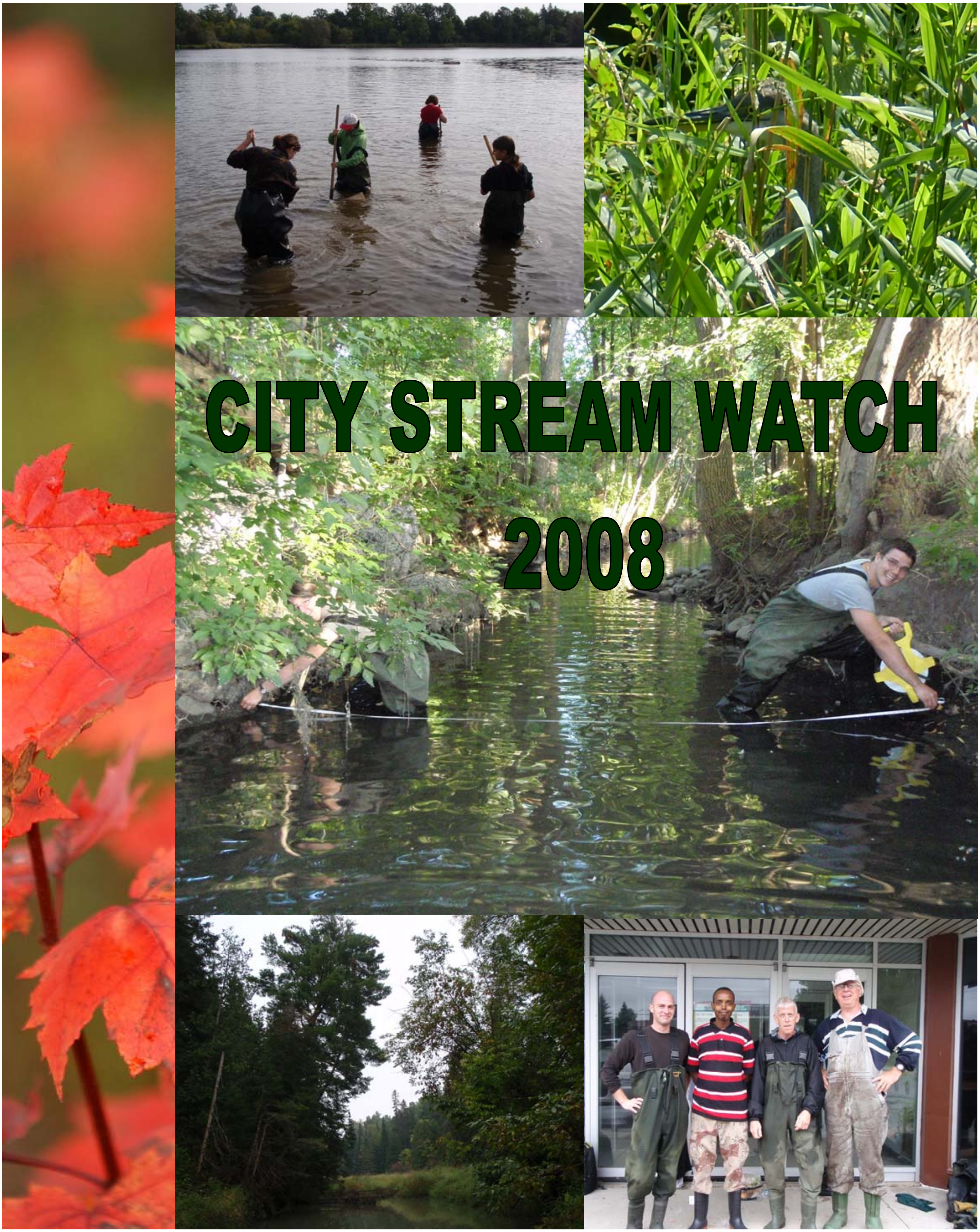
# CITY STREAM WATCH 2008



# City Stream Watch
## 2008 Annual Report

**Prepared by:**

Julia Sutton
City Stream Watch Coordinator
Rideau Valley Conservation Authority

**City Stream Watch Collaborative:**
(alphabetically)

Brian Bezaire, Water Quality Field Technician-Fisheries, City of Ottawa
Bruce Clarke, Ottawa Flyfishers Society
Jennifer Lamoureux, Fish Habitat Biologist, Rideau Valley Conservation Authority
Dr. Francis Pick, Rideau River Roundtable
Donna Silver, Heron Park Community Association
Peter Stewart-Burton, National Defence Headquarters Fish and Game Club

## Executive Summary


This document summarizes the activities of the City Stream Watch program for the 2008 season. The program is headed by a partnership of six groups from the Ottawa area:

- *The Heron Park Community Association*
- *The Rideau Valley Conservation Authority*
- *The City of Ottawa*
- *The Ottawa Flyfishers Society*
- *The Rideau River Roundtable*
- *National Defence Headquarters Fish and Game Club*

Working together, these organizations help outline a program that fulfills many of the community's needs for environmental information and promotion of local streams within the municipality.

The goal of the program is to obtain, record, and manage valuable information on the physical and biological characteristics of streams in the City of Ottawa, while ensuring that they are respected and valued natural features of the communities through which they flow. To this end, the program relies on and encourages the interest and commitment of volunteers from the community, guided by an experienced coordinator, to learn and conduct macro stream assessments on local waterways over a five-year cycle. Volunteers also participate in sampling fish communities through seining and electrofishing, aquatic invertebrate sampling, assisting in stream clean-ups and habitat rehabilitation projects such as riparian planting.

The City Stream Watch program uses a macro stream assessment protocol originally developed by the Ontario Ministry of Natural Resources. To facilitate its use by community volunteers, the Rideau Valley Conservation Authority has since altered the protocol to improve and enhance the information collected.

In 2008, the original four streams sampled in 2003 were re-surveyed: Black Rapids Creek, Cardinal Creek, Mud Creek and Sawmill Creek. A total of 148 volunteers from the community participated in the program throughout the spring, summer and fall, contributing a total of 1092.5 hours working on various projects. Approximately 32 kilometres of stream were surveyed in 2008. Volunteers also participated in intensive fish sampling, collecting fish data on 30 sites throughout the city. All information is housed in the Rideau Valley Conservation Authority's Watershed Information System and is available interactively on the Authority's website at *www.rvca.ca*.

In 2008 four stream cleanups were completed. In May, City Stream Watch (CSW) assisted the Urban Rideau Conservationists with their Mother's Day Cleanup on the Rideau River. Out of the 2008 creeks, Sawmill was the only creek in need of a cleanup, throughout the system. In August, 18 volunteers came out for the first phase of the Sawmill Creek Cleanup. On September 6, phase 2 of the Sawmill Creek Cleanup was completed by eight volunteers, despite the cold weather and constant downpour of rain. On September 22, as part of the nation-wide Great Canadian Shoreline Cleanup, 10 volunteers assisted in phase three of the Sawmill Creek cleanup. In total, volunteers spent over 111 hours cleaning local streams.

In 2009, the original four streams sampled in 2004 will be re-surveyed. This will allow managers to observe positive/negative trends that may have occurred over the past five years. We will also be adding Barrhaven Creek which has not yet been assessed. The data will complement work conducted by certain municipal and regional programs, most of which do not survey the smaller urban streams which are the focus of City Stream Watch. In addition, the intrinsic value of community-based environmental monitoring and stewardship through personal involvement will be further developed.

# Program Funders and Program Support

### *Ontario Ministry of Natural Resources (OMNR)*

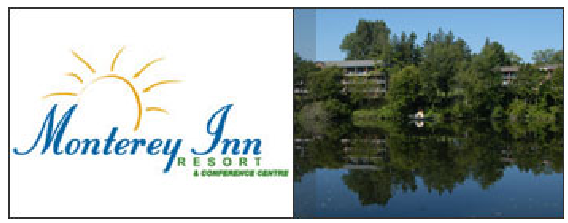
In 2008, OMNR donated $2,000.00 to the City Stream Watch program in order to put on a Biothon, entitled "Check Your Watershed Day". This day was held on July 19, in conjunction with other events happening across Ontario. Different groups of volunteers were placed at each of the 2008 creeks and participated in a half day of seining and fish identification and a half day of benthic invertebrate sampling and identification.

### *Shell Canada Limited*

Shell Environmental Fund provided $4,600 in funding. These funds went towards materials for the stream season, such as chest waders, garbage cleanup supplies, cameras, GPS units, thermometers and trees.

### *Monterey Inn Resort and Conference Centre*

Monterey Inn Resort and Conference Centre has been a long-time supporter of the City Stream Watch program. Monterey staff kindly donates lunches, snacks and beverages for various projects to reward volunteers for their efforts. A huge thanks from the program and its volunteers goes out to Jason Kelly (General Manager), Doris Kwok (Director of Marketing) and their talented and generous staff at the Monterey Inn Resort for their continued support of the program.



# Acknowledgements

**A very large and sincere thank you to all the volunteers who spent time with the program this season. The dedication and enthusiasm you have contributed to this project was extraordinary and very much appreciated.**

**Thank you so much to Jason Kelly (General Manager), Doris Kwok (Director of Marketing) and the talented and generous staff of the Monterey Inn Resort and Conference Centre for donating sandwiches and drinks for hungry volunteers during our full-day events throughout the summer and fall of 2008. We were always hungry!**

Thank you to **Shell Canada Limited** for their financial contribution to the program for survey and event supplies.

Thank you to the **Ontario Ministry of Natural Resources** for their financial contribution to the Biothon.

Thank you to Chuck Wheatley, Area Manager with the **City of Ottawa Parks Department** and his staff for arranging dumpsters to be delivered and removed during the cleanup efforts on Sawmill Creek.

Thank you to **Dymon Storage** on Bank St. for providing their dumpster during the TD Great Canadian Shoreline Cleanup on Sawmill Creek.

Thank you to the City Stream Watch collaborative for their continuing dedication and support to the program.

Thank you to Peter Stewart-Burton and Bob Mulvill of the **National Defense Headquarters Fish and Game Club** for assisting in organizing the Sawmill Creek cleanup, Phase One and Two.

Thank you to Donna Silver of the **Heron Park Community Association** for her assistance with the Sawmill Creek Cleanup, Phase One and Two.

Thank you to Bruce Clarke and the **Ottawa Flyfishers Society** for running the very popular fly fishing demonstration.

Thank you to Brian Bezaire of the **City of Ottawa** for running the first seine demonstration and fish identification session for CSW volunteers.

Thank you to Gemma Kerr of the **Urban Rideau Conservationists** for all the organizational work for the Mothers Day Cleanup on the Rideau River.

Thank you to Sean Crossan and the **Cardinal Creek Community Association** for promoting the program and taking part in various CSW activities within the community for the 2008 season.

Thank you to **Live 88.5FM** for inviting the program on the radio to promote the program and the Mothers Day Clean up on the Rideau River.

Thank you to **CBC Radio (In Town and Out, All in a Day)** and **CBC Television (evening news)** for taking an interest in the City Stream Watch program and featuring us on their station.

# Table of Contents

Preliminary Pages
Cover . . . . . . . . . . 1
Title . . . . . . . . . . 2
Executive Summary . . . . . . . . 3
Program Funders and Support . . . . . . 4
Acknowledgments . . . . . . . . 5
Table of Contents . . . . . . . . 6

1.0 Introduction . . . . . . . . . 8
1.1 City Stream Watch – An Evolving Program . . . 8
1.2 Partners of the City Stream Watch Program . . . 8
1.3 Stream Selection in 2008 . . . . . . 10
1.4 Stream Study Comparison 2003/2008 . . . . . 11

2.0 Methodology . . . . . . . . . 11
2.1 The Stream Watchers – The Heart of City Stream Watch . 11
2.2 The Macro Stream Assessment Protocol . . . 11
2.3 Fish Sampling through Seine Netting and Electrofishing 12
2.4 Stream Cleanups . . . . . . . 13
2.5 Riparian Planting/Bioengineering Initiatives/Fish and Wildlife Rehab. 13
2.6 Data Management . . . . . . . 13

3.0 Results . . . . . . . . . 14
3.1 The Community Response . . . . . . 14
3.2 Environmental Monitoring . . . . . . 15
3.2.1 Black Rapids Creek . . . . . . 15
Fish Community Sampling . . . . . 23
Temperature Profile . . . . . . 28
Invasive Species . . . . . . 31
2003/2008 Comparison . . . . . 32
3.2.2 Cardinal Creek . . . . . . . 34
Fish Community Sampling. . . . . . 42
Temperature Profile . . . . . . 45
Invasive Species . . . . . . 49
2003/2008 Comparison . . . . . 50
3.2.3 Mud Creek . . . . . . . 52
Fish Community Sampling. . . . . . 59
Temperature Profile . . . . . . 64
Invasive Species . . . . . . 66
2003/2008 Comparison . . . . . 67
3.2.4 Sawmill Creek . . . . . . . 69
Fish Community Sampling . . . . . 77
Temperature Profile. . . . . . . 81
Invasive Species . . . . . . 84
2003/2008 Comparison . . . . . 85

3.3 Special Events . . . . . . . . 86
3.3.1 Cardinal Creek Training Day . . . . . 86

3.3.2 Biothon . . . . . . . 86
3.3.3 Benthic Identification and Fly Fishing Demonstration . 87
3.3.4 Fish Sampling and Identification Sessions . . 87
3.4 Community Stream Clean-Ups . . . . . . 88
3.3.1 Rideau River . . . . . . . 88
3.3.2 Sawmill Creek . . . . . . . 88
3.4 Riparian Planting Projects . . . . . . 89
3.4.1 Sawmill Creek . . . . . . . 90
3.4.2 Green's Creek. . . . . . . . 91
3.4.3 Cardinal Creek. . . . . . . . 92
4.0 A Look Ahead to 2009. . . . . . . . 93
4.1 Recommendations . . . . . . . 94
4.2 Program Improvement . . . . . . . 94
4.3 Special Projects . . . . . . . . 95
5.0 References . . . . . . . . 105

Appendices
Appendix A – Macro Stream Assessment Protocol . . . 106
Appendix B – Protocol Summary and Definitions. . . . 109
Appendix C – Equipment List. . . . . . 116
Appendix D – Landowner Permission Form . . . . 117
Appendix E – Black Rapids Fish Community Data. . . . 118
Appendix F – Cardinal Creek Fish Community Data . . . 121
Appendix G – Mud Creek Fish Community Data . . . 123
Appendix H – Sawmill Creek Fish Community Data . . . 125
Appendix I – Erosion Sites . . . . . . . 126
i) Black Rapids Creek . . . . . . 126
ii) Cardinal Creek . . . . . . 127
iii) Mud Creek . . . . . . . 128
iv) Sawmill Creek . . . . . . 129
Appendix J – Maps of Potential Projects . . . . . 130
i) Black Rapids Creek . . . . . . 130
ii) Cardinal Creek . . . . . . 131
iii) Mud Creek . . . . . . . 132
iv) Sawmill Creek . . . . . . 133
Appendix K – Environmental Guide for Fish and Fish Habitat . 134
Appendix L – City Stream Watch 2007 Organizational Chart. . 139

# 1.0 Introduction

## 1.1 City Stream Watch – An Evolving Program

The health of Ontario's water resources is of paramount importance to its citizens. A dependable supply of clean freshwater is critical to a strong economy and high quality of life, and can only be achieved through proper management of all water supplies. Water resources are threatened by a myriad of stresses, including urbanization and development, pollution, and public apathy. The City Stream Watch program obtains, records and manages valuable information on the physical and biological characteristics of streams in the City of Ottawa. From this data, areas of concern are identified and remediation projects initiated, with the goal of ensuring that city streams remain respected and valued natural features of the communities through which they flow.

## 1.2 Partners of the City Stream Watch Program

The City Stream Watch program was initiated in 2003 through a partnership of six groups from throughout the City of Ottawa. Without the help and dedication of these organizations the Stream Watch program would not have become the success it is today.

### *The Heron Park Community Association*

The Heron Park Community Association, created in the mid 1980s, functions as a representative body in protecting community interests, supports programs that provide safety and information for community residents, and encourages social and recreational community activities. The Association was the lead organization of the City Stream Watch program and aids in training and recruiting volunteers and organizing conservation efforts on Sawmill Creek.

### *The Rideau Valley Conservation Authority*

Conservation Authorities in Ontario ensure the protection and restoration of Ontario's water, land and natural habitats through responsible management by providing programs that balance human, environmental, and economic needs. In 1966, in response to the above needs as they relate to the Rideau River watershed, the Rideau Valley Conservation Authority (RVCA) was established. The RVCA delivers a wide range of watershed management services to the community, including:

- Flood plain management
- Aquatic environment monitoring and reporting
- Land use and development review
- Regulations administration and enforcement
- Watershed management planning
- Stewardship advice and incentives programs
- Conservation information

The RVCA provides technical management and supervision to the City Stream Watch program to ensure the environmental data is collected, managed, and stored to meet appropriate standards.

### *The City of Ottawa*

The City of Ottawa is dedicated to monitoring and improving the natural environment, including water resources, of the municipality. The city's evolving environmental strategy works to ensure that environmental management is an integral part of its practices and policies. The City of Ottawa helps to coordinate, provide technical assistance and recruit volunteers for the City Stream Watch program.

### *The Ottawa Flyfishers Society*

The Ottawa Flyfishers Society is dedicated to promoting flyfishing as well as fish habitat conservation. The Society helps to recruit volunteers for the City Stream Watch program and concentrates its efforts on monitoring, maintaining and improving the natural beauty and health of Greens Creek.

### *The Rideau River Roundtable*

The Rideau River Roundtable consists of representatives from community groups, municipalities, government agencies and private businesses. The Roundtable is dedicated to conducting research and coordinating projects to protect and improve the Rideau River watershed.

### *National Defence Headquarters Fish and Game Club (NDHQ)*

The NDHQ Fish and Game Club is dedicated to observe and practice sound conservation of all wildlife and its habitat; to respect the property rights of others; to assist the authorities with implementing conservation measures for the benefit of the community; and to oppose activities such as poaching or pollution that are prejudicial to sound conservation of wildlife and its natural habitat, so as to provide a continuing source of enjoyment for all its present and future members. The NDHQ works closely with the City Stream Watch program to help maintain the health of Sawmill Creek, South of Walkley Road.

## 1.3 Stream Selection in 2008

In 2008 the original four streams from 2003 were re-surveyed. Those creeks were Black Rapids Creek, Cardinal Creek, Mud Creek and Sawmill Creek. Figure 1 shows the locations of the 2008 sample streams as well as all streams sampled from 2003 to 2007.

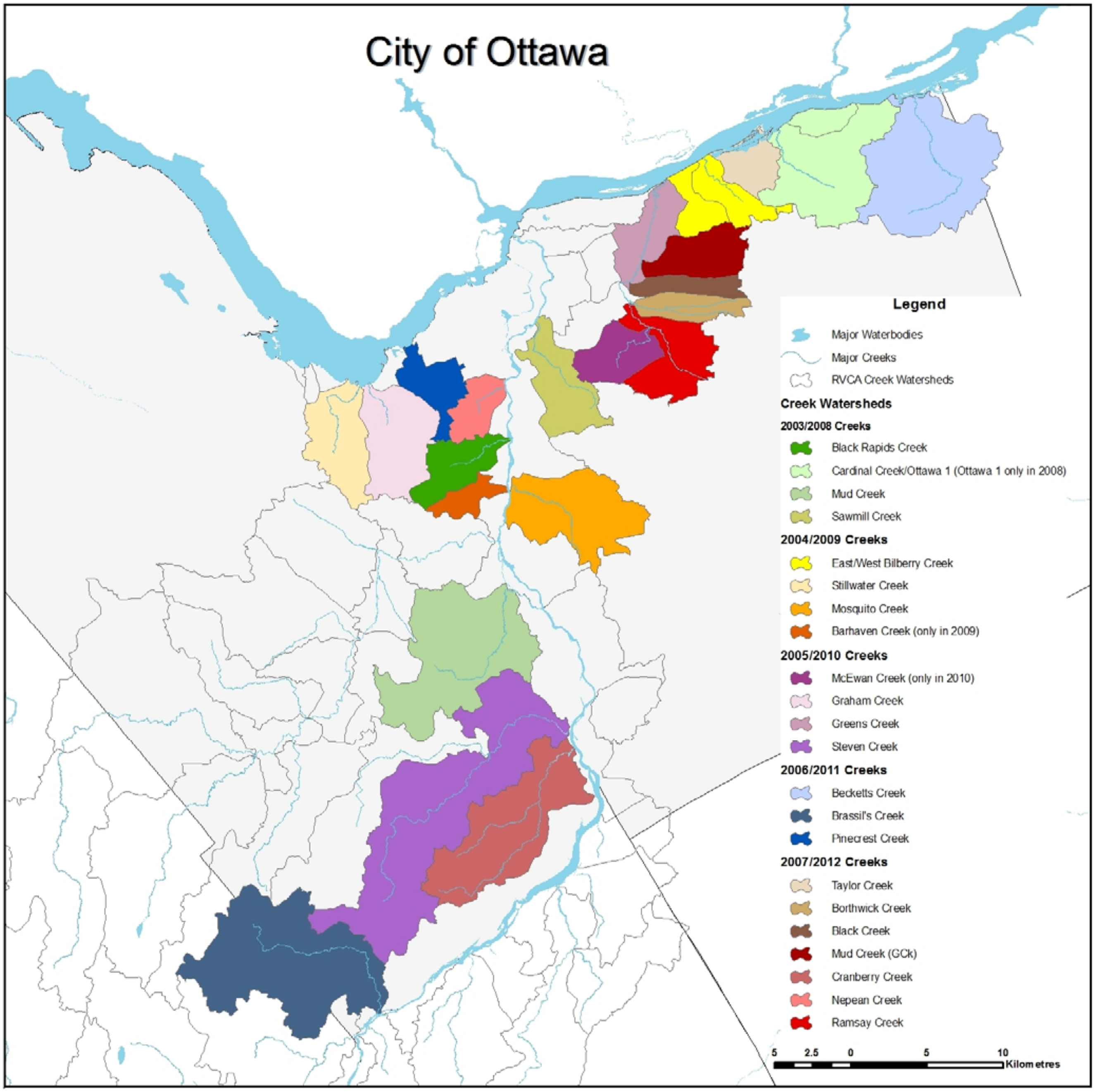



**Figure 1. Locations of Streams and Their Watersheds on the 2003-2012 Sampling Schedule**

## 1.4 Stream Study Comparison 2003/2008

The following chart is a comparison summary of activities done on each creek in both 2003 and 2008. Volunteer numbers continue to increase as the program has incorporated more activities and gained greater recognition within the community. In 2003, there were 26 volunteers and over five years, that number has grown to 148.

| ACTIVITIES | Black Rapids 2003 | Black Rapids 2008 | Cardinal 2003 | Cardinal 2008 | Mud 2003 | Mud 2008 | Sawmill 2003 | Sawmill 2008 |
|---|---|---|---|---|---|---|---|---|
| Number of sections surveyed | 57 | 56 | 51 | 74 | 37 | 95 | 54 | 98 |
| Number of volunteers | N/A | 38 | N/A | 34 | N/A | 32 | N/A | 84 |
| Total volunteer hours | 35 | 180 | 53 | 148.5 | 31.5 | 164 | 47.5 | 458.5 |
| Number of fish sampling sites | 1 | 10 | 2 | 6 | 1 | 9 | 0 | 5 |
| Number of temperature probes | N/A | 3 | N/A | 3 | N/A | 3 | N/A | 3 |

**Table 1. Stream Study Comparison Between 2003 and 2008**

# 2.0 Methodology

## 2.1 The Stream Watchers – The Heart of City Stream Watch

The City Stream Watch program relies on and encourages the interest and commitment of volunteers from the community in order to fulfill its goal. Two formal training sessions for interested volunteers were advertised and conducted in May of 2008. As well, informal training sessions for individuals or small groups were conducted throughout the field season to ensure that everyone had an opportunity to participate in the program. Volunteers were introduced to representatives from the various partners and the coordinator of the program. Volunteers were guided through the stream assessment protocol used for monitoring the streams (Appendix A), given a summary and definitions handout for future reference (Appendix B), shown the equipment used in sampling (Appendix C) and given a brief demonstration on how to use some of the more technical instruments. Representatives from RVCA then demonstrated the entire process for sampling one section of stream.

## 2.2 The Macro Stream Assessment Protocol

The City Stream Watch program utilizes a macro stream assessment protocol. The protocol was originally used by the Ontario Ministry of Natural Resources, but has been improved by the RVCA so that community volunteers can easily apply it. Changes to the original protocol were essential as volunteers have a variety of educational backgrounds and experiences.

Streams are sampled in 100-meter sections. At the start of each section, the date, time, and section number are recorded. Global Positioning System (GPS) coordinates are taken using a handheld GPS, pre-programmed for the NAD 83 Datum and displaying Universal Transverse Mercator (UTM) coordinates. These parameters were chosen to facilitate analysis and display of City Stream Watch data with other spatial information already digitally recorded in the RVCA's existing spatial database. Overhead cloud cover is estimated and recorded as a percent, air temperature in degrees Celsius is recorded, and a photo upstream is taken. Water temperature is recorded in degrees Celsius. Stream width is measured to the nearest tenth of a meter using a 60-meter tape at right angles to the banks at water level. Stream depth is measured using a meter stick, at the deepest point across the width of the stream.

After all necessary measurements are recorded for the start of the section, one volunteer remains at the start of the section and holds on to one end of the tape while the others begin walking upstream holding the other end. Volunteers walking upstream are asked to remember observations on land use, anthropogenic alterations of the stream, substrate characteristics and instream vegetation, bank characteristics and vegetation on the banks, tributaries, agricultural impacts, presence of wildlife and habitat, pollution and other characteristics as outlined in the macro stream assessment form. When the tape hits 50 metres, the volunteer left behind joins the others at the 50-metre mark, observing the stream characteristics while walking up.

Water temperature, stream width and stream depth are again recorded at the mid-way point of the section. The procedure used for observing the first 50 metres of the section is repeated for the second 50 metres, thereby completing a 100 metre section. Water temperature, stream width, and stream depth are recorded at the end of the section. The UTM coordinates are recorded for the end of the section and a photo is taken downstream. The volunteers then discuss what they observed, and the macro stream assessment form is filled out for the section. The entire procedure is repeated for each 100 metres section of stream.

In 2008, changes were made to the field sheets to provide more detail in the stream data. Many observations such as bank stability, buffer size, substrate type, instream vegetation, are now recorded in percentages, with some divided even further, into percentages for left bank and right bank. The new field sheets are attached in Appendix A.

## 2.3 Fish Sampling through Seine Netting and Electrofishing

This year's City Stream Watch program sampled a total of 30 fish sites on the four creeks. Sampling methods included seine netting and electrofishing. Appropriate seining sites were chosen and volunteers assisted in pulling the net through the water column, processing, and identifying the catch. The different species of fish were sorted and counted. Minnow species were counted and a bulk weight (weight of all the individuals of a particular species) was measured. Game species were counted, a round weight was taken, and individual fish were measured for total length (from tip of the nose to the end of the caudal fin). Volunteers gained valuable insight into fish sampling methodology as well as experience in identifying different fish species. Electrofishing was done by RVCA certified technicians and only volunteers with certification were able to participate due to safety requirements. There was one electrofishing demonstration on Mud Creek held where all volunteers stayed on the shore during the electrofishing but were able to fully participate after, processing and recording the fish species caught and their weight.

## 2.4 Stream Clean-Ups

In 2008, four stream cleanups were held on two systems within the city. Cleanups were completed on the Rideau River and Sawmill Creek. Volunteers were guided in the safe and appropriate removal of garbage from the creek bed and riparian areas. Only human-made (unnatural) materials were removed. Natural debris (i.e. sticks, logs, vegetation) was not removed or disturbed as it provides valuable habitat for fish and stream dwelling organisms.

## 2.5 Riparian Planting/Fish and Wildlife Habitat Rehabilitation

In 2008, three riparian planting initiatives were successfully carried out on streams in the city of Ottawa. Sawmill Creek was planted in the spring of 2008 as part of the Phase III Initiative to help reduce erosion from a failing bank, as well as to promote growth of natural plant species along the banks. Two other plantings were completed on Cardinal Creek and Green's Creek to try and increase shade and habitat in the riparian area, along with protecting the bank. Additional planting opportunities have been identified for 2009 and will commence in the spring.

## 2.6 Data Management

All data collected, as well as photos taken as part of the City Stream Watch program, have been entered and are maintained in a spatial database by the RVCA. Data on human alterations, instream vegetation, fish habitat, instream pollution or garbage, bank characteristics and invasive species is available for each section of the stream that was surveyed. Information on each stream is made available to the public through the Watershed Information System on the RVCA website *www.rvca.ca*.

Data collected is valuable and is used on a variety of levels. Various organizations and community groups throughout the City of Ottawa use City Stream Watch data for:

- Identifying potential rehabilitation projects (riparian and fish habitat)
- Identifying stream cleanup opportunities
- Sub Watershed Plans (RVCA/City of Ottawa)
- RVCA Planning and Regulations Review
- NCC rehabilitation projects (e.g. Pinecrest Creek Rehabilitation Project)
- Long-term monitoring of urban streams
- *Fisheries Act* Review
- Private consultants as background data

# 3.0 Results

## 3.1 The Community Response

A total of 148 volunteers from the community participated in the 2008 City Stream Watch program, consisting of people from a variety of backgrounds and experiences. Each volunteer approached the work in a slightly different way, contributing their own unique qualities to enhance the program as well as the experience of their fellow volunteers. The most significant quality they brought with them was their concern for the environment in which they live. As a result, 1092.5 volunteer hours were given to learning about, sampling and rehabilitating urban and rural streams in the City of Ottawa. Table 2 summarizes volunteer activities for the 2008 season.

| | Sawmill Creek | Black Rapids Creek | Mud Creek | Cardinal Creek | Green's Creek | Jock River | TOTAL |
|---|---|---|---|---|---|---|---|
| # of Sections Surveyed | 98 | 55 | 95 | 74 | Not to be sampled in 2008 | Not to be sampled in 2008 | **322** |
| # of Seining/ Electrofishing/Benthic identification/fly fishing demo Events | 1 | 2 | 2 | 1 | 0 | 1 | **7** |
| # of Seining/Electrofishing Sites | 5 | 10 | 9 | 6 | 0 | 0 | **30** |
| # of Species Caught | 16 | 19 | 15 | 15 | 0 | 0 | **NA*** |
| # of Cleanup Outings | 3 | 0 | 0 | 0 | 0 | 0 | **4**** |
| # of kilometres (km) Cleaned | 3.4 | 0 | 0 | 0 | 0 | 0 | **3.4** |
| # of Riparian Plantings | 1 | 0 | 0 | 1 | 1 | 0 | **3** |
| # of Temperature Probe Readings | 3 | 3 | 3 | 3 | 0 | 0 | **12** |
| # of Volunteers | 84 | 38 | 32 | 34 | 16 | 26 | **148** |
| # of Volunteer Hours | 458.5 | 180 | 164 | 148.5 | 32.5 | 109 | **1092.5**** |

**Table 2. City Stream Watch Accomplishments of 2008**

* This number represents the total number of species caught in all systems. Many species were found in more than one stream.
** A cleanup on the Rideau River was organized by the Urban Rideau Conservationists, which City Stream Watch took part in.

# 3.2 Environmental Monitoring

## 3.2.1 Black Rapids Creek

Black Rapids Creek is approximately six kilometres long and flows east from under Woodroffe Road and Merivale Road, before emptying into the Rideau River, south of the Black Rapids Locks. Land use around the creek is a mix of old field, wetland, forest, agriculture and urban development. The section between Prince of Wales Drive and Woodroffe Road has many meanders and good bird habitat. Old field and wet meadows line the creek and deciduous forest covers the steep slopes. Black Rapids is an important ecological link to other areas, such as the Rideau River for fish and wildlife (Del, Degan & Massé, 2007). Benthic macroinvertebrate inventories from 2003 to spring 2008 at Merivale Road ranged from very poor to fair, suggesting substantial pollution to severe organic pollution is likely.

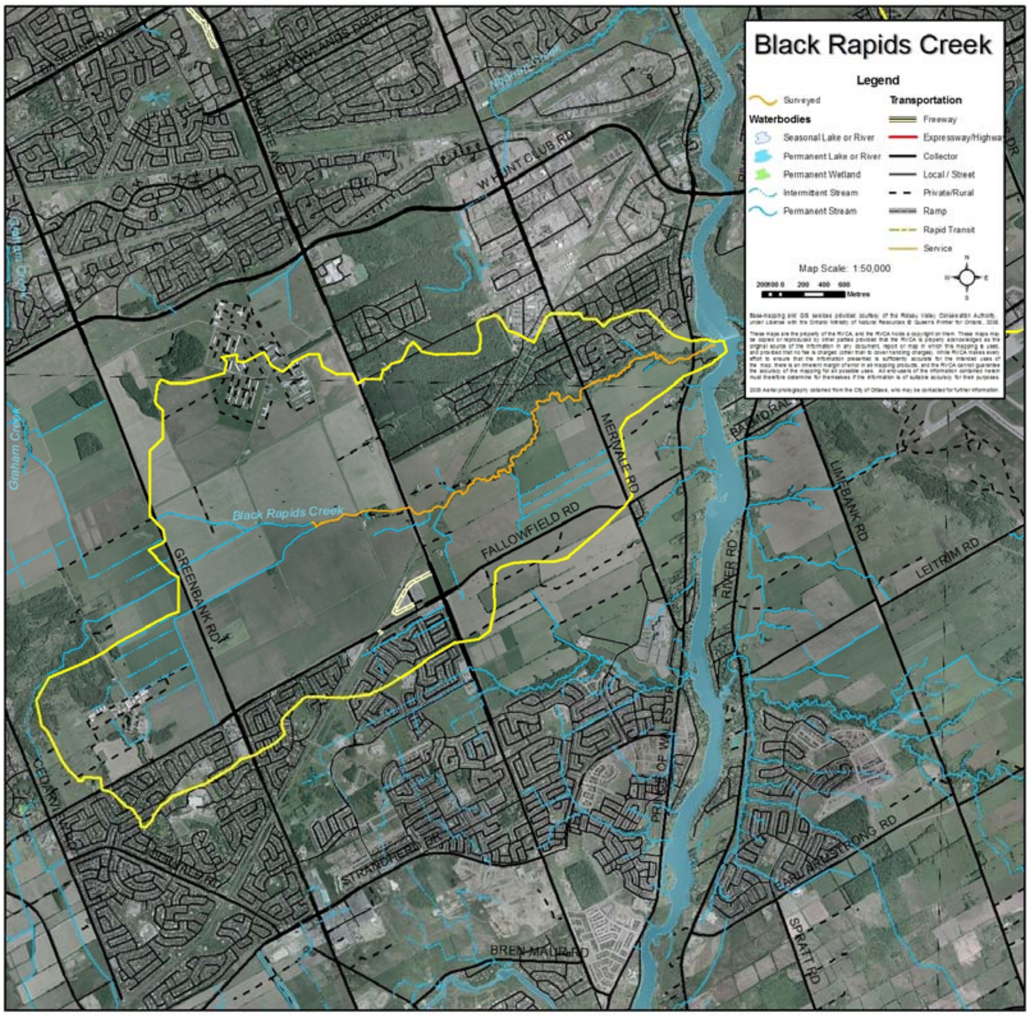



**Figure 2. Air photo of Black Rapids Creek and Surrounding Area**

Fifty-six sections or 5.6 kilometres were sampled in the 2008 season. The headwaters were too dry to sample by the end of the field season. The following is a summary of the 56 macro-stream assessment forms completed by technicians and volunteers. Observations concerning anthropogenic alterations, land use, in-stream vegetation, bank stability, wildlife and pollution are discussed.

## 1. Observations of Anthropogenic Alterations and Land Use

Figure 3 illustrates the classes of anthropogenic alterations observed by volunteers along Black Rapids Creek. Of the 56 sections of stream sampled, 52 percent of the stream remained without any anthropogenic alterations. Sections considered natural, but with some anthropogenic changes made up 34 percent of the sections sampled, and nine percent accounted for sections that were considered "altered" but still had natural features. Only five percent of the samples were "highly altered" with few natural portions. Areas that were listed as "altered" or "highly altered" were associated with road crossings, culverts, straightened areas of the creek or sections of the creek with little or no buffer and little aquatic or wildlife habitat. Most of these areas occurred in the headwaters, east of Greenbank, through Woodroffe where the creek is homogeneous. The area around Woodroffe is highly impacted with road crossings and drains from the road.

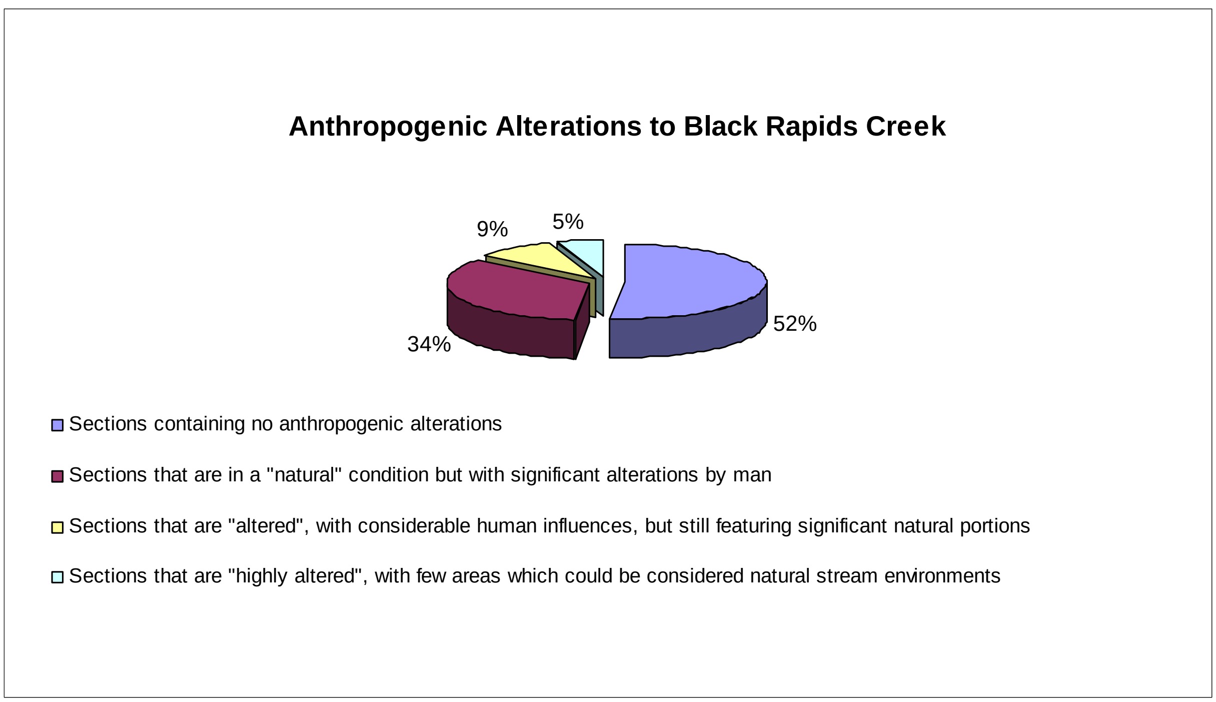



**Figure 3. Classes of Anthropogenic Alterations Occurring Along Black Rapids Creek**

Figure 4 demonstrates a number of different land uses identified by volunteers occurring along the banks adjacent to Black Rapids Creek. Natural areas make up 61 percent of the stream, characterized by forest, scrubland, meadow and wetland. The NCC was in the process of building a recreation path travelling along Black Rapids Creek between Merivale and Woodroffe. This path, along with the mouth of the creek at the Black Rapids Locks on the Rideau River, accounts for two percent recreational use. The path is well back from the creek in most sections. Agricultural land use surrounding Black Rapids Creek (including pasture and active agriculture) accounted for 30 percent, mainly occurring from Merivale Road to east of Woodroffe. Only five percent of the sections sampled had infrastructure. Roadways consist of a concrete bridge at Prince of Wales Drive, Merivale and Woodroffe.

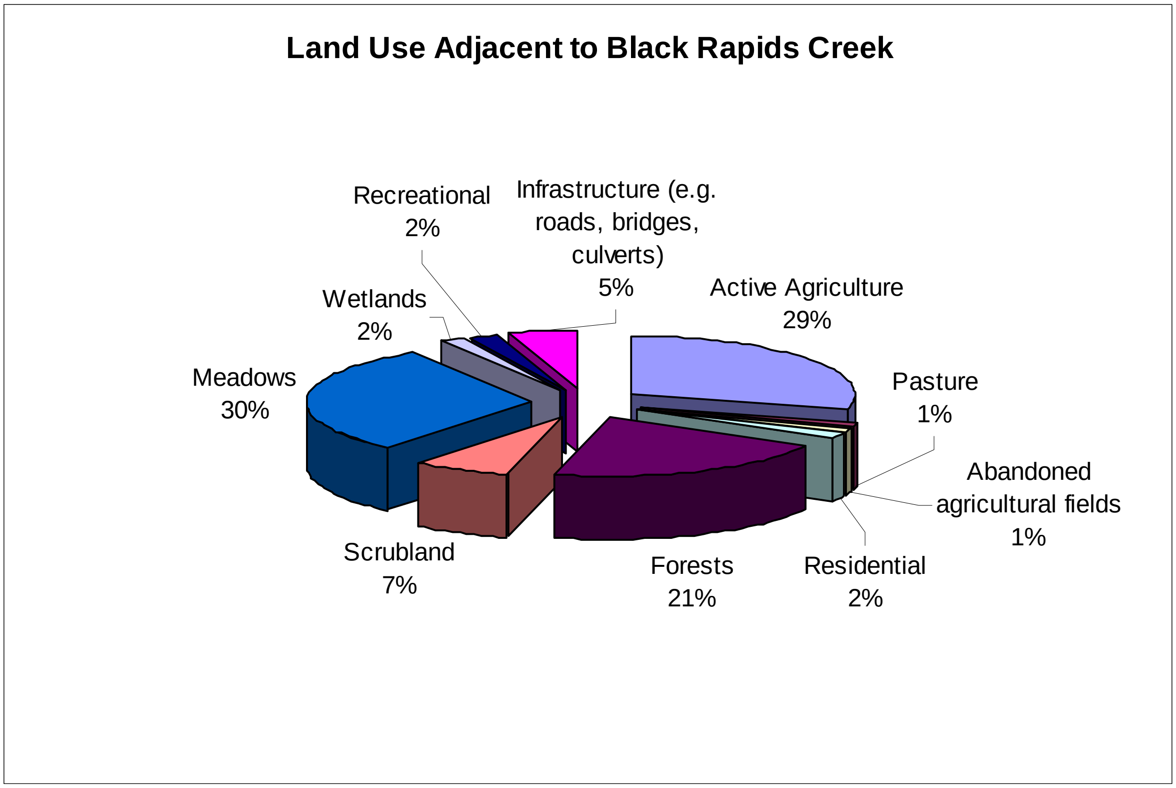



**Figure 4. Land Use Identified by Volunteers along Black Rapids Creek**

## 2. Instream Morphology of Black Rapids Creek

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. 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. Black Rapids Creek mainly consists of large runs with smaller pools and riffles, illustrated in Figure 5.

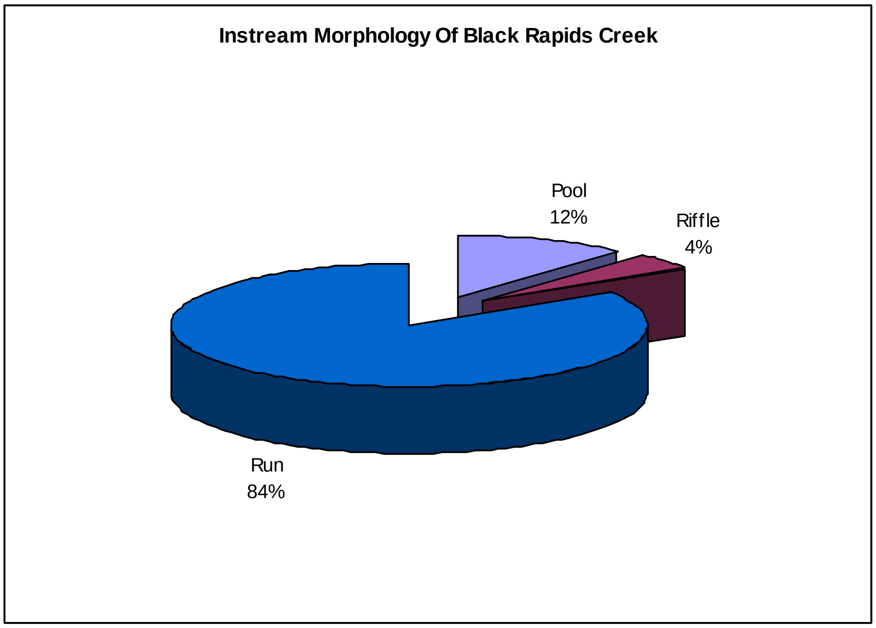



**Figure 5. Instream Morphology of Black Rapids Creek**

## 3. Types of Instream Substrate Along Black Rapids Creek

A variety of substrate can be found instream along Black Rapids Creek, although almost half of the substrate observed is clay, with some muck, detritus, cobble and sand. Diverse substrate is important for fish and benthic macroinvertebrate habitat because some species will only be found in certain types of substrate and will only reproduce on certain types of substrate. Boulders create instream cover and back eddies for large fish to hide and/or rest out of the current, and cobble provides important over wintering and/or spawning habitat for small or juvenile fish. Other substrates also provide instream habitat for fish and macroinvertebrates. Many areas of Black Rapids Creek, mainly upstream of Merivale Road, are homogeneous.

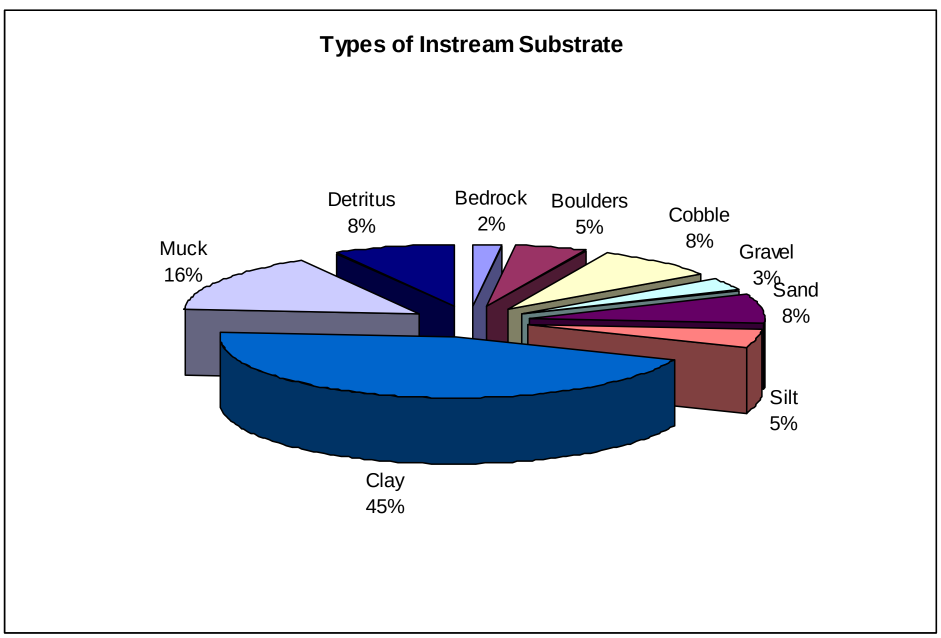



**Figure 6. Types of Instream Substrate Along Black Rapids Creek**

## 4. Observations 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. Figure 7 demonstrates the frequency of instream vegetation in Black Rapids Creek.

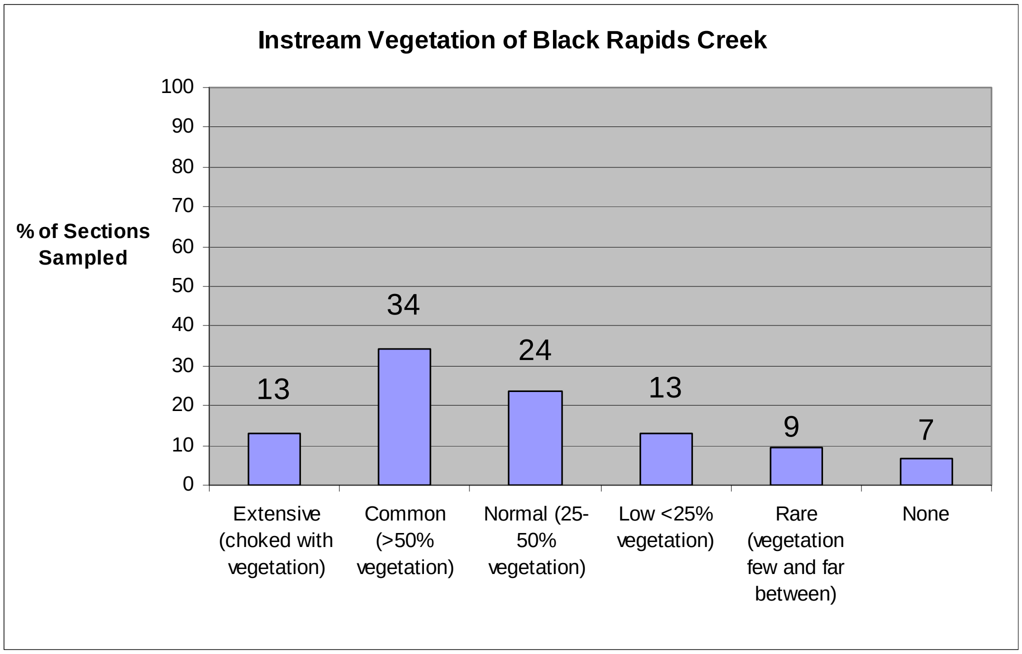



**Figure 7. Frequency of Instream Vegetation in Black Rapids Creek**

The instream vegetation in Black Rapids Creek varied throughout the stream. In 34 percent of sections sampled, vegetation was found to be common and 24 percent found to be normal. This coincided with areas that were in a "natural" condition. The areas considered extensive (13 percent) were areas with higher nutrient inputs, around stormwater outlets, cornfields and road crossings. Areas choked with vegetation can negatively affect the stream due to increased biological oxygen demand (BOD) when the plants die off. Extensive vegetation can also restrict the mobility of aquatic organisms. Some sections had areas with little, rare or no vegetation due to alterations to the stream, heavy clay bottom and a lack of cover. These sections made up 29 percent of the sections sampled.

