Pinecrest Creek 2017 Catchment Report

Watershed Features	
Area	17.1 Square kilometres 0.4% of the Rideau Valley watershed
Land Use	5.71% agriculture 85.59% urban 0.08% rural 4.04% forest 4.33% meadow 0.20% water body 0.06% wetland
Surficial Geology	48.93% clay 20.68% diamicton 4.51% organic deposits 1.07% Paleozoic bedrock 24.81% sand
Watercourse Type	2017 thermal conditions cold water system
Invasive Species	Ten invasive species were identified in 2017: banded mystery snail, bull thistle, common and glossy buckthorn, dog strangling vine, garlic mustard, Himalayan balsam, non-native honey suckle, Manitoba maple, wild/poison parsnip and purple loosestrife.
Fish Community	Eleven species of fish have been observed from 2011-2017 near the confluence. Species include: blacknose dace, bluntnose minnow, brown bullhead, creek chub, emerald shiner, *Etheostoma spp.*, longnose gar, rock bass, silver redhorse, white sucker, and yellow perch. Only white sucker were observed upstream of Carling Avenue.

Wetland Catchment Cover
0.06% unevaluated wetland

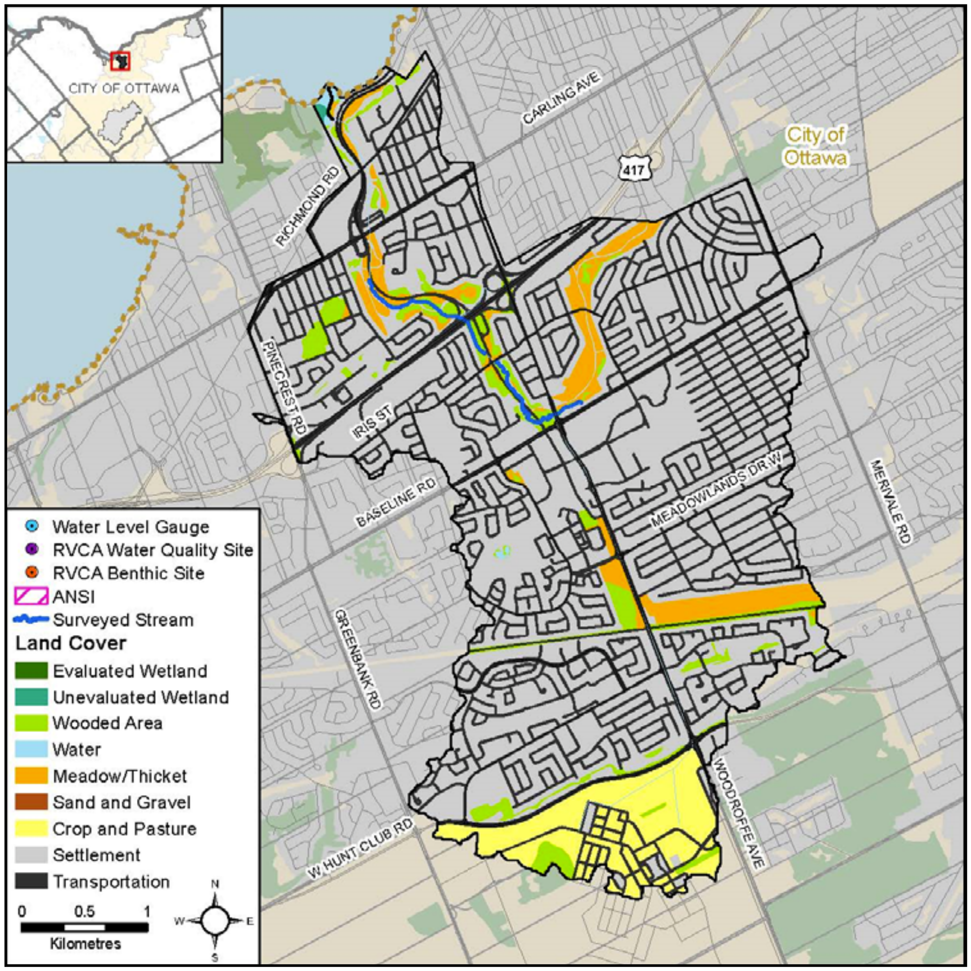
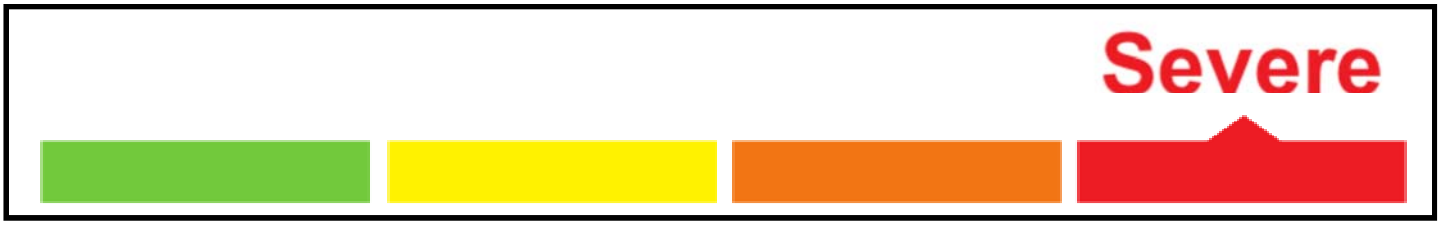


Figure 1 Land cover in the Pinecrest Creek catchment

Section of Pinecrest Creek along Connaught Park

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

Flood Warning Status - Rideau Valley Watershed Conditions



Flood Warning Conditions

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

The Ottawa River peaked on May 7th with a record flow of 5769 cubic meters per second, making it a 1:50 year flood event (RVCA, 2017). Pinecrest Creek is situated in a high density urban area, making it a system that is highly driven by storm water events. This year high water levels led to flood conditions at the mouth of the creek near the Ottawa River, as well as an increase in erosive forces affecting the shoreline of the creek itself but no housing or infrastructure. This year was quite a contrast to 2016, when the city experienced moderate to severe drought conditions throughout most of the year.

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

Flooded section of Pinecrest Creek near the Ottawa River

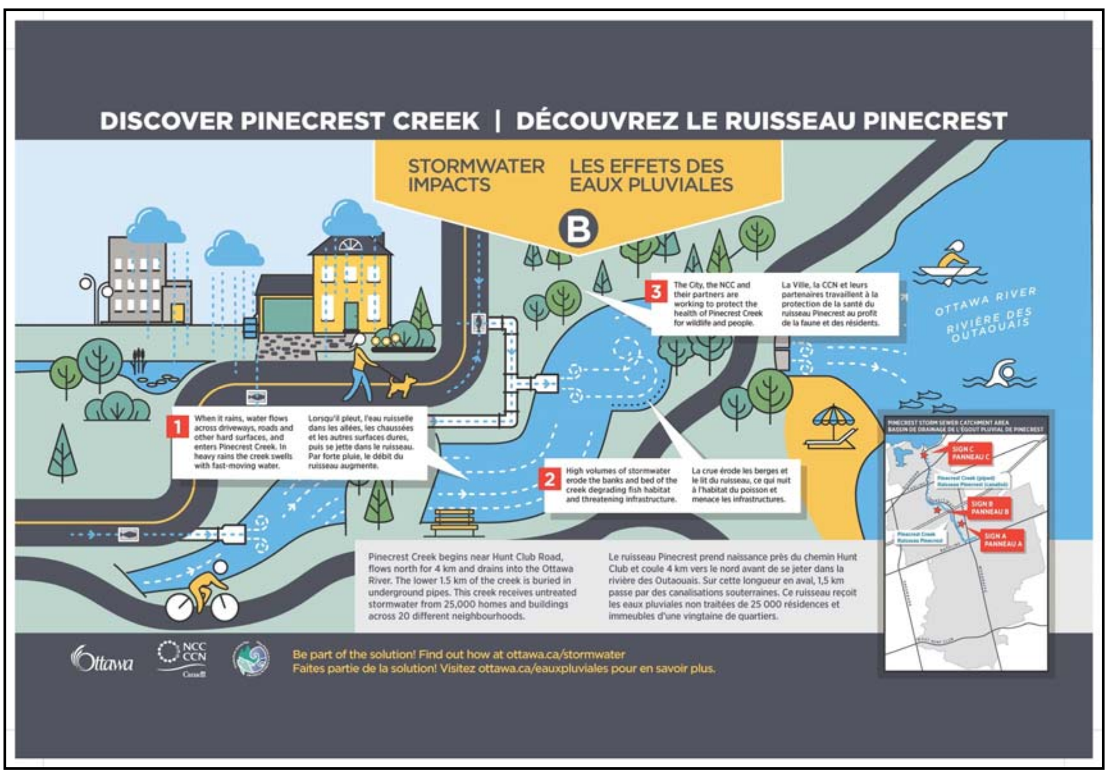
Flooded agricultural field in the Becketts Creek catchment

Introduction

Pinecrest Creek is a tributary of the Ottawa River located in the West end of the City of Ottawa. Although the stream has a length of 4.2 kilometers, only 2.5 kilometers of it is open to air, the remaining portions are piped underground. The buried sections of the stream are between West Hunt Club Road and Baseline Road, as well as Carling Road to the confluence with the Ottawa River by the Sir John A. Macdonald Parkway. The majority of the open surface portions of the stream flow through parklands belonging to the National Capital Commission (NCC) and are encroached by transportation corridors.

The sub-watershed of Pinecrest Creek drains 17.1 square kilometers of land and is comprised mainly of urban settlement areas, transportation infrastructure, recreational areas, industrial/commercial sections, a small fraction of agricultural land, and natural areas. The vegetation cover is comprised of 1.37 percent wetland and 98.63 percent wooded areas; of these woodlots 32 percent are one to ten hectares in size and 68 percent are less than one hectare in size. The majority of its natural headwater drainage features have been lost to urbanization and in so the system has become storm water driven with as many as 52 outfalls identified (J.F. Sabourin & Associates Inc., 2011). The Pinecrest Creek catchment is the most urbanized sub-watershed in the City of Ottawa (outside of the city center) with a 35 percent impervious cover (J.F. Sabourin & Associates Inc., 2011). With loss of flood storage capacity, increased erosive forces, pollution & degradation of water quality, increased presence of vegetative invasive species, substantial fish migratory obstructions, and restricted natural corridors for wildlife; these urbanization patterns have created significant environmental challenges in Pinecrest Creek.

In 2008 the NCC completed rehabilitation work in order to restore stability to areas that were threatened by severe erosion near recreational pathways and the transit corridor. Future development changes will continue to challenge the natural environment in the Pinecrest Creek Catchment, including light transit rail construction which will also lead to changes in the creek. These projects will also have renaturalization plans that will include riparian planting and consideration of butternut trees, a species at risk present in the Pinecrest Creek catchment. Improvements in the area are also planned by the City of Ottawa with their stormwater management retrofit plan that includes large scale projects such as the creation of a stormwater management pond in the Baseline/Woodroffe Road area; and a smaller pilot project that encompasses information sessions, signage and workshops on rainwater harvesting & infiltration landscaping, as well as the creation of rain gardens & de-paving projects (City of Ottawa, 2018).



City of Ottawa stormwater management signage present along Pinecrest Creek NCC pathways (image courtesy: City of Ottawa)

In 2017, the City Stream Watch program surveyed 28 sections (2.8 km) of Pinecrest Creek; five sites were sampled for fish community composition; three temperature loggers were deployed; three headwater drainage feature sites were assessed; and 743 meters of stream were cleaned of garbage. The following report summarizes findings of the areas surveyed and stream enhancement activities.

Pinecrest Creek Overbank Zone

Riparian Buffer Width Evaluation

The riparian buffer is the adjacent land area surrounding a stream or river. Naturally vegetated buffers are very important to protect the overall health of streams and watersheds. Natural shorelines provide buffering capacity of contaminants and nutrients that would otherwise run off freely into aquatic systems. Well established shoreline plant communities will hold soil particles in place preventing erosion and will also provide the stream with shading and cover. Environment and Climate Change Canada recommends a guideline of 30 meters of natural vegetation on both sides of the stream for at least 75 percent of the stream length (Environment Canada, 2013).

