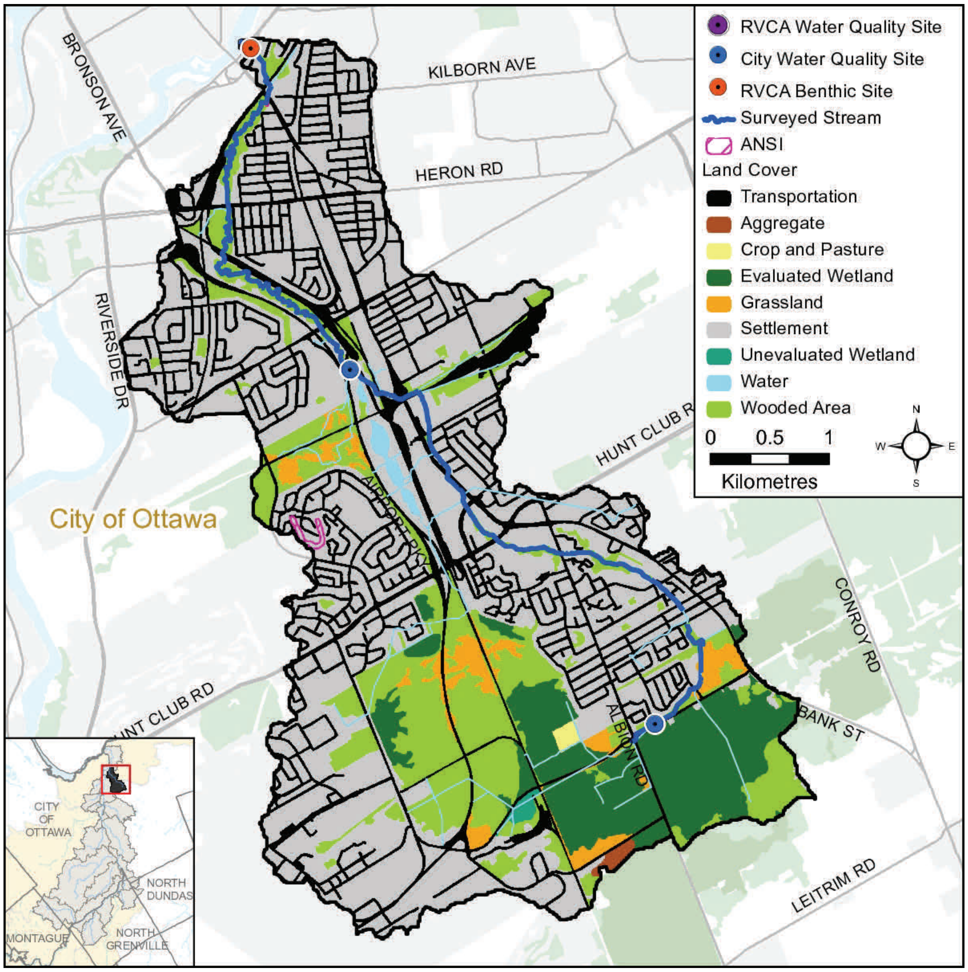
SAWMILL CREEK CATCHMENT
LOWER RIDEAU RIVER SUBWATERSHED REPORT 2012

RIDEAU VALLEY CONSERVATION AUTHORITY



The RVCA produces individual reports for 16 catchments in the Lower Rideau subwatershed. Using data collected and analysed by the RVCA through its watershed monitoring and land cover classification programs, surface water quality conditions are reported for Sawmill Creek along with a summary of environmental conditions for the surrounding countryside every six years.

This information is used to help better understand the effects of human activity on our water resources, allows us to better track environmental change over time and helps focus watershed management actions where they are needed the most.

The following pages of this report are a compilation of that work. For other Lower Rideau catchments and Lower Rideau Subwatershed Report, please visit the RVCA website at www.rvca.ca.

Inside

Catchment Facts

- The lower and middle reaches of Sawmill Creek are highly urbanized and the creek corridor is degraded and confined by development and transportation infrastructure including the Airport Parkway, the Transitway and Bank Street
- The upper reach is undergoing urbanization with more opportunity to maintain the functional integrity of the corridor by applying development setbacks and conveyance of the corridor into public ownership
- Drains 21 sq. km of land or 2.7% of the Lower Rideau Subwatershed and 0.5% of the Rideau Valley Watershed
- Dominant land cover is settlement (48%), followed by transportation (21%), woodland (16%), wetland (11%), grassland (3%) and water (1%)
- Riparian buffer (30 m. wide along both sides of Sawmill Creek and its tributaries) is comprised of woodland (41%), settlement (24%), wetland (17%), transportation (15%) and grassland (3%)
- Contains a cool/warm water recreational and baitfish fishery with 21 fish species
- Contains one municipal drain
- Water quality rating along Sawmill Creek is poor at Lester Road and poor in the reach from Bank Street to Walkley Road (in the vicinity of the outlet from the Sawmill Creek constructed wetland/ stormwater management facility), with no change in the water quality rating observed over a 12 year reporting period (2000-2005 vs. 2006-2011)
- Woodland cover has increased by 2.5 percent (52 ha.) from 2002 to 2008
- Four stewardship (landowner tree planting/clean water/shoreline naturalization) projects have been completed
- Major studies completed include: Sawmill Creek Watershed Study. 1994 (Gore & Storrie for RVCA); Sawmill Creek Subwatershed Study Update. 2003 (CH2MHill for City of Ottawa)
- Flow diversion and constructed wetland constructed in 2006, resulting in flood hazard reduction in South Keys, stormwater treatment and reduced downstream erosion
- Improved public access to corridor between Hunt Club and Walkley Roads via pathway system built in conjunction with the constructed wetland
- Erosion control measures implemented at several locations between Heron Road/Tax Centre Transit Station and Walkley Road in conjunction with Southeast Transitway construction
- Since 2003 the RVCA has monitored benthic macroinvertebrates at Riverside Drive and since 2004, City Stream Watch staff and community volunteers have completed 16 km of stream cleanup; in 2003 and 2008, stream surveys were undertaken by CSW staff and volunteers; between 2005 and 2008, 1200 trees and shrubs have been planted on and adjacent to eroding stream banks in the Heron Park area and a pathway was relocated away from the stream bank to allow for revegetation; also in 2008, RVCA staff and community volunteers conducted fish sampling and temperature profiling to gain a better understanding of temperature and habitat variations in the creek
- During 2009, the City and the University of Ottawa installed stream barbs downstream of Heron Road to direct flow away from an eroding stream bank

1) Surface Water Quality

Assessment of streams in the Lower Rideau is based on 24 parameters including nutrients (total phosphorus, total Kjeldahl nitrogen, nitrates), E. coli, metals (like aluminum and copper) and additional chemical/physical parameters (such as alkalinity, chlorides pH and total suspended solids). Each parameter is evaluated against established guidelines to determine water quality conditions. Those parameters that frequently exceed guidelines are presented below.

The assessment of water quality throughout the Lower Rideau Subwatershed also looks at water quality targets that are presented in the 2005 Lower Rideau Watershed Strategy (LRWS), to see if they are being met. The LRWS identifies improving water quality as a priority concern; specifically reducing the levels of nutrients, bacteria and contaminants in the Lower Rideau.

1) a. Sawmill Creek

Surface water quality conditions in Sawmill Creek are monitored through the City of Ottawa's Baseline Water Quality Program. (CK18-03-00 between Albion Road and Aladdin Lane and CK18-S upstream side of Airport Parkway off ramp bridge-culvert) (See Fig. 1 for their location).

The water quality rating for Sawmill Creek is "Poor" as determined by the CCME Water Quality Index (CCME WQI); analysis of the data has been broken into two periods 2000-2005 and 2006-2011, to examine if conditions have changed in this timeframe. Table 1 outlines the WQI scores and their corresponding ratings

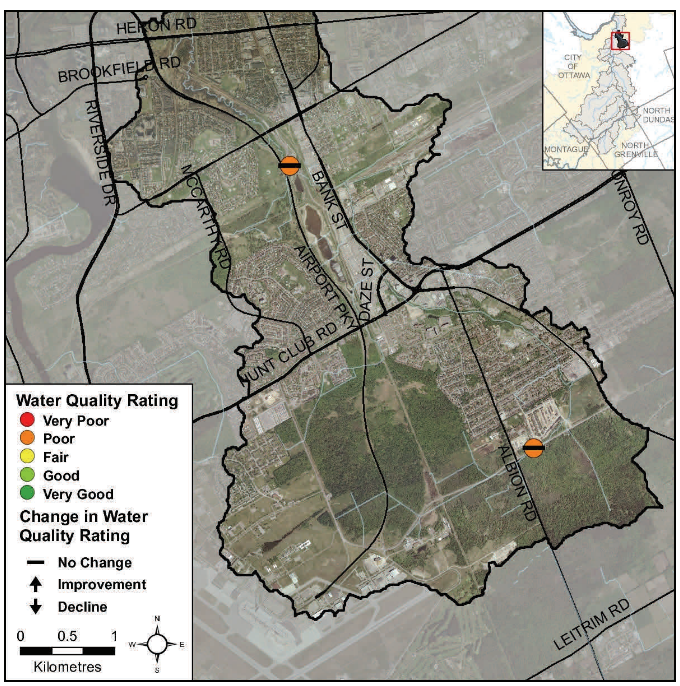


Figure 1. Sampling sites on Sawmill Creek

For more information on the CCME WQI please see the Lower Rideau Subwatershed Report.

Table 1. WQI Ratings and corresponding index scores (RVCA terminology, original WQI category names in brackets).

Rating	Index Score
Very good (Excellent)	95-100
Good	80-94
Fair	65-79
Poor (Marginal)	45-64
Very poor (Poor)	0-44

Sawmill Creek Nutrients

Total phosphorus (TP) is used as a primary indicator of excessive nutrient loading and may contribute to abundant aquatic vegetation growth and depleted dissolved oxygen levels. The Provincial Water Quality Objectives (PWQO) of 0.030 mg/l is used as the TP Guideline. Concentrations greater than 0.030 mg/l indicate an excessive amount of TP. Sawmill Creek TP results are shown in Figures 2a and 2b. In addition to the TP guideline, the Lower Rideau Watershed Strategy set a target for TP concentration of 0.030 mg/l at the 85th percentile for tributaries of the Rideau River, such as Sawmill Creek. Percentile plots of TP data are shown for two time periods 2000-2005 (Fig. 3a) and 2006-2011 (Fig. 3b). Any point to the left of the 85th percentile line (vertical) and above the guideline (horizontal line) have failed to reach the LRWS target.

Total Kjeldahl nitrogen (TKN) is used as a secondary indicator of nutrient loading; RVCA uses a guideline of 0.500 mg/l (TKN Guideline) to assess TKN concentrations. Sawmill Creek TKN results are shown in Figures 4a and 4b.

Tables 2 and 3 summarize average nutrient concentrations at monitored sites on Sawmill Creek and shows the proportion of samples that meet guidelines. Highlighted values indicate that the average has exceeded the guideline.

Table 2. Summary of total phosphorous results for Sawmill Creek from 2000-2005 and 2006-2011

Total Phosphorus 2000-2005			
Site	Average (mg/l)	% Below Guideline	No. Samples
CK18-03-00	0.028	76	71
CK18-S	0.041	46	39
Total Phosphorus 2006-2011			
Site	Average (mg/l)	% Below Guideline	No. Samples
CK18-03-00	0.033	60	65
CK18-S	0.039	32	62

Table 3. Summary of total Kjeldahl nitrogen results for Sawmill Creek from 2000-2005 and 2006-2011

Total Kjeldahl Nitrogen 2000-2005			
Site	Average (mg/l)	% Below Guideline	No. Samples
CK18-03-00	0.832	44	71
CK18-S	0.627	28	39
Total Kjeldahl Nitrogen 2006-2011			
Site	Average (mg/l)	% Below Guideline	No. Samples
CK18-03-00	0.681	23	65
CK18-S	0.666	6	62

Sawmill Creek Nutrients: Site CK18-03-00

The majority of samples at site CK18-03-00 were below the TP guideline of 0.030mg/l for both time periods (Fig. 2a, 2000-2005 and 2b, 2006-2011), seventy-six percent of samples were below the guideline in the 2000-2005 period this declined to thirty-two percent of samples in the 2006-2011 period. There was also a slight increase in average TP concentration from 0.028 mg/l (2000-2005) to 0.033 mg/l (2006-2011). The target of a TP concentration of 0.030mg/l at the 85th percentile has not been achieved at this site, and the concentration at the 85th percentile increased from 0.041 mg/l (2000-2005, Fig. 3a) to 0.050 mg/l (2006-2011, Fig. 3b).