## 5. Observations of Bank Stability

Bank stability indicates how much soil has eroded from the bank into the stream. Poor bank stability can greatly contribute to the amount of sediment carried in a waterbody as well as loss of bank vegetation due to bank failure, resulting in trees falling into the stream and the removal of aquatic plants, which provide habitat. Excessive erosion and deposition of sediment within a stream can also have detrimental effects to important fish and wildlife habitat.

This year, City Stream Watch recorded bank stability separately for left and right banks to obtain greater detail on the areas experiencing erosion. Figure 8 and 9 show the overall bank stability of Black Rapids Creek. For the left bank, 87 percent of sections sampled by volunteers were identified as being stable. The stability of the banks can be attributed to a healthy buffer of meadow and trees and between the creek and agriculture or residential development. Eroded sections were identified in 13 percent of surveyed sections. Erosion along this stream was moderate and does not pose a risk to overall stream health. A small amount of undercutting was observed, but nothing that was causing severe erosion problems. Only two sections were severely eroding for a large portion of the section length. These two areas were near the headwaters, where there was little or no buffer, and the buffer solely consisted of grass, and the banks were either steeply eroding or slumping into the creek. The right bank of Black Rapids Creek was similar, with 89 percent of the sections sampled considered stable and only 11 percent regarded as unstable. Areas of erosion have been identified on an aerial photo of Black Rapids Creek and are detailed in Appendix I.

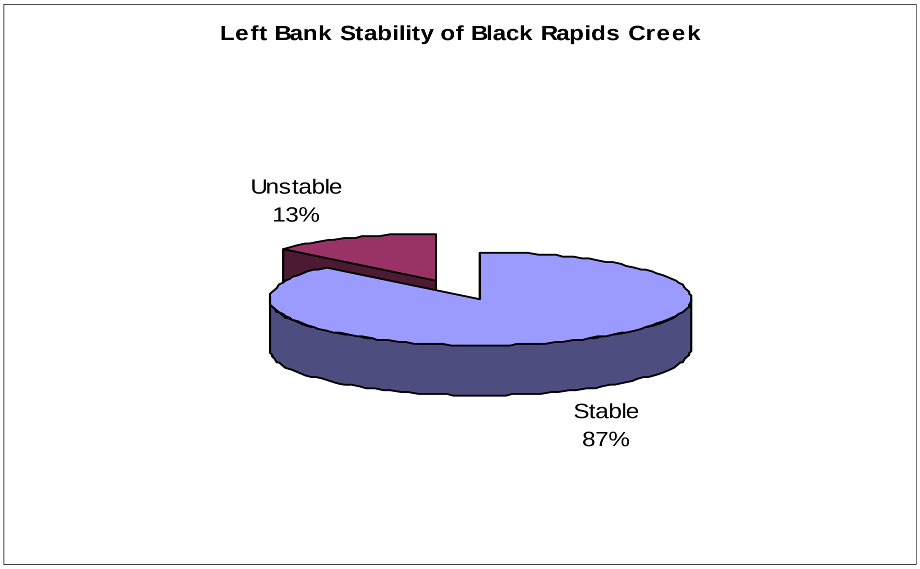



**Figure 8. Left Bank Stability of Black Rapids Creek**

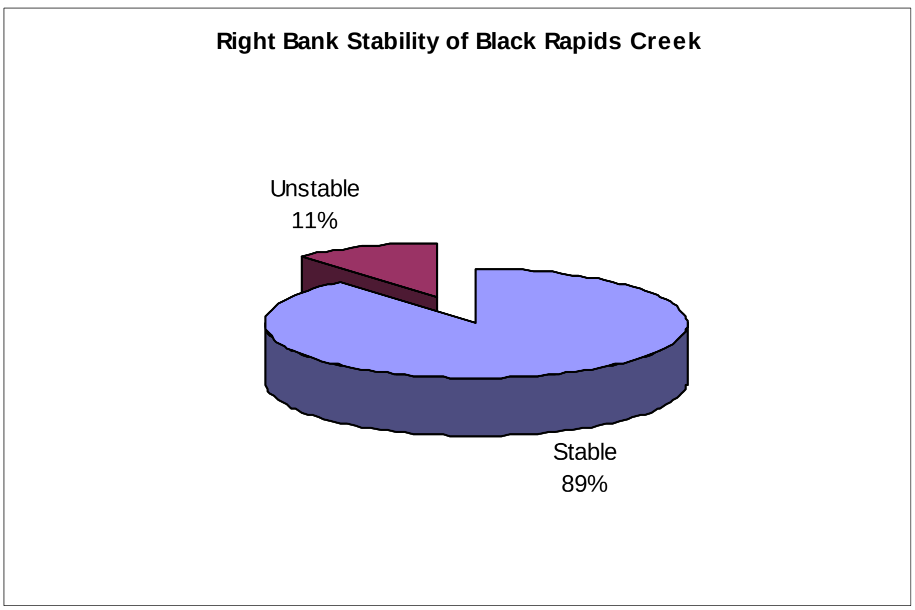



**Figure 9. Right Bank Stability of Black Rapids Creek**

## 6. Buffer Evaluation of Black Rapids Creek

Natural buffers between the creek and human alterations are extremely important for filtering excess nutrients running into the creek, infiltrating rainwater, bank stability and wildlife habitat. Natural shorelines also shade the creek, helping maintain baseflow levels and keeping water temperatures cool. According to the document *How Much Habitat Is Enough*, a stream should have riparian areas of 30 metres minimum or more, depending on the site conditions. Figure 10 demonstrates the buffer conditions between the left and right banks. Along Black Rapids, 13 – 19 percent had a buffer of only zero to five metres, nine to 16 percent had a buffer of five to 15 metres and 20-22 percent had 15-30 metres. Half of the right bank and 51 percent of the left bank had a buffer greater than 30 metres.

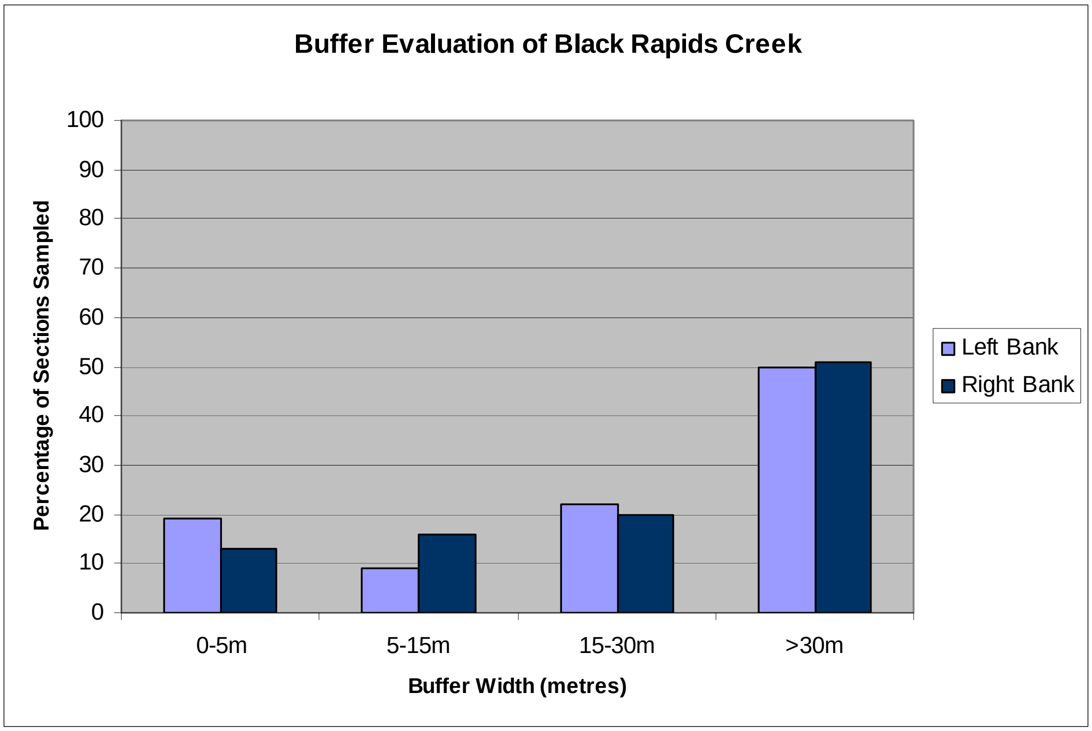



**Figure 10. Buffer Evaluation of Black Rapids Creek**

## 7. Observations of Wildlife

The diversity of fish and wildlife populations can be an indicator of water quality and overall stream health. Table 3 is a summary of all wildlife observed during stream surveys.

| Wildlife | Observed While Sampling |
|---|---|
| ***Birds*** | ducks, mallards, great blue heron, song sparrows, catbirds, chickadees, woodpecker, kingfishers, grackle, hawk spp., crows, field sparrow, blue jays, redwing blackbirds, ring-billed gulls, redstarts, mourning dove |
| ***Mammals*** | deer, raccoon, black squirrels, muskrat, beaver, chipmunk |
| ***Reptiles/Amphibians*** | green frogs, American toad, mink frog, snapping turtle |
| ***Aquatic Insects*** | water striders, water beetles, crayfish |
| ***Fish (as observed through seining and*** | creek chub, mottled sculpin, white sucker, brook stickleback, northern redbelly dace, blackchin shiner, central mudminnow, finescale dace, pearl |

| | |
|---|---|
| ***electrofishing)*** | dace, common shiner, longnose dace, fathead minnow, logperch, pumpkinseed, rock bass, smallmouth bass, largemouth bass, walleye, yellow perch, black crappie, tessellated darter, *Etheostoma spp*., *Cyprinid spp.* |
| ***Other*** | blackwinged damsel, male river jewelwing, jewelwing spp., bumblebees, gnats, mosquitoes, hornets, crickets, spiders, beetles, caterpillars, ants, molluscs, cicadas, snails |

**Table 3. Wildlife Observed on Black Rapids Creek During Stream Surveys**

## 8. Observations of Pollution/Garbage

Figure 11 demonstrates the incidence of pollution/garbage in Black Rapids Creek. Pollution and garbage in the stream is assessed visually and noted for each section where it is observed. For 64percent of the sections sampled, no pollution was observed. Aside from two sections, most of the areas where floating garbage or garbage on the stream bottom was observed nothing had accumulated, and it was only one or two pieces of garbage.

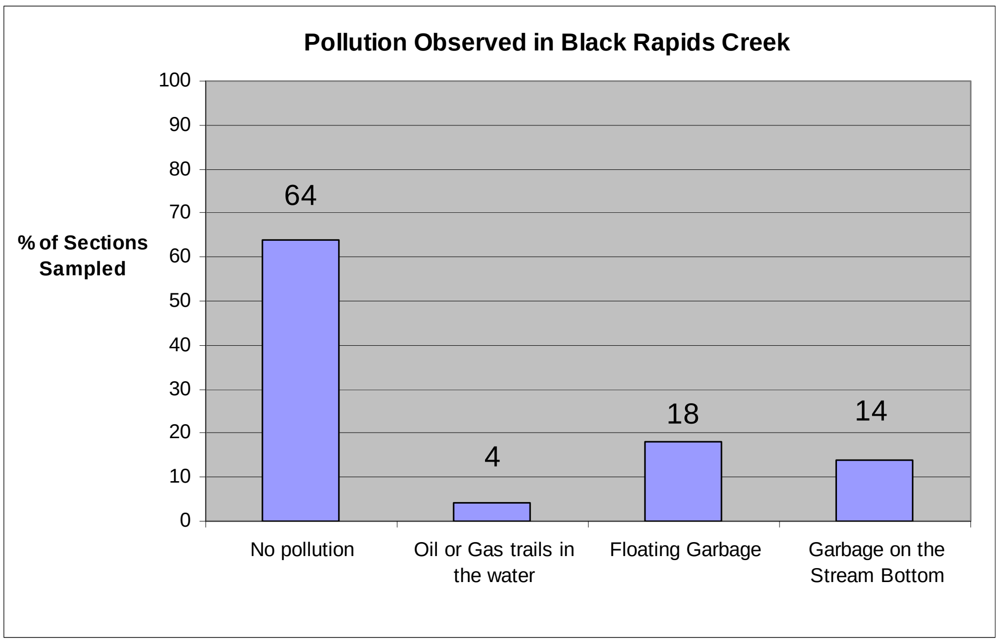



**Figure 11. Frequency of Pollution/Garbage Occurring in Black Rapids Creek**

Pollution observed includes garbage in the stream and along its banks. Much of it likely results in trash blowing in or being washed in from storm events, from residential areas, roadways, recreational pathways or construction sites. Two of the sections have been identified for cleanups in the future. One of these sites has a large oil drum on the stream bottom, along with metal and tires. Upstream from Merivale Road, there is an old beaver dam. When volunteers crossed the beaver dam and walked in the sediment accumulated on the upstream side, many gas vapours and trails were released, indicating there was a spill in the past, and this material is captured in the sediment at that location. This sediment should be removed and properly disposed of.

# 9. Fish Community Sampling

## Seine Netting

Seine netting is an effective way to sample fish communities in streams, rivers and lakes. Seine nets are dragged through the water column to collect fish in the near shore area. This data is used in conjunction with electrofishing to determine fish communities and distributions. Volunteers contributed 88 hours to assisting with seine netting activities along Black Rapids Creek. Volunteers were introduced to fish sampling methods as well as taught how to identify and process seine net catches.

Seven seine netting sites were completed along Black Rapids Creek on various dates. Figure 12 shows the locations of the sampling sites, and Table 5 is a summary of the fish caught. All fish were live released back to the stream after seining and electrofishing events.

## Electrofishing

Electrofishing is one of the key tools used to effectively sample fish communities. Basically, electricity is passed through the water using a backpack electrofisher which causes a muscle response reaction in fish, temporarily stunning them while the netters scoop them from the stream and place them in a recovery bucket. Electrofishing very seldom kills fish if the correct voltages are used. This makes it the most effective way to sample fish from a variety of habitats in otherwise hard to access areas of stream. Once the data is recorded the fish are returned to the area of stream from where they were collected.

RVCA staff electrofished three sites along Black Rapids Creek. A total of ten different species were identified. Some C*yprinid* (minnow) species, *Centrarchid* (sunfish) species and *Etheostoma* (darter) species were too small and could not be identified, and those are listed as *Cyprinid spp*., *Centrarchid spp*. and *Etheostoma spp*.

Water chemistry data was taken prior to seine netting and electrofishing using a YSI probe. This instrument measures water temperature, dissolved oxygen (DO), pH, and conductivity. Water temperature of a stream is classified into warm, cool and cold water systems. Temperature has a major influence on the biota found in a stream system. Dissolved oxygen is what stream-dwelling species such as fish and invertebrates use to breathe. Fast flowing, cold water will have higher dissolved oxygen content than slow moving warm water. This is because cold water has the ability to hold more oxygen as it constantly churns, thereby incorporating air from the atmosphere into the water. Conductivity is a measure of the water's ability to pass an electrical current. It is primarily affected by the geology of the area in which the stream flows. Streams with clay soils tend to have a higher conductivity because of ionized materials in the water. The pH of water is a scale used to evaluate the alkalinity or acidity of water and is ranked

on a scale of one to 14. Acidity increases, as pH gets lower (seven being neutral). The pH determines the solubility and availability of nutrients and heavy metals to stream dwelling organisms.

Table 4 summarizes water chemistry data for each seining and electrofishing site.

| Sampling Technique | Site # | Date (mm/dd/yy) | Air Temp C° | Water Temp C° | DO (mg/L) | pH | Conductivity (uS/cm) | Substrate | Instream Vegetation |
|---|---|---|---|---|---|---|---|---|---|
| Seining | 1a | 7/14/2008 | 19 | 18 | N/A | N/A | N/A | clay | grasses, submergents, algae |
| Seining | 1b | 5/27/2008 | 14 | 16 | N/A | N/A | N/A | sandy clay | grasses |
| Seining | 2 | 6/26/2008 | 24.7 | 22.9 | 12.8 | 8.52 | 346 | sandy clay with large gravel | submergents, algae |
| Seining | 3a | 6/26/2008 | 23.5 | 22.8 | 8.67 | 8.13 | 342 | clay | submergents, algae, lilypads |
| Seining | 3b | 7/30/2008 | 19 | 22.5 | N/A | N/A | N/A | clay with rocky areas | submergents, algae, arrowhead |
| Seining | 3b | 8/27/2008 | 23 | 22.39 | 8.73 | 8.18 | 339 | clay with rocky areas | submergents, algae, arrowhead |
| Seining | 4 | 7/14/2008 | 20 | 17 | N/A | N/A | N/A | bedrock | algae |
| Seining | 5 | 7/12/2008 | 28 | 18 | N/A | N/A | N/A | clay; some cobble, woody debris and muck | submergents, algae |
| Seining | 5 | 7/19/2008 | 24 | 21 | N/A | N/A | N/A | clay, some cobble, woody debris and muck | submergents, algae |
| Electrofishing | 1 | 6/10/2008 | 21.08 | 11.89 | 7.48 | 7.7 | 480 | clay, cobble | grasses, arrowhead, algae |
| Electrofishing | 2 | 7/19/2008 | 25 | 19.5 | N/A | N/A | N/A | clay, cobble | grasses, arrowhead, algae |
| Electrofishing | 3 | 7/9/2008 | 26 | 21 | N/A | N/A | N/A | cobble, boulder, clay, sand | grasses, algae |

**Table 4. Water Chemistry Results for Sampling Sites Along Black Rapids Creek**

(N/A: The YSI probe was under repair for a period of time, resulting in some days where no water chemistry data is collected, only water temperature.)


**Figure 12. Air Photo of Black Rapids Showing Sampling Sites**

Table 5 summarizes the biological data obtained from each sampling event on Black Rapids Creek. A total of 24 different fish species were collected. Top predators within the system are highlighted in bold. For a complete breakdown of species sampled, including number of each species caught, weight, comments, etc., please refer to Appendix E.

| Sample Technique | Date Sampled | Site # | Species Sampled | Total number of species Caught |
|---|---|---|---|---|
| **SEINING** | | | | |
| | 14-Jul | 1a | creek chub, white sucker, brook stickleback, **smallmouth bass, yellow perch**, logperch, pumpkinseed | 7 |
| | 27-May | 1b | brook stickleback, creek chub, northern redbelly dace, blackchin shiner, *Cyprinid spp*. | 5 |
| | 26-Jun | 2 | **yellow perch**, logperch, blackchin shiner, *Etheostoma spp*. (johnny or tessellated darter) | 4 |
| | 26-Jun | 3a | logperch, white sucker, blackchin shiner, yoy cyprinid spp., yoy *Etheostoma spp*. (johnny or tessellated darter) | 5 |
| | 30-Jul | 3b | pumpkinseed, rock bass, **largemouth bass**, logperch, **yellow perch**, **yoy walleye**, **smallmouth bass**, common shiner, *Etheostoma* spp. (johnny or tessellated darter), yoy *Centrarchid spp.* | 10 |
| | 27-Aug | 3b | yellow perch, pumpkinseed, **walleye**, logperch, rock bass, black crappie, **smallmouth bass** | 7 |
| | 14-Jul | 4 | creek chub, yoy white sucker, longnose dace, **walleye**, logperch, tessellated darter | 6 |
| | 12-Jul | 5 | creek chub, common shiner, brook stickleback, fathead minnow, white sucker, mottled sculpin, northern redbelly dace, *Cyprinid spp.* | 8 |

| | | | | |
|---|---|---|---|---|
| | 19-Jul | 5 | common shiner, fathead minnow, creek chub, white sucker, brook stickleback, mottled sculpin, northern redbelly dace | 7 |
| **EFISHING** | | | | |
| *problems with electrofisher | 10-Jun | 1 | creek chub | 1 |
| | 29-Jul | 2 | creek chub, brook stickleback, white sucker, central mudminnow, mottled sculpin, northern redbelly dace, finescale dace, pearl dace | 8 |
| | 9-Jul | 3 | creek chub, fathead minnow, northern redbelly dace, white sucker, mottled sculpin, brook stickleback, common shiner | 7 |

**Table 5. Fish Community Results for Seining Sites Along Black Rapids Creek**

## Fish Species Status, Trophic and Reproductive Guilds-Black Rapids Creek

Table 6 was generated by taking the fish community structure of Black Rapids Creek and classifying the recreational, commercial, or bait fishery importance, the Species at Risk status, reproductive guild (spawning habitat requirements), thermal classification, and trophic guild (feeding preference). The majority of the species within Black Rapids Creek are either significant to the recreational or baitfish fisheries. The fish community structure consists of a mix of warm and cool water species except for mottled sculpin which is a coldwater species.

| MNR Code | Common Name | Scientific Name | Recreational Fishery | Commercial Fishery | Bait Fishery | Status | Reproductive Guild | Thermal Classification | Trophic Guild |
|---|---|---|---|---|---|---|---|---|---|
| 281 | brook stickleback | *Culaea inconstans* | | | X | None | (guarders) Ariadnophils | Cool | Insectivore |
| 212 | creek chub | *Semotilus atromaculatus* | X | | X | None | (brood hiders) Lithopils | Cool | Insectivore/Generalist |
| 163 | white sucker | *Catostomus commersoni* | | | | None | (non guarder) Lithophils | Cool | Insectivore/ Omnivore |
| 182 | northern redbelly dace | *Phoxinus eos* | | | X | None | (non guarder) Phytophils | Cool/Warm | Herbivore |
| 141 | central mudminnow | *Umbra limi* | | | X | None | (non guarder) Phytophils | Cool/Warm | Insectivore/ Omnivore |
| 313 | pumpkinseed | *Lepomis gibbosus* | X | | | None | (nest spawners) Polyphils | Cool/Warm | Insectivore |
| 311 | rock bass | *Ambloplites rupestris* | X | | | None | (nest spawners) Lithophils | Warm | Insectivore |
| 317 | largemouth bass | *Micropterus salmoides* | X | Past | | None | (nest spawners) Phytophils | Warm | Insectivore/Piscivore |
| 316 | smallmouth bass | *Micropterus dolomieui* | X | Past | | None | (nest spawners) Lithophils | Cool | Insectivore/Piscivore |
| 209 | fathead minnow | *Pimephales promelas* | | | X | None | (guarder) Speleophils | Warm | Omnivore |
| 331 | yellow perch | *Perca* | X | X | | None | (non guarder) | Cool | Insectivore/Piscivore |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | *flavescens* | | | | | Phyto- lithophils | | |
| 198 | common shiner | *Luxilus cornutus* | | | X | None | (guarders) Lithopils | Cool | Insectivore |
| 334 | walleye | *Stizostedion vitreum* | X | X | | None | (non guarder) Lithophils | Cool | Piscivore |
| 319 | black crappie | *Pomoxis nigromaculatus* | X | | | None | (nestspawners) Phytophils | Cool | Insectivore/Piscivore |
| 211 | longnose dace | *Rhinichthys cataractae* | | | X | None | (non guarder) Lithophils | Cool | Insectivore |
| 342 | logperch | *Percina caprodes* | | | X | None | (non guarder) Psammophils | Cool | Insectivore |
| 214 | pearl dace | *Margariscus margarita* | | | X | None | (non guarder) Lithophils | Cool | Insectivore |
| 183 | finescale dace | *Phoxinus neogaeus* | | | X | None | (non guarder) Phyto- lithophils | Cool | Insectivore |
| 381 | mottled sculpin | *Cottus bairdi* | | | X | None | (guarders) Ariadnophils | Cold | Insectivore |
| 346 | tessellated darter | *Etheostoma olmstedi* | | | X | None | (guarder) Speleophils | Cool | Insectivore |
| 199 | blackchin shiner | *Notropis heterodon* | | | X | None | (non guarder) Phytophils | Cool | Insectivore |

**Table 6. Fish Species Status, Trophic and Reproductive Guilds for Black Rapids Creek**
(Source*: MTO Environmental Guide to Fish and Fish Habitat*, 2006).

Table 7 summarizes the fish community structure found in Black Rapids Creek and their sensitivity to sediment and turbidity for reproduction, feeding, and respiration. The composition of the fish community in Black Rapids Creek ranges from species that are moderately tolerant to those that are intolerant to sediment and turbidity. However, the majority of the species would be classified in the moderately tolerant range for reproduction and feeding. Fish species such as bass, black crappie and walleye that are sensitive to sediment and turbidity for feeding were caught close to the Rideau River where food could be found elsewhere if ideal conditions did not exist.

## Fish Species Sensitivity to Sediment/Turbidity for Black Rapids Creek

**Fish Species Sensitivity to Sediment/Turbidity for Black Rapids Creek**

| MNR Code | Common Name | Scientific Name | Reproduction | Feeding | Respiration |
|---|---|---|---|---|---|
| 281 | brook stickleback | *Culaea inconstans* | L | M | unknown |
| 212 | creek chub | *Semotilus atromaculatus* | M | H | H |
| 163 | white sucker | *Catostomus commersoni* | M | L | H |
| 182 | northern redbelly dace | *Phoxinus eos* | M | L | L |
| 141 | central mudminnow | *Umbra limi* | M | M | L |
| 313 | pumpkinseed | *Lepomis gibbosus* | L | M | unknown |
| 311 | rock bass | *Ambloplites nupestris* | L | H | unknown |
| 317 | largemouth bass | *Micropterus salmoides* | L | H | H |

| | | | | | |
|---|---|---|---|---|---|
| 316 | smallmouth bass | *Micropterus dolomieu* | M | H | unknown |
| 209 | fathead minnow | *Pimephales promelas* | L | L | unknown |
| 331 | yellow perch | *Perca flavescens* | M | H | unknown |
| 198 | common shiner | *Luxilus cornutus* | M | M | unknown |
| 334 | walleye | *Stizostedion vitreum* | M | H | H |
| 319 | black crappie | *Pomoxis nigromaculatus* | L | H | unknown |
| 211 | longnose dace | *Rhinichthys cataractae* | M | M | H |
| 342 | logperch | *Percina caprodes* | M | M | H |
| 214 | pearl dace | *Margariscus margarita* | M | M | H |
| 183 | finescale dace | *Phoxinus neogaeus* | M | M | unknown |
| 381 | mottled sculpin | *Cottus bairdi* | M | M | unknown |
| 199 | blackchin shiner | *Notropis heterodon* | M | M | L |
| 346 | tessellated darter | *Etheostoma olmstedi* | unknown | unknown | unknown |

**Table 7. Fish Species Sensitivity to Sediment/Turbidity (High, Moderate, Low or Unknown) for Black Rapids Creek** (Source: *MTO Environmental Guide to Fish and Fish Habitat*, 2006).

## 10. Temperature Profiling

Temperature is an important parameter in streams as it influences many aspects of physical, chemical and biological health. The temperature of a stream can vary considerably between the seasons as well as fluctuate between night and day. Many factors can influence fluctuations in stream temperature such as springs, tributaries, precipitation runoff and discharge pipes. The greatest factor of fluctuating temperature is solar radiation and runoff from developed areas. Streams with large amounts of riparian canopy cover will yield lower temperatures while areas with no trees may be warmer. The thermal classifications for cold, cool and warm water are as follows:

| Status | Water Temperature |
|---|---|
| **Cold** | **<19 Degrees Celsius** |
| **Cool** | **19-25 Degrees Celsius** |
| **Warm** | **>25 Degrees Celsius** |

**Table 8. Water Temperature Classifications (Minns et al. 2001)**

Three temperature dataloggers were set in Black Rapids Creek. The first logger was set earlier, on May 6, and recorded temperature for a 182-day period. The other two were set for a 127-day period on May 22nd. The dataloggers were removed September 19, 2008. Figure 13 shows the locations of dataloggers in Black Rapids Creek.


**Figure 13. Datalogger Locations Along Black Rapids Creek**

Dataloggers were set in three different locations along the stream to give a representative sample of how temperature fluctuates and differs throughout the course of the stream. Datalogger 1 was set in the lower reaches, upstream of the Prince of Wales Drive crossing. Datalogger 2 was placed upstream of the Merivale Road Crossing and datalogger 3 was set at the northbound crossing of Woodroffe Road. Figures 14, 15 and 16 show the datalogger results.

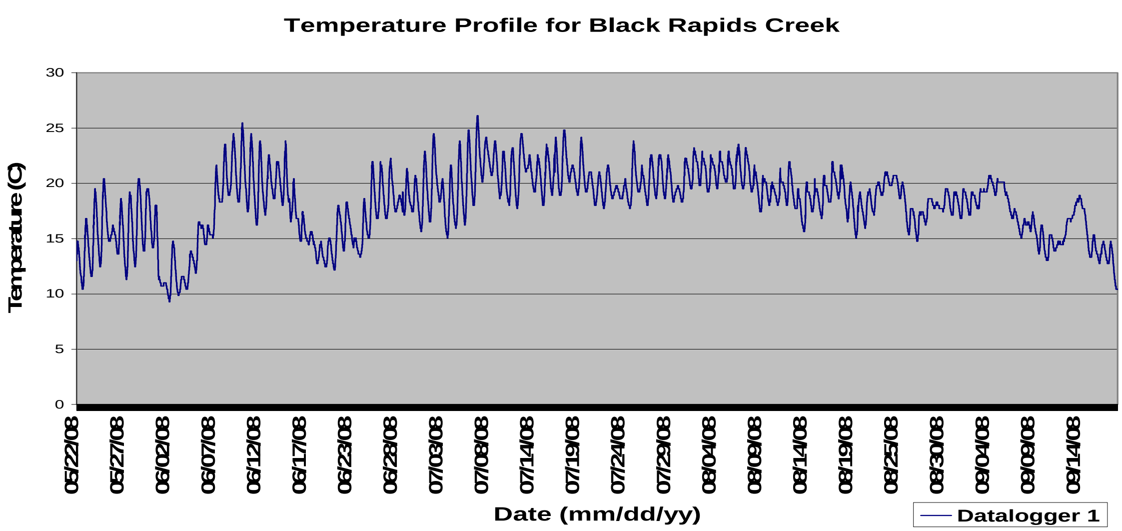



**Figure 14. Temperature Profile for Datalogger 1 at Prince of Wales Drive**

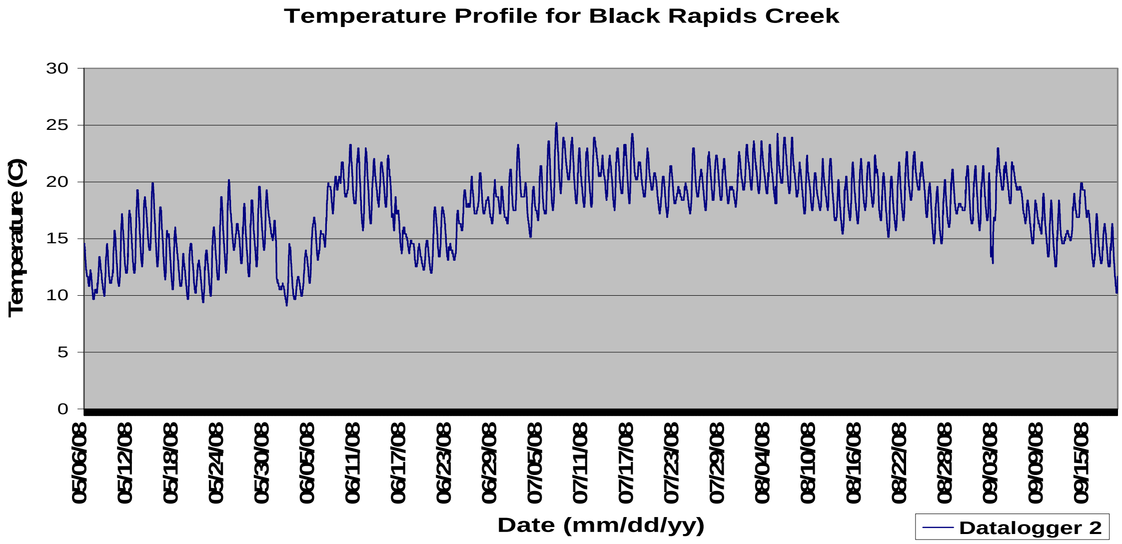



**Figure 15. Temperature Profile for Datalogger 2 at Merivale**

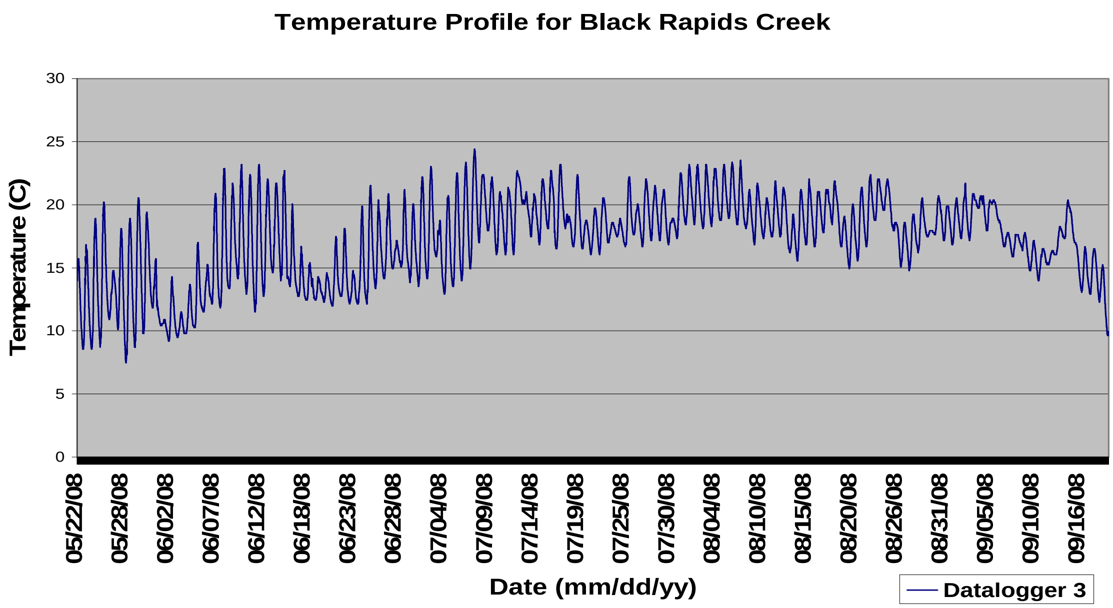



**Figure 16. Temperature Profile for Datalogger 3 at Woodroffe**

Figures 14, 15 and 16 have a consistent trend of fluctuating temperatures throughout the stream. Over the testing period this stream reached a maximum temperature of 26.12°C and a minimum of 7.48°C.

In comparison, the first and the third dataloggers show little variation and the temperature patterns are very similar which is typical for this type of stream. Datalogger 3 shows a slightly different fluctuation, but has a similar trend to datalogger 1 and 2. Temperature highs and lows can differ from section to section as factors such as overhead cover, water depth, flow, and stream morphology play a large role in determining temperature trends.

Based on the fish community structure and temperature data collected, Black Rapids Creek can be classified as a cool water system with cold water inputs. Through evaluation of the temperature data, Black Rapids Creeks' waters only rose above 25 degrees three times in June and July and did not stay more than 25°C over a day. This is also supported by the presence of cool water species, such as smallmouth bass and one coldwater species, mottled sculpin.

## 11. 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 and plant populations. These species originate from other countries and are introduced through global shipping containers, ship ballast water, pet trades, aquarium and horticultural activities, the live bait industry and more. Species such as European Frog-Bit (*Hydrocharis morsus-ranae*) can be transferred from waterway to waterway through seed dispersal and part of plants caught on boats, boat trailers or on other equipment (OMNR, 2008). Figure 17 shows the locations of invasive species found along Black Rapids Creek.

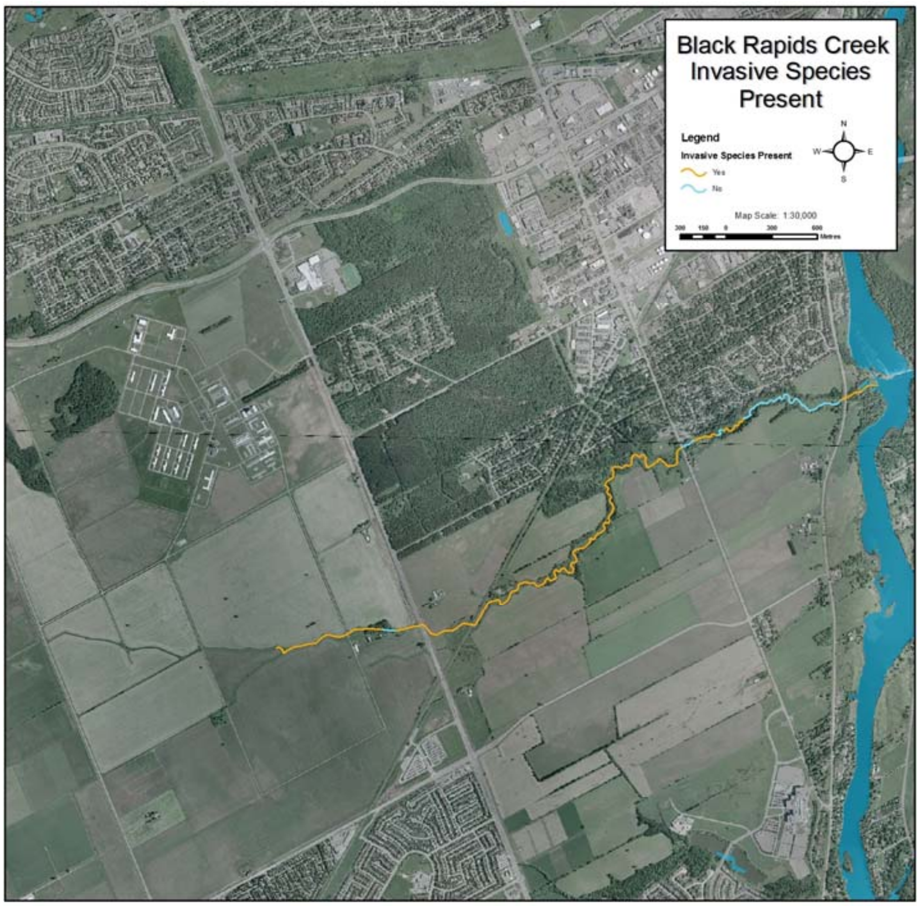



**Figure 17. Air Photo Showing Locations of Invasive Species Along Black Rapids Creek**

The most common invasive species along Black Rapids Creek is Purple Loosestrife (*Lythrum salicaria*), however, it does not appear to be outcompeting any native vegetation and is serving as a nectar source for pollinator species in areas where there the main vegetation type surrounding the creek is tall grass. There were three other invasive species found along Black Rapids Creek. Japanese Knotweed (*Polygonum cuspidatum*) was found at the mouth of the creek, on the left bank of the pedestrian bridge at the locks. Wild parsnip (*Pastinaca sativa*) and Manitoba Maple (*Acer negundo*) were found on various other sites of the creek. These species are not as invasive as the Japanese Knotweed, but they are still not native to the area and can outcompete native species. The Japanese Knotweed should be removed in the future, as it is starting to spread into the forested bank of the creek.

## 11. 2003/2008 Comparison of Black Rapids Creek

Black Rapids was sampled in its entirety in 2003 (57 sections) and 2008 (56 sections). The field sheets have been modified to include more variables in the assessment. Several of the questions have been modified and improved to provide more detail; therefore, making direct comparisons difficult (e.g. bank stability is now assessed for the right and left bank, whereas in 2003, they were lumped together). Tables 9 to 13 are a comparison between 2003 and 2008.

| Anthropogenic Alterations | 2003 (percent) | 2008 (percent) |
|---|---|---|
| *none* | 90 | 52 |
| *"natural" conditions with significant alterations by man* | 5 | 34 |
| *"altered" with considerable human impact but with significant natural areas* | 5 | 9 |
| *"highly altered" with few areas that could be considered natural* | 0 | 5 |

**Table 9. Comparison of Anthropogenic Alterations**

Alterations to Black Rapids Creek have increased over the last five years. Areas with no anthropogenic alterations have decreased by 38 percent, with more sections experiencing some sort of human alteration. A new pedestrian bridge was constructed near the mouth of the creek between 2003 and 2008. Highly altered areas have gone from zero to five percent, representing where the creek was realigned at Woodroffe Road in 2005 for the transitway lanes.

| Instream Vegetation | 2003 (percent) | 2008 (percent) |
|---|---|---|
| *extensive* | 28 | 13 |
| *common* | 28 | 34 |
| *normal* | 18 | 24 |
| *low* | 22 | 13 |
| *rare* | 4 | 9 |
| *none* | N/A | 7 |

**Table 10. Comparison of Instream Vegetation**

Instream vegetation is difficult to compare, and the data will vary from year to year, depending on when the stream was surveyed. The category for "none" was also added after 2003 and cannot be reflected in that year's data. Between 2003 and 2008, extensive vegetation has decreased, along with areas of low vegetation. Areas with common, normal and rare vegetation have increased.

| Bank Stability | 2003 (percent) | 2008 (percent) |
|---|---|---|
| *stable* | 95 | 87LB, 89RB |
| *unstable* | 5 | 11LB, 13RB |

**Table 11. Comparison of Bank Stability**

Bank stability was fine tuned in the stream assessments this year to separate left and right banks. However, it can still be concluded that erosion has increased in the last five years. This could be from loss of riparian buffers or greater urbanization around the system. As areas become more urbanized, areas impervious to precipitation increase (parking lots, buildings, roads, etc.), amplifying runoff into the stream. Higher amounts of runoff entering the system at a faster rate can cause water levels to rise more quickly and velocity to increase, compromising bank stability over time.

| Pollution/Garbage | 2003 (percent) | 2008 (percent) |
|---|---|---|
| *none* | 30 | 64 |
| *oil or gas trails* | 2 | 4 |
| *floating garbage* | 26 | 18 |
| *garbage on stream bottom* | 56 | 14 |
| *unusual colouration* | N/A | 0 |

**Table 12. Comparison of Pollution/Garbage**

Aside from oil and gas trails, pollution/garbage has improved. Much less garbage was observed in 2008 than in 2003. Unusual colouration of the streambed was added after 2003, so that data is not comparable. There was no unusual colouration observed in 2008.

| Species Caught | 2003 | 2008 |
|---|---|---|
| white sucker | X | X |
| creek chub | X | X |
| common shiner | | X |
| bluntnose minnow | X | |
| fathead minnow | | X |
| blacknose shiner | X | |
| rock bass | | X |
| mottled sculpin | X | X |
| brook stickleback | X | X |
| central mudminnow | | X |
| blackchin shiner | | X |
| longnose dace | | X |
| tessellated darter | | X |
| pumpkinseed | | X |
| yellow perch | | X |
| smallmouth bass | | X |
| largemouth bass | X | X |
| northern redbelly dace | X | X |
| finescale dace | | X |
| pearl dace | | X |
| Logperch | | X |
| black crappie | | X |
| Walleye | | X |
| *Etheostoma spp.* | | X |
| *Cyprinid spp.* | | X |
| **TOTAL SPECIES CAUGHT** | **8** | **23** |

**Table 13. Comparison of Fish Species**

Fish sampling was done on Black Rapids Creek in 2003 and in 2008. In 2003, eight species were captured, and in 2008, that number grew to 23. Two species caught in 2003 were not found in 2008, which were blacknose shiner and bluntnose minnow. This does not mean the species have disappeared but could be influenced by location and time of sampling and weather patterns. Fish sampling methods for 2008 on Black Rapids included seining and electrofishing, whereas only seining was used in 2003. Both methods have sampling bias and target different types of habitat. Using both methods increase the chances of capturing more fish species. Sampling in 2003 occurred in one location with no repetition, and sampling in 2008 occurred at ten sites at different dates over the spring and summer, which is also a reason for such an increase in the number of fish species caught. Seventeen species were caught in 2008 which had not been previously found, including walleye, tessellated darter, yellow perch and pearl dace.

**Juvenile walleye, caught July 14, 2008**

## 3.2.2 Cardinal Creek

Cardinal Creek, also locally known as Leonard Creek, is eight kilometres long and flows northwest under Innes Road and Highway 174 before emptying into the Ottawa River east of Petrie Island. The complete subwatershed is 41 kilometres square in size (Southern Ontario Land Resource Information System, 2002). Cardinal Creek is dominated by head-water streams, which are smaller, shorter systems feeding into the larger creek. Although these systems are smaller, they can contribute as much as 70percent of the flow and transport considerable amounts sediment downstream. The Cardinal subwatershed mainly consists of silt and clay (lacustrine) soils with areas of bedrock outcrops closer to the Ottawa River. (Geomorphic Solutions, 2007). The headwaters of Cardinal Creek are primarily surrounded by agriculture, with a number of municipal drains that empty into the stream. Further downstream, the area becomes more residential, and there are also some significant natural areas. The land use is fairly similar to 1926, where agriculture was the dominant land use. However, since 1926, riparian areas along the creek have increased, and agricultural activities remain at the top of the slope. Agriculture crops consist mainly of corn, soybeans and cereal grains. A small percentage of farms grow vegetables, hay, small fruit, and raise livestock (Gartner Lee, 2008). Housing development pressures have increased over recent years; more subdivisions are being built adjacent to the creek, and many of those have been built within the last ten years.

Forest cover in the Cardinal Creek subwatershed is estimated to be 18.5percent and wetlands encompass 1.1percent. The vegetation in the subwatershed is diverse, and most of the forests range from 40 to 55 years old, although some stands are older. Species at risk in the area are Butternut (*Juglans cinerea*), Blanding's Turtle (*Emydoidea blandingii*) and Northern Map Turtle (*Graptemys geographica*). Ninety-two bird species have been found there, and some of those species are dependent on habitat that has been declining, including birds that require forest interior (>200m) and grassland birds. The mouth of Cardinal Creek feeds into a wetland that extends to Petrie Island and intersects an area of significant nesting habitat for amphibians and reptiles. A karst feature on Watter's Road is being considered by the Ontario Ministry of Natural Resources (OMNR) as an Area of Scientific Natural Interest. Karst areas are formed when acidic water dissolves soluble bedrock, namely, limestone (Geomorphic Solutions, 2007). Just upstream of the karst, there is an online stormwater facility. At this point, the entire creek gets piped into the karst, and flows through to the north side of Watter's Road. In high flows, the stream can overflow into another channel which runs under the Watter's Road culvert. Figure 18 demonstrates a more detailed look at the creek and its surrounding area. A total of 7.4 kilometres of Cardinal Creek was sampled during the 2008 season.

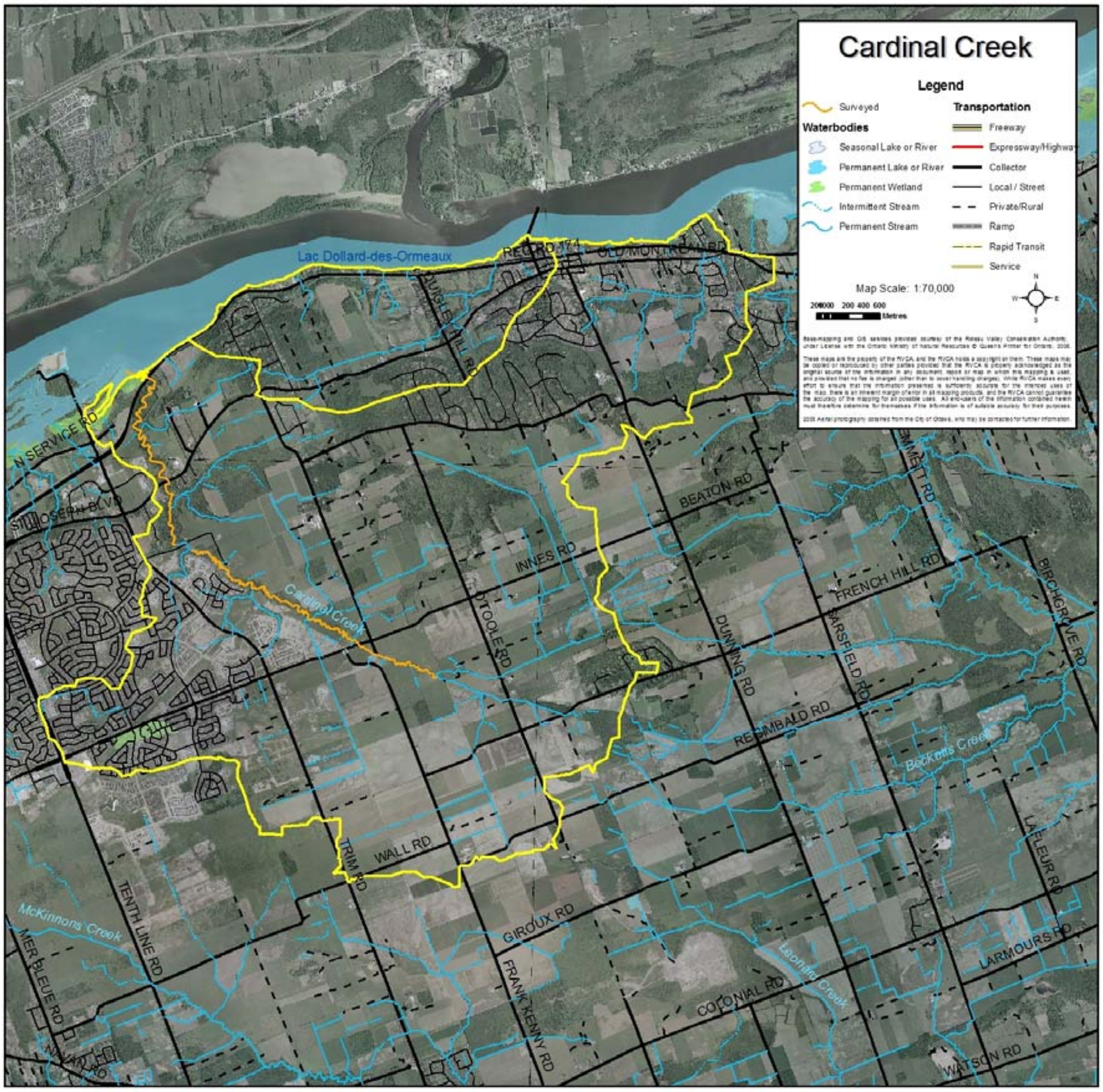



**Figure 18. Air photo of Cardinal Creek and surrounding area**

The following is a summary of the 74 macro stream assessment forms filled out by technicians and volunteers. Observations concerning anthropogenic alterations, land use, instream vegetation, bank stability, wildlife, and pollution/garbage are discussed.

