Sawmill Creek 2014 Summary Report

Watershed Features	
Area	20.73 square kilometres 0.49% of the Rideau Valley watershed
Land Use	48% urban/rural 16% wooded area 12% transportation 11% wetland 1% agriculture 1% waterbody 11% unclassified
Surficial Geology	40% sand 29% clay 12% gravel 9% diamicton 6% organic deposits 4% Paleozoic bedrock
Watercourse Type	*Watercourse Type:* 41% natural 59% channelized *Flow Type:* 100% permanent
Invasive Species	There were 16 invasive species observed in 2014: purple loosestrife, common buckthorn, glossy buckthorn, dog strangling vine, Himalayan balsam, honey suckle, Chinese mysterysnail, goldfish, Manitoba maple, curly leafed pondweed, flowering rush, garlic mustard, Japanese knotweed, wild parsnip, rusty crayfish, yellow iris
Fish Community	26 fish species have been captured in Sawmill Creek including four game fish species

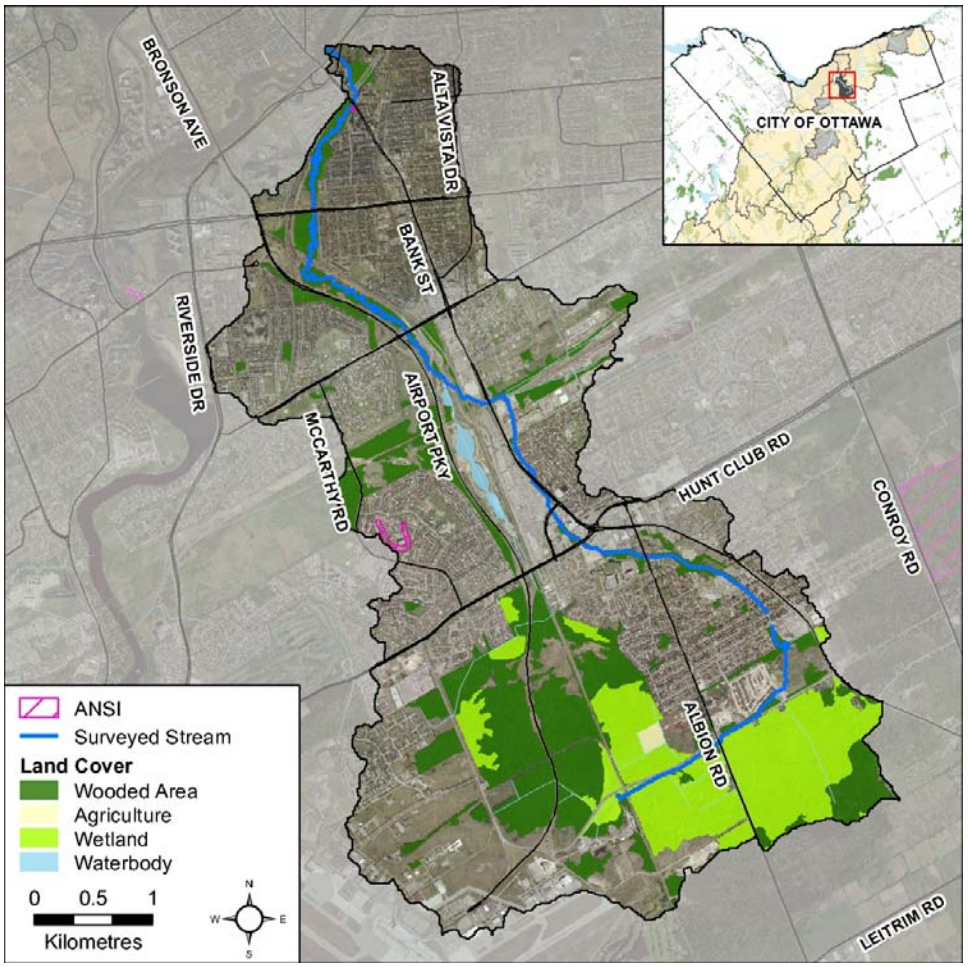


Figure 1 Land cover in the Sawmill Creek catchment

Vegetation Cover

Types	Hectares	% of Cover
Wetlands	221	40
Wooded	316	56
Hedgerow	19	3
Plantation	2	1
TOTAL		**100%**

Woodlot Cover

Size Category	Number of Woodlots	% of Woodlot Cover
10-30 ha	7	8
>30 ha	1	1

Wetland Cover

11% of the watershed is wetland

Wetlands make up 40% of the vegetation cover

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 2014 City Stream Watch collaborative.

Introduction

Sawmill Creek is approximately eleven kilometres long and drains 21 square kilometres of land. Beginning in a wetland south of Lester Road, the creek flows north through South Keys and Heron Park before emptying into the Rideau River near the intersection of Bank Street and Riverside Drive. Although Sawmill Creek is one of the last free-flowing coolwater streams left in the urban core of the City of Ottawa, the lower and middles reaches of the creek are highly urbanized and the creek corridor is degraded and confined by development and transportation infrastructure (RVCA 2012). The surficial geology in the subwatershed area is mainly marine clay plains with sand and rock ridges (RVCA, 2008). Due to its location in the City of Ottawa, much of the subwatershed is fairly urbanized, and the vegetation in the subwatershed has been impacted but there remain some more extensive forested areas around Blossom Park, McCarthy Woods and north of Walkley Road along the creek (CH2MHILL, 2003).

In 2014, 110 sections (11 km) of Sawmill 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 110 sections.

Sawmill 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. Sawmill Creek does not meet the target above. It has a buffer of greater than 30 meters along 30 percent of the right bank and 39 percent of the left bank. Figure 2 demonstrates the buffer conditions of the left and right banks separately.

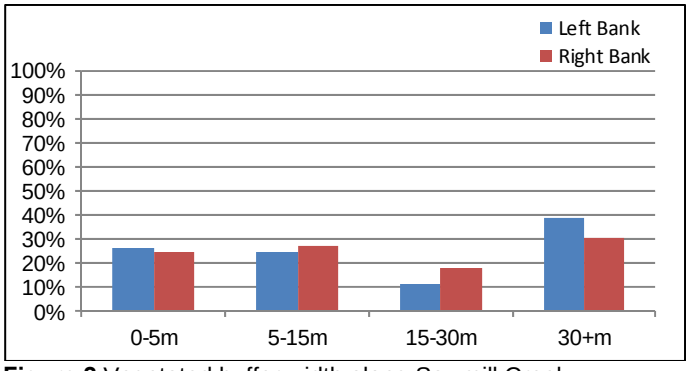


Figure 2 Vegetated buffer width along Sawmill Creek

Adjacent Land Use

The RVCA's Stream Characterization Survey Program identifies seven different land uses beside Sawmill 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 46 percent of the surveyed stream, characterized by forest, scrubland, and meadow. Fifty-four percent of the land use was made up of residential, industrial/commerical, infrastructure and recreation.

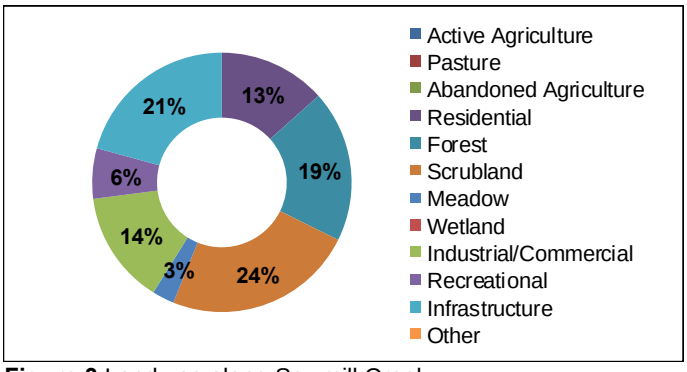


Figure 3 Land use along Sawmill Creek

Sawmill 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 high levels of bank erosion were observed along many sections of Sawmill Creek downstream of Walkley Road. Upstream of Walkley Road low to moderate levels of erosion were observed along the creek except for a stretch of the Creek upstream of Queensdale Avenue where high levels were seen again.

