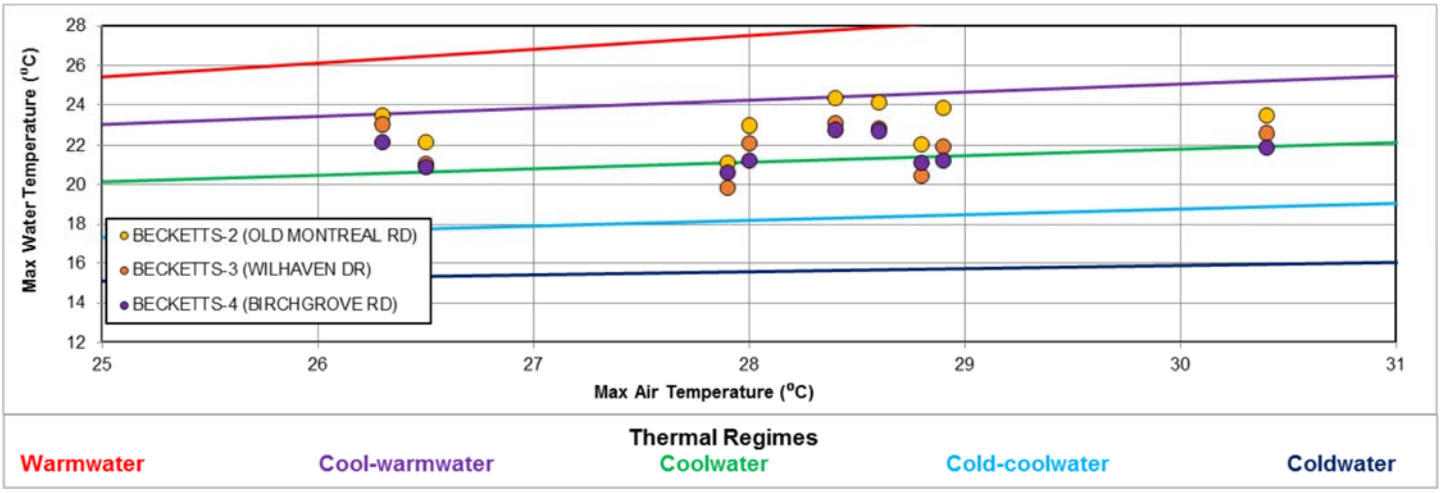



**Figure 28** Thermal Classification for Becketts Creek with the five thermal regimes adapted from Stoneman and Jones (1996) by Chu et al. (2009): **cool-warm water** category for all three sites sampled on Becketts Creek

## *Becketts Creek Fish Community*

### Fish Community Summary

Eight fish sampling sites were evaluated between May and October 2017. Two sites located near the confluence with the Ottawa River were sampled daily for four days with a large fyke net. The two sites near Wilhaven Drive and French Hill Road crossings were sampled with a seine net. The four most upstream sites, one near Birchgrove Road and three near Sarsfield Road, were sampled using a back pack electro-fisher.

**Table 2** Fish species observed along Becketts Creek in 2017

| Species | Thermal Class | MNR Species Code |
|---|---|---|
| black crappie *Pomoxis nigromaculatus* | Cool | BlCra |
| bluegill *Lepomis macrochirus* | Warm | Blueg |
| bluntnose minnow *Pimephales notatus* | Warm | BnMin |
| brook stickleback *Culaea inconstans* | Cool | BrSti |
| brown bullhead *Ameiurus nebulosus* | Warm | BrBul |
| central mudminnow *Umbra limi* | Cool-warm | CeMud |
| Cyprinid *spp.* | Variable | Ca_MI |
| common shiner *Luxilus cornutus* | Cool | CoShi |
| creek chub *Semotilus atromaculatus* | Cool | CrChu |
| johnny/tessalated darter *Etherostoma spp.* | Cool | EthSp |
| fathead minnow *Pimephales promelas* | Warm | FhMin |
| golden shiner *Notemigonus crysoleucas* | Cool | GoShi |
| northern pearl dace *Margariscus nachtriebi* | Cold-cool | PeDac |
| northern pike *Esox lucius* | Cool | NoPik |
| pumpkinseed *Lepomis gibbosus* | Warm | Pumpk |
| silver redhorse *Moxostoma anisurum* | Cool | SiRed |
| spottail shiner *Notropis hudsonius* | Cold-cool | SpShi |
| walleye *Sander vitreus* | Cool | Walle |
| white sucker *Catostomus commersonii* | Cool | WhSuc |
| **Total Species** | | **19** |

Nineteen species were captured in 2017, they are listed in Table 2 along with their thermal classification preferences (Coker et al., 2001) and MNR species codes. Becketts Creek has a mixed fish community ranging from cool to warm water species. The sampling locations where these species were observed, as well as RVCA historical sites, are depicted in Figure 30. 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 Becketts Creek refer to page 22 of this report.