Figure 2 demonstrates buffer conditions along the left and right banks of the surveyed sections of Pinecrest Creek. Buffers greater than 30 meters were present along 32 percent of the left bank and 17 percent of the right bank. Buffers of 15 to 30 meters in length were observed in 26 percent of the left bank and 36 percent of the right bank. Buffers of five to15 meters were found in 24 percent of the left bank and 27 percent of the right bank. Buffers smaller than five meters were present along 18 percent of the left banks and 20 percent of the right bank.

Improvements can be made in the riparian buffer in the areas where buffers are lower than the guidelines along 68 percent of the left bank and 83 percent of the right bank. Many areas along the right bank are park lands where there is opportunity to expand these buffer.

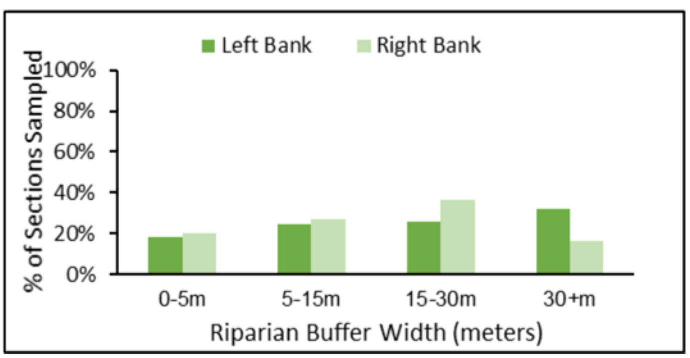


Figure 2 Vegetated buffer width along Pinecrest Creek

Section of Pinecrest Creek containing well established buffers that are less than 30 meters in length from the shoreline

Riparian Buffer Alterations

Alterations within the riparian buffer were assessed within three distinct shoreline zones (0-5 m, 5-15 m, 15-30 m), and evaluated based on the dominant vegetative community and/or land cover type.

The percentage of anthropogenic alterations to the natural riparian cover are shown in Figure 3. Pinecrest Creek riparian zones have portions of natural vegetative;. Anthropogenic alterations are associated with municipal infrastructure, including transit corridors and roadways, recreational land uses and residential urbanization.

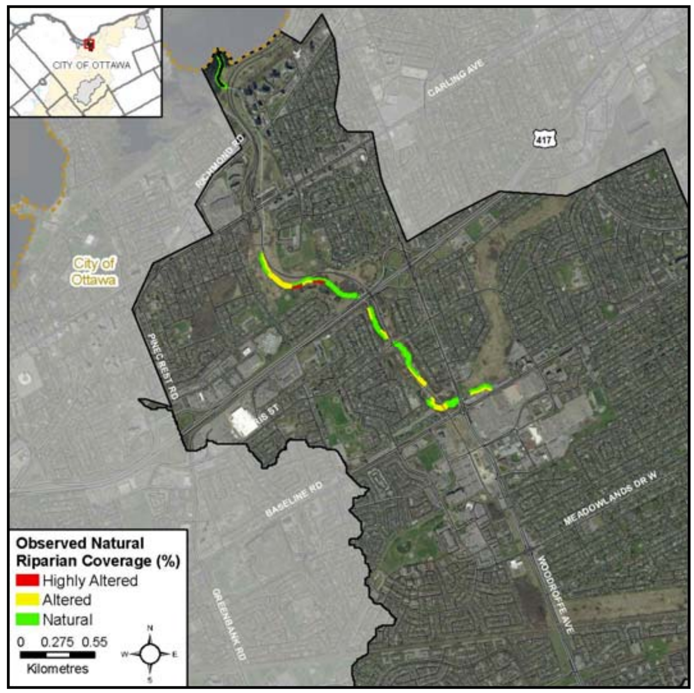


Figure 3 Riparian buffer alterations in Pinecrest Creek

Heavily modified stream section along Pinecrest Creek

Adjacent Land Use

Surrounding land use is considered from the beginning to end of the survey section (100 m) and up to 100 meters on each side of the river. Land use outside of this area is not considered for the surveys but is nonetheless part of the subwatershed and will influence the creek. Figure 4 shows the percent of surveyed sections that contain each type of land use.

Forests and scrubland were present in 89 percent and 75 percent of the sections surveyed. Meadows were present in 75 percent of the open creek areas, and wetland were in 18 percent. Wetland areas were mostly found at the mouth and small fragmented areas along stromwater drainage features.

Aside from the natural areas, the most common land uses in the catchment were associated with parks, transit corridors and roadways, with 100 percent of the sections containing infrastructure and 89 percent of the areas had recreational uses. Other uses observed included residential areas present in 39 percent of sections, industrial or commercial and other uses were identified in 18 percent of the adjacent land use.

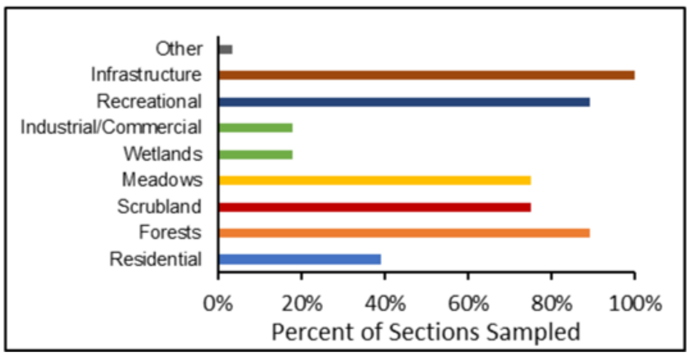


Figure 4 Adjacent land use 100 m from each shoreline and percentage of presence along open areas of Pinecrest Creek

Section of Pinecrest Creek containing mixed land uses including: infrastructure, residential, recreational, meadows, scrubland, and forest

Pinecrest Creek Shoreline Zone

Anthropogenic Alterations

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

Figure 5 shows the level of anthropogenic alterations of the 28 open sections surveyed in Pinecrest Creek. With only four percent remaining without any human alteration. Of the open sections, 32 percent fall in the classification of natural. Natural sections have not been straightened or diverted, have a riparian buffer greater than 15 meters, contain few lawns, ornamental gardens, beaches, rip rap or constructed wooden structures.

Altered sections account for 46 percent of surveyed areas, they may contain diverted or straightened sections and riparian buffers of five to 15 meters. Shoreline alterations also include concrete. One or two storm water outlets could also be present. Highly altered sections (18% of sections) have the highest proportions of alterations. Including riparian buffers less than five meters, shoreline alterations are found on most of the section, and portions of the stream may flow through culverts.

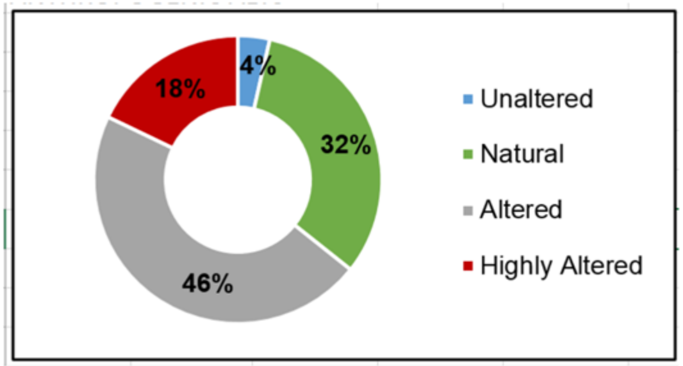


Figure 5 Anthropogenic alterations along Pinecrest Creek

A natural stream section of Pinecrest Creek near the mouth

A highly altered stream section flowing through a culvert underneath Woodroffe Avenue

Erosion

Stream erosion is the process by which water erodes and transports sediments, resulting in dynamic flows and diverse habitat conditions. Excessive erosion can result in drastic environmental changes, as habitat conditions, water quality and aquatic life are all negatively affected. Bank stability was assessed as the overall extent of each section with "unstable" shoreline conditions. These conditions are defined by the presence of significant exposed soils/roots, minimal bank vegetation, severe undercutting, slumping or scour and potential failed erosion measures (rip rap, gabion baskets, etc.).

Figure 6 shows the levels of stream erosion observed across Pinecrest Creek. Erosion was observed in most sections, with certain reaches having high levels above 41 percent. High erosion levels were observed in Connaught Park, near Highway 417 and along Baseline Road.

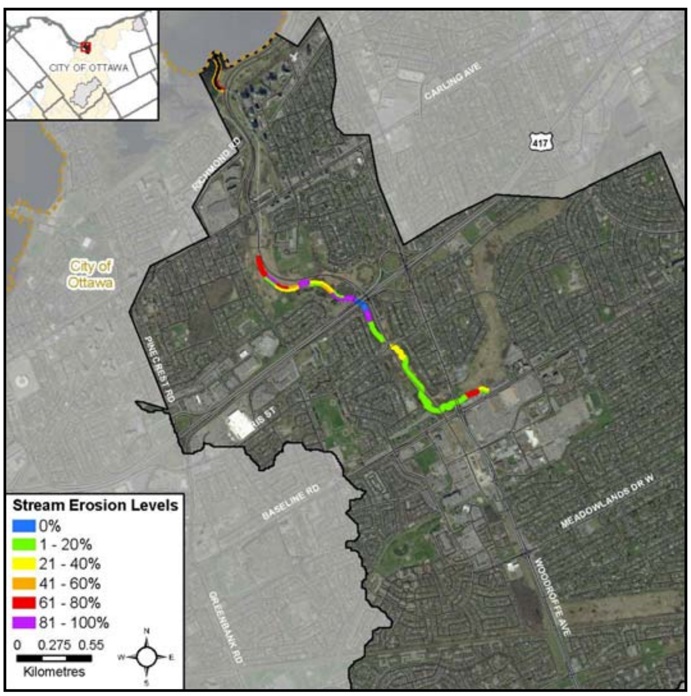


Figure 6 Erosion levels along Pinecrest Creek

Shoreline re-grading by NCC for erosion control along Pinecrest Creek

Undercut Stream Banks

Stream bank undercuts can provide excellent cover habitat for aquatic life, however excessive levels can be an indication of unstable shoreline conditions. Bank undercut was assessed as the overall extent of each surveyed section with overhanging bank cover present.

Figure 7 shows that undercut banks were present in the majority of the open portions of Pinecrest Creek, 79 percent of the sections had undercutting in the left bank and 71 percent of the right bank. Pinecrest Creek is stormwater driven, with high velocity water flows continuously eroding the banks.

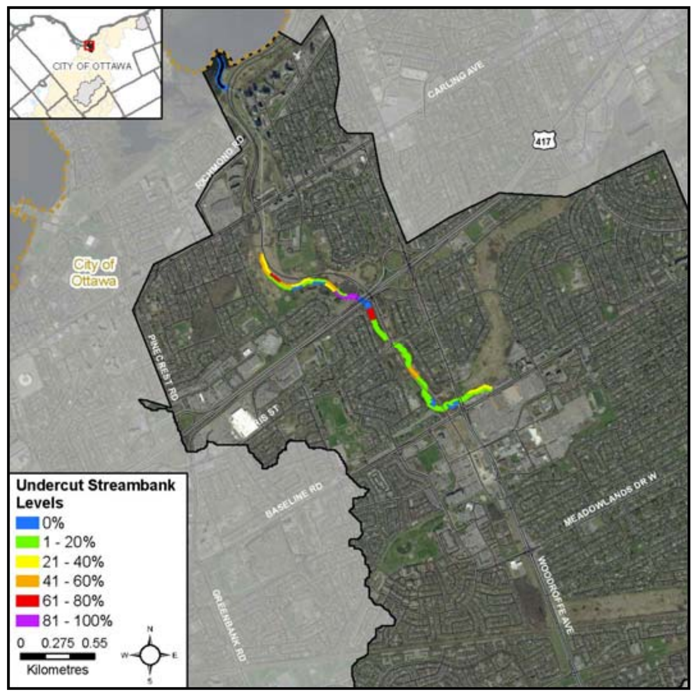


Figure 7 Undercut stream banks along Pinecrest Creek

Undercut banks along Pinecrest Creek

Stream Shading

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

Figure 8 shows the sections of Pinecrest Creek with levels of stream shading. The majority of sections (57%) had a shade cover of 80 to 100 percent of the stream aerial surface. Shading of 61 to 80 percent was observed in 25 percent of the sections. Moderate cover of seven percent of the sections had 41 to 60 percent shading and four percent of the sections had 21 to 40 percent coverage. Minimal shading of one to 20 percent was observed in only seven percent of sections and no cover was not observed in any of the sections. Figure 9 shows the distribution of these shading levels along Pinecrest Creek.

