

City Of Rockville Save Our Streams (SOS) Citizens Water Quality Monitoring Program

State of Our Stream Monitoring Report Update: Fall 2009 – Fall 2010

Purpose

This annual report documents the health of Rockville's streams. Results are based on water quality monitoring conducted by Rockville residents who explored stream habitat conditions, collected water chemistry data and sampled stream aquatic life.

This report will be updated annually to include the most current data collected from the three stream monitoring sites in Rockville. Data is collected twice per year (spring and fall), and this report includes data collected in the fall of 2009 through the fall of 2010.

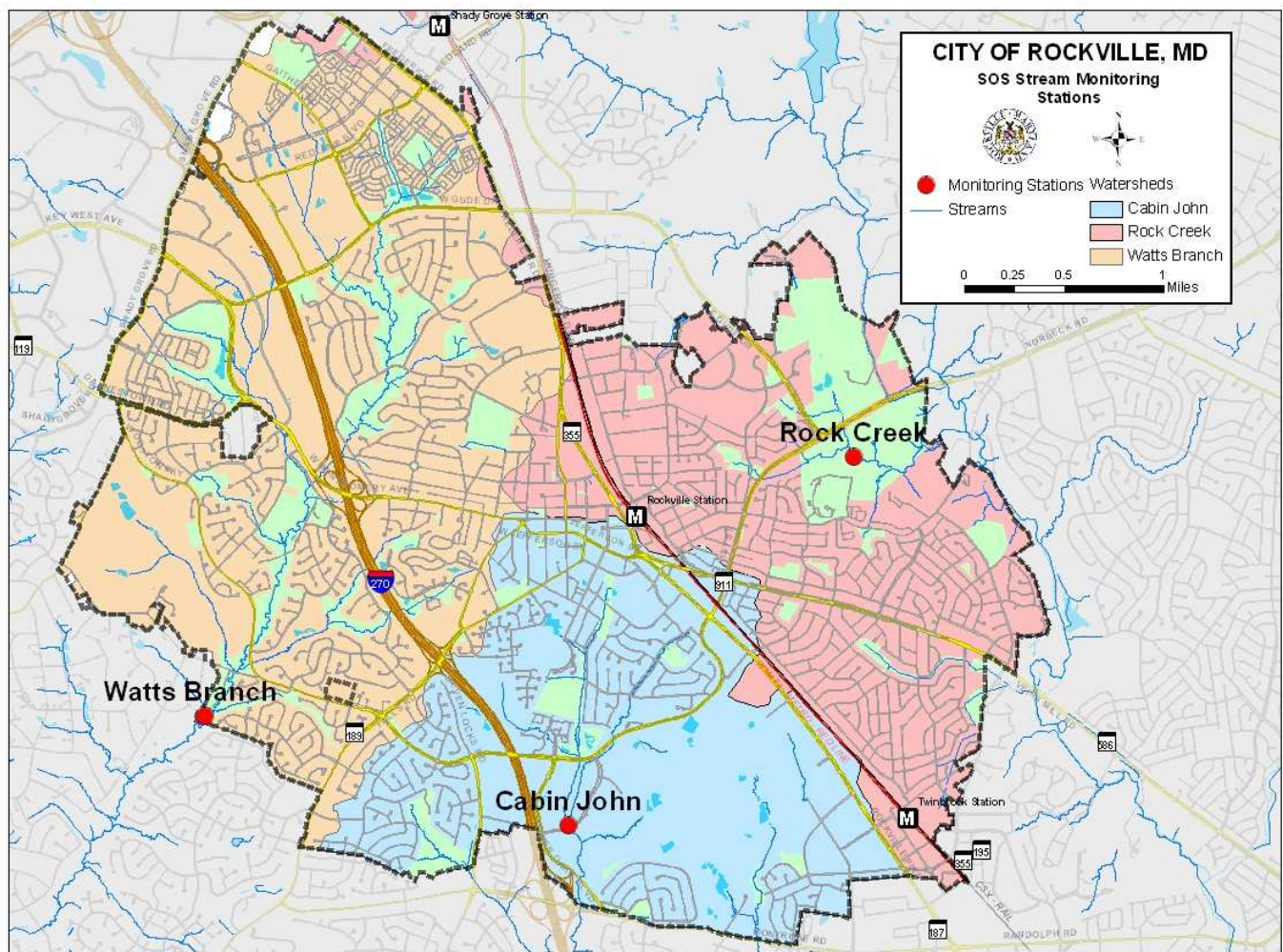


Figure 1. Map of stream monitoring sites

Background: A Snapshot of Stream Health

In October 2009, the Rockville citizen water quality monitoring group, Save Our Streams (SOS), completed its first assessment of biological, habitat and chemical conditions in the three waterways within the City of Rockville. The group documented the presence and community composition of aquatic life, scored the quality of stream habitat and measured water chemistry in three stream segments within the City of Rockville. Each of the three stream segments were located different Rockville watersheds – Watts Branch, Cabin John and Rock Creek.

SOS volunteers conduct monitoring twice a year, once in the spring and once in the fall. Since October 2009, SOS volunteers have participated in three stream monitoring events. As data is collected each year, it will be interesting to explore trends and changes in Rockville streams over time.

The data collected by the SOS volunteers is analyzed with computer software designed to rate streams on a variety of criteria. Streams are given a score that corresponds with an integrity rating ranging from optimal, suboptimal, marginal and poor. A stream rated as optimal would be one that provides excellent living conditions, including habitat and water quality, to support a wide variety of aquatic life such as many pollution intolerant species. In contrast, a stream rated as poor will generally show a more impaired system, one with less favorable habitat conditions and water quality, and one that likely does not support a diverse community of aquatic life.

Biological Monitoring

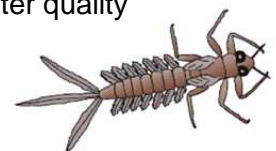
Biological monitoring (or a biosurvey) is used to determine environmental conditions of a stream by exploring the biological organisms present. Biological monitoring can be likened to using a thermometer to assess the health of a human. A numeric value is obtained at a point in time and compared to a normal or “reference” value (e.g. normal human body temperature is 98.6°) (Merritt, Cummins and Berg 1996). If the value on a thermometer used to take a child’s temperature deviates from the normal range, it indicates ill health. This is also the case in stream monitoring.

