Mosquito Creek 2015 Summary Report

Watershed Features	
Area	41.08 square kilometres 0.97% of the Rideau Valley watershed
Land Use	44% agriculture 22% forest 16% urban 10% rural 7% wetland 1% waterbody
Surficial Geology	40% clay 25% sand 15% gravel 13% diamicton 4% organic deposits 3% Paleozoic bedrock
Watercourse Type	*Watercourse Type:* 98% natural 2% channelized *Flow Type:* 100% permanent
Invasive Species	There were twelve invasive species observed in 2015: purple loosestrife, Manitoba maples, common buckthorn, garlic mustard, flowering rush, wild parsnip, curly leafed pondweed, honey suckle, European frogbit, Himalayan balsam, glossy buckthorn, phragmites
Fish Community	37 fish species have been captured in Mosquito Creek historically including nine game fish species

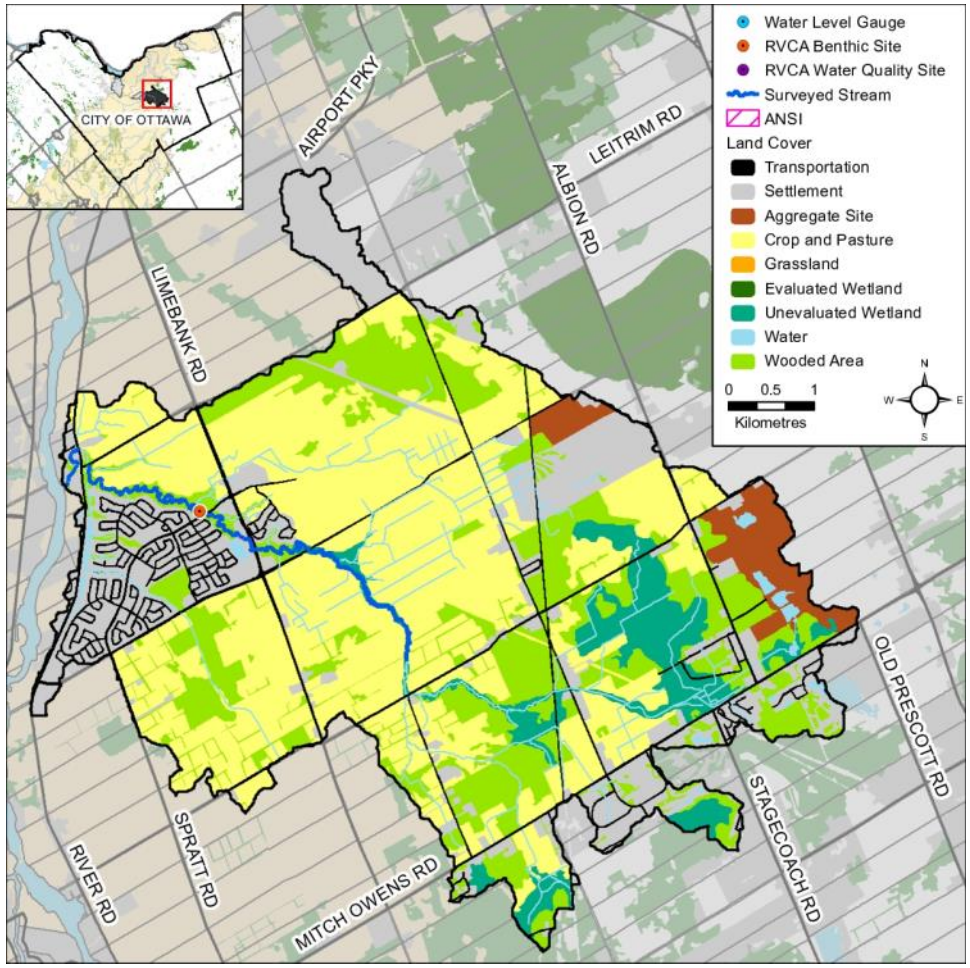


Figure 1 Land cover in the Mosquito Creek catchment

Woodlot Cover

Size Category	Number of Woodlots	% of Woodlot Cover
10-30 ha	15	10
>30 ha	6	4

Wetland Cover

7% of the catchment is wetland

Bedrock substrate along Mosquito Creek

The Rideau Valley Conservation Authority, in partnership with seven other agencies in Ottawa (City of Ottawa, Heron Park Community Association, Ottawa Flyfishers Society, Ottawa Stewardship Council, Rideau Roundtable, National Defence HQ - Fish and Game Club, and the National Capital Commission) form the 2015 City Stream Watch collaborative.

Introduction

The headwaters of Mosquito Creek begin at Rideau Road, at the confluence of the Spratt and Nolan municipal drains. Dancy and Downey municipal drains flow into Spratt and Nolan upstream of that confluence. Mosquito Creek then winds its way through agricultural fields north of Earl Armstrong Road, where land use changes from agricultural to residential. Halfway between Spratt Road and Leitrim Road, Mosquito Creek becomes deeper and requires a canoe or kayak to survey. Mosquito Creek winds around River Road, and becomes quite wide where it flows into the Rideau River.

Mosquito Creek provides significant spawning and rearing habitat for both baitfish and gamefish, which in turn, enhances the productivity of the Rideau River. Between the mouth of Mosquito Creek and the crossing at Leitrim Road, grassy banks provide important habitat for pike and muskellunge spawning during the spring freshet (RVCA, 2009).

The Mosquito Creek catchment has experienced increased development with the creation of the Riverside South Community north of Earl Armstrong Road beginning in the mid 1990’s. In the early 2000’s, residential development was extended to the area east of Limebank Road and there is currently active development taking place in the area south of Earl Armstrong Road, west of Limebank Road. Much of the land surrounding Mosquito Creek upstream of Earl Armstrong Road is currently owned by developers and is being leased out for agricultural purposes prior to future development.

In 2015, 75 sections (7.5 km) of Mosquito Creek were surveyed as part of the City Stream Watch monitoring activities. The following is a summary of observations made by staff and volunteers along those 75 sections.

Mosquito Creek Overbank Zone

Riparian Buffer Width Evaluation

The riparian or shoreline zone is that special area where the land meets the water. Well-vegetated shorelines are critically important in protecting water quality and creating healthy aquatic habitats, lakes and rivers. Natural shorelines intercept sediments and contaminants that could impact water quality conditions and harm fish habitat in streams. Well established buffers protect the banks against erosion, improve habitat for fish by shading and cooling the water and provide protection for birds and other wildlife that feed and rear young near water. A recommended target (from Environment Canada’s Guideline: How Much Habitat is Enough?) is to maintain a minimum 30 meter wide vegetated buffer along at least 75 percent of the length of both sides of rivers, creeks and streams. Mosquito Creek has a very healthy buffer width along most of its length. It surpassed the target above by having a buffer of greater than 30 meters along 80 percent of the right bank and 82 percent of the left bank. Figure 2 demonstrates the buffer conditions of the left and right banks separately.

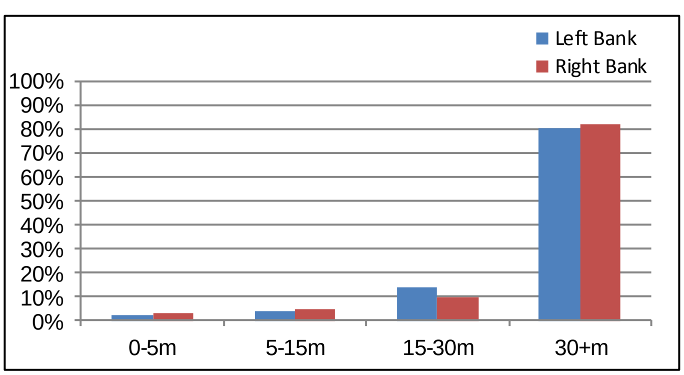


Figure 2 Vegetated buffer width along Mosquito Creek

Adjacent Land Use

The RVCA’s City Stream Watch Program identifies 11 different land uses beside Mosquito Creek (Figure 3). Surrounding land use is considered from the beginning to end of each survey section (100m) and up to 100m on each side of the creek. Land use outside of this area is not considered for the surveys but is nonetheless part of the subwatershed and will influence the creek. Natural areas made up 65 percent of the surveyed stream, characterized by forest, scrubland, meadow and wetland. Nineteen percent of the land use along the surveyed sections of the stream was made up of agriculture and abandoned agriculture while 10 percent was residential use. The remaining six percent of the land use surveyed was recreational, industrial/ commercial and infrastructure which includes any road crossings.

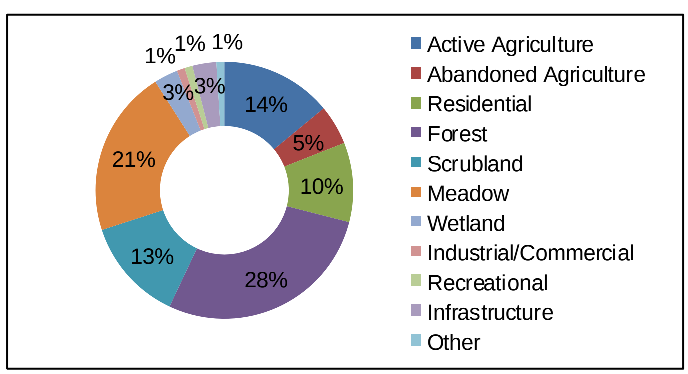


Figure 3 Land use along Mosquito Creek

Mosquito Creek Shoreline Zone

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 a detrimental effect on important fish and wildlife habitat. 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 potential to impact instream migration. Figure 4 shows moderate levels of bank erosion were observed along many sections of Mosquito Creek. There were a few sections where bank scouring on bends in the creek have resulted in higher levels of erosion observed downstream of Spratt Road.

Undercut Stream Banks

Undercut banks are a normal and natural part of stream function and can provide excellent refuge areas for fish. Figure 5 shows that the bank undercutting on Mosquito Creek varied considerably. Some parts of the creek had no bank undercutting interspersed with areas of low level undercutting. Moderate levels of undercutting were observed in sections downstream of Spratt Road. The bank and substrate composition in this area is dominated by clay and undercutting was seen along many of the bends in the creek.