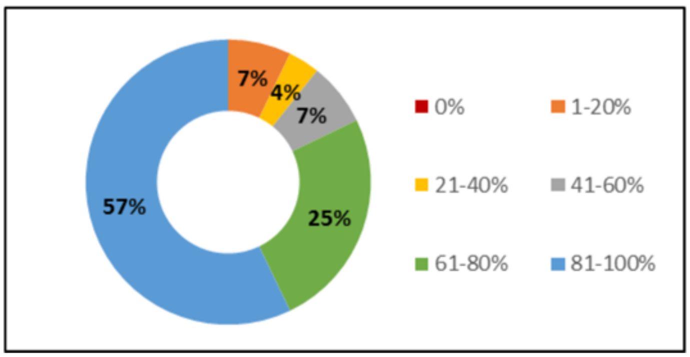


Figure 8 Stream shading along Pinecrest Creek

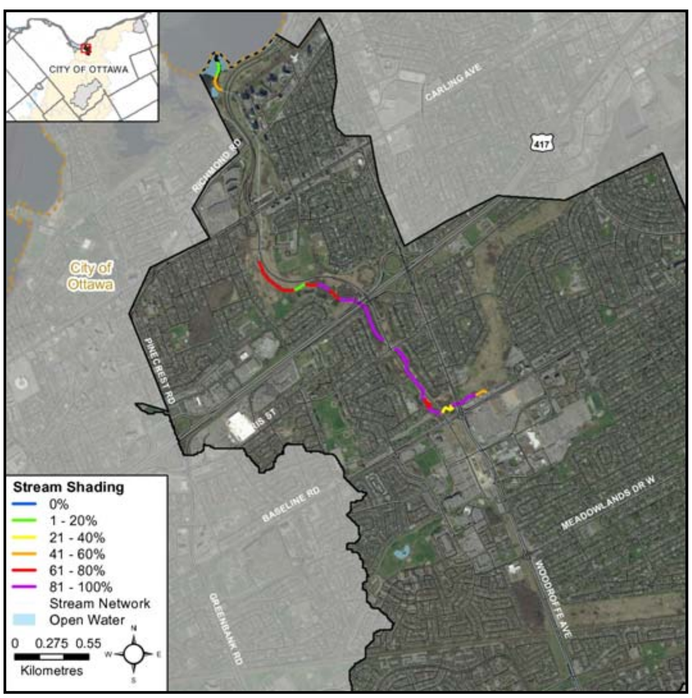


Figure 9 Stream shading along Pinecrest Creek

A mix of trees and grasses comprised the majority of shading. Overhanging plants were observed in 86 percent of the left bank and 82 percent of the right bank.

Overhanging Trees and Branches

Trees and branches that are less than one meter from the surface of the water are defined as overhanging. Overhanging branches and trees provide a food source, nutrients and shade which helps to moderate instream water temperatures.

Figure 10 shows the presence of overhanging trees and branches along Pinecrest Creek that were observed. In the open stream portions, 89 percent of the sections had overhanging trees and branches on the left bank, and 86 percent of the sections had overhanging trees on the right banks.

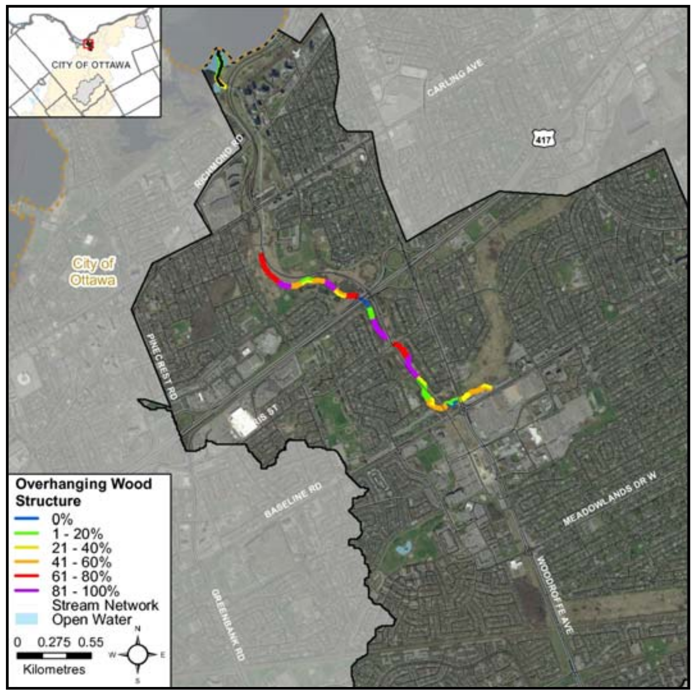
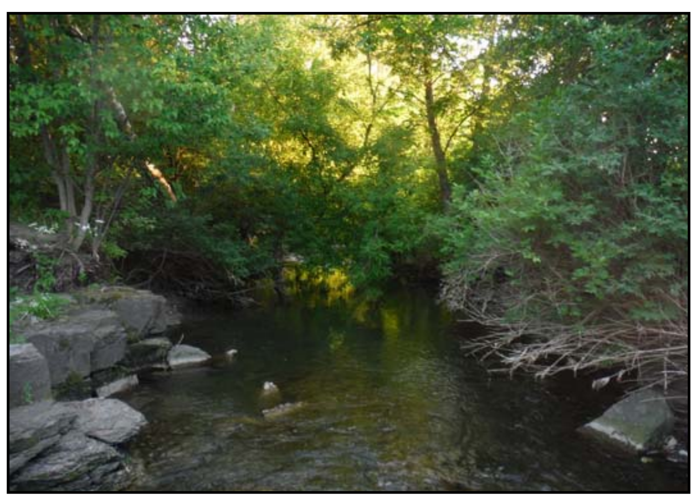


Figure 10 Overhanging trees and branches along Pinecrest Creek



Overhanging trees and branches along Pinecrest Creek

Pinecrest Creek Instream Aquatic Habitat

Habitat Complexity

Habitat complexity is a measure of the overall diversity of habitat types and features within a stream. Streams with high habitat complexity support a greater variety of species niches, and therefore contribute to greater diversity. Factors such as substrate, flow conditions (pools, riffles) and cover material (vegetation, wood structure, etc.) all provide crucial habitat to aquatic life. Habitat complexity is assessed based on the presence of boulder, cobble and gravel substrates, as well as the presence of instream woody material. A higher score shows greater complexity where a variety of species can be supported. Figure 11 shows habitat complexity of the sections surveyed: 14 percent had no complexity; 18 percent had a score of one; 25 percent scored two; 29 percent scored three; and 14 percent had the highest habitat diversity. Overall habitat complexity is of good quality in Pinecrest creek to support aquatic biota, with other factors limiting communities in this system.

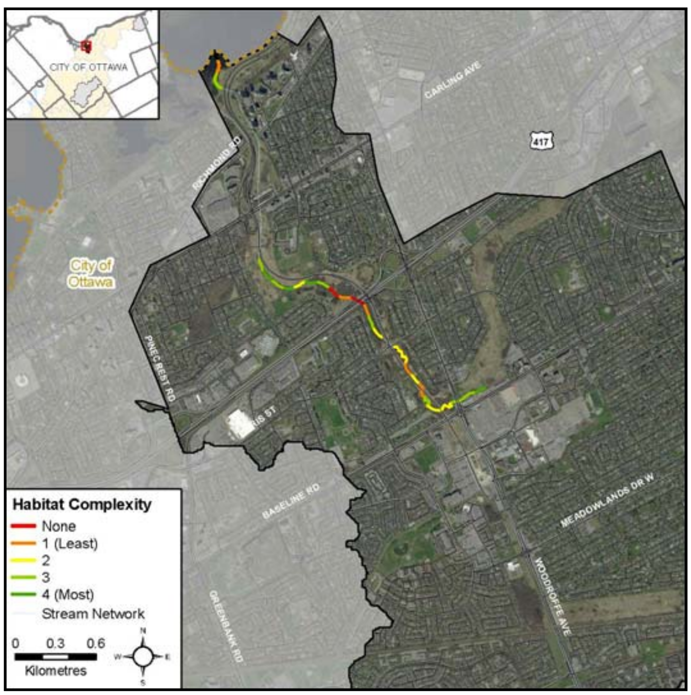


Figure 11 Instream habitat complexity along Pinecrest Creek

Diverse habitat cover in Pinecrest Creek

Instream Substrate

Diverse substrate is important for fish and benthic invertebrate habitat because some species have specific substrate requirements and for example will only reproduce on certain types of substrate. The absence of diverse substrate types may limit the overall diversity of species within a stream.

Figure 12 shows the overall substrates present in the open sections Pinecrest Creek. It is a system with residual clay and sand deposits from the Champlain Sea (J.F. Sabourin & Associates Inc., 2011), from the last ice age. This has left a mix of substrates ranging from clay to boulders, there are also areas of exposed bedrock.

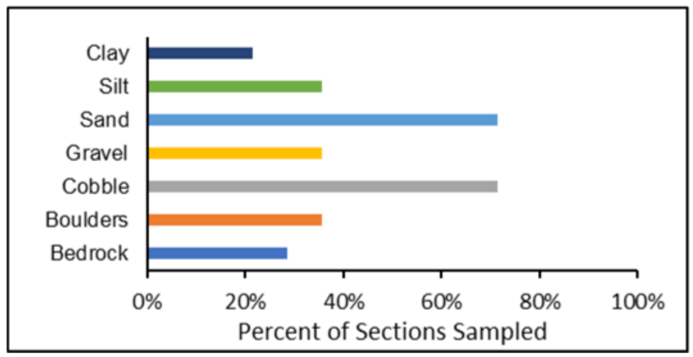


Figure 12 Instream substrates present along Pinecrest Creek

Figure 13 shows the dominant substrate in the open sections of Pinecrest Creek. Sand and cobble were the dominant substrate type in 25 percent of sections each. Gravel and clay were each identified as dominant in seven percent of sections; exposed bedrock dominated only 18 percent of sections.