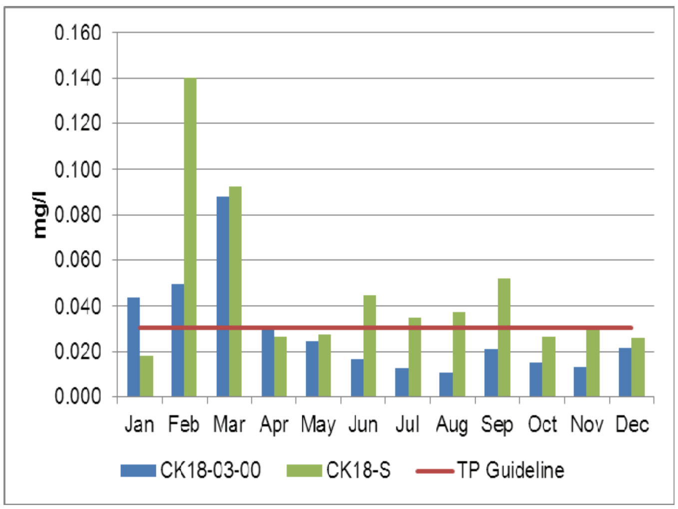


Figure 2a. Total phosphorous concentrations in Sawmill Creek from 2000-2005

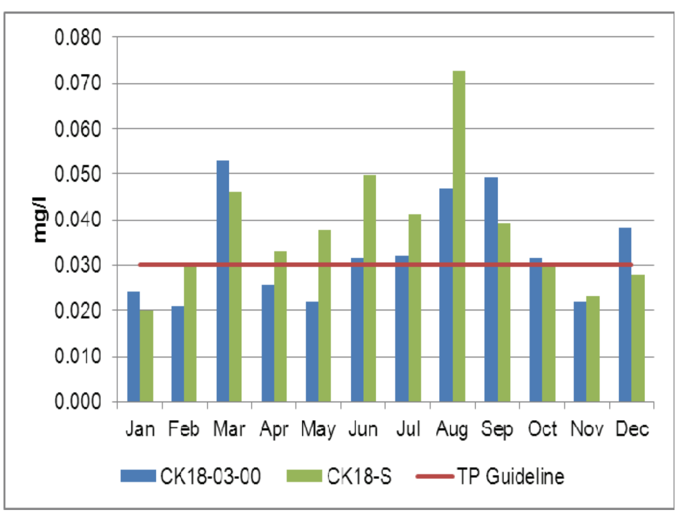


Figure 2b. Total phosphorous concentrations in Sawmill Creek from 2006-2011

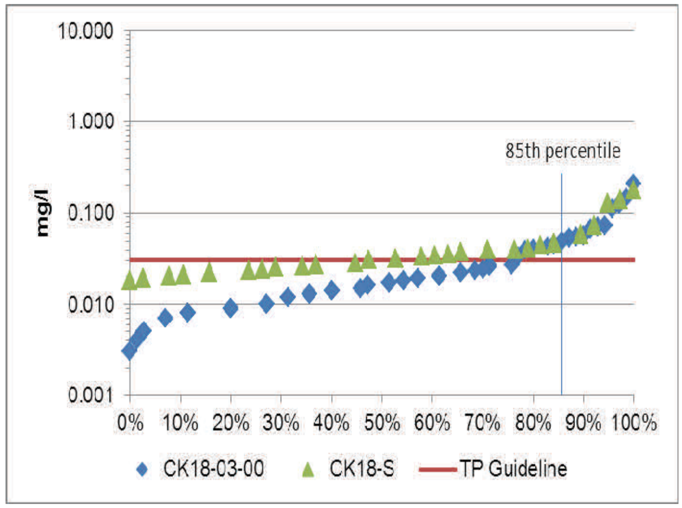


Figure 3a. Percentile plots of total phosphorous in Sawmill Creek from 2000-2005

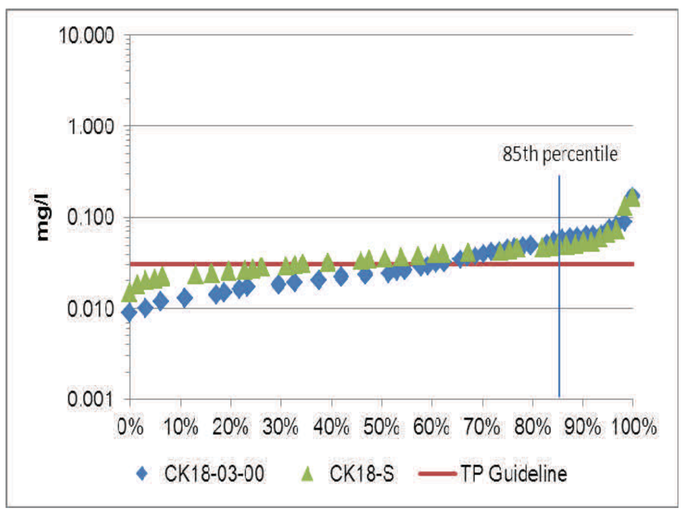


Figure 3b. Percentile plots of total phosphorous in Sawmill Creek from 2006-2011

TKN is used as a secondary indicatory of nutrient enrichment. Figures 4a, 2000-2005 and 4b, 2006-2011 show that the majority of results exceeded the TKN guideline of 0.500 mg/l, forty-four percent of samples were below the guideline in 2000-2005; this dropped to only twenty-eight percent of samples below the guideline in the 2006-2011 periods. The average concentration decreased from 0.832 mg/l to 0.681 mg/l, exceeding the guideline.

Sawmill Creek Nutrients: Site CK18-S

The majority of samples at site CK18-S were above the TP guideline of 0.030mg/l for both time periods (Fig. 2a, 2000-2005 and 2b, 2006-2011), forty-six percent of samples were below the guideline in the 2000-2005 period, this declined to thirty-two percent of samples in the 2006-2011 period. Average TP concentration decreased from 0.041 mg/l (2000-2005) to 0.039 mg/l (2006-2011). Percentile plots of TP data show that the target set by the LRWS has not been achieved. The concentration at the 85th percentile increased slightly from 0.042 mg/l (2000-2005, Fig. 3a) to 0.045 mg/l (2006 -2011, Fig. 3b).

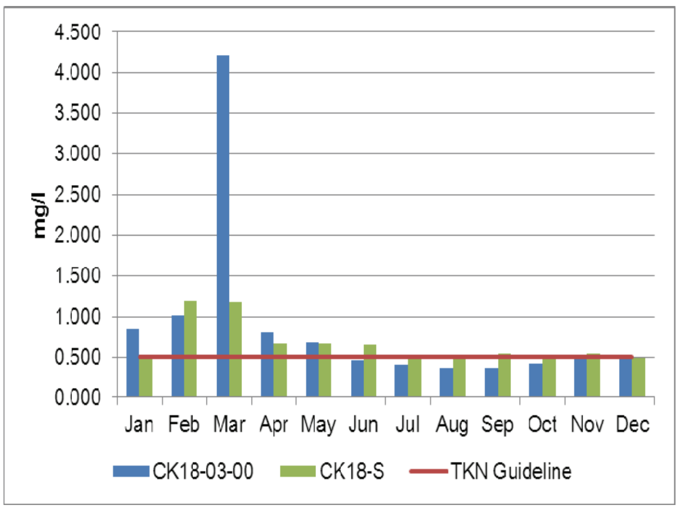


Figure 4a. Total Kjeldahl nitrogen concentrations in Sawmill Creek from 2000-2005

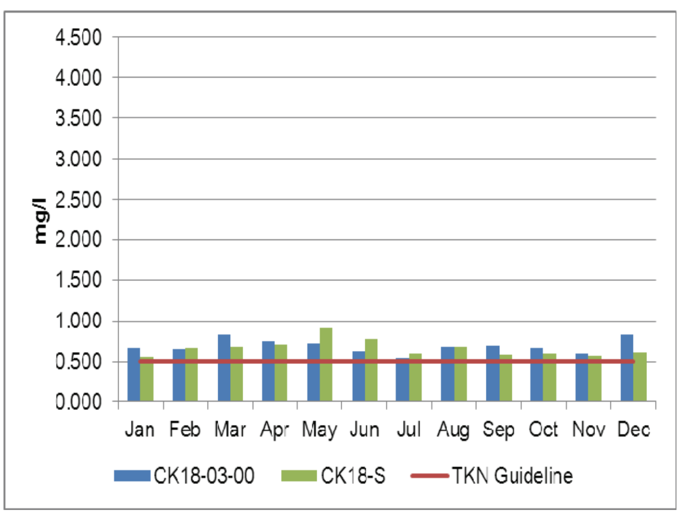


Figure 4b. Total Kjeldahl nitrogen concentrations in Sawmill Creek from 2006-2011

TKN results show that the majority of results exceeded the TKN guideline of 0.500 mg/l (Fig. 4a, 2000-2005 and Fig. 4b, 2006-2011), twenty-eight percent of samples were below the guideline in the 2000-2005 period and dropped to only six percent in the 2006-2011 period. The average concentration increased from 0.627 mg/l to 0.666 mg/l, exceeding the guideline.

Sawmill Creek Nutrients Summary

Overall the data suggests that nutrient loading is a significant problem at both sites CK18-03-00 and CK-18S; efforts should be made to reduce nutrients wherever possible to improve overall water quality.

Sawmill Creek E. coli

E. coli is used as an indicator of bacterial pollution from human or animal waste; in elevated concentrations it can pose a risk to human health. The PWQO Objectives of 100 colony forming units/100 millilitres is used. E. coli counts greater than this guideline indicate that bacterial contamination may be a problem within a waterbody. The Lower Rideau Watershed Strategy also set a target for E. coli counts of 200 CFU/100 ml at the 80th percentile for tributaries of the Rideau River, such as Sawmill.

Table 4 summarizes the geometric mean at monitored sites on Sawmill Creek and shows the proportion of samples that meet the E. coli guideline of 100 CFU/100ml. Highlighted values indicate average value exceeds the guideline.

Figure 5 shows the results of the geometric mean with respect to the guideline for the two periods 2000-2005 (Fig. 5a) and 2006-2011 (Fig. 5b). Figures 6a and 6b show percentile plots of the data for the two time periods of interest 2000-2005 (Fig. 6a) and 2006-2011 (Fig. 6b). Any point to the left of the 80th percentile line (vertical) and above the guideline (horizontal line) have failed to reach the LRWS target.

Table 4. Summary of E. coli counts in Sawmill Creek

E. coli 2000-2005			
Site	Geometric Mean (CFU/100ml)	% Below Guideline	No. Samples
CK18-03-00	25	78	69
CK18-S	315	19	37
E. coli 2006-2011			
Site	Geometric mean (CFU/100ml)	% Below Guideline	No. Samples
CK18-03-00	73	55	65
CK18-S	340	15	62

E. coli counts above the guideline of 100 colony forming units per 100 mL (CFU/100mL) were common at both water quality monitoring sites on Sawmill Creek.

Sawmill Creek E. coli: Site CK18-03-00

In comparing the two time periods at site CK18-03-00 the proportion of samples below the guideline decreased from twenty-five percent (Fig. 5a. 2000-2005) to seventy-three percent (Fig. 5b, 2006-2011), indicating higher counts occur more frequently. The count at the geometric mean increased from 25 CFU/100 ml to 73 CFU/100 ml. Percentile plots of E. coli data at site CK18-03-00 are shown for both periods. Figures 6a, 2000-2005 and 6b, 2006-2011 show that this target was exceeded in the 2006-2011 period, the E. coli count at the 80th percentile increased from 101 CFU/100 ml to 250 CFU/100 ml.

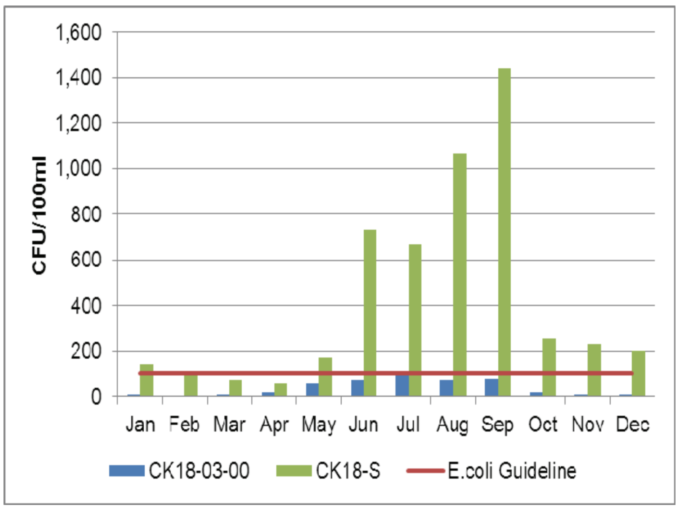


Figure 5a. E. coli counts in Sawmill Creek from 2000-2005

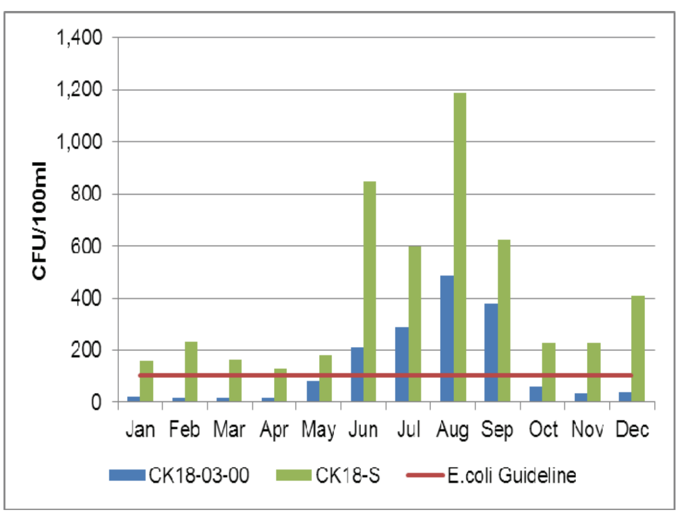


Figure 5b. E. coli counts in Sawmill Creek from 2006-2011

Sawmill Creek E. coli: *Site CK18-S*

A second water quality monitoring site, CK18-S is located downstream of CK18-03-00. The proportion of samples below the guideline at CK18-S decreased slightly from nineteen percent (Fig. 5a, 2000-2005) to fifteen percent (2006-2011). The count at the geometric mean increased from 315 CFU/100 ml to 340 CFU/100 ml. Figures 6a, 2000-2005 and 6b, 2006-2011 show that the LRWS target for E. coli was exceeded in both time periods in site CK18-S; and the E. coli count at the 80th percentile increased from 314 CFU/100 ml to 340 CFU/100 ml.