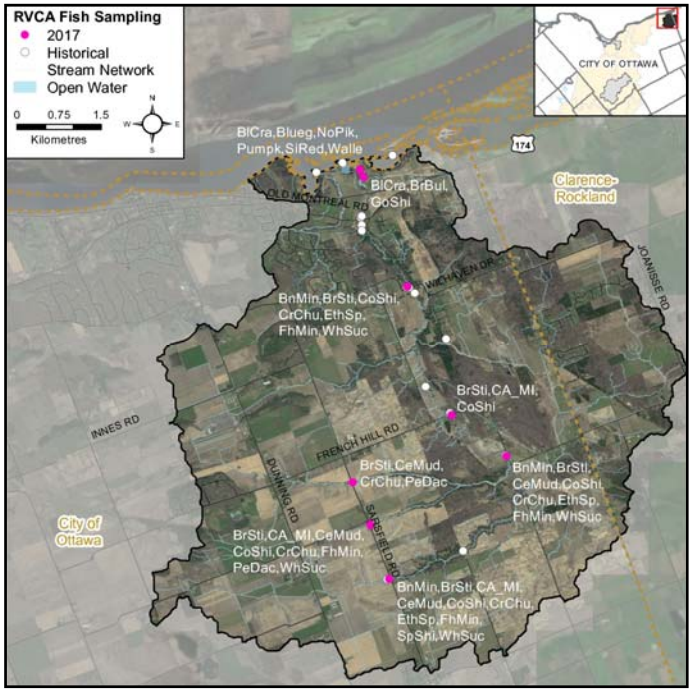



**Figure 30** Becketts Creek fish sampling locations and 2017 fish species observations

Retrieving a fyke net (above) and measuring a northern pike (below) in Becketts Creek near the Ottawa River

### 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.

The most notorious obstructions along Becketts Creek are a natural series of bedrock ledges/waterfalls upstream of Old Montreal Road, as well as a weir under Old Montreal Road. Additionally, in the sections that were surveyed in 2017, 14 woody material dams were observed. These were resulting form beaver activity in the area. The locations of the obstructions observed in 2017 are shown in Figure 31.

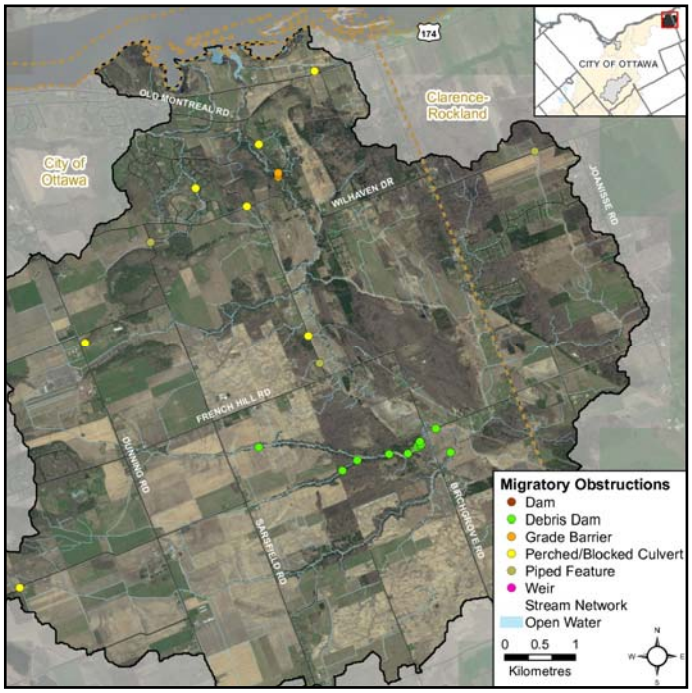



**Figure 31** Migratory obstructions along Becketts Creek

One of several bedrock water falls found along Becketts Creek

### Beaver Dams

Overall 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 woody material used in the dams which removes excess nutrient and toxins. Beaver dams are also considered potential barriers to fish migration.

In 2017, a total of 25 beaver dams were observed; their locations and condition are shown in Figure 32.

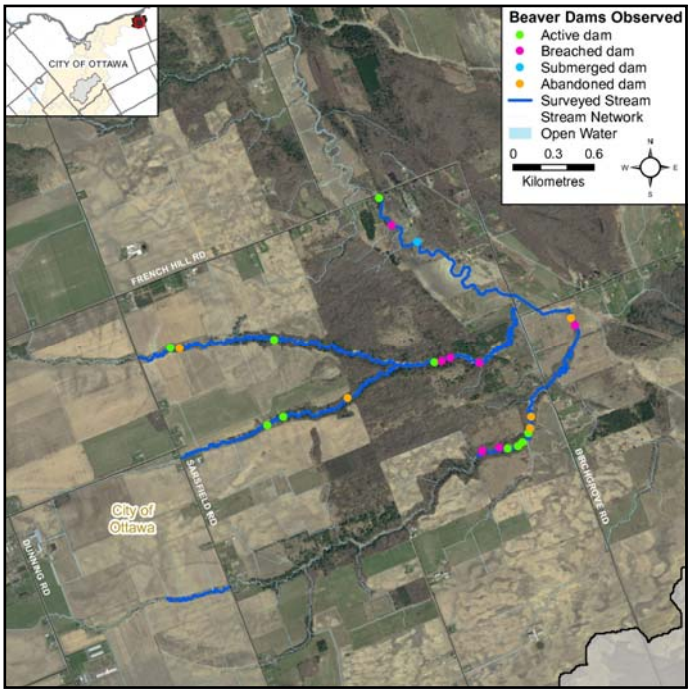



**Figure 32** Beaver Dam locations along Becketts Creek

Active beaver dam found on Becketts Creek

## ***Headwater Drainage Feature Assessment***

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

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

### Headwaters Sampling

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

Features are evaluated as per the Ontario Stream Assessment Protocol (OSAP, 2017). This protocol measures zero, first and second order headwater drainage features. It is a rapid assessment method characterizing the amount of water, sediment transport, and storage capacity within headwater drainage features. In 2017 the City Stream Watch program assessed 61 HDF sites in the Becketts Creek Catchment (Figure 33).