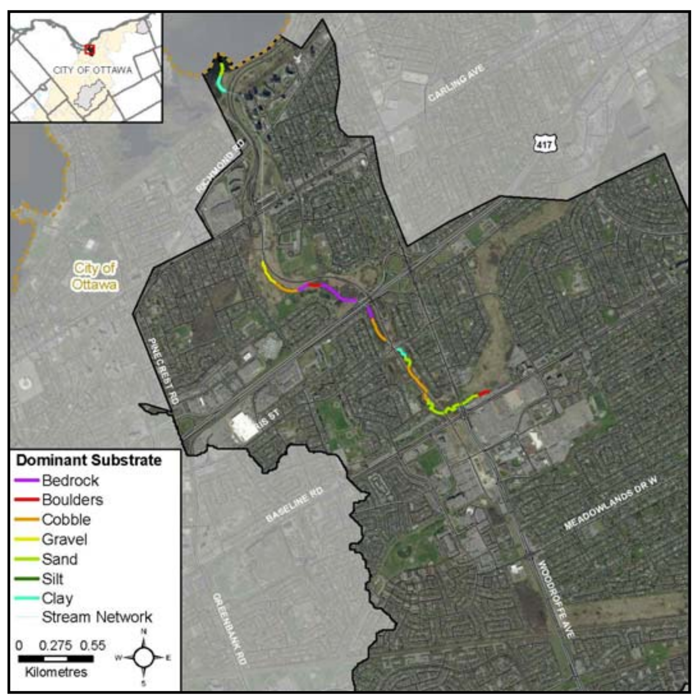


Figure 13 Dominant instream substrates along Pinecrest Creek

Instream Morphology

Pools and riffles are important habitat features for aquatic life. Riffles are fast flowing areas characterized by agitation and overturn of the water surface. Riffles thereby play a crucial role in contributing to dissolved oxygen conditions and directly support spawning for some fish species. They are also areas that support high benthic invertebrate populations which are an important food source for many aquatic species. Pools are characterized by minimal flows, with relatively deep water and winter and summer refuge habitat for aquatic species. Runs are moderately shallow, with unagitated surfaces of water and areas where the thalweg (deepest part of the channel) is in the center of the channel.

Figure 14 shows that Pinecrest Creek has a diversity of morphological conditions, suitable for a variety of aquatic species and life stages; 79 percent contained pools, 75 percent contained riffles and the majority, 100 percent, contained runs. Figure 15 shows the locations of riffle habitat along Pinecrest Creek.

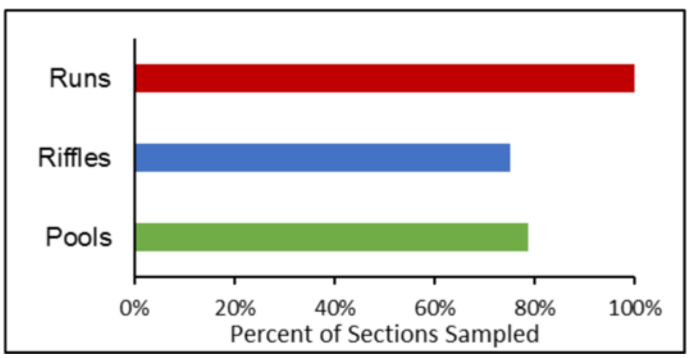


Figure 14 Instream morphology along Pinecrest Creek

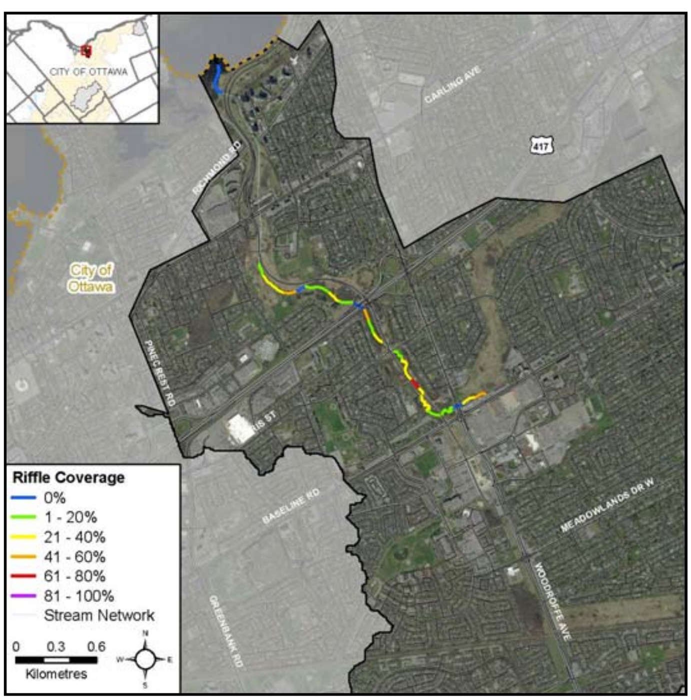


Figure 15 Riffle habitat locations along Pinecrest Creek

Instream Wood Structure

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

Instream woody structures found along Pinecrest Creek

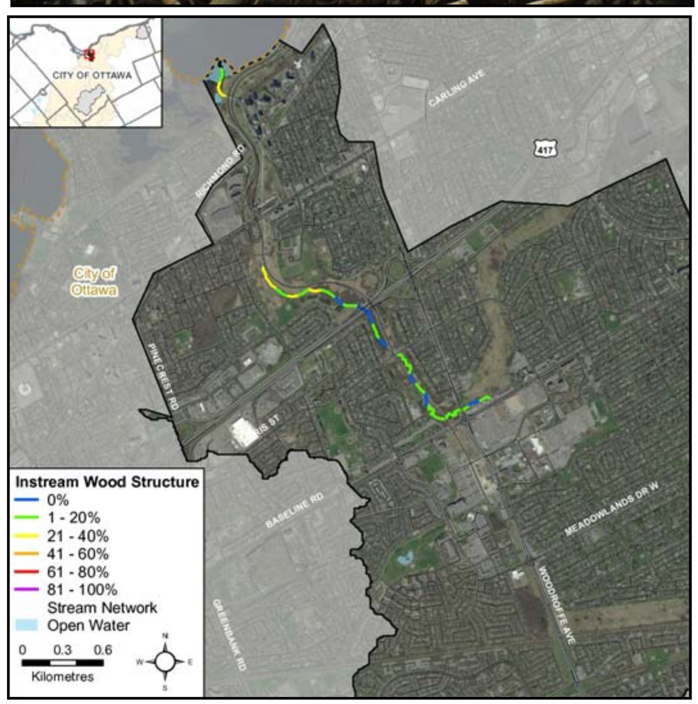


Figure 16 Instream wood structures along Pinecrest Creek

Instream Vegetation Type

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

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

Figure 17 shows the aquatic vegetation community structure. Narrowed-leaved vegetation is present in four percent of sections; broad leaved in four percent and robust emergent in four percent. Free floating and floating were not observed; submerged were in 11 percent; and algae and mostly mosses in 82 percent of sections.

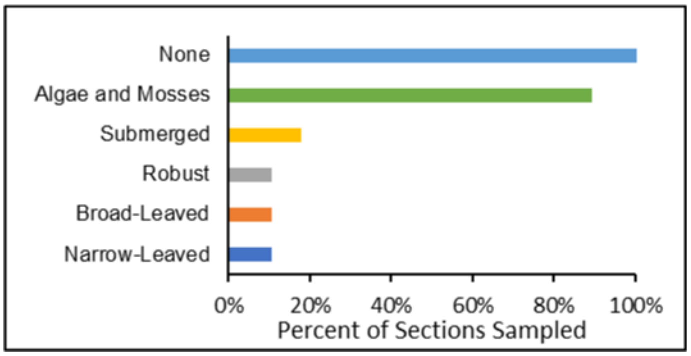


Figure 17 Aquatic vegetation presence along Pinecrest Creek

Pinecrest Creek does not have a large diversity of instream vegetation, with 82 percent of sections having no vegetation as the dominant type (Figure 18). This is due to the hard types of substrates found such as bedrock and flashy flows from stormwater runoff.

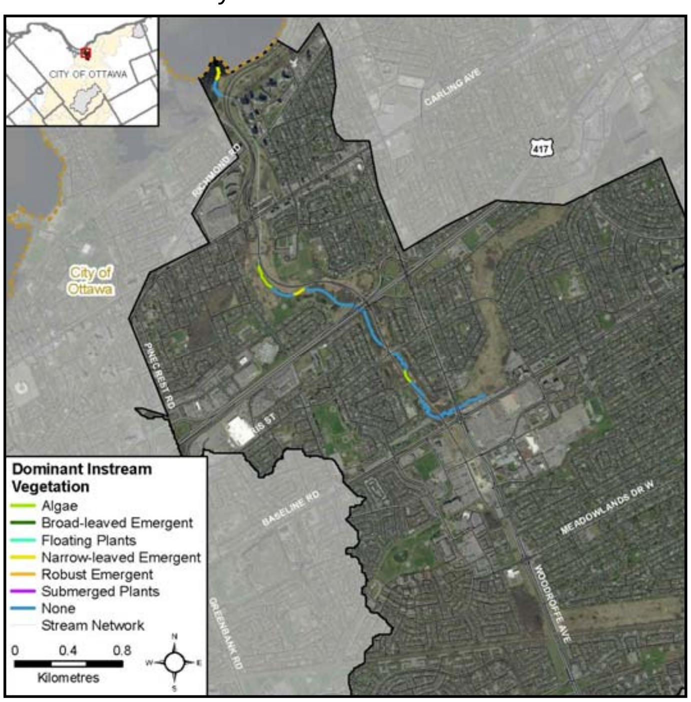


Figure 18 Dominant instream vegetation along Pinecrest Creek

Instream Vegetation Abundance

The abundance of instream vegetation is also crucial for overall aquatic ecosystem health. Lack of vegetation, rare or low abundances can impair the ability of plants to contribute adequately to dissolved oxygen, provide habitat, and remove nutrients and contaminants. Extensive amounts of vegetation can also have negative impacts by lowering dissolved oxygen levels. It can act as a physical barrier for humans and wildlife, and it leads to a reduction in plant diversity. Invasive species in particular tend to have this extensive mode of growth.

As seen in Figure 19, 100 percent of sections in Pinecrest Creek had no vegetation present, 43 percent had rare vegetation, and 25 percent had low vegetation levels. Normal abundance levels were observed in 21 percent of sections surveyed and common abundance was observed in four percent. No sections had extensive abundance levels.

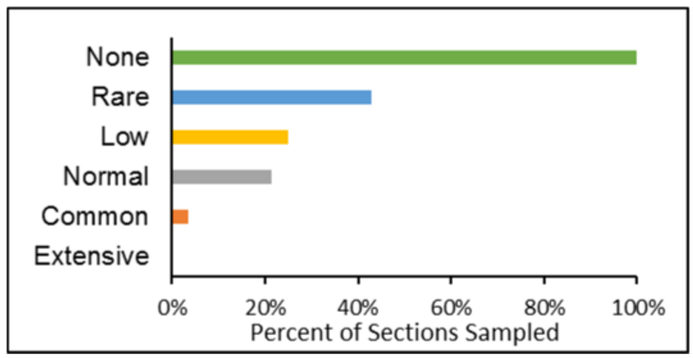


Figure 19 Instream vegetation abundance in Pinecrest Creek

Instream wetland vegetation along Pinecrest Creek

Section of Pinecrest Creek without aquatic vegetation

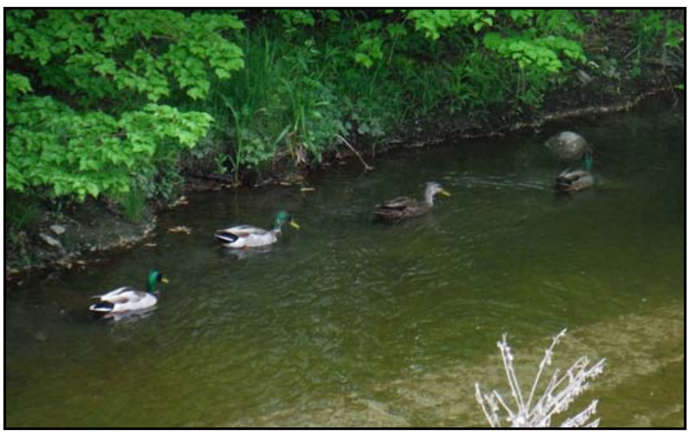
Pinecrest Creek Stream Health

Wildlife

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

Table 1 Wildlife observations along Pinecrest Creek in 2017

Wildlife Category	Observations
Birds	American crow, American robin, black-capped chickadee, Canada goose, chipping sparrow, downey woodpecker, finches, killdeer, mallard, northern cardinal, red-tailed hawk, sandpipers
Reptiles & Amphibians	northern leopard frog, other frogs
Mammals	chipmunks, dogs, eastern grey squirrel, mice
Benthic Invertebrates	aquatic sowbug, leeches, non-biting midges, snails
Other	dragonflies, butterflies, mosquitoes



Mallard ducks on Pinecrest Creek

Invasive Himalayan balsam along the bank of Pinecrest Creek

Invasive Species

Invasive species are harmful to the environment, the economy and our society. They have high reproduction, quick establishment of dense colonies, tolerate a variety of environmental conditions and lack natural predators. They can have major implications on stream health and reduce species diversity (OMNR 2012). They can be difficult to manage or eradicate, however it is important to continue to research, monitor and manage them.