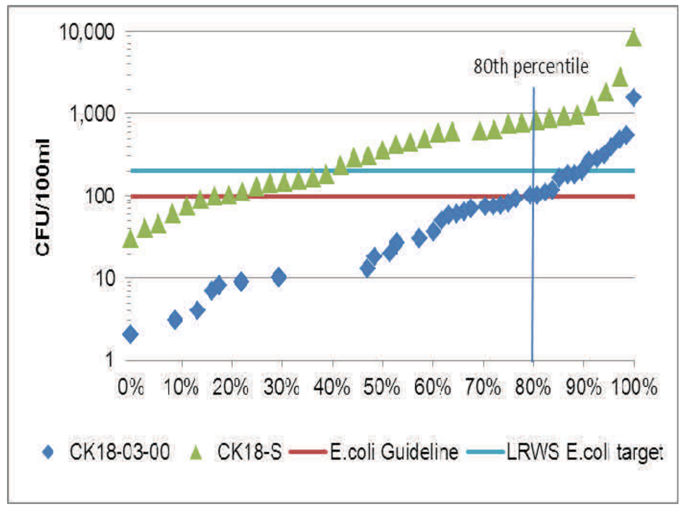


Figure 6a. Percentile plots for E. coli in Sawmill Creek from 2000-2005

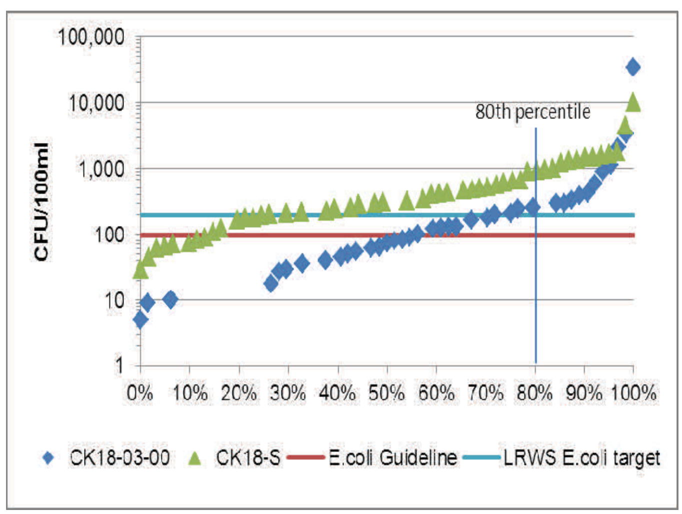


Figure 6b. Percentile plots of E. coli in Sawmill Creek from 2006-2011

Sawmill Creek E. coli: Summary

These statistics indicated that bacterial counts have increased at site CK18-03-00 and efforts should be made to reduce any possible sources of contamination to the creek to protect overall water quality and aquatic life.

These statistics for site CK18-S indicated that bacterial counts have decreased at this site though efforts should be continued to reduce any additional sources of contamination to the creek to protect overall water quality and aquatic life.

Sawmill Creek Metals

Of the metals routinely monitored in Sawmill Creek, aluminum (Al), copper (Cu) and iron (Fe) were metals that reported concentrations above their respective PWQO. In elevated concentrations these metals can have toxic effects on sensitive aquatic species.

Table 5 summarizes average metal concentrations at monitored sites on Sawmill Creek and shows the proportion of samples that meet guidelines. Highlighted values indicate average value exceeds the guideline.

Figures 7, 8 and 9, show the results for each site with respect to guidelines for the two periods 2000-2005 (Figures 7a, 8a and 9a) and 2006-2011 (Figures 7b, 8b and 9b). The guidelines for each metal as stated by the PWQO are Al 0.075 mg/l, Cu 0.005 mg/l and Fe 0.300 mg/l. The Lower Rideau Watershed Strategy set a target for Cu concentration of 0.005 mg/l (Cu guideline) at the 80th percentile for tributaries of the Rideau River, such as Sawmill Creek. Percentile plots of Cu data are shown for the two time periods 2000-2005 (Fig. 10a) and 2006-2011 (Fig. 10b). Any point to the left of the 80th percentile line (vertical) and above the guideline (horizontal line) have failed to reach the LRWS target.

Table 5. Summary of Metal concentrations in Sawmill Creek

Aluminum 2000-2005			
Site	Average (mg/l)	% Below Guideline	No. Samples
CK18-03-00	0.141	66	70
CK18-S	0.234	16	38
Aluminum 2006-2011			
Site	Average (mg/l)	% Below Guideline	No. Samples
CK18-03-00	0.100	62	65
CK18-S	0.202	23	62
Iron 2000-2005			
Site	Average (mg/l)	% Below Guideline	No. Samples
CK18-03-00	0.794	30	70
CK18-S	0.572	5	38
Iron 2006-2011			
Site	Average (mg/l)	% Below Guideline	No. Samples
CK18-03-00	0.589	17	65
CK18-S	0.430	31	62
Copper 2000-2005			
Site	Average (mg/l)	% Below Guideline	No. Samples
CK18-03-00	0.003	87	70
CK18-S	0.005	63	38
Copper 2006-2011			
Site	Average (mg/l)	% Below Guideline	No. Samples
CK18-03-00	0.005	62	65
CK18-S	0.007	34	62

Sawmill Creek Metals: Site CK18-03-00

The majority of metals monitored at site CK-18-03 were below guidelines however results for aluminum (Al), iron (Fe) and copper (Cu) were occasionally elevated.

Results for Al were typically below the guideline of 0.075 mg/l in both time periods (Fig. 7a, 2000-2005 and 7b. 2006-2011), sixty-six percent of samples were less than

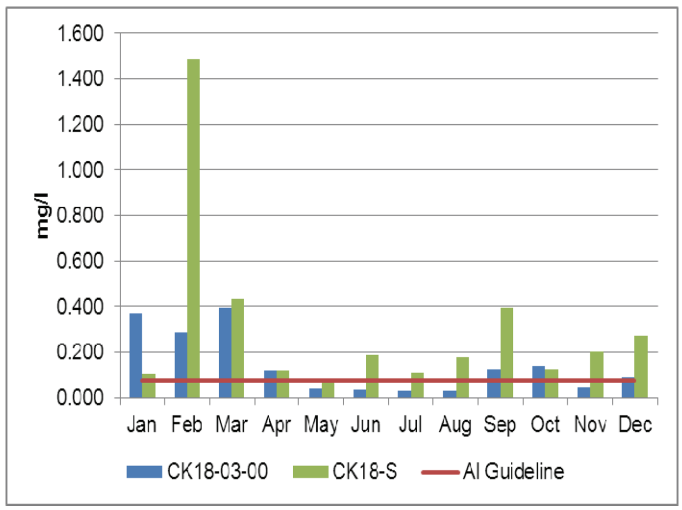


Figure 7a. Aluminum concentrations in Sawmill Creek from 2000-2005

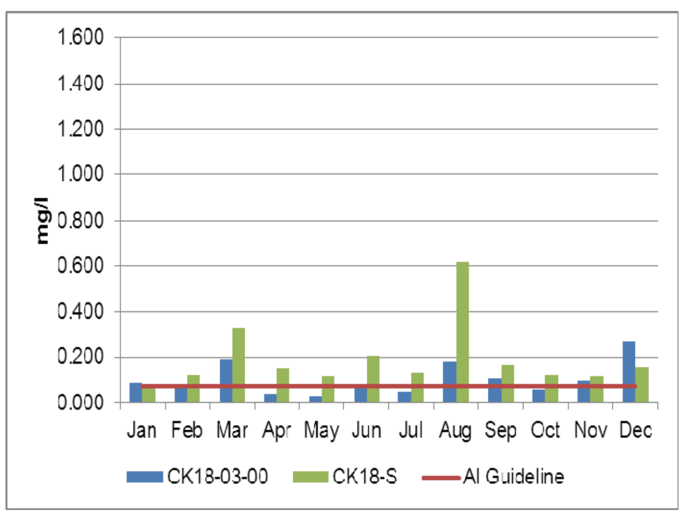


Figure 7b. Aluminum concentrations in Sawmill Creek from 2006-2011

the guideline in the 2000-2005 period this remained fairly consistent at sixty-two percent in the 2006-2011 period. There was a slight decrease in the average Al concentration from 0.141 mg/l (2000-2005) to 0.100 mg/l (2006-2011).

Figures 8a, 2000-2005 and 8b, 2006-2011 show that the Fe results often exceed the guideline of 0.300 mg/l however there was an overall decrease in the concentrations over the periods of interest. Thirty percent of samples were below the guideline in 2000-2005 and decreased to seventeen percent in the 2006-2011 period. The average concentration declined from 0.794 mg/l to 0.589 mg/l, exceeding the guideline.

Results for Cu concentrations were also occasionally above the guideline of 0.005 mg/l. The proportion of samples below the guideline decreased from eighty-seven percent (Fig. 9a, 2000-2005) to sixty-two percent (Fig. 9b, 2006-2011), the average concentration increased from 0.003 mg/l to 0.005 mg/l. The target of a Cu concentration of 0.005 mg/l at the 80th percentile was not achieved in the 2000-2005 period at site CK18-03-00. The concentration at the 80th percentile increased from 0.003 mg/l (2000-2005, Fig. 10a) to 0.008 mg/l (2006-2011, Fig. 10b).

Sawmill Creek Metals: Site CK18-S

Results for Al were generally below the guideline at CK18-S; sixteen percent of samples were below the guideline in the 2000-2005 period (Fig. 7a) and increased to twenty-three percent in the 2006-2011 period (Fig. 7b). There was a decrease in the average Al concentration from 0.234 mg/l (2000-2005) to 0.202 mg/l (2006-2011).

Figures 8a, 2000-2005 and 8b, 2006-2011 show that the Fe results often exceed the guideline of 0.300 mg/l though an overall decline was seen in samples above the