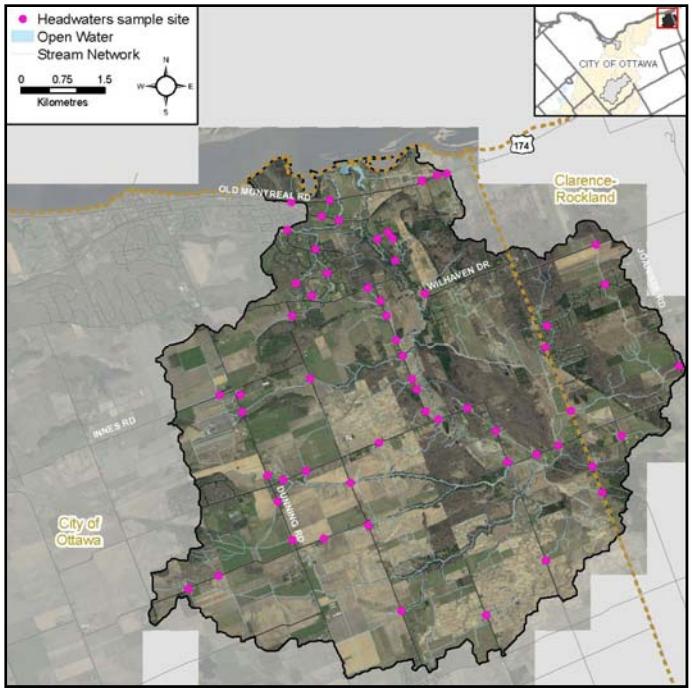



**Figure 33** Locations of HDF sampling sites in the Becketts Creek catchment

### 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 34 shows the feature type of the primary feature at the sampling locations. Channelized features were overall dominant, observed in 32 sites. Seven features were roadside ditches, two were tiled, and one pond outlet was observed. The natural features present included 15 natural channels and two wetlands. Two features were no longer present.

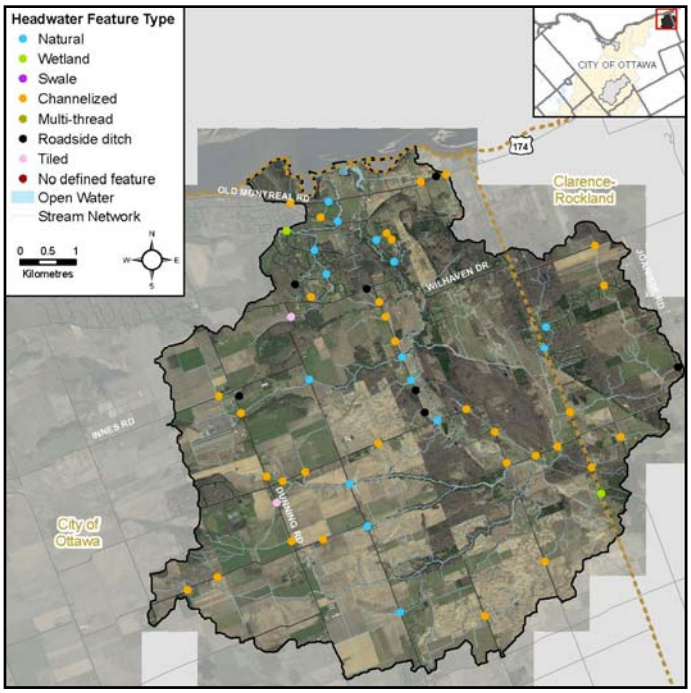



**Figure 34** Headwater feature types in the Becketts Creek catchment

Channelized drainage feature on Regimbald 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.

Flow conditions in the Becketts Creek catchment area are shown in Figure 35.

Intermittent feature with summer and spring conditions along Dunning Road

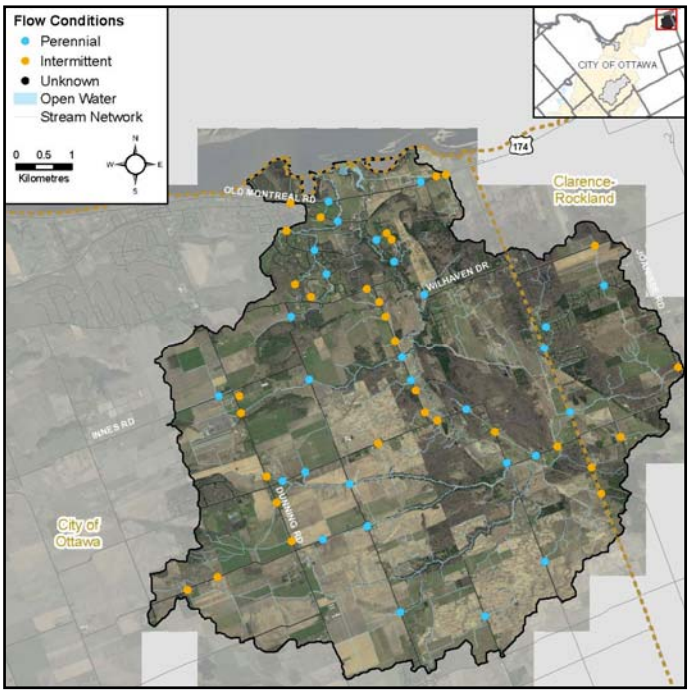



**Figure 35** Headwater feature flow conditions in the Becketts Creek catchment

### Feature Channel Modifications

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

Figure 36 shows channel modifications observed in Becketts Creek headwater drainage features. Most modifications in this catchment for headwater drainage features are dredging or straightening.