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

- banded mystery snail (*Viviparus georgianus)*
- bull thistle (*Chrisium vulgare*)
- common & glossy buckthorn (*Rhamnus cathartica & R. frangula*)
- dog strangling vine (*Cynanchum rossicum & C. louiseae)*
- garlic mustard (*Alliaria petiolata*)
- non-native honey suckle (*Lonicer asp.*)
- Manitoba maple (*Acer negundo*)
- periwinkle (*Vinca minor*)
- wild/poison parsnip (*Pastinaca sativa*)
- purple loosestrife (*Lythrum salicaria*)

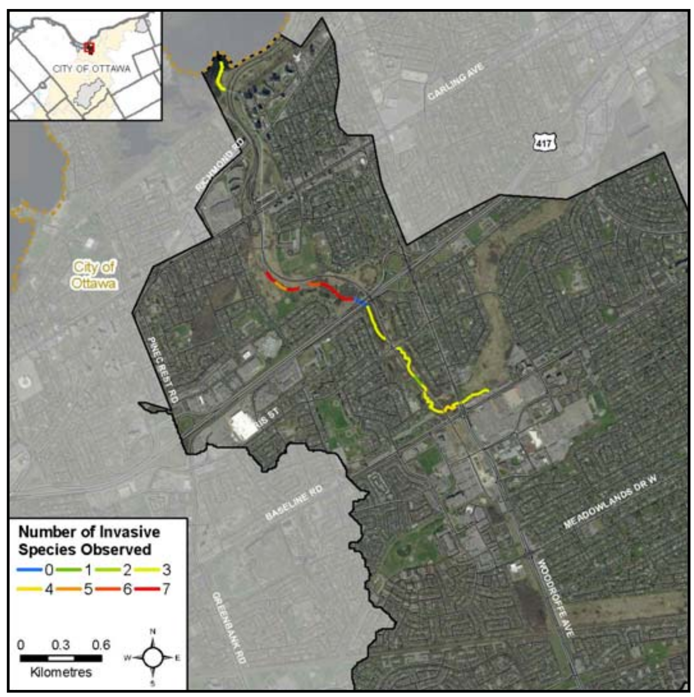


Figure 20 Invasive species abundance along Pinecrest Creek

Himalayan balsam at the entombment near Carling Avenue (left) in flowering stage (right) along Pinecrest Creek

Purple loosestrife flowering (left) and non-native honey suckle with berries (right) along Pinecrest Creek

To report and find information about invasive species visit

http://www.invadingspecies.com

Managed by the Ontario Federation of Anglers and Hunters

Pollution

Figure 21 shows the types of pollution observed in Pinecrest Creek. The levels of garbage found in the stream were high, with 25 of the 28 sections surveyed containing some type of pollution. Some of the garbage observed included styrofoam, plastics, cans, shopping carts, cigarette filters, furniture and dog waste.

In the upper regions of the catchment near Baseline Road garbage was present in high amounts in the riparian areas. The images show City Stream watch volunteers collecting garbage along Pinecrest Creek.

Two stream garbage clean up events were organized in 2017. Both events were organized in support of the City of Ottawa's "Clean up the Capital." In the spring clean up efforts were along reaches upstream of the Carling Avenue entombment. The fall clean up was done along the most upstream open portions of the stream along Baseline Road and Woodroffe Avenue.

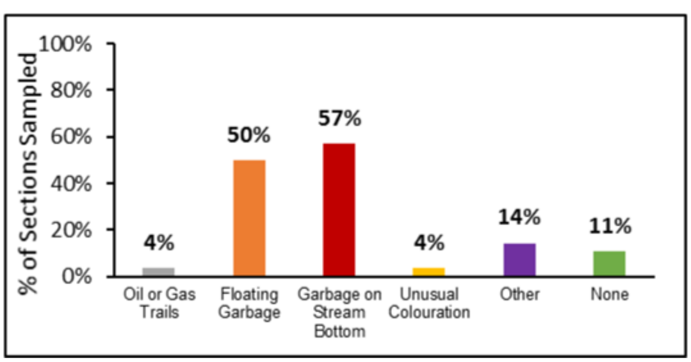
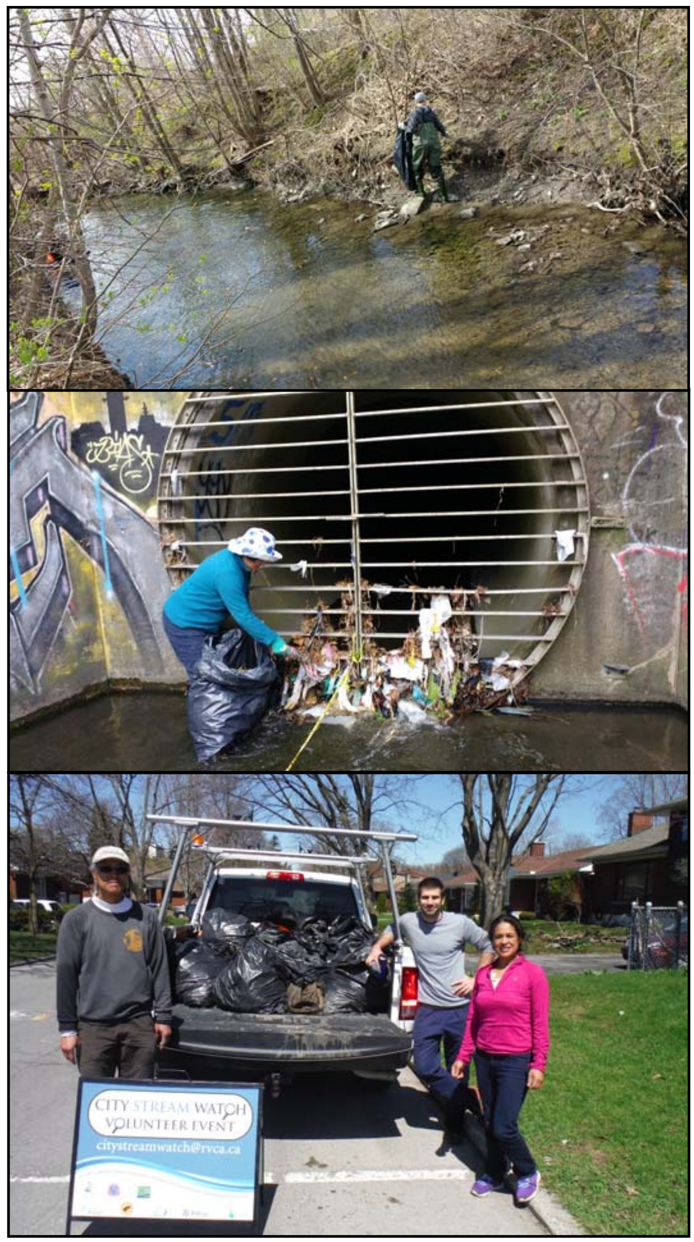


Figure 21 Pollution observed within Pinecrest Creek



CSW volunteers removing garbage along Pinecrest Creek

Pinecrest Creek Water Chemistry

Water Chemistry Assessment

Water chemistry collection is done at the start and end of each 100 meter section with a multiparameter YSI probe. The parameters monitored are: air and water temperature, pH, conductivity, dissolved oxygen concentration and saturation.

Volunteer and staff collect water chemistry measurements with a YSI probe on Pinecrest Creek

Dissolved Oxygen

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

Figure 22 shows the concentration levels found in the open portions of Pinecrest Creek. The two dashed lines depicted represent the Canadian water quality guidelines. Levels in sections one to three near the mouth fall within the Canadian water quality guidelines for the protection of warm-water biota. Surveyed portions upstream of the Carling Avenue entombment have adequate levels of oxygen to support cold-water aquatic life. Average levels across the system were 10.6 milligrams per liter.

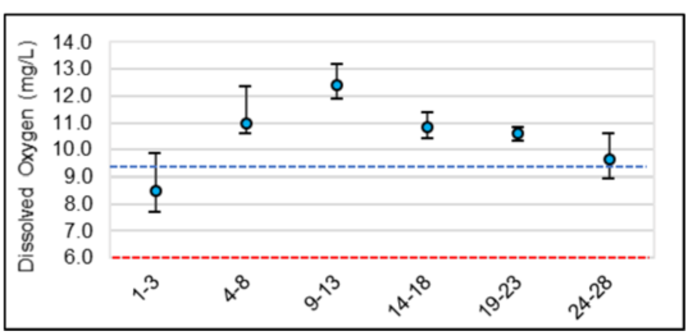


Figure 22 Dissolved oxygen ranges along Pinecrest Creek

Conductivity

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

Figure 23 shows specific conductivity levels in Pinecrest Creek, the average level is depicted by the dashed line (1783 µS/cm). Notable variability was observed at the mouth, (sec. 1-3) likely influenced by the Ottawa River; and near the upper reaches of the system along Baseline Road, where all the receiving water is stormwater input.

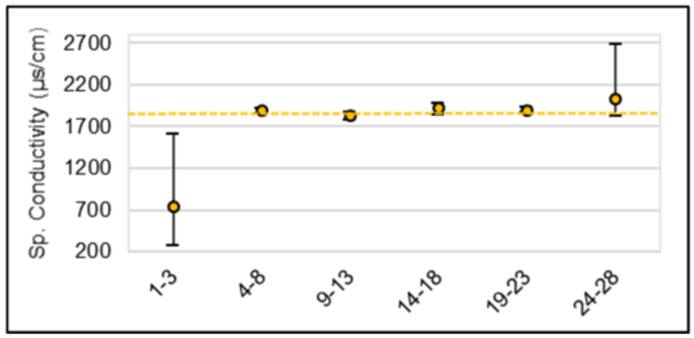


Figure 23 Specific conductivity ranges along Pinecrest Creek

pH

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

Figure 24 shows pH measurements along Pinecrest Creek meet the provincial water quality objective. Average levels across the system were pH 7.90 and are depicted by the dashed line.

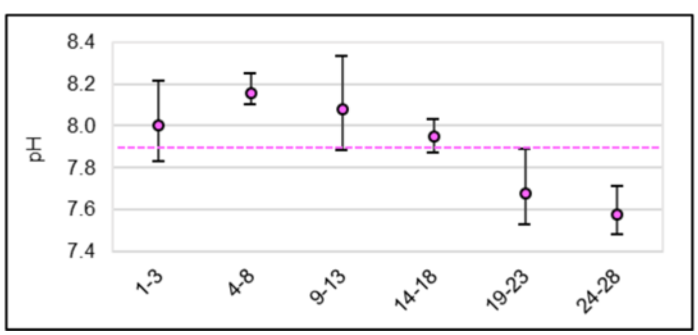


Figure 24 pH ranges along Pinecrest Creek

Oxygen Saturation (%)

Oxygen saturation is measured as the ratio of dissolved oxygen relative to the maximum amount of oxygen that will dissolve based on the temperature and atmospheric pressure. Well oxygenated water will stabilize at or above 100 percent saturation, however the presence of decaying matter/pollutants can drastically reduce these levels. Oxygen input through photosynthesis has the potential to increase saturation above 100 percent to a maximum of 500 percent, depending on the productivity level of the environment. In order to represent the relationship between concentration and saturation, the measured values have been summarized into 6 classes.

1) <100% Saturation / <6.0 mg/L Concentration

Oxygen concentration and saturation are not sufficient to support aquatic life and may represent impairment.