Rockville SOS stream teams perform biological monitoring (collection, identification and analyses of the composition of aquatic organisms) in Croydon Creek, a tributary of Rock Creek, Watts Branch and Cabin John Creek to determine stream health. The technical term for these organisms is benthic macroinvertebrates (bottom dwelling, large enough to be seen with the naked eye and lacking a backbone). Examples of benthic macroinvertebrates (BMIs) include insects in their larval or nymph form, crayfish, clams, snails and worms. These organisms live part or most of their life cycles attached to submerged rocks, logs and vegetation in creeks all over the planet.

Why Biological Monitoring?

Aquatic macroinvertebrates are good indicators of stream quality because:

- They are affected by the physical, chemical and biological conditions of the stream.
- They can't escape pollution and show the effects of short-and long-term pollution events.
- They may show the cumulative impacts of pollution.
- They may show the impacts from habitat loss not detected by traditional water quality assessments.
- They are a critical part of the stream's food web.
- Some are very intolerant of pollution.
- They are relatively easy to sample and identify.



The basic principle behind the study of macroinvertebrates is that some are more sensitive to pollution than others. Therefore, if a stream site is inhabited by organisms that can tolerate pollution - and the more pollution-sensitive organisms are missing - a pollution problem is likely.

For example, stonefly nymphs - aquatic insects that are sensitive to most pollutants - cannot survive if a stream's dissolved oxygen falls below a certain level. If a biosurvey shows that no stoneflies are present in a stream that supports them, a hypothesis might be that dissolved oxygen has fallen to a point that keeps stoneflies from reproducing - or has killed them outright.

This brings up both the advantage and disadvantage of the biosurvey. The advantage of the biosurvey is that it tells clearly when the stream ecosystem is impaired, or "sick," due to pollution or habitat loss. It is not difficult to realize that a stream full of many kinds of crawling and swimming "critters" is healthier than one without much life. The disadvantage of the biosurvey is that it cannot definitively tell why certain types of creatures are present or absent.