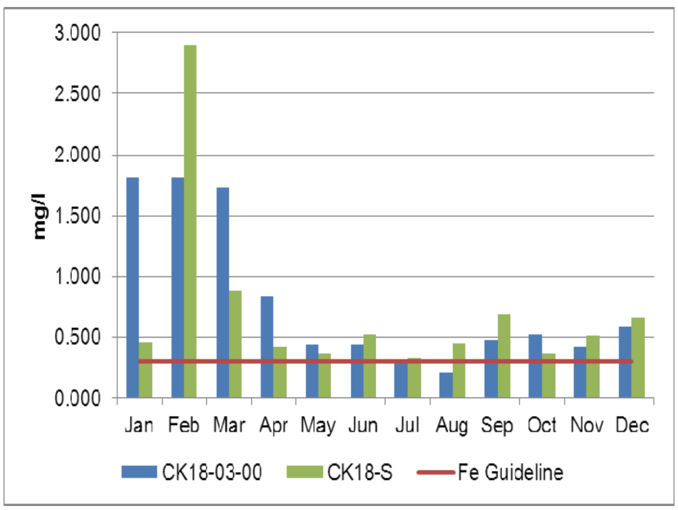


Figure 8a. Iron concentrations in Sawmill Creek from 2000-2005

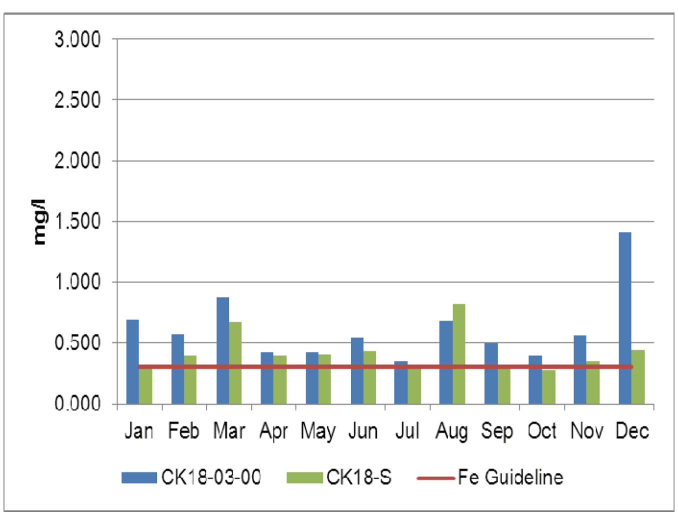


Figure 8b. Iron concentrations in Sawmill Creek from 2006-2011

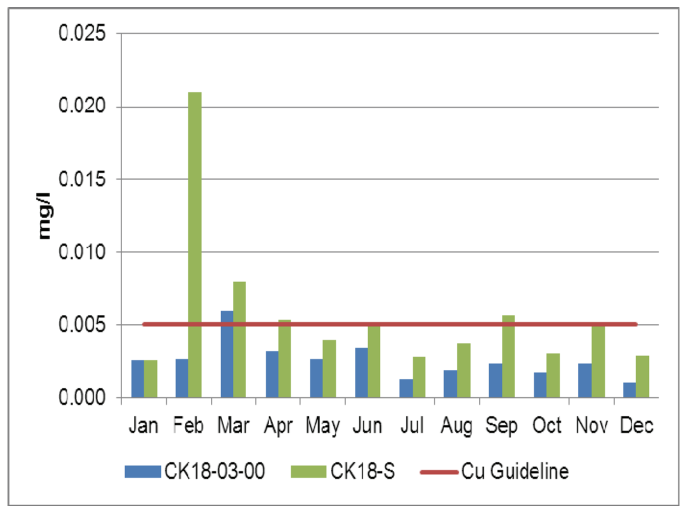


Figure 9a. Copper concentrations in Sawmill Creek from 2000-2005

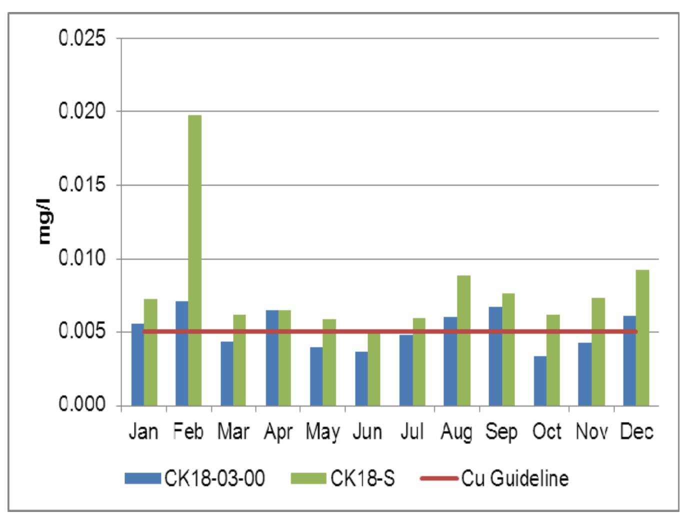


Figure 9b. Copper concentrations in Sawmill Creek from 2006-2011

guideline. Five percent of samples were below the guideline in 2000-2005 and improved to thirty-one percent in the 2006-2011 period. The average concentration increased from 0.572 mg/l to 0.430 mg/l, exceeding the guideline.

Results for Cu concentrations were also occasionally above the guideline of 0.005 mg/l. The proportion of samples below the guideline decreased slightly from sixty -three percent (Fig. 9a, 2000-2005) to thirty-four percent (Fig. 9b, 2006-2011), the average concentration increased from 0.005 mg/l to 0.007 mg/l. Percentile plots of Cu data show that the target of a Cu concentration of 0.005 mg/l at the 80th percentile was achieved at site CK18-S, the concentration at the 80th percentile increased from 0.006 mg/l (2000-2005, Fig. 10a) to 0.010 mg/l (2006-2011, Fig. 10b).

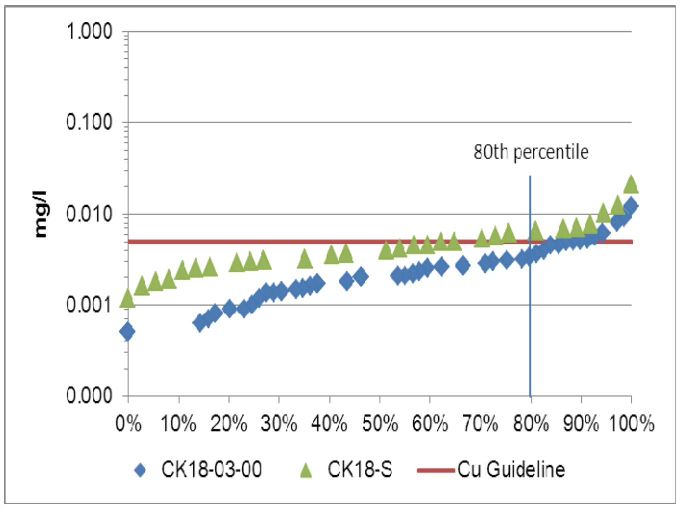


Figure 10a. Percentile plots of copper in Sawmill Creek from 2000-2005

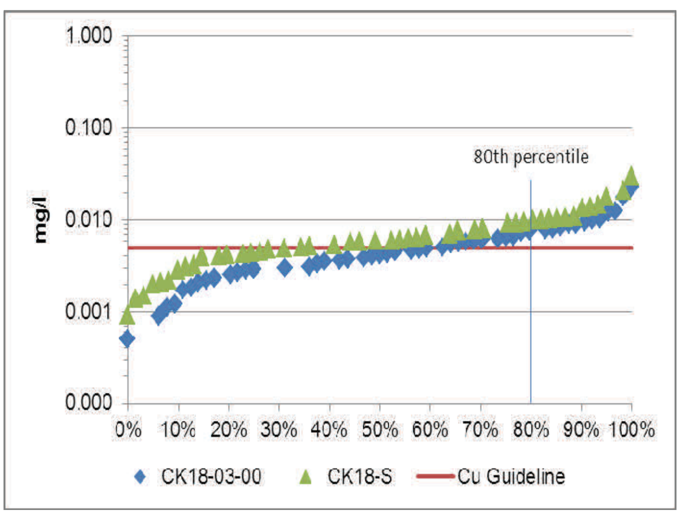


Figure 10b. Percentile plots of copper in Sawmill Creek from 2006-2011

Sawmill Creek Metals Summary

Overall the data shows that metal pollution at site CK18-03-00 is a problem in the creek and efforts should be made to reduce concentrations wherever possible.

Overall the data indicates that metal pollution in site CK18-S occasionally occurs at this site and efforts should be made to reduce sources where possible.

Benthic Invertebrates

Freshwater benthic invertebrates are animals without backbones that live on the stream bottom and include crustaceans such as crayfish, molluscs and immature forms of aquatic insects. Benthos represent an extremely diverse group of aquatic animals and exhibit wide ranges of responses to stressors such as organic pollutants, sediments and toxicants, which allows scientists to use them as bioindicators.

As part of the Ontario Benthic Biomonitoring Network (OBBN), the RVCA has been collecting benthic invertebrates at one location on Sawmill Creek at Riverside Drive since 2003. Monitoring data is analyzed and the results are presented using the Family Biotic Index, Family Richness and percent Ephemeroptera, Plecoptera and Trichoptera.

Benthic sampling site replicate one on Sawmill Creek at Riverside Drive in the City of Ottawa, this image was captured in the spring of 2008.

The Hilsenhoff Family Biotic Index (FBI) is an indicator of organic and nutrient pollution and provides an estimate of water quality conditions for each site using established pollution tolerance values for benthic invertebrates.

FBI results for Sawmill Creek show that it has “ Good” to “Poor” water quality conditions for the period from 2006 to 2011 (Fig.11) and scores an overall “Fair” surface water quality rating using a grading scheme developed by Conservation Authorities in Ontario for benthic invertebrates.

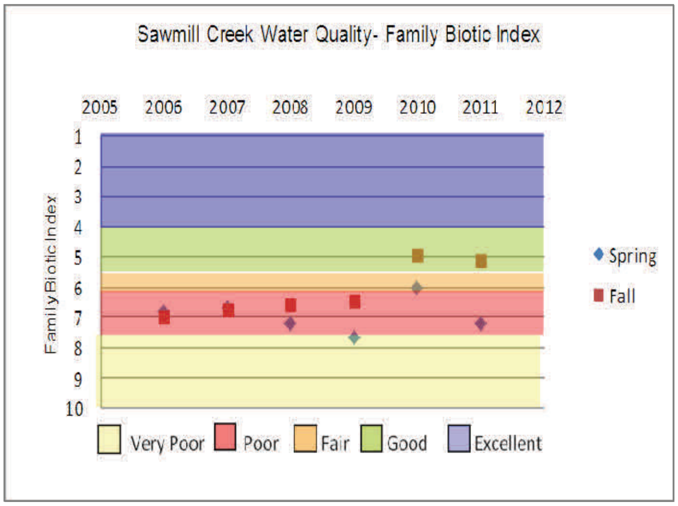


Figure 11. Surface water quality conditions in Sawmill Creek based on the Family Biotic Index

Family Richness indicates the health of the community through its diversity and increases with increasing habitat diversity suitability and healthy water quality conditions. Family Richness is equivalent to the total number of benthic invertebrate families found within a sample.

Using Family Richness as the indicator, Sawmill Creek is reported to have "Fair" water quality (Fig.12).

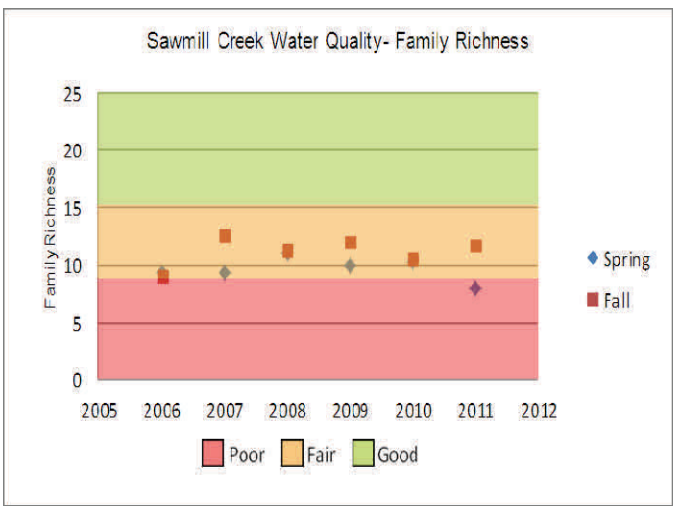


Figure 12. Surface water quality conditions in Sawmill Creek based on Family Richness

Ephemeroptera (Mayflies), Plecoptera (Stoneflies), and Trichoptera (Caddisflies) are species considered to be very sensitive to poor water quality conditions. High abundance of these organisms is generally an indication of good water quality conditions at a sample location.

With the EPT indicator, Sawmill Creek is reported to have water quality ranging from "Poor" to "Good" (Fig.13) from 2006 to 2011.

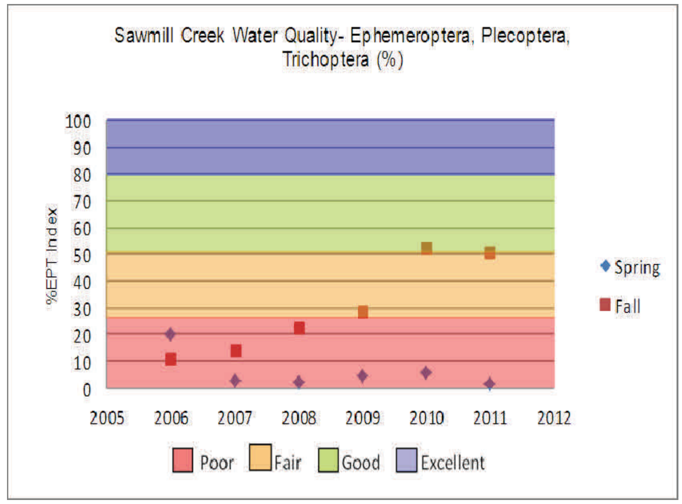
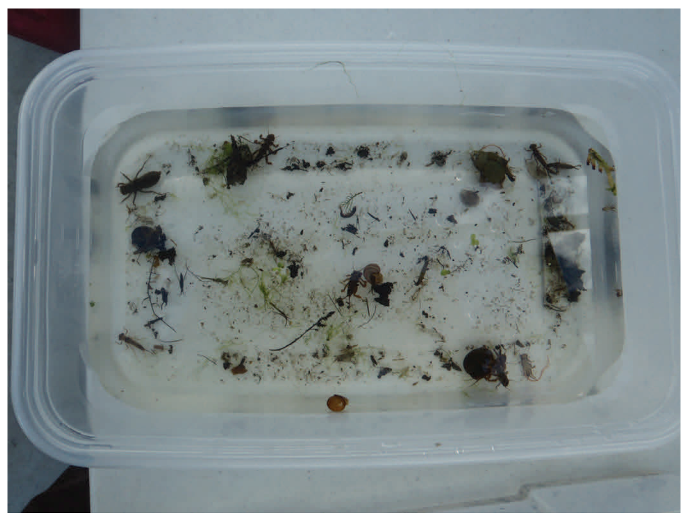


Figure 13. Surface water quality conditions in Sawmill Creek using the EPT Index

Overall Sawmill Creek has a water quality rating of "Poor" from 2006 to 2011.