2) >100% Saturation / <6.0 mg/L Concentration

Oxygen concentration is not sufficient to support aquatic life, however saturation levels indicate that the water has stabilized at its estimated maximum. This is indicative of higher water temperatures and stagnant flows.

3) <100% Saturation / 6.0—9.5 mg/L Concentration

Oxygen concentration is sufficient to support warm-water biota, however depletion factors are likely present and are limiting maximum saturation.

4) >100% Saturation / 6.0—9.5 mg/L Concentration

Oxygen concentration and saturation levels are optimal for warm-water biota.

5) <100% Saturation / >9.5 mg/L Concentration

Oxygen concentration is sufficient to support cold-water biota, however depletion factors are likely present and are limiting maximum saturation.

6) >100% Saturation / >9.5 mg/L Concentration

Oxygen concentration and saturation levels are optimal for warm and cold-water biota.

Site on Pinecrest Creek with optimal oxygen conditions

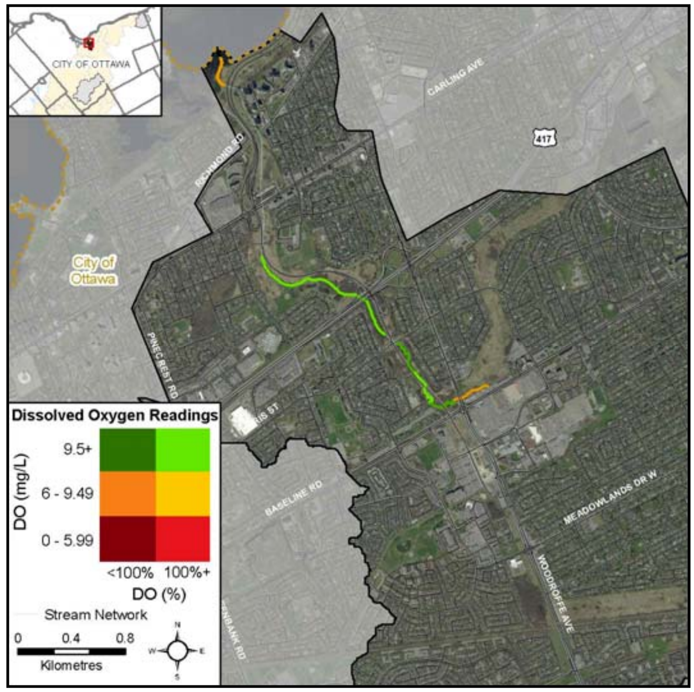


Figure 25 Bivariate assessment of dissolved oxygen concentration (mg/L) and saturation (%) on Pinecrest Creek

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

Areas near the confluence with the Ottawa River show adequate dissolved oxygen concentrations to support warm-water biota, however saturation levels are limited. Similar conditions are found in the upper reaches of the open portions of Pinecrest Creek along Baseline Road. These upper sections that are mostly fed by stormwater, seem to have lower water quality conditions than the rest of the system.

Site on Pinecrest Creek influenced by stormwater with limiting oxygen conditions

Specific Conductivity Assessment

Specific conductivity (SPC) is a standardized measure of electrical conductance, collected at or corrected to a water temperature of 25°C. SPC is directly related to the concentration of ions in water, and is commonly influenced by the presence of dissolved salts, alkalis, chlorides, sulfides and carbonate compounds. The higher the concentration of these compounds, the higher the conductivity. Common sources of elevated conductivity include storm water, agricultural inputs and commercial and industrial effluents.

In order to summarize the conditions observed, levels were evaluated as either normal, moderately elevated or highly elevated. These categories are defined by the amount of variation (standard deviation) at each section compared to the system's average.

Average levels of conductivity in Pinecrest Creek (1783 µS/cm) exceed guidelines (500 µS/cm) used for the Canadian Environmental Performance Index (Environment Canada 2011). These high levels of conductivity are indicative of a high presence of conductive ions in the stream water.

Figure 26 shows relative specific conductivity levels in Pinecrest Creek. Normal levels were observed across most of the system. Areas with highly elevated levels were observed at the confluence with the Ottawa River. Other sections with highly elevated levels were found near Woodroffe Avenue where there are several stormwater outflows.

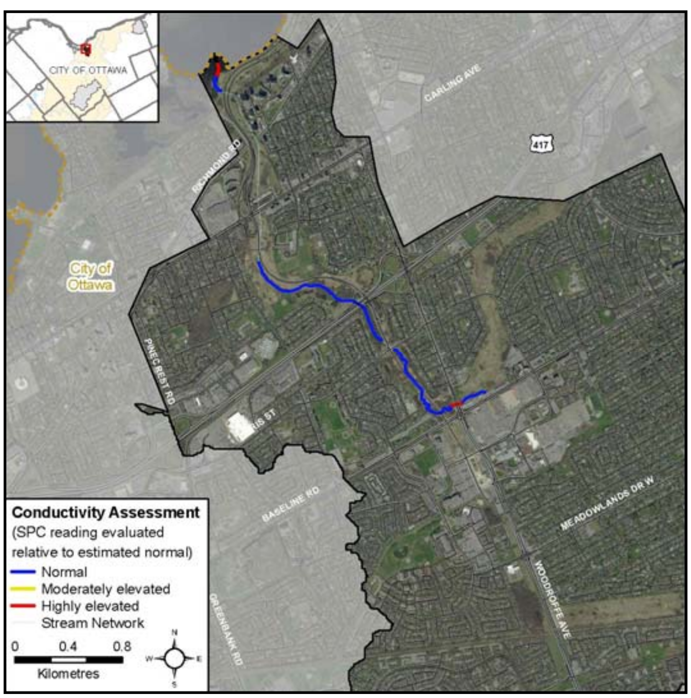


Figure 26 Relative specific conductivity levels along Pinecrest Creek

Storm water outflows in a section of Pinecrest Creek with elevated conductivity and reduced oxygen conditions downstream of Woodroffe Avenue

Section of Pinecrest Creek with elevated conductivity levels downstream of Woodroffe Avenue

Pinecrest Creek Thermal Classification

Thermal Classification

Instream water temperatures are influenced by various factors including, season, time of day, precipitation, storm water run off, springs, tributaries, drains, discharge pipes, stream shading from riparian vegetation and artificial shade created by infrastructure. To monitor water temperatures in Pinecrest Creek, three temperature loggers were placed; two were retrieved, as one (#1) was no longer present at the site location.

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

Within those three sites, white suckers have been reported, a cool fish species, with fish thermal preferences indicated by Cocker at al. (2001).

All other fish species were found near the Ottawa River.

Groundwater

Groundwater discharge areas can influence stream temperature, contribute nutrients, and provide important stream habitat for fish and other biota. During stream surveys, indicators of groundwater discharge are noted when observed. Indicators include: springs/seeps, watercress, iron staining, significant temperature change and rainbow mineral film. Figure 29 shows areas were one or more groundwater indicators were observed during stream surveys and headwater assessments.

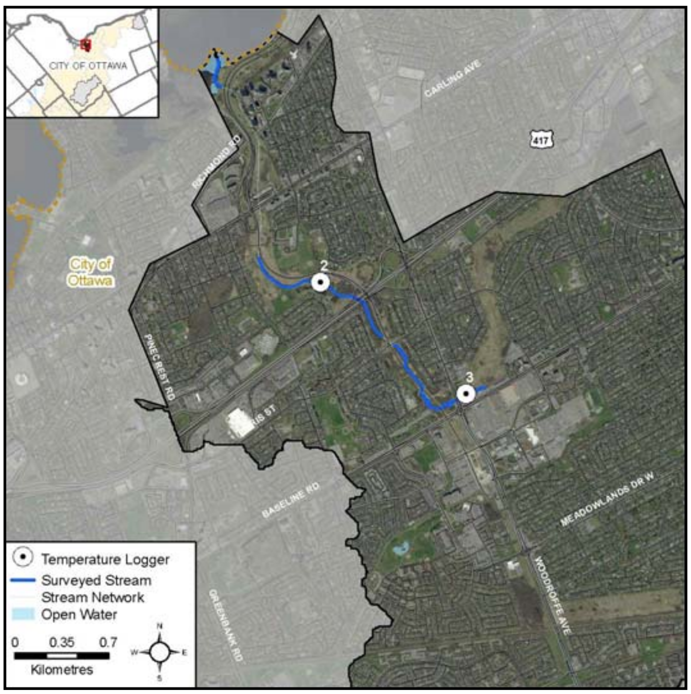


Figure 27 Temperature logger locations along Pinecrest Creek

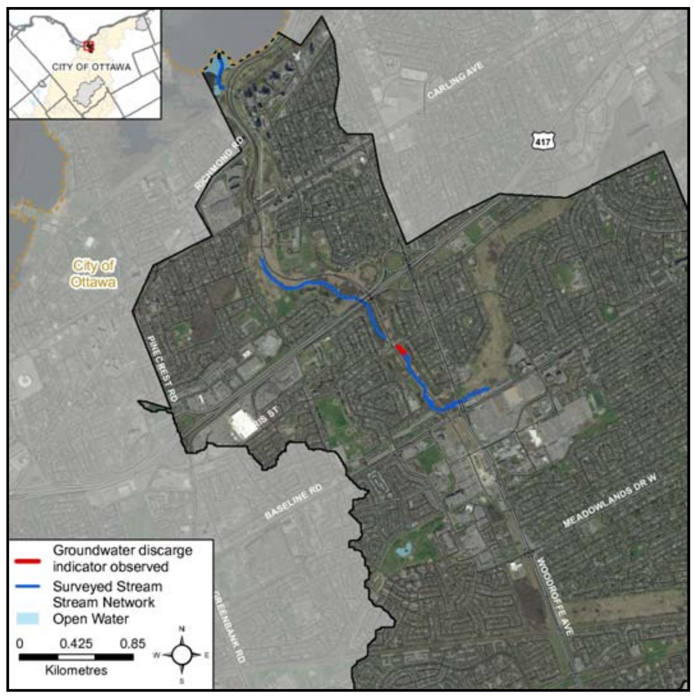


Figure 29 Groundwater indicators observed in Pinecrest Creek

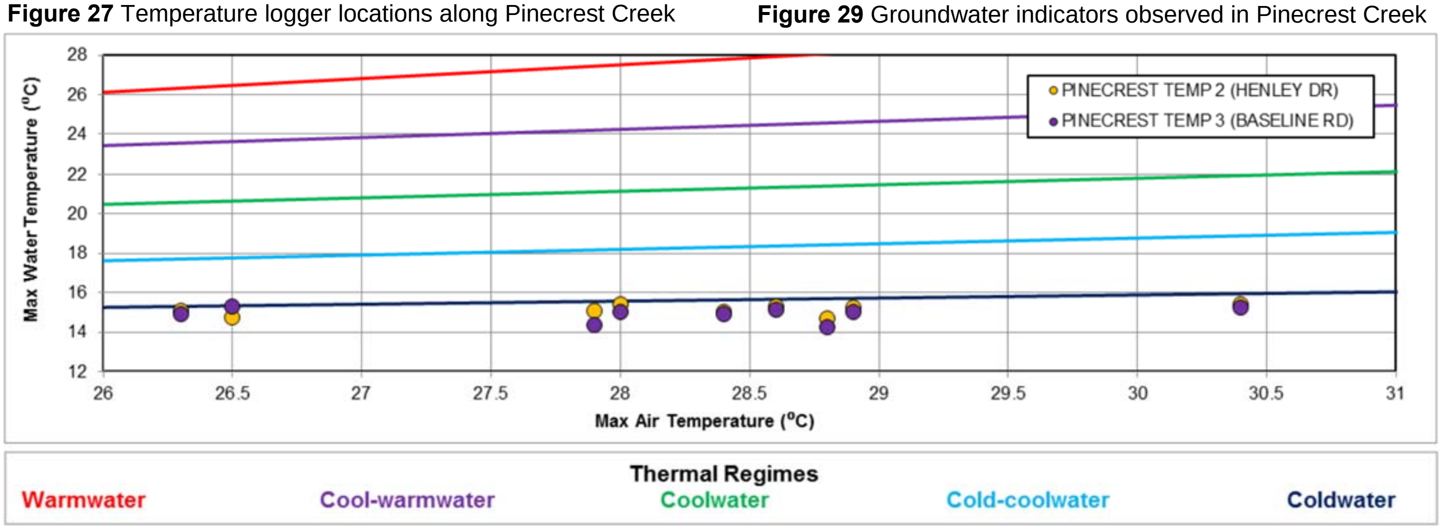


Figure 28 Thermal Classification for Pinecrest Creek with the five thermal regimes adapted from Stoneman and Jones (1996) by Chu et al. (2009): **cold water** category for twosites sampled on Pinecrest Creek

Pinecrest Creek Fish Community

Fish Community

Five fish sampling sites were evaluated between May and July 2017. One site near the confluence with the Ottawa River was sampled with a seine net. All other locations were sampled using a backpack electro-fisher. Two locations were located along Connaught Park, one location downstream of Iris Street and another situated near Westbury Road.