In this case, the absence of stoneflies might indeed be due to low dissolved oxygen. But is the stream under-oxygenated because it flows too sluggishly or because pollutants in the stream are damaging water quality by using up the oxygen? The absence of stoneflies might also be due to other pollutants discharged by factories or running off farmland, water temperatures that are too high, habitat degradation such as excess sand or silt on the stream bottom that has ruined stonefly sheltering areas or other conditions.

Thus a biosurvey should be accompanied by an assessment of habitat and water quality conditions in order to help explain biosurvey results.

Habitat Assessment

In a stream, habitat for macroinvertebrates includes the rocks and sediment of the stream bottom, the plants in and around the stream, leaf litter and other decomposing organic material that falls into the stream, as well as submerged logs, sticks and woody debris. Macroinvertebrates need the shelter and food these habitats provide and tend to congregate in areas that provide the best shelter, the most food and the most dissolved oxygen. A habitat survey examines these aspects and rates the stream according to their quality.

SOS team members rate several habitat parameters as optimal, suboptimal, marginal or poor based upon set criteria. The optimal category is a description of conditions that meet natural expectations; suboptimal includes descriptions of criteria that are less than desirable, but satisfy expectations under most circumstances; marginal is a description of moderate levels of degradation with severity at frequent intervals throughout the reach; and poor is a description of criteria for streams that have been substantially altered with severe degradation characteristics.

Habitat parameters rated are embeddedness, sediment deposition, bank stability, riparian buffer width and percent shade cover. Each parameter is visually scored following written guidelines provided on the habitat assessment field form. All parameters are combined for an overall habitat rating (Barbour and Stribling, 1994).

Causes of Poor Habitat Conditions

The primary cause of poor stream habitat in Montgomery County is altered stream *hydrology*. Increases in stormwater runoff associated with watershed development have accelerated channel erosion, habitat loss and sedimentation damages in county streams. These impacts started with the clearing of land more than 300 years ago for timber and agricultural purposes. Stream channels continue to adjust to

alterations in stream hydrology as watershed development has gradually shifted from agricultural to residential and commercial uses to accommodate the county's population growth.

Hard surfaces, impervious to water, such as roads, parking lots and rooftops, cover an increasing proportion of the landscape. Additions in impervious surfaces and highly compacted lawn surfaces increase the volume of water that rapidly runs off into streams during storms. Less rainfall can naturally infiltrate into soils, which may lower the water table, reduce well yields and limit replenishment of stream flows during dry weather periods. Before the mid-1980's, increases in impervious areas were not accompanied by stormwater controls to help mitigate the erosive effects of runoff. The combined effects of increased flooding, accelerated channel erosion and reduced groundwater replenishment of stream flows can often devastate natural stream channel habitat and its ability to support a diverse biological community.

Sediment is the most important pollutant in Maryland. It has been estimated that up to 75 percent of sediment deposits from developed urban and suburban areas are from accelerated stream channel erosion, rather than erosion from upland soils. Eroded stream channel sediments may also carry nutrients such as nitrogen and phosphorus, which can impact local and downstream waters. Severe channel erosion can also expose and potentially damage sanitary sewers and other utility lines, which can lead to catastrophic pollution and require extensive, costly repairs.

Other threatening impacts to stream habitat include trash, non-native invasive plants and deer browsing of woody vegetation.

Uses of the Biosurvey and Habitat Assessment

The information provided by biosurveys and habitat assessments can be used for many purposes.

- **To screen for impairment.** Biosurveys can be used to identify problem sites along a stream. A habitat assessment can help determine whether the problem is due, at least in part, to a habitat limitation such as poor bank conditions.
- **To determine the severity of the pollution problem and to rank stream sites.** To use biological data properly, water resource analysts generally compare the results from the stream sites under study to those of sites in ideal or nearly ideal condition (called a reference condition). Individual stream sites can then be ranked from best to worst, and priorities can be set for their improvement.
- **To identify water quality trends.** In any given site, biological data can be used to identify water quality trends (increasing or decreasing) over several years.