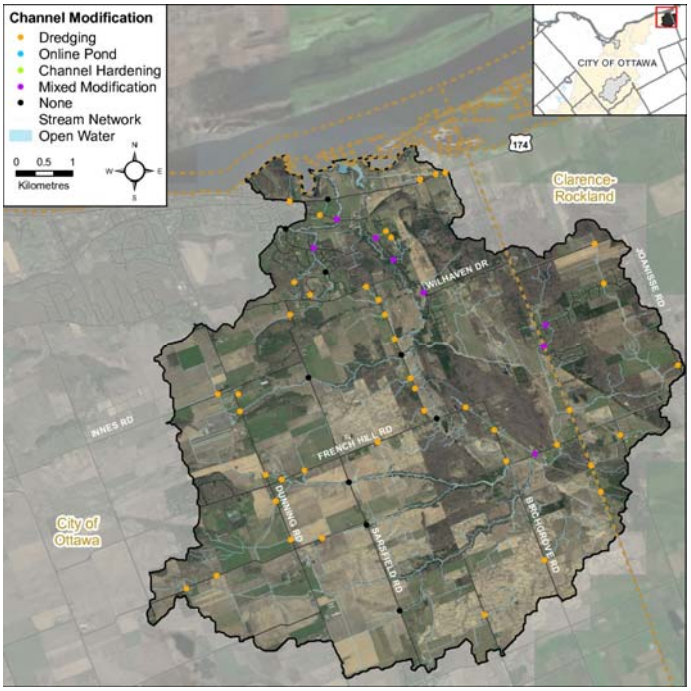



**Figure 36** Headwater feature channel modifications in the Becketts Creek Catchment

An example of mixed modifications: channel straightening and hardening with gabion baskets on Birchgrove 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 a very important role in flow, sediment movement and provides wildlife habitat. The following classifications are evaluated: no vegetation, lawn, wetland, meadow, scrubland and forest.

Figure 37 depicts the dominant vegetation observed at the sampled sites in the Becketts Creek catchment. No vegetation was the most common condition in springtime (27 features); flows and sediment transport are unmitigated by the lack of vegetative material. Of the remaining features: 17 were dominated by meadow, 14 by wetland vegetation and one was lawn.

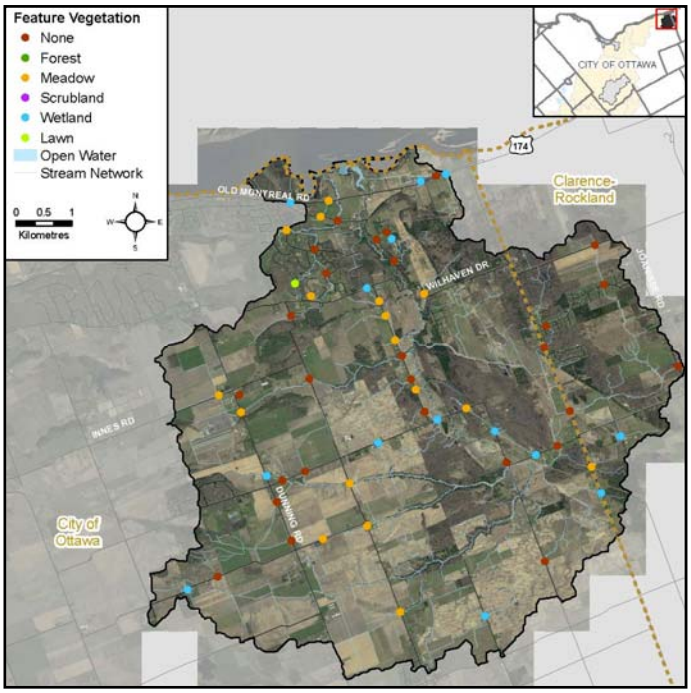



**Figure 37** Headwater feature vegetation in the Beckets Creek catchment

Instream meadow vegetation in HDF along Kinsella Drive

### 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 38 shows the type of riparian vegetation observed at the sampled headwater sites in the Becketts Creek catchment. These riparian zones have anthropogenic influences from agricultural areas as well as road infrastructure.

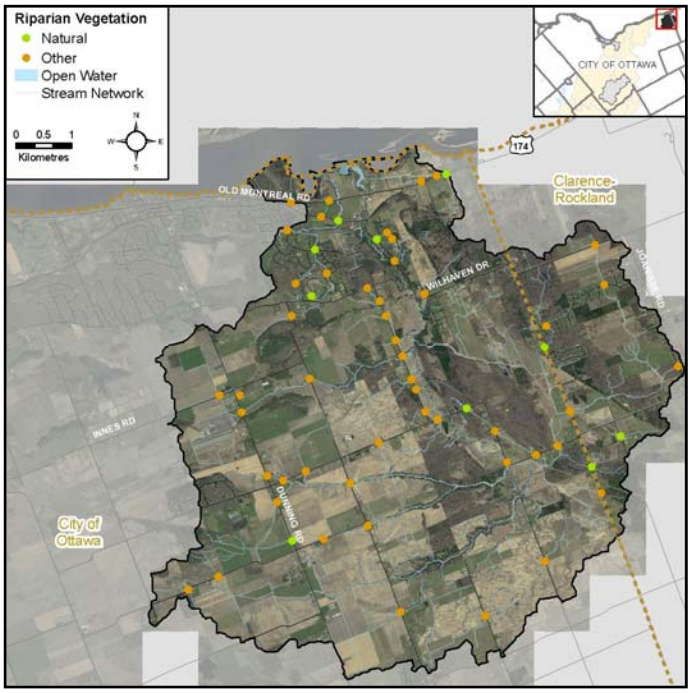



**Figure 38** Riparian vegetation types along headwater features in the Becketts Creek catchment

HDF with natural forest riparian vegetation along Becketts Creek Road

### Headwater Feature Sediment Deposition

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

From the upstream features assessed, sediment deposition ranged from none to extensive. Seven features had evidence of extensive deposition and six had substantial levels. Nine features had moderate amounts of deposits, 23 had minimal levels and 13 had no evidence of sediment deposition. Figure 39 shows the levels of sediment deposition in the catchment.