Three species were captured in 2017, only at the location near the confluence with the Ottawa River. They are listed in Table 2 along with their thermal classification preferences (Coker et al., 2001) and MNR species code. Pinecrest Creek has a mixed fish community ranging from cool to warm water species.

Table 2 Fish species observed along Pinecrest Creek in 2017

Species	Thermal Class	MNR Species Code
bluntnose minnow *Pimephales notatus*	Warm	BnMin
creek chub *Semotilus atromaculatus*	Cool	CrChu
white sucker *Catostomus commersonii*	Cool	WhSuc
Total Species		**3**

The sampling location where these species were observed, as well as RVCA historical sites, are depicted in Figure 30. The codes used in the figure are the MNR codes provided in Table 2.

For comparisons across sampling years and a complete list of RVCA historical fish records from Pinecrest Creek refer to page 20 of this report.

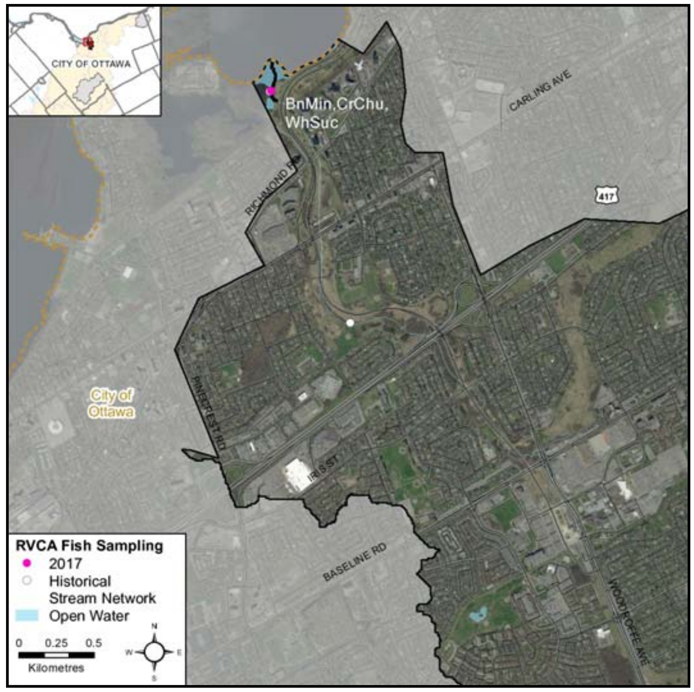


Figure 30 Pinecrest Creek fish sampling locations and 2017 fish species observations

CSW volunteers and staff pulling a seine net near the Ottawa River in Pinecrest Creek

A white sucker captured on Pinecrest Creek near the Ottawa River being measured for length

Migratory Obstructions

It is important to know locations of migratory obstructions because these can prevent fish from accessing important spawning and rearing habitat. Migratory obstructions can be natural or manmade, and they can be permanent or seasonal.

The most notorious obstructions along Pinecrest Creek is the perched culverts by the Sir John A. Macdonald Parkway, located downstream of the Carling entombment. In the Connaught Park area, there is one woody material dam that was observed, and further upstream there is a grade barrier created by bedrock ledges. The locations of the obstructions observed in 2017 are shown in Figure 31.

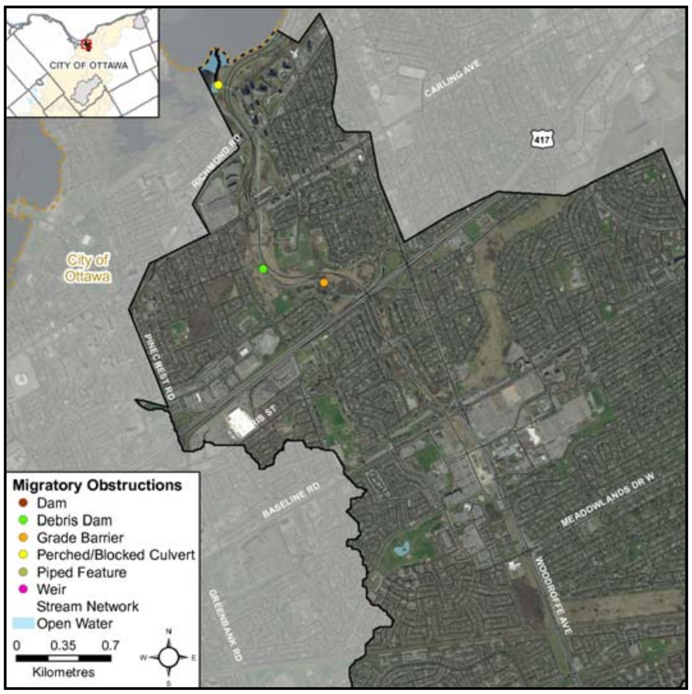


Figure 31 Locations of migratory obstructions along Pinecrest Creek

Bedrock ledges can become low flow grade barriers

Woody material dam along Pinecrest Creek in the Connaught Park area

Entombment of Pinecrest Creek near Carling Avenue

Perched culverts near the Sir john A. Macdonald Parkway (downstream of the Carling Avenue entombment)

Beaver Dams

Beaver dams are also considered potential barriers to fish migration. No active dams were identified on Pinecrest Creek in 2017.

Headwater Drainage Feature Assessment

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

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

Headwaters Sampling

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

Features are evaluated as per the Ontario Stream Assessment Protocol (OSAP, 2017). This protocol measures zero, first and second order headwater drainage features. It is a rapid assessment method characterizing the amount of water, sediment transport, and storage capacity within headwater drainage features. In 2017 the City Stream Watch program assessed three HDF sites in the Pinecrest Creek Catchment (Figure 32).

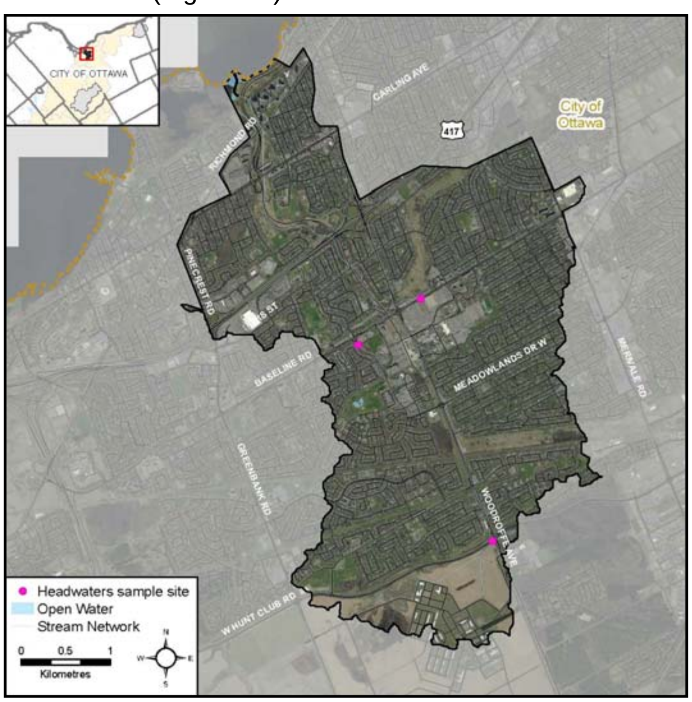


Figure 32 Location of headwater drainage features sampling sites in the Pinecrest Creek catchment

The headwater drainage features of the Pinecrest Creek catchment have been heavily modified throughout the urban development of the area. The majority of the features are no longer present, as they have been transformed into stormwater drainage features or disconnected from the system. Of the three HDFs assessed in the Pinecrest Creek catchment, two are part of the stormwater network connected to Pinecrest Creek, and one is no longer present or connected.

The images below show the conditions of these features sampled in 2017. The feature located along Baseline Road is located in a parking lot and was modified to a stormwater drain. The HDF along Centrepoint Road is no longer present, with no stormwater drains present at the site. The third feature evaluated along Hunt Club Road, was an intermittent constrained channel that conveyed snowmelt and rain water adjacent to a cropped field.

Headwater drainage feature in Pinecrest Creek catchment heavily modified into a stormwater drain along Baseline Road

Intermittent constrained channel HDF in Pinecrest Creek catchment at Hunt Club Road and Woodroffe Avenue

HDF is no longer present/connected to the Pinecrest Creek catchment along Centrepoint Road near Baseline Road

Stream Comparison Between 2011 and 2017

The following tables provide a comparison of observations on Pinecrest Creek between the 2006, 2011 and 2017 survey years (RVCA 2006, RVCA 2011). Monitoring protocols from 2006 were modified and enhanced, so data from that year cannot be compared to the later years (there are some exceptions). In order to accurately represent current and historical information, the site data was only compared for those sections which were surveyed in both reporting periods. This resulted in changes to our overall summary information, averages presented here differ from ones in this report. This information is therefore only a comparative evaluation and does not represent the entirety of our assessment.

Water Chemistry

Water chemistry parameters are collected throughout all the sections surveyed in the stream. This criteria reflects the overall conditions and changes in the environment. Variation in these conditions can be attributed to environmental and ecological changes. Some can be in part due to natural variability within the system from various weather, seasonal, and annual conditions.

Table 3 shows a comparison of these parameters between 2006, 2011 and 2017. Average summer water temperatures range from cooler water in 2006 (13.4°C) to warmer values in 2011 (18.9°C), within 5.5 degrees centigrade of variation. In 2017 cooler temperatures than the two previous reporting years are possibly due to cooler air temperatures and higher precipitation experienced in 2017. Aside from these general temperature observations, loggers provide a larger picture of stream thermal conditions.

Standardizing stream temperature accounts for climatic factors including air temperatures and precipitation. With the data collected from temperature loggers, standardized stream temperatures are calculated and summarized in Table 3. These values decreased by 0.18°C for every one degree of air temperature from 2011 to 2017.

Table 3 Water chemistry comparison (2011/2017)

Water Chemistry (2011—2017)				
YEAR	**PARAMETER**	**UNIT**	**AVERAGE**	**STND ERROR**
2011	pH	-	8.16	± 0.04
2017	pH	-	7.90	± 0.47
2011	Sp. Conductivity	µS/cm	1001	± 67
2017	Sp. Conductivity	µS/cm	1783	± 84
2011	Dissolved Oxygen	mg/L	8.9	±0.1
2017	Dissolved Oxygen	mg/L	10.6	± 0.2
2006	Water Temperature	°C	13.4	± 0.2
2011	Water Temperature	°C	18.9	± 0.4
2017	Water Temperature	°C	13.7	± 0.5
2011	Standardized Stream Temperature[1]	°C Water / 1°C Air	0.71	N/A
2017	Standardized Stream Temperature[1]	°C Water / 1°C Air	0.53	± 0.00

[1] ***Standardized Stream Temperature:*** Temperature data is collected via logger and standardized based on the following conditions:

- Daily maximum air temperatures must exceed 24.5 ºC
- No precipitation for 3 days preceding measurement
- Measurements to be taken between 4:00PM—6:00PM
- All temperatures points to be collected in July/August
- Logger must be deployed in flowing waters

Average dissolved oxygen levels were found to be increasing by 1.7 milligrams per liter from 2011 to 2017. These changes can also be attributed to cooler temperatures which are conducive to the stream's ability to hold more oxygen.