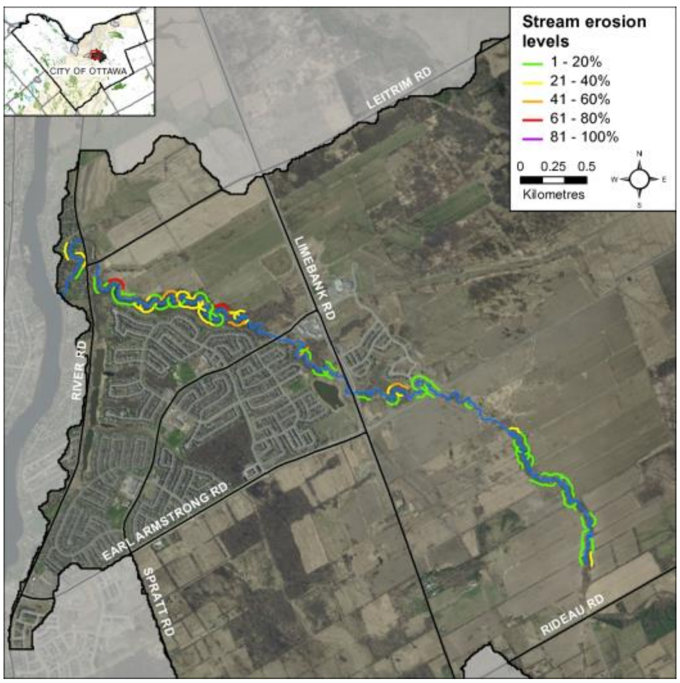


Figure 4 Erosion along Mosquito Creek

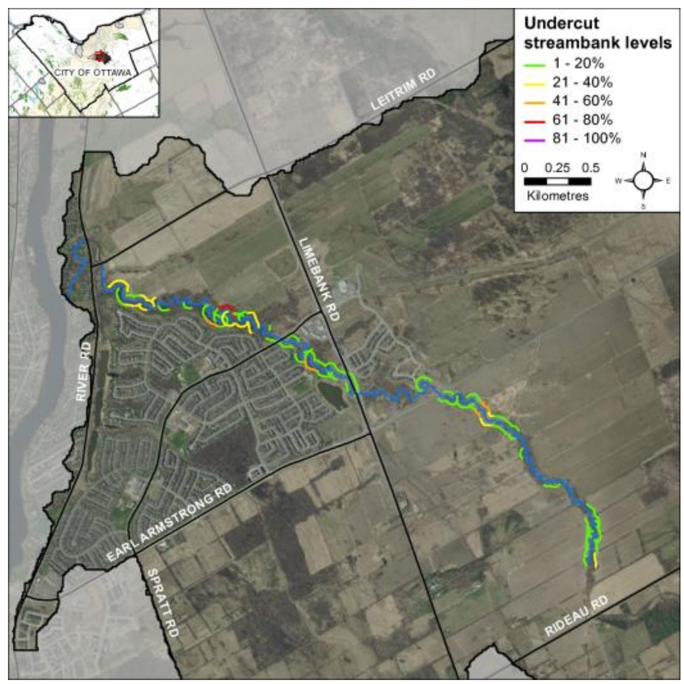


Figure 5 Undercut stream banks along Mosquito Creek

Stream bank erosion along Mosquito Creek

Bank undercutting along Mosquito 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. Figure 6 shows stream shading along Mosquito Creek. Much of Mosquito Creek has a well vegetated buffer so the stream is shaded by a combination of trees, shrubs and grasses along most of its length.

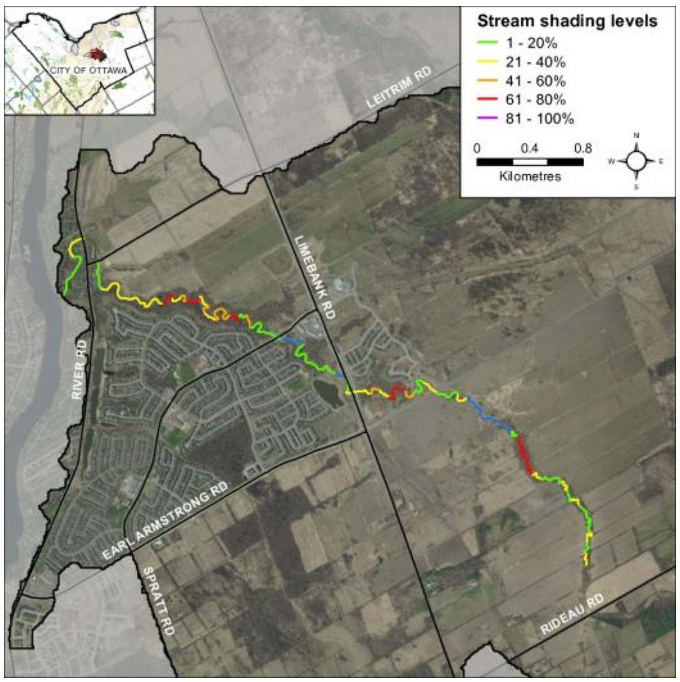


Figure 6 Stream shading along Mosquito Creek

Stream shade along Mosquito Creek

Instream Woody Debris

Figure 7 shows that overall, the surveyed sections along Mosquito Creek had moderate levels of instream woody debris in the form of branches and trees. Instream woody debris is important for fish and benthic habitat, by providing refuge and feeding areas.

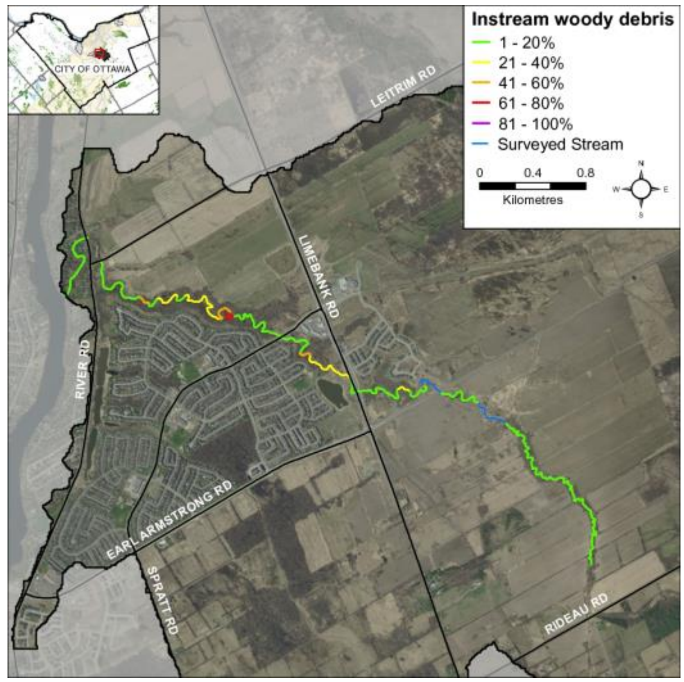


Figure 7 Instream woody debris along Mosquito Creek

Instream woody debris along Mosquito Creek

Overhanging Trees and Branches

Figure 8 shows that most of the sections surveyed on Mosquito Creek had low to moderate levels of overhanging branches and trees. Trees and branches that are less than one meter from the surface of the water are defined as overhanging. At this proximity to the water branches and trees provide a food source, nutrients and shade which helps to moderate instream water temperatures.

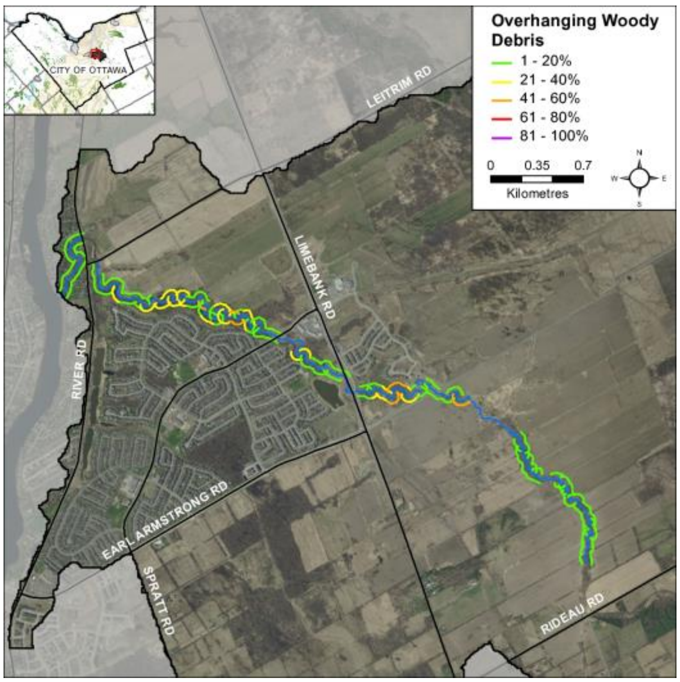


Figure 8 Overhanging trees and branches

Overhanging trees and branches on Mosquito Creek

Anthropogenic Alterations

Figure 9 shows that 88 percent of the sections on Mosquito Creek remain "unaltered" or "natural". Sections considered "altered" account for eight percent of the stream, while only four percent of the sections sampled were considered "highly altered". Very few of the surveyed sections of Mosquito Creek were channelized so the highly altered sections of the creek refer to areas where the creek runs through a culvert or there is a road crossing with associated instream/shoreline modifications.

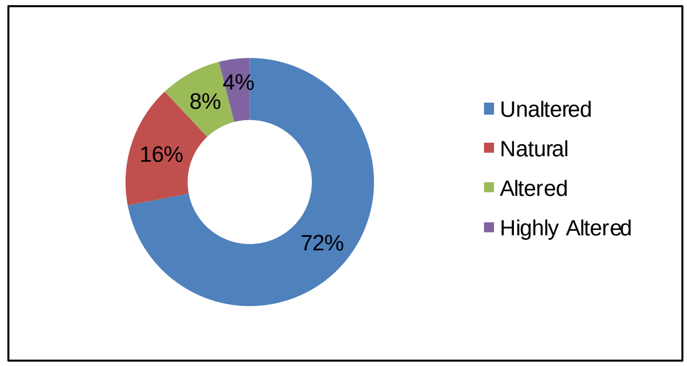


Figure 9 Anthropogenic alterations along Mosquito Creek

A highly altered section of Mosquito Creek running through the culvert at Limebank Road

Mosquito Creek Instream Aquatic Habitat

Habitat Complexity

Streams are naturally meandering systems that move over time with varying degrees of habitat complexity. Examples of habitat complexity include habitat types such as pools and riffles as well as substrate variability and woody debris structure. A high percentage of habitat complexity (heterogeneity) typically increases the biodiversity of aquatic organisms within a system. Overall, Mosquito Creek had high levels of habitat complexity although there were some small isolated homogeneous sections observed throughout the 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. Figure 11 shows that 39 percent of the instream substrate observed on Mosquito Creek was clay. Thirty seven percent of the substrate was recorded as silt and sand and the remaining 24 percent was made up of gravel, cobble, boulder and bedrock. Figure 12 shows the distribution of the dominant substrate types along the system. Clay was recorded as the dominant substrate from the mouth of the creek to until a few sections before Spratt Road at which point the substrate changes to a mix of bedrock and cobble. Upstream of Spratt Road the dominate substrate fluctuates between clay, cobble, sand and silt.