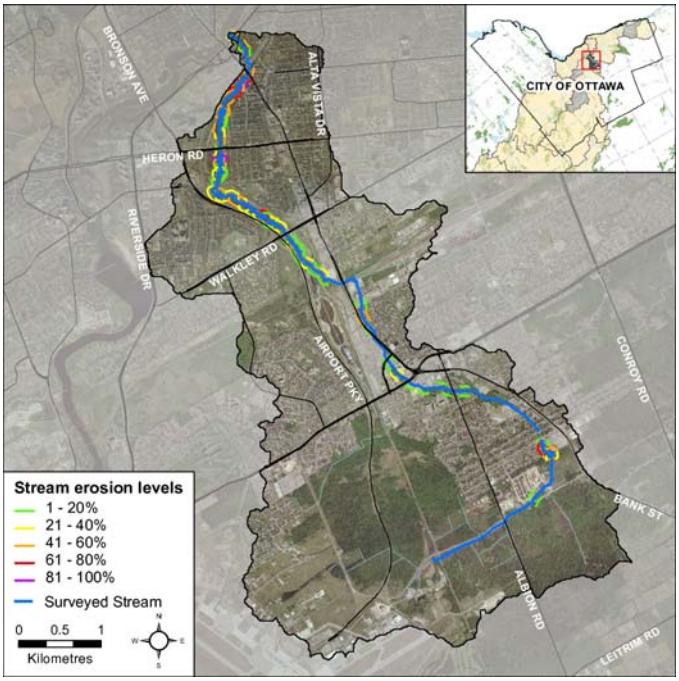


Figure 4 Erosion along Sawmill Creek

Stream bank erosion along Sawmill Creek

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 Sawmill Creek was moderate overall. Some sections of the creek had no bank undercutting, these were interspersed with areas of low and moderate level undercutting. Most of the bank undercutting was observed downstream of Walkley Road and upstream of Queensdale Avenue.

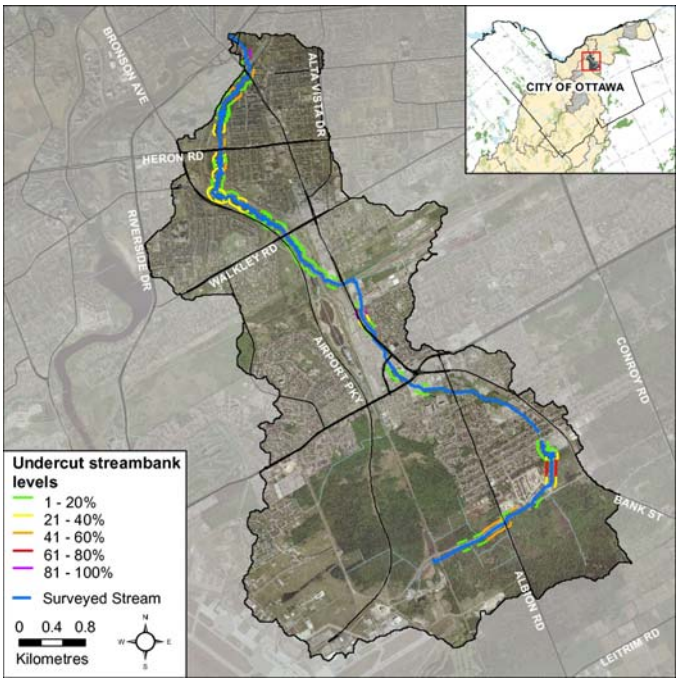


Figure 5 Undercut stream banks along Sawmill Creek

Bank undercutting along Sawmill 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 Sawmill Creek. High levels of shading were seen along most of the creek. Much of Sawmill Creek is surrounded by a well forested buffer that helps shades the creek.

Instream Woody Debris

Figure 7 shows that overall, the surveyed sections along Sawmill 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. Some areas with high levels of instream woody debris were observed downstream of Walkley Road and upstream of Albion Road.

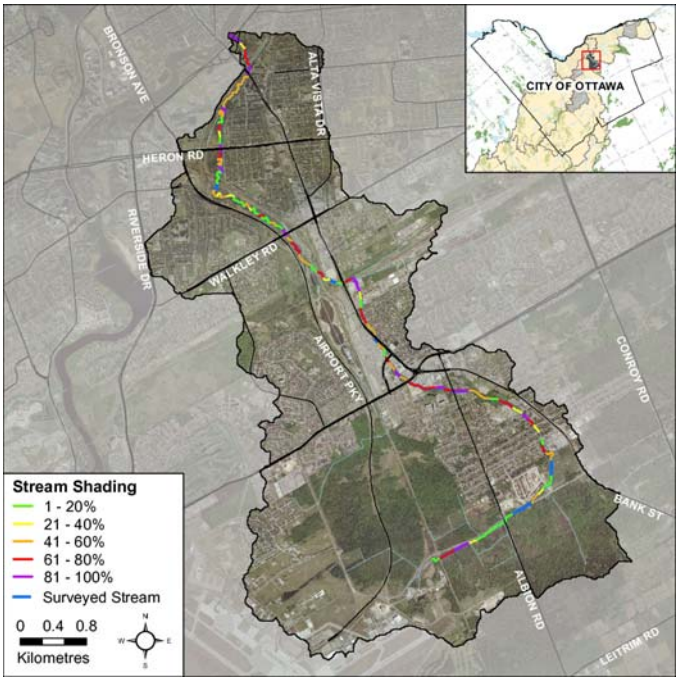


Figure 6 Stream shading along Sawmill Creek

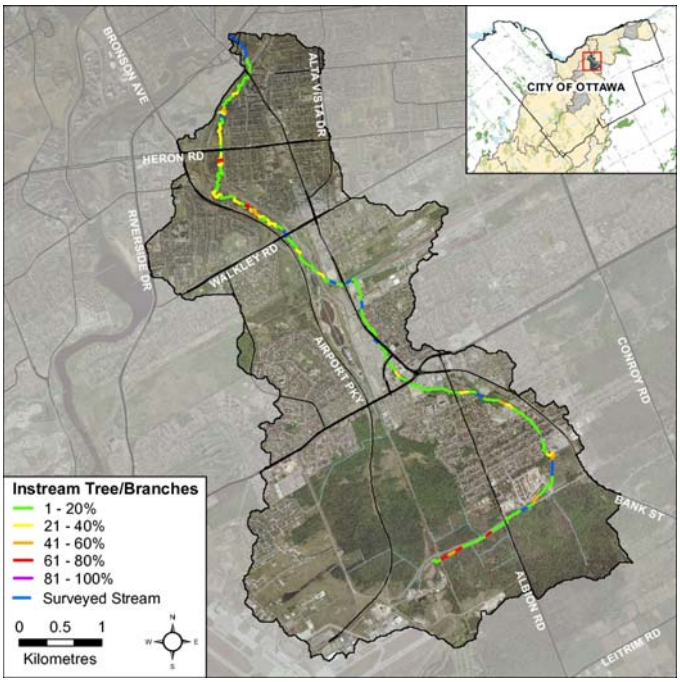


Figure 7 Instream woody debris along Sawmill Creek

Stream shade along Sawmill Creek

Instream woody debris along Sawmill Creek

Overhanging Trees and Branches

Figure 8 shows that overall, Sawmill Creek had moderate to high coverage from 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.

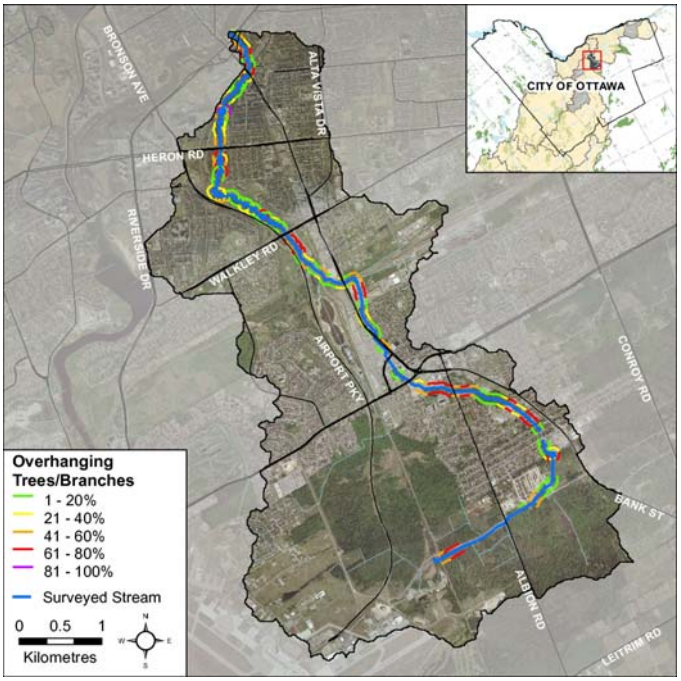


Figure 8 Overhanging trees and branches on Sawmill Creek

Overhanging trees and branches on Sawmill Creek

Anthropogenic Alterations

Figure 9 shows that only 28 percent of the sections on Sawmill Creek remain “unaltered” or "natural". Sections considered "altered" account for 16 percent of the stream, while 56 percent of the sections sampled were considered “highly altered”. Sawmill Creek runs through an urban residential and commercial area in the City of Ottawa which accounts for its high levels of anthropogenic alterations including road crossings, channelization, stream realignments and channel hardening.