Water Chemistry

Readings of temperature, pH, dissolved oxygen (DO), conductivity, total dissolved solids (TDS) and salinity are taken at monitoring sites as part of the SOS stream monitoring program. These physical properties of water help in understanding the water quality of a stream at the time it is monitored.

The rates of biological and chemical processes depend on **temperature**. Aquatic organisms from microbes to fish are dependent on certain temperature ranges for their optimal health. Optimal temperatures for fish depend on the species: Some survive best in colder water, whereas others prefer warmer water. Benthic macroinvertebrates are also sensitive to temperature and will move in the stream to find their optimal temperature. If temperatures are outside this optimal range for a prolonged period of time, organisms are stressed and can die.

Temperature affects the oxygen content of the water (oxygen levels become lower as temperature increases); the rate of photosynthesis by aquatic plants; the metabolic rates of aquatic organisms; and the sensitivity of organisms to toxic wastes, parasites and diseases.

Causes of temperature change include weather, removal of shading streambank vegetation, impoundments (a body of water confined by a barrier, such as a dam), discharge of cooling water, urban storm water and groundwater inflows to the stream.

PH is a term used to indicate the alkalinity or acidity of a substance as ranked on a scale from 1.0 to 14.0. Acidity increases as the pH gets lower. In the water, pH affects many chemical and biological processes. For example, different organisms flourish within different ranges of pH. The largest variety of aquatic animals prefer a range of 6.5-8.0. A pH outside this range reduces the diversity in the stream because it stresses the physiological systems of most organisms and can reduce reproduction. Low pH can also allow toxic elements and compounds to become mobile and "available" for uptake by aquatic plants and animals. This can produce conditions that are toxic to aquatic life, particularly to sensitive species like rainbow trout. Changes in acidity can be caused by atmospheric deposition (acid rain), surrounding rock and certain wastewater discharges.

Oxygen is measured in its dissolved form as **dissolved oxygen (DO)**. If more oxygen is consumed than is produced, dissolved oxygen levels decline and some sensitive animals may move away, weaken or die. DO levels fluctuate seasonally and over a 24-hour period. They vary with water temperature and altitude. Cold water holds more oxygen than warm water and water holds less oxygen at higher altitudes. Aquatic animals are most vulnerable to lowered DO levels in the early morning on hot summer days when stream flows are low, water temperatures are high and aquatic plants have not been producing oxygen since sunset.

A stream system both produces and consumes oxygen. It gains oxygen from the atmosphere and from plants as a result of photosynthesis. Running water, because of its churning, dissolves more oxygen than still water, such as that in a reservoir behind a dam. Respiration by aquatic animals, decomposition and various chemical reactions consume oxygen.

Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron and aluminum cations (ions that carry a positive charge). Organic compounds like oil, phenol, alcohol and sugar do not conduct electrical current well and therefore have a low conductivity when in water. Conductivity is also affected by temperature: the warmer the water, the higher the conductivity. For this reason, conductivity is reported as conductivity at 25 degrees Celsius (25 C).

Conductivity in streams and rivers is affected primarily by the geology of the area through which the water flows. Streams that run through areas with granite bedrock tend to have lower conductivity because granite is composed of more inert materials that do not ionize (dissolve into ionic components) when washed into the water. On the other hand, streams that run through areas with clay soils tend to have higher conductivity because of the presence of materials that ionize when washed into the water.

Discharges to streams can change the conductivity depending on their make-up. A failing sewage system would raise the conductivity because of the presence of chloride, phosphate and nitrate; an oil spill would lower the conductivity.

Total dissolved solids (TDS) in stream water consist of calcium, chlorides, nitrate, phosphorus, iron, sulfur, and other ions. The concentration of total dissolved solids affects the water balance in the cells of aquatic organisms.

Higher concentrations of suspended solids can serve as carriers of toxics, which readily cling to suspended particles. Total solids also affect water clarity. Higher solids decrease the passage of light through water, thereby slowing photosynthesis by aquatic plants. Water will heat up more rapidly and hold more heat; this, in turn, might adversely affect aquatic life that has adapted to a lower temperature regime.