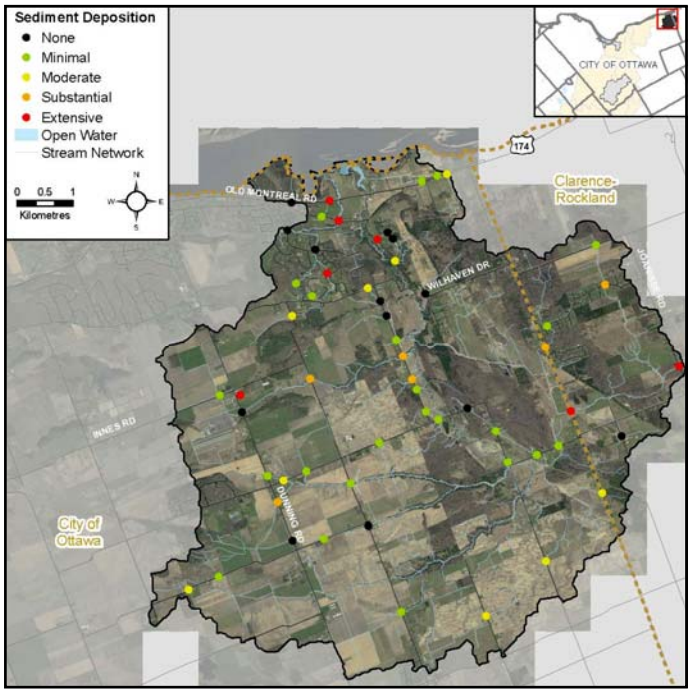



**Figure 39** Headwater feature sediment deposition in the Becketts Creek catchment

Extensive sediment deposition observed on Joannise Road

### Headwater Feature Upstream Roughness

Feature roughness is a relative measure of the amount of material within the feature that diffuses flows (OSAP, 2017). 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 Becketts Creek catchment, 29 of the sites had minimal roughness, 15 had moderate, 11 had high, and four had extreme coverage. Figure 40 shows the various feature roughness across the area.

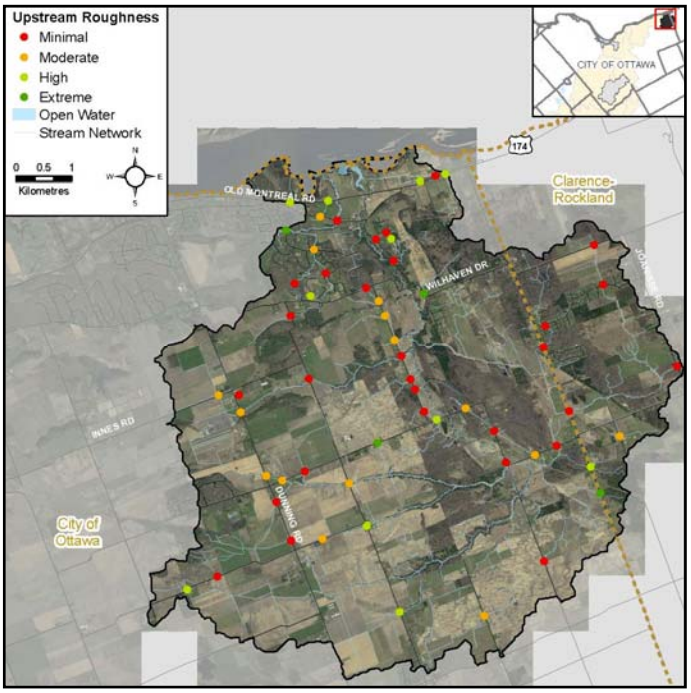



**Figure 40** Headwater feature roughness in the Becketts Creek catchment

High feature roughness in springtime provided by cattails within feature on French Hill Road

## *Stream Comparison Between 2006, 2011 and 2017*

The following tables provide a comparison of observations on Becketts Creek between the 2006, 2011 and 2017 survey years (RVCA 2006, RVCA 2011). Monitoring protocols from 2006 were modified and enhanced, so data from that year cannot be compared to the later years (there are some exceptions). In order to accurately represent current and historical information, the site data was only compared for those sections which were surveyed in both reporting periods. This resulted in changes to our overall summary information, averages presented here differ from ones in this report. This information is therefore only a comparative evaluation and does not 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 overall 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 parameters between 2006, 2011 and 2017. Average summer water temperatures range from cooler water in 2017 (17.7°C) to warmer values in 2011 (19.1°C), with 1.4 degrees centigrade of variation. In 2017 cooler temperatures than the two previous reporting years are possibly due to cooler air temperatures and higher precipitation experienced in 2017. Aside from these general temperature observations, loggers provide a detailed summary of stream thermal conditions.

Standardizing stream temperature accounts for climatic factors including air temperatures and precipitation. With the data collected from temperature loggers, standardized stream temperatures are calculated and summarized in Table 3. These values decreased by 0.05°C for every degree of air temperature from 2011 to 2017.