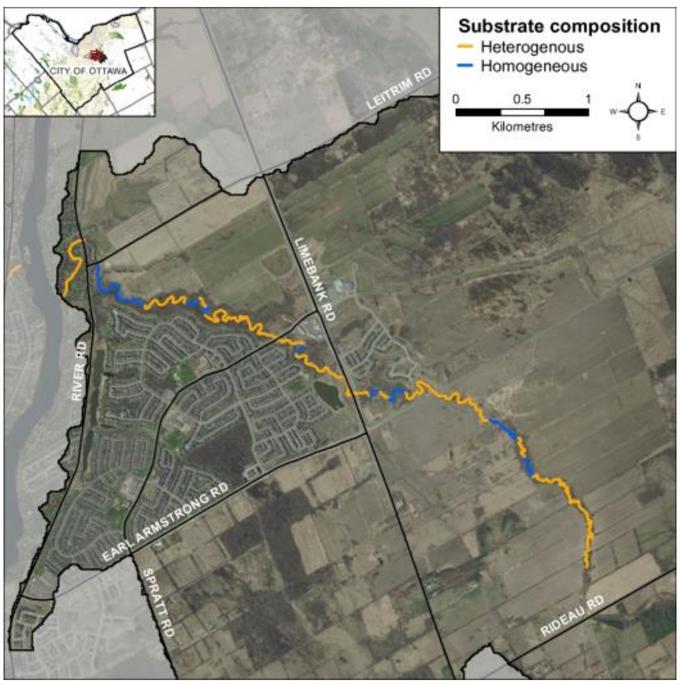


Figure 10 Instream habitat complexity in Mosquito Creek

Habitat complexity on Mosquito Creek

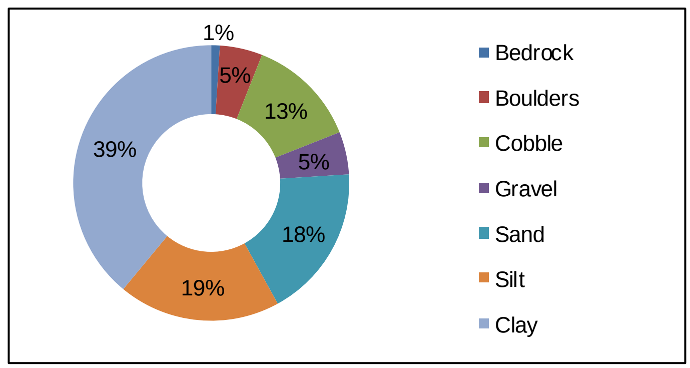


Figure 11 Instream substrate along Mosquito Creek

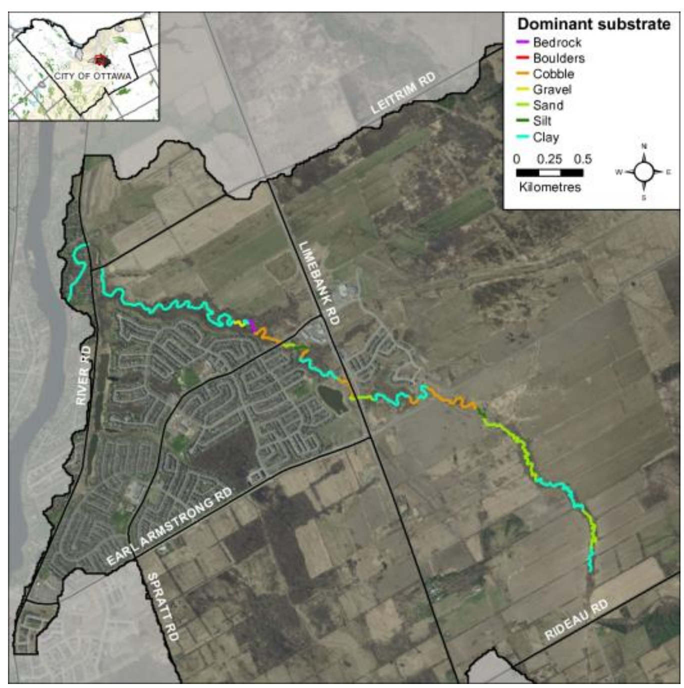


Figure 12 Dominant instream substrate in Mosquito Creek

Cobble and Boulder Habitat

Boulders create instream cover and back eddies for large fish to hide and/or rest out of the current. Cobble provides important over-wintering and/or spawning habitat for small or juvenile fish. Cobble can also provide habitat conditions for benthic invertebrates that are a key food source for many fish and wildlife species. Figure 13 shows the distribution of cobble and boulder habitat along Mosquito Creek. Areas of cobble and boulder habitat are well dispersed throughout the creek except for near the mouth of the creek where clay substrates dominated

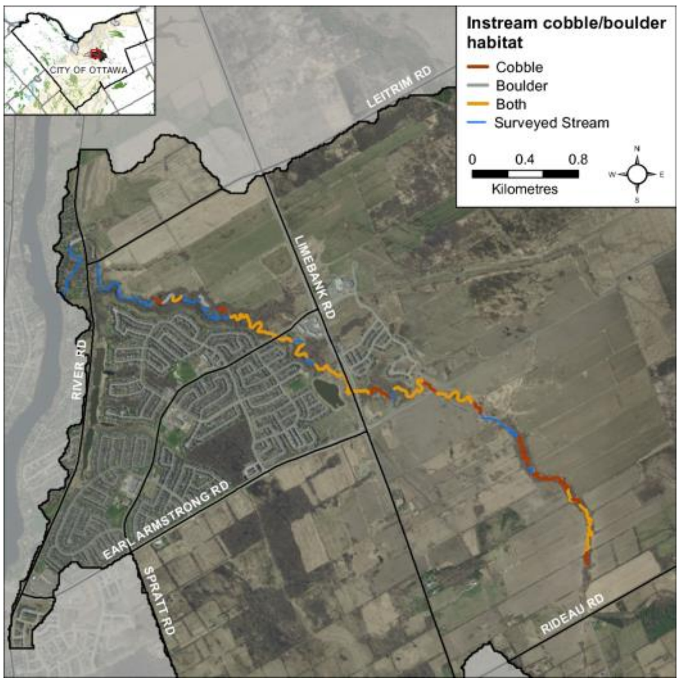


Figure 13 Cobble and boulder habitat in Mosquito Creek

Cobble and boulder habitat observed along Mosquito Creek downstream of Spratt Road

Instream Morphology

Pools and riffles are important habitat features for fish. 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 sauger and walleye. Pools provide shelter for fish and can be refuge areas 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 surfaces of water and areas where the thalweg (deepest part of the channel) is in the center of the channel.

Figure 14 shows that Mosquito Creek has good variability in instream morphology; 54 percent consists of pools, 42 percent consists of runs and four percent consists of riffles. Figure 15 shows where areas of riffle habitat was observed in Mosquito Creek.

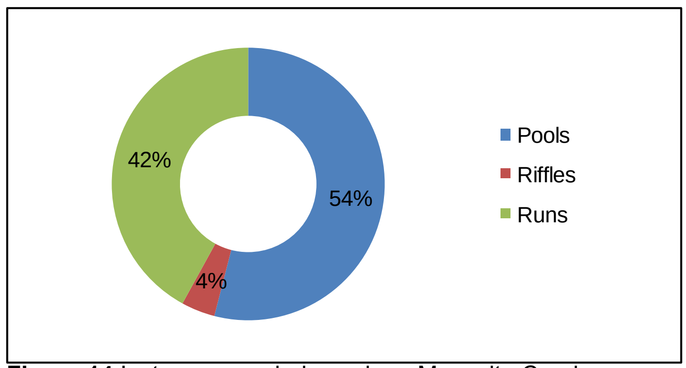


Figure 14 Instream morphology along Mosquito Creek

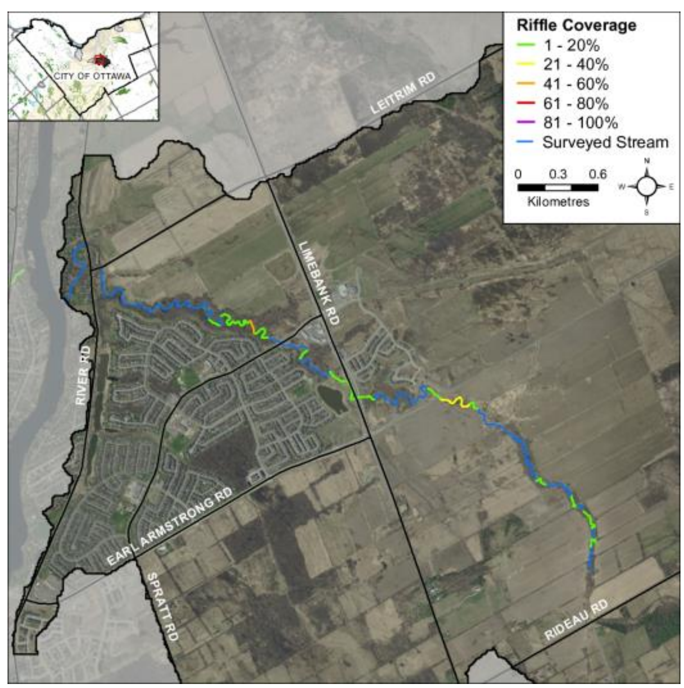


Figure 15 riffle coverage in Mosquito Creek

Vegetation Type

Instream vegetation provides a variety of functions and is a critical component of the aquatic ecosystem. For example emergent plants along the shoreline can provide shoreline protection from wave action and important rearing habitat for species of waterfowl. Submerged plants provide habitat for fish to find shelter from predator fish while they feed. Floating plants such as water lilies shade the water and can keep temperatures cool while reducing algae growth. Figure 16 depicts the high diversity of plant community structure in Mosquito Creek. The vegetation type observed in highest percentage, at 27 percent, is algae. Submerged plants and narrow leaved emergents were also recorded often, at 23 percent and 16 percent respectively. The distribution of overall dominant types of instream vegetation is reflected in Figure 17.

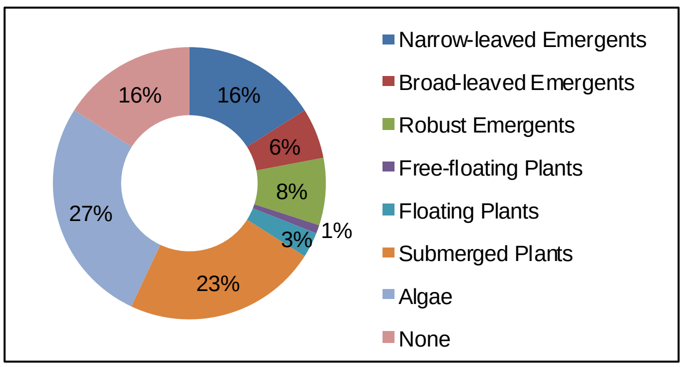


Figure 16 Vegetation types along Mosquito Creek

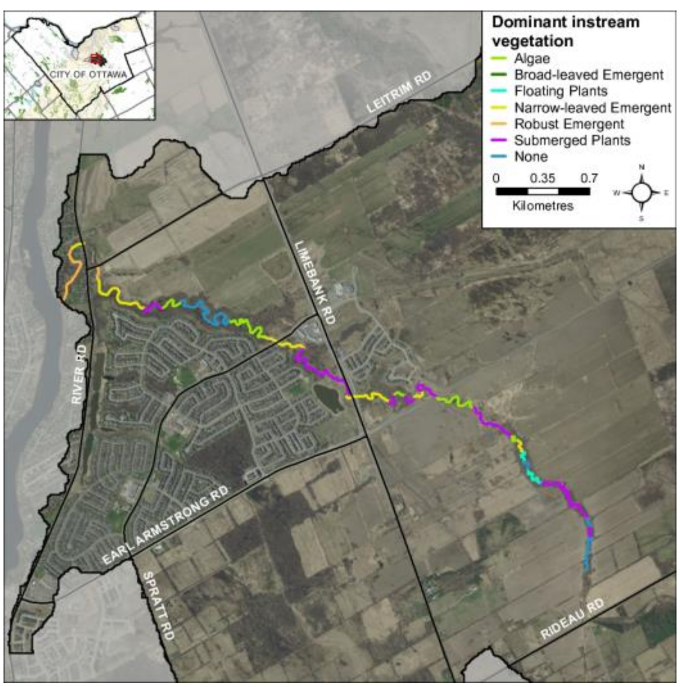


Figure 17 Dominant instream vegetation types in Mosquito Creek

Instream Vegetation Abundance

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. Too much vegetation can also be detrimental. Figure 18 demonstrates that overall Mosquito Creek had normal to low levels of instream vegetation. Common levels accounted for 19 percent, normal levels accounted for 38 percent, low levels accounted for 27 percent, and rare levels accounted for 16 percent.