Sources of total solids include industrial discharges, sewage, fertilizers, road runoff, and soil erosion. Total solids are measured in milligrams per liter (mg/L).

State of Our Streams Results: Rockville's Streams

Data collected by the Save Our Streams volunteers between the fall of 2009 through the fall of 2010 has been compiled into this section of the annual report. A brief discussion of stream and habitat scores, macroinvertebrate assemblage and community composition, as well as the biotic index and water chemistry data is provided. This section of the report will be updated annually, as more data is collected over time.

Please note that efforts are made each season to maintain and improve data quality under this program. Due to changes in volunteer availability and participation, as well the potential for human and instrumentation error, there may be discrepancies in the dataset. As the Save Our Streams program matures, data discrepancies will likely decrease, as participants in the program will become more familiar with the field instruments and protocols.

Stream and Habitat Scores

Stream Scores are based on several parameters: total taxa, EPT taxa, Biotic Index, % EPT and % tolerant (these parameters are discussed in greater detail in the Glossary of Terms) and are compared to values calculated from formulas derived from hundreds of stream collections (reference sites) from all across West Virginia. It is assumed that the West Virginia reference streams are similar to streams in Rockville. The integrity rating for the stream score is as follows:

Stream Score

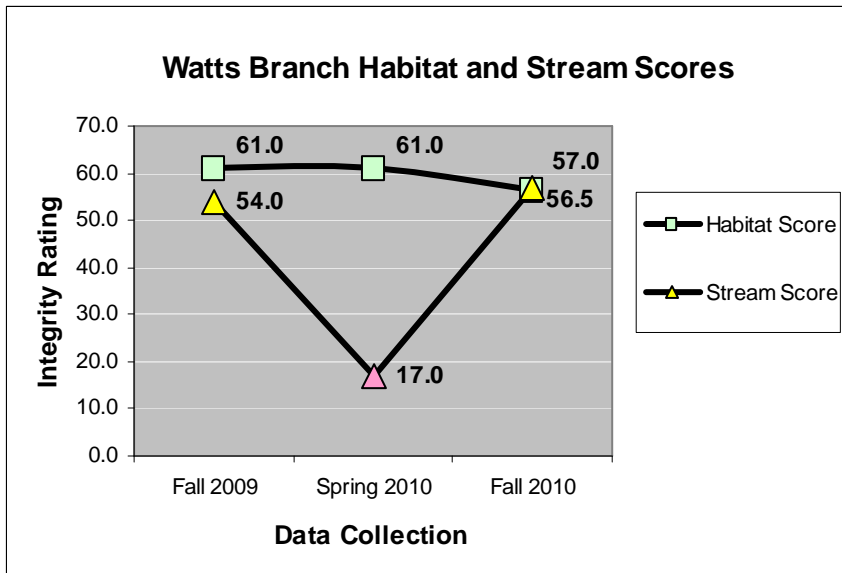
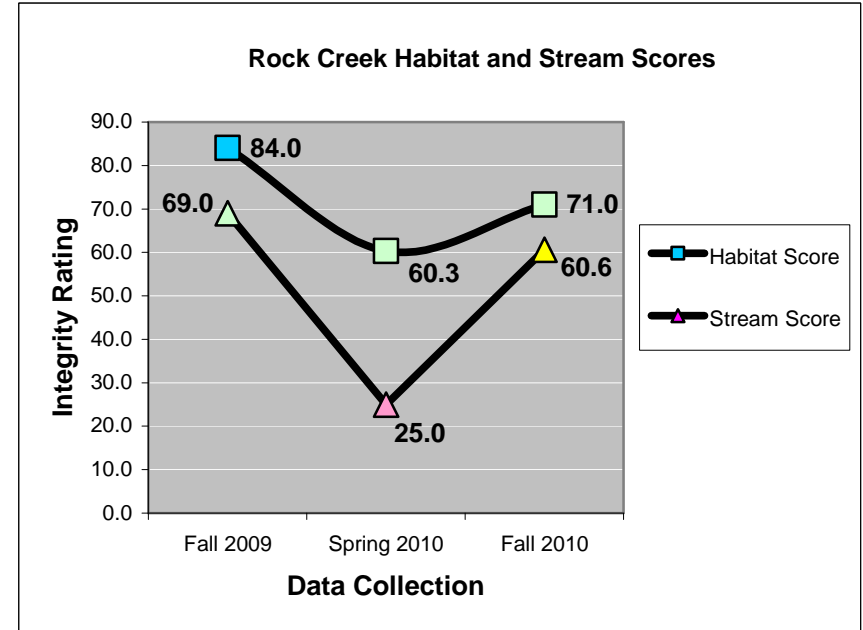
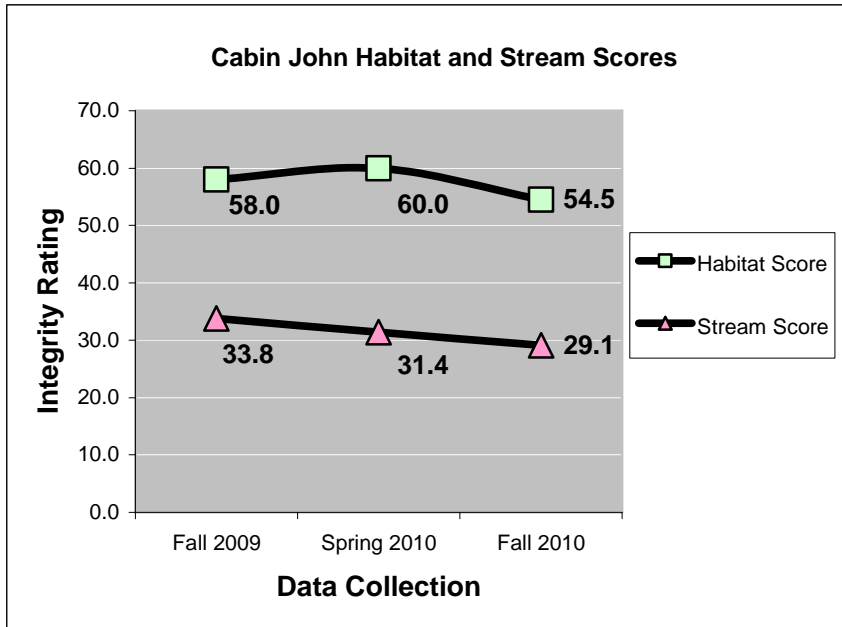
| | | | | |
|------------------------|-----------------|-----------------------|-----------------------|--------------|
| Integrity Rating Scale | > 80 Optimal | 80 - 65 Suboptimal | 64.9 - 50 Marginal | < 50 Poor |
|------------------------|-----------------|-----------------------|-----------------------|--------------|