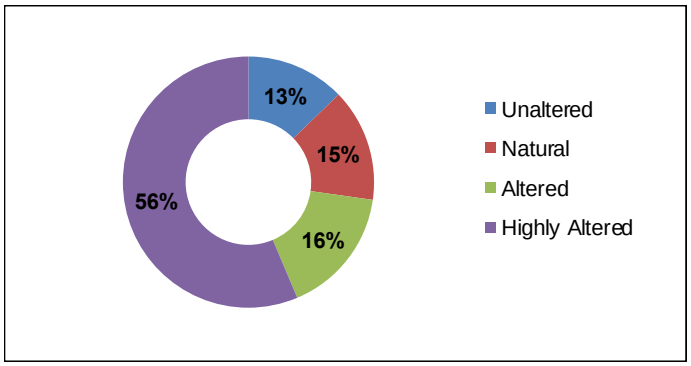


Figure 9 Anthropogenic alterations along Sawmill Creek

A highly altered section of Sawmill Creek where armour stone has been used to protect urban infrastructure at the top of the bank from the effects of stream erosion

Sawmill Creek Instream Aquatic Habitat

Habitat Complexity

Streams are naturally meandering systems and move over time; there are varying degrees of habitat complexity, depending on the creek. Examples of habitat complexity include variable 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. The complexity of Sawmill Creek varies between homogeneous and heterogeneous throughout the creek. Fifty one percent of the system was considered homogeneous and forty nine percent of the system was considered heterogeneous.

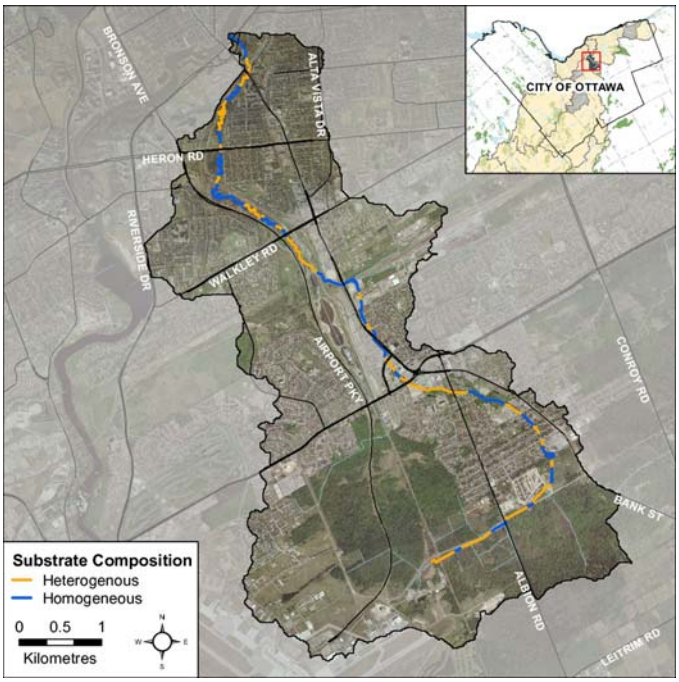


Figure 10 Instream habitat complexity in Sawmill Creek

Habitat complexity on Sawmill 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 29 percent of the instream substrate observed on Sawmill Creek was clay. Thirty eight percent of the substrate was recorded as silt and sand, 32 percent was recorded as gravel, cobble and boulders, and the remaining one percent was bedrock. Figure 12 shows the distribution of the dominant substrate types along the system. Clay substrates dominate overall especially downstream of Walkley Road and upstream of Hunt Club Road. Areas dominated by cobble and boudler substrate were seen near the mouth of the creek and just upstream of Walkley Road. Sand and silt substrates were also observed in areas throughout the creek.

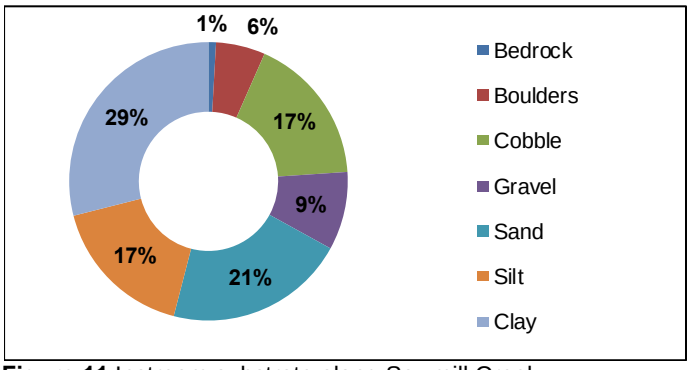


Figure 11 Instream substrate along Sawmill Creek

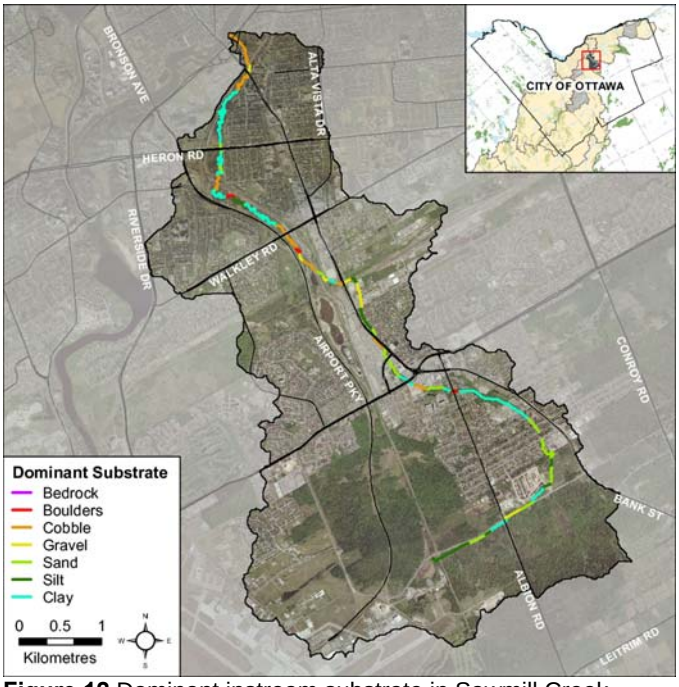


Figure 12 Dominant instream substrate in Sawmill Creek

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 Sawmill Creek. Areas of cobble and boulder habitat are found along most of the creek.

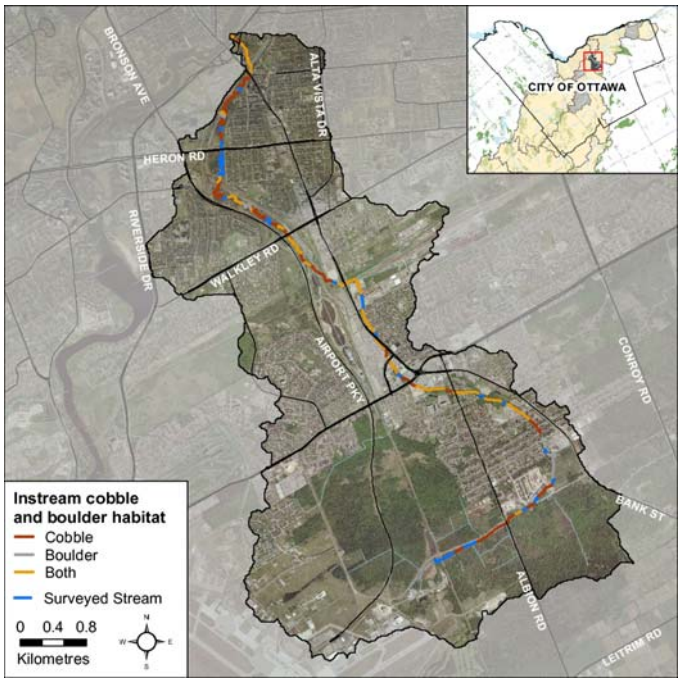


Figure 13 Cobble and boulder habitat in Sawmill Creek

Cobble and boulder habitat observed along Sawmill Creek

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 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 Sawmill Creek has some variability in instream morphology; 81 percent consists of runs, 13 percent consists of riffles and six percent consists of pools. Figure 15 shows where areas of riffle habitat was observed in Sawmill Creek. Areas of riffle habitat were found along most of the creek.