Common aquatic invertebrates found in Sawmill Creek

Identifying benthic invertebrates in the field at Sawmill Creek

2) a. Overbank Zone

Riparian Buffer along Sawmill Creek and Tributaries

Figure 14 shows the extent of the naturally vegetated riparian zone in the catchment, 30 metres on either side of all waterbodies and watercourses. Results from the RVCA's Land Cover Classification Program show that 61 percent of streams and creeks are buffered with woodland, wetland and grassland; the remaining 39 percent of the riparian buffer is occupied by settlement and transportation.

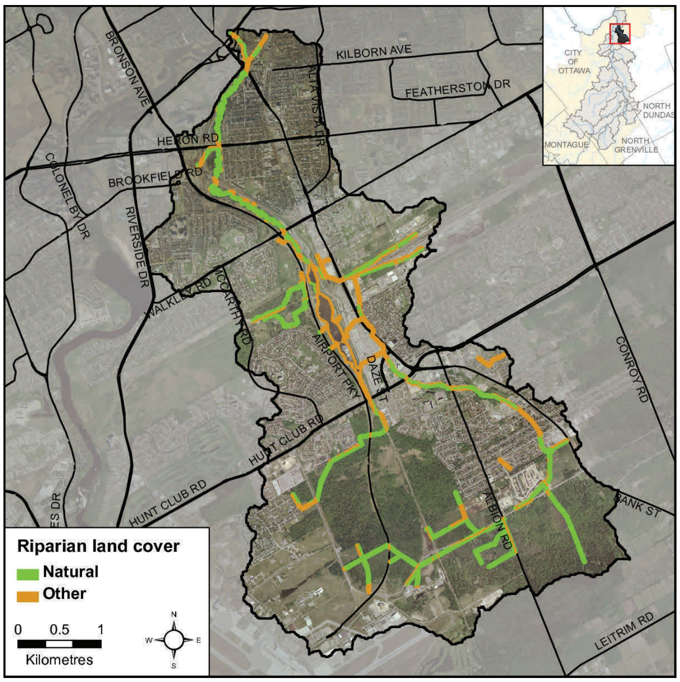


Figure 14. Catchment land cover in the riparian zone

Data from the RVCA's Macrostream Survey Program (Stream Characterization) is used in this section of the report and is generated from an assessment of 97 (100 metres long) sections along Sawmill Creek in 2008.

Riparian Buffer along Sawmill Creek

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 metres wide vegetated buffer along at least 75 percent of the length of both sides of rivers, creeks and streams. Figure 15 demonstrates the buffer conditions of the left and right banks separately. Sawmill Creek had a buffer of greater than 30 metres along 24 percent of the right and left banks.

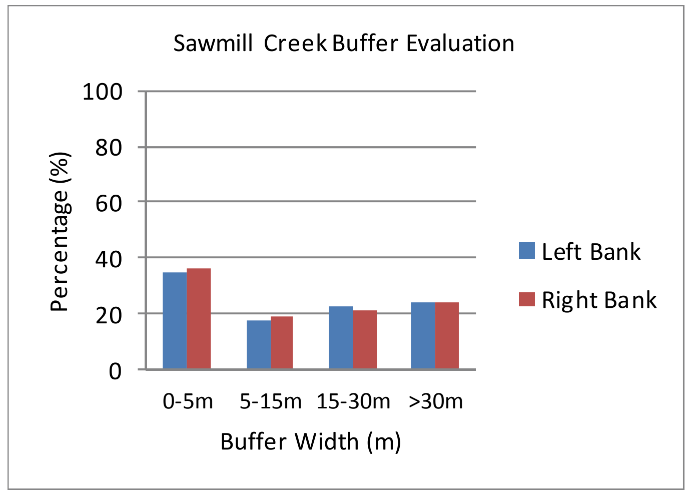


Figure 15. Vegetated buffer width along Sawmill Creek

Land Use beside Sawmill Creek

The RVCA's Macrostream Survey Program identified eight different land uses beside Sawmill Creek (Fig.16). Surrounding land use is considered from the beginning to the end of the survey section (100m) and up to 100m 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 47 percent of the stream, characterized by wetland, forest, scrubland and meadow. The remaining land use consisted of residential, industrial/commercial, infrastructure, and recreational.

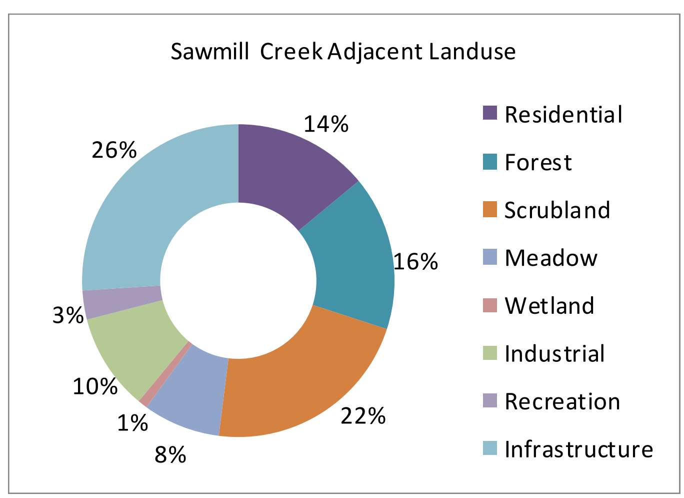


Figure 16. Land use alongside Sawmill Creek

2) b. 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. 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 potential to impact instream migration. Figure 17 shows the bank stability of the left and right bank along Sawmill Creek.

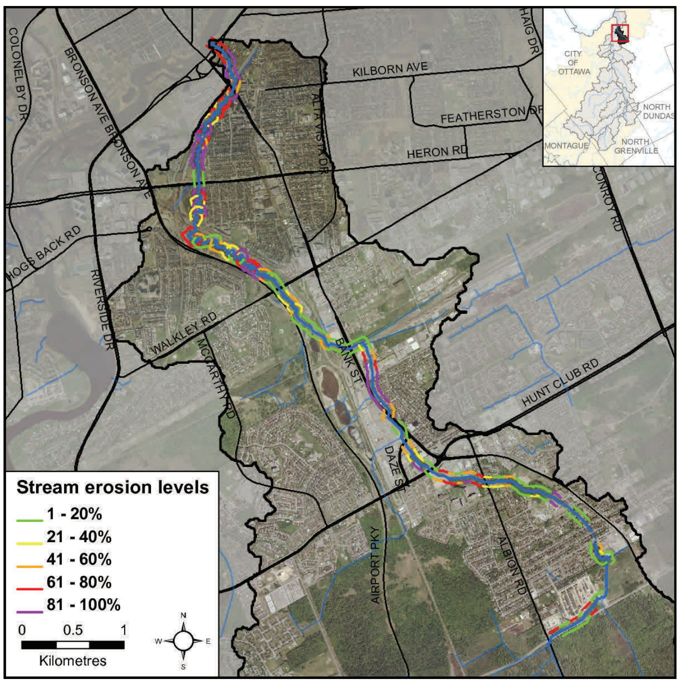


Figure 17. Erosion along Sawmill Creek

Streambank Undercutting

Undercut banks are a normal and natural part of stream function and can provide excellent refuge areas for fish. Figure 18 shows that Sawmill Creek had several locations with identified undercut banks.

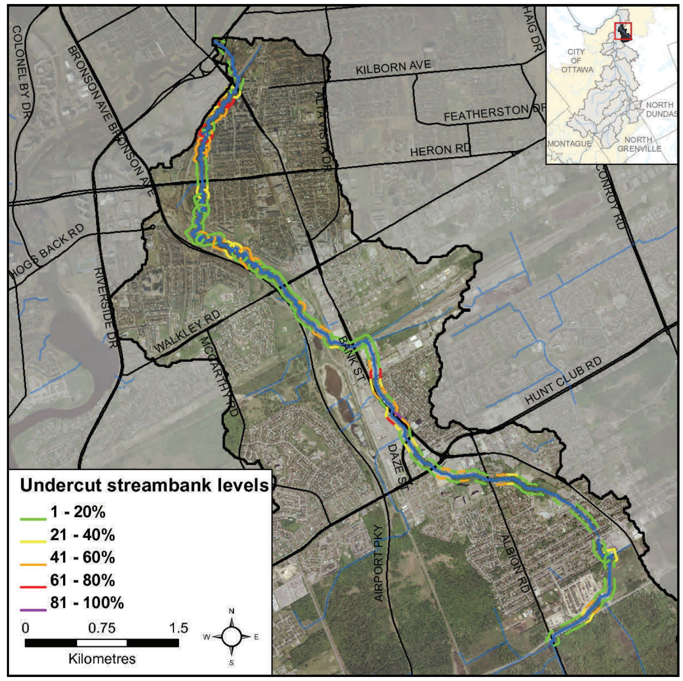


Figure 18. Undercut streambank along Sawmill Creek

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 19 shows the stream shading locations along Sawmill Creek.

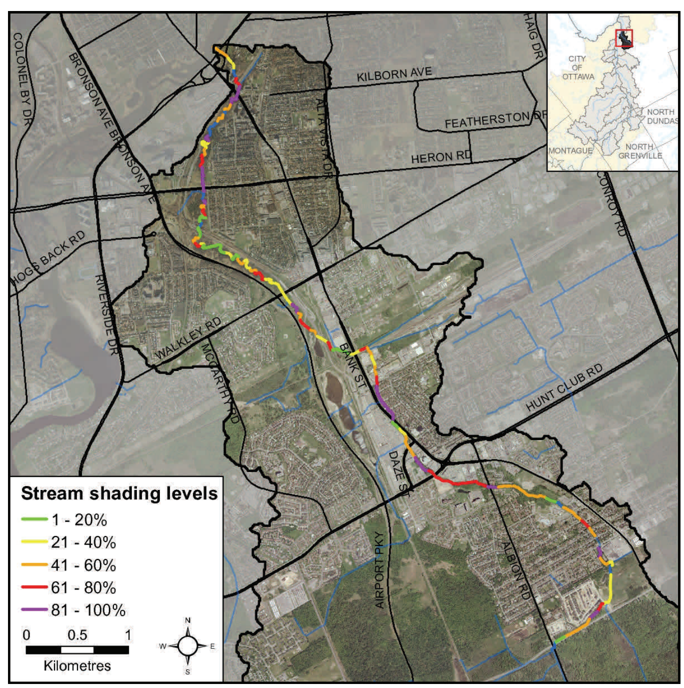


Figure 19. Stream shading along Sawmill Creek

Human Alterations

Figure 20 shows that 22 percent of Sawmill Creek remains “unaltered.” Sections considered “natural” with some human changes account for 13 percent of sections. "Altered" sections accounted for 30 percent of the stream, with the remaining 35 percent of sections sampled being considered “highly altered” (e.g., include road crossings, shoreline/ instream modifications and little or no buffer).

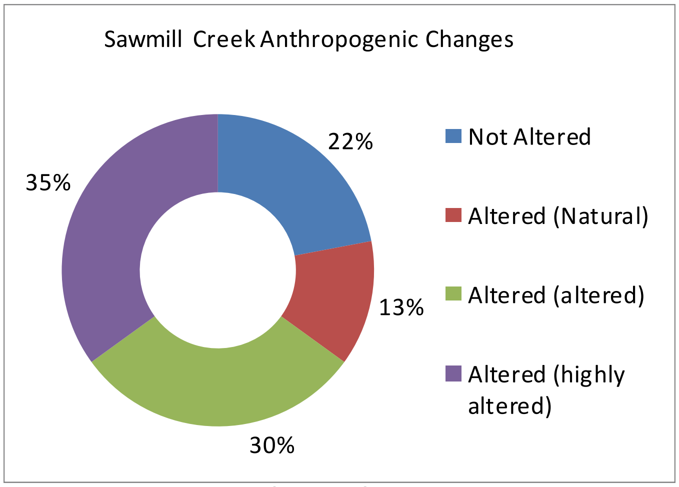


Figure 20. Alterations to Sawmill Creek

Overhanging Trees and Branches

Figure 21 shows that the majority of Sawmill Creek had varying levels of overhanging trees and branches. Overhanging trees and branches provide a food source, nutrients and shade which helps to moderate instream water temperatures.