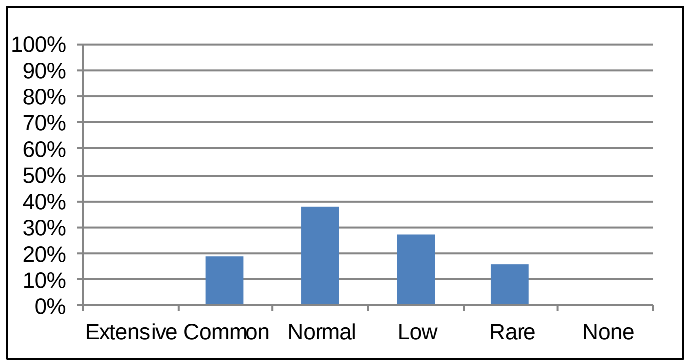


Figure 18 Instream vegetation abundance in Mosquito Creek

Floating plants and robust emergents observed on Mosquito Creek

Mosquito Creek Stream Health

Invasive Species

Invasive species can have major implications 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. Invasive species were observed along 100 percent of the sections surveyed along Mosquito Creek (Figure 19). Figure 20 shows the variety of invasive species observed along Mosquito Creek. The invasive species that were observed most frequently were purple loosestrife (*Lythrum salicaria),* Manitoba maple (*Acer negundo*), common buckthorn (*Rhamnus cathartica)*, and garlic mustard (*Alliaria petiolata*).

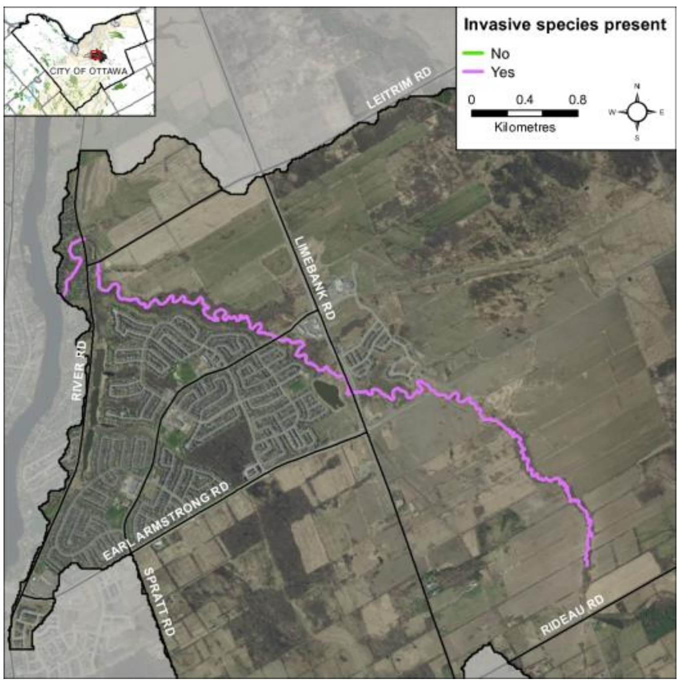


Figure 19 Presence of invasive species along Mosquito Creek

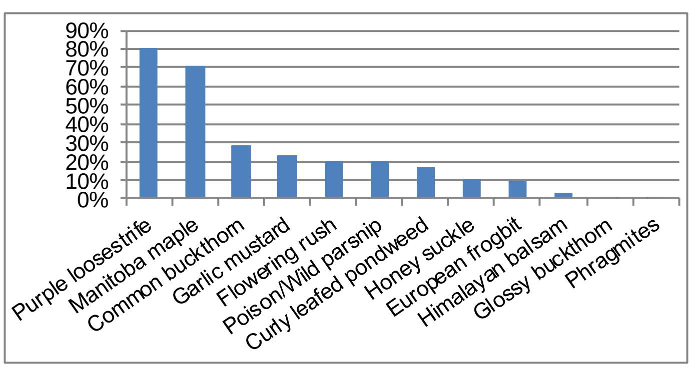


Figure 20 Invasive species observed along Mosquito Creek

Pollution

Figure 21 demonstrates the incidence of pollution/ garbage in Mosquito Creek. Fifty six percent of the sections surveyed on Mosquito Creek did not have any observable garbage. Twenty seven percent had garbage on the stream bottom, 21 percent had floating garbage, and one percent had an unclassified type of pollution. Most of the sections where garbage was observed had more than one type of garbage and were near road crossings.

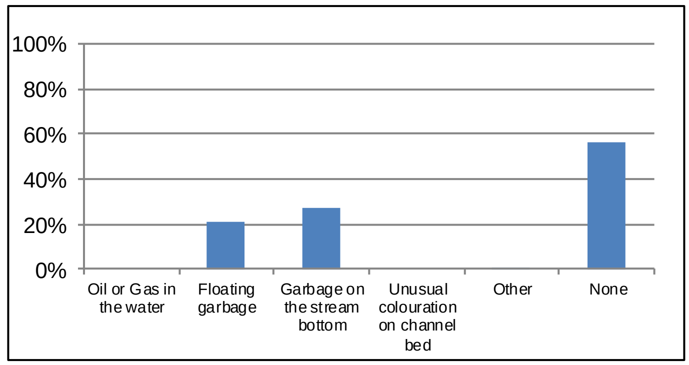


Figure 21 Pollution observed along Mosquito Creek

Wildlife

The diversity of fish and wildlife populations can be an indicator of water quality and overall stream health.

Wildlife	Observed
Birds	green heron, belted kingfisher, mallard, canada goose, wood duck, red-winged black bird, northern cardinal, american robin, american goldfinch, white-throated sparrow, american crow, blue jay, gray catbird, hawk, turkey vulture, pileated woodpecker, northern flicker, tree swallow, woodpecker spp., black-capped chickadee, sand piper, gull spp., song sparrow
Mammals	white tailed deer, north american beaver, raccoon, red squirrel, muskrat
Reptiles Amphibians	painted turtle, snapping turtle, green frog, tadpoles, tree frog, leopard frog, wood frog, bull frog
Aquatic Insects	water strider, water boatmen, crayfish spp.
Other	admiral butterfly, caterpillar, monarch butterfly, damselfly spp., ebony jewelwing, mosquito, bee spp., bumblebee, black-margined loosestrife bettle, snail, spider spp., slug

Table 1 Wildlife observed along Mosquito Creek

Mosquito Creek Water Chemistry

Water Chemistry Measurement

During the stream characterization survey, a YSI probe is used to collect water chemistry information. Dissolved oxygen, conductivity and pH are measured at the start and end of each section.

Volunteers measuring water chemistry using a YSI

Dissolved Oxygen

Dissolved oxygen is a measure of the amount of oxygen dissolved in water. The Canadian Environmental Quality Guidelines of the Canadian Council of Ministers of the Environment (CCME) suggest that for the protection of aquatic life the lowest acceptable dissolved oxygen concentration should be 6 mg/L for warmwater biota (red line in Figure 22) and 9.5 mg/L for coldwater biota (blue line in Figure 22) (CCME, 1999). Figure 22 shows that most of the stretches of Mosquito Creek meet the standard for warmwater biota. The stretch of creek from the mouth of the creek to River Road had lower average dissolved oxygen compared to other stretches and doesn't meet standard of 6 mg/L for warmwater biota.

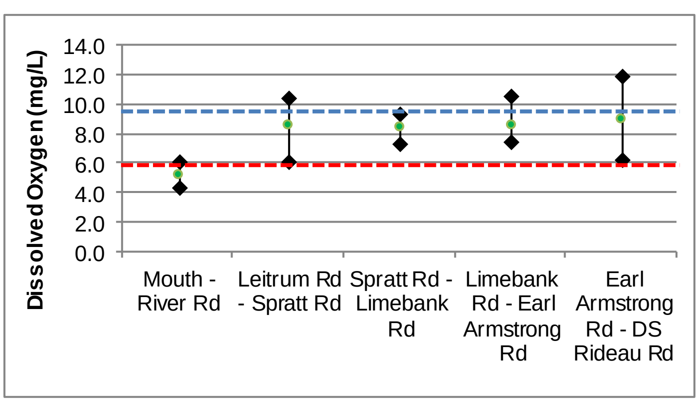


Figure 22 Dissolved oxygen ranges in Mosquito Creek

Conductivity

Conductivity in streams is primarily influenced by the geology of the surrounding environment, but can vary drastically as a function of surface water runoff. Currently there are no CCME guideline standards for stream conductivity, however readings which are outside the normal range observed within the system are often an indication of unmitigated discharge and/or stormwater input. The average specific conductivity observed within Mosquito Creek was 874 µs/cm. Figure 23 shows that the conductivity readings varied moderately along the course of the creek. The lowest average specific conductivity reading on Mosquito Creek was 752 µs/cm which was recorded in the stretch of the creek from the mouth to River Road. A slightly elevated average specific conductivity of 1011 µs/cm was recorded between Leitrim Road and Spratt Road, then the average specific conductivity moderates in the last three sections at 899 µs/cm , 852 µs/cm and 855 µs/cm respectively.

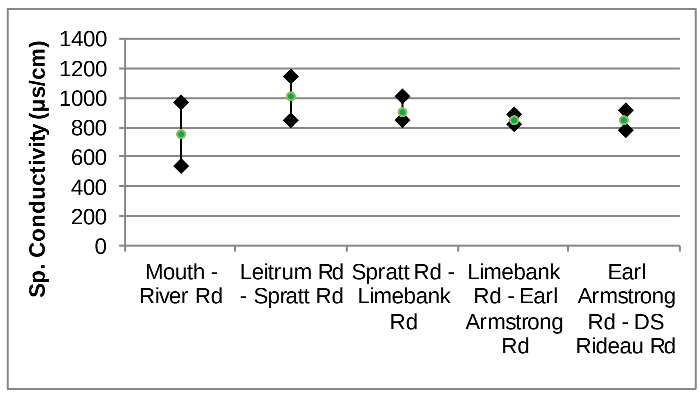


Figure 23 Conductivity ranges in Mosquito Creek

pH

Based on the PWQO for pH, a range of 6.5 to 8.5 should be maintained for the protection of aquatic life. Average pH values for Mosquito Creek ranged between 7.6 and 8.1, thereby meeting the provincial standard.