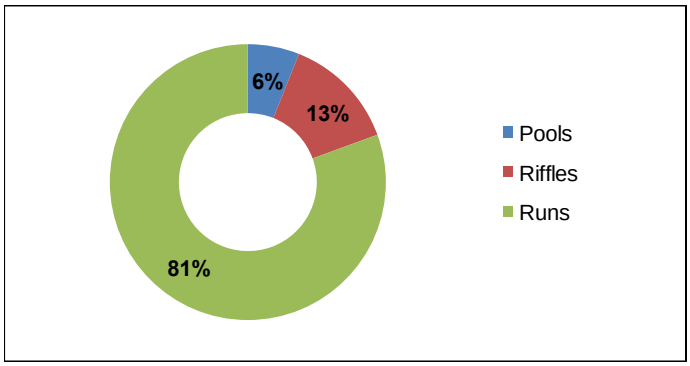


Figure 14 Instream morphology along Sawmill Creek

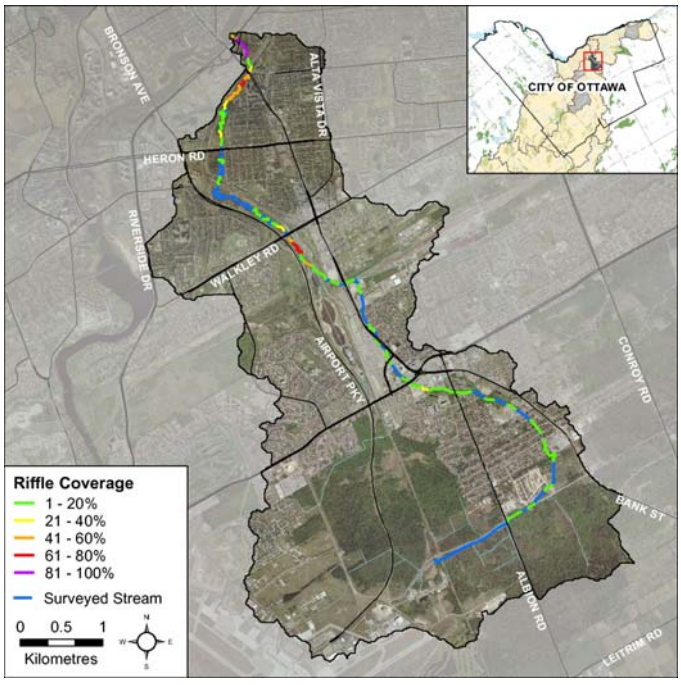


Figure 15 riffle coverage in Sawmill Creek

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 diversity of plant community structure in Sawmill Creek. Areas with no vegetation were recorded most frequently at 36 percent. Algae was recorded at 28 percent and submerged plants were recorded at 24 percent. The remaining 12 percent was narrow-leaved emergents, broad-leaved emergent, robust emergents and floating plants. The distribution of overall dominant types of instream vegetation is reflected in Figure 17.

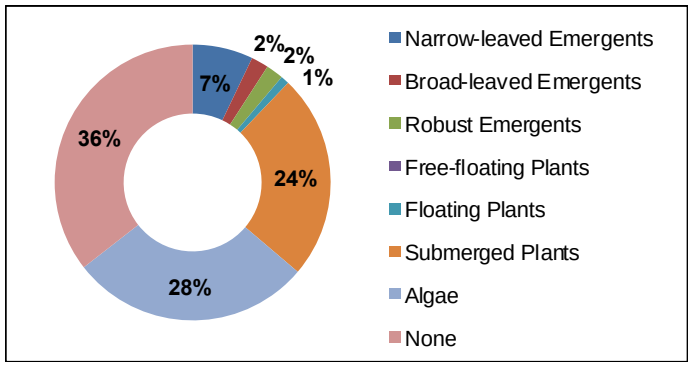


Figure 16 Vegetation types along Sawmill Creek

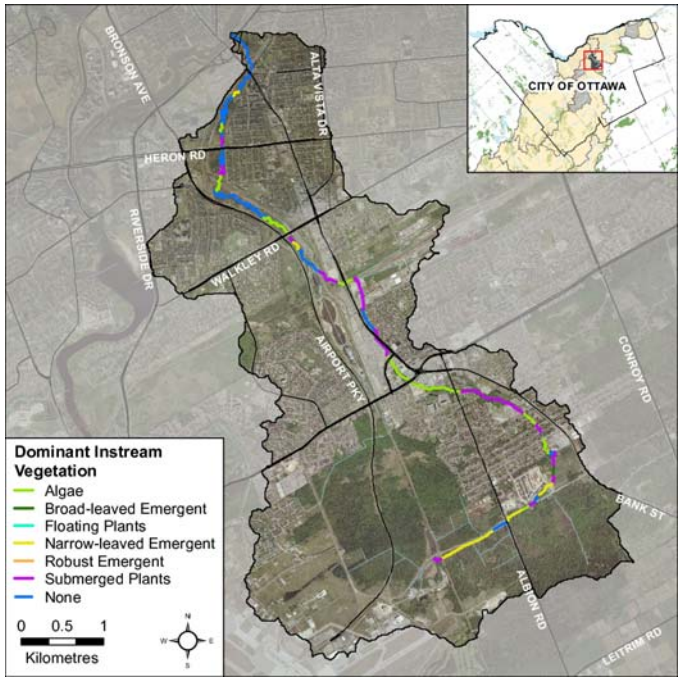


Figure 17 Dominant instream vegetation types

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 Sawmill Creek had low levels of instream vegetation. Areas with no vegetation accounted for 33 percent. Rare levels accounted for 18 percent, and low levels accounted for 19 percent. Normal and common levels accounted for 17 and 11 percent respectively. The remaining two percent was extensive levels. The low levels of vegetation on Sawmill Creek are the result of the very high flows following rain events as well as clay substrates as most types of vegetation have trouble establishing root structure in these conditions.

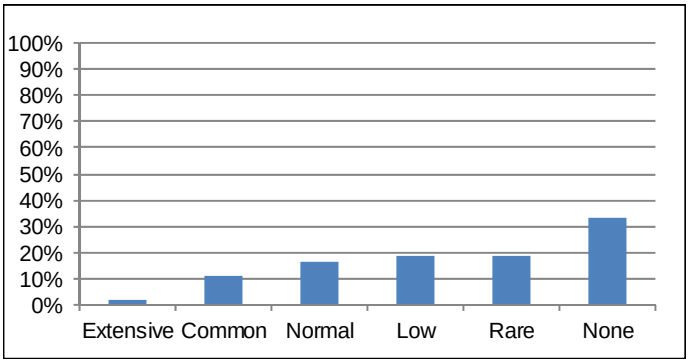


Figure 18 Instream vegetation abundance in Sawmill Creek

High flows observed on Sawmill Creek following a rain event

Sawmill Creek Stream Health

Invasive Species

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 87 percent of Sawmill Creek (Figure 19). Figure 20 shows the variety of invasive species observed along Sawmill Creek. The invasive species that were observed most often were common buckthorn (*Rhamnus cathartica*) which was observed in 55 percent of the sections with invasive species, glossy buckthorn (*Rhamnus* frangula) which was observed in 52 percent of the sections with invasive species, purple loosestrife (*Lythrum salicaria*) which was observed in 35 percent of the sections with invasive species, and Manitoba maple (*Acer negundo*) which was observed in 32 percent of the sections with invasive species.

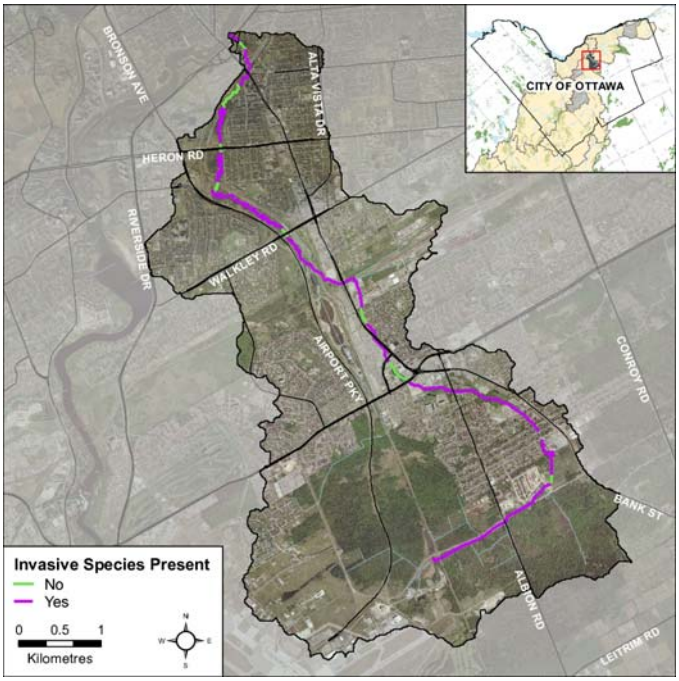


Figure 19 Presence of invasive species along Sawmill Creek

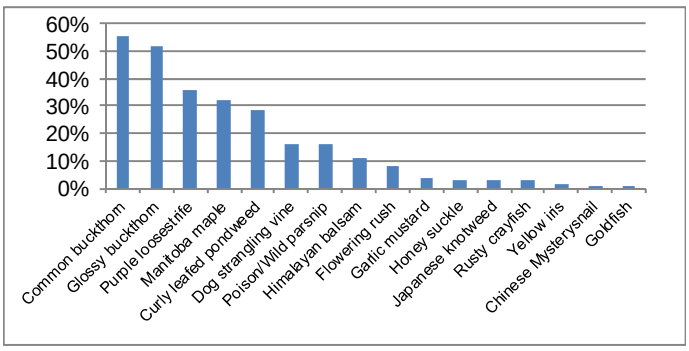


Figure 20 Invasive species observed along Sawmill Creek

Pollution

Figure 21 demonstrates the incidence of pollution/ garbage in Sawmill Creek. Only 14 percent of the sections surveyed on Sawmill Creek did not have any observable garbage. Garbage on the stream bottom was seen most often at 69 percent followed by floating garbage at 59 percent. Unusual coloration in the channel bed and unclassified garbage accounted for 6 percent of the pollution seen along the creek. Pollution along Sawmill Creek is an ongoing issue given the creek's proximity to urban residential and commercial development.