**Table 3** Water chemistry comparison (2006/2011/2017)

| Water Chemistry (2006—2017) | | | | |
|---|---|---|---|---|
| YEAR | PARAMETER | UNIT | AVERAGE | STND ERROR |
| 2011 | pH | - | 8.10 | ± 0.02 |
| 2017 | pH | - | 8.03 | ± 0.04 |
| 2011 | Sp. Conductivity | us/cm | 627.1 | ± 15.2 |
| 2017 | Sp. Conductivity | us/cm | 666.3 | ± 10.7 |
| 2011 | Dissolved Oxygen | mg/L | 7.92 | ± 0.16 |
| 2017 | Dissolved Oxygen | mg/L | 8.37 | ± 0.16 |
| 2006 | Water Temperature | ºC | 18.9 | ± 0.2 |
| 2011 | Water Temperature | ºC | 19.1 | ± 0.4 |
| 2017 | Water Temperature | ºC | 17.7 | ± 0.3 |
| 2011 | Standardized Stream Temperature[1] | ºC Water / 1ºC Air | 0.84 | ± 0.01 |
| 2017 | Standardized Stream Temperature[1] | ºC Water / 1ºC Air | 0.79 | ± 0.02 |

[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
- All temperatures points to be collected in July/August
- Logger must be deployed in flowing waters

Average dissolved oxygen levels were found to be increasing by 0.44 milligrams per liter from 2011 to 2017. These changes can also be attributed to weather patterns and cooler temperatures which are conducive to the stream's ability to hold more oxygen.

Average specific conductivity increased from 2011 to 2017 by 39.2 µS/cm and pH decreased by 0.07 units from 2011 to 2017. These slight changes may be indicative of increased anthropogenic input, specifically ionic compounds including road salts and fertilizers.

### *Invasive Species*

The overall percentage of sections surveyed where invasive species were observed had a significant reduction of 23 percent (Table 4). Purple loosestrife had a drastic reduction of observations by 72 percent, this decline may be associated to management efforts for this species (OMNR 2012). Decreases in observations of Manitoba maple may be due to increased beaver activity observed. Other invasive species have expanded their range, most notably poison parsnip. There are also other species that were not previously reported in the system that are now present including banded mystery snail, invasive buckthorn, invasive honey suckle, Japanese knotweed and periwinkle.

**Table 4** Invasive species presence observed in 2011 and 2017 (NPR are Not Previously Reported species)

| Invasive Species | 2011 | 2017 | +/- |
|---|---|---|---|
| banded mystery snail | NPR | 1% | ▲ |
| common & glossy buckthorn | NPR | 9% | ▲ |
| flowering rush | 8% | 4% | ▼ |
| garlic mustard | 0% | 7% | ▲ |
| honey suckle | NPR | 9% | ▲ |
| Japanese knotweed | NPR | 1% | ▲ |
| Manitoba maple | 70% | 40% | ▼ |
| periwinkle | NPR | 1% | ▲ |
| poison/wild parsnip | 24% | 51% | ▲ |
| purple loosestrife | 81% | 9% | ▼ |
| **Total** | **94%** | **71%** | ▼ |

### *Pollution*

Garbage accumulation on Becketts Creek was found to increase from 2006 to 2011 and then decreased significantly in 2017. Frequent precipitation events in 2017 may have flushed garbage downstream. In 2017 the polluted sections contained mostly garbage, such as tires, lodged in the stream bottom. During the headwater drainage feature assessments, dumping and garbage associated with the roadside was observed (see p. 9) and one case was reported to the Ministry of Environment.

**Table 5** Pollution levels (presence in % of sections)

| Pollution/Garbage | 2006 | 2011 | 2017 | +/- |
|---|---|---|---|---|
| floating garbage | 14% | 27% | 8% | ▼ |
| garbage on stream bottom | 19% | 17% | 7% | ▼ |
| unusual Coloration | 0% | 0% | 1% | ▲ |
| other | 1% | 37% | 1% | ▼ |
| **Total presence in % of sections** | **24%** | **39%** | **16%** | ▼ |

### *Instream Aquatic Vegetation*

Table 6 shows instream aquatic vegetation changes from 2011-2017. Broad leaved emergent plants (e.g. arrowhead), robust emergent plants (e.g. cattails) and submerged plants (e.g. pondweed) had increased presence in the number of sections surveyed. Other types of aquatic vegetation had decreased incidence, possibly associated to heavy rainfall which can make it difficult for certain plants to establish.

**Table 6** Instream aquatic vegetation (presence in % of sections)

| Instream Vegetation | 2011 | 2017 | +/- |
|---|---|---|---|
| narrow-leaved emergent plants | 86% | 64% | ▼ |
| broad-leaved emergent plants | 36% | 53% | ▲ |
| robust emergent plants | 33% | 39% | ▲ |
| free-floating plants | 34% | 1% | ▼ |
| floating plants | 9% | 6% | ▼ |
| submerged plants | 37% | 43% | ▲ |
| algae and mosses | 100% | 32% | ▼ |

### Fish Community

Fish sampling was carried out in 2007, 2011 and 2017 to evaluate fish community composition in Becketts Creek (see Table 7). In total 31 species have been observed by City Stream Watch. In 2006 19 species were captured at two sites; 26 species were found at 11 sites in 2011; and in 19 species were observed in eight sites in 2017. Deep water levels due to significant precipitation events in 2017 limited the type and effort of sampling. The majority of species observed in 2017 had been captured in previous years, with the spottail shiner as a new record. It is also important to note one invasive species, the common carp (Scott and Crossman 1998).