Average specific conductivity increased from 2011 to 2017 by 782 µS/cm; and pH decreased by 0.26 units from 2011 to 2017. These changes may be indicative of increased anthropogenic input, specifically ionic compounds including road salts and unmitigated stormwater runoff from impermeable surfaces.

Invasive Species

The overall percentage of sections surveyed where invasive species were observed had an increase of 5% (Table 4). Purple loosestrife had a reduction of observations by five percent, this decline may be associated to management efforts for this species (OMNR 2012). Other invasive species have expanded their range, most notably garlic mustard. There are also other species that were not previously reported in the system that are now present including banded mystery snail, bull thistle, common & glossy buckthorn, dog-strangling vine, non-native honey suckle, poison/wild parsnip.

Table 4 Invasive species presence observed in 2011 and 2017 (NPR are not previously reported species)

Invasive Species	2011	2017	+/-
banded mystery snail	NPR	18%	▲
bull thistle	NPR	7%	▲
common & glossy buckthorn	NPR	64%	▲
dog-strangling vine	NPR	3%	▲
garlic Mustard	38%	78%	▲
himalayan balsam	54%	57%	▲
(non-native) honeysuckle	NPR	36%	▲
Manitoba maple	27%	57%	▲
poison/Wild parsnip	NPR	7%	▲
purple loosestrife	19%	14%	▼
Total	**84%**	**89%**	▲

Pollution

Garbage accumulation on Pinecrest Creek was found to increase from 2006 to 2011 and then decreased significantly in 2017. Frequent precipitation events in 2017 may have flushed garbage downstream. In 2017 the polluted sections contained mostly garbage such as cans, cigarette butts, dog waste bags, furniture, glass, packaging, plastic bags, plastic fragments, shopping carts, spray paint cans, styrofoam and other items. Stream clean ups were organized in 2006, 2011, 2017.

Table 5 Pollution levels (presence in % of sections)

Pollution/Garbage	2006	2011	2017	+/-
floating garbage	4%	65%	50%	▼
garbage on stream bottom	92%	69%	57%	▼
oil or gas trails in the water	0	4%	4%	
unusual color of stream bed	0	4%	4%	
Total	**96%**	**100%**	**89%**	▼

Instream Aquatic Vegetation

Table 6 shows instream aquatic vegetation changes from 2011-2017. Narrow-leaved emergent plants (e.g. grasses), broad leaved emergent (e.g. arrowhead), and robust emergent plants (e.g. cattails) were only observed near the confluence with the Ottawa River. Submerged plants (e.g. pondweed) had a slight increase over the years. Algae and mosses were seen in fewer sections in 2017, however mosses are still the prevalent type of vegetation in Pinecrest Creek.

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

Instream Vegetation	2011	2017	+/-
narrow-leaved emergent plants	0	4%	▲
broad-leaved emergent plants	0	4%	▲
robust emergent plants	0	4%	▲
submerged plants	8%	11%	▲
algae and mosses	100%	82%	▼

Fish Community

Fish community sampling was carried out in 2011 and 2017 to evaluate fish community composition in Pinecrest Creek (see Table 7). In total 11 species have been observed by City Stream Watch. In 2011 nine species were captured at seven sites; in 2011 three species were found at one of five sampled sites. Fewer fish species were captured in 2017, however two new species were observed: bluntnose minnow and creek chub. Fish sampling efforts at the mouth of Pinecrest Creek were longer in 2011 with the use of a windemere trap over a few days. In 2017 the same area was sampled with a seine net in one day. All species except for white sucker have been observed downstream of the culverts located near the Sir John A. Macdonald Parkway.

Table 7 Comparison of fish species caught in 2011 and 2017

Species	2011	2017
blacknose dace *Rhinichthys atratulus*	X	
bluntnose minnow *Pimephales notatus*		X
brown bullhead *Ameiurus nebulosus*	X	
creek chub *Semotilus atromaculatus*		X
emerald shiner *Notropis atherinoides*	X	
Johnny/Tessalated darter *Etheostoma Spp.*	X	
longnose gar *Lepisosteus osseus*	X	
rock bass *Ambloplites rupestris*	X	
silver redhorse *Moxostoma anisurum*	X	
white sucker *Catostomus commersonii*	X	X
yellow perch *Perca flavescens*	X	
Total Species 11	**9**	**3**

White suckers caught in Pinecrest Creek in the Connaught park area in 2011 upstream of the Carling Ave entombment

Other records from the City of Ottawa have also confirmed observations of two fish species caught upstream of the Carling Avenue entombment: white sucker and creek chub.

The City of Ottawa have observations of white sucker downstream of Iris street and City Stream Watch has caught this species in the past in the Connaught Park area. Areas along the NCC pathway have constructed habitat features such as refuge pools that have allowed for this species to reside in these reaches of the creek.

Creek chub observations from the City of Ottawa are from a location upstream of Iris Street.

Monitoring and Restoration

Monitoring and Restoration Projects on Pinecrest Creek

Table 8 highlights recent monitoring and restoration work that has been done on Pinecrest Creek by the City Stream Watch Program, the National Capital Commission and the City of Ottawa. Potential restoration opportunities are listed on the following page.

Table 8 Monitoring and Restoration on Pinecrest Creek

Accomplishment	Year	Description
City Stream Watch Stream Monitoring	2006	2.5 km of stream was surveyed
	2011	2.6 km of stream was surveyed
	2017	2.8 km of stream was surveyed
City Stream Watch Fish Sampling	2011	Seven fish community sites were sampled
	2017	Five fish community sites were sampled
City Stream Watch Thermal Classification	2011	Three temperature probes were deployed
	2017	Three temperature probes were deployed
City Stream Watch Headwater Drainage Feature Assessment	2017	Three headwater drainage feature sites were assessed in the Pinecrest Creek catchment
City Stream Watch Stream Cleanups	2006	2 km of stream was cleaned of garbage
	2011	2.2 km of stream was cleaned of garbage
	2017	0.75 km of stream was cleaned of garbage
City Stream Watch Riparian Planting	2010	300 trees and shrubs were planted by volunteers
City Stream Watch Invasive Species Removals	2014	0.1 km of shoreline was cleared of invasive Himalayan balsam
	2015	0.8 km of shoreline was cleared of invasive Himalayan balsam
National Capital Commission Rehabilitation Projects	2008	Seven restoration projects were completed to mitigate bank erosion, increase flood plain access and improve stream function
City of Ottawa Stormwater Management Retrofit Plan	2011	A comprehensive study was completed to minimize negative impacts of uncontrolled stormwater runoff in the Pinecrest Creek catchment Click to view: Pinecrest Creek/Westboro Stormwater Management Retrofit Study
	2017	Pinecrest Neighborhood Rain Project implemented as a two year pilot project: Ottawa.ca/Pinecrestrain


Established willow tree rooting along Pinecrest Creek.


Temperature probe installation in Pinecrest Creek near Baseline Road

Potential Riparian Restoration Opportunities

Riparian restoration opportunities were assessed in the field and include potential enhancement through riparian planting, erosion control, invasive species management in Pinecrest Creek (Figure 33).

Invasive species management is needed along most of Pinecrest Creek in order to maintain native vegetative species diversity. These opportunities will be more effective if implemented after transitway projects are completed.

Riparian planting opportunities were identified in a couple of sections in the Connaught Park area (North of Highway 417). Erosion control opportunities are still present, further work can be done to mitigate the effects of highly erosive water forces that the creek experiences on a continuous basis. Stormwater mitigation will be the largest contributor to overall erosion control.

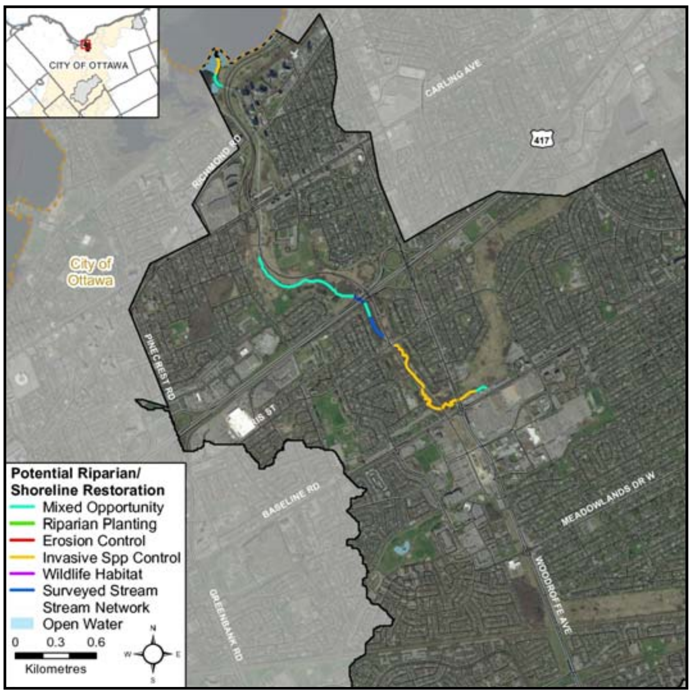


Figure 33 Potential riparian/shoreline restoration opportunities along Pinecrest Creek

City Stream Watch volunteer using a field guide to identify invasive species found along Pinecrest Creek.

Potential Instream Restoration Opportunities

Instream restoration opportunities were assessed in the field and include potential enhancement through channel modification, stream cleanups and fish habitat creation.

Stream Cleanup

Pinecrest Creek is highly polluted with garbage due to its highly urbanized surrounding areas and unmitigated stormwater input. The system can benefit from more frequent stream and shoreline clean ups in the areas shown in Figure 34.

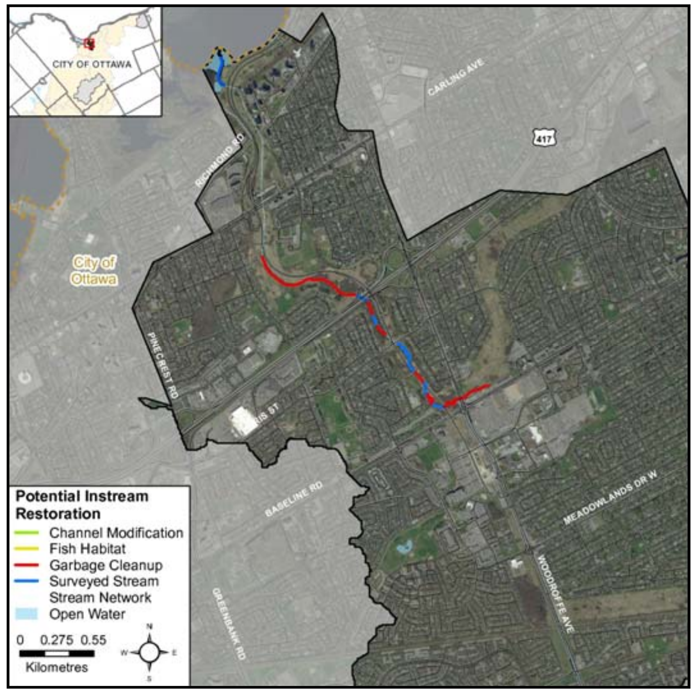


Figure 34 Potential instream restoration opportunities along Pinecrest Creek

Low diversity riparian area that can benefit from riparian planting along Pinecrest Creek



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

RVCA City Stream Watch would like to thank all the **volunteers** who assisted in the collection of information and stream clean ups; and to our **City Stream Watch Collaborative members**: City of Ottawa, Ottawa Flyfishers Society, Ottawa Stewardship Council, Rideau Roundtable, Canadian Forces Fish and Game Club, and the National Capital Commission