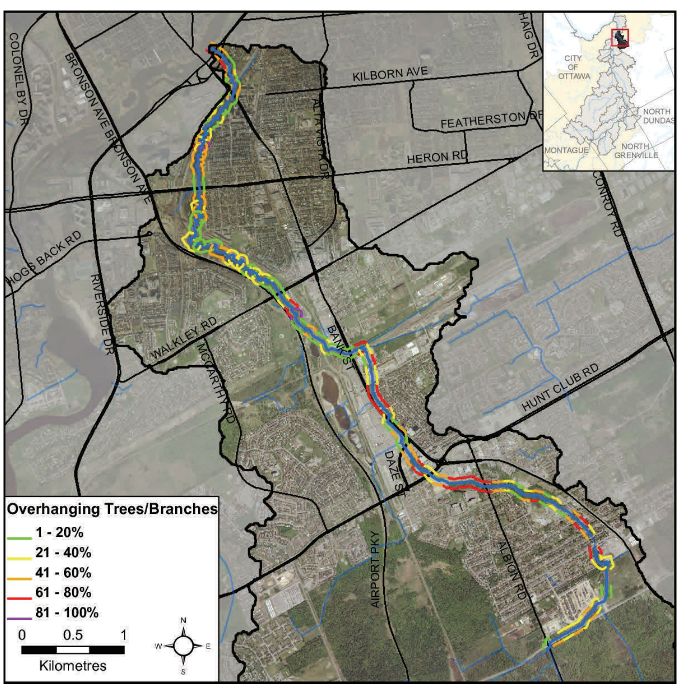


Figure 21. Overhanging trees and branches

Instream Woody Debris

Figure 22 shows that the majority of Sawmill Creek had varying levels of instream woody debris in the form of trees and branches. Instream woody debris is important for fish/benthic habitat by providing refuge/feeding areas.

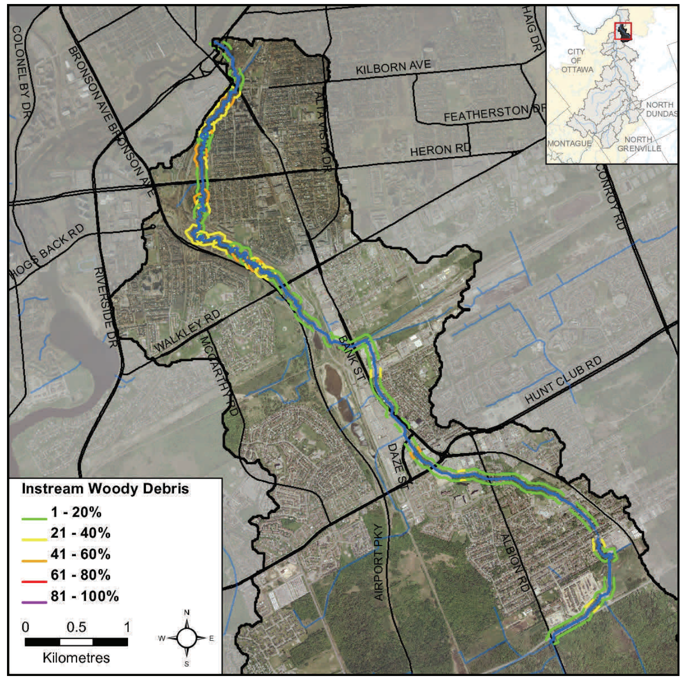


Figure 22. Instream woody debris

2) c. 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. A high percentage of habitat complexity (heterogeneity) typically increases the biodiversity of aquatic organisms within a system. Eighty percent of Sawmill Creek was considered heterogeneous as seen in Figure 23.

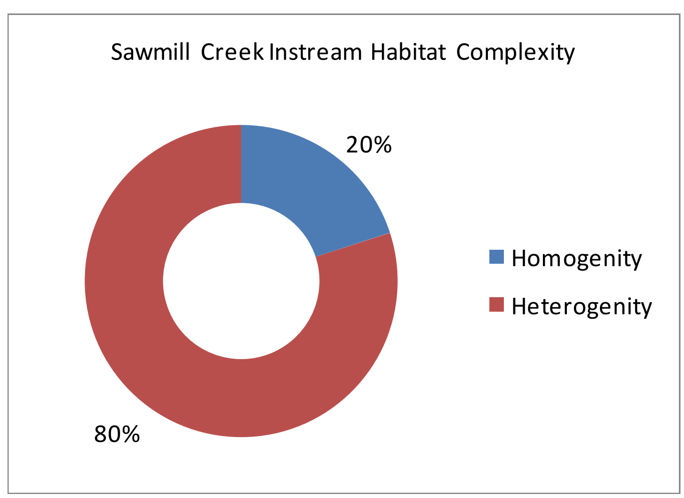


Figure 23. Instream habitat complexity in Sawmill Creek.

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. Sawmill Creek had highly variable substrate conditions. Figure 24 shows the substrate diversity for Sawmill Creek.

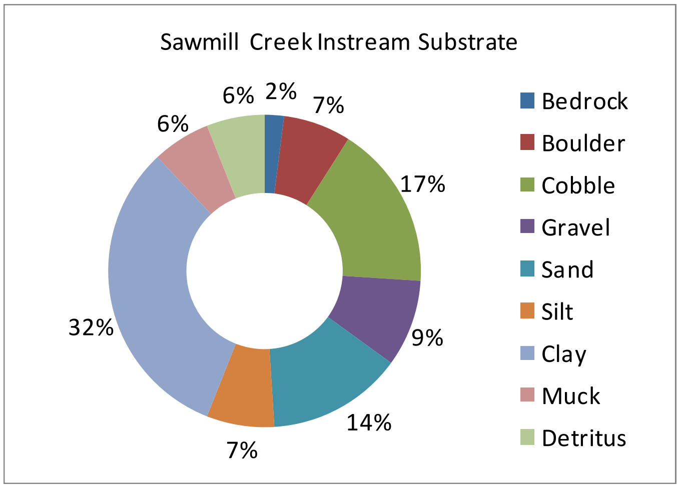


Figure 24. Instream substrate in Sawmill Creek

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 25 shows where cobble and boulder substrate was found in Sawmill Creek.

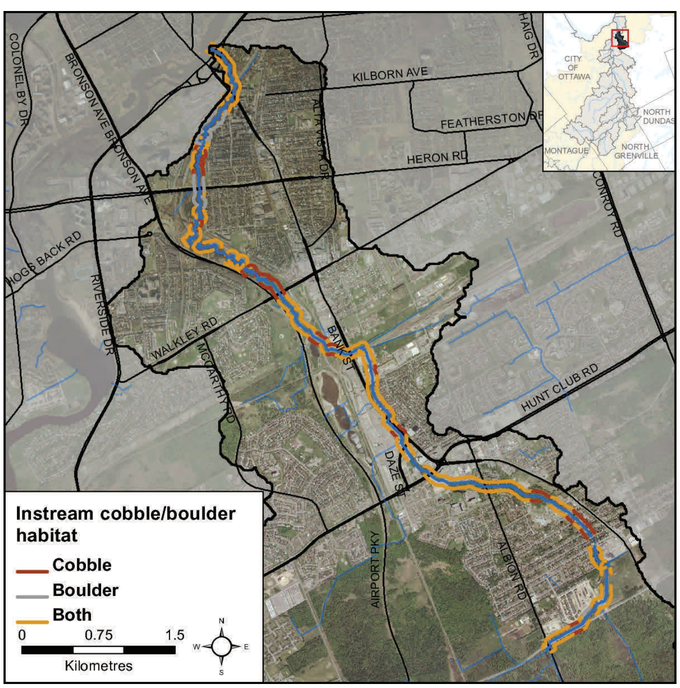


Figure 25. Instream cobble and boulder habitat along Sawmill Creek

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 be refuge pools 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 26 shows that Sawmill Creek was somewhat variable; 77 percent consisted of runs, 11 percent pools and 12 percent riffles.

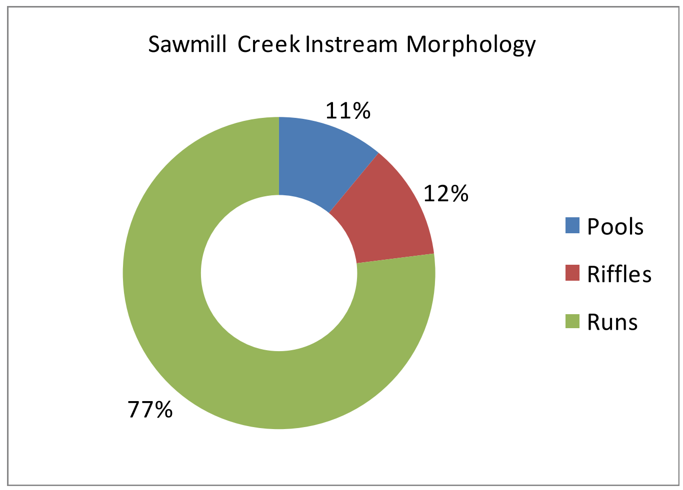


Figure 26. Instream morphology in Sawmill Creek

Types of Instream Vegetation

Sawmill Creek had limited diversity of instream vegetation, which was likely a function of the dominance of clay substrate as well as heavy canopy cover (Figure 27). The dominant vegetation type recorded at sixty-four percent consisted of algae. Submerged vegetation was recorded at 27 percent. A total of eight percent of the sections recorded narrow emergent vegetation. Robust emergents made up the remainder of the vegetation type at one percent.

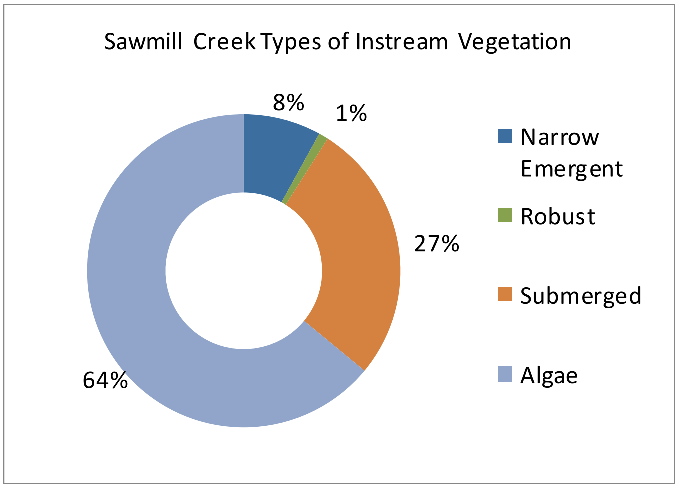


Figure 27. Instream vegetation types in Sawmill Creek.

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. Too much vegetation can also be detrimental. Figure 28 demonstrates that Sawmill Creek had a variety of instream vegetation levels for most of its length.

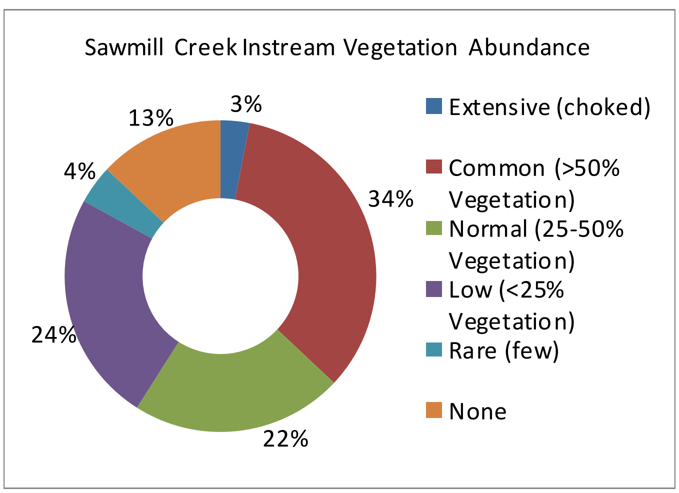


Figure 28. Vegetation abundance in Sawmill Creek

Riparian Restoration

Figure 29 depicts the locations where various riparian restoration activities can be implemented as a result of observations made during the stream survey assessments.

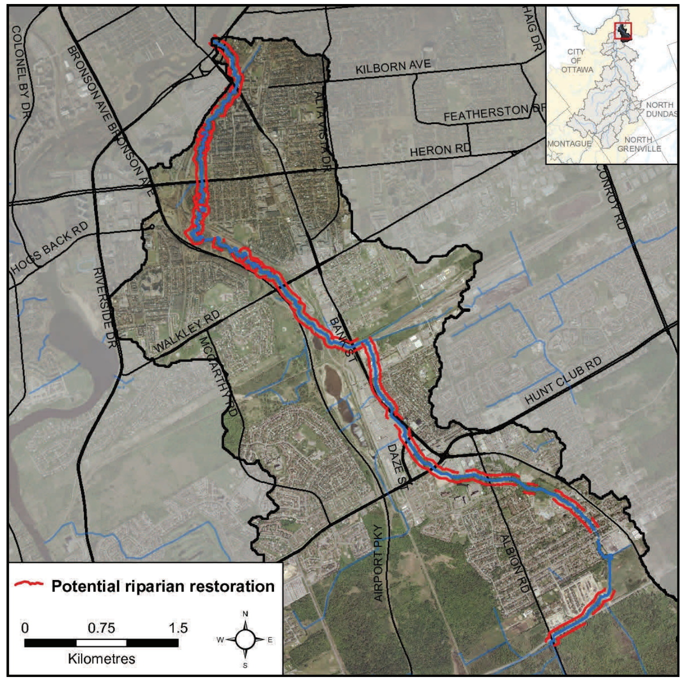


Figure 29. Riparian restoration opportunities

Instream Restoration

Figure 30 depicts the locations where various instream restoration activities can be implemented as a result of observations made during the stream survey assessments.