Values used to derive **Habitat Scores** are based on composite scores of the habitat parameters explored in the field. Higher scores on both stream and habitat parameters are more favorable and indicate less degraded streams. A relationship between habitat scores and stream scores seems to be emerging in that streams with larger buffer zones (riparian buffer width is the specific parameter) have higher stream scores. With continued monitoring, trends or correlations between stream score and habitat score may be apparent as more data is collected. The integrity rating for the habitat score is as follows:

Habitat Score

| | | | | |
|------------------------|-----------------|---------------------|-------------------|--------------|
| Integrity Rating Scale | > 76 Optimal | 75-51 Suboptimal | 50-26 Marginal | 25-1 Poor |
|------------------------|-----------------|---------------------|-------------------|--------------|

Stream and Habitat Scores



Stream Score

| Integrity Rating Scale | > 80 Optimal | 80 - 65 Suboptimal | 64.9 - 50 Marginal | < 50 Poor |
|------------------------|-----------------|-----------------------|-----------------------|--------------|
| | | | | |

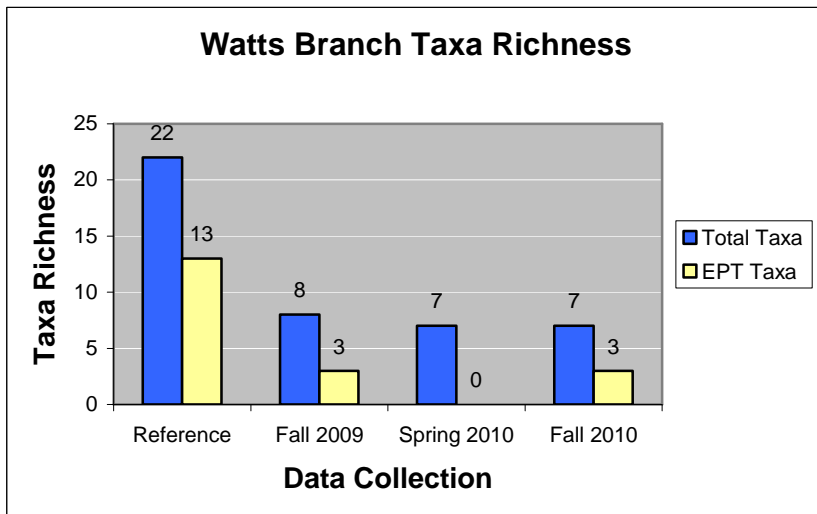
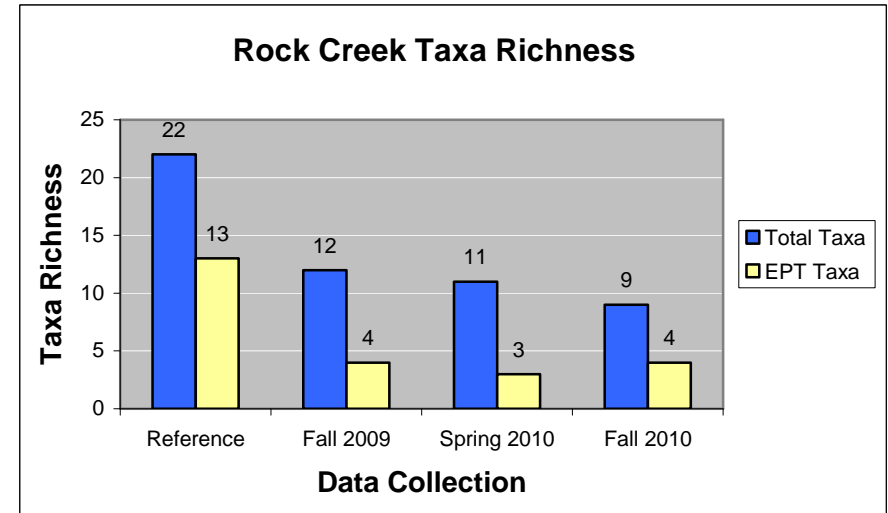
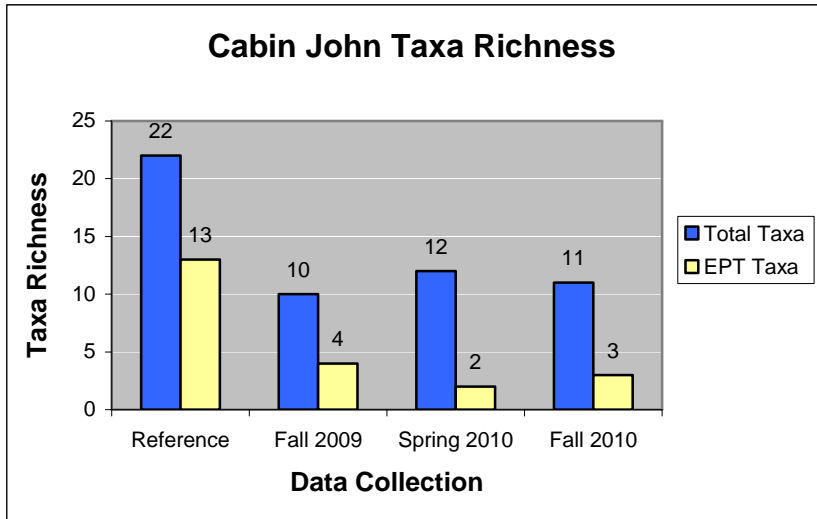
Habitat Score

| Integrity Rating Scale | > 76 Optimal | 75 - 51 Suboptimal | 50 - 26 Marginal | 25 - 1 Poor |
|------------------------|-----------------|-----------------------|---------------------|----------------|
| | | | | |

As shown on the graphs, the Cabin John stream-monitoring site has shown the most consistency in habitat and stream scores over the last three seasons. In the spring of 2010, the data show a considerable decrease in stream score (both receiving a Poor rating) for the Rock Creek and Watts Branch sites.