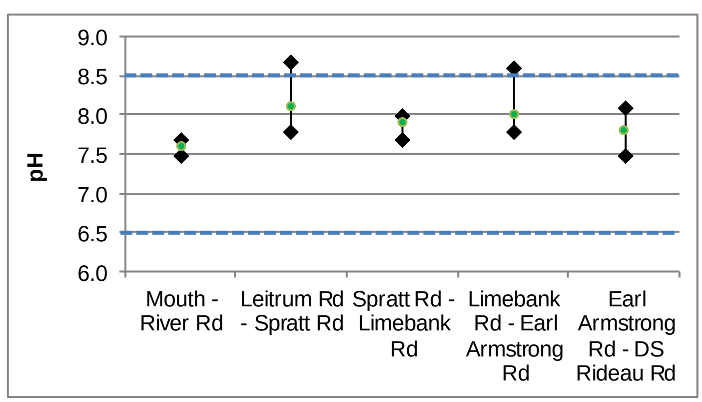


Figure 24 pH ranges in Mosquito Creek

Mosquito Creek Thermal Classification

Thermal Classification

Many factors can influence fluctuations in stream temperature, including springs, tributaries, precipitation runoff, discharge pipes and stream shading from riparian vegetation. Four temperature loggers were deployed in early spring to monitor water temperature in Mosquito Creek. Water temperature is used along with the maximum air temperature (using a revised Stoneman and Jones method) to classify sampling reaches into one of five categories that correspond to the thermal preferences of local fish communities (Figure 27). Figure 25 shows the locations where temperature loggers were installed on Mosquito Creek. Unfortunately logger 2 at Spratt Road and logger 4 at Rideau Road were not retrieved.

Analysis of the data collected indicates that the thermal classification of Mosquito Creek ranges between cool-warm water and warm water (Figure 27).

Groundwater

Groundwater discharge areas can influence stream temperature, contribute nutrients, and provide important stream habitat for fish and other biota. During stream surveys and headwater drainage feature monitoring, indicators of groundwater discharge are noted when observed. Figure 26 shows areas where one or more groundwater indicators were observed on Mosquito Creek. Groundwater indicators were observed between Leitrim Road and Spratt Road as well as in the upper reaches of the creek upstream of Earl Armstrong Road and the headwaters on Rideau Road and Mitch Owens Road.

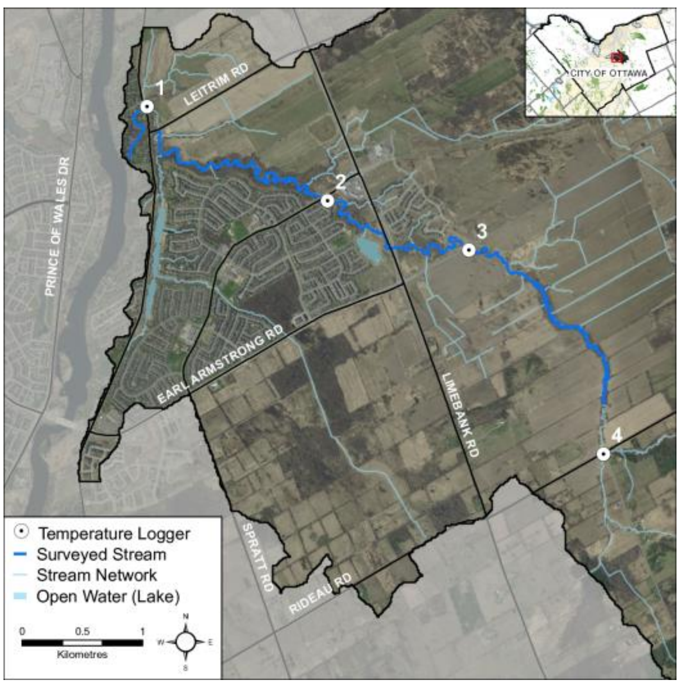


Figure 25 Temperature loggers along Mosquito Creek

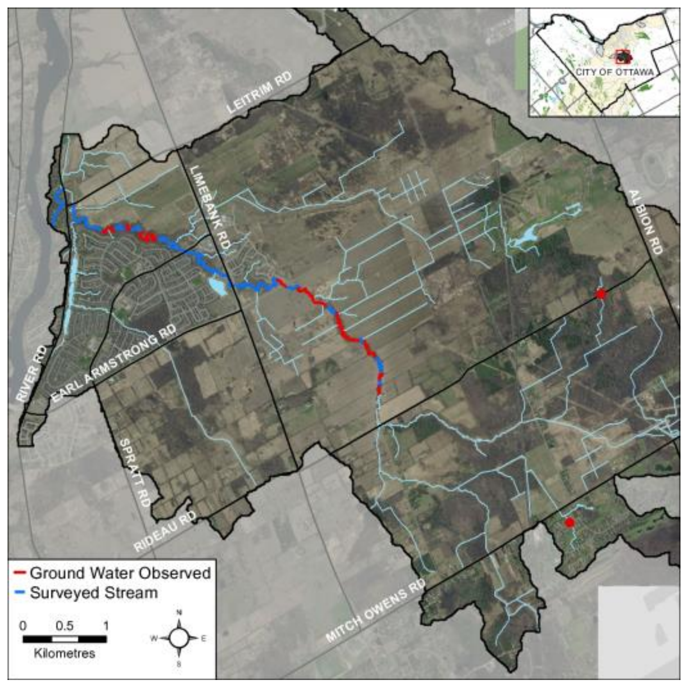


Figure 26 Groundwater indicators observed

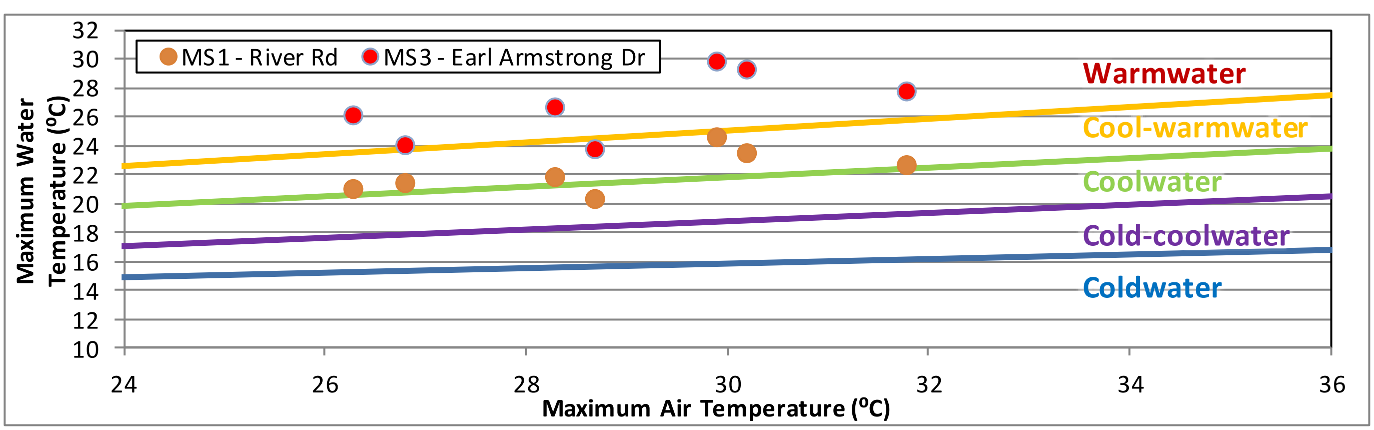


Figure 27 Thermal Classification for Mosquito Creek

Mosquito Creek Fish Community

Fish Community

Fish sampling sites located along Mosquito Creek are shown in Figure 28. The provincial fish codes shown in Figure 28 are listed (in Table 2) beside the common name of those fish species identified in Mosquito Creek. For a list of fish species caught on tributaries of Mosquito Creek please refer to the 2012 RVCA Lower Rideau Catchment Report for Mosquito Creek. The thermal classification of Mosquito Creek ranges between cool-warm water and warm water, with 37 fish species having been observed historically including nine game fish species.

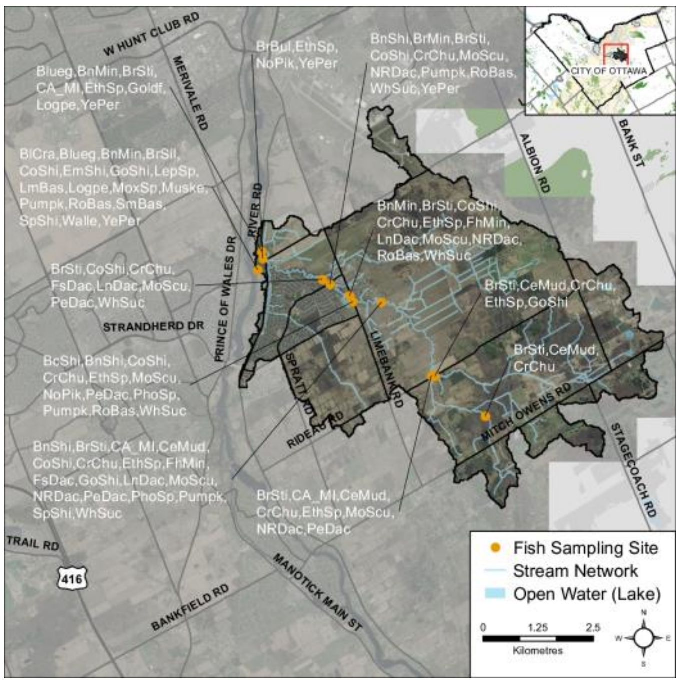


Figure 28 Mosquito Creek fish community

Species observed in Mosquito Creek (with fish code)			
black crappie.........	BlCra	goldfish....................	Goldf
blackchin shiner.....	BcShi	largemouth bass.......	LmBas
blacknose shiner....	BnShi	Lepomis sp..............	LepSp
bluegill.................	Blueg	logperch..................	Logpe
bluntnose minnow..	BnMin	longnose dace..........	LnDac
brassy minnow......	BrMin	mottled sculpin.........	MoScu
brook silverside......	BrSil	muskellunge.............	Muske
brook stickleback...	BrSti	northern pearl dace....	PeDac
brown bullhead......	BrBul	northern pike............	NoPik
carps and minnows.	CA_MI	northern redbelly dace	NRDac
Chrosomus sp.......	PhoSp	pumpkinseed............	Pumpk
common shiner......	CoShi	Moxostoma sp..........	MoxSp
creek chub............	CrChu	rock bass.................	RoBas
emerald shiner.......	Emshi	smallmouth bass.......	SmBas
Etheostoma sp......	EthSp	spotfin shiner............	SfShi
fathead minnow......	FhMin	walleye....................	Walle
finescale dace.......	FsDac	white sucker.............	WhSuc
golden shiner.........	GoShi	yellow perch.............	YePer

Table 2 Fish species observed in Mosquito Creek

Young largemouth bass captured on Mosquito Creek

Walleye captured on Mosquito Creek

Moxostoma species captured on Mosquito 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. Figure 29 shows that on the surveyed sections of Mosquito Creek, two grade barriers were observed during headwaters monitoring. Both were the result of culvert crossings, one at Limebank Road and the other at Earl Armstrong Road.

Beaver Dams

Beaver dams can also act as obstructions to fish migration. Figure 30 shows that many beaver dams were observed on Mosquito Creek upstream of Spratt Road and in the upper reaches of the creek. The head, or difference between the water level up and down stream, of the beaver dams ranged from 0 cm to 45 cm.