Figure 19 illustrates the classes of anthropogenic alterations volunteers observed along Cardinal Creek. Natural areas make up the majority of the stream. Of the 74 sections of stream sampled, volunteers identified that 82 percent displayed no human alterations. Although land use surrounding the creek includes infrastructure, residential, commercial and agriculture, most of the creek has not been altered and has a natural buffer. Eleven percent of the sampled sections of Cardinal Creek had some sort of alteration but were still considered natural and five percent of the sections were altered with considerable human impact. Only two percent of the surveyed sections were observed as 'highly altered' with few areas that could be considered natural. The altered and highly altered sections of the stream coincide with bridge structures for roadways that pass over the creek, storm water outlets, an online stormwater management facility, shoreline modification and armouring. In the 74 sections surveyed, Cardinal Creek only had five road crossings.

# 1. Observations of Anthropogenic Alterations and Land Use

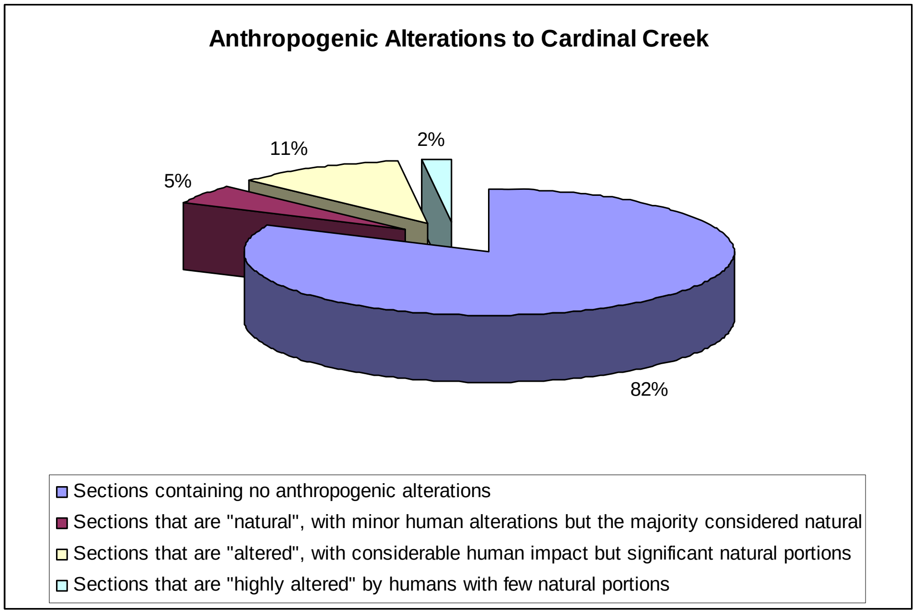



**Figure 19. Classes of Anthropogenic Alterations Occurring Along Cardinal Creek**

Figure 20 demonstrates the different land uses recognized adjacent to Cardinal Creek. Volunteers identified seven major land uses along the creek. As mentioned previously, there are parts of Cardinal that have a large buffer, protecting the stream from the adjacent development occurring along the creek. Of the sections surveyed, 34 percent of the land use along Cardinal is forest, 28 percent is meadow, seven percent is scrubland and two percent wetland. Agriculture makes up 15 percent of the land use, and residential accounts for eight percent. The remaining land use is infrastructure (roads, culverts, hydro lines, etc.) at four percent, recreational at one percent and industrial/commercial at one percent.

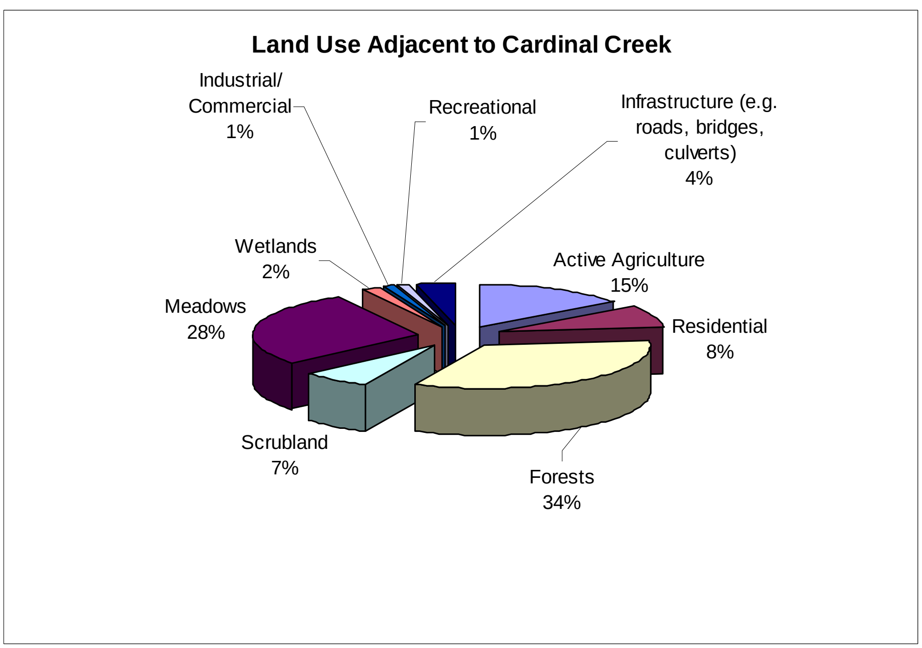



**Figure 20. Land Use Identified Along Cardinal Creek**

## 2. Instream Morphology of Cardinal Creek

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. 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. Cardinal Creek mainly consists of large runs with few pools and riffles and is illustrated in Figure 21. The most substantial riffles occur at a number of waterfalls. Instream morphology is very homogeneous from Watter's Road upstream into the headwaters.

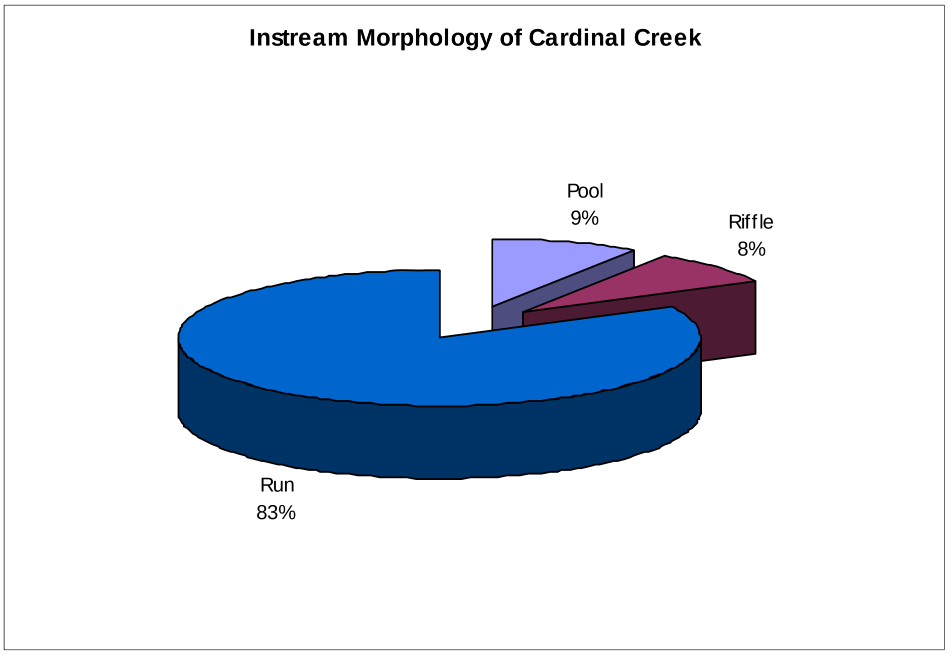



**Figure 21. Instream Morphology of Cardinal Creek**

## 3. Types of Instream Substrate Along Cardinal Creek

A variety of substrate can be found instream along Cardinal Creek, although the majority of the substrate is clay with some cobble and detritus. Diverse substrate is important for fish and benthic macroinvertebrate habitat because some species will only be found in certain types of substrate and will only reproduce on certain types of substrate. Boulders create instream cover and back eddies for large fish to hide and/or rest out of the current, and cobble provides important over wintering and/or spawning habitat for small or juvenile fish. Other substrates also provide instream habitat for fish and macroinvertebrates. Figure 22 demonstrates the instream substrate that was observed along Cardinal Creek. Many areas were homogeneous, with little cobble, boulder and gravel.

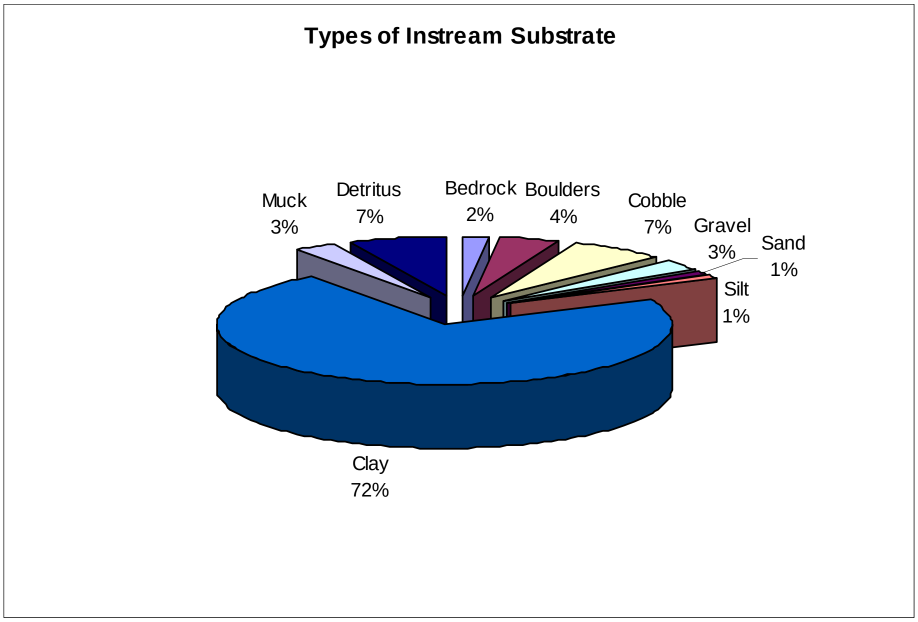



**Figure 22. Types of Instream Substrate Along Cardinal Creek**

## 4. Observations of Instream Vegetation

The instream vegetation in Cardinal Creek varied by location throughout the stream. In 43 percent of the sections surveyed, vegetation levels were common, 20 percent were low, 14 percent were normal and in 15 percent, vegetation was rare. Eight percent of the sections had no vegetation, and one percent of the sections were choked with vegetation. The areas choked with vegetation occurred in the headwaters where the channel gets narrower and some of the overhanging grasses along the shore have spread into the stream channel itself.

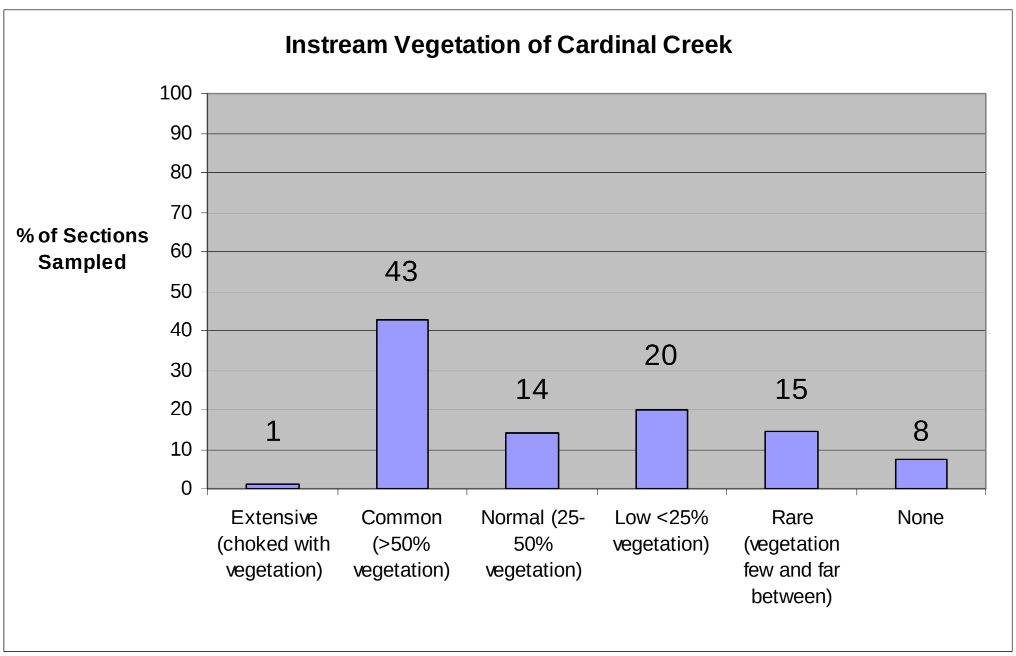



**Figure 23. Frequency of Instream Vegetation in Cardinal Creek**

## 5. Observations of Bank Stability

Figures 24 and 25 show the overall bank stability of Cardinal Creek. Stream sections between Highway 174 and Old Montreal Road are experiencing some erosion on the outside of meanders where the banks are steep. Also, in the headwaters, south of Frank Kenny Road, the banks are steep there, and erosion is occurring due to lack of a buffer strip and fluctuating water levels. The left bank of Cardinal Creek is a little less stable than the right bank, with 72 percent of the sections considered stable and 28 percent considered unstable. For the right bank, 78 percent is considered stable and 23 percent unstable. As land use around the creek changes from agricultural to residential, impervious areas (buildings, parking lots, etc.) around the creek increase, exacerbating water level fluctuations. Velocity may increase during storm events, amplifying erosion. Even areas of the creek that have a healthy buffer can be affected due to an increase in stormwater inputs.

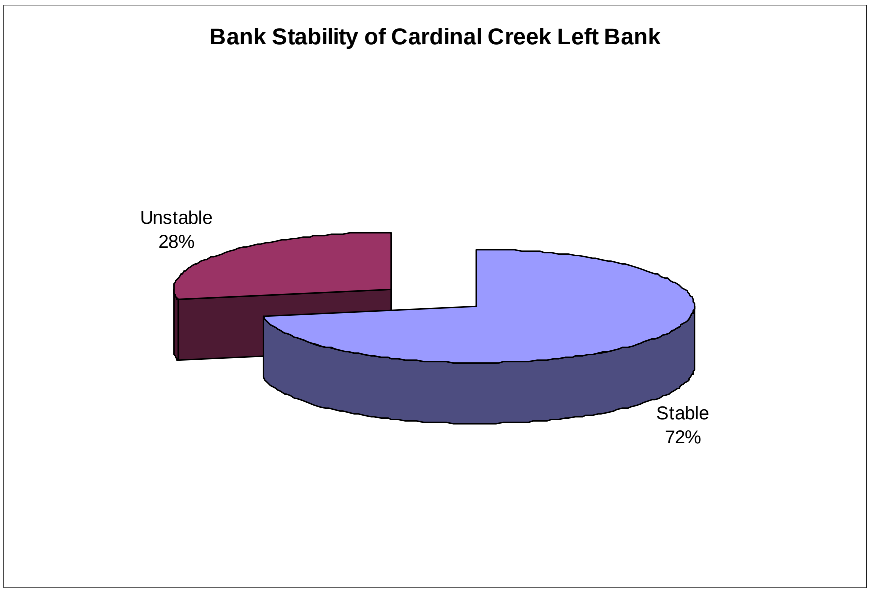



**Figure 24. Left Bank Stability of Cardinal Creek**

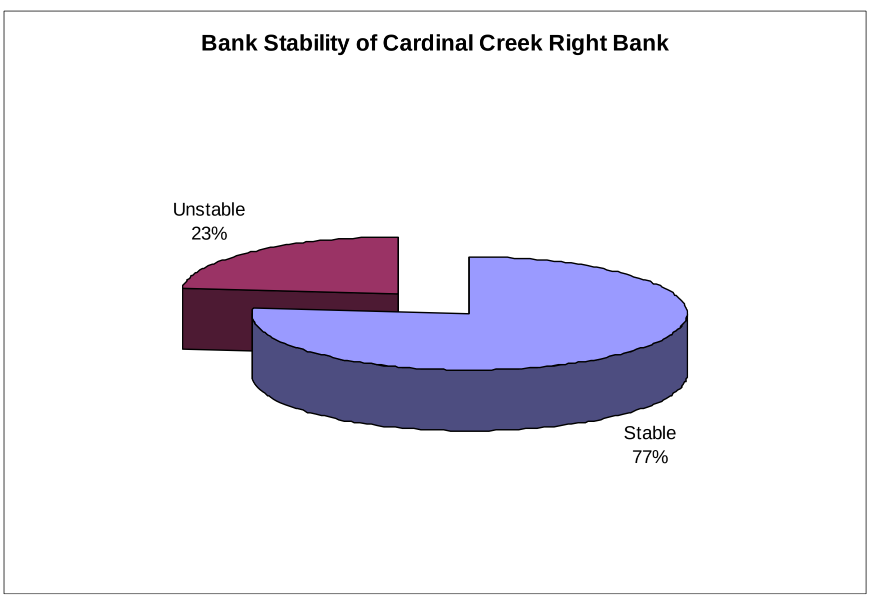


**Figure 25. Right Bank Stability of Cardinal Creek**

Areas of erosion have been identified on an aerial photo of Cardinal Creek and are detailed in Appendix I. Some of the more severe areas of erosion are listed in Appendix J on aerial photos as potential rehabilitation projects, either using bioengineering or riparian plantings.

## 6. Buffer Evaluation of Cardinal Creek

Natural buffers between the creek and human alterations are extremely important for filtering excess nutrients running into the creek, infiltrating rainwater, bank stability and wildlife habitat. Natural shorelines also shade the creek, helping maintain baseflow levels and keeping water temperatures cool. According to the document *How Much Habitat Is Enough*, a stream should have riparian areas of 30 metres minimum or more, depending on the site conditions. Of the sections sampled, two to five percent had a buffer of only zero to five metres, seven to 12 percent had a buffer of five to 15 metres and 16-17percent had 15-30 metres of buffer. For the left bank, 67 percent had a buffer greater than 30 metres, and the right had 74 percent.

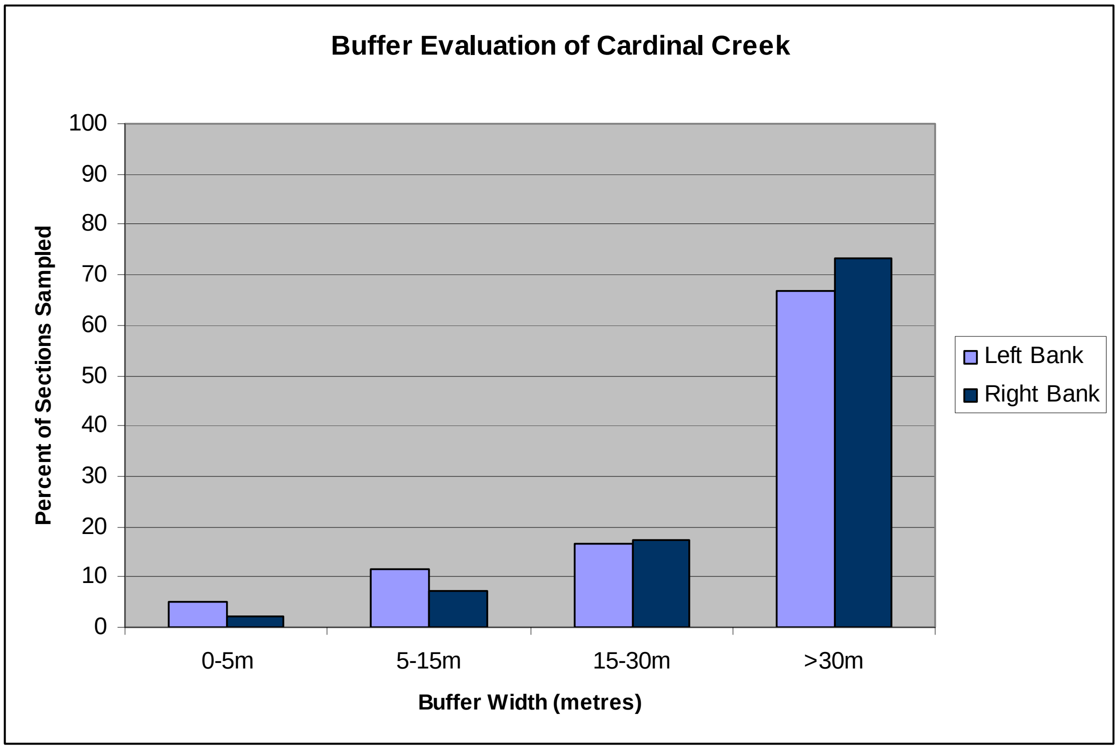



**Figure 26. Buffer Evaluation of Cardinal Creek**

## 7. Observations of Wildlife

Volunteers recorded the presence of many types of wildlife in and around Cardinal Creek. Table 14 is a summary of wildlife observed during stream surveys.

| Wildlife | Observed While Sampling |
|---|---|
| ***Birds*** | ducks, mallards, great blue heron, chickadees, kingfishers, robin, grackle, golden eagle, crows, blue jays, redwing blackbirds, ring-billed gulls, mourning dove, turkey vultures, cardinals, catbird, nuthatch, woodpecker, hawk, swallow, northern flicker, american bittern, american goldfinch |
| ***Mammals*** | deer, raccoons, red squirrels, beaver, river otter |
| ***Reptiles/Amphibians*** | green frogs, american toads, mink frog, snapping turtle |
| ***Aquatic Insects*** | water striders, water beetles, crayfish, snails, diving water beetles, mayfly |
| ***Fish (as observed through seining and electrofishing)*** | creek chub, white sucker, common shiner, golden shiner, emerald shiner, fathead minnow, bluntnose minnow, brook stickleback, spottail shiner, blackchin shiner, northern redbelly dace, tessellated darter, johnny darter, yellow bullhead, logperch, yellow perch, northern pike, *Cyprinid spp., Centrarchid spp.* |
| ***Other*** | bumblebees, mosquitoes, crickets, spiders, caterpillars, molluscs, monarch butterflies and dragonflies (red rock skimmers, blue-faced darners and jewelwing spp.) |

**Table 14. Wildlife Observed Along Cardinal Creek**

## 8. Observations of Pollution/Garbage

Cardinal Creek maintains a healthy buffer throughout the majority of the creek, and although floating garbage and garbage on the stream bottom was observed, it occurred singly, and aside from one area, did not accumulate to the point where the creek required a garbage cleanup. Also, some of the garbage observed was large, and due to the inaccessibility of some parts of the creek, would require cleanup via canoes. Garbage found included tires, part of an old car, styrofoam, plastic bottles, plastic, an old rusty oil drum and random pieces of metal, etc. Figure 27 illustrates the incidence of pollution in Cardinal Creek.

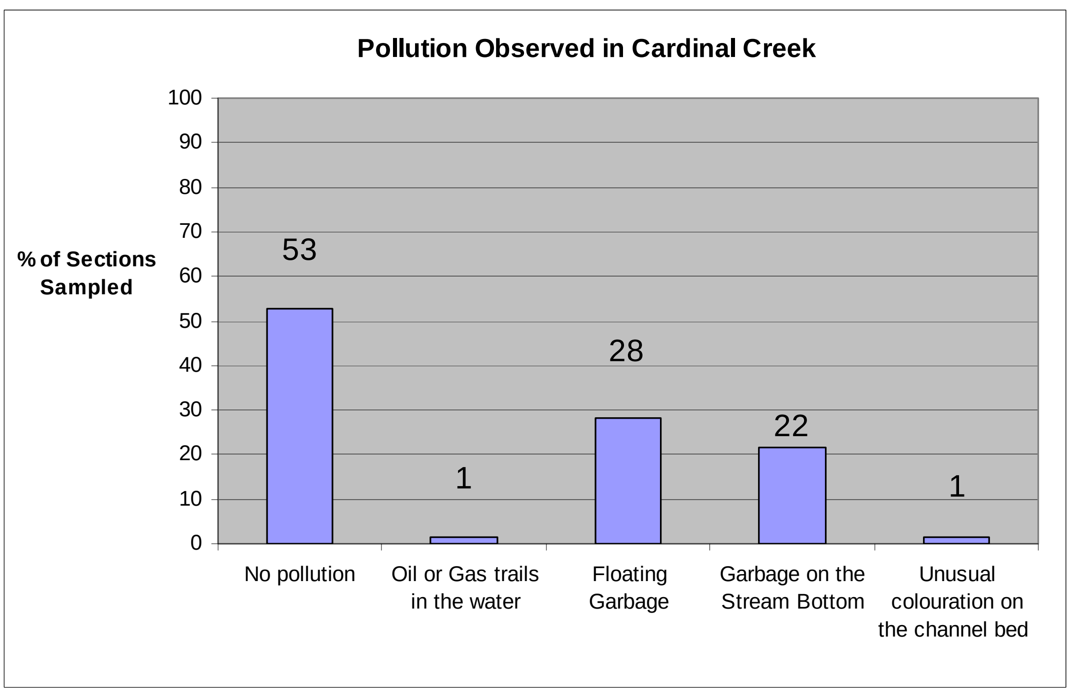



**Figure 27. Frequency of Pollution/Garbage Occurring in Cardinal Creek**

Two sections are listed in Appendix J as potential projects for a stream cleanup. One section is near the mouth of the creek, and access would be somewhat difficult. The other is a site near Frank Kenny Road where there is part of an old car in the creek.

## 9. Fish Community Sampling

Seine netting was carried out at six sites along Cardinal Creek. Volunteers contributed 17 hours to assist with these. Volunteers were introduced to fish sampling methods as instructed on how to identify and process seine net catches. No electrofishing was done on Cardinal due to visibility and depth issues. Table 15 illustrates the water chemistry data for each seining site. The YSI probe was under repair for some of the dates when the seining was done, so no values were obtained for those dates, aside from water and air temperature. All fish were live released back to the stream after seining events.

Figure 28 shows the seining locations for Cardinal Creek.

| Location | Site # | Date (mm/dd/yy) | Air Temp C° | Water Temp C° | DO (mg/L) | pH | Conductivity (uS/cm) | Substrate | Instream Vegetation |
|---|---|---|---|---|---|---|---|---|---|
| Cardinal Creek | 1 | 6/17/2008 | 11.43 | 17.59 | 11.76 | 8.34 | 460 | clay | grasses |
| Cardinal Creek | 2 | 6/17/2008 | 22.86 | 18.3 | 6.4 | 7.96 | 471 | clay | grasses, submerged |
| Cardinal Creek | 3 | 6/17/2008 | 21.3 | 20.21 | 15.72 | 8.37 | 557 | clay | grasses |
| Cardinal Creek | 4 | 6/26/2008 | 30 | 20.09 | 6.02 | 7.97 | 669 | clay | grasses, rushes, arrowhead |
| Cardinal Creek | 4 | 7/30/2008 | 21 | 19 | N/A | N/A | N/A | clay | grasses, rushes, arrowhead |
| Cardinal Creek | 5 | 6/26/2008 | 30 | 19.47 | 6.69 | 8.04 | 669 | clay | grasses, rushes, arrowhead |
| Cardinal Creek | 5 | 7/30/2008 | 20 | 19 | N/A | N/A | N/A | clay | grasses, rushes, arrowhead |
| Cardinal Creek | 6 | 7/19/2008 | 26 | 24 | N/A | N/A | N/A | clay | grasses, algae |

**Table 15. Water Chemistry Results for Seining Sites Along Cardinal Creek**

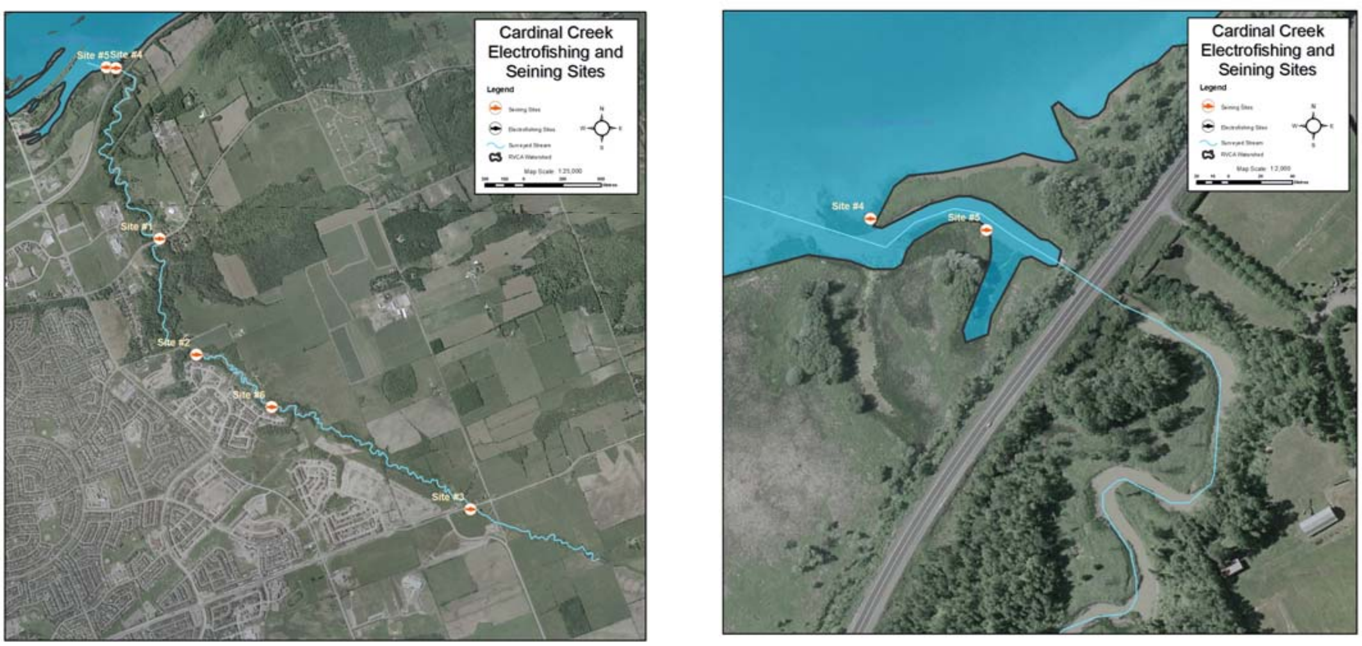



**Figure 28. Air photo of Cardinal Creek showing Seining Sites**

Table 16 summarizes the biological data obtained from each seine netting event on Cardinal Creek. A total of nineteen different fish species were collected. Top predators within the stream ecosystem are highlighted in bold.

| Sample Technique | Date Sampled | Site # | Species Sampled | Total number of species Caught |
|---|---|---|---|---|
| **SEINING** | | | | |
| | 17-Jun | 1 | white sucker, johnny darter, bluntnose minnow, blackchin shiner, common shiner, emerald shiner, brook stickleback, creek chub, *Cyprinid spp.* | 9 |
| | 17-Jun | 2 | fathead minnow, *Cyprinid spp*., creek chub, white sucker, common shiner, emerald shiner, northern redbelly dace | 7 |
| | 17-Jun | 3 | brook stickleback, creek chub, white sucker, common shiner, fathead minnow, golden shiner, *Cyprinid spp*. | 7 |
| | 26-Jun | 4 | spottail shiner, **yoy yellow perch** | 2 |
| | 30-Jul | 4 | yellow bullhead, spottail shiner, white sucker, tessellated darter, trout-perch, yoy *Centrarchid spp*. | 6 |
| | 26-Jun | 5 | spottail shiner, **yoy yellow perch** | 2 |
| | 30-Jul | 5 | spottail shiner, trout-perch, yoy *Centrarchid spp*., logperch, *Etheostoma spp*. (johnny or tessellated), **yellow perch, northern pike** | 7 |
| | 19-Jul | 6 | white sucker, common shiner, creek chub, *Cyprinid spp.*, brook stickleback | 5 |

**Table 16. Fish Community Results for Seining Sites along Cardinal Creek**

## Fish Species Status, Trophic, and Reproductive Guilds – Cardinal Creek

Table 17 was generated by taking the fish community structure of Cardinal Creek and classifying the recreational, commercial, or bait fishery importance, the Species at Risk status, reproductive guild (spawning habitat requirements), thermal classification, and trophic guild (feeding preference). The majority of the species within Cardinal Creek are significant to the recreational or baitfish fisheries. The fish community structure consists of a mix of warm and cool water species, aside from trout-perch which is coldwater. The trout-perch was caught at the mouth of Cardinal Creek, along with yellow bullhead, which is a warm water species.

| MNR Code | Common Name | Scientific Name | Recreational Fishery | Commercial Fishery | Bait Fishery | Status | Reproductive Guild | Thermal Classification | Trophic Guild |
|---|---|---|---|---|---|---|---|---|---|
| 196 | emerald shiner | *Notropis atherinoides* | | | X | None | (open substrate) Pelagophils | Cool | Insectivore |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 291 | trout-perch | *Percopsis omiscomaycus* | | | X | None | (non guarder) Lithophils | Cold | Insectivore |
| 281 | brook stickleback | *Culaea inconstans* | | | X | None | (guarders) Ariadnophils | Cool | Insectivore |
| 212 | creek chub | *Semotilus atromaculatus* | X | | X | None | (brood hiders) Lithophils | Cool | Insectivore/ Generalist |
| 163 | white sucker | *Catostomus commersoni* | | | | None | | Cool | Insectivore/ Omnivore |
| 209 | fathead minnow | *Pimephales promelas* | | | X | None | (guarders) Speleophils | Warm | Omnivore |
| 331 | yellow perch | *Perca flavescens* | X | X | | None | (non guarder) Phyto-lithophils | Cool | Insectivore/ Piscivore |
| 198 | common shiner | *Notropis cornutus* | | | X | None | (guarder) Lithophils | Cool | Insectivore |
| 194 | golden shiner | *Notemigonus crysoleucas* | | | X | None | (non guarder) Phytophils | Cool/Warm | Omnivore |
| 208 | bluntnose minnow | *Pimephales notatus* | | | X | None | (guarders) Speleophils | Warm | Omnivore |
| 201 | spottail shiner | *Notropis hudsonius* | | | X | None | (non guarders) Litho-pelagophils | Cool | Insectivore |
| 232 | yellow bullhead | *Ictalurus natalis* | X | | | None | (guarders) Ariadnophils | Warm | Insectivore |
| 346 | tessellated darter | *Etheostoma olmstedi* | | | X | None | (guarders) Speleophils | Cool | Insectivore |
| 182 | northern redbelly dace | *Phoxinus eos* | | | X | None | (non guarder) Phytophils | Cool/Warm | Herbivore |
| 199 | blackchin shiner | *Notropis heterodon* | | | X | None | (non guarder) Phytophils | Cool | Insectivore |
| 131 | northern pike | *Esox lucius* | X | | | None | (non guarder) Phytophils | Warm | Piscivore |
| 341 | johnny darter | *Etheostoma nigrum* | | | X | None | (guarders) Speleophils | Cool | Insectivore |
| 342 | logperch | *Percina caprodes* | | | X | None | (non guarder) Psammophils | Cool | Insectivore |

**Table 17. Fish Species Status, Trophic and Reproductive Guilds for Cardinal Creek** (Source: *MTO Environmental Guide to Fish and Fish Habitat*, 2006)

Table 18 summarizes the fish community structure observed in Cardinal Creek and their sensitivity to sediment and turbidity for reproduction, feeding, and respiration. The composition of the fish community in Cardinal Creek ranges from species that are fairly tolerant to those that are intolerant to sediment and turbidity. However, the majority of the species would be classified in the moderately tolerant range for reproduction and feeding.

## Fish Species Sensitivity to Sediment/Turbidity for Cardinal Creek

**Fish Species Sensitivity to Sediment/Turbidity for Cardinal Creek**

| MNR Code | Common Name | Scientific Name | Reproduction | Feeding | Respiration |
|---|---|---|---|---|---|
| 196 | emerald shiner | *Notropis atherinoides* | M | L | H |
| 291 | trout-perch | *Percopsis omiscomaycus* | M | M | H |
| 281 | brook stickleback | *Culaea inconstans* | L | M | unknown |
| 212 | creek chub | *Semotilus atromaculatus* | M | M | H |
| 163 | white sucker | *Catostomus commersoni* | M | H | L |
| 209 | fathead minnow | *Pimephales promelas* | L | L | unknown |
| 331 | yellow perch | *Perca flavescens* | M | H | unknown |
| 198 | common shiner | *Luxilus cornutus* | M | M | unknown |
| 194 | golden shiner | *Notemigonus crysoleucas* | M | M | L |
| 208 | bluntnose minnow | *Pimephales notatus* | M | L | unknown |
| 210 | spottail shiner | *Notropis hudsonius* | M | M | H |
| 232 | yellow bullhead | *Ameiurus natalis* | L | L | unknown |
| 199 | blackchin shiner | *Notropis heterodon* | M | M | L |
| 131 | northern pike | *Esox lucius* | M | H | L |
| 182 | northern redbelly dace | *Phoxinus eos* | M | M | L |
| 346 | tessellated darter | *Etheostoma olmstedi* | unknown | unknown | unknown |
| 341 | johnny darter | *Etheostoma nigrum* | M | M | unknown |
| 342 | logperch | *Percina caprodes* | M | M | H |

**Table 18. Fish Species Sensitivity to Sediment/Turbidity (High, Moderate, Low or unknown) for Cardinal Creek** (Source: *MTO Environmental Guide to Fish and Fish Habitat*, 2006)

## 10. Temperature Profiling

Four temperature dataloggers were set in Cardinal Creek, but only three could be recovered in September. Two of the three temperature dataloggers recorded temperatures for a 127-day period. Readings began on May 15, and the dataloggers were removed September 19, 2008. The third temperature logger was placed in Cardinal Creek on May 22 for 124 days and was removed on September 23. Figure 29 shows the locations of dataloggers in Cardinal Creek.


**Figure 29. Datalogger Locations Along Cardinal Creek**

Data loggers were set in four different locations in the stream to give a representative sample of how temperature fluctuates and differs throughout the course of the stream. Sites begin at the downstream end of the creek and were placed in order upstream. Datalogger 4 was set just upstream of Highway 174. Datalogger 3 was set just downstream of Old Montreal Road, and datalogger 2 was placed halfway between Old Montreal Road and Innes Road, just downstream of a stormwater inflow pipe, near Caprihani Way. Datalogger 1 was placed just downstream of Innes Road, and this one could not be recovered. Datalogger 4 was placed on a different date than Datalogger 2 and 3. Figures 30, 31 and 32 show results from Dataloggers 2 to 4.

| | **Water Temperature** |
|---|---|
| **Cold** | **<19 Degrees Celsius** |
| **Cool** | **19-25 Degrees Celsius** |
| **Warm** | **>25 Degrees Celsius** |

**Table 19. Water Temperature Classifications (Minns et al. 2001)**

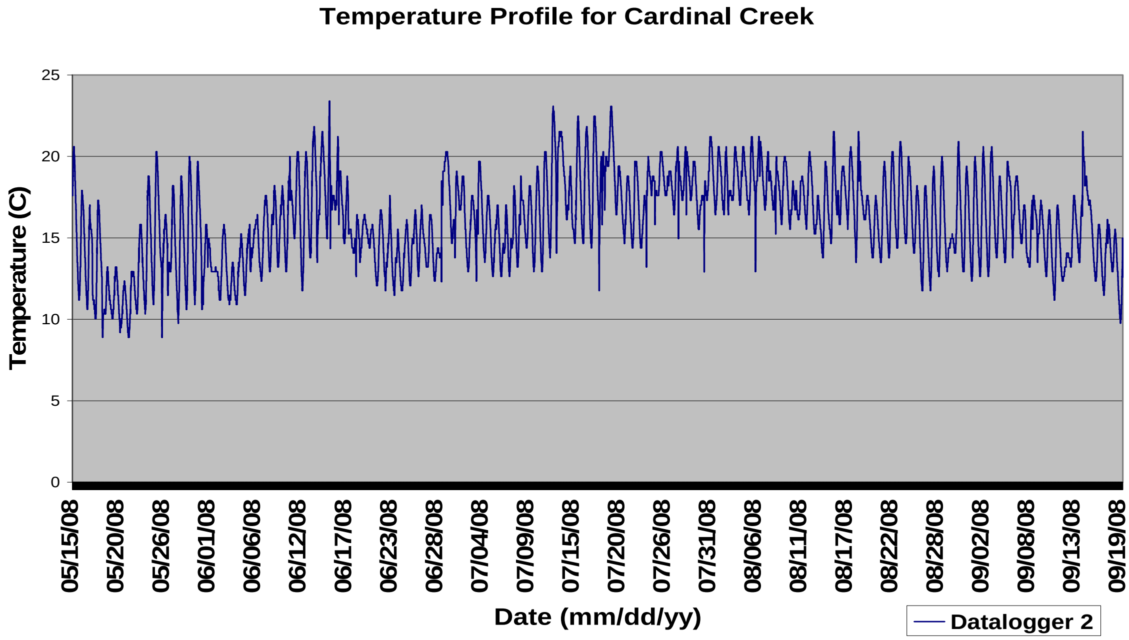



**Figure 30. Temperature Profile for Datalogger 2 between Old Montreal Rd. and Innes Rd.**

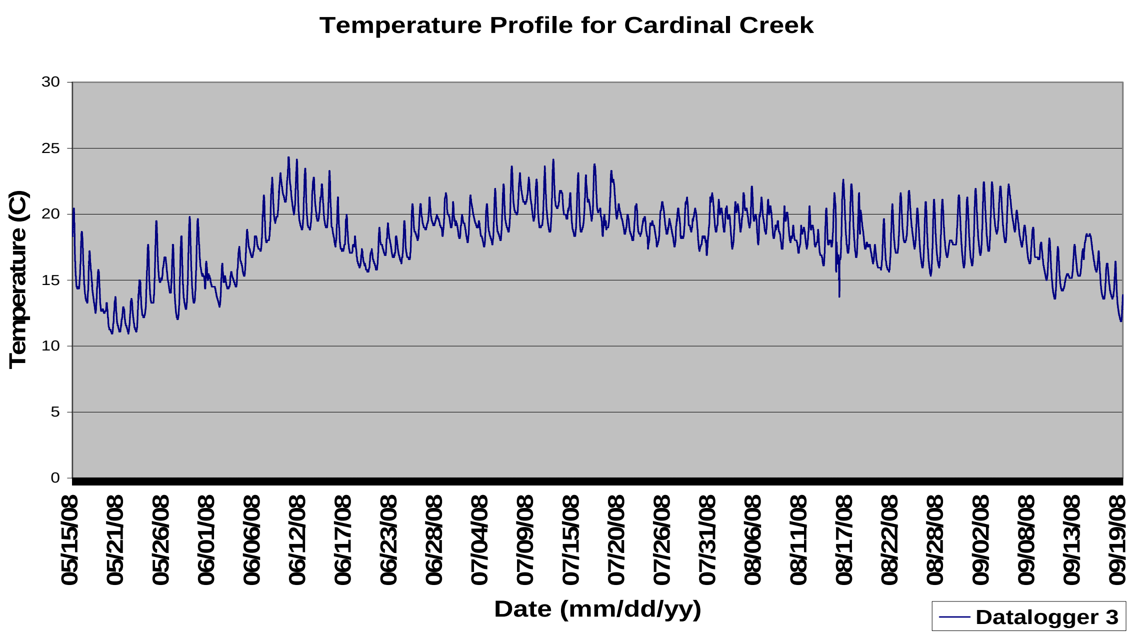



**Figure 31. Temperature Profile for Datalogger 3 at Old Montreal Rd.**

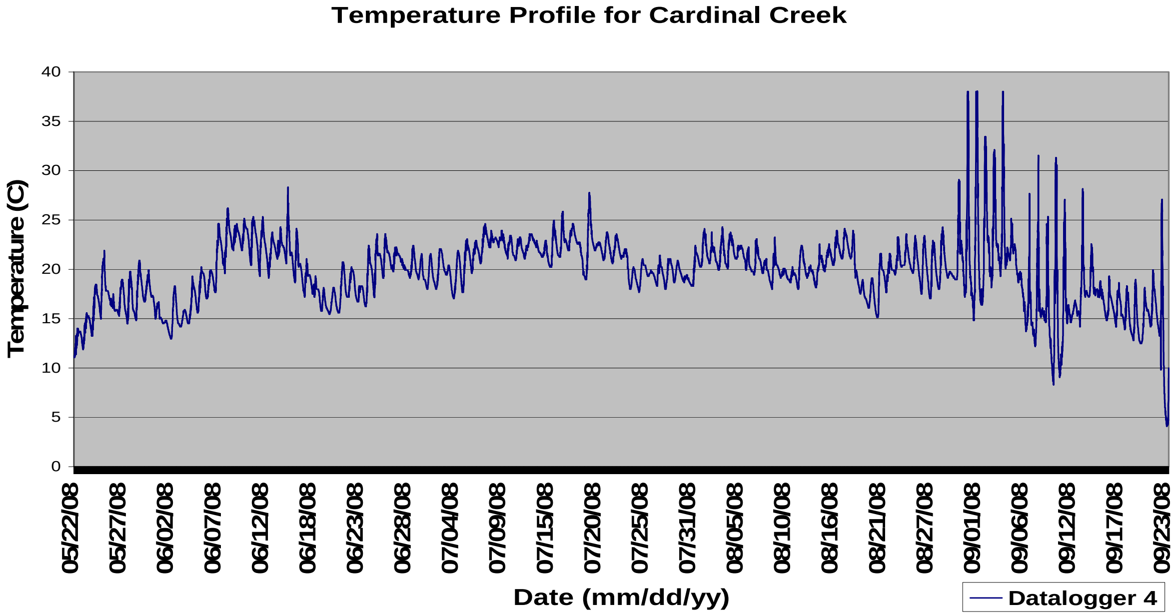



**Figure 32. Temperature Profile for Datalogger 4 at Hwy 174**

Figures 30 and 31 have a consistent trend of fluctuating temperatures throughout the stream. Excluding datalogger 4, over the testing period this stream reached a maximum temperature of 24.32°C and a minimum of 8.89°C.

In comparison, the first and the third dataloggers show similar variation and the temperature patterns are very similar, but datalogger 3 recorded warmer temperatures than datalogger 2. Datalogger 4 has higher temperatures than both and shows different fluctuations beginning in September. For datalogger 4, the maximum temperature was 38.02°C and the minimum was 4.09°C. Although the datalogger was found in the water when it was picked up, it likely was out of water during those large temperature fluctuations in September and was recording air temperatures.

Based on the fish community structure and temperature data collected, Cardinal Creek can be classified as a cool water system with warm water reaches. Datalogger 4, near the mouth of the creek at the Ottawa River, falls within the warm water range.

# 11. Invasive Species

The most common invasive species along Cardinal Creek is purple loosestrife (*Lythrum salicaria*), however, it does not appear to be outcompeting any native vegetation and is serving as a nectar source for pollinator species in areas where there the main vegetation type surrounding the creek is tall grass. Yellow iris (*Iris psuedoacorus*), flowering rush (*Butomus umbellatus*) and European frog-bit (*Hydrocharis morsus-ranae*) are found only around the mouth of the creek, at the Ottawa River, in the first eight sections. These have not spread to other parts of the creek yet, and removal of these species is recommended in Appendix J for Potential Projects. The other invasive species found along Cardinal Creek are Manitoba maple (*Acer negundo*) and wild parsnip (*Pastinaca sativa*). Wild parsnip occurs mainly from the subdivisions south of Watters Road to the headwaters and surrounds the creek in the open, meadow areas. Figure 33 shows the locations of invasive species found along Cardinal Creek. Sections where invasive species were observed are highlighted in orange.