**Table 7** Comparison of fish species caught between 2007-2017

| Species | 2007 | 2011 | 2017 |
|---|---|---|---|
| black crappie *Pomoxis nigromaculatus* | | X | X |
| blacknose dace *Rhinichthys atratulus* | X | | |
| bluegill *Lepmois macrochirus* | | X | X |
| bluntnose minnow *Pimephales notatus* | X | X | X |
| brook stickleback *Culaea inconstans* | X | X | X |
| brown bullhead *Ameiurus nebulosus* | X | X | X |
| central mudminnow *Umbra limi* | X | X | X |
| cyprinid *spp.* | X | X | X |
| common carp *Cyprinus carpio* | | X | |
| common shiner *Luxilus cornutus* | X | X | X |
| creek chub *Semotilus atromaculatus* | X | | X |
| *Etherostoma spp.* | X | X | X |
| fathead minnow *Pimephales promelas* | X | X | X |
| golden shiner *Notemigonus crysoleucas* | | X | X |
| largemouth bass *Micropterus salmoides* | X | | |
| logperch *Percina caprodes* | X | X | |
| longnose dace *Rhinichthys cataractae* | X | X | |
| northern pearl dace *Margariscus nachtriebi* | | X | X |
| northern pike *Esox Lucius* | | X | X |
| northern redbelly dace *Chrosomus eos* | X | | |
| pumpkinseed *Lepomis gibbosus* | X | X | X |
| rock bass *Ambloplites rupestris* | X | X | |
| *Rhinichthys spp.* | | X | |
| shorthead redhorse *Moxostoma macrolepidotum* | | X | |
| silver redhorse *Moxostoma anisurum* | | X | X |
| spottail shiner *Notropis hudsonius* | | | X |
| tadpole madtom *Noturus gyrinus* | | X | |
| walleye *Sander vitreus* | | X | X |
| white sucker *Catostomus commersonii* | X | X | X |
| yellow bullhead *Ameiurus natalis* | | X | |
| yellow perch *Perca flavescens* | X | X | |
| **Total Species 31** | **18** | **26** | **19** |

Assessing bulk weights of fish captured by electrofishing in Becketts Creek

### *Beaver Activity and Dams*

The total number of beaver dams observed in 2017, compared to 2011 increased by two, lodges decreased by two (Table 8). More notably, the total beaver activity in the area has increased in 26 percent of sections.

**Table 8** Number of beaver dams observed (2011/2017)

| Metric | 2011 | 2017 | +/- |
|---|---|---|---|
| Number of lodges | 6 | 4 | ▼ |
| Percent of sections with beaver cropping | 8 % | 34 % | ▲ |
| **Total number of dams** | **12** | **14** | ▲ |

### *Bank Erosion*

Bank stability has decreased since 2011, Table 9 shows the average proportion of sections surveyed which had bank erosion observed. Bank erosion is observed in more areas. This increase in process may be in part due to high precipitation and increased erosive forces experienced in 2017.

**Table 9** Left and right bank erosion levels (2011/2017)

| Level of Erosion | 2011 | 2017 | +/- |
|---|---|---|---|
| Left Bank | 26% | 30% | ▲ |
| Right Bank | 25% | 31% | ▲ |

### Monitoring and Restoration Projects on Becketts Creek

Table 8 highlights recent and past monitoring that has been done on Becketts Creek by the City Stream Watch Program. Monitoring activities and efforts have changed over the years. Potential restoration opportunities are listed on the following page.

**Table 10** City Stream Watch monitoring efforts on Becketts Creek

| Accomplishment | Year | Description |
|---|---|---|
| **City Stream Watch Stream Monitoring** | 2006 | 11.6 km of stream was surveyed |
| | 2011 | 15.8 km of stream was surveyed |
| | 2017 | 13.0 km of stream was surveyed |
| **City Stream Watch Fish Sampling** | 2007 | two fish community sites were sampled |
| | 2011 | 11 fish community sites were sampled |
| | 2017 | eight fish community sites were sampled |
| **City Stream Watch Thermal Classification** | 2011 | five temperature probes were deployed |
| | 2017 | five temperature probes were deployed |
| **City Stream Watch Headwater Drainage Feature Assessment** | 2017 | 61 headwater drainage feature sites were sampled in the Becketts Creek catchment |

Active beaver dam on Becketts Creek in 2011 (left) and 2017 (right)

Temperature probe installation in Becketts Creek near Old Montreal Road

### Potential Riparian Restoration Opportunities

Riparian restoration opportunities were assessed in the field and include potential enhancement through riparian planting, erosion control, invasive species management and/or wildlife habitat creation (Figure 41).

### Invasive Species Control

Invasive species management is recommended especially in areas where new invasive species were observed in single instances, these include Japanese knotweed and Periwinkle.

### Riparian Planting

Various sections of Becketts Creek riparian area can benefit from riparian planting. Many sections had unstable banks and signs of erosion, planting would counter these negative effects on the system. Runoff and anthropogenic impacts would also be mitigated.

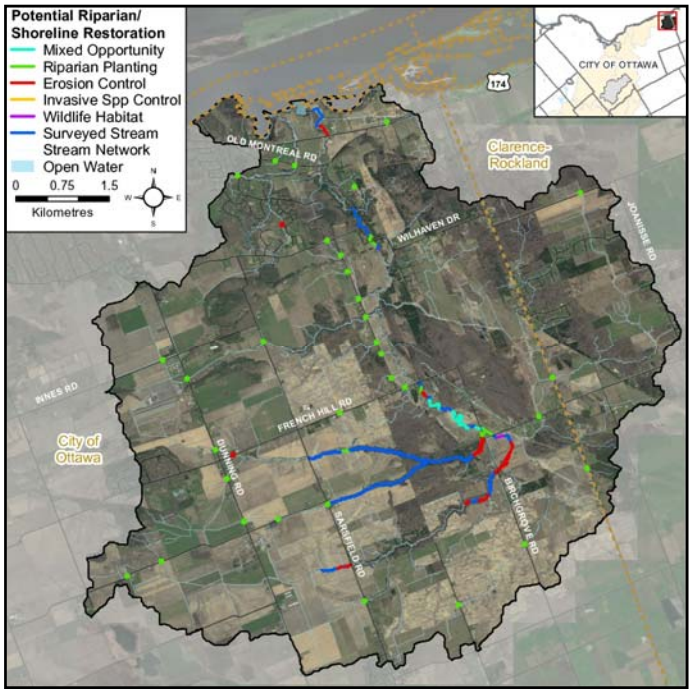



**Figure 41** Potential riparian/shoreline restoration opportunities along Becketts Creek

Shoreline of Becketts Creek with potential for riparian planting and bioengineering

### Potential Instream Restoration Opportunities

### Fish Habitat Enhancement

Fish habitat restoration potential was assessed in a single area shown in Figure 42. Potential habitat enhancement work could include the installation of rock (cover and riffle creation) and instream woody structure.