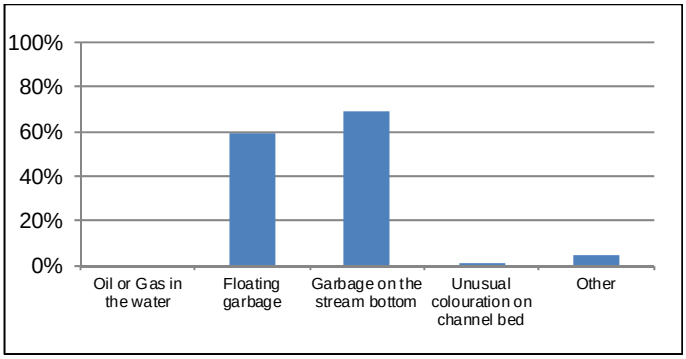


Figure 21 Pollution observed along Sawmill Creek

Wildlife

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

Wildlife	Observed
Birds	black-capped chickadee, bluejay, canada goose, cardinal, catbird, cedar waxwing, crow, downy woodpecker, goldfinch, grackle, great blue heron, grosbeak spp, gull, hawk spp, heron spp, killdeer, kingfisher, mallard, ovenbird, owl spp, pigeon, red-winged blackbird, robin, song sparrow, sparrow spp, swallow, thrush spp, woodpecker spp
Mammals	beaver, coyote tracks, deer tracks, dog, grey squirrel, groundhog, muskrat, raccoon tracks, red squirrel, skunk skull, vole
Reptiles Amphibians	bullfrog, green frog, leopard frog, tadpoles
Aquatic Insects	bivalves, crayfish, isopods, leaches, water striders
Other	admiral butterfly, bluets, bumblebees, cicada, ebony jewelwing, mosquitoes, snails, spiders, wasps

Table 1 Wildlife observed along Sawmill Creek

Sawmill 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 all of the stretches of Sawmill Creek meet the standard for warmwater biota. The stretch of creek between Walkley Road and Bank Street had and average dissolved oxygen slightly higher that the other stretches and meets the threshold for coldwater biota.

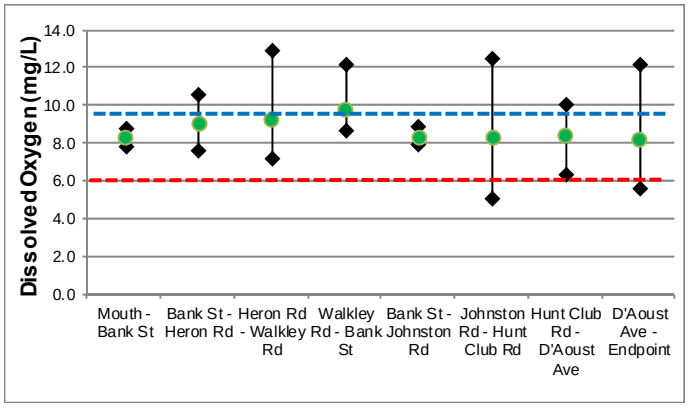


Figure 22 Dissolved oxygen ranges in Sawmill Creek

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 conductivity observed within Sawmill Creek was quite high at 1126 µs/cm. Figure 23 shows that the conductivity readings varied along the course of the creek. The lowest conductivity reading on Sawmill Creek was 367 µs/cm which was recorded upstream of D'Aoust Avenue. There is a significant spike in conductivity in the middle sections of the creek. The rise in conductivity starts around Bank Street, reaching its highest point between Walkley Road and Johnston Road before it starts to come back down again. The conductivity in this area is likely heavily influenced by stormwater runoff from stormwater outlets and roads that are in very close proximity to the creek.

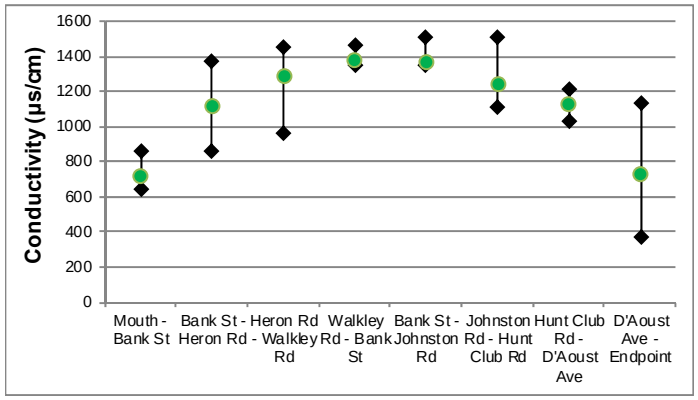


Figure 23 Conductivity ranges in Sawmill Creek

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 Sawmill Creek ranged between 7.0 and 8.3, thereby meeting the provincial standard.

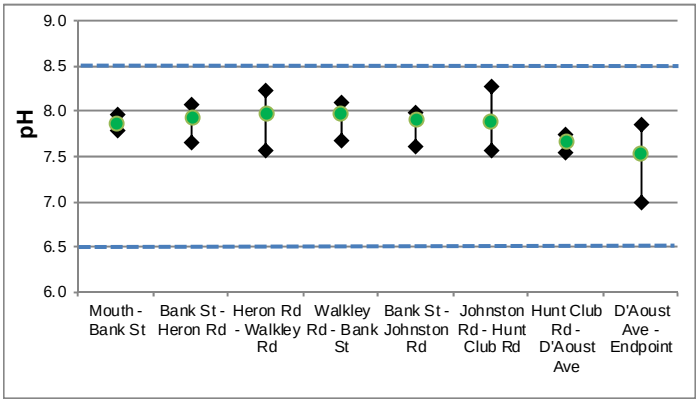


Figure 24 pH ranges in Sawmill Creek

Sawmill 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. Three temperature loggers were deployed in late April to monitor water temperature in Sawmill 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 Sawmill Creek. Unfortunately logger 1 which was installed at the mouth of the creek at Riverside Drive was not retrieved because it went missing.

Analysis of the data collected indicates that the thermal classification of Sawmill Creek ranges between cool-warm water and cold-cool water (Figure 27). The cold-cool water reach of the creek was downstream of multiple observations of groundwater input which were seen upstream of Queensdale Avenue.

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 26 shows areas where one or more of the above groundwater indicators were observed during stream surveys.