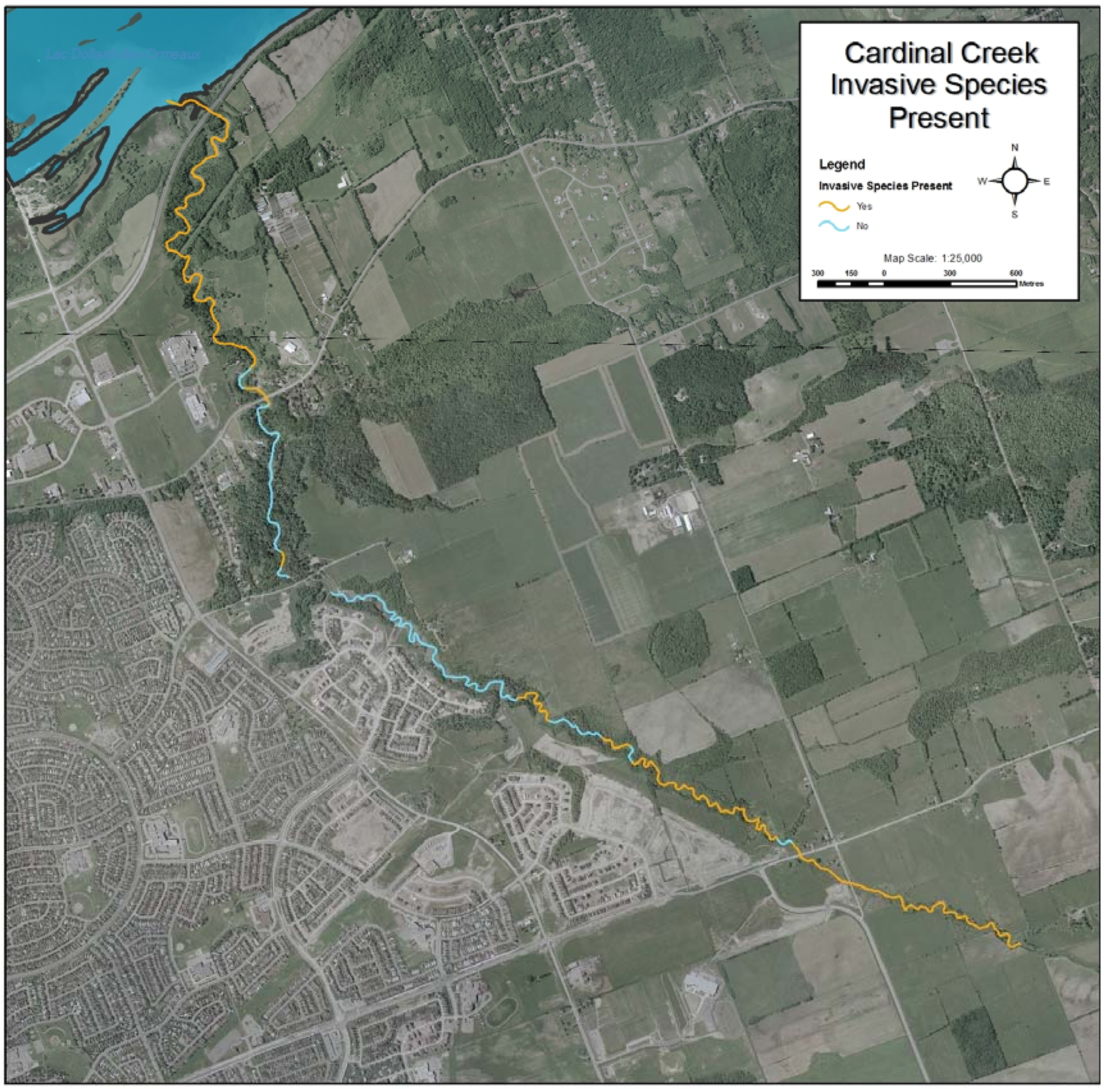



**Figure 33. Locations of Invasive Species Observed Along Cardinal Creek**

## 12. 2003/2008 Comparison of Cardinal Creek

Over half of Cardinal Creek was sampled in 2003 (51 sections) and to its entirety in 2008 (74 sections). Therefore, only the first 51 sections from 2008 have been compared. The field sheets have been modified to include more variables in the assessment. Several of the questions have been modified and improved to provide more detail; therefore, making direct comparisons difficult. The following tables are a comparison between 2003 and 2008.

| Anthropogenic Alterations | 2003 (percent) | 2008 (percent) |
|---|---|---|
| *none* | 68 | 78 |
| *"natural" conditions with significant alterations by man* | 12 | 8 |
| *"altered" with considerable human impact but with significant natural areas* | 16 | 12 |
| *"highly altered" with few areas that could be considered natural* | 4 | 2 |

**Table 19. Comparison of Anthropogenic Alterations**

Between 2003 and 2005, anthropogenic alterations have declined in all categories along Cardinal Creek. This is mainly due to areas between Watter's Road and Innes Road where buffers along the creek have improved. An area north of Old Montreal Road where there was previously little buffer has naturalized more. Although residential development has increased along the creek, a buffer has been maintained and the shoreline has remained natural in most areas. A small bridges north of Innes Road has also been removed.

| Instream Vegetation | 2003 (percent) | 2008 (percent) |
|---|---|---|
| *extensive* | 0 | 0 |
| *common* | 12 | 33 |
| *normal* | 20 | 19 |
| *low* | 29 | 22 |
| *rare* | 39 | 20 |
| *none* | N/A | 6 |

**Table 20. Comparison of Instream Vegetation**

Instream vegetation is difficult to compare, and the data can depend on when the stream was surveyed. The category for "none" was also added after 2003 and cannot be reflected in the 2003 data. Instream vegetation has varied in the last five years. The geology of Cardinal Creek is mainly clay and silt, and it is very difficult to see instream vegetation in most areas, unless they are emergents or floating plants. In the majority of areas, instream vegetation is observed through feeling it or picking it up while walking along the creek. Light does not penetrate through the water much, which would limit the growth of instream vegetation, as would the hard, consolidated clay bottom.

| Bank Stability | 2003 (percent) | 2008 (percent) |
|---|---|---|
| *stable* | 88 | 76LB, 83RB |
| *unstable* | 12 | 24LB, 17LB |

**Table 21. Comparison of Bank Stability**

Bank stability was fine tuned this year to separate erosion observations for left and right banks; however, it can still be concluded that erosion has increased in the last five years, especially on the left bank. As land use around the creek changes from agricultural to residential, impervious areas around the creek (parking lots, buildings, etc.) increase, exacerbating water level fluctuations. Velocity may increase during storm events, amplifying erosion. Even areas of the creek that have a healthy buffer can be affected due to an increase in stormwater inputs.

| Pollution/Garbage | 2003 (percent) | 2008 (percent) |
|---|---|---|
| *none* | 41 | 45 |
| *oil or gas trails* | 0 | 2 |
| *floating garbage* | 22 | 33 |
| *garbage on stream bottom* | 49 | 25 |
| *unusual colouration* | N/A | 2 |

**Table 22. Comparison of Pollution/Garbage**

Sections without pollution/garbage have only increased by one percent. Oil and gas trails increased, along with floating garbage; however, garbage on the stream bottom has greatly improved. Unusual colouration of the streambed was added after 2003 and was only found in two percent of the sections surveyed in 2008.

| Species Caught | 2003 | 2008 |
|---|---|---|
| white sucker | X | X |
| creek chub | X | X |
| common shiner | X | X |
| bluntnose minnow | | X |
| fathead minnow | | X |
| blackchin shiner | | X |
| golden shiner | | X |
| emerald shiner | | X |
| brook stickleback | X | X |
| spottail shiner | X | X |
| longnose dace | X | |
| tessellated darter | | X |
| johnny darter | | X |
| Logperch | | X |
| yellow perch | | X |
| northern pike | | X |
| northern redbelly dace | | X |
| trout-perch | | X |
| yellow bullhead | | X |
| brown bullhead | X | |
| *Centrarchid spp.* | | X |
| *Cyprinid spp.* | | X |
| **TOTAL SPECIES CAUGHT** | **7** | **20** |

Juvenile pike caught at mouth of Cardinal Creek, July 30, 2008

Pike spawning habitat at mouth of Cardinal Creek

**Table 23. Comparison of Fish Species**

Fish sampling was done on Cardinal Creek in 2003 and in 2008. In 2003, seven species were captured, and in 2008, that number grew to 20. Some sites in 2008 were sampled twice, in June and July, which may account for the increase in species captured. Two species caught in 2003 were not found in 2008, which were brown bullhead and longnose dace. This does not mean the species have disappeared but could be influenced by location and time of sampling. Fifteen species were caught in 2008 which had not been in 2003, including trout-perch, yellow perch, yellow bullhead, northern pike and logperch.

## 3.2.3 Mud Creek

Mud Creek is approximately 11 kilometres long. Its headwaters consist mostly of agricultural drains and begin north of Bankfield Road and to the west of Third Line Road. Two headwater channels meet just east of Third Line Road to form one channel. The Mud Creek subwatershed consists of approximately 62 square kilometres. The land use in the area is mainly agricultural, but development pressures occur around the Manotick area. The geology of the area consists mainly of marine clays and till, with some gravel deposits, glaciofluvial deposits and wetlands. In the City of Ottawa Official Plan, there are four designated land uses in the Mud Creek subwatershed: Agricultural Resource Area (80.5percent of total area), village ((8.4percent), general rural area (7.8percent) and Sand and Gravel Resource Area (3.3percent). Most of the surrounding area of Mud Creek is agricultural, with some amounts of riparian cover, either by forest, wetland, scrubland or old field meadow. 7.8percent of the Mud Creek subwatershed is forests >50 years old. These forests are important for nesting, feeding and wildlife habitat. Between 1970 and 2004, 93 species of bird, 23 species of mammal and 16 species of amphibian and reptiles have been identified in the subwatershed. The Manotick Drumlin Forest is 22.2 hectares, and has been recognized by the OMNR as an ANSI (Marshall Macklin Monaghan Ltd., 2005).

In general, water quality, aside from a few reaches, can be classified as poor or marginal (Marshall Macklin Monaghan Ltd., 2005). The benthic index for the subwatershed, which also indicates water quality, was found to be fairly poor to fair, indicating fairly substantial to substantial pollution likely (RVCA, 2008). The Mud Creek system is considered to be unstable, mainly due to agricultural drains feeding into Mud Creek. The stream is likely still recovering from the historic removal of vegetation and that sediment is still moving through they system (Marshall Macklin Monaghan Ltd., 2005). The area where the water quality improves is where Mud Creek intersects with the Kars Esker, and from that receives cool, clean water. According to the draft subwatershed study done, Mud Creek has poor water quality, lacks riparian cover, contains migratory obstructions to fish and stream flow, has a lack of baseflow, a lack of stormwater management and needs to conserve environmentally important areas (Marshall Macklin Monaghan Ltd., 2005). The riparian cover of the subwatershed is less than what CWS advises for healthy watersheds (Environment Canada, 2004). That said, Mud Creek does receive groundwater inputs, which contribute cold water to the creek and can be refuge areas for certain fish species. Closer to the mouth at the Rideau River, the morphology of Mud Creek is more varied, with pools, riffles and meanders. Because of the fish community found in Mud Creek, and its closeness to the Rideau River, it was recommended in the Village of Manotick Environmental Management Plan that the banks of Mud Creek should have a 30 metre buffer and not be touched (Marshall Macklin Monaghan Ltd, 2005).

Mud Creek was surveyed from its mouth at the Rideau River eastward, past the 416 and then surveys followed the west channel after the stream splits. Consequently, 9.4 kilometre of stream were surveyed instead of the full length. We were unable to complete other split northward due to duck hunting season. The following is a summary of the 94 macro-stream assessment forms filled out by volunteers.

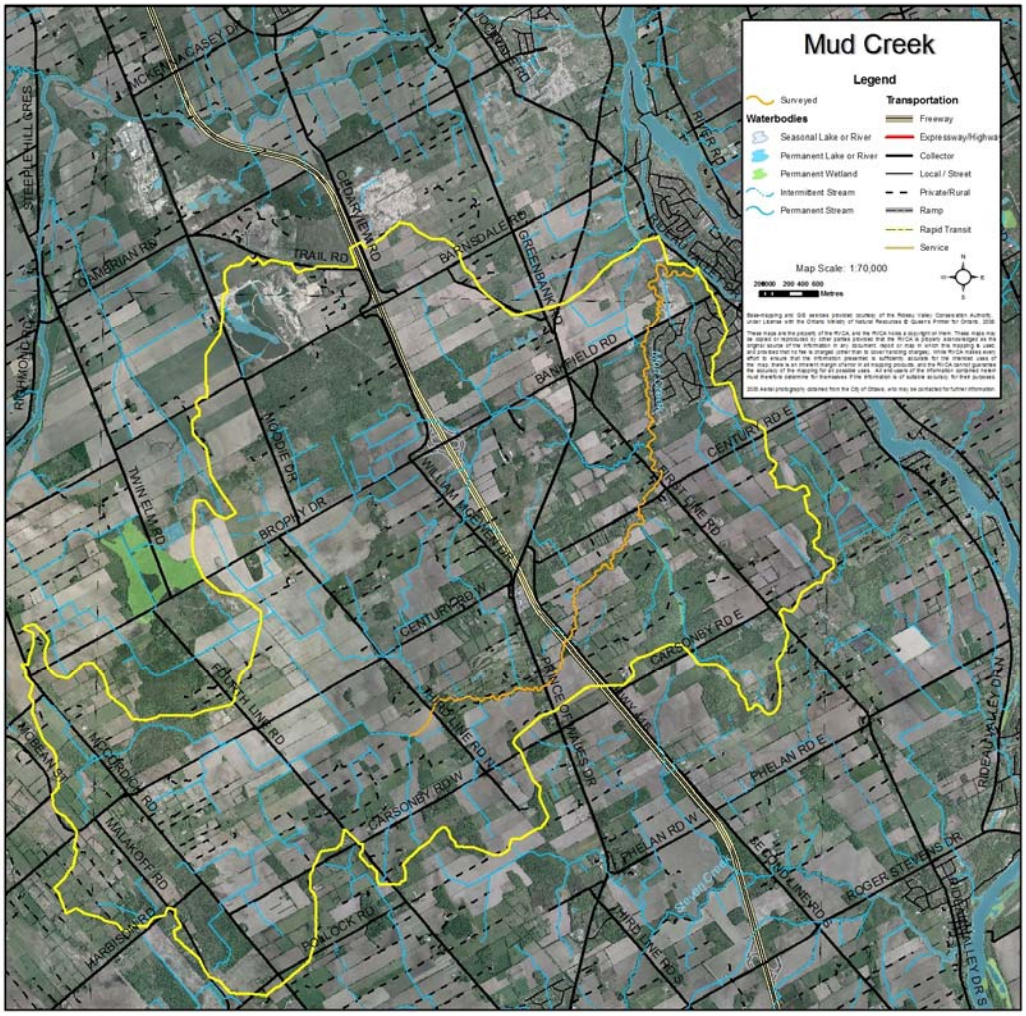



Figure 34. Air Photo of Mud Creek and Surrounding Area

## 1. Observations of Anthropogenic Alterations and Land Use

Figure 35 illustrates the classes of anthropogenic alterations that volunteers observed along Mud Creek. Over half of the surveys completed on Mud Creek had no anthropogenic alterations. These coincided with areas that had not been straightened and had a good buffer between the creek and other land uses. Of the stream area sampled, 26 percent contained sections that were natural but had some sort of human alteration, and 17 percent had areas that were altered but still had some natural features. These areas represented sections where the creek did not meander much and that had little or no buffer from human impact.

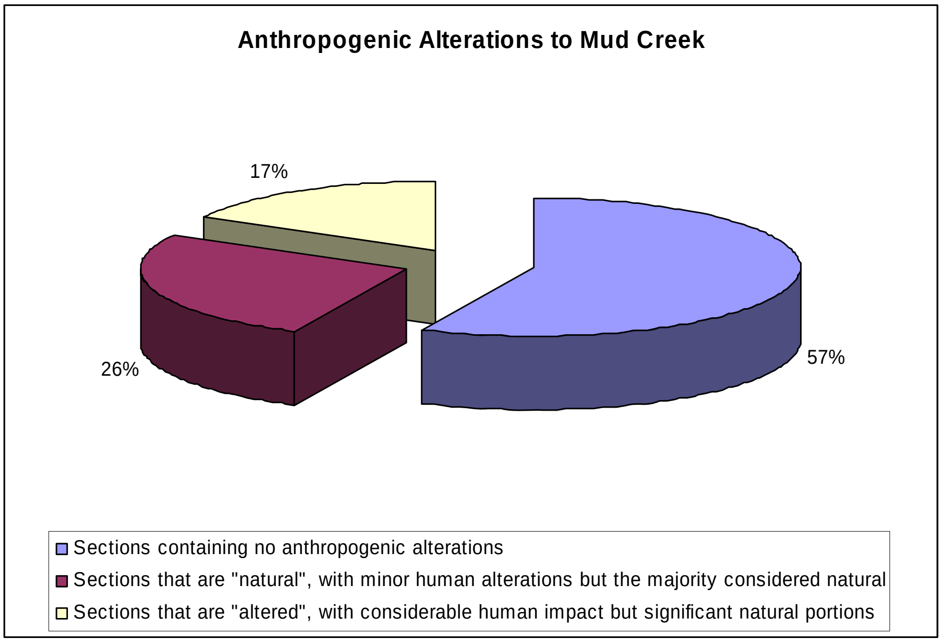



**Figure 35. Classes of Anthropogenic Alterations Occurring Along Mud Creek**

Figure 36 demonstrates the eleven different land uses identified by volunteers occurring along the banks adjacent to Mud Creek. Over half of the land use adjacent to Mud Creek is considered natural, consisting of 20 percent meadow, 18 percent forest, nine percent scrubland and five percent wetland. Agricultural land use accounts for 29 percent, which begins to occur between Bankfield and First Line Road and continues to the headwaters. Residential land use is observed at 12 percent of the creek, and this refers mainly to the sections from Rideau Valley Drive to halfway between Bankfield and First Line Road. The three other land uses occurring along Mud Creek are industrial/commercial (one percent), recreational (one percent) and infrastructure. Out of the sections surveyed, the creek had seven road crossings, which in comparison with the other land uses, only makes up two percent of the total land use.

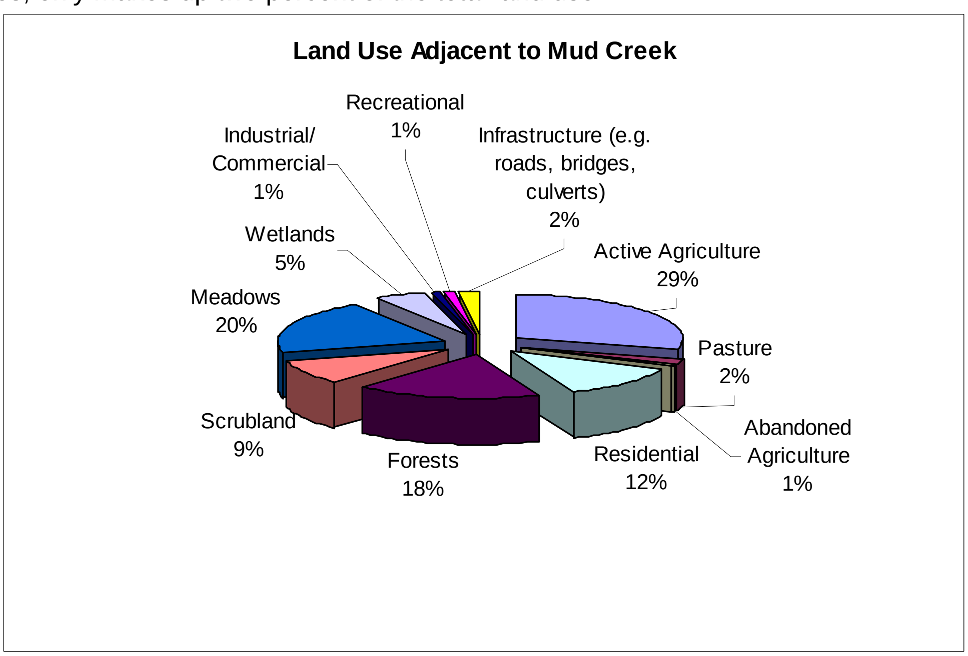



**Figure 36. Land Use Identified by Volunteers Along Mud Creek**

## 2. Instream Morphology of Mud Creek

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. 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. Mud Creek mainly consists of large runs with some pools and little riffle, illustrated in Figure 37. The most substantial riffle occurs downstream of Bankfield Road, and is a very important instream habitat feature. Upstream of Bankfield Road there are several other smaller riffles.

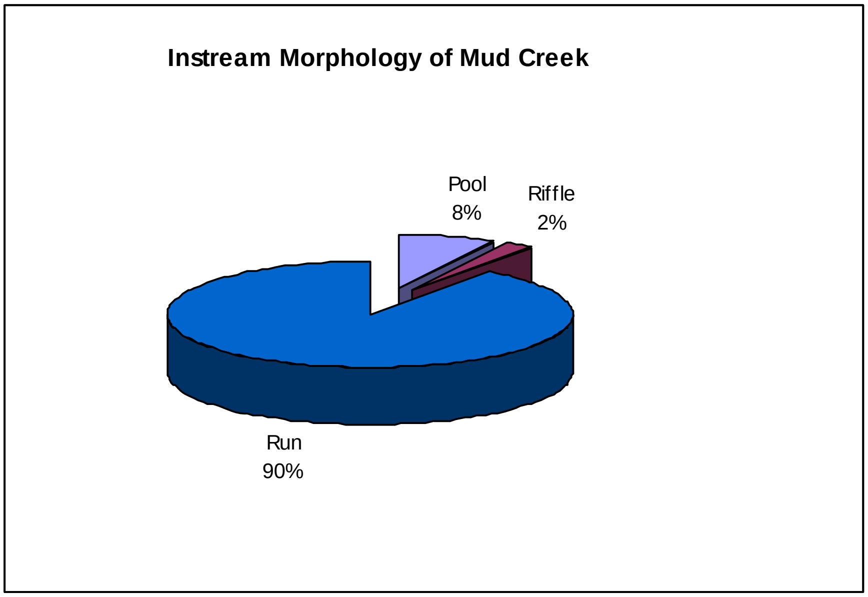



**Figure 37. Instream Morphology of Mud Creek**

## 3. Types of Instream Substrate Along Mud Creek

A variety of substrate can be found instream along Mud Creek, although the majority of the substrate is clay with some muck and detritus. Diverse substrate is important for fish and benthic macroinvertebrate habitat because some species will only be found in certain types of substrate and will only reproduce on certain types of substrate. Boulders create instream cover and back eddies for large fish to hide and/or rest out of the current, and cobble provides important over wintering and/or spawning habitat for small or juvenile fish. Other substrates also provide instream habitat for fish and macroinvertebrates. Many areas of Mud Creek are homogeneous, with little cobble, boulder and gravel. Figure 38 demonstrates the types of substrate observed.

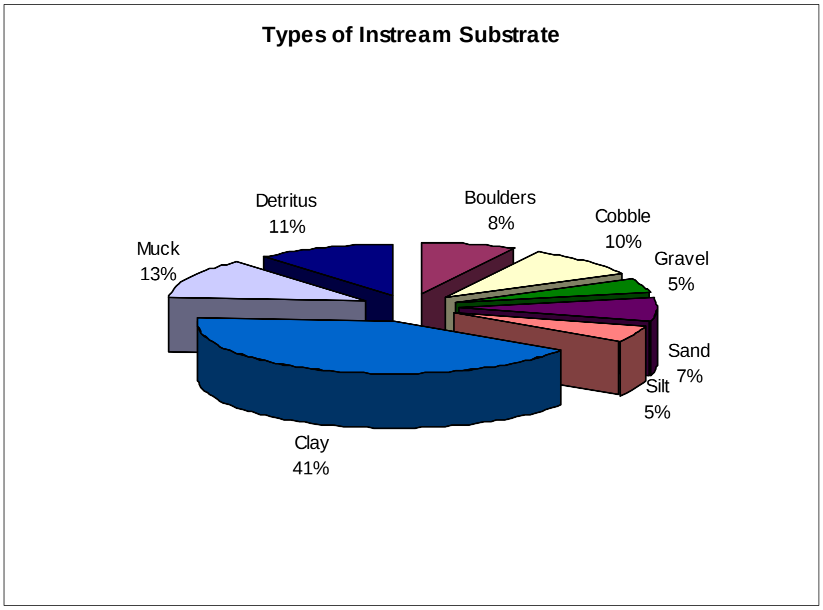



**Figure 38. Types of Instream Substrate Along Mud Creek**

## 4. Observations of Instream Vegetation

Volunteers found Mud Creek mainly contained a healthy amount of instream vegetation, with over half of the sections considered common. Eighteen percent of the vegetation observed was considered normal. Instream vegetation was found to be low in six percent of the area surveyed and there was none observed in one percent. Extensive levels of vegetation occurred in 21 percent of the sections surveyed. Extensive vegetation can have negative affects on the stream, such as biological oxygen demand (BOD), which reduces the amount of dissolved oxygen in the system. Choked vegetation also can impact the mobility and migration of aquatic organisms as well as affects the feeding patterns of fish, especially if water levels are low.

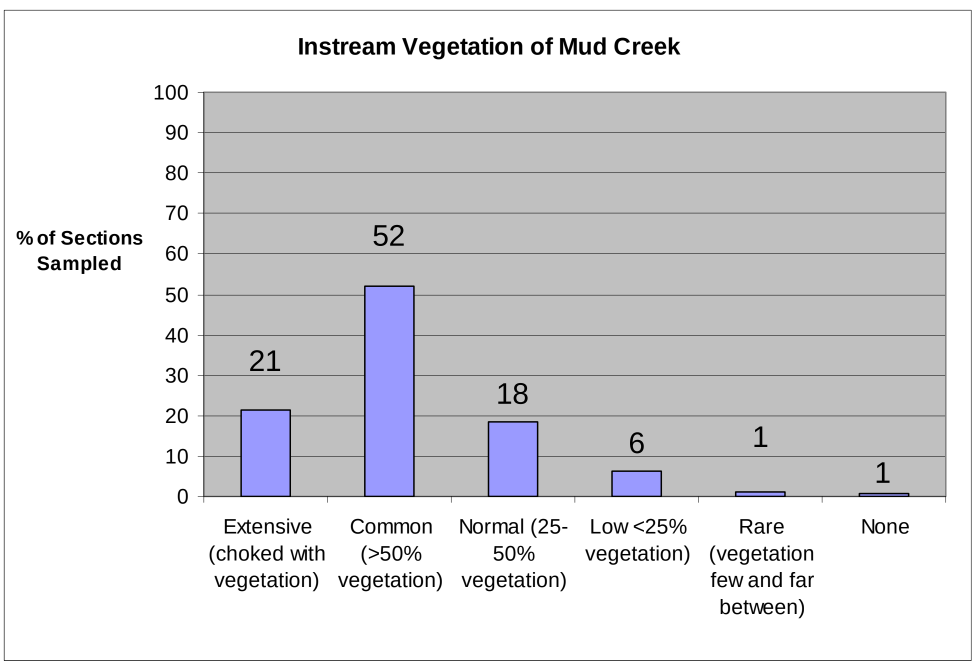



**Figure 39. Frequency of Instream Vegetation in Mud Creek**

## 5. Observations of Bank Stability

Figures 40 and 41 show the overall bank stability of Mud Creek for left and right banks. The left and right banks are fairly similar. The left bank was found to be stable for 69 percent of the sections sampled and 31 percent unstable, compared to the right bank at 70 percent stable. Many of the unstable areas coincided with areas that had small buffers of less than 10 metres or areas with steep banks.

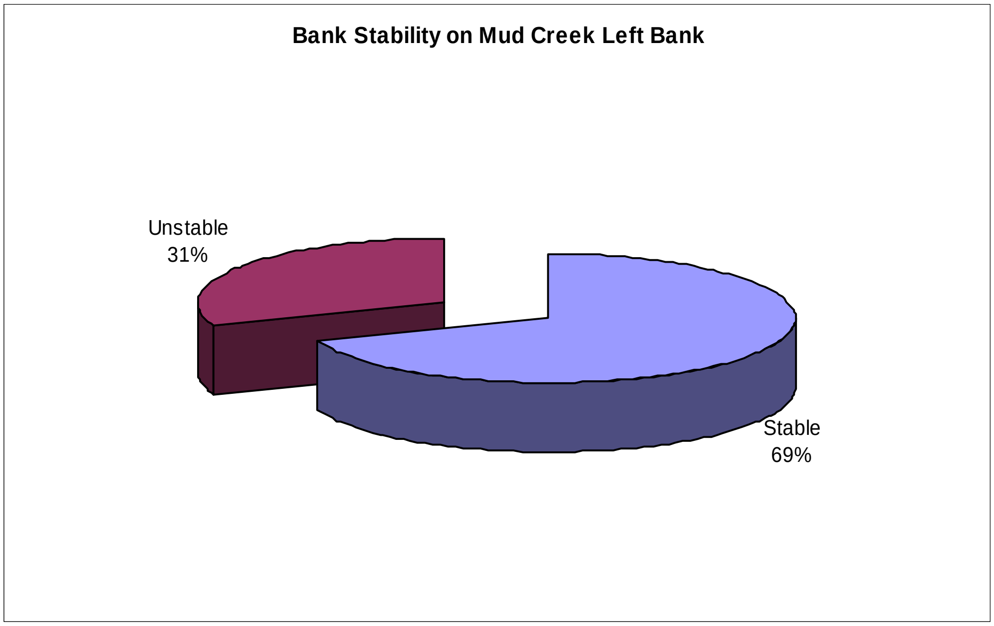



**Figure 40. Left Bank Stability of Mud Creek**

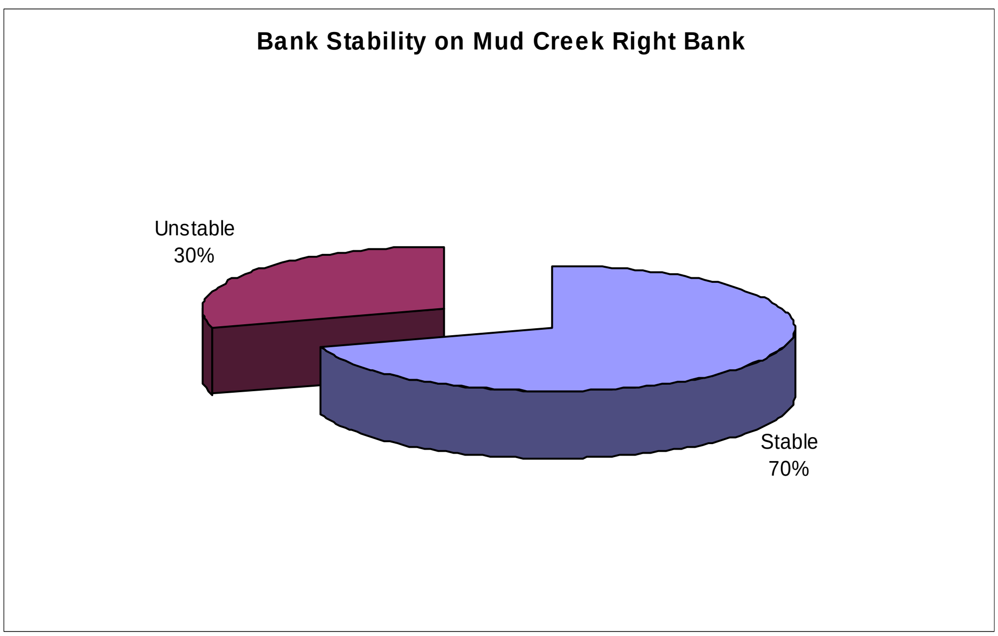



**Figure 41. Right Bank Stability of Mud Creek**

Areas of erosion have been identified on an aerial photo of Mud Creek and can be found in Appendix I.

## 6. Buffer Evaluation of Mud Creek

Natural buffers between the creek and human alterations are extremely important for filtering excess nutrients running into the creek, infiltrating rainwater, bank stability and wildlife habitat. Natural shorelines also shade the creek, helping maintain baseflow levels and keeping water temperatures cool. According to the document *How Much Habitat Is Enough*, a stream should have riparian areas of 30 metres minimum or more, depending on the site conditions. Figure 42 compares the buffer width for both left and right banks along Mud Creek. A buffer of only zero to five metres was observed along 24-28 percent of the creek, seven to 15 percent had a buffer of five to 15 metres and 11-16 percent had a buffer of 15-30 metres. Over half of the right bank had a buffer of over 30 metres, and the left 45percent.

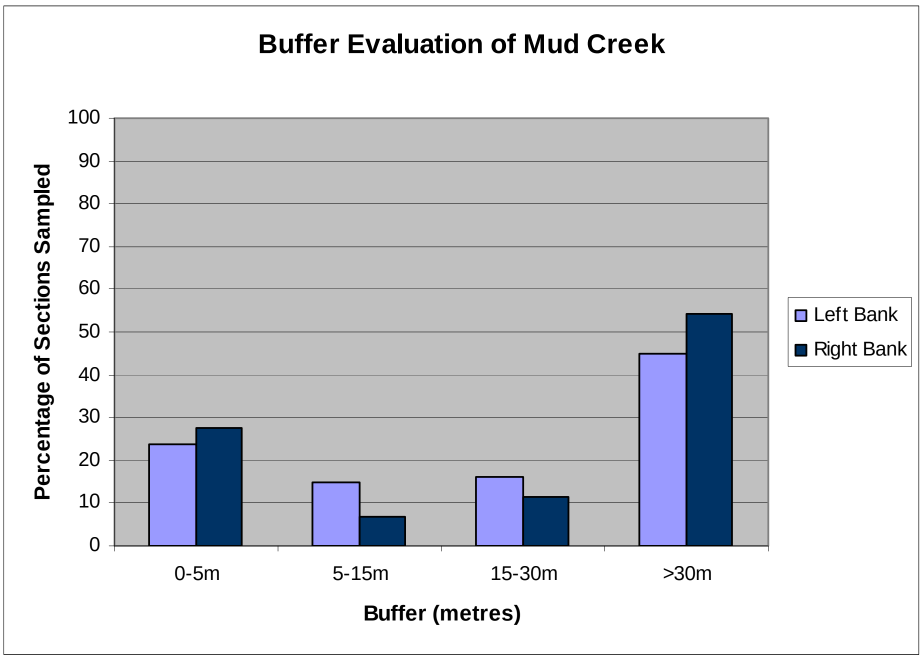



**Figure 42. Buffer Evaluation of Mud Creek**

## 7. Observations of Wildlife

The presence of diverse fish and wildlife populations can be an indicator of water quality and overall stream health. Table 24 is a summary of all wildlife observed while surveying on Mud Creek.

| Wildlife | Observed While Sampling |
|---|---|
| ***Birds*** | ducks, mallards, great blue heron, chickadees, kingfishers, robin, grackle, crows, blue jays, red-winged blackbirds, ring-billed gulls, mourning dove, turkey vultures, pileated woodpecker, hawk, canada geese, merganzers, phoebe, grouse, owl |
| ***Mammals*** | deer, raccoons, red squirrels, beaver, chipmunk, skunk |
| ***Reptiles/Amphibians*** | green frogs, leopard frog |
| ***Aquatic Insects*** | water striders, water beetles, crayfish, snails, whirligig beetles, leech, midge |

| | |
|---|---|
| ***Fish (as observed through seining and electrofishing)*** | brook stickleback, creek chub, white sucker, central mudminnow, bluntnose minnow, golden shiner, blacknose shiner, blackchin shiner, blacknose dace, longnose dace, tessellated darter, mottled sculpin, rock bass, pumpkinseed, yellow perch, largemouth bass, *Cyprinid spp*. |
| ***Other*** | butterflies, bumblebees, mosquitoes, crickets, spiders, caterpillars, molluscs, blue-faced darners, jewelwing, red rock skimmer, gnats |

**Table 24. Wildlife Observed Along Mud Creek**

## 8. Observations of Pollution/Garbage

Figure 43 demonstrates the incidence of pollution/garbage in Mud Creek. Garbage was not a major issue in Mud Creek and did not occur in large quantities. Fifty-eight percent of the creek was free of garbage. In the sections where garbage was observed, it was usually one or two pieces. Four percent of the sections had visible oil or gas trails in the water.

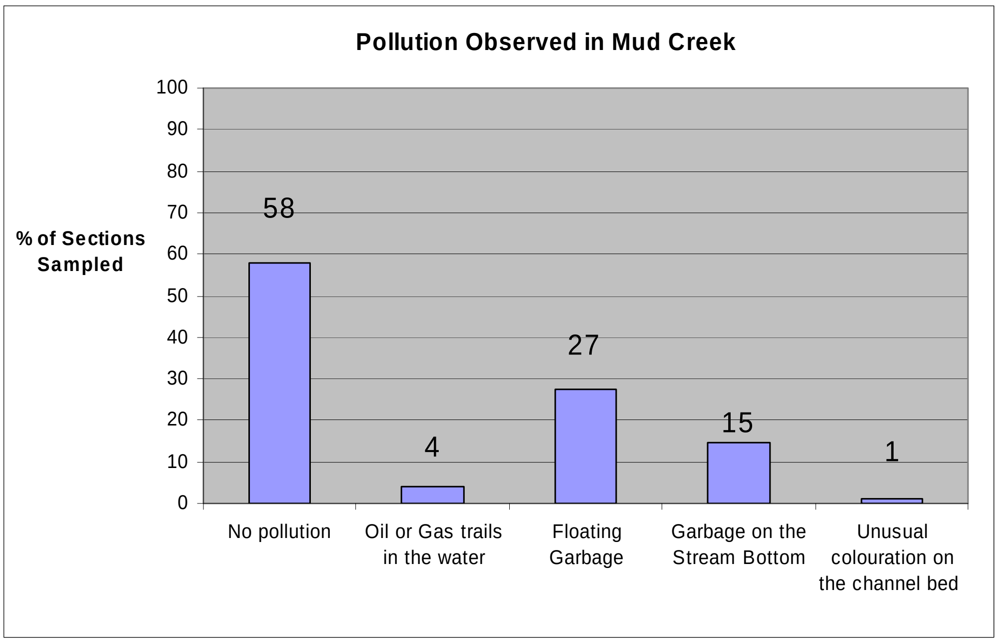



**Figure 43. Frequency of Pollution/Garbage Occurring in Mud Creek**

Although there were few pieces of garbage found along Mud Creek, there was a large variety. The majority of the garbage found likely enters the creek by blowing in from the surrounding residential areas or has been there for many years. Items found included plastic bottles, plywood, street signs, tires, an exercise ball, a boogie board, a red handle, styrofoam, beer bottles, wrappers, roofing/siding material, pop cans, plastic plant containers, wood pallets, netting, plastic, an old snow fence, random metal pieces and old car pieces. Some of these items, especially the netting can have a negative effect on wildlife and fish that inhabit Mud Creek because they can get caught in the netting.

## 9. Fish Community Sampling

### Seine Netting

Seine netting was completed at seven sites along Mud Creek. One volunteer assisted in seining and processing the catch for one of the sites, and one of the seining sites was from the Biothon that was held, where three volunteers helped with the seining and processing. Another seine was done by volunteers during the electrofishing demonstration, and six volunteers assisted with this data collection. Figure 44 shows the locations of the seining sites. A total of 15 different fish species were collected throughout the sites. All fish were live released back to the stream after seining and electrofishing events.

## Electrofishing

Mud Creek was electrofished at two sites. The first electrofishing site was sampled by RVCA staff in June. The second site was done in August for an electrofishing demonstration by RVCA staff for City Stream Watch volunteers. This event was attended by 22 volunteers, and although they remained on the bank during the electrofishing for safety reasons, they were all able to assist with processing the fish that were caught. Figure 44 shows the locations of the electrofishing sites along Mud Creek. A total of ten different species were caught. Two species that were not caught seining include mottled sculpin and longnose dace. Mottled sculpin are a coldwater species.

Table 25 illustrates the water chemistry values obtained from each site at the time of sampling. The YSI probe was out for repair during three of the sampling dates, and therefore, no water chemistry data is listed, only water and air temperature.

| Sampling Technique | Site # | Date (mm/dd/yy) | Air Temp C° | Water Temp C° | DO (mg/L) | pH | Conductivity (uS/cm) | Substrate | Instream Vegetation |
|---|---|---|---|---|---|---|---|---|---|
| Seining | 1 | 6/5/2008 | 19.62 | 17.46 | 17.2 | 7.99 | 704 | clay | grasses |
| Seining | 2 | 6/9/2008 | 23.3 | 22.53 | 8.9 | 8.09 | 837 | clay, silt, cobble and gravel | narrow-leaved emergents |
| Seining | 3 | 6/9/2008 | 31.06 | 23.3 | 10.01 | 8.14 | 841 | clay with gravel | narrow-leaved emergents |
| Seining | 4 | 6/26/2008 | 30 | 23.3 | 11.75 | 8.63 | 239 | clay | narrow-leaved emergents, arrowhead |
| Seining | 5 | 7/14/2008 | 21 | 19 | N/A | N/A | N/A | clay | rushes, grasses, submergents |
| Seining | 6 | 7/19/2008 | 24 | 20 | N/A | N/A | N/A | clay with woody debris | submerged, grasses, arrowhead, pickerelweed |
| Seining | 7 | 8/24/2008 | 24 | 18 | 14.4 | 8.12 | 749 | clay with some cobble and boulders | grasses, submergents, algae |
| Electrofishing | 1 | 6/20/2008 | 24.57 | 18.14 | 6.33 | 8.28 | 702 | sandy clay, muck, cobble | submerged, algae |
| Electrofishing | 2 | 8/24/2008 | 24 | 19 | N/A | N/A | N/A | sand, cobble, boulder | algae, submerged |

**Table 25. Water Chemistry for Sampling Sites Along Mud Creek**

Table 26 summarizes the biological data obtained from each sampling event along Mud Creek. A young of the year largemouth bass was captured at the mouth of Mud Creek, along with yellow perch. Some *Cyprinid* (minnow) species were too small to be identified, and those are listed as *Cyprinid spp*. Top predators are highlighted in bold. For a complete list of species sampled, including number of each species, weight, comments, etc., please see Appendix G.

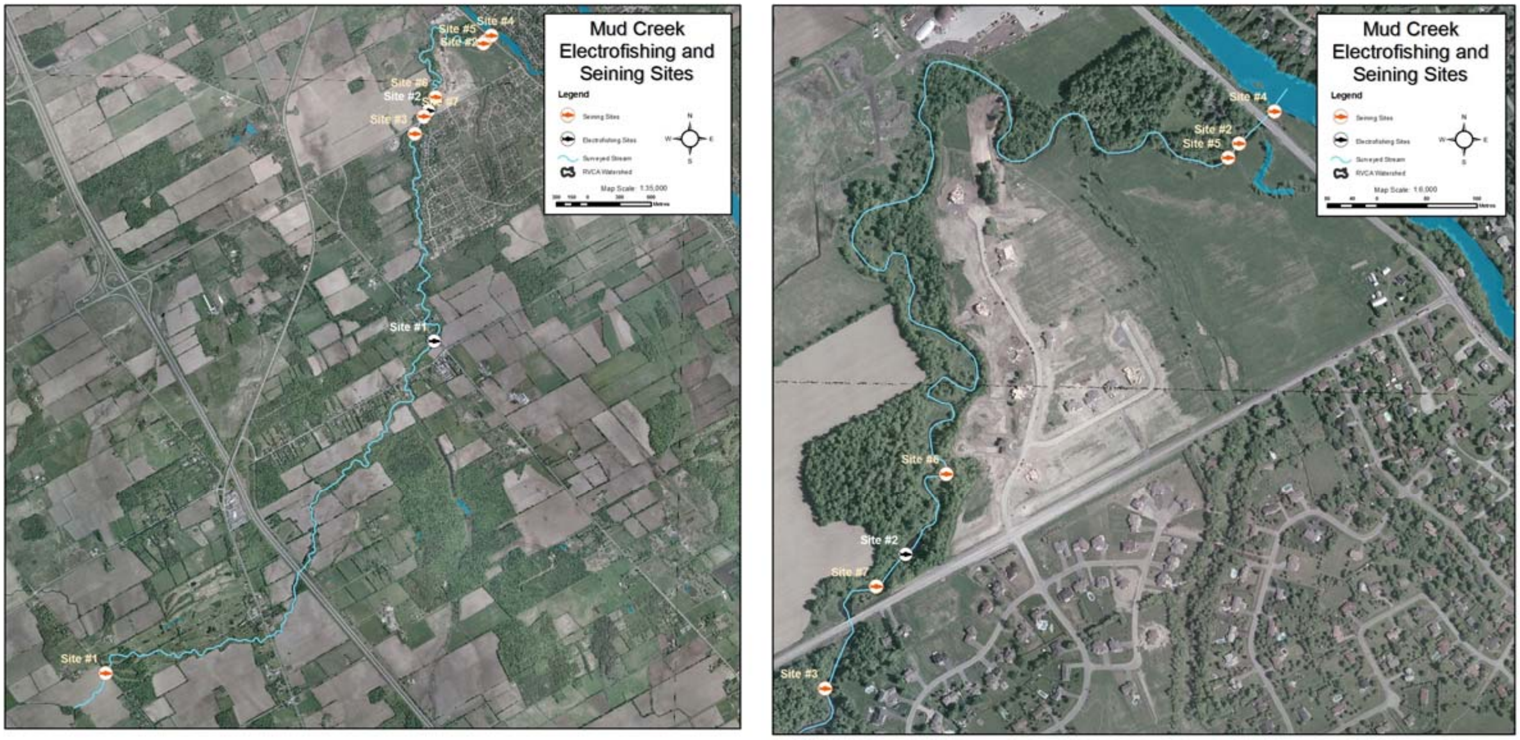



**Figure 44. Air Photo of Mud Creek Showing Sampling Sites**

| Sample Technique | Date Sampled | Site # | Species Sampled | Total number of species Caught |
|---|---|---|---|---|
| **SEINING** | | | | |
| | 5-Jun | 1 | brook stickleback, white sucker, blacknose dace, creek chub, blackchin shiner, *Cyprinid spp.* | 6 |
| | 9-Jun | 2 | white sucker, *Cyprinid spp*. | 2 |
| | 9-Jun | 3 | rock bass, blacknose shiner, common shiner, bluntnose minnow, white sucker, **yellow perch**, golden shiner, *Cyprinid spp.* | 8 |
| | 26-Jun | 4 | pumpkinseed, golden shiner, rock bass **yoy largemouth bass** | 4 |
| | 14-Jul | 5 | **yellow perch**, pumpkinseed, brook stickleback, creek chub, tessellated darter | 5 |
| | 19-Jul | 6 | creek chub, rock bass, **yellow perch**, brook stickleback, common shiner, white sucker | 6 |
| | 24-Aug | 7 | rock bass, common shiner | 2 |

| EFISHING | | | | |
|---|---|---|---|---|
| *problems with electrofisher this day | 20-Jun | 1 | mottled sculpin, central mudminnow, brook stickleback | 3 |
| | 24-Aug | 1 | creek chub, mottled sculpin, longnose dace, central mudminnow, tessellated darter, common shiner, white sucker, bluntnose minnow, rock bass | 9 |

**Table 26. Fish Community Results for Seining and Electrofishing Sites along Mud Creek**

## Fish Species Status, Trophic, and Reproductive Guilds - Mud Creek

The following table was generated by taking the fish community species of Mud Creek and classifying the recreational, commercial, or bait fishery importance, the Species at Risk status, reproductive guild (spawning habitat requirements), thermal classification, and trophic guild (feeding preference).

The fish community in Mud Creek is made up of cold, cool and warm water species. The coldwater species found in Mud Creek was Mottled Sculpin. Spawning habitat requirements within Mud are diverse and can been seen in the table below. There is a good mix of fish from the recreational and bait fishery in Mud Creek. Fish such as largemouth bass and yellow perch were found in the lower reaches and are fish commonly targeted by sports fishermen.

The following table summarizes the fish community structure found in Mud Creek and their sensitivity to sediment and turbidity for reproduction, feeding, and respiration. The composition of the fish community in Mud Creek ranges from species that are fairly tolerant to sediment and turbidity, to species that are intolerant, though the majority of the species are classified in the moderately tolerant range. Fish that rely heavily on sight to feed (largemouth bass) are extremely sensitive to increased sediment and turbidity.

| MNR Code | Common Name | Scientific Name | Recreational Fishery | Commercial Fishery | Bait Fishery | Status | Reproductive Guild | Thermal Classification | Trophic Guild |
|---|---|---|---|---|---|---|---|---|---|
| 163 | white sucker | *Catostomus commersoni* | | | | None | (non guarder) Lithophils | Cool | Insectivore/ Omnivore |
| 281 | brook stickleback | *Culaea inconstans* | | | X | None | (guarders) Ariadnophils | Cool | Insectivore |
| 212 | creek chub | *Semotilus atromaculatus* | X | | X | None | (brood hiders) Lithopils | Cool | Insectivore/Generalist |
| 313 | pumpkinseed | *Lepomis gibbosus* | X | | | None | (nest spawners) Polyphils | Warm | Insectivore |
| 311 | rock bass | *Ambloplites rupestris* | X | | | None | (nest spawners) Lithophils | Cool | Insectivore |
| 331 | yellow perch | *Perca flavescens* | X | X | | None | (non guarder) Phyto-lithophils | Cool | Insectivore/Piscivore |
| 141 | central mudminnow | *Umbra limi* | | | X | None | (non guarder) Phytophils | Cool/Warm | Insectivore/ Omnivore |
| 211 | longnose dace | *Rhinichthys cataractae* | | | X | None | (non guarder) Lithophils | Cool | Insectivore |
| 208 | bluntnose | *Pimephales* | | | X | None | (guarder) | Warm | Omnivore |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | minnow | *notatus* | | | | | Speleophils | | |
| 210 | blacknose dace | *Rhinichthys atratulus* | | | X | None | (non guarder) Lithophils | Cool | Insectivore/ Generalist |
| 200 | blacknose shiner | *Notropis heterolepis* | | | X | None | (non guarder) Phytophils | Cool | Insectivore |
| 199 | blackchin shiner | *Notropis heterodon* | | | X | None | (non guarder) Phytophils | Cool | Insectivore |
| 346 | tessellated darter | *Etheostoma olmstedi* | | | X | None | (guarder) Speleophils | Cool | Insectivore |
| 381 | mottled sculpin | *Cottus bairdi* | | | X | None | (guarders) Ariadnophils | Cold | Insectivore |
| 194 | golden shiner | *Notemigonus crysoleucas* | | | X | None | (non guarder) Phytophils | Cool/Warm | Omnivore |
| 317 | largemouth bass | *Micropterus salmoides* | X | past | | None | (nest spawners) Phytophils | Warm | Insectivore/Piscivore |
| 198 | common shiner | *Notropis cornutus* | | | X | None | (guarders) Lithopils | Cool | Insectivore |

**Table 27. Fish Species Status, Trophic and Reproductive Guilds for Mud Creek** (Source: *MTO Environmental Guide to Fish and Fish Habitat*, 2006).

The following table summarizes the fish community structure found in Mud Creek and their sensitivity to sediment and turbidity for reproduction, feeding, and respiration. The composition of the fish community in Mud Creek ranges from species that are fairly tolerant to sediment and turbidity, to species that are intolerant, though the majority of the species are classified in the moderately tolerant range. Fish that rely heavily on sight to feed (largemouth bass) are extremely sensitive to increased sediment and turbidity.