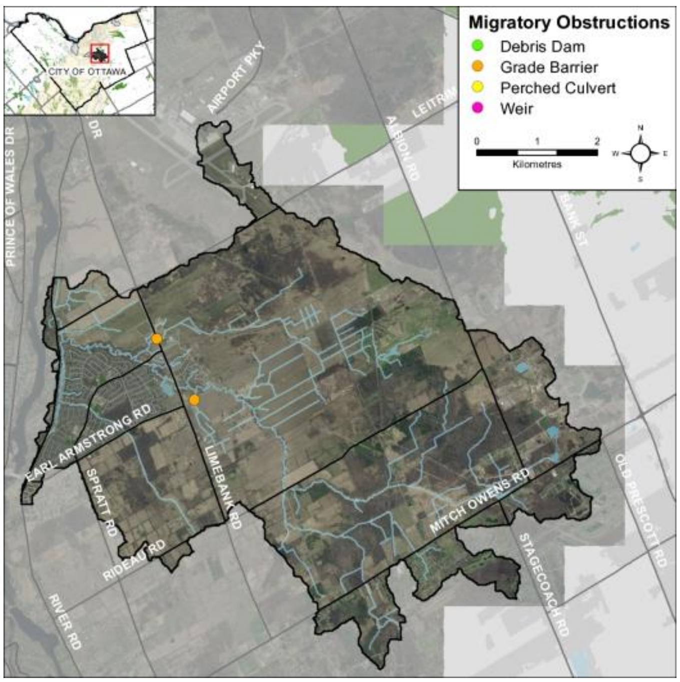


Figure 29 Mosquito Creek migratory obstructions

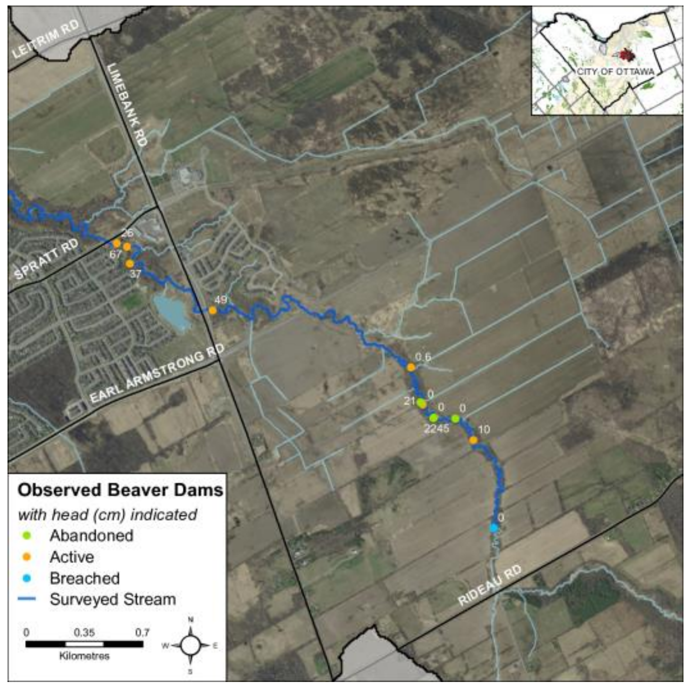


Figure 30 Beaver dams observed on Mosquito Creek

Culvert along Earl Armstrong Road creating a grade barrier

A beaver dam on Mosquito Creek

Headwater Drainage Feature Assessment

Headwaters Sampling

The RVCA City Stream Watch program assessed Headwater Drainage Features for Barrhaven Creek, Bilberry Creek, Mosquito Creek and Stillwater Creek in 2015. This protocol measures zero, first and second order headwater drainage features (HDF). It is a rapid assessment method characterizing the amount of water, sediment transport, and storage capacity within headwater drainage features (HDF). 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. An HDF is a depression in the land that conveys surface flow. Additionally, this module provides a means of characterizing the connectivity, form and unique features associated with each HDF (OSAP Protocol, 2013). In 2015 the program sampled 17 sites in the Mosquito Creek catchment area. Figure 31 demonstrates the 2015 Mosquito Creek sampling locations.

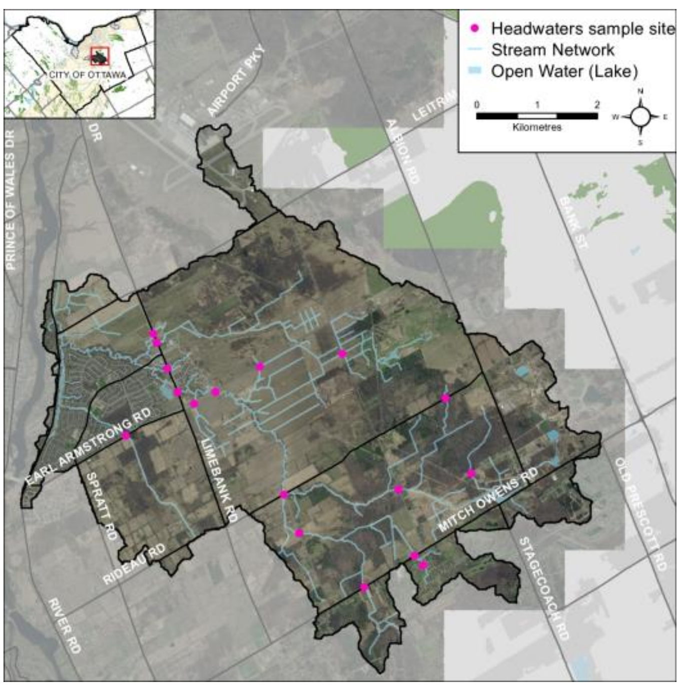


Figure 31 Mosquito Creek HDF sampling sites

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. A mix of feature types, dominated by natural channel features, were observed on Mosquito Creek. Other classification present included roadside ditch, channelized features, swale and wetland features. Figure 32 shows the feature type of the primary feature at the sampling locations.

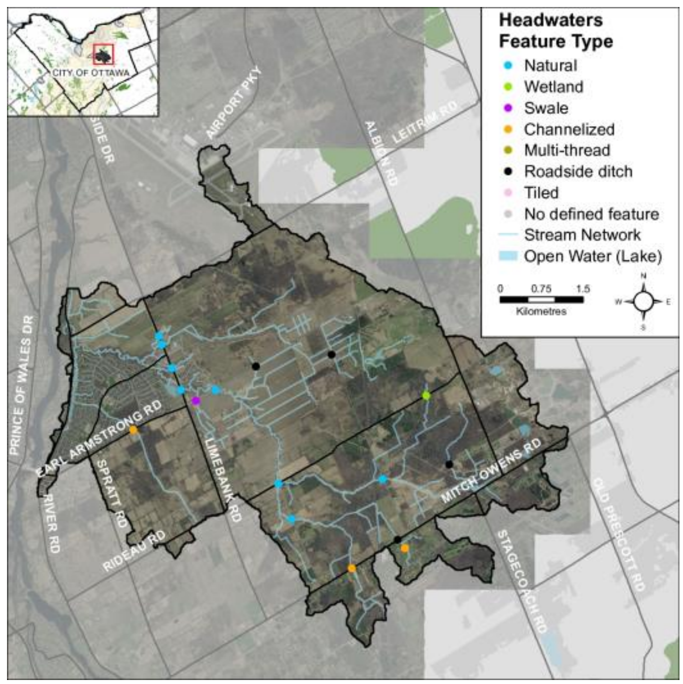


Figure 32 Mosquito Creek HDF feature types

Channelized HDF feature along Mitch Owens Road—Spring condition above and summer condition to the left

Headwater Feature Flow

The observed flow condition within headwater drainage features can be highly variable depending on timing relative to the spring freshet, recent rainfall, soil moisture, etc. Flow conditions are assessed in the spring and in the summer to determine if features are perennial and flow year round, if they are intermittent and dry up during the summer months or if they are ephemeral systems that do not flow regularly and generally respond to specific rainstorm events or snowmelt. Flow conditions in headwater systems can change from year to year depending on local precipitation patterns. Figure 33 shows the observed flow conditions at the sampling locations in the Mosquito Creek catchment.

Feature Channel Modifications

Channel modifications were assessed at each headwater drainage feature sampling location. Modifications include channelization, dredging, hardening and realignments. Land use in the Mosquito Creek catchment varies widely from residential development to agriculture and natural areas. As a result, the sampling locations for the Mosquito Creek catchment area range from no channel modifications in the natural areas to channel hardening in the newly developed areas along Limebank Road and dredging in agricultural areas near Mitch Owens Road. Figure 34 shows the channel modifications observed at the sampling locations for Mosquito Creek.

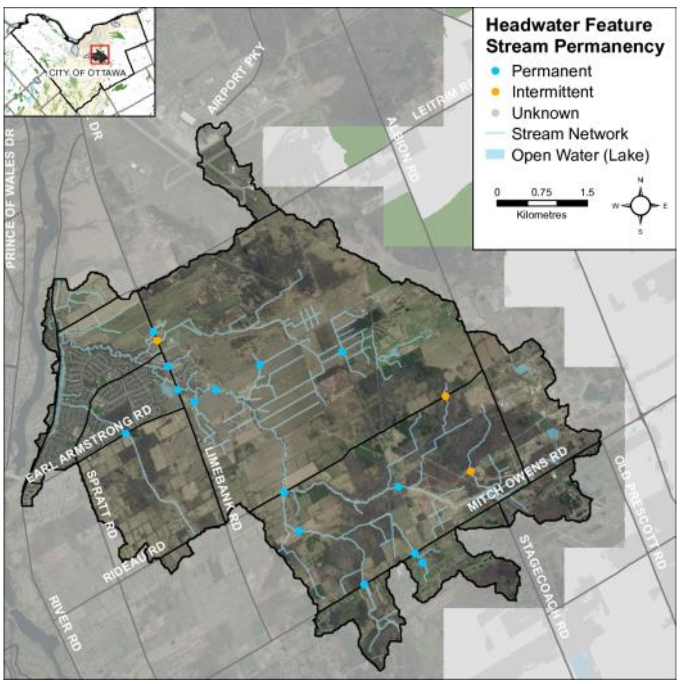


Figure 33 Mosquito Creek HDF flow conditions

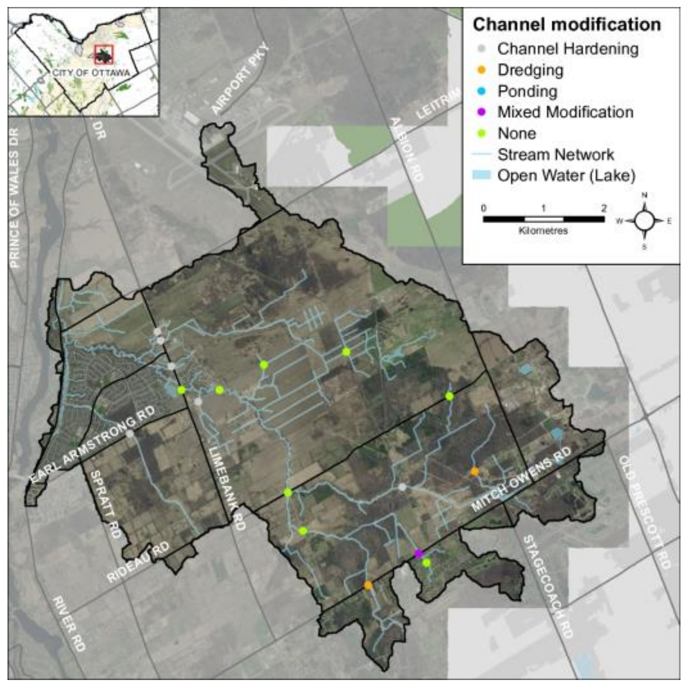


Figure 34 Mosquito Creek HDF channel modifications

Permanent HDF sampling site along Downey Road

Channel hardening at an HDF site along Limebank 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 and sediment movement and provides wildlife habitat. The following classifications are evaluated no vegetation, lawn, wetland, meadow, scrubland and forest. Headwaters features in the Mosquito Creek catchment were dominated by meadow vegetation with some classified as wetland vegetation and no vegetation. Figure 35 depicts the dominant vegetation observed at the sampled headwater sites in the Mosquito Creek catchment.