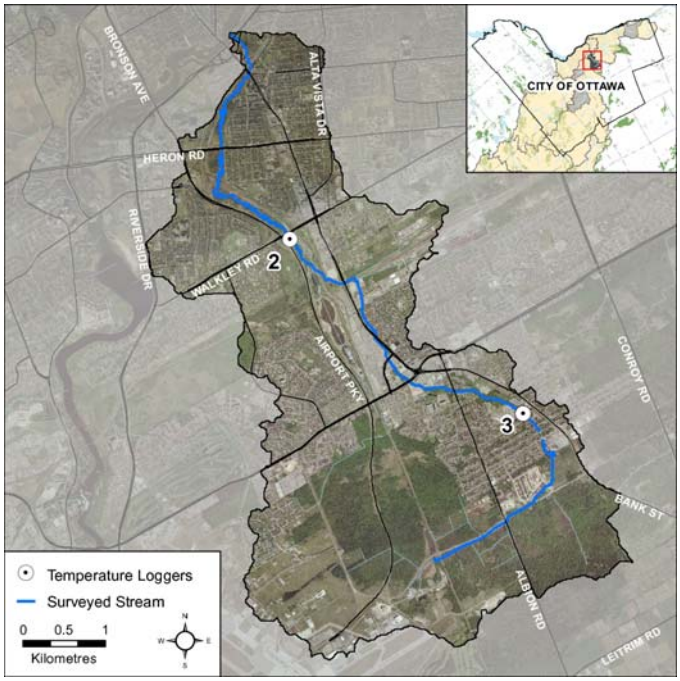


Figure 25 Temperature loggers along Sawmill Creek

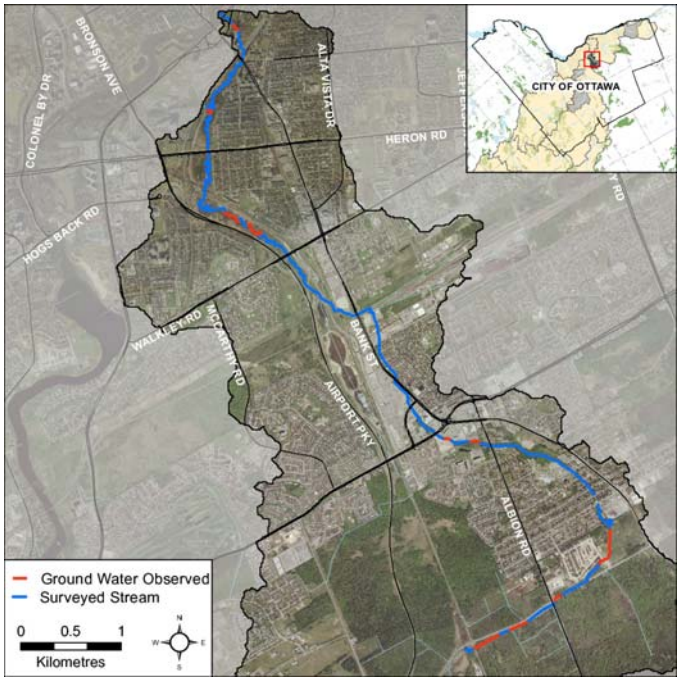


Figure 26 Groundwater indicators observed

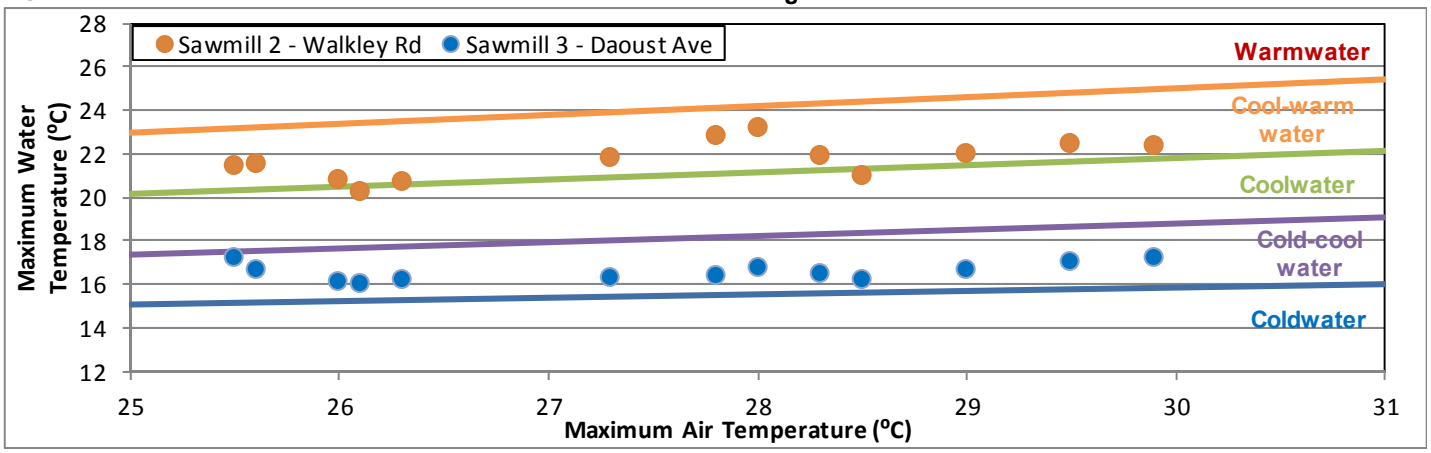


Figure 27 Thermal Classification for Sawmill Creek

Sawmill Creek Fish Community

Fish Community

Fish community sampling results for all the fish sampling sessions completed by RVCA from 2003 to 2014 along Sawmill 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 Sawmill Creek. The thermal classification of Sawmill Creek ranges between cool-warm and cold-cool water. Twenty six fish species have been observed.

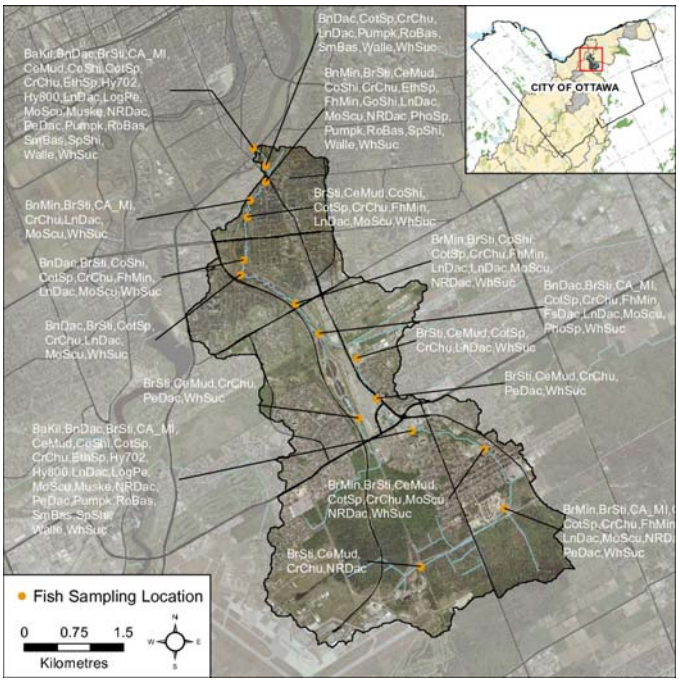


Figure 28 Sawmill Creek fish community

Species observed in Sawmill Creek (with fish code)			
banded killifish	BaKil	golden shiner	GoShi
blacknose dace	BnDac	logperch	LogPe
bluegill/pumpkinseed	Hy702	longnose dace	LnDac
bluntnose minnow	BnMin	mottled sculpin	MoScu
brassy minnow	BrMin	muskellunge	Muske
brook stickleback	BrSti	northern redbelly dace	NRDac
central mudminnow	CeMud	pearl dace	PeDac
common shiner	CoShi	pumpkinseed	Pumpk
Cottus spp	CotSp	rock bass	RoBas
creek chub	CrChu	smallmouth bass	SmBas
Cyprinid spp	Ca_MI	spottail shiner	SpShi
Etheostoma spp	EthSp	walleye	Walle
fathead minnow	FhMin	white sucker	WhSuc

Table 2 Fish species observed in Sawmill 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 along Sawmill Creek, a perched culvert, two weirs and one grade barrier were observed.

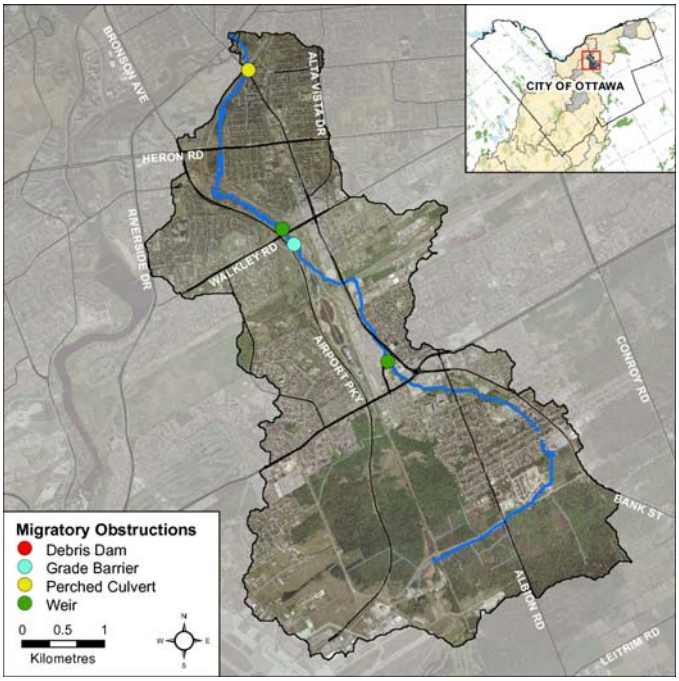


Figure 29 Sawmill Creek migratory obstructions

A perched culvert observed along Sawmill Creek at Bank Street

Beaver Dams

Beaver dams can also act as obstructions to fish migration. Figure 30 shows that there were seven beaver dams observed on Sawmill Creek, most of them were between Heron Road and Walkley Road. There was only one active beaver dam and the head, or difference between the water level up and down stream, of the that beaver dam was 120 cm.