## Fish Species Sensitivity to Sediment/Turbidity for Mud Creek

| MNR Code | Common Name | Scientific Name | Reproduction | Feeding | Respiration |
|---|---|---|---|---|---|
| 163 | white sucker | *Catostomus commersoni* | M | L | H |
| 281 | brook stickleback | *Culaea inconstans* | L | M | unknown |
| 212 | creek chub | *Semotilus atromaculatus* | M | M | H |
| 313 | pumpkinseed | *Lepomis gibbosus* | L | M | unknown |
| 311 | rock bass | *Ambloplites rupestris* | L | H | unknown |
| 331 | yellow perch | *Perca flavescens* | M | H | unknown |
| 141 | central mudminnow | *Umbra limi* | M | M | L |
| 211 | longnose dace | *Rhinichthys cataractae* | M | M | H |
| 208 | bluntnose minnow | *Pimephales notatus* | M | L | unknown |
| 381 | mottled sculpin | *Cottus bairdi* | M | M | unknown |
| 194 | golden shiner | *Notemigonus crysoluecas* | M | M | L |
| 317 | largemouth bass | *Micropterus salmoides* | L | H | H |
| 198 | common shiner | *Luxilus cornutus* | M | M | unknown |
| 210 | blacknose dace | *Rhinichthys atratulus* | M | M | H |
| 200 | blacknose shiner | *Notropis heterolepis* | M | M | H |
| 199 | blackchin shiner | *Notropis heterodon* | M | M | L |
| 346 | tessellated darter | *Etheostoma olmstedi* | unknown | unknown | unknown |

**Table 28. Fish Species Senstivity to Sediment/Turbidity (High, Moderate, Low,**

**unknown) for Mud Creek** (Source: *MTO Environmental Guide to Fish and Fish Habitat*, 2006)

## 10. Temperature Profiles

Three temperature dataloggers were set in Mud Creek for a 112-day period beginning on April 25 and removed on September 19, 2008. Figure 45 shows the locations of the dataloggers in Mud Creek. Datalogger 3 was placed in the headwaters of Mud Creek on a part that was not surveyed. Water levels dropped where datalogger 2 and 3 were placed, and when they were retrieved, they were out of water. These dataloggers were launched earlier, and they were set to take temperature levels every five minutes. As a result, the temperature loggers stopped recording in mid-August. The temperature loggers on the other creeks were launched later, taking temperature levels every eight minutes which made them last longer.


**Figure 45. Datalogger Locations Along Mud Creek**

Dataloggers were set in three different locations along the stream to give a representative sample of how temperature fluctuates and differs throughout the system. Sites begin at the furthest downstream site and were placed in order upstream. Datalogger 1 was set just downstream of Bankfield Road. Datalogger 2 was set just upstream of Century Rd. Datalogger 3 was set upstream of Century Road, at the intersection with Third Line Road. Figures 46, 47 and 48 show the results from dataloggers 1, 2 and 3. The thermal classifications for cold, cool and warm water fluvial systems are as follows:

| Status | Water Temperature |
|---|---|
| Cold | <19 Degrees Celsius |
| Cool | 19-25 Degrees Celsius |
| Warm | >25 Degrees Celsius |

**Table 29. Water temperature classifications (Minns et al. 2001)**

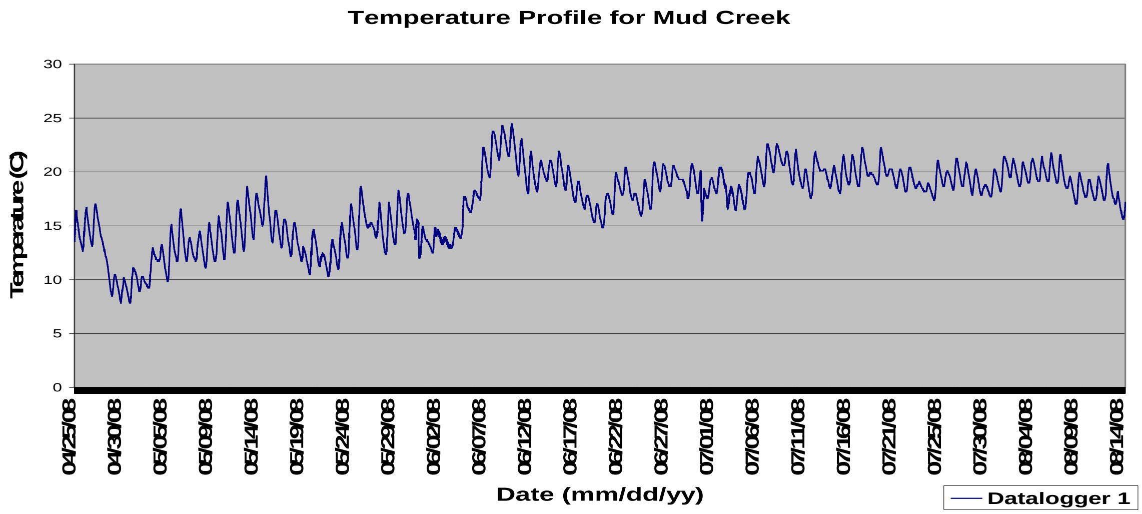



**Figure 46. Temperature Profile for Datalogger 1 at Bankfield Road**

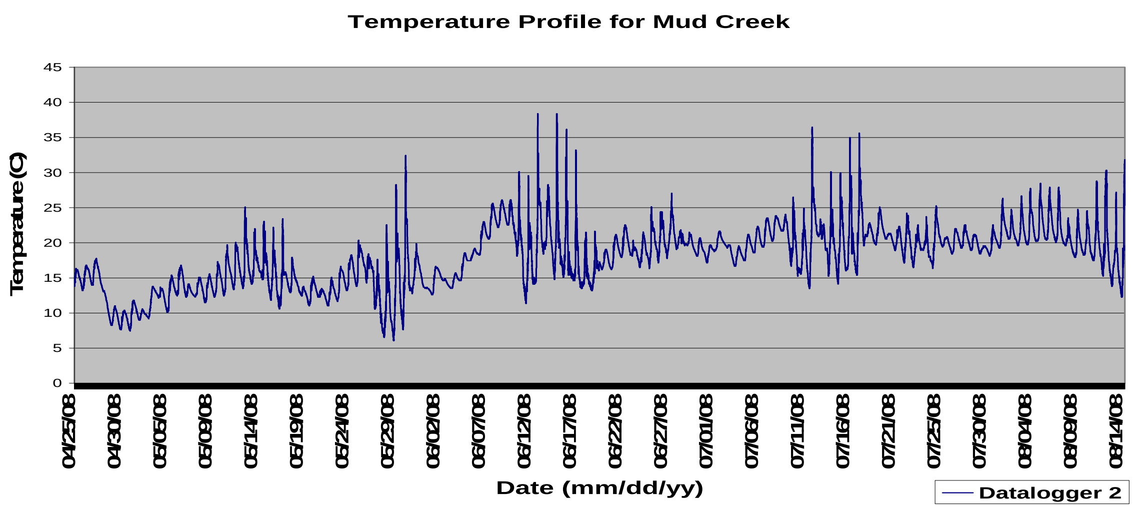



**Figure 47. Temperature Profile for Datalogger 2 at Century Road**

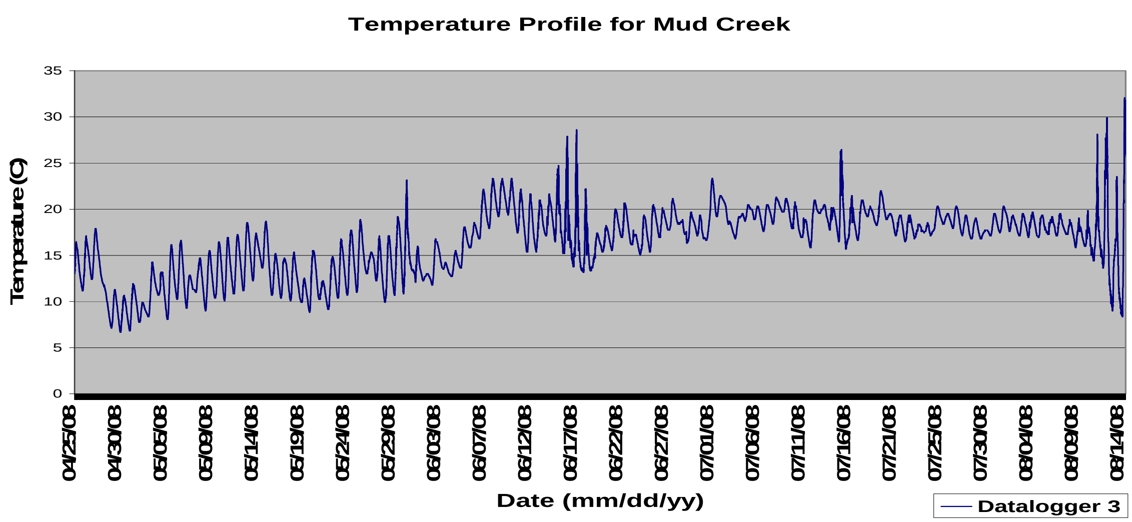



**Figure 48. Temperature Profile for Datalogger 3 at Third Line Road**

Although they follow similar trends, dataloggers two and three have much larger fluctuations. Datalogger 1 had a maximum temperature of 24.47°C and a minimum of 7.84°C. Datalogger 2 reached a high of 38.38°C and a low of 6.07°C. Datalogger 3 was similar to 2, but had a lower maximum temperature of 33.36°C and a minimum of 6.66°C. It is likely that dataloggers 2 and 3 were out of water when the large fluctuations occurred. Considering the data from the first temperature logger and the fish community structure, Mud Creek can be classified as a cool water stream, with some cold water reaches. Mottled sculpin were found in the headwaters as well, and they are a coldwater species.

## 11. Invasive Species

Figure 49 shows the locations of invasive species found along Mud Creek, highlighted in orange.

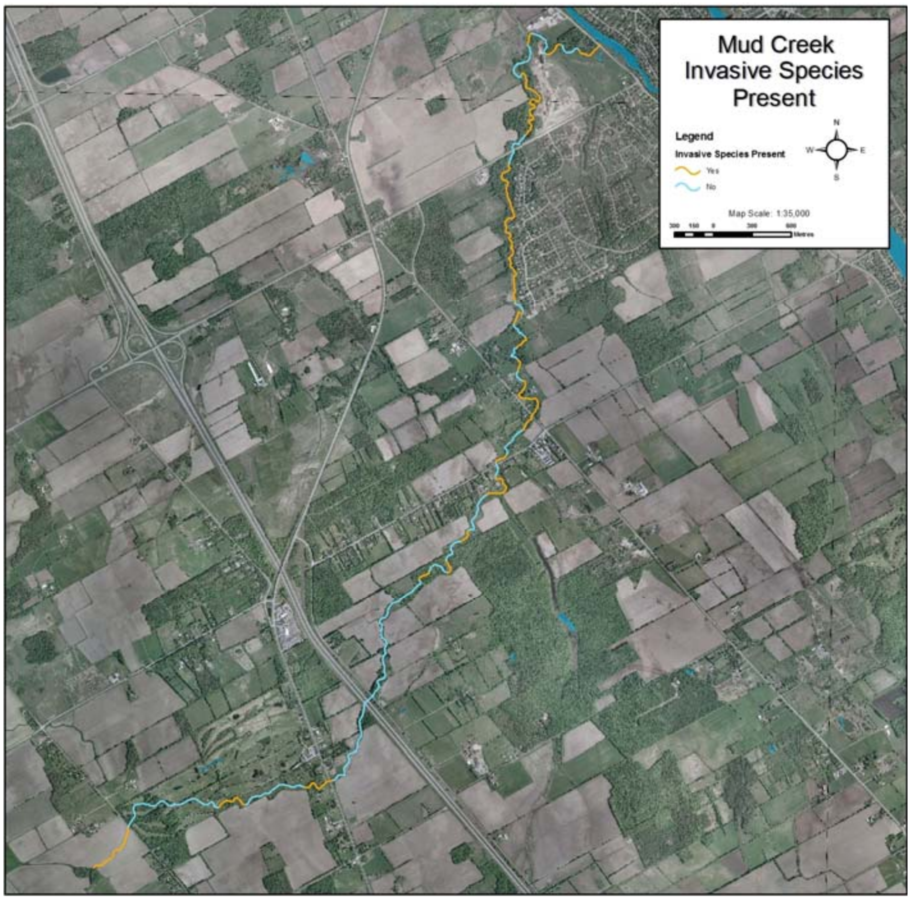



**Figure 49. Air Photo of Mud Creek Showing Locations of Invasive Species**

At the mouth of Mud Creek, flowering rush was found in the beginning sections near the mouth and a couple of times in other sections of the creek. Flowering rush (*Butomus umbellatus*) is an aggressive grower and could outcompete the native vegetation in that area. Its removal is listed in Appendix J under Potential Projects. The other invasive species found along Mud Creek include purple loosestrife (*Lythrum salicaria*), Manitoba maple (*Acer negundo*), myrtle/periwinkle (*Vinca minor*), European frogbit (*Hydrocharis morsus-ranae*) and garlic mustard (*Alliaria petiolata*). The purple loosestrife was found in many parts of the creek, but it did not seem to be out- competing the native vegetation. Myrtle/periwinkle is sold at plant nurseries as a ground cover for shade. This ornamental species can escape into natural areas, and it crowds out the native vegetation. European frogbit can also be very difficult to get rid of, once established, it forms very thick mats of instream vegetation. Garlic mustard actually interferes with the relationship between tree roots and the soil, affecting the growth of the trees, so it can also be a problem in natural areas. It spreads aggressively and needs constant pulling for several years in a row to control. There are several methods of control being examined by the Nature Conservancy of Canada, on their properties.

## 12. 2003/2008 Comparison of Mud Creek

One third of Mud Creek was sampled in 2003 (37 sections). In 2008, 95 sections were completed. Therefore, only data from the first 37 sections have been compared. The field sheets have been modified to include more variables in the assessment. Several of the questions have been modified and improved to provide more detail; therefore, making direct comparisons difficult. The following tables are a comparison between 2003 and 2008.

| Anthropogenic Alterations | 2003 (percent) | 2008 (percent) |
|---|---|---|
| *none* | 60 | 62 |
| *"natural" conditions with significant alterations by man* | 37 | 27 |
| *"altered" with considerable human impact but with significant natural areas* | 3 | 11 |
| *"highly altered" with few areas that could be considered natural* | 0 | 0 |

**Table 30. Comparison of Anthropogenic Alterations**

Areas without anthropogenic alterations on Mud Creek have roughly stayed the same. Other areas, however, have become more altered. This is mainly due to increased residential development adjacent to the creek south of Bankfield Road. There is fencing along many parts of the creek in that area and some shoreline modifications. Also, there was ongoing construction on Bankfield Road during 2008, furthering the alterations in that area. The first 37 sections of Mud Creek still have no areas experiencing “highly altered” conditions.

| Instream Vegetation | 2003 (percent) | 2008 (percent) |
|---|---|---|
| *extensive* | 12 | 4 |
| *common* | 49 | 63 |
| *normal* | 27 | 17 |
| *low* | 12 | 14 |
| *rare* | 0 | 0 |
| *none* | N/A | 2 |

**Table 31. Comparison of Instream Vegetation**

Instream vegetation is difficult to compare, and the data can depend on when the stream was surveyed. The category for “none” was also added after 2003 and cannot be reflected in the 2003 data. Instream vegetation data does differ, with less extensive vegetation and more common vegetation. There was a slight increase for areas with low levels of vegetation and less area with normal levels of vegetation.

| Bank Stability | 2003 (percent) | 2008 (percent) |
|---|---|---|
| *stable* | 90 | 73LB, 70RB |
| *unstable* | 10 | 27LB, 30RB |

**Table 32. Comparison of Bank Stability**

Bank stability was fine tuned in the stream assessments this year to separate left and right banks. However, it can still be concluded that erosion has increased in the last five years, with slightly more erosion on the right bank.

| Pollution/Garbage | 2003 (percent) | 2008 (percent) |
|---|---|---|
| *none* | 59 | 43 |
| *oil or gas trails* | 3 | 0 |
| *floating garbage* | 32 | 38 |
| *garbage on stream bottom* | 27 | 19 |
| *unusual colouration* | N/A | 0 |

**Table 33. Comparison of Pollution/Garbage**

Sections without pollution/garbage have decreased, as well as oil and gas trails and garbage on the stream bottom. Unusual colouration of the streambed was added after 2003 and not observed in the first 37 sections surveyed in 2008.

| Species Caught | 2003 | 2008 |
|---|---|---|
| white sucker | X | X |
| creek chub | X | X |
| common shiner | X | |
| bluntnose minnow | X | X |
| blacknose shiner | X | X |
| rock bass | X | X |
| johnny darter | X | |
| mottled sculpin | X | X |
| brook stickleback | | X |
| central mudminnow | | X |
| golden shiner | | X |
| blackchin shiner | | X |
| blacknose dace | | X |
| longnose dace | | X |
| tessellated darter | | X |
| pumpkinseed | | X |
| yellow perch | | X |
| largemouth bass | | X |
| *Cyprinid spp.* | | X |
| **TOTAL SPECIES CAUGHT** | **8** | **17** |

**Table 34. Comparison of Fish Species**

Electrofishing site on Mud Creek

Calculating weight of sample

Fish sampling was done on Mud Creek in 2003 and in 2008. In 2003, eight species were captured, and in 2008, that number grew to 17. Two species caught in 2003 were not found in 2008, which were common shiner and johnny darter. This does not mean the species have disappeared but could be influenced by location and time of sampling. Fish sampling methods for 2008 on Mud Creek included seining and electrofishing, whereas only seining was used in 2003. Both methods have sampling bias and target different types of habitat. Using both methods may increase the chances of capturing more fish species. Sampling in 2003 occurred at one location with no repetition, and in 2008 sampling took place at nine sites, from late spring to late summer, and could also account for the increase in species captured.

## 3.2.4 Sawmill Creek

The Sawmill Creek subwatershed drains twenty-two kilometres and is located in the urban landscape of Ottawa South. Sawmill Creek is approximately ten kilometres long, and flows North through South Keys and Heron Park before emptying into the Rideau River. Although the creek is one of the last free-flowing coldwater streams left in the urban core of the City of Ottawa, many sections of the creek have been channelized for development. The surficial geology in the subwatershed area is mainly marine clay plains with sand and rock ridges. Due to its location, much of the subwatershed is fairly urbanized, and the vegetation in the subwatershed has been somewhat impacted, but there are some more extensive forested areas around Blossom Park, at McCarthy's Woods and north of Walkley Road along the creek (CH2MHILL, 2003). The area south of Heron Road to Walkley Road contains great wildlife habitat, especially for birds. Ninety-two bird species have been observed in the subwatershed, and thirteen species of butterfly have been recorded. Plant inventories list 505 species of plants within the subwatershed, one third which are non-native. Other species found include northern redbelly snake, eastern garter snake, snapping turtle and Midland painted turtle. A study done in 1992 showed a low diversity of amphibians in the subwatershed (CH2MHILL, 2003), and when the City Stream Watch surveys were conducted, amphibians were rarely observed. However, a northern leopard frog was noted, and this was not a species found in the 1992 report. Benthic macroinvertebrate inventories from 2003 to spring 2008 ranged from fairly poor to very poor, suggesting there is substantial pollution to severe organic pollution. A constructed wetland was built along Sawmill Creek to help mitigate flow and improve water quality.

Where Sawmill Creek is less impacted from development, the riparian areas continue to play an important role for wildlife and fish habitat (supplying nutrients through the addition of woody debris, shelter, creation of instream features for fish) and bank stabilization. The entire length of Sawmill Creek was sampled during the 2008 season for a total of 9.8 kilometres. Caution was needed when sampling the creek after periods of rain, as it experienced large, fast fluctuations in water levels. The dramatic fluctuation in water levels is characteristic of urban streams, as storm sewers shorten runoff travel time to stream channels while total runoff volume is increased with an increase in impervious surfaces. The following is a summary of the 98 macro stream assessment forms filled out by volunteers.

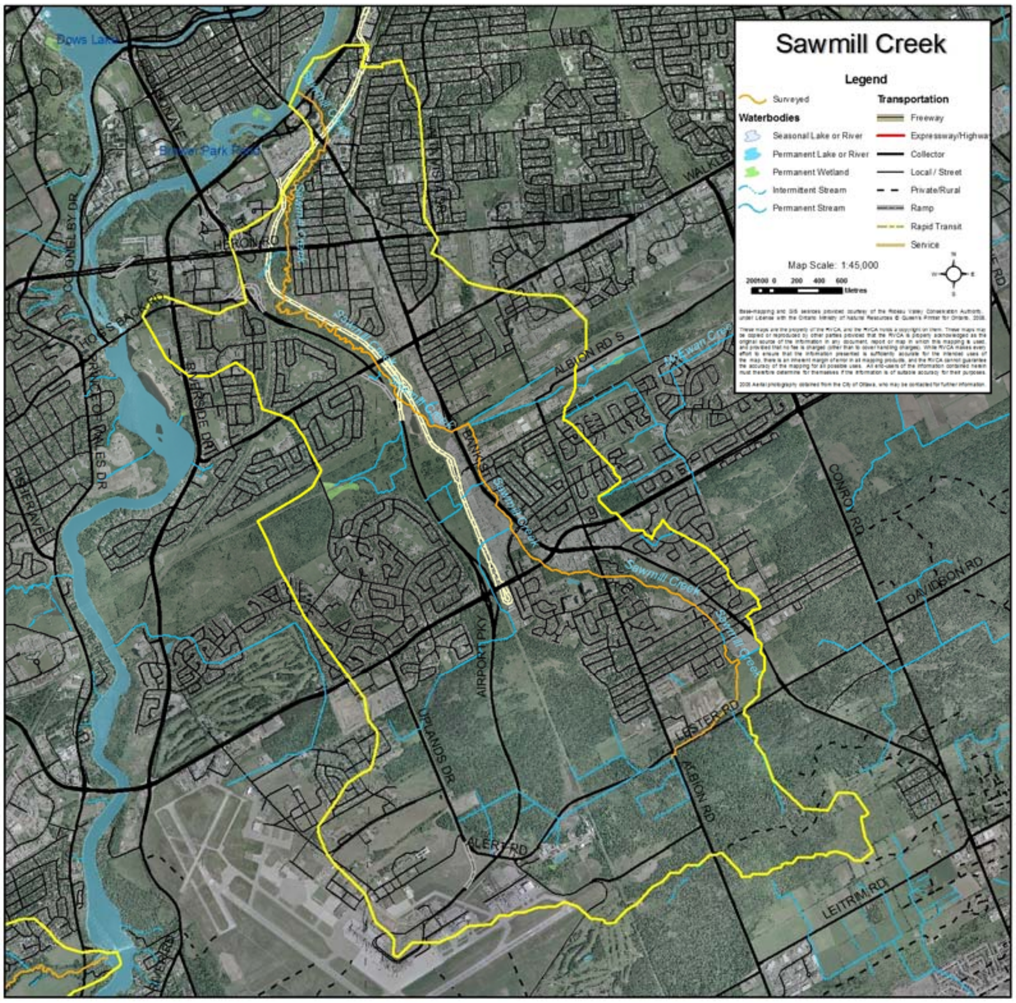



**Figure 50. Air Photo of Sawmill Creek and Surrounding Area**

## 1. Observations of Anthropogenic Alterations and Land Use

Figure 51 illustrates the classes of anthropogenic alterations observed by volunteers along Sawmill Creek. Of the 98 sections of stream surveyed, volunteers identified that 22 percent displayed no human alterations or disturbances. This area lies mainly between Heron Road, south to Walkley where the creek has a larger buffer than it does for the other sections. Of the remaining sections, 13 percent were considered natural with some human alteration. 30 percent of the creek was considered altered but with some natural portions. The remaining 35 percent was considered highly altered with few natural portions. These areas were sections of Sawmill that had been straightened and/or relocated. This area occurs mainly from the Home Depot on Bank Street to south of South Keys and Blossom Park shopping center. This area contains the highest amount of anthropogenic alterations where the creek has a limited buffer, and sometimes has no buffer at all. This area tends to collect a lot of garbage, and due to its channelization, is not able to access its floodplain or contain healthy fish habitat from the lack of stream meanders and pools created by natural stream processes. The other area of Sawmill that is highly altered occurs in the headwaters, where it has been channelized along and across Lester Road. Along that stretch, it could be mistaken for a roadside ditch.

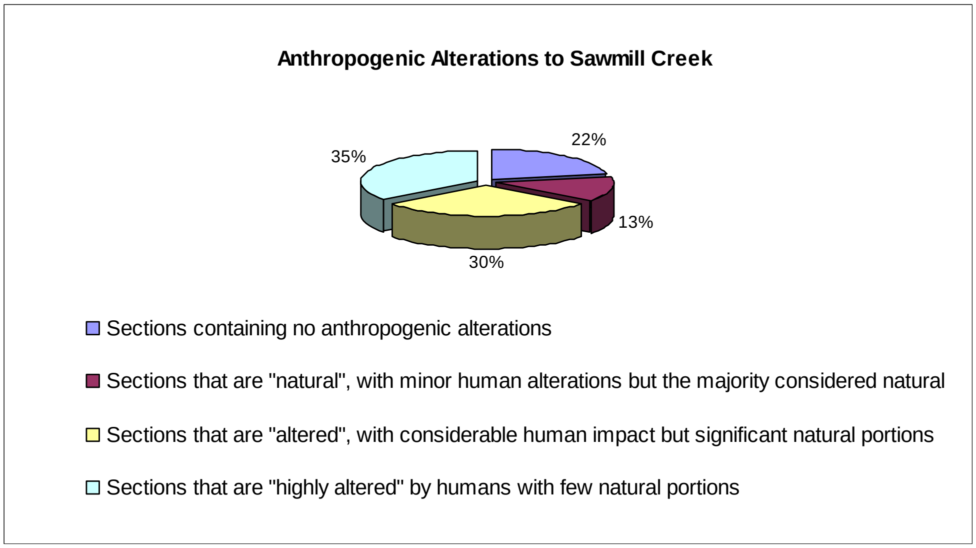



**Figure 51. Classes of Anthropogenic Alterations Occurring Along Sawmill Creek**

Figure 52 demonstrates the nine different land uses adjacent to Sawmill Creek observed by volunteers. Despite its urban location, 47 percent of the creek still contains natural areas, and these mainly occur from Heron Road south to the Home Depot on Bank Street. There are also some natural sections from Billing's Bridge to Heron Road. The natural areas consist of 22 percent scrubland, one percent wetland, eight percent meadow and 17 percent forest. Three percent of the creek is considered recreational, where paths were observed along the banks of the creek. Residential areas account for 14 percent of the land use adjacent to the creek and one percent was observed as "other" which was a school, cemetery and construction site. The more heavily urbanized sections along Sawmill were recorded as nine percent industrial/commercial. Sawmill Creek has many road and transitway crossings, and infrastructure accounts for 25 percent of the creek's surrounding land use. Infrastructure also includes the newly constructed wetland and stormwater outlets. Two of the stormwater outlets along Sawmill were reported by City Stream Watch due to substance leaks. One outlet was leaking an odorous brown sludge, and another outlet was staining the substrate white and smelled of sulphur.

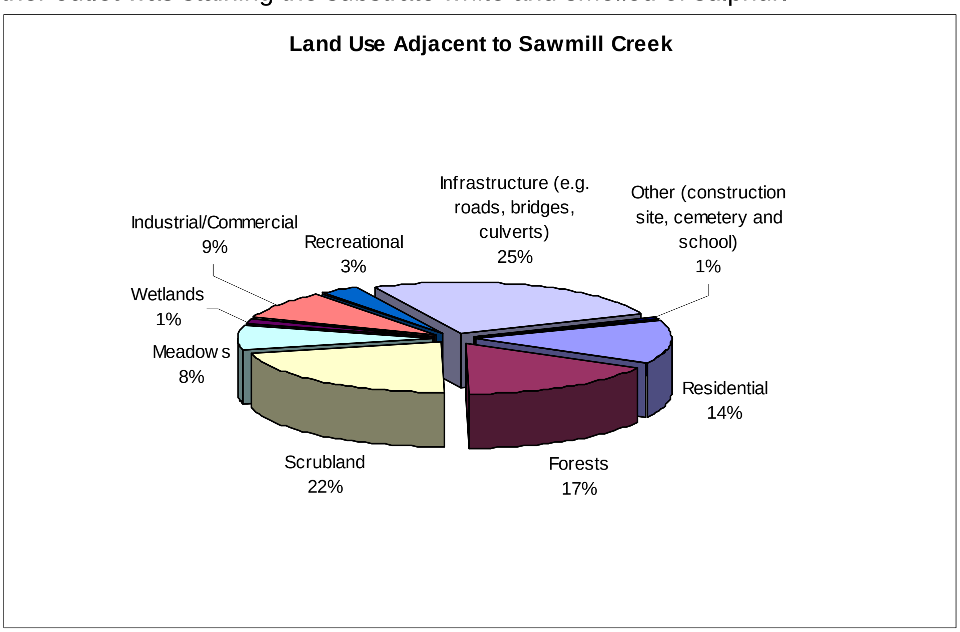



**Figure 52. Land Use Identified by Volunteers Along Sawmill Creek**

## 2. Instream Morphology of Sawmill Creek

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. 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. Sawmill Creek consists mainly of runs, with significant pool and riffle features.

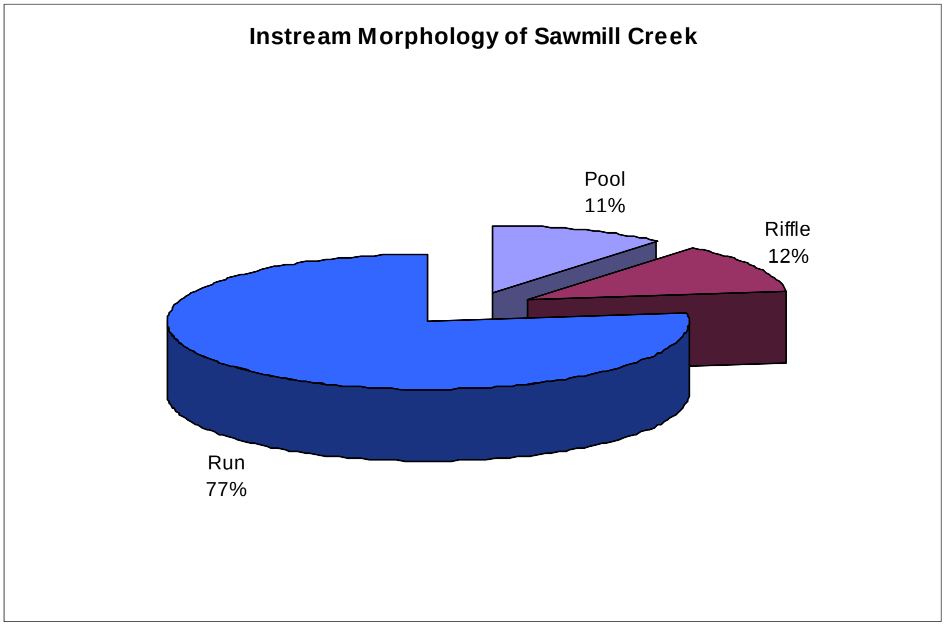



**Figure 53. Instream Morphology of Sawmill Creek**

## 3. Types of Instream Substrate Along Sawmill Creek

A variety of substrate can be found instream along Sawmill Creek and is demonstrated in Figure 54. Diverse substrate is important for fish and benthic macroinvertebrate habitat because some species will only be found in certain types of substrate and will only reproduce on certain types of substrate. Boulders create instream cover and back eddies for large fish to hide and/or rest out of the current, and cobble provides important over wintering and/or spawning habitat for small or juvenile fish. Other substrates also provide instream habitat for fish and macroinvertebrates.

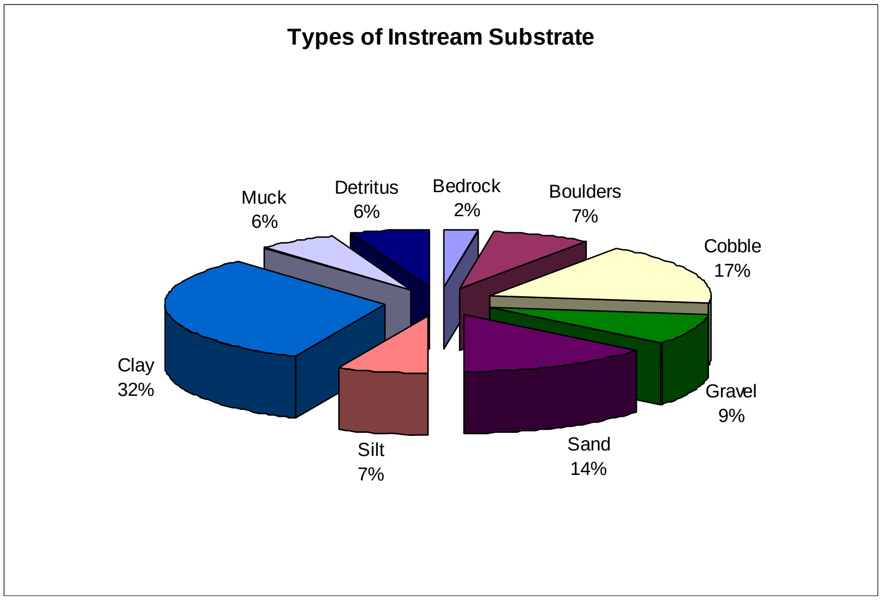



**Figure 54. Types of Instream Substrate Along Sawmill Creek**

## 4. Observations of Instream Vegetation

Figure 55 demonstrates the incidence of instream vegetation in Sawmill Creek. Instream vegetation was categorized as being common for 34 percent of the stream and 22 percent normal. Low vegetation made up 24 percent of the creek. For four percent of the creek, vegetation was rare, and for 13 percent of the creek, there was none. Three percent of the creek was considered to have extensive vegetation.

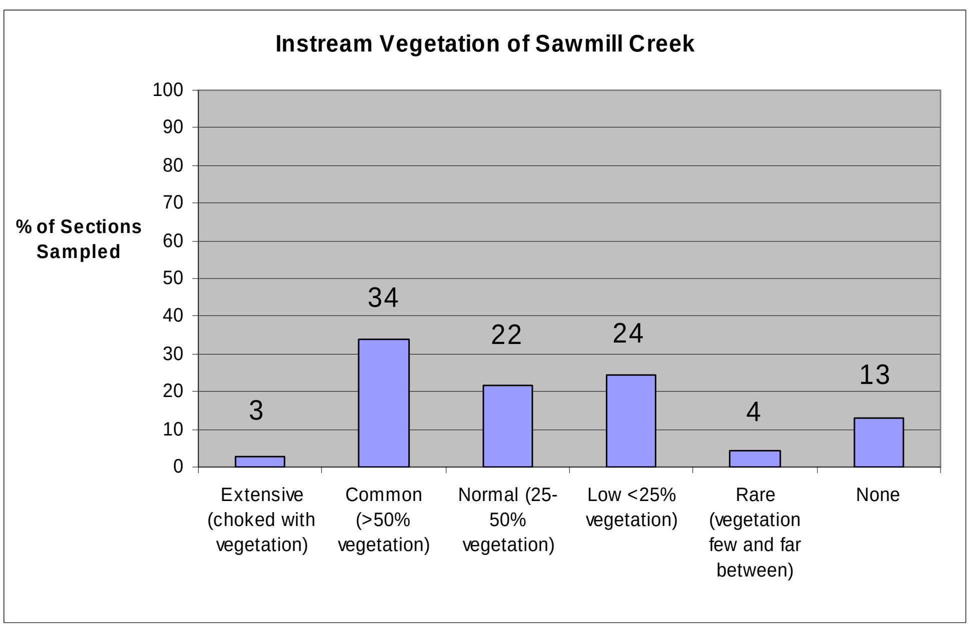



**Figure 55. Frequency of Instream Vegetation in Sawmill Creek**

A lack of instream vegetation can greatly increase bank erosion and sediment pollution, which was a problem, observed in many areas along the stream. Instream vegetation also provides habitat for fish and wildlife, aids in removing contaminants from the water, and contributes oxygen to the stream. Areas with little or no vegetation can negatively impact aquatic organisms by resulting in reduced refuge and cover areas. Extensive vegetation can also negatively impact the stream by reducing the amount of dissolved oxygen in the system and can impact the mobility and migration of aquatic organisms as well as the feeding patterns of fish. High levels of nutrients can lead to extensive vegetation growth. Stormwater outlets can carry water with high levels of nutrients and contaminants during rain events, elevating the levels in the stream. In many sections of Sawmill the vegetation was common, however it was algae and was not providing the benefits a common level of varied instream vegetation would if there were emergents, submergents, etc.

## 5. Observations of Bank Stability

The majority of Sawmill Creek has steep banks and a lot of clay. As the area around Sawmill Creek has become more urbanized and the surfaces surrounding it impervious to water (parking lots, buildings, etc.), the amount of direct runoff into Sawmill Creek has greatly increased. Even short rain events will cause water levels in the creek to rise significantly, and as water levels rise and the water flows faster, bank erosion occurs. Much of the buffer area has been reduced from Sawmill Creek, and there is not enough vegetation to filter and absorb the runoff coming in from the impervious areas. This combination puts a lot of pressure on the banks, which is evident in the observations made by the volunteers. Just over half of the right and left banks were considered stable. The left bank was considered to be 52 percent stable, and the right bank 55 percent stable. Black Rapids Creek, which has less anthropogenic alterations, better buffers and a higher percentage of natural land use, has more stable banks (87 percent stable on left bank and 89 percent stable on the right bank). Figures 56 and 57 demonstrate the bank stability of Sawmill Creek. Areas of erosion have been identified on an aerial photo of Sawmill Creek and can be found in Appendix I.

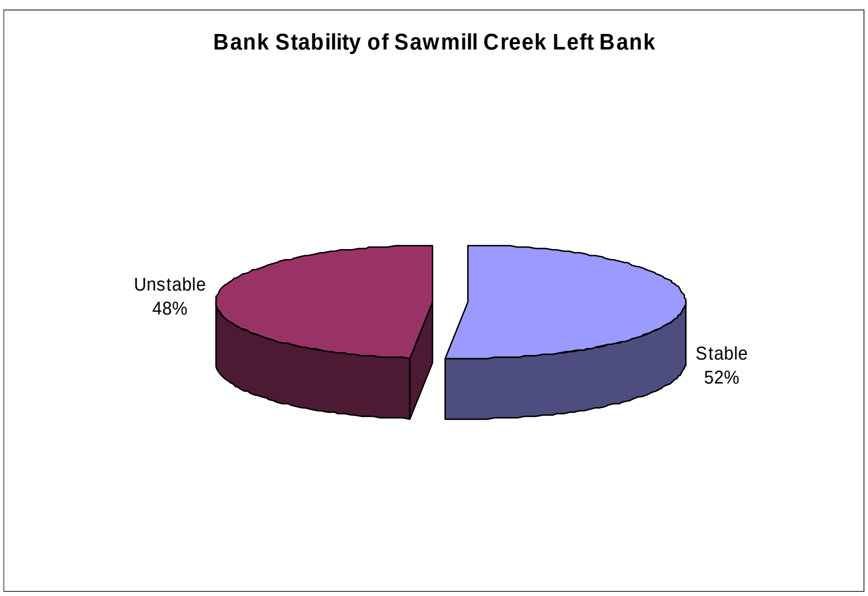



**Figure 56. Left Bank Stability of Sawmill Creek**

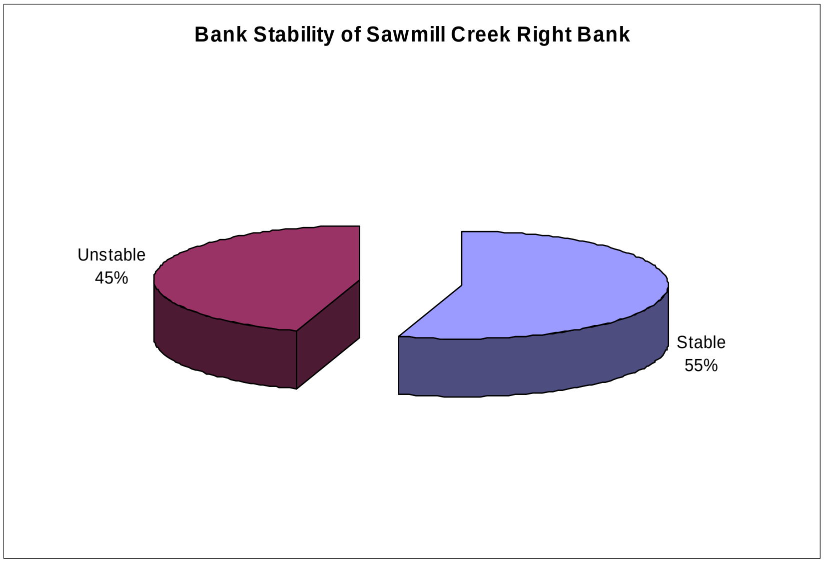



**Figure 57. Right Bank Stability of Sawmill Creek**

## 6. Buffer Evaluation of Sawmill Creek

Buffer widths for both the left and right banks of Sawmill Creek are illustrated in Figure 58. Thirty-five percent of the left bank and 36 percent of the right bank had a buffer of only zero to five metres, 18- 19 percent had a buffer of five to 15 metres and 21-23 percent had 15 - 30 metres. Only 24 percent of both banks had a buffer greater than 30 metres. Natural buffers between the creek and human alterations are extremely important for filtering excess nutrients running into the creek, infiltrating rainwater, bank stability and wildlife habitat. Natural shorelines also shade the creek, helping maintain baseflow levels and keeping water temperatures cool. According to the document *How Much Habitat Is Enough*, riparian areas of a stream should be a minimum of 30 metres or more, depending on the site conditions. Sawmill only meets this requirement for 24 percent of its stream length.

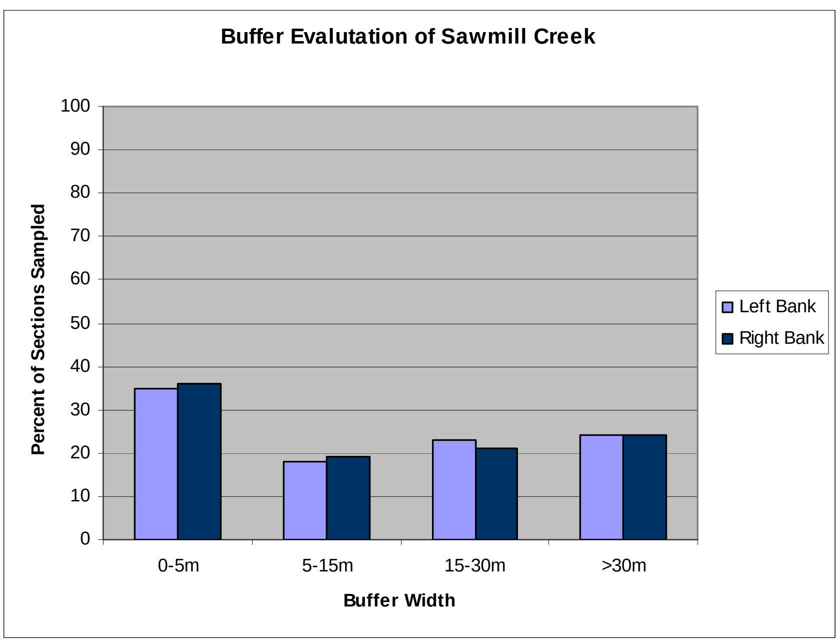



**Figure 58. Buffer Evaluation of Sawmill Creek**

## 7. Observations of Wildlife

Volunteers recorded the presence of types of wildlife in and around Sawmill Creek. Table 35 is a summary of the wildlife observed.

| Wildlife | Observed While Sampling |
|---|---|
| ***Birds*** | ducks, ducklings, mallards, great blue heron, chickadees, kingfishers, robins, grackle, crows, blue jays, redwinged blackbirds, ring-billed gulls, mourning dove, turkey vultures, pileated woodpeckers, canada geese, pigeon, green herons, goldfinch, catbirds, cardinals |
| ***Mammals*** | deer, raccoons, black squirrels, beaver, chipmunk, muskrat |
| ***Reptiles/Amphibians*** | green frogs, leopard frog, mink frog, american toad |
| ***Aquatic Insects*** | water striders, water boatmen, crayfish, snails, leech, |
| ***Fish (as observed through seining and electrofishing)*** | white sucker, mottled sculpin, brook stickleback, creek chub, bluntnose minnow, fathead minnow, central mudminnow, common shiner, blacknose dace, longnose dace, bluegill, rock bass, smallmouth bass, logperch, muskellunge, *Cyprinid spp*. |
| ***Other*** | butterflies, bumblebees, mosquitoes, crickets, spiders, caterpillars, molluscs, blue-faced darners, jewelwing, red rock skimmer, common whitetail, slugs, cicadas, beetles, ants |

**Table 35. Wildlife Observed Along Sawmill Creek**

## 8. Observations of Pollution/Garbage

Figure 59 demonstrates the incidence of pollution/garbage along Sawmill Creek. Pollution and garbage are major issues for Sawmill. Due to its urban location, much of the garbage in the surrounding areas, from residential buildings to roads and parking lots, gets washed into the creek. There were only two sections on Sawmill that did not have the occurrence of garbage.

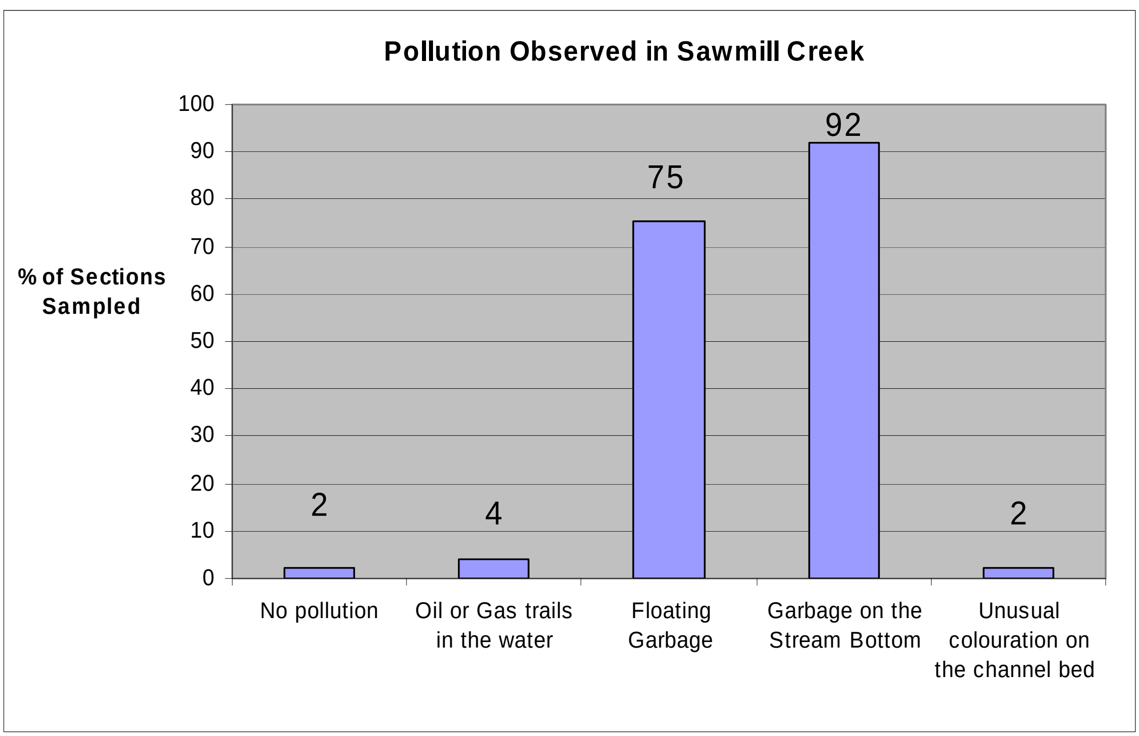



**Figure 59. Frequency of Pollution/Garbage Occurring in Sawmill Creek**

On many surveys, both floating garbage and garbage on the stream bottom was observed. A wide variety of pollution was recorded along Sawmill Creek. Some of the items included tires, shopping carts, lots of metal, netting, construction waste (including old sediment fences from past development projects), construction cones, a computer, microwave, mattress, pillows, clothing, bicycles, stuffed animals/dolls, video game controller, plastic, plastic containers, plastic bottles, plastic bags, cans, a scooter motor, rebar, basketballs, volleyballs, tennis balls, old culverts, blankets, glass, many paint cans, carpet, an iron, lawn chairs, old oil drum, caution tape, garden hoses, shoes, car parts, propane tank, fast food waste, an old safe, Styrofoam, cell phone, a stool, a suitcase and a grill. Three spills were reported to the Ontario Ministry of the Environment and the City of Ottawa. The first was an aerosol paint leaking into the creek, where fish were observed as being affected by the spill, the second was brown sludge leaking from a stormwater outlet on Walkley Road. and the third was a stormwater outlet staining the creek substrate white. The amount of garbage along Sawmill is a concern and can negatively impact fish and wildlife. As Sawmill Creek flows through a highly developed area, many species of wildlife depend on the creek as their refuge area. A resident near Billing's Bridge observed a duckling caught in a plastic bag that could not get free, and it drowned. The more garbage in the creek, the more people will not see it as a healthy stream, and they will continue to dump their garbage in or around it. Although it may be very urbanized, a large variety of fish and wildlife inhabit Sawmill Creek and the surrounding area.

## 9. Fish Community Sampling

### Seining

Seine netting was completed at two sites along Sawmill Creek, once on June 17, 2008 with one volunteer and again on July 19, 2008 as part of the biothon. 14 volunteers assisted that day in the seining and processing of the fish species. Most sites on Sawmill were more suitable for electrofishing, due to shallow depths and narrow channel width, so only two sites were sampled with a seine net. Figure 60 shows the locations of the sampling sites. A total of seven species were collected from the sites. All fish were live released back to the stream after seining and electrofishing events.