Headwater Feature Riparian Vegetation

Headwater riparian vegetation evaluates the type of vegetation that is found along the 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. The majority of the sample locations in Mosquito Creek were dominated by natural vegetation in the form of scrubland, meadow and forest. Figure 36 depicts the type of riparian vegetation observed at the sampled headwater sites in the Mosquito Creek catchment.

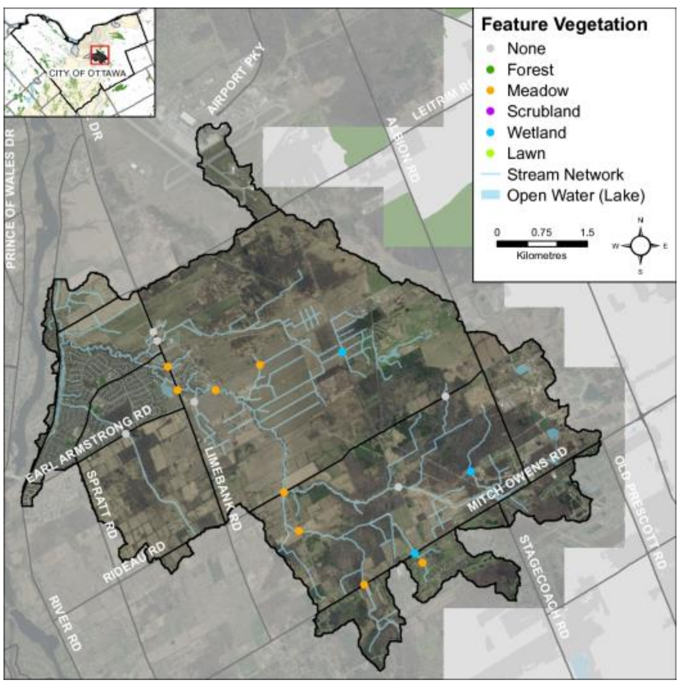


Figure 35 Mosquito Creek HDF feature vegetation

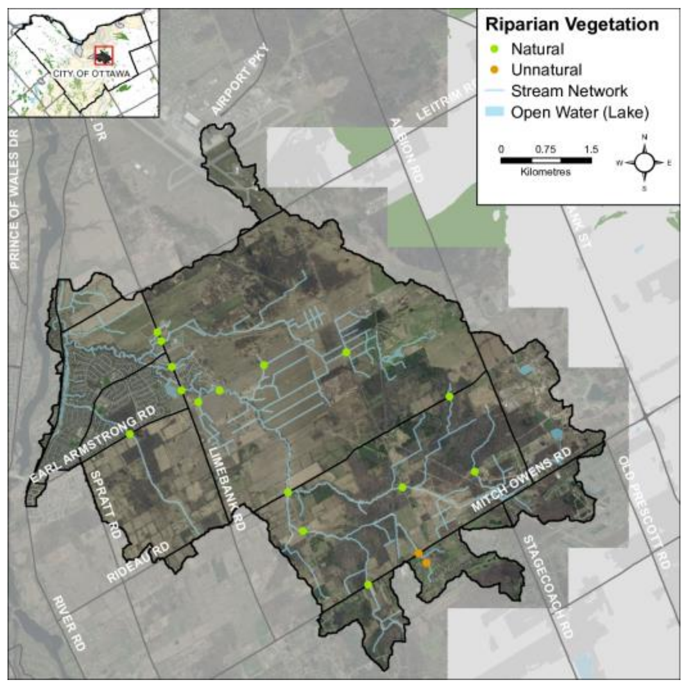


Figure 36 Mosquito Creek HDF riparian vegetation

Wetland feature vegetation observed at a site on Tullamore St.

A natural riparian buffer along Bowesville Road

Headwater Feature Sediment Deposition

Assessing the amount of recent sediment deposited in a channel provides an index of the degree to which the feature could be transporting sediment to downstream reaches (OSAP, 2013). Evidence of excessive sediment deposition might indicate the requirement to follow up with more detailed targeted assessments upstream of the site location to identify potential best management practices to be implemented. Conditions ranged from no deposition observed to substantial and extensive deposition along earl Armstrong Road and Limebank Road. Overall, most sites had minimal to moderate levels of sediment deposition. Figure 37 depicts the degree of sediment deposition observed at the sampled headwater sites in the Mosquito Creek catchment.

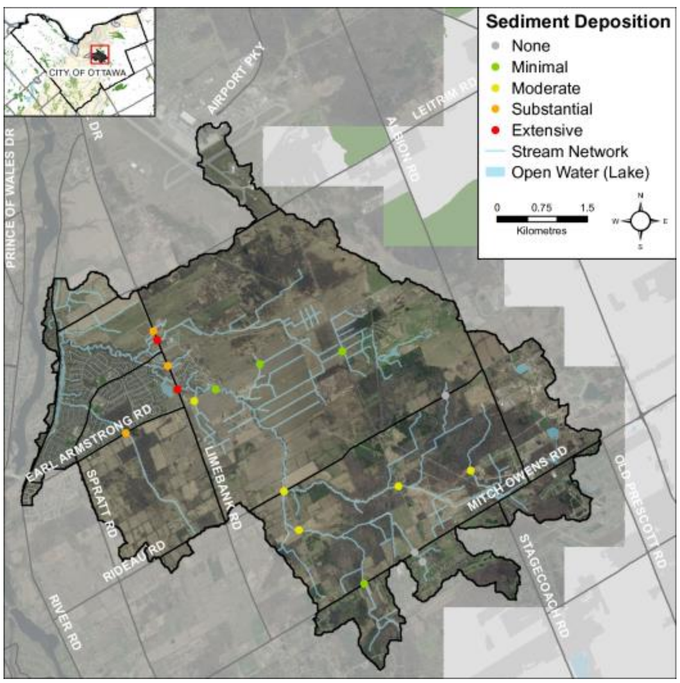


Figure 37 Mosquito Creek HDF sediment deposition

Spring conditions at a sampling site along Mitch Owens Rd

Headwater Feature Upstream Roughness

Feature roughness will provide a measure of the amount of materials within the bankfull channel that could slow down the velocity of water flowing within the headwater feature (OSAP, 2013). Materials on the channel bottom that provide roughness include vegetation, woody debris and boulders/cobble substrates. Roughness can provide benefits in mitigating downstream erosion on the headwater drainage feature and the receiving watercourse by reducing velocities. Roughness also provides important habitat conditions to aquatic organisms. The features roughness of the sample locations in the Mosquito Creek catchment area varied considerably from minimal to extreme levels. Figure 38 shows the feature roughness conditions at the sampling locations in the Mosquito Creek catchment.

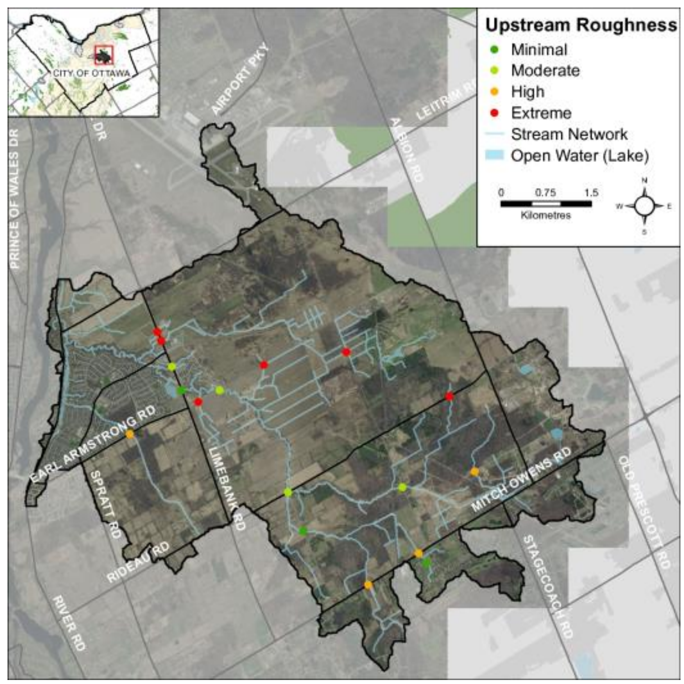


Figure 38 Mosquito Creek HDF feature roughness

Summer conditions at the same site along Mitch Owens Rd

Stream Comparison Between 2009 and 2015

The following tables provide a comparison of observations on Mosquito Creek between the 2009 and 2015 survey years. Mosquito Creek was also surveyed in 2004, but the surveying protocol has changed significantly since that time so data from 2004 cannot be compared to data from 2009 and 2015. In order to accurately represent current and historical information, the site data was only compared for those locations which were surveyed in both reporting periods. In some instances, this resulted in changes to our overall summary information. This information is therefore only a comparative evaluation and does not represent the entirety of our assessment.

Anthropogenic Changes

Table 4 shows that between 2009 and 2015 anthropogenic alterations along Mosquito Creek have decreased. In 2009, 17 percent of the sections had no anthropogenic alterations, in 2015 that number has increased to 72 percent. It is likely that this change had been caused by changes in the stream survey protocol and the classification of channelization. In 2010 anthropogenic alterations were further defined in the protocol, which has caused some land uses to shift categories. In the case of Mosquito Creek it appears as though many of the sections that were considered natural in 2009 were classified as having no anthropogenic alterations in 2015.

Anthropogenic Alterations	2009 (%)	2015 (%)
No anthropogenic alterations	17	72
"Natural" conditions with minor human alterations	78	16
"Altered" with considerable human impact but significant natural portions	5	8
"Highly altered" by humans with few natural portions	0	4

Table 4 Comparison of anthropogenic alterations along Mosquito Creek between 2009 and 2015

An anthropogenic alteration to Mosquito Creek

Bank Stability Changes

According to observations bank stability on Mosquito Creek has improved overall since 2009. In 2009, 73 percent of the left bank and 72 percent of the right bank were considered stable. In 2015, 88 percent of the left bank and 90 percent of the right bank were stable.

Bank Stability	2009 (%) Left Bank	2009 (%) Right Bank	2015 (%) Left Bank	2015 (%) Right Bank
Stable	73	72	88	90
Unstable	27	28	12	10

Table 5 Comparison of bank stability along Mosquito Creek between 2009 and 2015

Changes in Instream Vegetation

Figure 39 shows that there has been a slight overall decrease in instream vegetation in Mosquito Creek since 2009. The amount of extensive and common levels of vegetation totaled 29 percent in 2009. In 2015 no extensive levels were recorded and common levels totaled 19 percent. The amount of normal levels of vegetation totaled 17 percent in 2009 and increased to 38 percent in 2015. The amount of low levels of vegetation has remained the same at 27 percent in both 2009 and 2015 whereas the rare levels have decreased from 24 percent in 2009 to 16 percent in 2015. The vegetation levels in Mosquito Creek appear to be normal overall so the change and shift over time may be attributable to climatic variables as well as the stage of the growing season when observations took place.