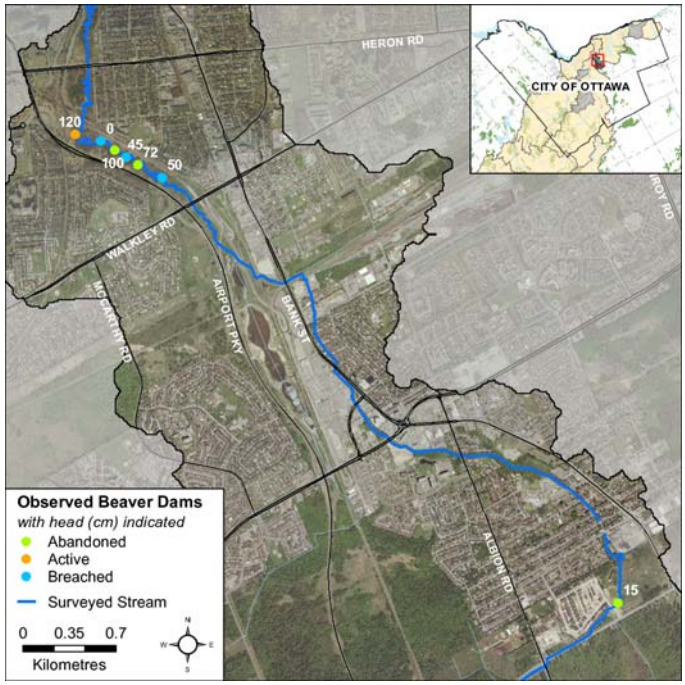


Figure 30 Beaver dams observed on Sawmill Creek

An active beaver dam on Sawmill Creek

Headwater Drainage Feature Sampling

The Headwater Drainage Feature sampling protocol is a rapid assessment method characterizing the amount of water, sediment transport, and storage capacity within headwater drainage features (HDF). An HDF is a depression in the land that conveys surface flow. These features may provide direct, both permanent and seasonal, habitat for fish by the presence of refuge pools, seasonal flow, or groundwater discharge. They may also provide indirect habitat through the contribution of exported food (detritus/invertebrates) (Wipfli and Gregovich 2002).
As a result of their importance and a lack of existing information for headwater drainage features, the City Stream Watch program incorporated monitoring of these systems at four sites in the Sawmill Creek catchment in 2014 (Figure 31).

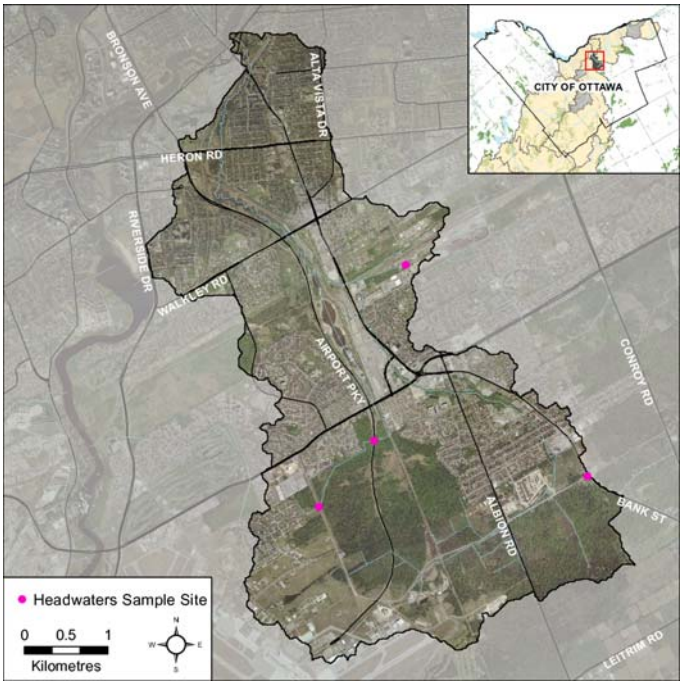


Figure 31 HDF sampling sites on Sawmill Creek

A headwaters site at Uplands Drive

Stream Comparison Between 2008 and 2014

The following tables provide a comparison of observations on Sawmill Creek between the 2008 and 2014 survey years. Sawmill Creek was also surveyed in 2003, but the surveying protocol has changed significantly since that time so data from 2003 cannot be compared to data from 2008 and 2014. The sections surveyed in 2014 were different from the sections surveyed in 2008 so the comparison is only done for those sections that were surveyed in both years.

Anthropogenic Changes

Table 3 shows that between 2008 and 2014 anthropogenic alterations along Sawmill Creek have increased. In 2008, 23 percent of the sections had no anthropogenic alterations, in 2014 that number has decreased to 14 percent. This change many be 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.

Anthropogenic Alterations	2008 (%)	2014 (%)
No anthropogenic alterations	23	14
"Natural" conditions with minor human alterations	11	14
"Altered" with considerable human impact but significant natural portions	32	18
"Highly altered" by humans with few natural portions	34	54

Table 3 Comparison of anthropogenic alterations along Sawmill Creek between 2008 and 2014

Anthropogenic alterations on Sawmill Creek at Kingsdale Avenue

Bank Stability Changes

According to observations bank stability on Sawmill Creek has improved overall since 2008. In 2008, 53 percent of the left bank and 55 percent of the right bank were considered stable. In 2014, 79 percent of the left bank and 80 percent of the right bank were stable. Although Sawmill Creek appears to be stable overall, areas with high levels of erosion were observed downstream of Walkley Road in 2014.

Bank Stability	2008 (%) Left Bank	2008 (%) Right Bank	2014 (%) Left Bank	2014 (%) Right Bank
Stable	53	55	79	80
Unstable	47	45	21	20

Table 4 Comparison of bank stability along Sawmill Creek

Changes in Instream Vegetation

Figure 32 shows that there has been a considerable decrease in instream vegetation in Sawmill Creek since 2008. The amount of common levels of vegetation totaled 34 percent in 2008, and that number has decreased to nine percent in 2014. Conversely, in 2008 the amount of area classified as having no vegetation totaled 14 percent, that number increased to 34 percent in 2014. The decrease in instream vegetation may be in part attributed to increased sedimentation in the system as well as high flows following rain events but vegetation growth is also dependent on climatic variables as well as the stage of the growing season when observations took place.

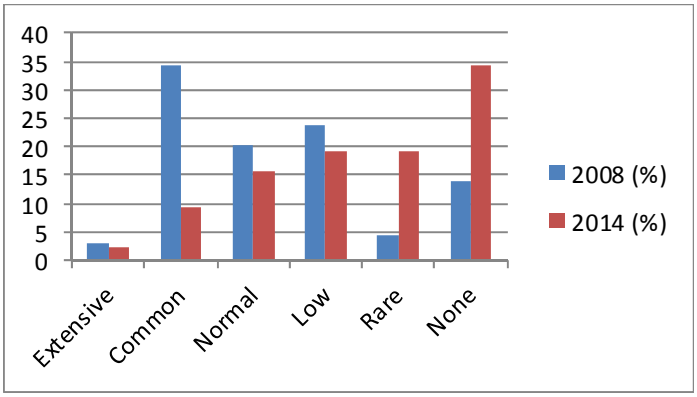


Figure 32 Comparison of instream vegetation levels between 2008 and 2014

Changes in Pollution and Garbage

Overall the amount of pollution and garbage in Sawmill Creek has decreased slightly since 2008. Table 5 shows that the number of sections surveyed that were free from garbage was three percent in 2008 and that number has only climbed to 5 percent in 2014.

Pollution/Garbage	2008 (%)	2014 (%)
None	3	5
Floating garbage	72	65
Garbage on stream bottom	88	76
Oil or gas trails	3	0
Discoloration of channel bed	2	1

Table 5 Comparison of pollution/garbage levels between 2008 and 2014

Fish Community

Fish sampling was conducted on Sawmill Creek by the City Stream Watch program in 2008 and 2014. In total, 26 species of fish have been captured through City Stream Watch fish sampling efforts (Table 6).
In 2008, 16 species were captured by seining at two sites and electrofishing at three sites. In 2014, 20 species were caught electrofishing at six sites.
Five species caught in 2008 were not found in 2014. This does not mean the species have disappeared from Sawmill Creek but could be influenced by location, weather conditions, time of sampling and sampling method. Conversely, ten new species were caught in 2014 that were not found in 2008. The new species caught in 2014 include: walleye, spottail shiner, pumpkinseed, pearl dace, northern redbelly dace, golden shiner, fathead minnow, common shiner, brassy minnow and banded killifish.