### Electrofishing

Sawmill Creek was electrofished by RVCA staff on July 2, 2008 and July 8, 2008. A total of three sites, each at a minimum of 70 metres, were sampled. (See discussion at 3.2.1 for a description of electrofishing). Figure 60 shows the locations of the electrofishing sites along Sawmill Creek. A total of fourteen different species were identified during sampling. Top predators are highlighted in bold and were caught at the mouth of the creek. A one metre long muskellunge was caught at the mouth, and it is clearly using the area for food and refuge.

Table 36 illustrates the water chemistry values obtained from each site at the time of seining. The YSI probe was out for repair during all but the first seining event, and therefore only water temperature was recorded. Table 37 summarizes the biological data obtained from each sampling event along Sawmill Creek.

| **Sampling Technique** | **Site #** | **Date (mm/dd/yy)** | **Air Temp C°** | **Water Temp C°** | **DO (mg/L)** | **pH** | **Conductivity (uS/cm)** | **Substrate** | **Instream Vegetation** |
|---|---|---|---|---|---|---|---|---|---|
| Seining | 1 | 6/17/2008 | 16.59 | 18.95 | 11 | 8.2 | 961 | clay | none |
| Seining | 2 | 7/19/2008 | 21 | 19 | N/A | N/A | N/A | clay; some muck, cobble and | submerged, algae |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | woody debris | |
| Electrofishing | 1 | 7/2/2008 | 24 | 22 | N/A | N/A | N/A | clay, sand, boulder | algae, submerged |
| Electrofishing | 2 | 7/2/2008 | 27 | 25 | N/A | N/A | N/A | cobble, sandy clay | algae |
| Electrofishing | 3 | 7/8/2008 | 22 | 18.25 | N/A | N/A | N/A | clay | algae, some grasses |

**Table 36. Water Chemistry Results for Sampling Sites Along Sawmill Creek**


**Figure 60. Air photo of Sawmill Creek Showing Sampling Sites**

| Sample Technique | Date Sampled | Site # | Species Sampled | Total number of species Caught |
|---|---|---|---|---|
| **SEINING** | | | | |
| | 17-Jun | 1 | bluntnose minnow, white sucker, common shiner, creek chub, brook stickleback, *Cyprinid spp*. | 6 |
| | 19-Jul | 2 | creek chub, white sucker, bluntnose minnow, fathead minnow, *Cyprinid spp.* | 5 |

| EFISHING | | | | |
|---|---|---|---|---|
| | 2-Jul | 1 | **muskellunge**, mottled sculpin, hybrid bluegill, rock bass, white sucker, **yoy smallmouth bass**, longnose dace, darter spp., logperch, blacknose dace, creek chub | 11 |
| | 2-Jul | 2 | white sucker, longnose dace, creek chub, *Cyprinid spp.* | 4 |
| | 8-Jul | 3 | creek chub, mottled sculpin, brook stickleback, central mudminnow, *Cyprinid spp*. | 5 |

**Table 37. Fish Community Results for Sampling Sites Along Sawmill Creek**

## Fish Species Status, Trophic, and Reproductive Guilds - Sawmill Creek

The following table was generated by taking the fish community structure of Sawmill Creek and classifying the recreational, commercial, or bait fishery importance, the Species at Risk status, reproductive guild (spawning habitat requirements), thermal classification, and trophic guild (feeding preference).

Most of the fish community in Sawmill Creek is made up of cool water species, and mottled sculpin, which is a coldwater species, was caught at two sites. Spawning habitat requirements within Sawmill are diverse and can been seen in the table below. There is a good mix of fish from the recreational and bait fishery in Sawmill Creek. Many people fish at the mouth of Sawmill where it empties into the Rideau River, and is also where we caught the muskellunge and smallmouth bass.

| MNR Code | Common Name | Scientific Name | Recreational Fishery | Commercial Fishery | Bait Fishery | Status | Reproductive Guild | Thermal Classification | Trophic Guild |
|---|---|---|---|---|---|---|---|---|---|
| 210 | blacknose dace | *Rhinichthys atratulus* | | | X | None | (non guarder) Lithophils | Cool | Insectivore/Generalist |
| 163 | white sucker | *Catostomus commersoni* | | | | None | (non guarder) Lithophils | Cool | Insectivore/ Omnivore |
| 281 | brook stickleback | *Culaea inconstans* | | | X | None | (guarders) Ariadnophils | Cool | Insectivore |
| 212 | creek chub | *Semotilus atromaculatus* | X | | X | None | (brood hiders) Lithopils | Cool | Insectivore/Generalist |
| 208 | bluntnose minnow | *Pimephales notatus* | | | X | None | (guarder) Speleophils | Warm | Omnivore |
| 314 | bluegill | *Lepomis macrochirus* | X | | | None | (nest spawners) Lithophils | Cool/Warm | Insectivore |
| 198 | common shiner | *Notropis cornutus* | | | X | None | (guarders) Lithopils | Cool | Insectivore |
| 141 | central mudminnow | *Umbra limi* | | | X | None | (non guarder) Phytophils | Cool/Warm | Insectivore/ Omnivore |
| 211 | longnose dace | *Rhinichthys cataractae* | | | X | None | (non guarder) Lithophils | Cool | Insectivore |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 311 | rock bass | *Ambloplites rupestris* | X | | | None | (nest spawners) Lithophils | Cool | Insectivore |
| 316 | smallmouth bass | *Micropterus dolomieui* | X | past | | None | (nest spawners) Lithophils | Cool | Insectivore/Piscivore |
| 342 | log perch | *Percina caprodes* | | | X | None | (non guarder) Psammophils | Cool | Insectivore |
| 309 | fathead minnow | *Pimephales promelas* | | | X | None | (guarder) Speleophils | Warm | Omnivore |
| 381 | mottled sculpin | *Cottus bairdi* | | | X | None | (guarders) Ariadnophils | Cold | Insectivore |
| 132 | muskellunge | *Esox masquinongy* | X | | | None | (non guarder) Phytophils | Warm | Piscivore |

**Table 38. Fish Species Status, Trophic and Reproductive Guilds for Sawmill Creek** (Source: *MTO Environment Guide to Fish and Fish Habitat*, 2006)

The following table summarizes the fish community structure found in Sawmill Creek and their sensitivity to sediment and turbidity for reproduction, feeding, and respiration. The composition of the fish community in Sawmill Creek ranges from species that are fairly tolerant to sediment and turbidity, to species that are intolerant, though the majority of the species are classified in the moderately tolerant range. Fish that rely heavily on sight to feed (smallmouth bass, muskellunge) are extremely sensitive to increased sediment and turbidity.

**Fish Species Sensitivity to Sediment/Turbidity for Sawmill Creek**

| MNR Code | Common Name | Scientific Name | Reproduction | Feeding | Respiration |
|---|---|---|---|---|---|
| 210 | blacknose dace | Rhinichtyhys atratulus | M | M | H |
| 163 | white sucker | Catostomus commersoni | M | L | H |
| 281 | brook stickleback | Culaea inconstans | L | M | unknown |
| 212 | creek chub | Semotilus atromaculatus | M | M | H |
| 208 | bluntnose minnow | Pimephales notatus | M | L | unknown |
| 314 | bluegill | Lepomis macrochirus | L | M | unknown |
| 198 | common shiner | Luxilus comutus | M | M | unknown |
| 141 | central mudminnow | Umbra limi | M | M | L |
| 211 | longnose dace | Rhinichthys cataractae | M | M | H |
| 311 | rock bass | Ambloplites rupestris | L | H | unknown |
| 316 | smallmouth bass | Micropterus dolomieu | M | H | unknown |
| 342 | logperch | Percina caprodes | M | M | H |
| 381 | mottled sculpin | Cottus bairdi | M | M | unknown |
| 132 | muskellunge | Esox masquinongy | M | H | L |
| 309 | fathead minnow | Pimephales promelas | L | L | unknown |

**Table 39. Fish Species Sensitivity to Sediment/Turbidity (High, Moderate, Low, unknown) for Sawmill Creek** (Source: *MTO Environment Guide to Fish and Fish Habitat*, 2006)

## 10. Temperature Profiles

Three temperature dataloggers were set in Sawmill Creek. Dataloggers 1 and 3 were set on May 15, 2008. Datalogger 2 was set on May 22, 2008. Dataloggers 1 and 2 were removed on September 19, 2008, and datalogger 3 was removed on September 15, 2008 during a survey. Figure 61 shows the locations of dataloggers in Sawmill Creek.


**Figure 61. Datalogger Locations Along Sawmill Creek**

Dataloggers were set in three different locations along the stream to give a representative sample of how temperature fluctuates and differs throughout the course of the stream. Sites begin at the furthest downstream site and were placed in order upstream. Datalogger 1 was set just upstream of Riverside Drive East. Datalogger 2 was set just downstream of Walkley Road, and datalogger 3 was along a section upstream of Albion Road. Figures 62, 63 and 64 show the results from the three dataloggers.

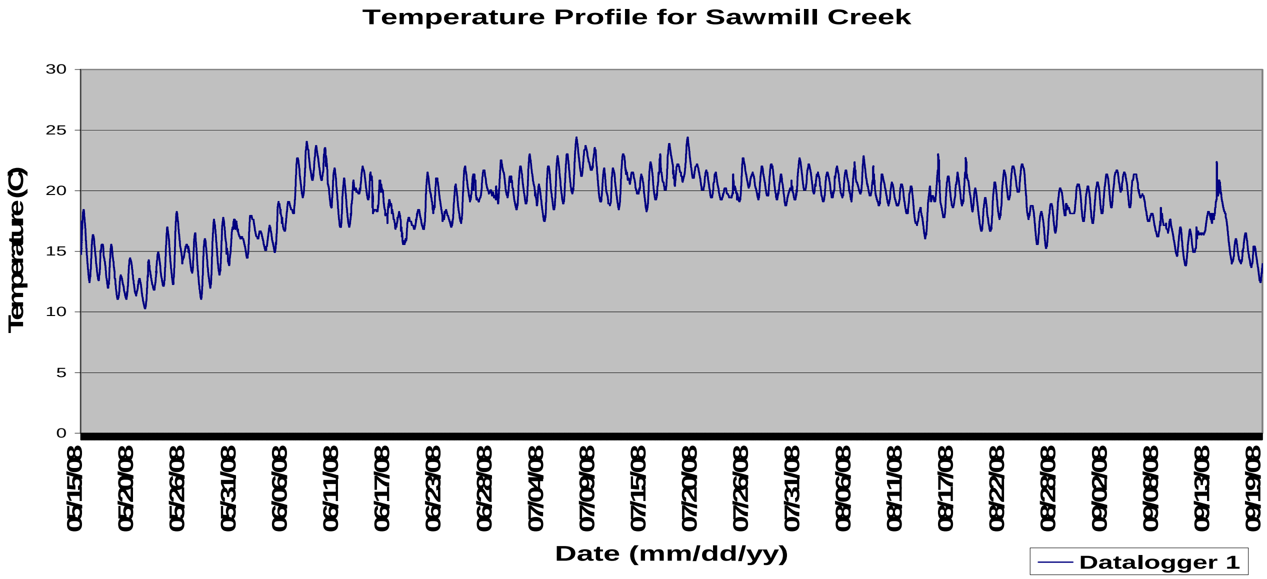



**Figure 62. Temperature Profile of Datalogger 1 at Riverside Drive**

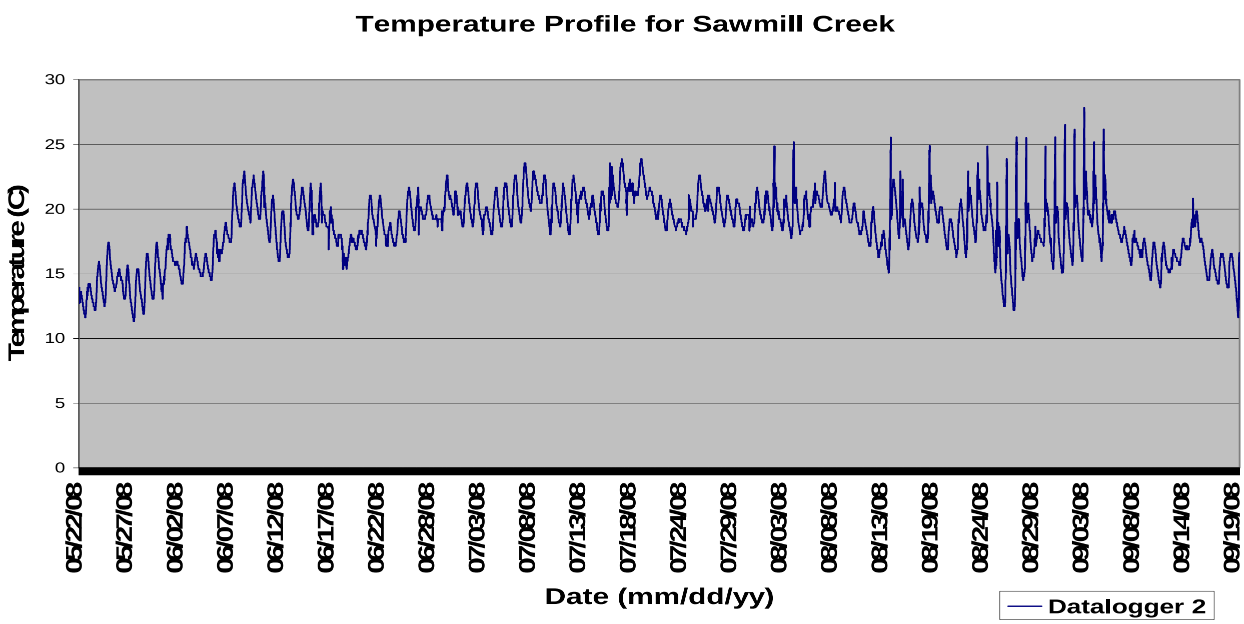



**Figure 63. Temperature Profile of Datalogger 2 at Walkley Road**

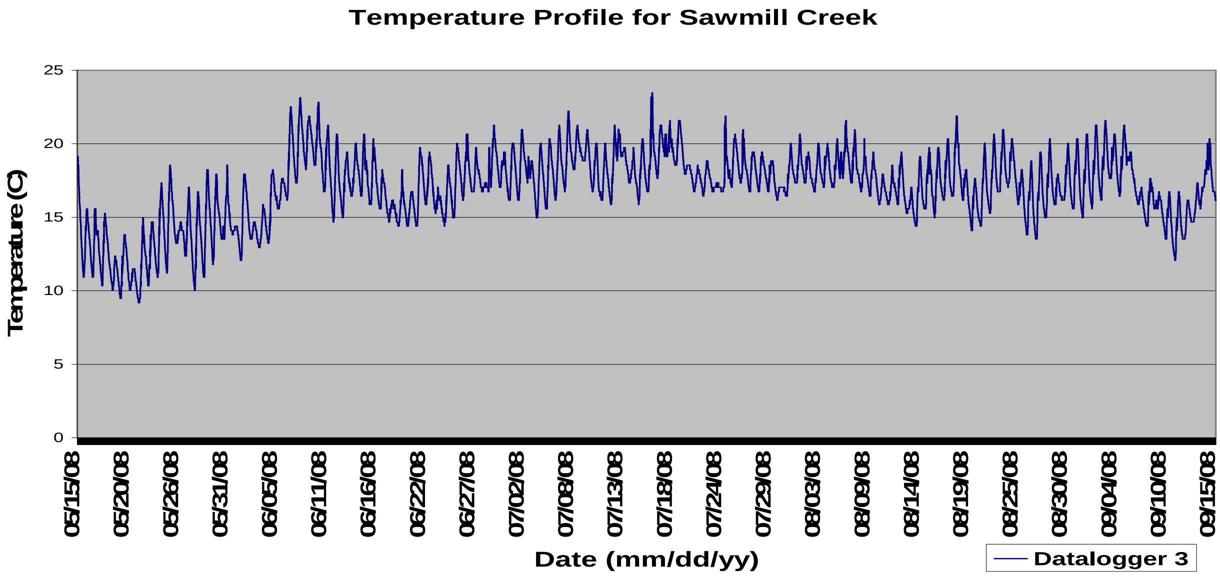



**Figure 64. Temperature Profile of Datalogger 3 at Albion Road**

Sawmill Creek can be classified as a cool water stream with some coldwater inputs. The maximum stream temperature in for datalogger 1 was 24.41°C. Datalogger 2 had a maximum temperature of 27.81°C, and datalogger 3 had a maximum of 23.46°C. All three trends look fairly similar, aside from the second datalogger. That datalogger was in an area of Sawmill that has been straightened, and the instream substrate is muck with little variation. There is some riparian cover, but there are stormwater outlets in the area. It is also possible that water levels fell below the datalogger, and it was recording air temperature.

Much of the fish community was made up of cool water fish species with only three warm water species, two cool/warm water species and one coldwater species.

## 11. Invasive Species

Figure 65 shows the locations of invasive species found along Sawmill Creek, highlighted in orange.

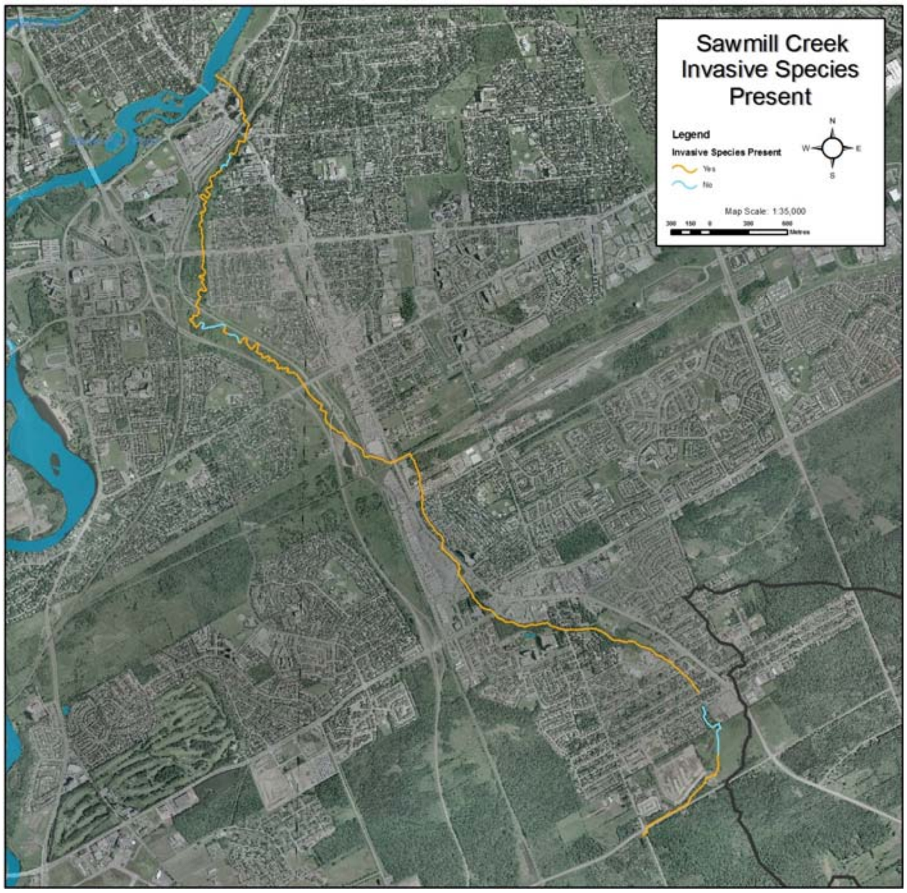



**Figure 65. Air Photo of Sawmill Creek Showing Locations of Invasive Species**

There were only a few sections along the Sawmill Creek valley that did not have some type of invasive species. The types varied in severity, though. Most parts of Sawmill Creek had purple loosestrife (*Lythrum salicaria*), which did not seem to be having a negative effect on the surrounding vegetation. Manitoba maple (*Acer negundo*) was also found in some areas. Many banks of the creek have been taken over by Common or Glossy Buckthorn (*Rhamnus cathartica* or *Rhamnus frangula*). Buckthorn presence is an issue because it forms large, dense canopies and crowds out native species, leading to a monoculture of buckthorn. Due to the bank stability issues along Sawmill Creek, it would not be a good idea to remove the buckthorn. Garlic mustard (*Alliaria petiolata*) was also found in many parts of the creek. This small, herbaceous plant interferes with the relationship between tree roots and the soil, slowing the growth of the tree. In areas with bank stability issues, it is important that the trees remain as healthy as possible in order to help with bank stability. There is also dog-strangling vine/pale swallowwort (*Cynanchum rossicum*), which grows in disturbed areas. This plant wraps around the vegetation it grows on which affects the native plant's success. It can be found in a few areas along Sawmill, and one location is the Heron Park area. The banks along Sawmill Creek here are steep and eroding. Efforts should be made to keep the dog-strangling vine under control so that it does not affect the vegetation in that area and jeopardize those banks. The other invasive species found are Japanese knotweed (*Polygonum cuspidatum*) and Common Reed (*Phragmites australis*), and both of these species are problematic, outcompeting native vegetation and forming monocultures.

## 12. 2003/2008 Comparison of Sawmill Creek

Half of Sawmill Creek was sampled in 2003 (54 sections). In 2008, Sawmill was sampled in its entirety (98 sections). Therefore, only data from the first 54 sections have been compared. The field sheets have been modified to include more variables in the assessment. Several of the questions have been modified and improved to provide more detail, therefore making direct comparisons difficult. The following tables are a comparison between 2003 and 2008. There was no fish sampling done on Sawmill Creek in 2003, therefore no comparisons have been made between that fish data.

| Anthropogenic Alterations | 2003 (percent) | 2008 (percent) |
|---|---|---|
| *none* | 33 | 28 |
| *"natural" conditions with significant alterations by man* | 19 | 20 |
| *"altered" with considerable human impact but with significant natural areas* | 31 | 20 |
| *"highly altered" with few areas that could be considered natural* | 17 | 32 |

**Table 40. Comparison of Anthropogenic Alterations**

Overall, alterations to Sawmill Creek have increased over the last five years. Natural areas stayed relatively the same, while "altered" areas decreased and unaltered and "highly altered" areas increased. Since 2003, there has been more development along Sawmill Creek. Home Depot was constructed with the channel being relocated, and Artistic Landscape expanded their operation, resulting in a reduction of buffer. An offline constructed wetland was also built between Bank St. and the Airport Parkway, resulting in more outlets draining into the creek.

| Instream Vegetation | 2003 (percent) | 2008 (percent) |
|---|---|---|
| *extensive* | 0 | 2 |
| *common* | 3 | 36 |
| *normal* | 3 | 22 |
| *low* | 34 | 24 |
| *rare* | 60 | 7 |
| *none* | N/A | 9 |

**Table 41. Comparison of Instream Vegetation**

Instream vegetation is difficult to compare, and the data can depend on when the stream was surveyed. The category for "none" was also added after 2003 and cannot be reflected in the 2003 data. Instream vegetation data does differ, with a two percent increase in extensive vegetation, a 33 percent increase in common vegetation and a 19 percent increase in normal vegetation. Areas with both low and rare vegetation decreased significantly.

| Bank Stability | 2003 (percent) | 2008 (percent) |
|---|---|---|
| *stable* | 81 | 44 |
| *unstable* | 19 | 56 |

**Table 42. Comparison of Bank Stability**

Over the last five years, bank stability has drastically changed, moving from 81 percent stable to 44 percent stable. Due to its location in the urban core of Ottawa, much of the area surrounding Sawmill Creek is impervious (parking lots, buildings, roads, etc.), and the stream receives a large amount of runoff during precipitation events. Water levels in Sawmill can fluctuate greatly with only a small amount of precipitation.

| Pollution/Garbage | 2003 (percent) | 2008 (percent) |
|---|---|---|
| *none* | 2 | 2 |
| *oil or gas trails* | 2 | 6 |
| *floating garbage* | 80 | 89 |
| *garbage on stream bottom* | 87 | 89 |
| *unusual colouration* | N/A | 0 |

**Table 43. Comparison of Pollution/Garbage**

Sections without pollution/garbage remained the same. Oil and gas trails, floating garbage and garbage on the stream bottom all increased. Unusual colouration of the streambed was added after 2003 and not observed in the first 54 sections surveyed in 2008.

## 3.3 Special Events

Over the summer, City Stream Watch ran four special events outside of regular sampling, riparian planting and garbage cleanups. These events included a training session and benthic sampling day on Cardinal Creek, a Biothon that took place on all 2008 creeks, two fish sampling and identification sessions (using seining and electrofishing methods) and a benthic sampling/flyfishing demonstration with the Ottawa Flyfishers Society.

### 3.3.1 Cardinal Creek Training Day

On June 14, a morning session was held for interested volunteers to train them on the macro stream survey protocol. In the afternoon, more volunteers took part in a session on benthic macroinvertebrate sampling. Volunteers were introduced to the basics of the Ontario Benthos Biomonitoring Network (OBBN) protocol and how to process and identify benthic macroinvertebrates to different orders. Freshwater benthic macroinvertebrates, or more simply "benthos", are animals without backbones that live on the stream bottom. These animals live on rocks, logs, sediment, debris and aquatic plants during some period in their life. The benthos includes crustaceans such as crayfish, molluscs such as clams and snails, aquatic worms and the immature forms of aquatic insects such as stonefly and mayfly nymphs. Benthos represents 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. City councillors Bob Monette and Rob Jellett attended the morning session, along with MPP Jean-Marc Lalonde.

### 3.3.2 Biothon

A biothon was held on July 19 in conjunction with other groups across Ontario participating in a “Check Your Watershed Day”. Although City Stream Watch volunteers gathered different stream data, they still joined other groups across Ontario in learning more about their local creeks and actively getting involved. For the Biothon, there was one group placed on each of the four 2008 streams. Volunteers spent half the day sampling and identifying benthos and half the day learning fish sampling and fish identification. The benthic session taught the importance of aquatic invertebrates as part of the food chain and their role as bioindicators of aquatic health. The fish session was spent learning how to seine net and how to process the fish caught. Key identification features were taught for the species found. A total of 24 volunteers participated in this event. Each participant received a free pass to the RVCA's conservation areas, and a draw was held for each of the groups. The winners of the draw received *Fishes of the Great Lakes Region, Second Edition by Hubbs and Lagler,* which is an excellent resource for identifying different fish species. The Monterey Resort Inn and Conference Center generously supplied lunch for the volunteers during the Biothon.

## 3.3.3 Benthic Identification and Flyfishing Demonstration

On September 20, 2008, City Stream Watch teamed up with a member of the City Stream Watch collaborative, the Ottawa Flyfishers Society (OFS), to put on a very exciting day of benthic i.d. and fly fishing lessons. The event was held at the Jock River Landing, and staff from the RVCA taught the basics of the OBBN protocol (Ontario Benthos Biomonitoring Network), how to process and identify the benthos to the order level and provided different information on benthos and how they relate to fly fishing. Volunteers had a chance to put on the waders and try out the OBBN protocol and identify the organisms. After a lunch provided by the Monterey Inn and Resort Conference Center, volunteers got down to the serious business of fly fishing. The OFS gave an introduction to fly fishing and provided some samples of fly ties. The group then split up, and volunteers were able to try fishing and get help with their techniques from the fly fishers. The Ottawa Flyfishers Society was formed in 1983 to unite local area fly fishers. The Society is dedicated to fostering and furthering the practice of activities associated with the art of flyfishing, conservation and resource renewal.

## 3.3.4 Fish Sampling and Identification Sessions

A total of three fish sampling and identification sessions were held during the 2008 season. The first was held on Black Rapids Creek, just downstream of the Merivale Road Crossing. Eighteen volunteers attended the session where they learned how to seine net and process the fish that were caught. Key identification features were taught for each of the species captured. The second fish sampling session was held as part of the biothon where volunteers spent a half day seine netting. The same things were taught at this event as the first. The third fish sampling event was an electrofishing demonstration. Due to safety issues, electrofishing is always done with RVCA staff. Many volunteers are curious about electrofishing and want to know how it is done. On August 24, 2008, 22 volunteers stood on the banks while RVCA staff electrofished a riffle and pool on Mud Creek in Manotick. Before beginning, all safety features of the electrofisher were explained to volunteers and all safety features tested before sampling began. Once the sampling was complete, volunteers participated in sorting, identifying and processing (measuring and weighing) the fish, and a small group of volunteers also participated in seining a pool upstream of the electrofishing site. All fish were live released back into the stream.

# 3.4 Community Stream Cleanups

## 3.4.1 Rideau River

The City Stream Watch Program joined forces with the Urban Rideau Conservationists (URC) to help clean the Rideau River as part of their "Mother's Day Cleanup" held on May13, 2007. The URC received a grant from the City of Ottawa to carry out this cleanup and recruited a number of partners from around the City of Ottawa. Long time City Stream Watch partner, Monterey Inn Resort and Conference Centre, provided sandwiches, vegetable platters and beverages for hungry volunteers at the end of the morning.

## 3.4.2 Sawmill Creek

Due to the amount of garbage found along Sawmill Creek, City Stream Watch dedicated the other three cleanups to Sawmill. On August 9, City Stream Watch, in conjunction with the Heron Park Community Association and the National Defence Headquarter Fish and Game Club (NDHQ), held the first stream cleanup. Eighteen volunteers were spread out along the creek from the mouth at the Rideau River to Heron Road. This entire section was cleaned up. The material removed from the stream is garbage and debris of human origin, such as tires, cans, etc. The second cleanup was organized for September 6 with the NDHQ Fish and Game Club. Despite the constant pouring rain, eight soaked volunteers turned out to pick up garbage in Sawmill from the Home Depot upstream to Blossom Park Shopping Center. Due to the weather, we were not able to clean the entire section, so four volunteers focused on the worst sections which were behind the Home Depot on Bank Street, upstream to South Keys Shopping Center. The other four volunteers concentrated their efforts on the section of the creek south of Queensdale Avenue, where Sawmill runs between Blossom Park Shopping Center and residential buildings. Many shopping carts were taken out of the creek in that spot. The City of Ottawa provided a dumpster for this event, and the shopping carts were taken to a metal recycling facility. The Monterey Inn Resort and Conference Center supplied delicious sandwiches for hungry and soggy volunteers at lunchtime! The last cleanup on Sawmill Creek was held in the evening, as part of the TD Great Canadian Shoreline Cleanup. Ten volunteers started at Heron Park and worked south; however, they did not get far before stopping at a very large log jam where an incredible amount of garbage had gotten lodged in. Volunteers spent the remainder of the cleanup gathering that garbage and carrying it up the banks to the road. In total, 3.4 kilometres of Sawmill was cleaned up, and volunteers contributed a total of 105 hours. Figure 66 shows the stretches of Sawmill Creek that were cleaned.


**Figure 66. Map of Sawmill Creek Showing Sections Cleaned in 2008**

## 3.5 Riparian Planting Projects

Riparian zones are the vegetated transition areas between aquatic and terrestrial habitat. They make up one of the most important aspects of stream health because they protect surface water from polluted runoff, siltation and most importantly, erosion. Riparian zones also offer very important habitat for many fish and wildlife species. Healthy riparian zones are densely populated with vegetation, and thus have an intricate root system that helps to stabilize the bank and prevent erosion. In a stream surrounded by a healthy riparian zone, increased sediment from banks is minimized. Water bodies that have lost this essential vegetation require rehabilitation projects such as these to help restore stream health.

It is crucial for landowners who live around water to leave a natural buffer of vegetation between their property and the water edge. Removing this vegetation eliminates root systems, which are required to stabilize banks, and increases runoff, which allows pollutants and silt to degrade habitat for aquatic life. For more information on how to naturalize your property and eliminate erosion of your property, visit “Living By the Water Project” on the web at http://www.livingbywater.ca/main.html.

### 3.5.1 Sawmill Creek-Project Planting

City Stream Watch, in cooperation with Heron Park Community Association has completed two phases of a shoreline rehabilitation project on Sawmill Creek. The goal of this project was to restore a failed bank on the east side of the stream just north of Heron Road. Phase I planting was done in 2005 where 350 small shrubs were planted along a failed bank to help re-vegetate the lower areas of the bank. A pathway was also relocated further away from the crest of the slope. Phase II was completed in the spring of 2006 at the same location where 600 more trees were planted along the upper sections of the bank failure and in areas where more planting was necessary. No planting was done in 2007 in order to give the plants a chance to grow for a year, but more planting was done in 2008. Figure 67 shows the location of the tree planting site.

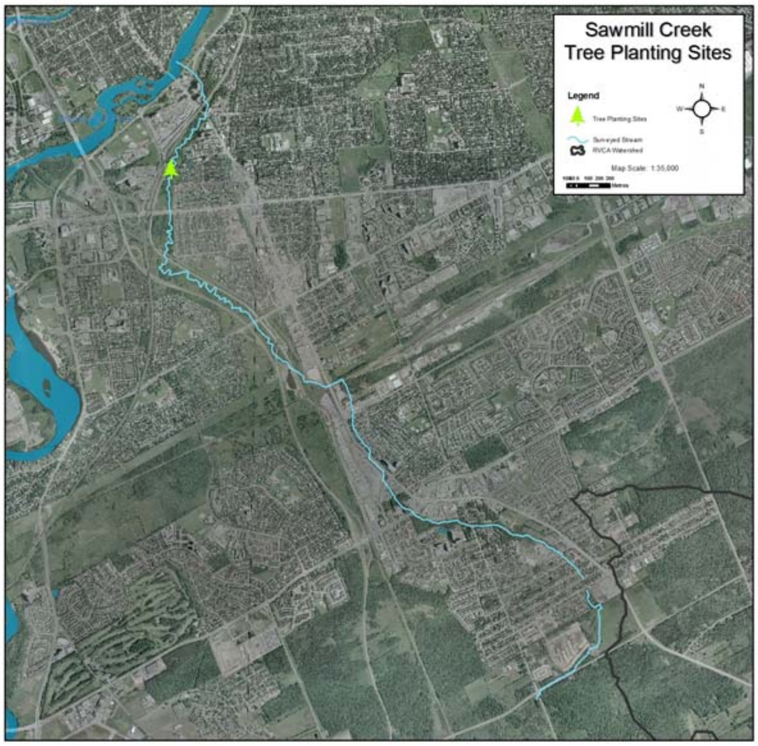



**Figure 67. Air Photo of Sawmill Creek Showing Tree Planting Site**

Sumac and red osier dogwood were planted by six volunteers to help fill in some of the gaps. A total of 210 trees were planted in cool, rainy weather. The bank closest to the water is still experiencing a lot of erosion, and bioengineering is needed instead of tree planting to help vegetation hold against fluctuating water levels and higher velocities during storm events. Bioengineering uses plant material in different ways where trees planted would normally wash out. Cuttings from willows, dogwoods and other species can be used together in a number of ways to hold in the banks while the cuttings sprout. There are a number of different methods that can be used. The path that was relocated in 2005 is not being used, and people are still using the path on the crest of the slope. Signage and proper fencing would be needed to keep people from trampling the vegetation there. Later in the 2008 season, dog-strangling vine was found growing over much of the vegetation surrounding the site. Dog-strangling vine (*Cynanchum rossicum*) is an invasive species and wraps around trees

and shrubs, eventually outcompeting them. This species will need to be monitored and removed on a regular basis to help keep that section of the creek vegetated.

### 3.5.2 Green's Creek

On May 10, a tree plant was held on Green's Creek near the intersection of Innes and Blair Road. That area of the creek lacks a buffer on the right bank, and there is some erosion occurring on the left bank. Sixteen volunteers planted 180 red osier dogwoods and 70 sumac along the banks of Green's Creek. This site is large and could benefit from more trees and shrubs, all along Innes Road. Figure 68 shows the location of the planting site.

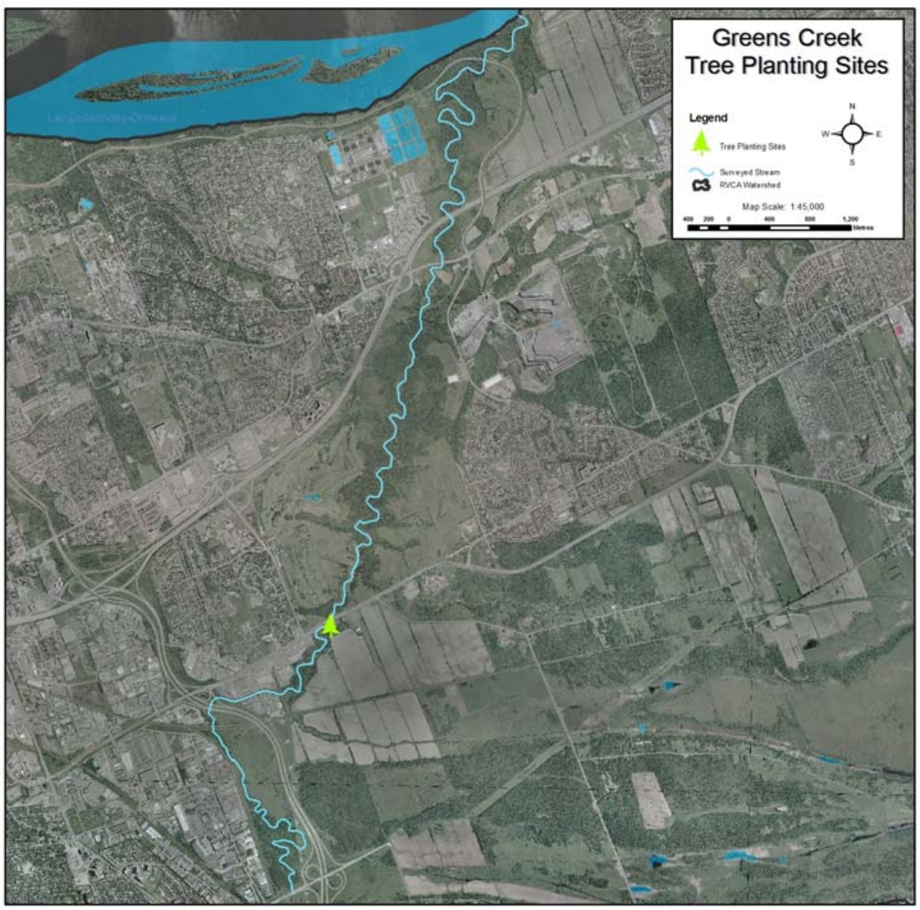



**Figure 68. Air Photo of Green's Creek Showing Tree Planting Site**

## 3.5.3 Cardinal Creek

The Cardinal Creek Community Association held a tree planting event on May 31, 2008 in the morning. In the afternoon, City Stream Watch joined up with some of those volunteers and provided 295 trees and shrubs to plant. The area of focus is where the trailhead comes down to Cardinal Creek in the Springridge subdivision. This is also where a stormwater retention pond holds water and releases it into Cardinal Creek. On each side of the pond is a grassy hill that comes down to the edge of the creek. Aside from leaving an area of access to the stormwater outlet, all of the grassy area should be planted with trees to help filter some of the runoff from the subdivision and the recreation path. Planting trees will also increase shading around the pond and will help thermally mitigate the potential that the stormwater facility is releasing warmer water to Cardinal Creek. Volunteers planted staghorn sumac, red osier dogwood, red pine, peachleaf willow, white spruce, silver maple and tamarack. This area is very large, and many more trees could be planted here. Some dogwoods were planted just south of Watters Road that is also open grass and experiencing some erosion. More trees and shrubs could be planted here in the future as well. Figure 69 shows the area planted.

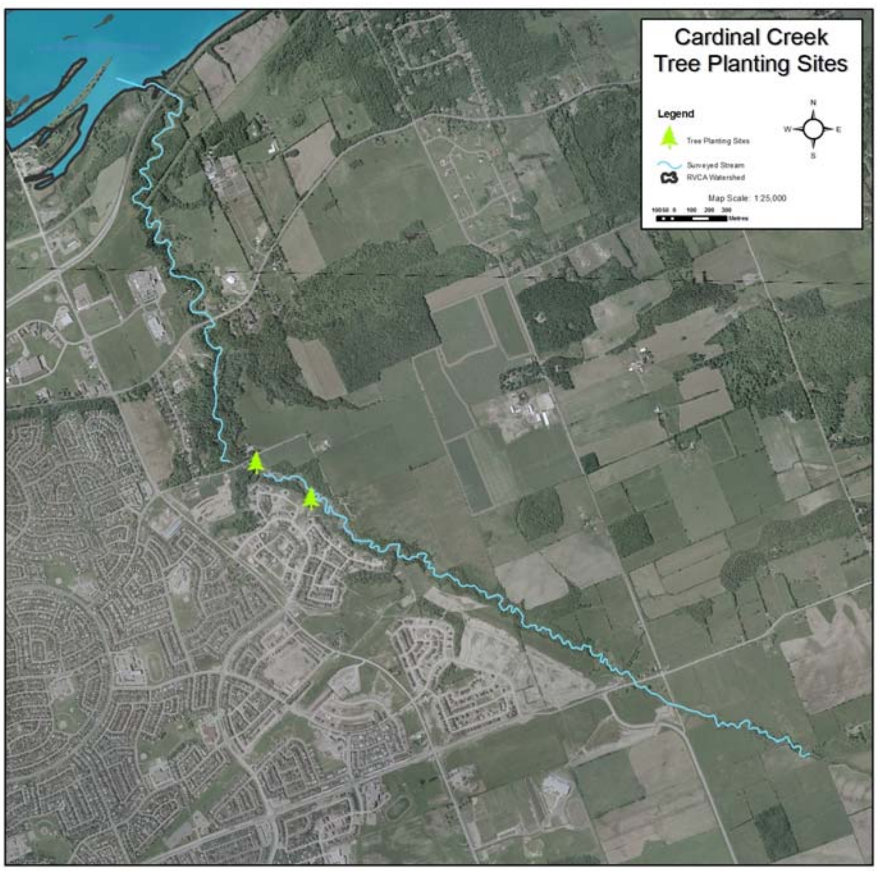



**Figure 69. Air Photo of Cardinal Creek Showing Tree Planting Sites**

# 4.0 A Look Ahead to 2009

The City Stream Watch program is currently planning projects for the 2009 season. Stream surveys run on a 5-year cycle, and in 2009, the program will be returning to the streams sampled in 2004, as well as adding an unsurveyed stream that has not yet been sampled. This allows managers to update data and do comparative analysis to see if the creek has undergone change in the intervening years and to determine what may have caused those changes.

The streams to be re-surveyed in 2009 include Mosquito Creek, Stillwater Creek and Bilberry Creek. Barrhaven Creek will be surveyed for the first time. Figure 70, below, illustrates the stream watersheds in relation to the City of Ottawa. Maps of 2009 streams in relation to other years can be found at the beginning of the report on page 10.

The program is always looking to extend its efforts to new initiatives and goals. For the 2009 program, various projects have been identified and plan to be implemented beginning in the spring. Some projects include:

- Stream surveys on Mosquito, Bilberry, Stillwater and Barrhaven
- Fish community sampling through seine netting and electrofishing
- Aquatic invertebrate sampling/identification
- Flyfishing demonstration by OFS members, along with invertebrate ID session
- Temperature profiling of 2009 streams
- Cleanups on city streams as part of Canadian Rivers Day and the TD Great Canadian Shoreline Cleanup (Sawmill Creek and another TBD)
- Riparian planting on Mud Creek (tributary of Green's Creek) and Sawmill Creek at the mouth
- One small-scale bioengineering project (site TBD)
- Invasive plant species removal—dog strangling vine on Sawmill Creek and Green's Creek; flowering rush and yellow iris on Cardinal Creek

Many of these projects are explained further in the special projects section or are shown in Appendix J, where maps of Potential Projects are listed. New projects continue to be identified and included in the 2009 program in hopes of continuing the success of City Stream Watch as well as keeping volunteers interested in the program. For more information, refer to the RVCA website (www.rvca.ca) in the spring for updates and information on the program and how to sign up.

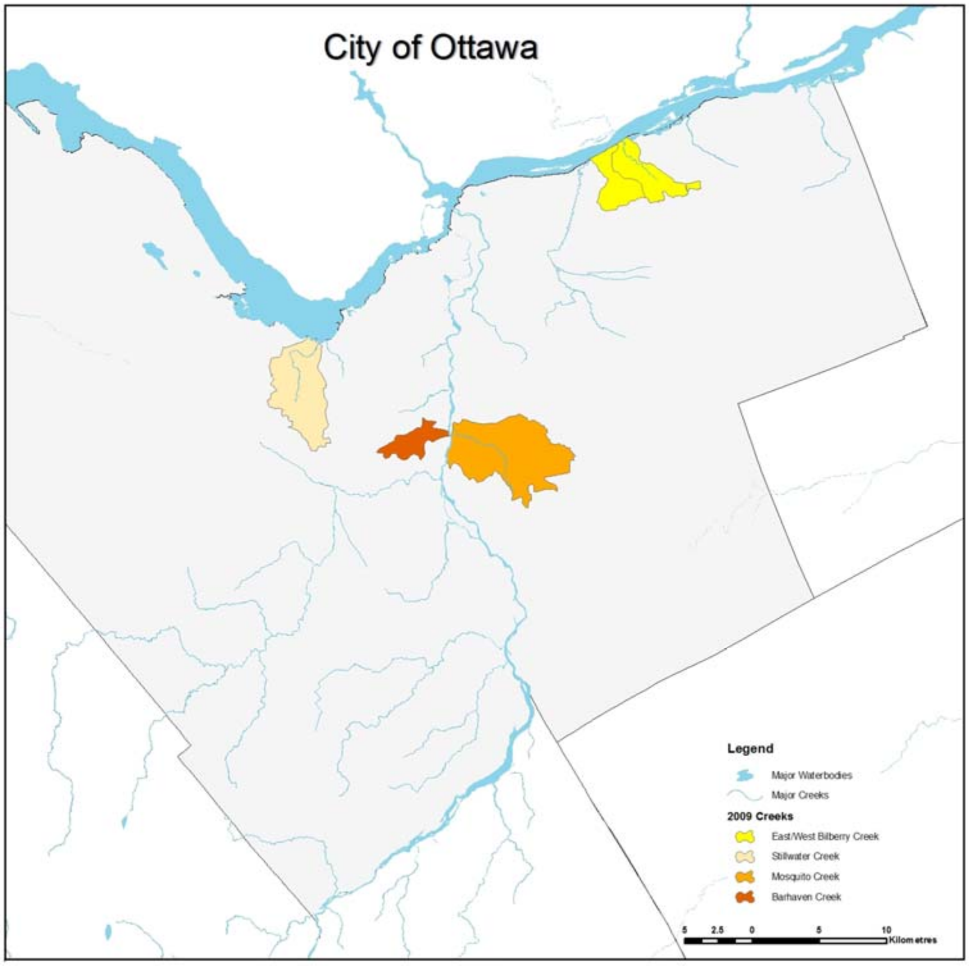



**Figure 70. Locations of Streams and Their Watersheds to be re-surveyed in 2009**

## 4.1 Recommendations

It is important that City Stream Watch be sustained in order to inform, involve and educate community residents on the state of urban creeks and streams, as well as to encourage restoration projects and sound stewardship practices. To this end, the City Stream Watch program should build on the successes achieved during the past six years. Through its ongoing activities, temporal and spatial environmental trends of streams in the Ottawa area may be observed and recorded. The data will complement work conducted by a few municipal and watershed-based programs, most of which do not monitor the smaller urban streams that are the focus of this program and will incorporate the intrinsic value of community-based environmental monitoring and stewardship through personal involvement.

## 4.2 Program Improvements

The following are recommendations to improve the program.

- Continue to develop creative means in order to contact, as well as ensure, the involvement and ongoing interest of all concerned members of the community.
- Build upon a strong relationship with collaborative groups and continue to look for new organizations which could strengthen the program

- Employ a summer student to assist with fieldwork and allow more flexibility to match volunteer schedules
- Continue contacting the community early in the year to maximize both the involvement and the diversity of participants.
- Foster relationships with environmentally oriented groups (i.e. Scouts Canada) to facilitate student involvement.
- Continue to run stream cleanups on city streams to enhance fish and wildlife habitat and maintain the natural beauty of our city's streams
- Develop a more aggressive approach to youth recruitment to entice educators and high school students to participate in the program (hours of participation can be counted toward the student's volunteer hours to graduate)
- Develop new, creative projects to keep volunteer interest high
- Continue to ensure that the needs of the participating community are satisfied as they relate to their continued involvement in the program
- Attract funding opportunities from outside funders for the program and rehabilitation projects
- Develop relationships with universities to attract students to participate to gain experience
- Begin to bring in one stream restoration project a year, aside from riparian planting and collaborate projects with goals already established in subwatershed studies
- Every year, many seasonal migratory obstructions are observed and could be easily removed, for which City Stream Watch could take a more active role
- Get more businesses involved that are adjacent to the creeks — contact businesses to do their own cleanups, improve the buffer, etc., with guidance from the City Stream Watch program
- Engage more neighborhoods surrounding creeks with information on the importance of riparian vegetation, ways to lessen the impact on streams from residential buildings. This can be done with the help of the collaborative members and educational material already available through the RVCA
- Begin the pilot project of Adopt-A-Stream to encourage stream stewardship on creeks between survey years
- Focus on potential projects identified in 2008

## 4.3 Special Projects

The following are projects that have been developed from information obtained through monitoring, and could be implemented through City Stream Watch or other community based environmental initiatives.

Table 44 identifies possible rehabilitation projects that were developed through monitoring.