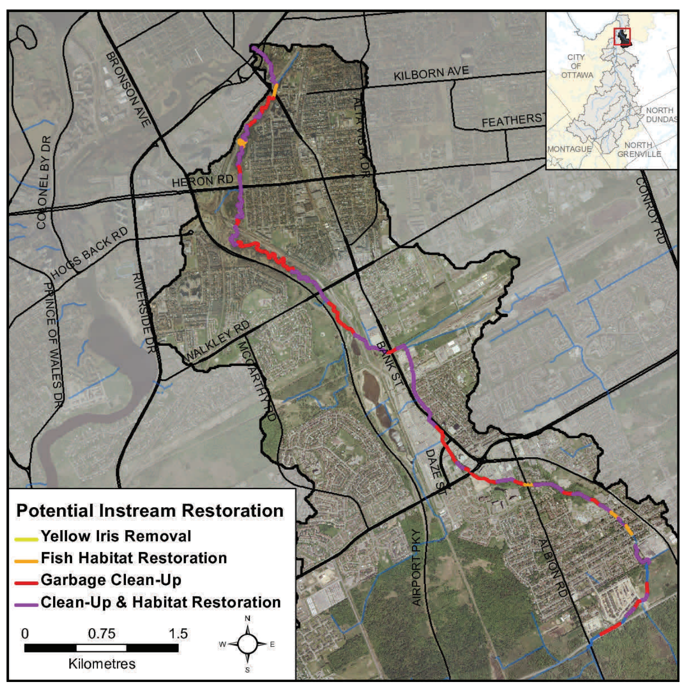


Figure 30. Instream restoration opportunities

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. Ninety percent of the sections surveyed along Sawmill Creek has invasive species (Figure 31). The species observed in Sawmill Creek were purple loosestrife, Manitoba maple, garlic mustard, common/European buckthorn, dog-strangling vine, ornamental goutweed, Japanese knotweed and poison parsnip.

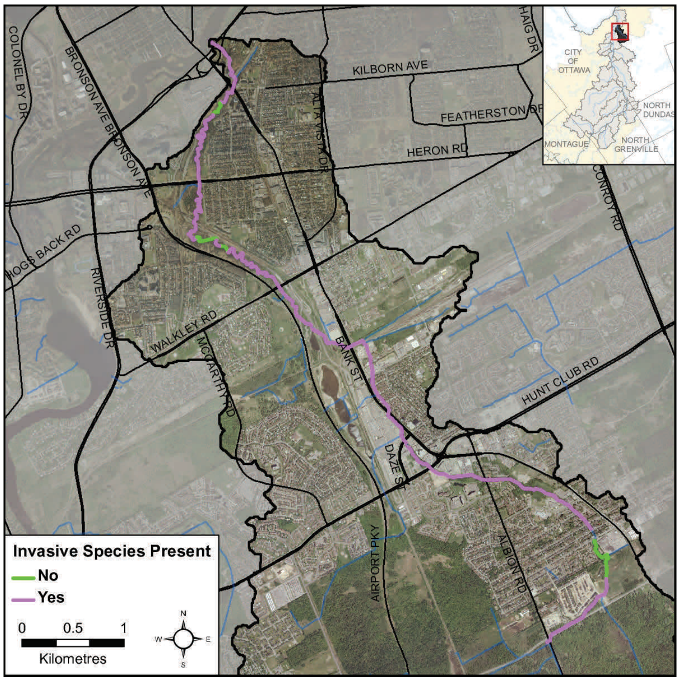


Figure 31. Invasive species along Sawmill Creek

Thermal Classification

Temperature is an important parameters' in streams as it influences many aspects of physical, chemical and biological health. Three temperature dataloggers were deployed in Sawmill Creek from April to late September 2008 (Figure 32) to give a representative sample of how water temperature fluctuates. Many factors can influence fluctuations in stream temperature, including springs, tributaries, precipitation runoff, discharge pipes and stream shading from riparian vegetation. Water temperature is used along with the maximum air temperature (using the Stoneman and Jones method) to classify a watercourse as either warmwater, coolwater or cold water. Analysis of the data collected indicates that Sawmill Creek is a coolwater system.

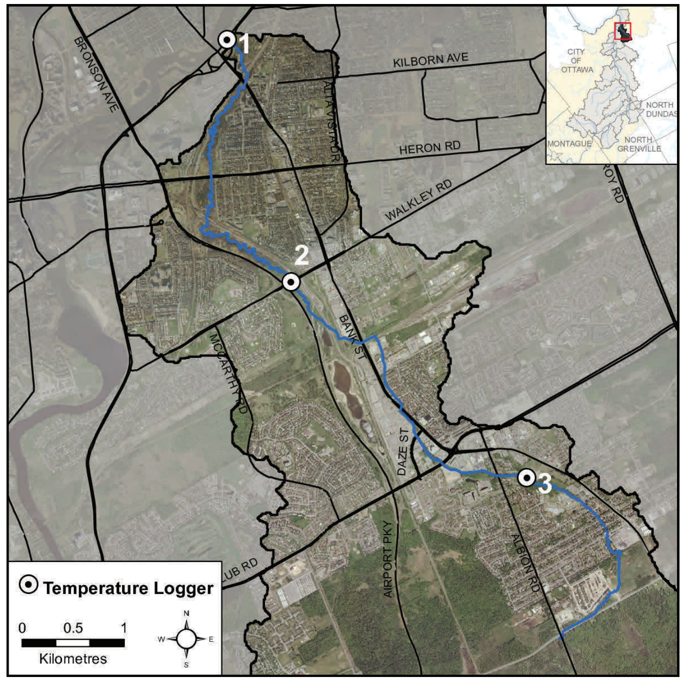


Figure 32. Temperature dataloggers along Sawmill Creek

Fish Sampling

Fish sampling sites located along Sawmill Creek are shown in Figure 33 and 34. The provincial fish codes shown on the map below are listed (in Table 6) beside the common name of those fish species identified in Sawmill Creek (Data source: RVCA and City of Ottawa)

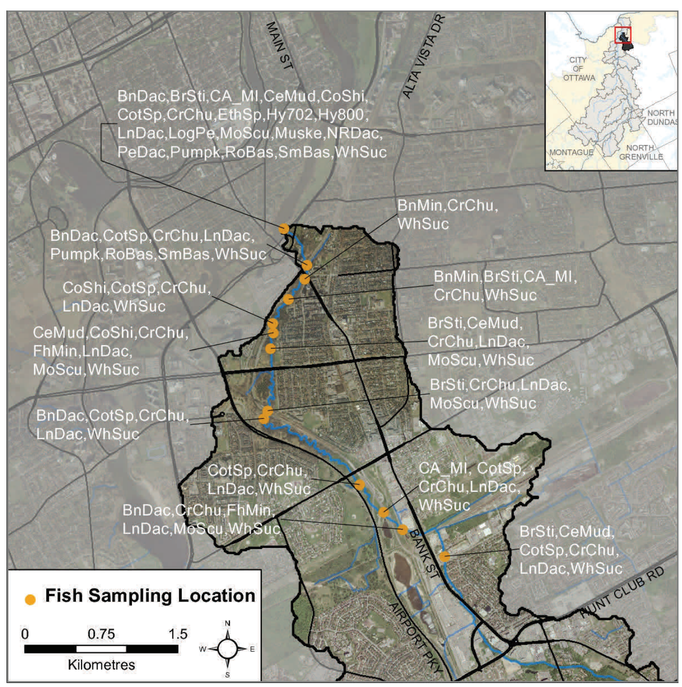


Figure 33. Fish species observed along Sawmill Creek

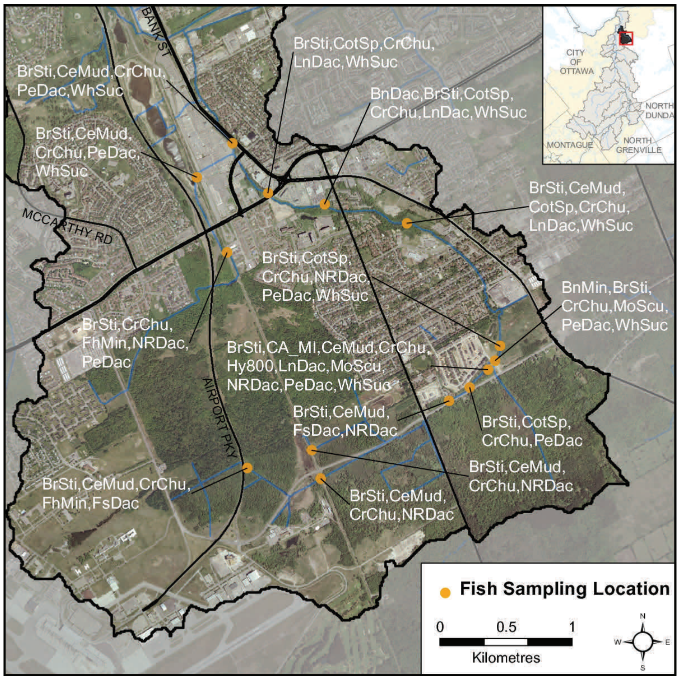


Figure 34. Fish species observed along Sawmill Creek

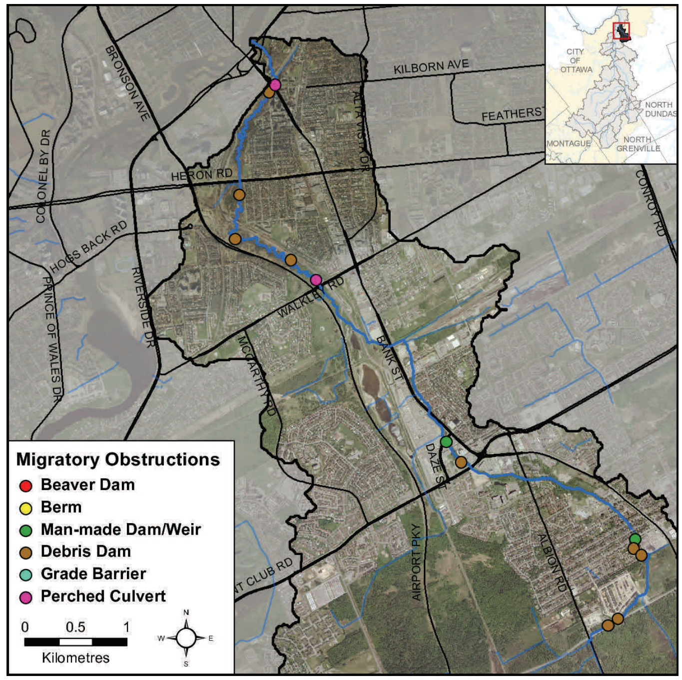


Figure 35. Migratory obstructions in Sawmill Creek

Table 6. Fish species observed in Sawmill Creek

BnDac **blacknose dace**	BnMin **bluntnose minnow**	BrSti **brook stickleback**	CeMud **central mud minnnow**	CoShi **common shiner**
CrChu **creek chub**	EthSp. **ehteostoma spp.**	FhMin **fathead minnow**	FsDac **finescale dace**	Blue **bluegill**
Logpe **logperch**	LnDac **longnose dace**	MoScu **mottled sculpin**	NRDac **northern redbelly dace**	PeDac **pearl dace**
Pumpk **pumpkin-seed**	RoBas **rockbass**	SmBas **smallmouth bass**	WhSuc **white sucker**	CA_MI **carps and minnows**
CotSp **sculpin species**	Muske **muskel-lunge**	Hy800 **hybrid sculpin**		

Migratory Obstructions

It is important to know the locations of migratory obstructions because they can prevent fish from accessing important spawning and rearing habitat (Figure 35). Migratory obstructions can be natural or manmade, and they can be permanent or seasonal. There were 12 migratory obstructions within the Sawmill Creek catchment at the time of the survey.

Water Chemistry

During the macrostream survey, a YSI probe is used to collect water chemistry, as follows:

- Dissolved Oxygen is a measure of the amount of oxygen dissolved in water. The lowest acceptable concentration of dissolved oxygen is 6.0 mg/L for early stages of warmwater fish and 9.5 mg/L for cold water fish (CCME, 1999). A saturation value (concentration of oxygen in water) of 90 percent or above is considered healthy
- Conductivity is 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 is a measure of relative acidity or alkalinity, ranging from 1 (most acidic) to 14 (most alkaline/basic), with 7 occupying a neutral point.

2008 data for these three parameters is summarized in Table 7.