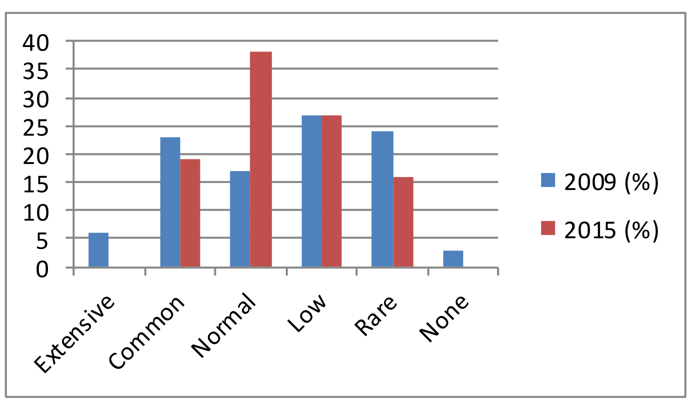


Figure 39 Comparison of instream vegetation levels between 2009 and 2015

Changes in Pollution and Garbage

Overall the amount of pollution and garbage in Mosquito Creek has decreased since 2009. Table 6 shows that the number of sections surveyed that were free from garbage has increased from 32 to 56 percent since 2009.

Pollution/Garbage	2009 (%)	2015 (%)
None	32	56
Floating garbage	45	21
Garbage on stream bottom	21	27
Oil or gas trails	1	0
Discoloration of channel bed	6	0

Table 6 Comparison of pollution/garbage levels between 2009 and 2015

Fish Community

Fish sampling was conducted on Mosquito Creek by the City Stream Watch program in 2004, 2009 and 2015. In total, 33 species of fish have been captured through City Stream Watch fish sampling efforts.

In 2004, 10 species were captured in one fish sampling session using a seine net. In 2009 fish sampling effort was significantly increased resulting in 23 species captured at six sites using a variety of methods (seine net, electrofishing, fyke net, windermere trap). In 2015, 25 species were caught in 17 fish sampling sessions at eight sites using a variety of methods (electrofishing, seining, fyke nets).

Six species caught in 2009 were not found in 2015. This does not necessarily mean the species have disappeared from Mosquito Creek but species presence could be influenced by location, weather conditions, time of sampling and sampling method.

Light beacons marking the location of a fyke net set near the mouth of Mosquito Creek in 2015

Species	Code	2004	2009	2015
black crappie…………	BlCra			X
blackchin shiner………	BcShi		X	
blacknose shiner……..	BnShi	X	X	
bluegill…………………	Blueg	X	X	X
bluntnose minnow……	BnMin	X	X	X
brassy minnow……….	BrMin		X	
brook silverside……….	BrSil			X
brook stickleback…….	BrSti		X	X
brown bullhead……….	BrBul		X	
carps and minnows…..	CA_MI		X	X
Chrosomus sp……….	PhoSp		X	
common shiner……….	CoShi	X	X	X
creek chub……………	CrChu	X	X	X
emerald shiner……….	Emshi	X		
Etheostoma sp……….	EthSp		X	X
fathead minnow………	FhMin	X	X	X
finescale dace……….	FsDac	X	X	
golden shiner…………	GoShi		X	X
goldfish……………….	Goldf			X
largemouth bass……..	LmBas			X
Lepomis sp…………..	LepSp			X
logperch………………	Logpe			X
longnose dace……….	LnDac		X	X
mottled sculpin………	MoScu		X	X
northern pearl dace…..	PeDac			X
northern redbelly dace	NRDac		X	X
pumpkinseed…………	Pumpk		X	X
Moxostoma sp……….	MoxSp			X
rock bass…………….	RoBas	X	X	X
spotfin shiner…………	SfShi		X	
walleye……………….	Walle			X
white sucker…………	WhSuc	X	X	X
yellow perch…………	YePer		X	X
Total Species		**10**	**23**	**25**

Table 7 Comparison of fish species caught in 2004, 2009 and 2015

Northern Pearl Dace captured on Mosquito Creek in 2015

Monitoring and Restoration

Monitoring and Restoration Projects on Mosquito Creek

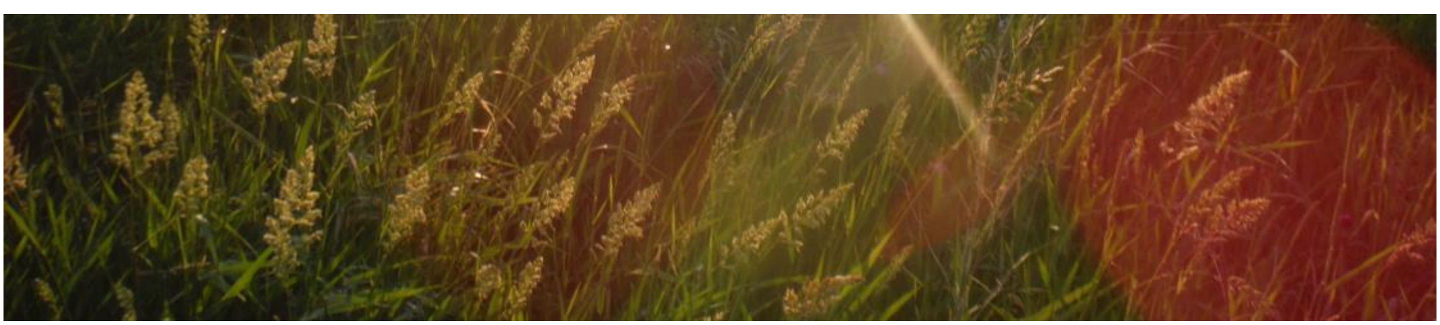
Table 8 below highlights the monitoring and restoration work that has been done on Mosquito Creek to date by the Rideau Valley Conservation Authority. Potential restoration opportunities are listed on the following page.

Accomplishment	Year	Description
City Stream Watch Stream Characterization Monitoring	2004	28 stream surveys were completed on Mosquito Creek
	2009	85 stream surveys were completed on Mosquito Creek
	2015	75 stream surveys were completed on Mosquito Creek
City Stream Watch Fish Sampling	2004	One site was sampled on Mosquito Creek
	2009	Six sites were sampled on Mosquito Creek
	2015	Eight sites were sampled on Mosquito Creek
City Stream Watch Thermal Classification	2004	Two temperature loggers were deployed
	2009	Four temperature loggers were deployed
	2015	Four temperature loggers were deployed
City Stream Watch Headwater Drainage Feature Sampling	2015	17 headwater drainage feature sites were sampled in the Mosquito Creek catchment
City Stream Watch Riparian Planting	2006, 2007	Volunteers planted native trees and shrubs along Mosquito Creek north of Spratt Road

Table 8 Monitoring and Restoration on Mosquito Creek

Volunteers measuring bankfull width and water depth on Mosquito Creek

Volunteers doing stream surveys on Mosquito Creek



Potential Riparian Restoration Opportunities

Figure 40 depicts the locations where City Stream Watch staff and volunteers observed areas where the riparian zone could be restored or enhanced using one or more of the following techniques: riparian planting, erosion control, invasive species control and wildlife habitat creation.
The majority of the opportunities listed were riparian planting and erosion control. The areas highlighted for riparian planting were focused near Leitrim Road and upstream of Limebank Road. An erosion control opportunity was identified close to Rideau Road.

Potential Instream Restoration Opportunities

Figure 41 depicts the locations where City Stream Watch staff and volunteers made note of areas where there were one or more of the following instream restoration opportunities: fish habitat enhancement, garbage cleanup and channel modification.
One opportunity for fish habitat restoration was identified upstream of Earl Armstrong Road in a section that had homogeneous substrate and very low habitat diversity. Fish habitat could be improved in the section through riffle creation and the introduction of some habitat diversity through the installation of woody debris.

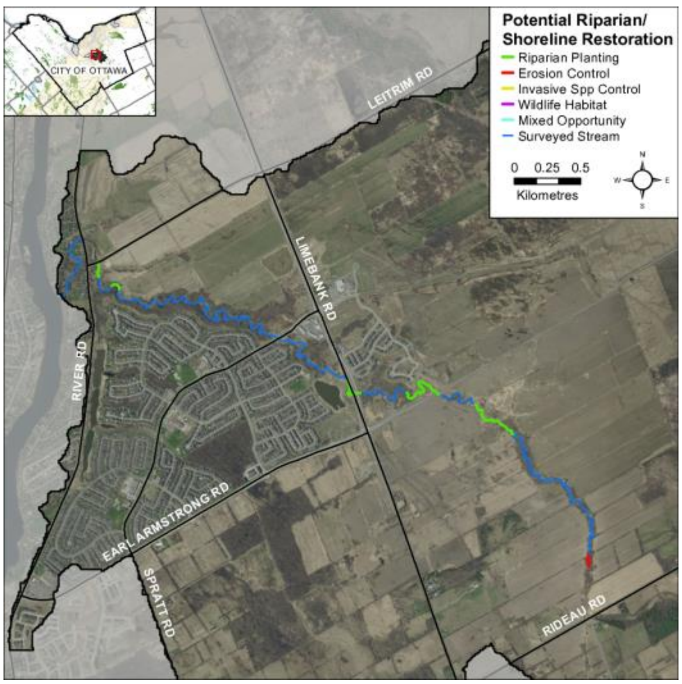


Figure 40 Potential riparian/shoreline restoration opportunities

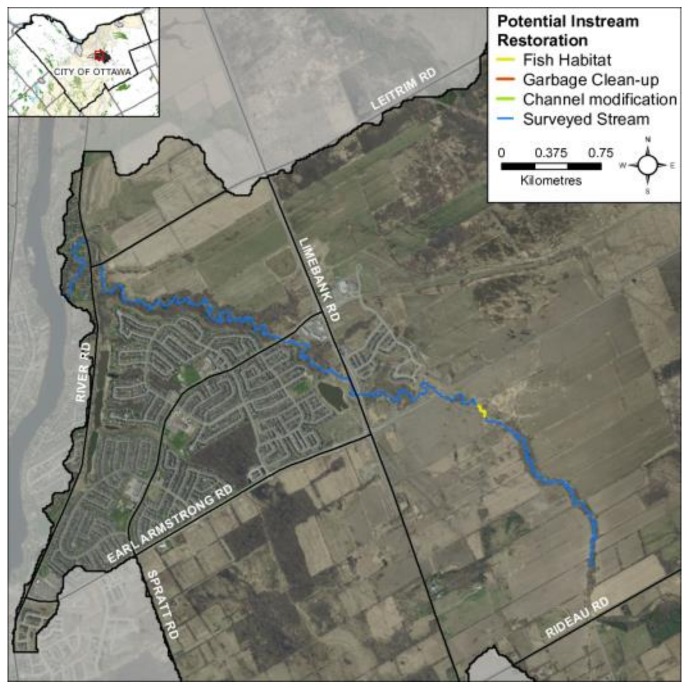


Figure 41 Potential instream restoration opportunities

A section upstream of Earl Armstrong Road where a riparian planting opportunity was identified

A section upstream of Earl Armstrong Road where a fish habitat enhancement opportunity was identified



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For more information on the overall 2015 City Stream Watch Program and the volunteer activities, please refer to the City Stream Watch 2015 Summary Report.