**Table 44. City Stream Watch – Project Potentials**

| Location | Issue | Picture | Remediation Strategy | Expected Results |
|---|---|---|---|---|
| Sawmill Creek just north of Hunt Club Road. | Woody debris has accumulated at a culvert area along Sawmill Creek. The wood has dammed the stream, thereby pooling water above the culvert making it impossible for the culvert to allow high water to pass. This, in turn, has caused the stream to alter its course, creating an erosion and siltation problem. Secondly a cement wall has failed, as seen in the picture, creating a flow deflector, which is severely eroding the east bank. |  | • Determine land ownership<br>• Partner with the City of Ottawa with the culvert removal<br>• Utilize existing volunteer base of the City Stream Watch program to participate in this rehabilitation effort by removing woody debris blocking the area<br>• Plant shrubs and trees to stabilize banks to help stop erosion. | • Community involvement<br>• Enhance fish and wildlife habitat<br>• Reduce erosion of banks<br>• Eliminate possibility of bank failure causing tree collapse into stream<br>• Remove potential migratory obstruction |

| Location | Issue | Picture | Remediation Strategy | Expected Results |
|---|---|---|---|---|
| Many sections of Sawmill Creek Heron Road south to Home Depot on Bank Street require a cleanup. | The accumulation of garbage along various stretches of Sawmill Creek is an ongoing problem. Not only does man-made pollution take away from the aesthetic quality of the stream but it limits and degrades the quality of fish and wildlife habitat. |  | • Determine land ownership<br>• Utilize existing volunteer base of the City Stream Watch to participate in annual cleanup efforts. Sawmill Creek cleanup days should be carried out in the summer and fall to facilitate the removal of garbage and to rid the stream and riparian areas of unnatural debris. | • Community involvement<br>• Enhancement of fish and wildlife habitat<br>• Enhancement of the creek's aesthetic qualities |

| Location | Issue | Picture | Remediation Strategy | Expected Results |
|---|---|---|---|---|
| Mud Creek (Tributary of Green's Creek) – Various Locations | Erosion of the stream bank along Mud Creek is a common problem along the system. There is little disturbance along the stream although erosion sites were observed along the system throughout sampling. Mud Creek would benefit from planting along its banks and in some areas the clearing of wood debris jams. |  | • Determine land ownership<br>• Riparian planting where possible<br>• Identification of areas that require more intensive methods of erosion protection (i.e. bioengineering, etc.)<br>• Utilize existing volunteer base of the City Stream Watch program and recruit volunteers from neighbouring communities to participate in this rehabilitation effort | • Community involvement<br>• Effective stream bank protection<br>• Reduce siltation of fish spawning habitat<br>• The enhancement of conditions for natural colonization of existing plant community<br>• Produce streamside wildlife habitat |

| Location | Issue | Picture | Remediation Strategy | Expected Results |
|---|---|---|---|---|
| Graham Creek at Andrew Haydon Park. On right bank just downstream from bridge. | The planting site on Graham Creek in Andrew Haydon Park needs to be continually monitored. It is important that a small buffer is left from grass cutting operations to help the bank re-establish a plant community. |  | • Collaborate with City of Ottawa<br>• Phase I and II of planting along this section have been completed. It is important to monitor the site to ensure plants continue to grow. If plant die-off is observed or damage is done to the site new planting initiatives will be initiated. | • Effective stream bank protection<br>• Reduce siltation of fish spawning habitat<br>• Enhance conditions for natural colonization of existing plant community<br>• Produce streamside wildlife habitat<br>• Enhancement of the creek's aesthetic qualities |

| Location | Issue | Picture | Remediation Strategy | Expected Results |
|---|---|---|---|---|
| Sawmill Creek just North of Heron Park Community Centre (Heron Road.). | Phase I, II and III planting took place on in 2005, 2006 and 2008 to help rehabilitate a failed bank on Sawmill Creek. Planting work has been successful although monitoring needs to be done often to ensure planting communities are successful. Dog-stangling vine, an invasive species, is common in the area. An attempt should be made to try and control the dog-strangling vine so that it does not jeopardize existing riparian vegetation and the newly planted trees and shrubs. |  | • Collaborate with City of Ottawa<br>• Utilize existing volunteer base of the City Stream Watch program and residents from the Heron Park community to hold a day of dog-strangling vine removal. | • Promote community involvement in rehabilitation projects<br>• Enhance fish and wildlife habitat<br>• Enhance the creek's aesthetic qualities.<br>• Erosion control<br>• Create awareness on the effect invasive species can have on native vegetation and begin to monitor the area, creating long-term biodiversity |
| **Location** | **Issue** | **Picture** | **Remediation Strategy** | **Expected Results** |
| Mud Creek (Tributary of Green's Creek) – Various Locations | There are areas where the accumulation of garbage and debris has collected in debris jams along Mud Creek. Some pollution is large and has been in and around the stream for a long time. Man-made pollution takes away from the aesthetic quality of the stream and also limits and degrades the quality of fish and wildlife habitat. |  | • Determine land ownership<br>• Utilize existing volunteer base of the City Stream Watch to participate in annual cleanup efforts. Cleanup days should be carries out in the summer and fall to facilitate the removal of garbage and to rid the stream and riparian areas of unnatural debris. | • Community involvement<br>• Enhancement of fish and wildlife habitat<br>• Enhancement of the creek's aesthetic qualities |

| Location | Issue | Picture | Remediation Strategy | Expected Results |
|---|---|---|---|---|
| Mosquito Creek downstream of Spratt Road in the Riverside South Subdivision | Erosion of stream banks along Mosquito Creek is a problem. Increased development over the past several years along with creation of roads, bridges, and residential properties has increased runoff and caused significant erosion along the stream. Planting is completed and continued monitoring is important. |  | • Determine land ownership<br>• Phase I and II of planting along this section have been completed. It is important to monitor the site to ensure plants continue to grow. If plant die-off is observed or damage is done to the site, we will discuss with landowners and new planting initiatives will be initiated. Mosquito Creek will be surveyed during 2009 | • Enhance fish and wildlife habitat<br>• Enhance the creek's aesthetic qualities.<br>• Protect stream bank<br>• Erosion control |

| Location | Issue | Picture | Remediation Strategy | Expected Results |
|---|---|---|---|---|
| Cardinal Creek | Near the mouth of Cardinal Creek, upstream of the 174 crossing, a log has fallen across the creek. Over time, tires have gathered on the upstream side of the log, and there are now a total of 20 tires stuck. |  | • Determine land ownership<br>• Using canoes, remove the tires from the upstream side of the log jam with a small crew of volunteers<br>• Due to access and use of canoes, crew number should be limited<br>• Use RVCA trucks to take tires away and dispose of properly | • Community involvement<br>• Enhancement of fish and wildlife habitat<br>• Enhancement of the creek's aesthetic qualities |

| Location | Issue | Picture | Remediation Strategy | Expected Results |
|---|---|---|---|---|
| Sawmill Creek | At the mouth of Sawmill Creek, where it empties into the Rideau River, there is a very minimal buffer. Erosion along the shoreline needs to be mitigated. There is no buffer around the creek from Riverside Drive. This issue has also been mentioned in the subwatershed study update for Cardinal Creek. There is a park on either side of the creek, with lots of room for vegetation. |  | • Discuss options with the NCC about developing a larger buffer and plant trees and shrubs along the bank in spring 2009. Plant shrubs where Riverside Drive crosses Sawmill Creek to help filter runoff. | • Increased collaboration with the NCC<br>• Enhancement of fish and wildlife habitat;<br>• Erosion control<br>• Enhancement of the creek's aesthetic qualities |
| **Location** | **Issue** | **Picture** | **Remediation Strategy** | **Expected Results** |
| Black Rapids Creek, Cardinal Creek, Mud Creek (Manotick) and Sawmill Creek | There are a number of seasonal and year-round migratory obstructions along all of the creeks which inhibit fish passage. Some of these obstructions are old log jams, piles of rock, a structure and a gabion basket. Some of the obstructions also affect stream flow, causing the banks on either side of the obstruction to erode. | <br>Gabion basket across Sawmill Creek | • Determine land ownership<br>• Utilize existing volunteer base of the City Stream Watch to remove the obstruction. In some cases, the projects need landowner permission and involvement. Work with landowners to remove migration barriers along various systems | • Community involvement<br>• Improve stream flow<br>• Mitigate fish passage<br>• Restore natural stream flows |

| Location | Issue | Picture | Remediation Strategy | Expected Results |
|---|---|---|---|---|
| Black Rapids Creek-at the mouth | The mouth of Black Rapids Creek is an important spawning area for fish. It is also the site of the Black Rapids Locks on the Rideau River, so there is a lot of traffic and the grounds need to be maintained for visitors. A minimal buffer exists adjacent to the creek. There is also Japanese Knotweed, and invasive species growing on the right bank near the walking bridge which should be removed before it spreads into the forested ravine. |  | • Determine land ownership<br>• Talk with Parks Canada/ NCC to see about the possibility of expanding the buffer around part of the mouth of the creek and removal of Japanese Knotweed. If the project goes forward, use existing volunteer base of the City Stream Watch to do the riparian planting and invasive species removal | • Enhancement of fish and wildlife habitat<br>• Collaboration with Parks Canada/NCC<br>• Enhancement of the creek's aesthetic qualities<br>• Protection of local, native species and biodiversity |

| Location | Issue | Picture | Remediation Strategy | Expected Results |
|---|---|---|---|---|
| Mud Creek | There is an old bridge across the creek that someone had made with large cobble. This cobble is a temporary barrier to fish migration in low flows. |  | • Determine land ownership<br>• Speak with landowners about footpath and possibility of removal. If landowners agree, take obstruction apart | • Increase fish movement through this area of Sawmill Creek<br>• Enhanced fish habitat |

| Location | Issue | Picture | Remediation Strategy | Expected Results |
|---|---|---|---|---|
| Mud Creek | The City of Ottawa works and maintenance building on Rideau Valley Drive backs onto Mud Creek. The buffer on the right bank is not very minimal and the banks are steep. |  | • Determine land ownership<br>• Discuss opportunities with the City of Ottawa to plant trees and shrubs at the top of the slope to help protect that meander curve from future erosion. | • Collaboration with City of Ottawa<br>• Fish and wildlife habitat enhancement<br>• Bank stabilization and increased filtration of runoff |
| **Location** | **Issue** | **Picture** | **Remediation Strategy** | **Expected Results** |
| Mud Creek, Manotick | Flowering rush is an invasive species and can outcompete native vegetation. It was found in the second and third sections of Mud Creek. |  | • Using existing CSW volunteer base, with canoes, to pull flowering rush out from shorelines.<br>• This site should continue to be monitored to see if removal was successful or if more removal is required. | • Protection of native plant species<br>• Protection of biodiversity<br>• Fish and wildlife enhancement |

| Location | Issue | Picture | Remediation Strategy | Expected Results |
|---|---|---|---|---|
| Cardinal Creek | At the mouth of Cardinal Creek, three types of invasive species were observed that can negatively impact native flora and fauna. During the first 8 sections of the creek surveys from 2008, yellow iris and flowering rush were observed. An attempt should be made to control these species before they expand farther up the stream. |  | • Determine land ownership<br>• Use a small crew of canoes to access areas with invasive species and remove invasive species using approved methods. Due to access and limited availability of boats, removal will be done with a small number of volunteers. | • Enhancement of fish and wildlife habitat;<br>• Enhancement of the creek's aesthetic qualities.<br>• Protection of local, native species and biodiversity |

| Location | Issue | Picture | Remediation Strategy | Expected Results |
|---|---|---|---|---|
| Cardinal Creek | There is an area on the left bank just downstream of Montreal Road that has been re-enforced with rip rap. This rip rap is causing erosion on the left bank downstream, where the rip rap ends. Bioengineering techniques are needed to help stabilize the steep bank. This project would take quite a bit of planning and a thorough site design; therefore, it would be a long-term project, and the field work may be completed in future years. | No photo available | • Determine land ownership<br>• Look for collaboration on the project design with the City of Ottawa<br>• Do a site visit and discuss best bioengineering technique for rehabilitation.<br>• Raise funds to implement the project<br>• Volunteers could assist with certain elements of the project | • Community involvement<br>• New project for volunteers<br>• Collaboration with landowners<br>• Bank stabilization<br>• Fish and wildlife habitat enhancement |

| Location | Issue | Picture | Remediation Strategy | Expected Results |
|---|---|---|---|---|
| Cardinal Creek | Near the hydro lines between Springridge Road and Valin Street, there is a migratory obstruction across the creek. It is a pile of cobble, and in low water levels, fish cannot migrate upstream. |  | • Determine land ownership<br>• Discuss best way to mitigate the obstruction<br>• Cobble should not be removed from the creek because the morphology of this part of Cardinal Creek does not vary much<br>• Place cobble strategically so that it does not result in a barrier but still provides important habitat | • Increase fish movement through this area of Cardinal Creek<br>• Fish and wildlife habitat enhancement |

# 5.0 References


1. Canadian Wildlife Service (CWS), Environment Canada. 2004. How Much Habitat Is Enough? Retrieved from http://www.ec.gc.ca/EnviroZine/english/issues/64/feature2_e.cfm

2. CH2MHILL. May 2003. *Sawmill Creek Subwatershed Update*.

3. Del Degan & Masse. 2007. *The NCC's Valued Natural Ecosystems and Habitats.*

4. Gartner Lee. 2008. *Greater Cardinal Creek Subwatershed Study: Master Plan Class Environmental Assessment Existing Conditions Report*. DRAFT.

5. Geomorphic Solutions. April 2007. *Cardinal Creek Geomorphic Assessment*.

6. Marshall Macklin Monaghan Ltd. May 2005. *Jock River 2 and Mud Creek Subwatershed Study: Existing Conditions Report.* Vol.1. DRAFT.

7. Marshall Macklin Monaghan Ltd. & WESA. June 2005. *Village of Manotick Environmental Management Plan: Special Design Area Component.*

8. Ministry of Transportation. October 2006. *Environmental Guide for Fish and Fish Habitat.*

9. Ontario Ministry of Natural Resources. 2008. *Field Guide to Aquatic Invasive Species.*

10. Rideau Valley Conservation Authority (RVCA). 2003. *City Stream Watch Annual Report*. Manotick, ON: Brian Bezaire

11. Southern Ontario Land Resource Information System (SOLRIS). 2002. Peterborough, ON: Ministry of Natural Resources. Available: Rideau Valley Conservation Authority

# Appendix A

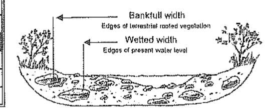
Name of Stream/River/Drain:

| Date: | Time: | Section: # | Photo: Up - # Down - # |
|---|---|---|---|

| | Start | Middle | End |
|---|---|---|---|
| UTM Easting | | | |
| UTM Northing | | | |
| Water temperature (°C) | | | |
| pH | | | |
| Dissolved oxygen (mg/L) | | | |
| Conductivity (µs/cm) | | | |
| Air temperature (°C ) | | | |
| Max wetted width (m) | | | |
| Max bankfull width (m) | | | |
| Max wetted depth (m) | | | |

**Cloud Cover:**

| | |
|---|---|
| % | 75 - 100% |
| % | 25 - 74% |
| % | 0 - 24% |




1. Has this section been altered? Yes / No (circle one) If yes, select one of:

| | |
|---|---|
| √ | *Natural*, minor human alterations but the majority considered natural. |
| √ | *Altered*, considerable human impact but significant natural portions. |
| √ | *Highly altered* by humans with few natural portions. |

2. What is the general land-use along this 100m section?

| | |
|---|---|
| % | Active agriculture |
| % | Pasture |
| % | Abandonned agricultural fields |
| % | Residential |
| % | Forests |
| % | Scrubland |
| % | Meadows |
| % | Wetlands |
| % | Industrial/Commercial |
| % | Recreational |
| % | Infrastructure (e.g., roads, bridges, culverts) |
| % | Other (specify) ______ |
| 100% | Total |

3. Instream Substrate?

| | |
|---|---|
| % | Bedrock - exposed rock |
| % | Boulders - > 25cm |
| % | Cobble - 8 - 25cm |
| % | Gravel - 0.2 - 8cm |
| % | Sand - 0.05 - 0.10cm, gritty |
| % | Silt - < 0.05cm, powdery |
| % | Clay - 0.01cm, greasy feel |
| % | Muck - combo sand, silt, clay |
| % | Detrius - organic material |
| % | Other |
| 100% | Total |

4. Substrate type is fairly: Homogeneous / Heterogeneous (circle one)

5. Instream Morphology

(A) Type:

| | |
|---|---|
| % | Natural |
| % | Channelized |
| 100% | Total |

(B) Flow:

| | |
|---|---|
| √ | Permanent |
| √ | Intermittent |
| √ | Ephemeral |

( C) Features:

| | |
|---|---|
| % | Pools |
| % | Riffles |
| % | Runs |
| 100% | Total |

6. Instream Habitat

| | | Left | Right | |
|---|---|---|---|---|
| (A) Undercut banks | | % | % | |
| (B) Boulder | | % | % | |
| Cobble | | % | % | |
| None | | % | % | |
| | Total | 100% | 100% | |
| ( C) Large trees & branches | | % | % | Instream |
| | | % | % | Overhanging |
| | | % | % | None |
| | Total | 100% | 100% | |
| (D) Vascular plants: | | % | % | Instream |
| | | % | % | Overhanging |
| | | % | % | None |
| | Total | 100% | 100% | |

7. Shore cover (% stream shaded): %

8. Beaver Activity

Are there any beaver dams in this 100m section: Yes / No (circle one)

(A) If yes, please specify the number:

| | |
|---|---|
| # | Active beaver dams |
| # | Abandoned beaver dams |
| # | Beaver lodges |

(B) Tree cropping:

| | |
|---|---|
| % | Extensive |
| % | Common |
| % | Low |
| % | None |
| 100% | Total |

| Dam # | Location (UTM) Easting | Northing | Photo Numbers US | CS | DS | Head (cm) |
|---|---|---|---|---|---|---|
| | | | # | # | # | |
| | | | # | # | # | |

9. Migratory Obstructions — Are there any migratory obstructions present? Yes / No (circle one)

(A) If yes, specify if they are: Seasonal [ % ] Permanent [ % ]

| # | Location (UTM) Easting | Northing | Photo # | Short description |
|---|---|---|---|---|
| | | | # | |
| | | | # | |

10. Instream Vegetation

| | |
|---|---|
| % | Extensive (choked with vegetation) |
| % | Common (>50% vegetation) |
| % | Normal (25-50% vegetation) |
| % | Low (<25% vegetation) |
| % | Rare (vegetation few and far between) |
| % | None |
| 100% | Total |

11. Are there dominant types of instream vegetation?

| | |
|---|---|
| % | Narrow-leaved Emergents (e.g., grasses, sedges) |
| % | Broad-leaved Emergents (e.g., arrowhead) |
| % | Robust Emergents (e.g., cattails, rushes, burreed) |
| % | Free-floating Plants (e.g., duckweed) |
| % | Floating Plants (e.g., water lilies) |
| % | Submerged Plants (e.g., coontail, pondweed) |
| % | Algae (e.g., filamentous, non-filamentous) |
| 100% | Total |

Tributaries: 12. Are there any major tributaries in this section? Yes / No (circle one)

| # | Location (UTM) Easting | Northing | Photo # | Short description |
|---|---|---|---|---|
| | | | # | |
| | | | # | |

13. Do any of these tributaries obviously alter the stream? Yes / No (circle one)

(A) If yes, in what way (e.g., pollution)

(B) What are the types of tributaries?

| | |
|---|---|
| % | Small, intermittent natural streams |
| % | Large, permanent natural streams |
| % | Other (e.g., ditch or ravine) ______________ |

14. Any tribs worthy of further study? Yes / No If so, which ones?__________

15. Is this tributary flowing at present? Yes / No (circle one)

16. Are there any storm water outlets in this section? Yes / No (circle one)

| # | Location (UTM) Easting | Northing | Photo # | Short description |
|---|---|---|---|---|
| | | | # | |
| | | | # | |

17. Bank Erosion: How would you characterize bank erosion:

| Left | Right | |
|---|---|---|
| % | % | Stable (little or no erosion) |
| % | % | Unstable (eroding, little or no vegetation) |
| 100% | 100% | Total |

18. Bank Steepness:

| Left | Right | |
|---|---|---|
| % | % | Steep >25% |
| % | % | Moderate 11-24% |
| % | % | Low 0-10% |
| 100% | 100% | Total |

19. Composition of banks?

| Left | Right | |
|---|---|---|
| % | % | Bedrock - exposed rock |
| % | % | Boulders - rock over 25cm |
| % | % | Cobble - 8 - 25cm |
| % | % | Gravel - 0.2 - 8cm |
| % | % | Sand - >0.05 - O.10cm, gritty |
| % | % | Silt - >0.05 - 0.10cm, powdery |
| % | % | Clay - 0.01, greasy feel |
| 100% | 100% | Total |

20. Shoreline structures on banks:

| Left | Right | |
|---|---|---|
| % | % | Natural |
| % | % | Bioengineering |
| % | % | Wooden retaining wall |
| % | % | Rip rap stone |
| % | % | Armour stone |
| % | % | Gabion cage |
| % | % | Concrete (e.g., bridge) |
| % | % | Other (please specify) |
| 100% | 100% | Total |

21. Dominant vegetation types along banks?

| Left | Right | |
|---|---|---|
| % | % | Coniferous Trees (Softwoods) |
| % | % | Deciduous Trees (Hardwoods) |
| % | % | Dead Trees |
| % | % | Tall Shrubs |
| % | % | Low Shrubs |
| % | % | Dead Shrubs |
| % | % | Tall Grass |
| % | % | Short Grass |
| % | % | Wetland Plants (cattails, sedges, other) |
| % | % | Ground Cover |
| % | % | Mosses |
| 100% | 100% | Total |

22. Shoreline Classification:

| Left | Right | |
|---|---|---|
| % | % | Natural |
| % | % | Regenerative |
| % | % | Ornamental |
| % | % | Degraded |
| % | % | Total |

23. Vegetated Buffer:

| Left | Right | |
|---|---|---|
| % | % | 0-5m |
| % | % | 5-15m |
| % | % | 15-30m |
| % | % | 30m + |
| 100% | 100% | Total |

24. Are there any agricultural impacts in the section? Yes / No If yes, what kinds:

(A) Cattle access Yes / No

| Left | Right | |
|---|---|---|
| | | Extreme (>20m) |
| | | Moderate (10-20m) |
| | | Low (<10m) |

| # | Location (UTM) Easting | Northing | Photo # |
|---|---|---|---|
| | | | |
| | | | |

(B) Field erosion Yes / No

| Left | Right | |
|---|---|---|
| | | Observed |
| | | Potential |

| # | Location (UTM) Easting | Northing | Photo # |
|---|---|---|---|
| | | | |
| | | | |

( C) Agricultural drain Yes / No

| # | Location (UTM) Easting | Northing | Photo # |
|---|---|---|---|
| | | | |
| | | | |

(D) Tile drain Yes / No

| Left | Right |
|---|---|
| | |

If yes, how many? ________

| # | Location (UTM) Easting | Northing | Photo # |
|---|---|---|---|
| | | | |
| | | | |

25. Did you notice any wildlife? Yes / No

| | | | |
|---|---|---|---|
| | Water Birds (ducks, herons, etc.) ________ | | Dragonflies & Damselflies ________ |
| | Land Birds ________ | | Butterflies and Moths ________ |
| | Reptiles (snakes, turtles) ________ | | Aquatic Insects ________ |
| | Amphibians (frogs, salamanders) ________ | | Fish ________ |
| | Large Mammals ________ | | Flying insects ________ |
| | Small Mammals ________ | | Other ________ |

Observed:

26. Did you notice any critical fish habitat? Yes / No

If yes, what kind?

| | |
|---|---|
| Spawning | |
| Evidence of groundwater springs | |
| Other | |

27. Springs in this 100m? Yes / No (circle one)

If yes, how many? [ # ]

28. Pollution in or entering stream in this 100m? Yes / No (circle one) If yes, which kinds?

| | |
|---|---|
| | Oil or Gas trails in the water |
| | Floating garbage |
| | Garbage on the stream bottom |
| | Unusual colouration on channel bed (e.g., red iron staining) |

Observed: ________

29. Invasive Species in the stream? Y / N (circle one) Observed: ________

30. Potential angling opportunities in this 100m section? Y / N (circle one) If yes, identify: ________

31. Are there any potential enhancement opportunities in this 100m section? Yes / No (circle one)

| | | | |
|---|---|---|---|
| | Riparian planting | | Invasive species control |
| | Stream garbage clean-up | | Cattle access restriction |
| | Fish habitat enhancement | | |
| | Erosion control (bioengineering) | | |
| | Channel enhancement or modification | | |

Comments:

Name of Surveyors:
1. ________
2. ________
3. ________

Date entered: YYYY-MM-DD

Entered by:

# Appendix B

**RVCA MACRO STREAM SURVEY – SUMMARY AND DEFINITIONS**

**Descriptive Information**
**Name of watercourse:** Record the name of the watercourse that is being surveyed

**Date:** Record the date that the sampling occurred on.

**Start time:** Record the time the sampling started.

**Section number** is the section number of the current 100 metres of stream being sampled. Please note that sampling always occurs in the upstream direction (i.e., the first section sampled will be the furthest one downstream and they are numbered chronologically as you progress upstream).

**Starting and ending UTM coordinates:** UTM coordinates are needed for both the starting and ending points of the 100 metre sections. These are taken using the GPS receivers. The GPS supplies both an easting and northing. The UTM grid number is 18 for all of Eastern Ontario.

**Upstream and downstream photos:** Record the photo number from the digital camera so that it will be easy to correctly label the photos when they are uploaded and organized later at the office. An upstream photo should be taken while looking upstream at the start of the stream section while the downstream photo should be taken while looking downstream at the end of the stream section.

**Water temperature** in °C at the starting point, middle, and end of the 100 metre section.

**pH** is measured using the YSI at the starting point and end of the 100 metre section.

**Dissolved oxygen** in mg/L and is measured using the YSI at the starting point and end of the 100 metre section.

**Conductivity** in µs/cm measured using the YSI at the starting point and end of the 100 metre section.

**Air temperature** is measured in °C at the starting point of the 100 metre section.

**Max wetted width (m):** The maximum distance from the edge of the present water level on one stream bank to the edge of the present water level on the opposite stream bank. The transect is taken perpendicular to the stream flow.

**Max bankfull width (m):** The maximum distance from high water mark (i.e., the edge of terrestrial rooted vegetation) on one stream bank to the opposite stream bank. The transect is taken perpendicular to the stream flow.

**Max wetted depth (m):** The maximum depth of water at the present level within this section

**Overhead cloud cover:** Record the overhead cloud cover in percent

1. Please determine if the 100 metre section of the stream being surveyed has been altered; once determined please circle either “Yes” or “No” on the field sheet.
   An **unaltered natural section of stream** is one characterized as having a series of meanders, pools, and riffles, with a significant amount of riparian (transitional zone between aquatic and terrestrial habitats that contains moist soils and lush plant growth) area.

   A natural stream can be altered in a number of ways:
   - The shoreline can be armored to varying extents (retaining walls, rip-rap);

- The stream channel can be diverted or straightened;
- Riparian vegetation can be replaced by lawn, beaches, etc;
- Docks or other structures may extend into the stream.

An **altered section of stream** can be altered to varying degrees. It can be:

- **Natural** with minor human alterations but the majority considered natural.
- **Altered** with considerable human influences, but still featuring significant natural portions
- **Highly altered** by humans with areas that could be considered natural

2. **Land use:** Please note and record the land use patterns along this section of the stream. *Must total to 100percent*

**Active agricultural:** Refers to land that is currently being farmed.

**Pasture:** Refers to land being used by grazing livestock.

**Abandoned agricultural fields:** Refers to land previously, but not currently, farmed.

**Residential:** Refers to land occupied by homes.

**Forests:** Areas of high tree density.

**Scrub land:** Areas of high woody shrub density.

**Meadows:** Rolling or flat terrain where grasses dominate.

**Wetlands:** Land where saturation with water is the dominant factor determining the soil development and has specialized plants and animals adapted to live in such conditions.

**Industrial/Commercial:** Refers to land occupied by industry/businesses.

**Recreational:** Used for recreational activities such as soccer fields, walking trails etc.

**Infrastructure:** Public facilities and services required for development including roads, bridges, culverts etc.

**<u>Instream Substrate</u>**

3. **Instream substrate** is the material that constitutes the stream bed. Please record the percentage of each instream substrate present in the section of the stream.

4. The instream substrate can be **homogenous** (all of one type), or **heterogenous** (diverse types). *Check one*

**<u>Morphology</u>**

5. **Stream morphology** refers to the physical structure and shape of the stream.

**A) Type:** Record the type of stream present in the section in percent. *Must total to 100percent*

**Natural:** Contains a series of meanders, pools, and riffles with unaltered stream banks

**Channelized:** Constructed or altered/straightened channel, drain, ditch or canal that is straight and uniform in structure

**B) Flow:** Record the flow regime of the stream section being surveyed. *Check one*

**Permanent:** A stream that flows all year

**Intermittent:** A stream that typically flows for at least six months a year and has a defined channel
**Ephemeral:** A stream that flows for a short period of time in the spring or in response high precipitation events but does not have a defined channel

**C) Features:** Record the natural features of the stream in percent. *Must total to 100percent*
**Pools:** Any area of the stream that has a deep pocket of water typically found between riffles
**Riffles:** Shallow, moderate to rapid current velocity, agitated water surface, substrate typically composed of gravel, pebble, cobble and boulder-sized particles
**Runs:** Characterized by moderately shallow water (10-30cm deep), an unagitated surface with substrate typically composed of gravel and/or cobble, and areas where the thalweg (deepest part of the channel) is in the center of the channel

**<u>Instream Habitat</u>**

6. **How would you characterize the type of major structures in this 100m stretch?**
**A)** Record the percentage of each bank that is **undercut**.
A bank that has been eroded away and overhangs the water.

**B)** Record the percent of the right and left sides of the stream section containing boulders and cobble. *Must total to 100percent for each bank*
**Boulder:** Instream rocks greater than 25 cm in diameter. Boulders create instream cover and back eddies for large fish to hide and/or rest out of the current

**Cobble:** Instream rocks 8-25 cm in diameter. Cobble provides important over wintering and/or spawning habitat for small or juvenile fish

**None:** Areas of the stream that are not comprised of boulders or cobble buts till possess areas that can provide some instream habitat for fish and macroinvertebrates (e.g., bedrock, fine organic islands etc.)

**C) Large woody debris:** Record the percent of the stream and riparian area containing large woody debris for both the left and right sides. *Must total to 100percent for each bank*
Fallen trees, stumps and/or logs that are within the stream **(instream)** or < 1m above water surface **(overhanging)**

**D) Vascular plants:** Record the percent of each bank that has vascular plants. *Must total to 100percent for each bank.*
Vegetation provides shelter, protection and habitat for food items (e.g., macroinvertebrates) and can be found **instream** or **overhanging** (<1 m above water surface)

7. **Shore cover (percent stream shaded):** The percent of the stream that is shaded by overhanging trees and tree canopy that is >1m above stream surface

**<u>Beaver Activity</u>**

8. Record if there are any beaver dams in the stream section being surveyed by circling "Yes" or "No"
If yes:
**A)** Record the number of active and/or abandoned beaver dams in the stream section.
**Active beaver dam:** Characterized as a maintained beaver dam that is holding back water and acting as a barrier to movement. Active beaver dams are generally reinforced with mud and have new beaver chews present on twigs

**Abandoned beaver dam:** Characterized as an old beaver dam that is not holding back any water and is not reinforced

**Head (cm):** The distance (in cm) between the water surface upstream of the dam and the water surface downstream of the dam

**B)** Record if there is any tree cropping within the stream section.
**Tree cropping:** Tree cropping is characterized as the presence of chews on the bottom of tree trunks and generally are found on the trees within the riparian zone of the waterbody. Tree cropping can be characterized as being **extensive, common, low** or **none**

**Migratory Obstructions**

9. Indicate if there are there any migratory obstructions in the surveyed stream section by circling "Yes" or "No"
If yes,
**Migratory obstruction:** A natural (e.g., log jam) or constructed (e.g., perched culvert) obstruction that blocks fish movement

**Seasonal:** Obstruction only present when water levels are very low (e.g., not enough water for fish movement) or too high (e.g., extreme velocities)

**Permanent:** Obstruction is present at all times of the year during all flow conditions

**Instream Vegetation**

10. **Aquatic vegetation** refers to vegetation occurring within the stream. *Check one*

**Extensive:** Vegetation within entire stream
**Common:** >50percent
**Normal:** 25-50percent
**Low:** <25percent
**Rare:** Vegetation very sparse

11. **Dominant types of instream vegetation** are dominant plant types that occur in the stream. Record the percentage of each vegetation type. *Must total 100percent*

**Narrow-leaved emergents:** Plants with submerged roots and stems emerging from the water (e.g., grasses, sedges)
**Broad-leaved emergents:** Plants with submerged roots, stems emerging from the water with leaves attached to main stem (e.g., arrowhead)
**Robust emergents:** Plants with submerged roots with hard or woody steams emerging from the water (e.g., cattails, rushes, burreed)
**Free-floating plants:** Plants that are not rooted to the substrate and are freely moving on the water surface (e.g., duckweed)
**Floating plants:** Characterized by having a leaf floating on the surface attached to a main stem (e.g., frogbit, duckweed)
**Submerged plants:** Completely submerged vegetation including coontail, pondweed etc.
**Algae:** Simple photosynthetic organisms, often covering substrate; feels slimy. Can be filamentous or non-filamentous

**Tributaries**

12. Indicate if there are any **tributaries** in the surveyed stream section by circling "Yes" or "No"
**Tributaries** are waterways that flow into/enter the stream.
If yes, number the tributaries upstream chronologically. Also, record the location using UTM coordinates and take a photo looking upstream towards the tributary from the stream section.

13. **A)** Tributaries drain water into the stream, as well as anything suspended or dissolved in the water. Tributaries can alter the character of the stream in a number of ways, including **sediment deposition**, **nutrient loading**, **and other pollutants**.

**B) Intermittent natural streams** are natural streams that flow periodically throughout the year, usually in the spring and in times of high amounts of precipitation.

**Permanent natural streams** are natural streams that flow year round.

14. Is the tributary significant enough to justify further surveying?

15. Is water entering the stream from the tributary?

**Bank Characteristics**

16. **Bank stability:** *Each bank must total 100percent*
**Stable:** No sign of erosion and banks are generally well vegetated or covered with boulders or cobble. Undercuts may be present but the bank is fully stable

**Unstable**: Signs of erosions are present and generally <50percent of banks are vegetated or covered with boulders/cobble. Bank could be slumping or sloughing and sever unstable undercutting is present

17. **Steepness** of the shoreline is represented by the general slope, calculated by: $\frac{\text{Rise}}{\text{Run}}$ x 100percent
*Each bank must total 100percent*

18. **Soil composition:** *Each bank must total 100percent*
**Bedrock** – Exposed rock.
**Boulders** – Rock over 25 cm (10 in) in diameter.
**Cobble** – Rock between 8 cm and 25 cm (3 – 10 in) in diameter.
**Gravel** – Rock between 0.2 cm and 8 cm (1/8 – 2 in) in diameter.
**Sand** – Rock between 0.05cm and 0.2cm in diameter (feels gritty between fingers)
**Silt** – Approximately 0.05 cm in diameter (feels powdery/velvety between fingers)
**Clay** – Approximately 0.01cm in diameter (feels greasy between fingers)

19. **Shoreline structures:** Natural or human-made structures generally in place to reduce erosion and increase bank stability. *Each bank must total 100percent*

**Natural –** Consists of vegetation, trees and/or rock material
**Bioengineering –** Shoreline stabilization structures that are comprised of vegetation (e.g., live crib walls, brush bundles)
**Wooden retaining wall** – A vertical wall made of wood used to stabilize a shoreline
**Rip Rap stone** – Chunks of broken concrete/brick used to armor a shoreline
**Armor stone** – Large (e.g., ≥1m in length) chunks of stone placed on shorelines to stabilize banks and prevent further erosion
**Gabion cage** – A square or rectangular cage filled with rocks used to armor a shoreline.
**Concrete wall** – A concrete wall (including bridge structures) used to armor a shoreline
**Other** – please specify

20. **Dominant vegetation**: The type of vegetation that is dominant along the stream banks in and beyond the riparian zone. *Each bank must total 100percent*

**Coniferous trees**: Softwoods, evergreens
**Deciduous trees**: Hardwoods
Dead trees:
**Tall shrubs:** Shrubs >1m in height with stems that are brown, hard and woody (not green and herbaceous).
**Low shrubs:** Shrubs <1m in height with stems that are brown, hard and woody (not green and herbaceous).

**Dead shrubs:**
**Tall grasses:** >1m
**Short grasses:** <1m
**Wetland plants:** cattails, sedges, etc.
**Ground cover:**
**Mosses**

21. **Agricultural impacts:** If agricultural impacts are present within the 100m section of stream that is being surveyed, please indicate (with a check mark) whether they were observed on the left or right bank (or both) then take a photo and record the location (UTM).

**Cattle access:** Evidence of cattle using the stream, such as tracks or manure. Cattle access can be **extreme** (>20 metre of the stream bank in the 100 metre section), **moderate** (10-20 metre) or **low** (<10 metre).

**Field erosion:** Evidence of excavation/deposition of material from fields in or around the stream. Erosion can be **observed** (present at time of sampling) or **potential**

**Agricultural drain:** A drainage ditch from agricultural fields entering the stream.

**Tile Drain:** A tile is a perforated pipe buried under ground that drains an area. It usually drains water into the stream by a protruding pipe from the bank.

**What is extent of the vegetated buffer (if present)?** A vegetated buffer is the area directly adjacent to the stream, consisting of natural vegetation (grasses, shrubs, trees, etc.). Record this in meters.

22. **Water birds:** ducks, geese, etc.
**Land birds:** osprey, king fisher, etc.
**Reptiles:** snakes, turtles, etc.
**Amphibians:** frogs, toads, etc.
**Large mammals:** deer, beavers
**Small mammals:** muskrat, weasel, mink
**Dragonflies and damselflies**
**Butterflies and moths**
**Aquatic insects:** water striders, whirligig beetles, dragonflies/nymphs, etc.
**Fish:** minnows, bass, pike, perch, sunfish spp., etc.
**Flying Insects**: mosquitoes, etc.

23. **Critical fish habitat** are areas that are directly responsible for the level of recruitment of individuals into a population.

**Spawning habitat** are areas fish utilize for reproduction. For example, pike spawning habitat includes submerged vegetation (i.e., grasses/sedges). Areas that are known spawning habitats within the surveyed stream section should be examined thoroughly.

**Groundwater springs** provide thermal refuge for fish and their offspring as groundwater is typically cooler in temperature than the waterbody it is entering. As water temperatures increase through the summer months, fish will seek out cool water areas.

24. Springs are areas where groundwater flows out of the ground.

**Watercress** is an indicator of the presence of springs. Watercress has alternate, compound leaves with 3-11 oval leaflets, shiny, dark green, rounded at the tip, smooth, without teeth or with wavy-toothed margins. Flowers are white with 4 petals about 1/6-1/4 inch across

The water from the spring is generally **cooler** than the waterbody that it is entering. If a sudden decrease in temperature is observed in a localized area, a spring is likely present.

25. Is there any **pollution** in the stream, entering the stream, or near the stream? The pollution can be in the form of **oil/gas** on the stream surface, **floating garbage**, **garbage on the stream bottom** and/or **unusual colouration on the channel bed.**

26. **Invasive species** are non-native plant and animal species.
Examples of invasive species in and around the Rideau River are:

| | |
|---|---|
| -Purple loosestrife | - Flowing rush |
| -Eurasian water milfoil | - Curly pondweed |
| -Zebra mussels | - European fingernailclam |
| -European frogbit | - Rusty crayfish |
| -Common carp | - Red-eared slider (turtle) |

27. **Potential angling opportunities** includes presence of anglers, used/old fishing line, bait containers, lures, areas with good fish habitat, etc.

28. Potential enhancement opportunities improve existing habitat conditions.

**Riparian planting:** Planting vegetation along the stream banks help to stabilize the banks, decrease erosion and increase wildlife habitat

**Stream garbage pick-up:** Removing garbage from the stream increases its overall health

**Fish habitat enhancement:** Adding instream structure, removing barriers to migration, and increasing the heterogeneity of the stream can all enhance fish habitat quality

**Invasive species control:** Removing invasive species from an area decreases the competition with native species and increases the overall health and abundance of native species

**Cattle access:** Fencing cattle out of creeks, installation of alternate watering devices, bed-level crossings, and/or riparian plantings will decrease erosion, increase riparian vegetation and improve water quality and fish habitat by lowering the amount of sediment entering the watercourse and creating buffered areas

# Appendix C

## Equipment List / Stream Watch Crew (2 person minimum)

1 handheld GPS unit
1 60 metre Tape / 50 meter length of rope
1 meter stick
1 thermometer
1 clipboard with several stream assessment forms
2 Pencils
Insect repellent
Sunscreen
1 waders/person
1 camera
2 extra batteries for GPS unit
Bottled water
1 garbage bag

# Appendix D

## Landowner Permission Letter

Dear Landowner:

The Rideau Valley Conservation Authority, in partnership with a collaborative of six other agencies

- City of Ottawa
- Heron Park Community Association
- National Defence Headquarters Fish and Game Club
- Ottawa Flyfishers Society
- Rideau River Roundtable

is conducting surveys that are designed to record basic stream characteristics, including information about the banks and the instream features. This year's focus is on Black Rapids Creek, Mud Creek, Sawmill Creek and Cardinal Creek. The survey examines and collects information regarding fish community/habitat, aquatic invertebrates, aquatic and riparian vegetation, bank stability, stream temperatures, etc.

The program is designed to increase public participation and awareness concerning the state of streams within the city. These efforts will provide officials with valuable information needed to better manage stream resources.

While we are completing the surveys, we may need to access the creek via your property. We seek your permission to carry out these surveys on the creeks adjacent to your land. The work will involve a crew of 2-3 people working for approximately 1 hour on the site. We will respect all private property and leave the site clean and with minimal disturbance.

If you would like more information on the project or have any concerns, please contact me. To learn more about the program and view 2003 – 2007 reports, visit us on the web at: http://www.rvca.ca/programs/streamwatch/index.html

Thank you for your cooperation.

Best regards,

Julia

Julia Sutton
City Stream Watch Coordinator
Rideau Valley Conservation Authority
(613) 692-3571 Ext. 1180
citystreamwatch@rvca.ca

Jennifer Lamoureux
Aquatic and Fish Habitat Biologist
Rideau Valley Conservation Authority
(613) 692-3571 Ext. 1108
Jennifer.Lamoureux@rvca.on.ca

# Appendix E

## Black Rapids Fish Community Data

SEINING DATA

| Site # | Seine # | Date | Species | Number | Total Length (mm) | Weight (g) | Comments |
|---|---|---|---|---|---|---|---|
| 1a | 1 | 7/14/2008 | creek chub | 1 | N/A | | too small to weigh |
| | 1 | | white sucker | 13 | N/A | 13.2 | young of year (yoy) |
| | 1 | | brook stickleback | 1 | N/A | 0.4 | |
| | 1 | | **smallmouth bass** | 1 | 22 | 2.9 | yoy |
| | 2 | | **smallmouth bass** | 1 | 31 | 1.3 | |
| | 2 | | logperch | 1 | N/A | 1.1 | |
| | 2 | | **yellow perch** | 1 | 250 | 110.8 | |
| | 2 | | **yellow perch** | 1 | 100 | 12.3 | |
| | 2 | | **yellow perch** | 1 | 310 | 13.7 | |
| | 2 | | **yellow perch** | 1 | 110 | 15.8 | |
| | 2 | | pumpkinseed | 2 | N/A | 22.9 | |
| | 2 | | creek chub | 3 | N/A | 33.5 | |
| | 2 | | brook stickleback | 23 | N/A | 23.3 | |
| 1b | 1 | 5/27/2008 | brook stickleback | 7 | N/A | 6.8 | |
| | 1 | | creek chub | 2 | N/A | 6.6 | |
| | 1 | | northern redbelly dace | 3 | N/A | 6.1 | |
| | | | blackchin shiner | 1 | N/A | N/A | |
| | 1 | | *Cyprinid spp.* | 18 | N/A | 11.6 | too small to i.d. |
| 2 | 1 | 6/26/2008 | logperch | 2 | N/A | N/A | too small to weigh |
| | 1 | | blackchin shiner | 7 | N/A | 1.8 | yoy |
| | 1 | | *Etheostoma spp.* | 4 | N/A | N/A | too small to weigh |
| | 1 | | **yellow perch** | 1 | | 1.7 | |
| | 1 | | **yellow perch** | 1 | 11 | 13.1 | |
| 3a | 1 | 6/26/2008 | blackchin shiner | 1 | N/A | N/A | too small to weigh |
| | 1 | | *Cyprinid spp* | 2 | N/A | N/A | very tiny |
| | 1 | | darter spp. | 3 | N/A | 0.8 | |
| | 1 | | logperch | 24 | N/A | 11.9 | |
| | 1 | | white sucker | 2 | N/A | 0.4 | very small |
| 3b | 1 | 7/30/2008 | pumpkinseed | 27 | N/A | N/A | scale problems |
| | 1 | | rock bass | 2 | N/A | N/A | scale problems |
| | 2 | | pumpkinseed | 1 | 8.5 | N/A | scale problems |
| | 2 | | pumpkinseed | 25 | N/A | N/A | scale problems |
| | 2 | | pumpkinseed | 3 | N/A | 158.4 | |
| | 2 | | rock bass | 19 | N/A | 15.5 | |
| | 2 | | **largemouth bass** | 1 | 190 | 91.8 | |
| | 2 | | **largemouth bass** | 1 | 78 | 4.4 | |
| | 2 | | **smallmouth bass** | 1 | 59 | 2.3 | |
| | 2 | | **smallmouth bass** | 1 | 51 | 2.3 | |
| | 2 | | **yellow perch** | 1 | 116 | 17.9 | |
| | 2 | | **yellow perch** | 1 | 102 | 13.7 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2 | | **yellow perch** | 1 | 122 | 18.9 | |
| | 2 | | **yellow perch** | 1 | 125 | 21.3 | |
| | 2 | | **yellow perch** | 1 | 101 | 10.4 | |
| | 2 | | **yellow perch** | 1 | 65 | 1.8 | |
| | 2 | | **yellow perch** | 21 | N/A | 39.7 | all ~53mm long |
| | 2 | | logperch | 9 | N/A | 11.4 | |
| | 2 | | **walleye** | 1 | 70 | 2.5 | |
| | 2 | | common shiner | 38 | N/A | 28.7 | |
| | 2 | | darter spp. | 1 | N/A | 0.6 | |
| | 2 | | *Centrarchid spp*. | 59 | N/A | 17.2 | yoy; can still see through |
| 3b | 1 | 8/27/2008 | **yellow perch** | 1 | 20.5 | 85.8 | |
| | 1 | | **yellow perch** | 1 | 7 | 3.4 | |
| | 1 | | **yellow perch** | 1 | 7 | 3.6 | |
| | 1 | | **yellow perch** | 1 | 7 | 2.4 | |
| | 1 | | **yellow perch** | 1 | 7.25 | 3.9 | |
| | 1 | | **yellow perch** | 1 | 6.5 | 2.8 | |
| | 1 | | **yellow perch** | 1 | 7.25 | 2.9 | |
| | 1 | | **yellow perch** | 1 | 7.2 | 3.5 | |
| | 1 | | **yellow perch** | 1 | 7 | 3.5 | |
| | 1 | | **yellow perch** | 1 | 7.5 | 4.5 | |
| | 1 | | **yellow perch** | 1 | 7.03 | 3.6 | |
| | 1 | | **yellow perch** | 1 | 7 | 2.7 | |
| | 1 | | **yellow perch** | 1 | 8 | 4.4 | |
| | 1 | | **yellow perch** | 1 | 7 | 2.9 | |
| | 1 | | **yellow perch** | 1 | 7 | 3.5 | |
| | 1 | | **yellow perch** | 1 | 7.5 | 4.4 | |
| | 1 | | **yellow perch** | 1 | 7.5 | 3.6 | |
| | 1 | | **yellow perch** | 1 | 7 | 3.4 | |
| | 1 | | **yellow perch** | 1 | 7 | 3.8 | |
| | 1 | | **yellow perch** | 1 | 6.5 | 2.6 | |
| | 1 | | **yellow perch** | 1 | 6.5 | 3.5 | |
| | 1 | | **yellow perch** | 1 | 7 | 3.1 | |
| | 1 | | **yellow perch** | 1 | 7 | 3.1 | |
| | 1 | | **yellow perch** | 1 | 6 | 2.3 | |
| | 1 | | **yellow perch** | 1 | 7 | 4.1 | |
| | 1 | | **yellow perch** | 1 | 7.25 | 3.2 | |
| | 1 | | **yellow perch** | 1 | 6.5 | 2.7 | |
| | 1 | | **yellow perch** | 1 | 6.5 | 2.6 | |
| | 1 | | **yellow perch** | 1 | 7 | 2.4 | |
| | 1 | | **yellow perch** | 1 | 7 | 3.2 | |
| | 1 | | **yellow perch** | 1 | 7 | 2.7 | |
| | 1 | | **yellow perch** | 1 | 7 | 2.9 | |
| | 1 | | **smallmouth bass** | 11 | N/A | 19 | yoy |
| | 1 | | **smallmouth bass** | 24 | N/A | 32.9 | yoy |
| | 1 | | **smallmouth bass** | 15 | N/A | 19.9 | yoy |
| | 1 | | **walleye** | 1 | 18.3 | 23 | |
| | 1 | | logperch | 4 | N/A | 8.2 | |
| | 1 | | pumpkinseed | 18 | N/A | 279.8 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | | rock bass | 26 | N/A | 61.4 | |
| | 1 | | black crappie | 4 | N/A | 19 | |
| 4 | 1 | 7/14/2008 | **walleye** | 1 | 88 | 6.1 | juvenile |
| | 1 | | white sucker | 1 | N/A | N/A | yoy-too small to weigh |
| | 1 | | longnose dace | 2 | N/A | 23.6 | |
| | 1 | | creek chub | 3 | N/A | 79.5 | |
| | 1 | | tessellated darter | 1 | N/A | N/A | |
| | 2 | | logperch | 3 | N/A | 2.5 | |
| 5 | 1 | 7/12/2008 | creek chub | 133 | N/A | 313.7 | |
| | 1 | | fathead minnow | 21 | N/A | 69.4 | |
| | 1 | | white sucker | 10 | N/A | 54.1 | |
| | 1 | | brook stickleback | 38 | N/A | 30.1 | |
| | 1 | | mottled sculpin | 45 | N/A | 18.2 | |
| | 1 | | common shiner | 8 | N/A | 54.7 | |
| | 1 | | northern redbelly dace | 20 | N/A | 45.5 | |
| | 2 | | creek chub | 28 | N/A | 6.2 | |
| | 2 | | white sucker | 43 | N/A | 35.6 | |
| | 2 | | brook stickleback | 10 | N/A | 5.8 | |
| | 2 | | mottled sculpin | 19 | N/A | 4.2 | |
| | 2 | | *Cyprinid spp*. | 1 | N/A | N/A | yoy |
| 5 | 1 | 7/19/2008 | creek chub | 41 | N/A | 130 | |
| | 1 | | fathead minnow | 3 | N/A | 16.7 | |
| | 1 | | white sucker | 32 | N/A | 112.3 | |
| | 1 | | brook stickleback | 44 | N/A | 31.4 | |
| | 1 | | mottled sculpin | 1 | N/A | 24.7 | |
| | 1 | | common shiner | 3 | N/A | 30.1 | |
| | 1 | | northern redbelly dace | 16 | N/A | 26.7 | |