Table 7. 2008 Water chemistry collected along Sawmill Creek

Month	Range	DO (mg/L)	DO (%)	Conductivity (µs/cm)	pH
May-08	low	-	-	-	-
	high	-	-	-	-
Jun-08	low	7.86	90	489	7.94
	high	8.09	93	1239	8.56
Jul-08	low	-	-	-	-
	high	-	-	-	-
Aug-08	low	1.83	21	680	7.87
	high	11.24	113	1316	8.24

3) ***Land Cover***

Settlement is the dominant land cover type in the catchment as shown in Table 8 and displayed in the map on the front cover of the report.

Table 8. Catchment land cover type

Cover Type	Area (ha)	Area (% of Cover)
Settlement	999	48
Transportation	439	21
Woodland	338	16
Wetland	222	11
Grassland	57	3
Water	62	1

Woodland Cover

The Sawmill Creek catchment contains 338 hectares of woodland (Fig.36) that occupies 16 percent of the drainage area. This figure is less than the 30 percent of woodland area required to sustain forest birds, according to Environment Canada's Guideline: "How much habitat is enough?" When forest cover declines below 30 percent, forest birds tend to disappear as breeders across the landscape.

Thirty-five (43%) of the 81 woodland patches in the catchment are very small, being less than one hectare in size. Another 39 (48%) of the wooded patches ranging from one to less than 20 hectares in size tend to be dominated by edge-tolerant bird species. The remaining seven (nine percent of) woodland patches range between 21 and 123 hectares. Six of these patches contain woodland between 20 and 100 hectares and may support a few area-sensitive species and some edge intolerant species, but will be dominated by edge tolerant species.

Conversely, one (1%) of the 81 woodland patches in the drainage area exceeds the 100 plus hectare size needed to support most forest dependent, area sensitive birds and is large enough to support approximately 60 percent of edge-intolerant species. No patch tops 200 hectares, which according to the Environment Canada Guideline will support 80 percent of edge-intolerant forest bird species (including most area sensitive species) that prefer interior forest habitat conditions.

Forest Interior

The same 81 woodlands contain 16 forest interior patches (Fig.36) that occupy six percent (124 ha.) of the catchment land area. This is below the ten percent figure referred to in the Environment Canada Guideline that is considered to be the minimum threshold for supporting edge intolerant bird species and other forest dwelling species in the landscape.

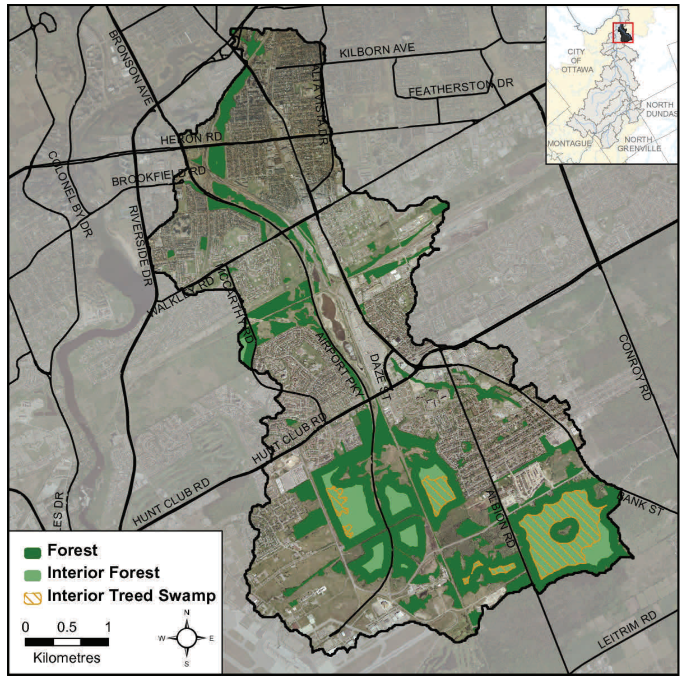
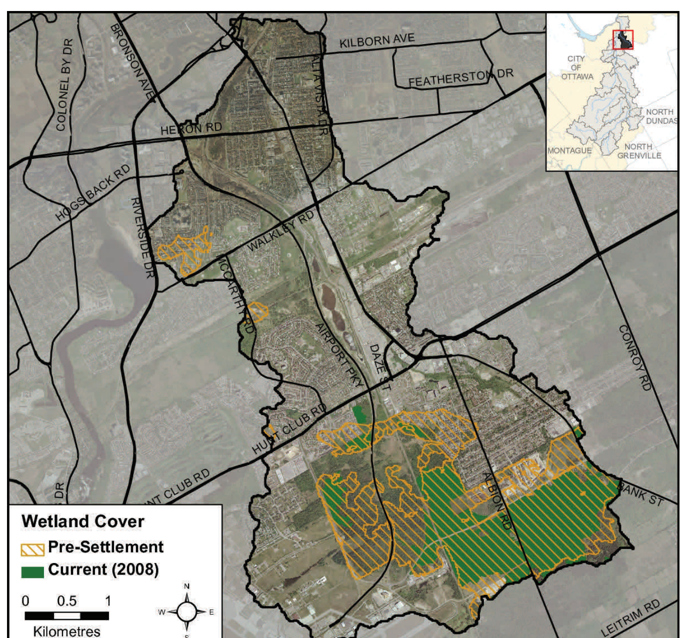


Figure 36. Catchment woodland cover and forest interior

Most patches (13) have less than 10 hectares of interior forest, eight of which have small areas of interior forest habitat less than one hectare in size. Conversely, three patches have greater than 10 hectares of interior forest, with one patch exceeding 50 hectares (at 65 hectares).



Pre-Settlement data provided by: Ducks Unlimited Canada, 2010. Southern Ontario Wetland Conversion Analysis, http://www.ducks.ca/aboutduc/news/archives/prov2010/pdf/duc_ontariowca.pdf, (March 2010)

Figure 37. Pre-settlement and present day wetland cover

4) Stewardship and Protection

The RVCA and its partners are working to protect and enhance environmental conditions in the Lower Rideau Subwatershed.

Rural Clean Water Projects

Figure 38 shows the location of all Rural Clean Water Projects in the Sawmill Creek drainage area. From 2006 to 2011, landowners completed 1 educational initiative project. In total, RVCA contributed $1,000 to projects valued at $7,841.

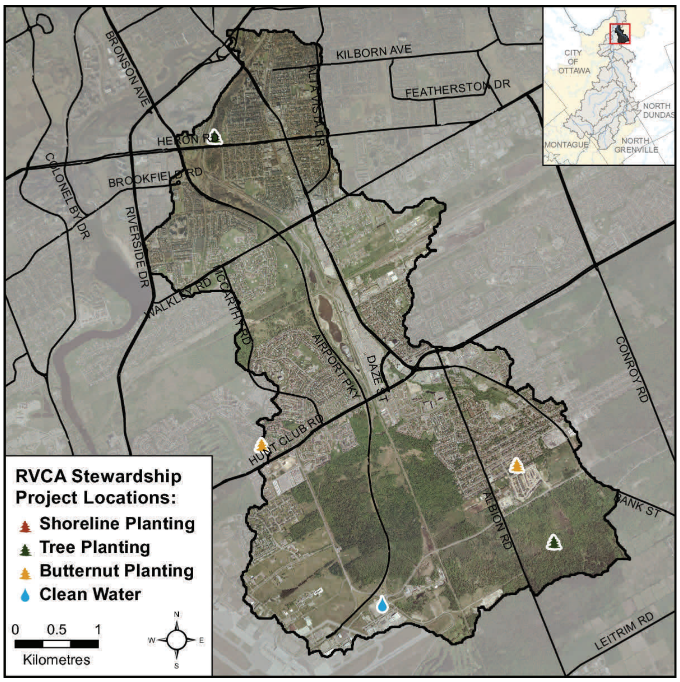


Figure 38. RVCA stewardship program project locations

Prior to 2006, no Rural Clean Water projects were completed.

Tree Planting Projects

The location of all tree planting and shoreline projects is also shown in Figure 38. From 2006 to 2011, 5.450 trees, valued at $8,439, were planted on 1 site through the RVCA Tree Planting Program.

Before that, from 1984 to 2006, landowners helped plant 350 trees, valued at $407, on 1 project site, using the RVCA Tree Planting Program, on .2 hectares of private land; fundraising dollars account for $52 of that amount.

City Stream Watch Program

The City Stream Watch Program and its volunteers planted 810 trees and shrubs in total along Sawmill Creek in 2006 and 2008.

Valley, Stream, Wetland and Hazard Land Regulation

Less than one percent of the catchment drainage area is within the regulation limit of Ontario Regulation 174/06 (Fig.39), giving protection to wetland areas and river or stream valleys that are affected by flooding and erosion hazards.

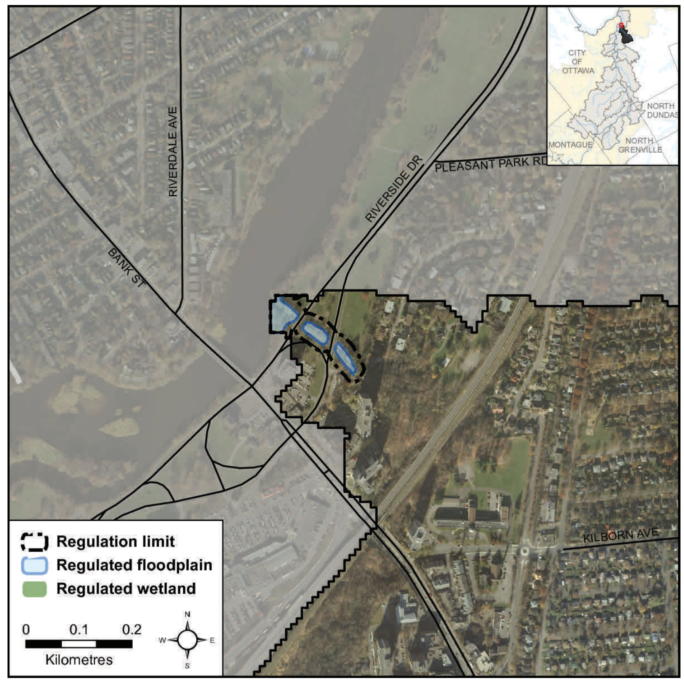


Figure 39. RVCA regulation limits

Natural features within the regulation limit include 200 metres of stream (representing one percent of all streams in the catchment).

Plotting of the regulation limit on the remaining 24.1 km (or 99 percent) of streams requires identification of flood and erosion hazards and valley systems.

Within the regulation limit, “development” and “site alteration” require RVCA permission, as do any proposed works to alter a watercourse, which are subject to the “alteration to waterways” provision of Ontario Regulation 174/06.

5) Issues

- Many untreated stormwater outfalls
- Poor performance of two existing stormwater management ponds
- Hydrocarbon contamination in the Cahill tributary
- Direct contamination with chlorides due to proximity to roads
- Erosion and slope stability hazards in the middle and lower reaches. Marginal slope stability is a continuing issue on the reach between Bank Street and Heron Road
- Flooding in the South Keys area east of Bank Street between the rail line and Cahill Drive, Johnston Road and Albion Road
- 1984 floodplain mapping study is obsolete since numerous changes have occurred in the catchment area, including culvert crossings and the flow diversion
- Corridor is of minimal width in some areas due to historical encroachment of development and filling activity
- Excessive sediment accumulation in the Ledbury Avenue area
- Channelization, straightening of remaining tributaries
- Continuity of green corridor limited by existing development
- Dumping of snow in the creek corridor and the resulting damage to vegetation is a perennial issue on some commercial properties
- Barriers to fish movement
- Limited public access to the creek corridor for recreational use
- Loss of headwater tributaries due to urban drainage practices
- Removal of natural riparian vegetation along the creek
- Levels of nutrients and bacteria in tributaries that regularly exceed provincial guidelines
- Altered hydrology causing in-stream erosion and loss of aquatic habitat
- Loss of wetland habitat
- Reduced biodiversity
- Increasing presence of invasive species
- Nutrient, E.coli and metal exceedances observed in water samples taken

6) Opportunities for Action

- Educate landowners about appropriate best management practices for lawn maintenance and waste disposal practices
- Engage community associations and other interest groups in creek clean up, invasive species removal and riparian planting
- Remove barriers to fish movement and improve in-stream structure
- Improve access to the corridor for public use and recreation
- Monitor storm sewer outfalls and investigate upstream sources of pollutants as necessary
- Determine impact of Hunt Club Ridge and Transport Canada stormwater management facilities on the creek and examine options for improvements to the operation of these ponds, including retrofit opportunities
- In accordance with direction provided in the Sawmill Creek Subwatershed Study, runoff control is required for new development and redevelopment, including the use of infiltrative BMP's where soil conditions are suitable
- Require geotechnical investigation for new development or redevelopment on adjacent table lands to ensure adequate slope stability
- Target riparian and instream restoration at sites identified in this report (as shown in Figures 29, 30 and 35) and explore other restoration and enhancement opportunities along the Sawmill Creek riparian corridor

Refer to the Sawmill Creek Watershed Study (1994) and the Sawmill Creek Subwatershed Study Update (2003) for more issues