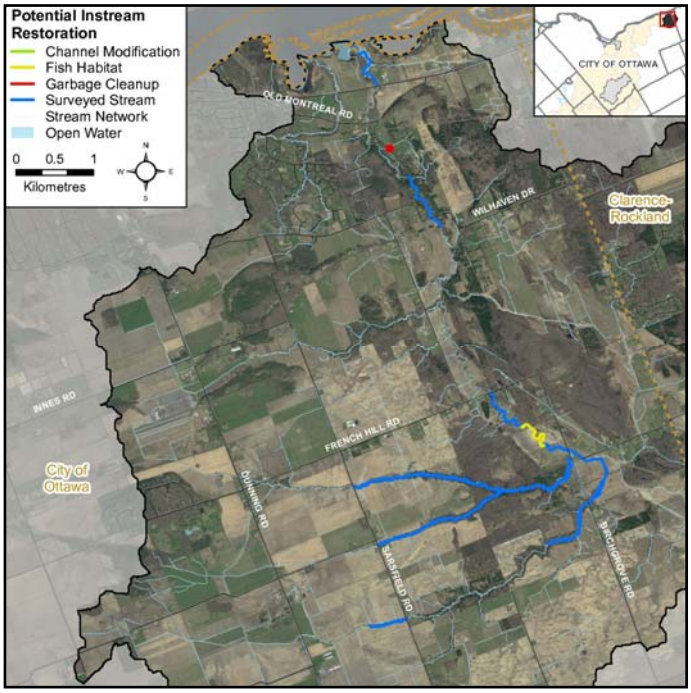



**Figure 42** Potential instream restoration opportunities in Becketts Creek

### Tile Outlet Control

Due to the high agricultural land use in the Becketts Creek catchment, many 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, 2011).

Headwater drainage feature that could benefit from tile outlet control in the Becketts Creek catchment



**References**


1. Canadian Council of Ministers of the Environment (CCME), 1999. Canadian water quality guidelines for the protection of aquatic life: Dissolved oxygen (freshwater). In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.
2. Environment Canada, 2011. Canada's Freshwater Quality in a Global Context Indicator. Data sources and methods. ISBN: 978-1-100-17978-0 . Available online: http://publications.gc.ca/collections/collection_2011/ec/En4-144-3-2011-eng.pdf
3. Environment Canada, 2013. *How Much Habitat is Enough? Third Edition*. Environment Canada, Toronto, Ontario. Accessed online: https://www.ec.gc.ca/nature/default.asp?lang=En&n=E33B007C-1.
4. Chu, C., Jones, N.E., Piggott, A.R. and Buttle, J.M., 2009. Evaluation of a simple method to classify the thermal characteristics of streams using a nomogram of daily maximum air and water temperatures. *North American Journal of Fisheries Management*, *29*(6), pp.1605-1619.
5. Coker, G.A., Portt, C.B. and Minns, C.K., 2001. *Morphological and ecological characteristics of Canadian freshwater fishes*. Burlington, Ontario: Fisheries and Oceans Canada.
6. Ministry of Environment and Energy (MOEE), 1994. Water management policies, guidelines, provincial water quality objectives of the Ministry of Environment and Energy. Copyright: Queens Printer for Ontario, 1994.
7. Ontario Ministry of Natural Resources (OMNR), 2012. Ontario Invasive Species Strategic Plan. Toronto: Queens Printer for Ontario. Accessed online: https://dr6j45jk9xcmk.cloudfront.net/documents/2679/stdprod-097634.pdf.
8. Rideau Valley Conservation Authority (RVCA), 2006. *City Stream Watch 2006 Annual Report.* Manotick, ON: Grant Nichol.
9. Rideau Valley Conservation Authority (RVCA), 2011. *Becketts Creek 2011 Summary Report.* Manotick, ON: Julia Sutton.
10. Rideau Valley Conservation Authority (RVCA), 2017. Around the Rideau May/June 2017. Manotick, ON. Available online: https://www.rvca.ca/media/k2/attachments/ATR_May-June_2017.pdf
11. Scott, W.B. and E.J. Crossman. 1998. Freshwater Fishes of Canada. Galt House Publications Ltd, Oakville pp.1-966.
12. Stanfield, L. (editor) 2017. Ontario Stream Assessment Protocol (OSAP). Version 10.0. Fish and Wildlife Branch, Ontario Ministry of Natural Resources, Peterborough, Ontario.
13. Stoneman, C.L. and Jones, M.L., 1996. A simple method to classify stream thermal stability with single observations of daily maximum water and air temperatures. *North American Journal of Fisheries Management*, *16*(4), pp.728-737.
14. Stuart, V., Harker, D.B. and Clearwater, R.L., 2010. *Watershed Evaluation of Beneficial Management Practices (WEBs): Towards Enhanced Agricultural Landscape Planning-Four-Year Review (2004/5-2007/8)*. Agriculture and Agri-Food Canada, Ottawa, Ont.


For more information on the overall 2017 City Stream Watch Program and the volunteer activities, please refer to the City Stream Watch 2017 Summary Report: https://www.rvca.ca/rvca-publications/city-stream-watch-reports

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