ELECTROFISHING DATA

| Site # | Date | Species | Number | Total Length (mm) | Weight (g) | Comments |
|---|---|---|---|---|---|---|
| 1 | 6/10/2008 | creek chub | 1 | 90 | 13.2 | problems with electrofisher |
| 2 | 7/29/2008 | creek chub | 77 | N/A | 754.9 | |
| | | brook stickleback | 56 | N/A | 35.1 | |
| | | white sucker | 12 | N/A | 70.4 | |
| | | central mudminnow | 84 | N/A | 225.1 | |
| | | mottled sculpin | 3 | N/A | 3.2 | |
| | | northern redbelly dace | 14 | N/A | 29.4 | |
| | | finescale dace | 4 | N/A | 33.6 | |
| | | pearl dace | 18 | N/A | 97.7 | |
| 3 | 7/9/2008 | creek chub | 25 | N/A | 523.9 | |
| | | fathead minnow | 7 | N/A | 36.2 | |
| | | northern redbelly dace | 6 | N/A | 6.8 | |
| | | white sucker | 41 | N/A | 1821.5 | |
| | | mottled sculpin | 40 | N/A | 131.8 | |
| | | brook stickleback | 10 | N/A | 4.9 | |
| | | common shiner | 12 | N/A | 98 | |

# Appendix F

## Fish Community Data for Cardinal Creek

SEINING DATA

| Site # | Seine # | Date | Species | Number | Total Length (mm) | Weight (g) | Comments |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 6/17/2008 | bluntnose minnow | 7 | N/A | 18.9 | |
| | 1 | | blackchin shiner | 1 | N/A | N/A | too small to weigh |
| | 1 | | brook stickleback | 1 | N/A | N/A | too small to weigh |
| | 1 | | creek chub | 16 | N/A | 112.8 | |
| | 1 | | white sucker | 38 | N/A | 328.4 | four large; rest are yoy |
| | 1 | | johnny darter | 45 | N/A | 53.3 | |
| | 1 | | common shiner | 6 | N/A | 24.3 | |
| | 1 | | emerald shiner | 9 | N/A | 29.9 | |
| | 1 | | *Cyprinid spp*. | 22 | N/A | 61.1 | |
| 2 | 1 | 6/17/2008 | creek chub | 2 | N/A | 52 | |
| | 1 | | white sucker | 11 | N/A | 22 | |
| | 1 | | common shiner | 21 | N/A | 158.5 | |
| | 1 | | emerald shiner | 3 | N/A | 11.4 | |
| | 1 | | northern redbelly dace | 1 | N/A | N/A | |
| | 1 | | *Cyprinid spp*. | 21 | N/A | 14.6 | very tiny |
| | 1 | | fathead minnow | 1 | N/A | N/A | too small to weigh |
| 3 | 1 | 6/17/2008 | brook stickleback | 9 | N/A | 6.29 | |
| | 1 | | creek chub | 28 | N/A | 241.7 | |
| | 1 | | white sucker | 10 | N/A | 94.7 | |
| | 1 | | common shiner | 172 | N/A | 573.4 | |
| | 1 | | fathead minnow | 4 | N/A | 3.4 | |
| | 1 | | golden shiner | 2 | N/A | 6.3 | |
| | 1 | | *Cyprinid spp*. | 27 | N/A | 53.2 | |
| 4 | 1 | 6/26/2008 | **yellow perch** | 20 | N/A | 8.6 | yoy |
| | 1 | | spottail shiner | 4 | N/A | 14 | |
| 4 | 1 | 7/30/2008 | yellow bullhead | 1 | 290 | 322.3 | |
| | 1 | | yellow bullhead | 1 | 270 | 260.4 | |
| | 1 | | spottail shiner | 3 | N/A | 8.2 | |
| | 1 | | white sucker | 1 | N/A | N/A | too small to weigh |
| | 2 | | spottail shiner | 13 | N/A | 11.1 | |
| | 2 | | tessellated darter | 2 | N/A | N/A | too small to weigh |
| | 2 | | yoy *Centrarchid spp.* | 2 | N/A | N/A | too small to weigh and i.d.; still see-through |
| | 2 | | trout-perch | 1 | N/A | 1 | |
| 5 | 1 | 6/26/2008 | **yellow perch** | 1 | N/A | N/A | yoy |
| | 1 | | spottail shiner | 9 | N/A | 21.1 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | 1 | 7/30/2008 | **yellow perch** | 1 | 195 | 75 | |
| | 1 | | **northern pike** | 1 | 130 | 10.8 | |
| | 1 | | logperch | 2 | N/A | N/A | too small to weigh |
| | 1 | | *Etheostoma spp*. | 6 | N/A | 1.9 | too small to i.d. |
| | 1 | | trout-perch | 1 | N/A | N/A | too small to weigh |
| | 1 | | spottail shiner | 2 | N/A | 16.9 | |
| | 1 | | *Centrarchid spp.* | 3 | N/A | N/A | yoy; still see-through |
| 6 | 1 | 7/19/2008 | white sucker | 41 | N/A | 1273.9 | |
| | 1 | | common shiner | 123 | N/A | 1108.3 | |
| | 1 | | creek chub | 32 | N/A | 189.5 | |
| | 1 | | brook stickleback | 18 | N/A | 12.9 | |
| | 1 | | *Cyprinid spp*. | 25 | N/A | 23.9 | |

# Appendix G

## Fish Community Data for Mud Creek

SEINING DATA

| Site # | Seine # | Date | Species | Number | Total Length (mm) | Weight (g) | Comments |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 6/5/2008 | brook stickleback | 20 | N/A | 30.7 | |
| | 1 | | white sucker | 6 | N/A | 27 | |
| | 1 | | blacknose dace | 1 | N/A | N/A | |
| | 1 | | creek chub | 1 | N/A | N/A | |
| | 1 | | blackchin shiner | 1 | N/A | N/A | |
| | 1 | | *Cyprinid spp*. | 14 | N/A | 55.7 | |
| 2 | 1 | 6/9/2008 | white sucker | 3 | N/A | 13.43 | |
| | 1 | | *Cyprinid spp.* | 1 | N/A | N/A | too small to weigh |
| 3 | 1 | 6/9/2008 | rock bass | 2 | N/A | 380 | |
| | 1 | | *Cyprinid spp*. | 1 | N/A | N/A | |
| | 2 | | white sucker | 2 | N/A | 328 | |
| | 2 | | **yellow perch** | 1 | 13 | 8.5 | |
| | 2 | | golden shiner | 1 | N/A | N/A | |
| | 2 | | blacknose shiner | 1 | N/A | N/A | |
| | 2 | | common shiner | 2 | N/A | 1.7 | |
| | 2 | | bluntnose minnow | 6 | N/A | 6.1 | |
| 4 | 1 | 6/26/2008 | pumpkinseed | 1 | N/A | 5.8 | |
| | 1 | | golden shiner | 1 | N/A | 7.9 | |
| | 2 | | **largemouth bass** | 1 | N/A | N/A | too small to weigh |
| | 2 | | rock bass | 1 | N/A | 4.2 | |
| 5 | 1 | 7/14/2008 | **yellow perch** | 1 | 135 | 25.3 | |
| | 1 | | pumpkinseed | 1 | N/A | 8.8 | |
| | 2 | | **yellow perch** | 1 | 160 | 47.2 | |
| | 2 | | brook stickleback | 1 | N/A | 4.3 | |
| | 2 | | creek chub | 8 | N/A | 426 | |
| | 2 | | tessellated darter | 4 | N/A | 3 | |
| 6 | 1 | 7/19/2008 | **yellow perch** | 1 | 150 | 36.3 | |
| | 1 | | **yellow perch** | 1 | 116 | 18.4 | |
| | 1 | | **yellow perch** | 1 | 115 | 16.9 | |
| | 1 | | **yellow perch** | 1 | 80 | 8.6 | |
| | 1 | | **yellow perch** | 1 | 102 | 10.7 | |
| | 1 | | **yellow perch** | 1 | 100 | 10.2 | |
| | 1 | | creek chub | 17 | N/A | 217.6 | |
| | 1 | | rock bass | 1 | 135 | 50.4 | |
| | 1 | | rock bass | 2 | N/A | 13.4 | |
| | 1 | | white sucker | 6 | N/A | 556 | |
| | 1 | | common shiner | 19 | N/A | 146.4 | |
| | 1 | | brook stickleback | 1 | N/A | 0.4 | |
| 7 | 1 | 7/24/2008 | rock bass | 4 | N/A | 114.5 | |
| | 1 | | common shiner | 1 | N/A | 23.9 | |

ELECTROFISHING DATA

| Site # | Date | Species | Number | Total Length (mm) | Weight (g) | Comments |
|---|---|---|---|---|---|---|
| 1 | 6/20/2008 | mottled sculpin | 9 | N/A | 67.1 | problems with electrofisher |
| | | central mudminnow | 2 | N/A | 12.5 | |
| | | brook stickleback | 3 | N/A | 2 | |
| 2 | 8/24/2008 | creek chub | 37 | N/A | 185.4 | |
| | | mottled sculpin | 34 | | 184.8 | |
| | | longnose dace | 176 | | 963.6 | |
| | | central mudminnow | 6 | | 43.5 | |
| | | tessellated darter | 5 | | 17.2 | |
| | | common shiner | 2 | | 24.4 | |
| | | white sucker | 1 | | 38.5 | |
| | | bluntnose minnow | 1 | | 7.4 | |
| | | rock bass | 8 | | 77.6 | |

# Appendix H

## Fish Community Data for Sawmill Creek

SEINING DATA

| Site # | Seine # | Date | Species | Number | Total Length (mm) | Weight (g) | Comments |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 6/17/2008 | bluntnose minnow | 3 | N/A | 8.2 | |
| 1 | 1 | | white sucker | 7 | N/A | 39.9 | |
| 1 | 1 | | common shiner | 15 | N/A | 43.3 | |
| 1 | 1 | | creek chub | 23 | N/A | 112.4 | |
| 1 | 1 | | *Cyprinid spp*. | 4 | N/A | 4.4 | yoy |
| 1 | 1 | | brook stickleback | 1 | N/A | N/A | too small to weigh |
| 2 | 1 | 7/19/2008 | creek chub | 10 | N/A | 73.3 | |
| 2 | 1 | | white sucker | 12 | N/A | 45.4 | |
| 2 | 1 | | bluntnose minnow | 1 | N/A | 4.2 | |
| 2 | 2 | | white sucker | 25 | N/A | 551.1 | |
| 2 | 2 | | *Cyprinid spp.* | 6 | N/A | N/A | too small to i.d. |
| 2 | 2 | | fathead minnow | 2 | N/A | N/A | |
| 2 | 2 | | creek chub | 44 | N/A | 283.6 | |

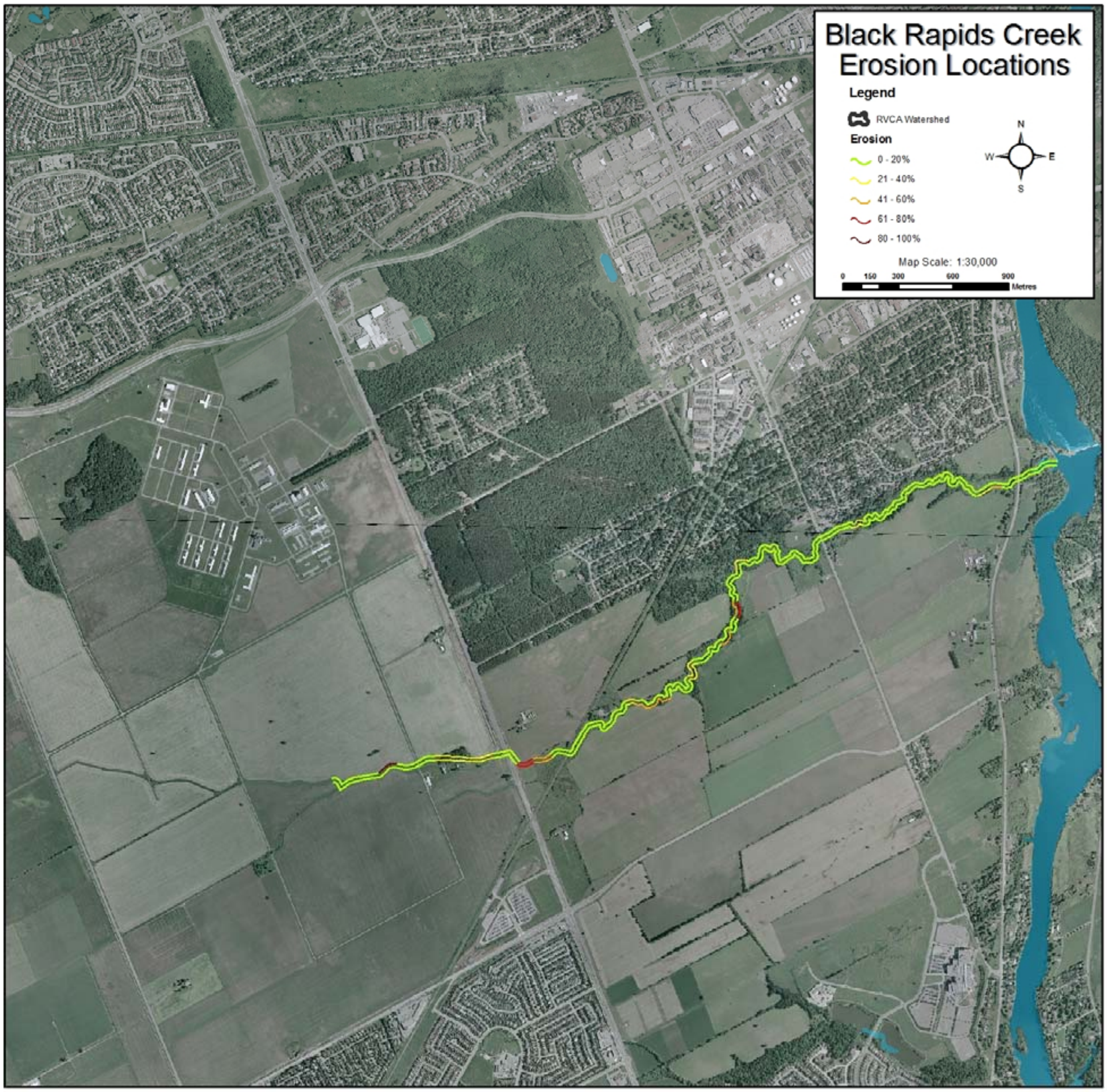
ELECTROFISHING DATA

| Site # | Date | Species | Number | Total Length (mm) | Weight (g) | Comments |
|---|---|---|---|---|---|---|
| 1 | 7/2/2008 | muskellunge | 1 | 1000 | N/A | unable to weigh |
| 1 | | mottled sculpin | 11 | N/A | 51.7 | |
| 1 | | hybrid bluegill | 1 | | 25.2 | |
| 1 | | rock bass | 11 | | 371.1 | |
| 1 | | white sucker | 4 | | 287.5 | |
| 1 | | smallmouth bass | 5 | | 2.6 | yoy |
| 1 | | longnose dace | 7 | | 42.6 | |
| 1 | | darter spp. | 1 | | | yoy |
| 1 | | logperch | 2 | | 5.6 | |
| 1 | | blacknose dace | 7 | | 3.4 | |
| 1 | | creek chub | 4 | | 15.4 | |
| 2 | 7/2/2008 | white sucker | 10 | | 904.6 | |
| 2 | | longnose dace | 32 | | 138.4 | |
| 2 | | creek chub | 8 | | 197.1 | |
| 2 | | *Cyprinid spp.* | 15 | | 0.7 | yoy |
| 3 | 7/2/2008 | creek chub | 30 | | 207.2 | |
| 3 | | mottled sculpin | 32 | | 81 | |
| 3 | | brook stickleback | 25 | | 22.1 | |
| 3 | | central mudminnow | 15 | | 79.8 | |
| 3 | | *Cyprinid spp*. | 18 | | 11.2 | |

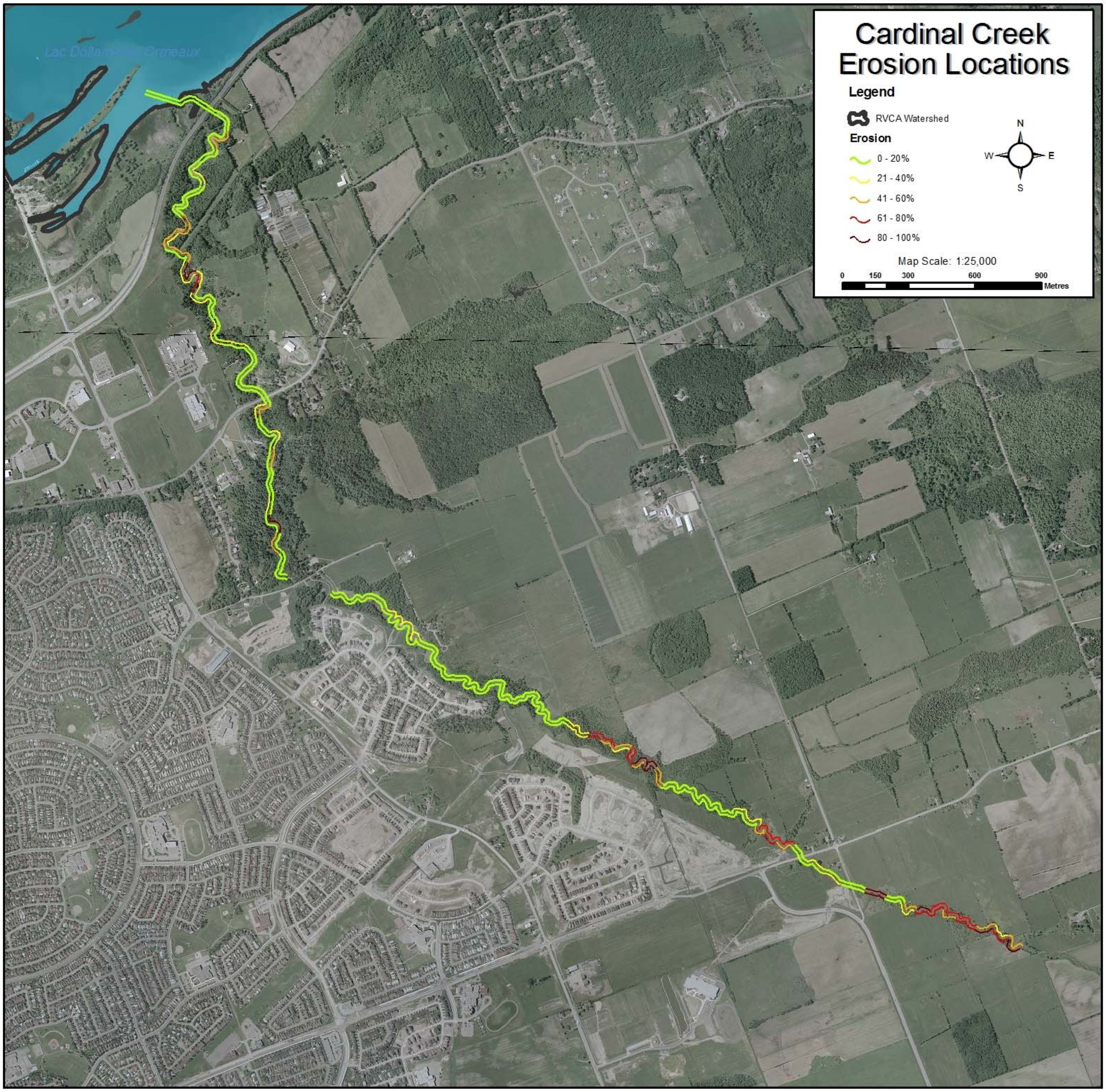
# Appendix I

## Maps of Erosion Sites

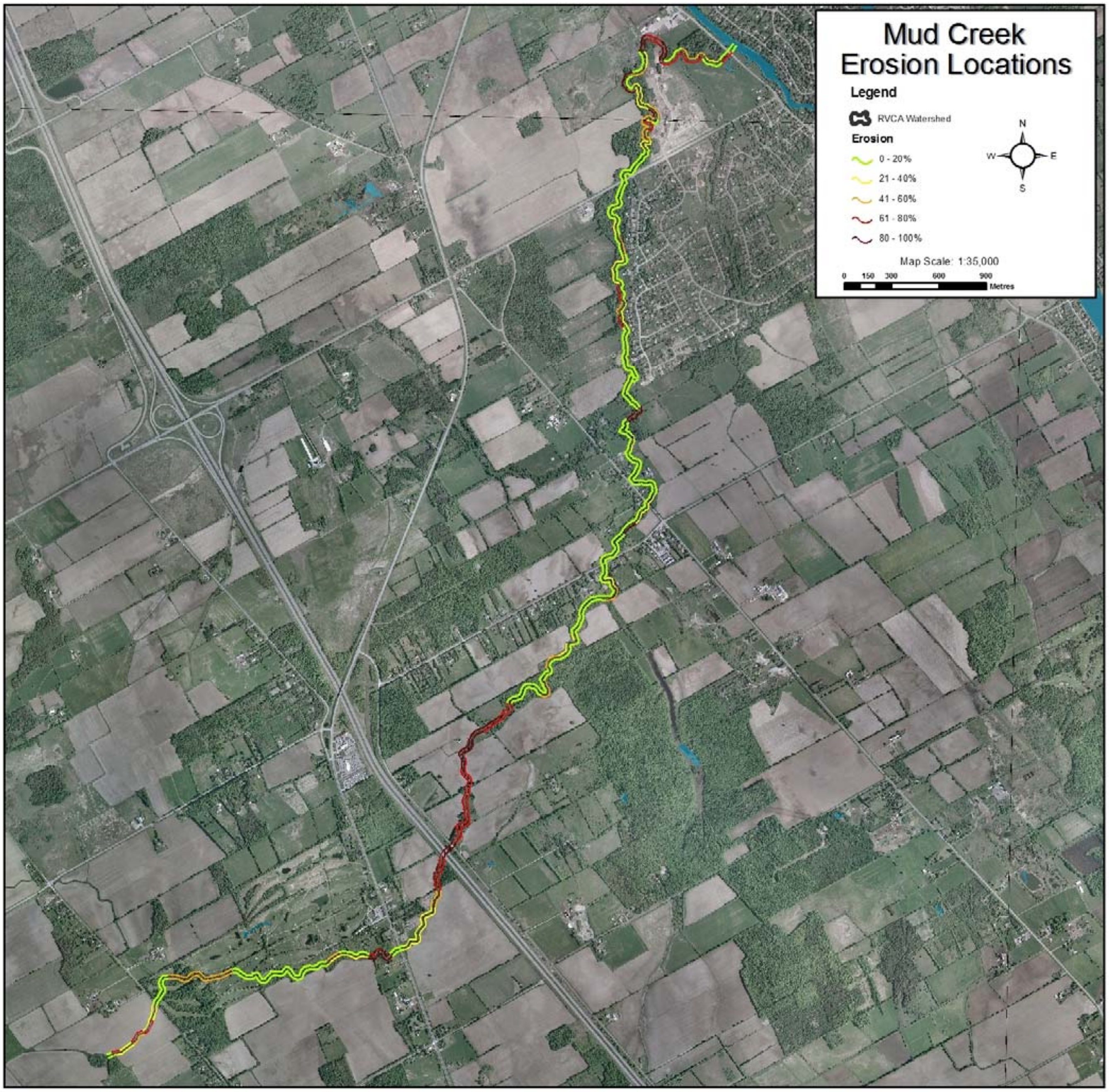
*i) Black Rapids Creek Erosion*



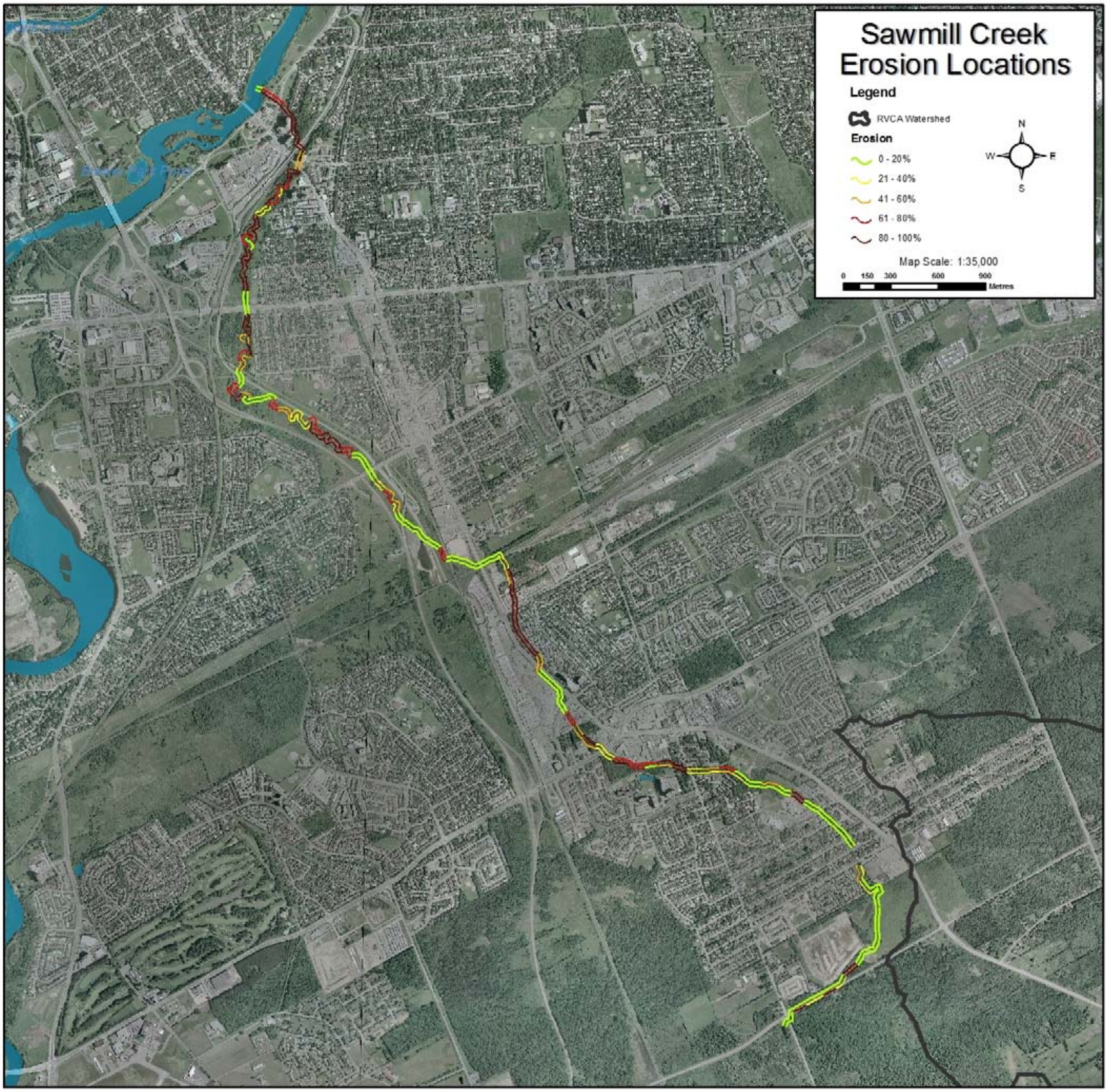
ii) *Cardinal Creek Erosion*



### ii) Mud Creek Erosion



### iii) Sawmill Creek Erosion

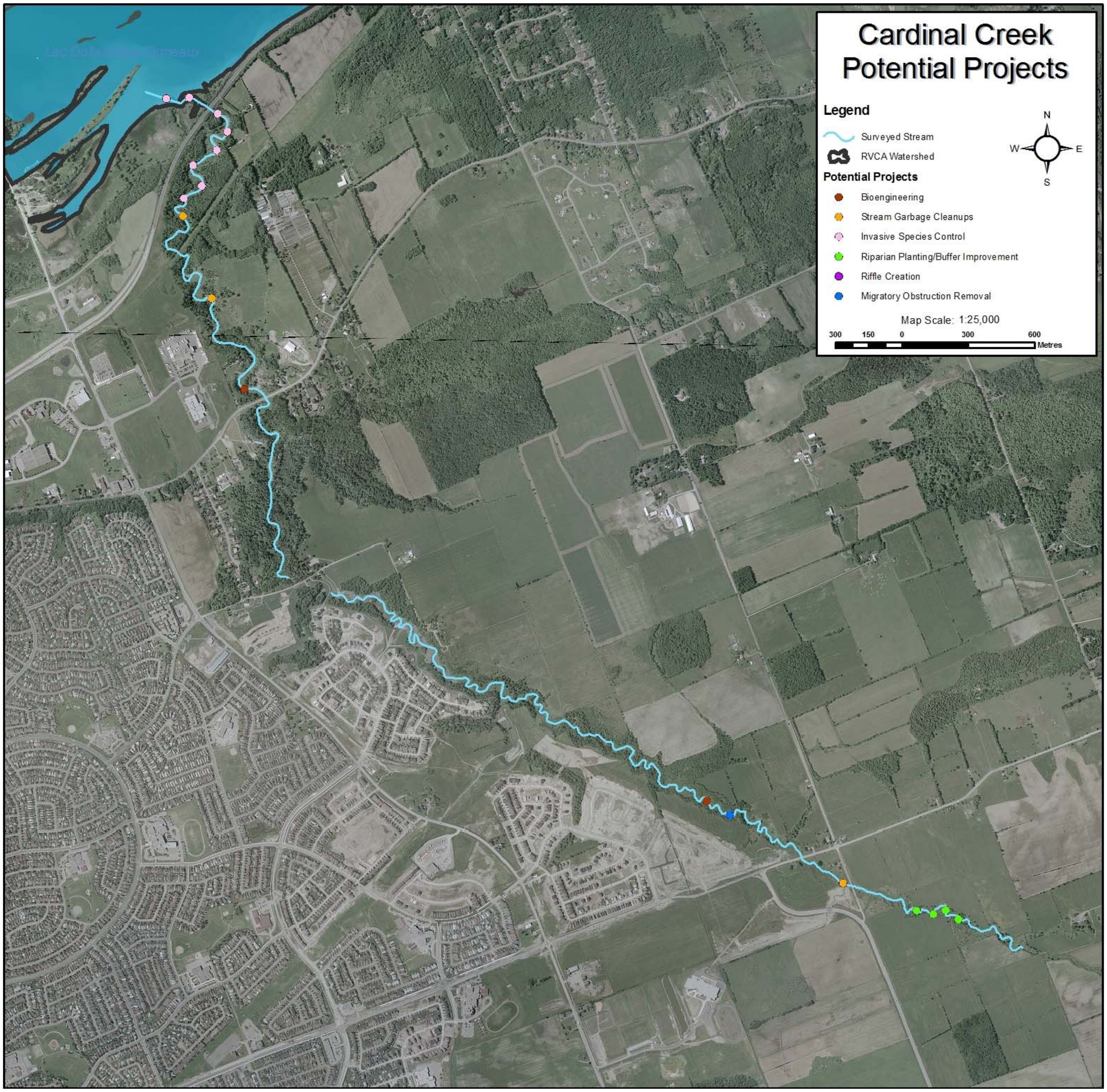


# Appendix J

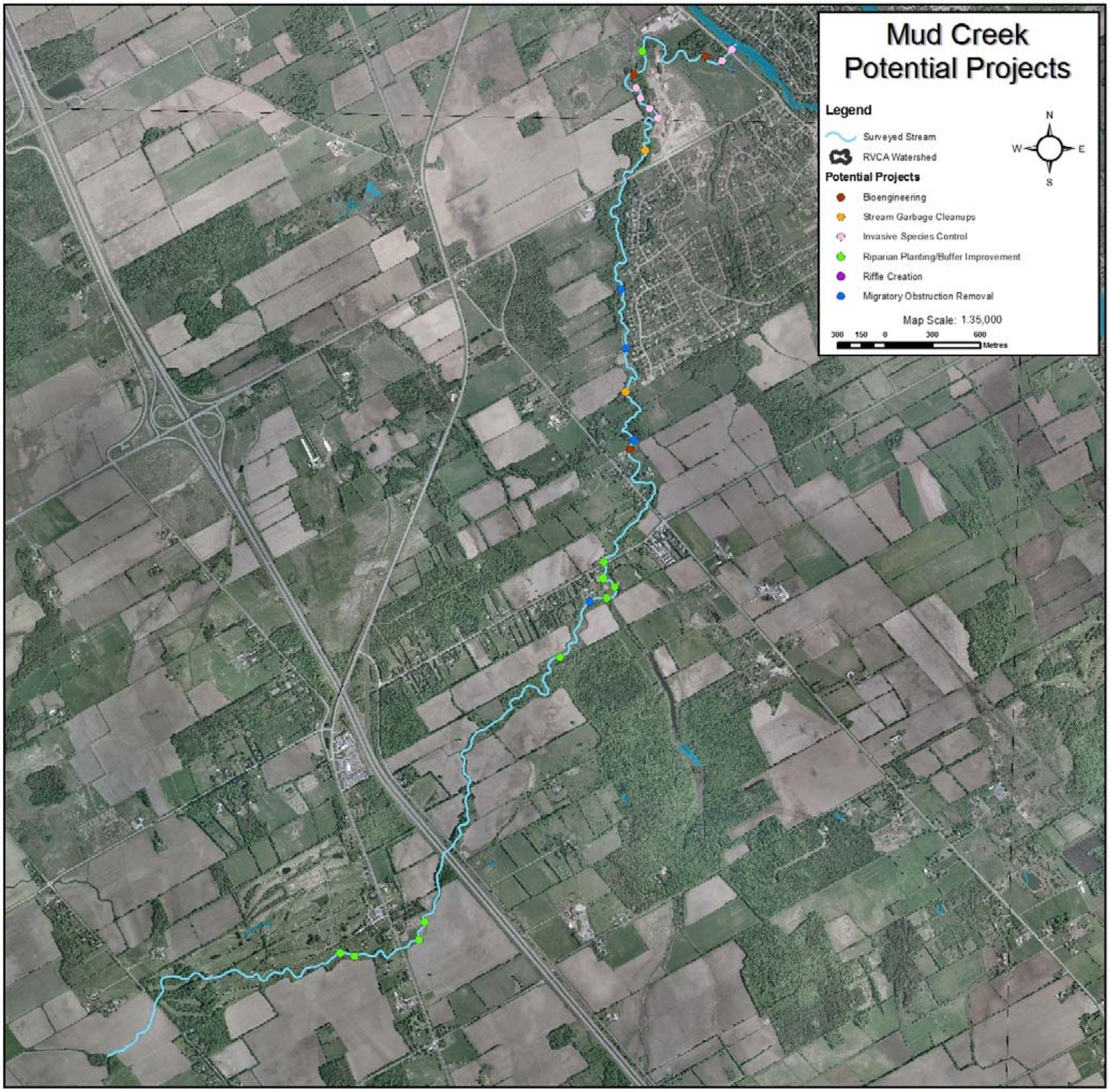
## *Maps of Potential Project Areas*

i) *Black Rapids Creek Projects*

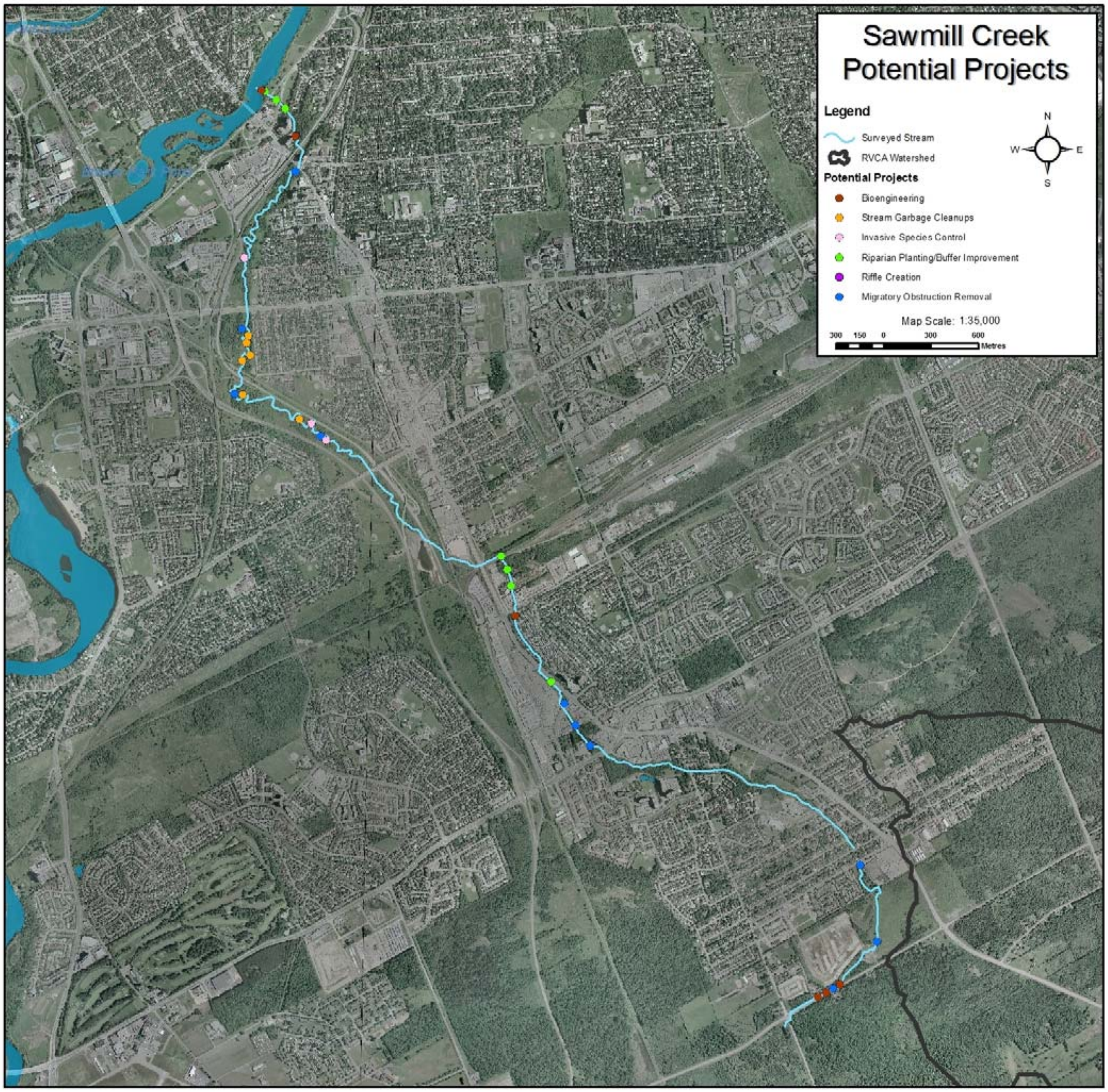
### *i) Cardinal Creek Projects*



### ii) Mud Creek Projects



### *iii) Sawmill Creek Projects*



# Appendix K



| Ontario Fish Species | | |
|---|---|---|
| **Reproductive Guild** | **Common Names** | **Scientific Name** |
| **A. NON-GUARDER** | | |
| **A.1 Open Substrate Spawners** | | |
| **A.1.1 Pelagophils** | | |
| • non-adhesive eggs scattered in open water in areas where current direction is favourable to egg distribution and survival | American eel | *Anguilla rostrata* |
| | American shad | *Alosa sapidissima* |
| | longjaw cisco | *Coregonus alpenae* |
| | blackfin cisco | *C. nigripinnis* |
| | shortnose cisco | *C. reighardi* |
| | shortjaw cisco | *C. zenithicus* |
| | emerald shiner | *Notropis atherinoides* |
| | freshwater drum | *Aplodinotus grunniens* |
| **A.1.2 Litho-pelagophils** | | |
| • fishes which undergo full range of transition from lithophils to pelagophils<br>• eggs initially deposited on rocks/gravel but eggs or embryos become buoyant and are carried away from spawning substrates | lake sturgeon | *Acipenser fulvescens* |
| | gizzard shad | *Dorosoma cepedianum* |
| | cisco (lake herring) | *Coregonus artedi* |
| | bloater | *C. hoyi* |
| | deepwater cisco (chub) | *C. johannae* |
| | kiyi | *C. kiyi* |
| | *goldeneye* | *Hiodon alosoides* |
| | mooneye | *H. tergisus* |
| | burbot | *Lota lota* |

| Ontario Fish Species | | |
|---|---|---|
| **Reproductive Guild** | **Common Names** | **Scientific Name** |
| **A.1.3 Lithophils** | | |
| • deposit eggs on a rock, rubble or gravel bottom (streams or lakes)<br>• usually well oxygenated waters; embryos hatch early and are highly photophobic | lake whitefish | *Coregonus clupeaformis* |
| | pygmy whitefish | *Prosopium coulteri* |
| | round whitefish | *P. cylindraceum* |
| | Arctic grayling | *Thymallus articus* |
| | rainbow smelt | *Osmerus mordax* |
| | redside dace | *Clinostomus elongatus* |
| | lake chub | *Couesius plumbeus* |
| | pugnose shiner | *Notropis anogenus* |
| | blacknose dace | *Rhinichthys atratulus* |
| | longnose dace | *R. cataractae* |
| | pearl dace | *Margariscus margarita* |
| | longnose sucker | *Catostomus catostomus* |
| | white sucker | *C. commersoni* |
| | northern hog sucker | *Hypentelium nigricans* |
| | spotted sucker | *Minytrema melanops* |
| | silver redhorse | *Moxostoma anisurum* |
| | river redhorse | *M. carinatum* |
| | black redhorse | *M. duquesnei* |
| | golden redhorse | *M. erythrurum* |
| | shorthead redhorse | *M. macrolepidotum* |
| | greater redhorse | *M. valenciennesi* |
| | trout-perch | *Percopsisomiscomaycus* |
| | sauger | *Stizostedion canadense* |
| | blue pike (blue pickerel) walleye (yellow pickerel) | *S. vitreum* |
| **A.1.4 Phyto-lithophils** | | |
| • deposit eggs usually in clear water habitats on submerged plants, if available or on other submerged debris such as logs, gravel and rocks<br>• late hatching, presence of cement glands | alewife | *Alosa pseudoharengus* |
| | finescale dace | *Phoxinus neogaeus* |
| | brassy minnow | *Hybognathus hankinsoni* |
| | silvery minnow | *H. nuchalis* |
| | gravel chub | *Erimystax x-punctata* |
| | spotfin shiner | *Cyprinella spiloptera* |
| | silver chub | *Macrhybopsis storeriana* |
| | redfin shiner | *Lythrurus umbratilis* |
| | mimic shiner | *Notropis volucellus* |
| | brook silverside | *Labidesthes sicculus* |
| | white perch | *Morone americana* |
| | white bass | *M. chrysops* |
| | yellow perch | *Perca flavescens* |
| | Iowa darter | *Etheostoma exile* |

| Ontario Fish Species | | |
|---|---|---|
| **Reproductive Guild** | **Common Names** | **Scientific Name** |
| **A.1.5 Phytophils** | | |
| • scatter or deposit eggs with an adhesive membrane that sticks to submerged, live or dead, aquatic plants, or to recently flooded terrestrial plants<br>• sometimes deposited on logs and branches but never on the bottom<br>• adapted to low oxygen concentrations<br>• cement glands present | spotted gar | *Lepisosteus oculatus* |
| | longnose gar | *L. osseus* |
| | central mudminnow | *Umbra limi* |
| | grass pickerel | *Esox americanus vermiculatus* |
| | northern pike | *E. lucius* |
| | muskellunge | *E. masquinongy* |
| | chain pickerel | *E. niger* |
| | northern redbelly dace | *Phoxinus eos* |
| | golden shiner | *Notemigonus crysoleucas* |
| | bridle shiner | *Notropis bifrenatus* |
| | pugnose minnow | *Opsopoeodus emiliae* |
| | blackchin shiner | *Notropis heterodon* |
| | lake chubsucker | *Erimyzon sucetta* |
| | bigmouth buffalo | *Ictiobus cyprinellus* |
| | banded killifish | *Fundulus diaphanus* |
| | greenside darter | *Etheostoma blennioides* |
| | least darter | *E. microperca* |
| **A.1.6 Psammophils** | | |
| • eggs scattered directly on sand or near fine roots of plants that hang over the sandy bottom<br>• usually adapted to running water<br>• eggs adhesive<br>• usually in highly oxygenated waters | quillback | *Carpiodes cyprinus* |
| | blacknose shiner | *Notropis heterolepis* |
| | spottail shiner | *N. hudsonius* |
| | sand shiner | *N. stramineus* |
| | eastern sand darter | *Ammocrypta pellucida* |
| | logperch | *Percina caprodes* |

| Ontario Fish Species | | |
|---|---|---|
| **Reproductive Guild** | **Common Names** | **Scientific Name** |
| **A.2 BROOD HIDERS** | | |
| **A.2.1 Lithophils** | | |
| • hide eggs in natural or specially constructed places<br>• none guard deposited eggs through to emergence<br>• in most cases the hiding places are excavated in gravel<br>• generally eggs are buried under gravel<br>• clean gravel or rocks and cold, clean fast flowing water or springs are almost essential to assume some exchange of water around eggs to provide sufficient oxygen | chum salmon | *Oncorhynchus keta* |
| | pink salmon | *O. gorbuscha* |
| | coho salmon | *O. kisutch* |
| | sockeye salmon | *O. nerka* |
| | chinook salmon | *O. tshawytscha* |
| | rainbow trout | *O. mykiss* |
| | Atlantic salmon | *Salmo salar* |
| | Arctic char | *Salvelinus alpinus* |
| | brook trout | *S. fontinalis* |
| | lake trout | *S. namaycush* |
| | hornyhead chub | *Nocomis biguttatus* |
| | river chub | *N. micropogon* |
| | creek chub | *Semotilus atromaculatus* |
| | fallfish | *S. corporalis* |
| | rainbow darter | *Etheostoma caeruleum* |
| | channel darter | *Percina copelandi* |
| | blackside darter | *P. maculata* |
| | river darter | *P. shumardi* |
| **B. GUARDERS** | | |
| **B.1. SUBSTRATUM CHOOSERS:** spawning site is guarder and kept clean by parent | | |
| **B.1.1 Phytophils** | | |
| • eggs are scattered or attached onto submerged plants<br>• male guards and fans eggs | white crappie | *Pomoxis annularis* |
| **B.2 NEST SPAWNERS:** variable structures built for egg deposition and guarding | | |
| **B.2.1 Lithophils** | | |
| • eggs deposited in single layer or multi layer clutches on cleaned rocks or in pits dug in gravel | common shiner | *Luxilus cornutus* |
| | cutlips minnow | *Exoglossum maxillingua* |
| | black bullhead | *Ameiurus melas* |
| | rock bass | *Ambloplites rupestris* |
| | green sunfish | *Lepomis cyanellus* |
| | bluegill | *L. macrochirus* |
| | longear sunfish | *L. megalotis* |
| | smallmouth bass | *Micropterus dolomieu* |
| | fourhorn sculpin | *Myoxocephalus quadricornis* |

| Ontario Fish Species | | |
|---|---|---|
| **Reproductive Guild** | **Common Names** | **Scientific Name** |
| **B.2.2 Phytophils** | | |
| • nests built on a soft, muddy bottom usually amid algae, plants, plant roots, leaves | bowfin | *Amia calva* |
| | largemouth bass | *Micropterus salmoides* |
| | black crappie | *Pomoxis nigromaculatus* |
| **B.2.3 Speleophils** | | |
| • guard spawn in natural holes and cavities or in specially constructed burrows<br>• frequently eggs are deposited on a cleaned area of the undersurface of flat stones | bluntnose minnow | *Pimephales notatus* |
| | fathead minnow | *P. promelas* |
| | yellow bullhead | *Ameiurus natalis* |
| | brown bullhead | *A. nebulosus* |
| | channel catfish | *Ictalurus punctatus* |
| | stonecat | *Noturus flavus* |
| | tadpole madtom | *N. gyrinus* |
| | brindled madtom | *N. miurus* |
| | fantail darter | *Etheostoma flabellare* |
| | johnny darter | *E. nigrum* |
| | mottled sculpin | *Cottus bairdi* |
| | slimy sculpin | *C. cognatus* |
| | spoonhead sculpin | *C. ricei* |
| **B.2.4 Polyphils** | | |
| • fishes that are not particular in the selection of nest building material and substrate<br>• usually circular nests with sticks and roots left in place<br>• often among or next to plants growing in muddy or sandy shallows of slow rivers or lagoons | pumpkinseed | *Lepomis gibbosus* |
| **B.2.5 Ariadnophils** | | |
| • skill nest building and parental care remarkably well developed<br>• nest materials are bound together by a viscid thread secreted by male | brook stickleback | *Culaea inconstans* |
| | threespine stickleback | *Gasterosteus aculeatus* |
| | ninespine stickleback | *Pungitius pungitius* |

References: Balon (1975) and Robins *et al.* (1991)

# Appendix L

## City Stream Watch 2008 Organizational Chart