Rock bass captured on Sawmill Creek in 2014

Species	Code	2008	2014
banded killifish	BaKil		X
blacknose dace	BnDac	X	X
bluegill x pumpkinseed	Hy702	X	
bluntnose minnow	BnMin	X	
brassy minnow	BrMin		X
brook stickleback	BrSti	X	X
central mudminnow	CeMud	X	
common shiner	CoShi		X
Cottus spp	CotSp	X	
creek chub	CrChu	X	X
Cyprinid spp	Ca_MI	X	X
Etheostoma spp	EthSp	X	X
fathead minnow	FhMin		X
golden shiner	GoShi		X
logperch	LogPe	X	X
longnose dace	LnDac	X	X
mottled sculpin	MoScu	X	X
muskellunge	Muske	X	
northern redbelly dace	NRDac		X
pearl dace	PeDac		X
pumpkinseed	Pumpk		X
rock bass	RoBas	X	X
smallmouth bass	SmBas	X	
spottail shiner	SpShi		X
walleye	Walle		X
white sucker	WhSuc	X	X
Total		**16**	**20**

Table 6 Comparison of fish species caught in 2008 and 2014

Walleye captured on Sawmill Creek in 2014 near the perched culvert at Bank Street

Monitoring and Restoration

Monitoring and Restoration Projects on Sawmill Creek

Table 7 below highlights the monitoring and restoration work that has been done on Sawmill Creek to date by the Rideau Valley Conservation Authority. Potential future restoration opportunities are listed on the following page.

Accomplishment	Year	Description
City Stream Watch Monitoring	2003	54 stream surveys were completed on Sawmill Creek
	2008	98 stream surveys were completed on Sawmill Creek
	2014	110 stream surveys were completed on Sawmill Creek
City Stream Watch Fish Sampling	2008	Five fish sampling sessions were conducted on Sawmill Creek
	2014	Nine fish sampling sessions were conducted on Sawmill Creek
City Stream Watch Termal Classification	2008	Three temperature loggers were deployed
	2014	Three temperature loggers were deployed
City Stream Watch Riparian Planting	2005, 2006 and 2008	City Stream Watch volunteers planted shrubs and trees on failing slopes in the Heron Park area
Shoreline Naturalization Program	2012	City Stream Watch volunteers planted 450 trees and shrubs near Johnston Road
City Stream Watch Garbage Cleanups	2004 to 2014	City Stream Watch volunteers helped with annual stream garbage cleanups on Sawmill Creek every year from 2004 to 2014
City Stream Watch Headwater Drainage Feature Sampling	2014	Four headwater drainage feature sites were sampled in the Sawmill Creek catchment

Table 7 Monitoring and Restoration on Sawmill Creek

Volunteers at a Sawmill Creek cleanup upstream of Hunt Club Road in 2014

Volunteers at a Sawmill Creek cleanup upstream of Queensdale Avenue in 2014

Potential Riparian Restoration Opportunities

Figure 33 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.
There are a variety of restoration opportunities listed for various sections of Sawmill Creek especially in the areas where there is little riparian buffer.

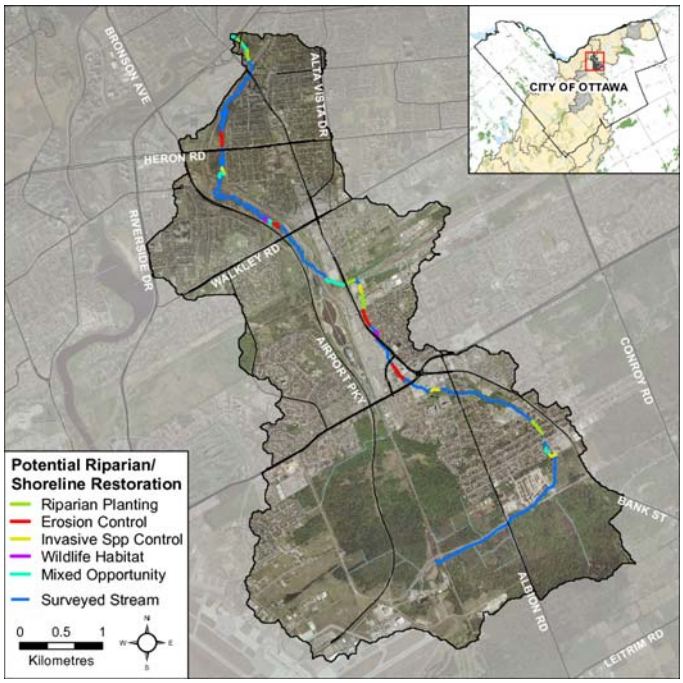


Figure 33 Potential riparian/shoreline restoration opportunities

Potential Instream Restoration Opportunities

Figure 34 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.
Most of the instream restoration opportunities listed for Sawmill Creek are stream garbage cleanups. There is also a fish habitat enhancement opportunity where there is a perched culvert at Bank Street.

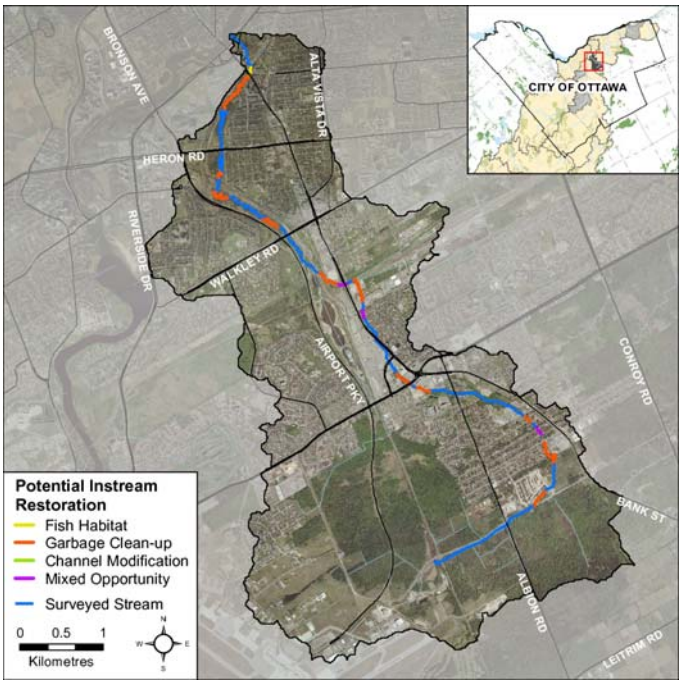
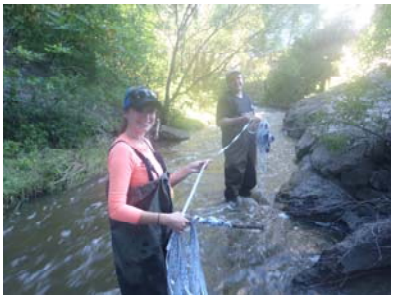


Figure 34 Potential instream restoration opportunities

An invasive species removal opportunity where Japanese knotweed was observed along Sawmill Creek

A fish habitat enhancement opportunity where a there is a perched culvert on Sawmill Creek at Bank Street



References

1. Canadian Council of Ministers of the Environment (CCME), 1999. *Canadian Environmental Quality Guidelines and Summary Table* Retrieved From: http://www.ccme.ca/pulicatioins/ceqg_rcqe.html
2. Canadian Wildlife Service (CWS), Environment Canada. 2013. *How Much Habitat Is Enough? Third Edition* Retrieved from: http://www.ec.gc.ca/nature/E33B007C-5C69-4980-8F7B-3AD02B030D8C/894_How_much_habitat_is_enough_E_WEB_05.pdf
3. Chu, C., N.E. Jones, A.R. Piggot and J.M. Buttle. 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: 1605-1619
4. Coker, G.A, C.B. Portt, and C.K. Minns. 2001. Morphological and Ecological Characteristics of Canadian Freshwater Fishes. Can. MS Rpt. Fish. Aquat. Sci. 2554: iv+89p.
5. Rideau Valley Conservation Authority (RVCA). 2008. *City Stream Watch Annual Report.* Manotick, ON: Julia Sutton
6. Rideau Valley Conservation Authority (RVCA). 2012. *Sawmill Creek Catchment: Lower Rideau Subwatershed Report 2012* Retrieved from: http://204.101.207.53/IM/Documents/watershed_planning/Lower_Rideau/Sawmill_Creek_Catchment_Report.pdf
7. Scott, W.B. and E.J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Research Board of Canada Bulletin 184: 966 pages
8. Stoneman, C.L. and M.L. Jones. 1996. *A Simple Method to Evaluate the Thermal Stability of Trout Streams*
9. Wipfli, M.S.; Gregovich, D.P. 2002. Export of invertebrates and detritus from fishless headwater streams in southeastern Alaska; implications for downstream salmonid production. Freshwater Biology. 47: 957-969.

For more information on the overall 2014 City Stream Watch Program and the volunteer activities, please refer to the City Stream Watch 2014 Summary Report.