It will be important to assess future data collected in the spring season in order to draw any conclusions about this finding.

Macroinvertebrate Assemblage



Total Taxa is a measure of the overall variety of the macroinvertebrate groups collected while EPT Taxa is the number of groups of insect in the orders Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (Caddisflies). Insects in the EPT taxa are generally considered less tolerant to pollution or disturbance. Both Total Taxa and EPT Taxa are predicted to decrease with disturbance.

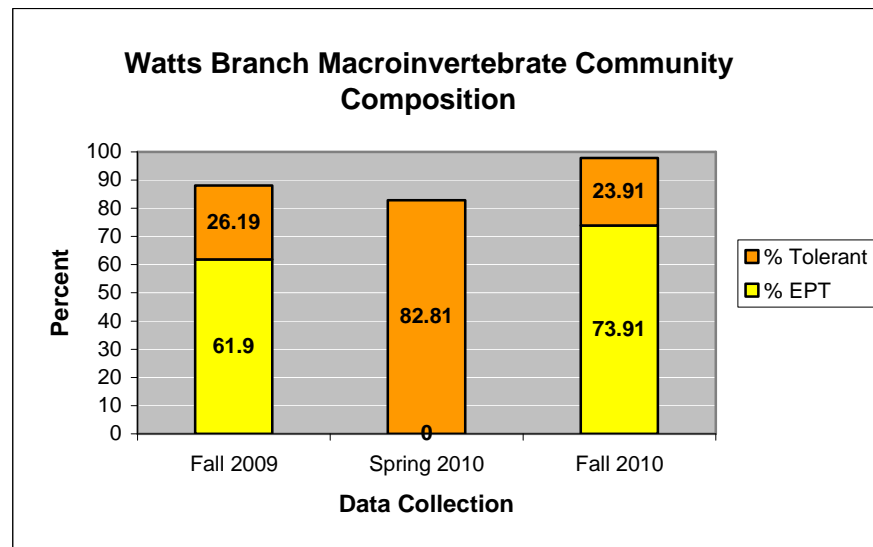
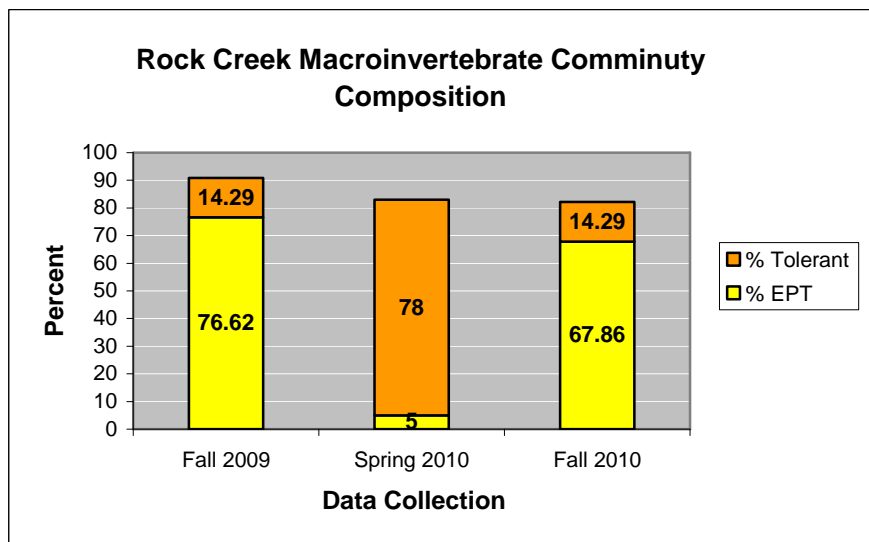
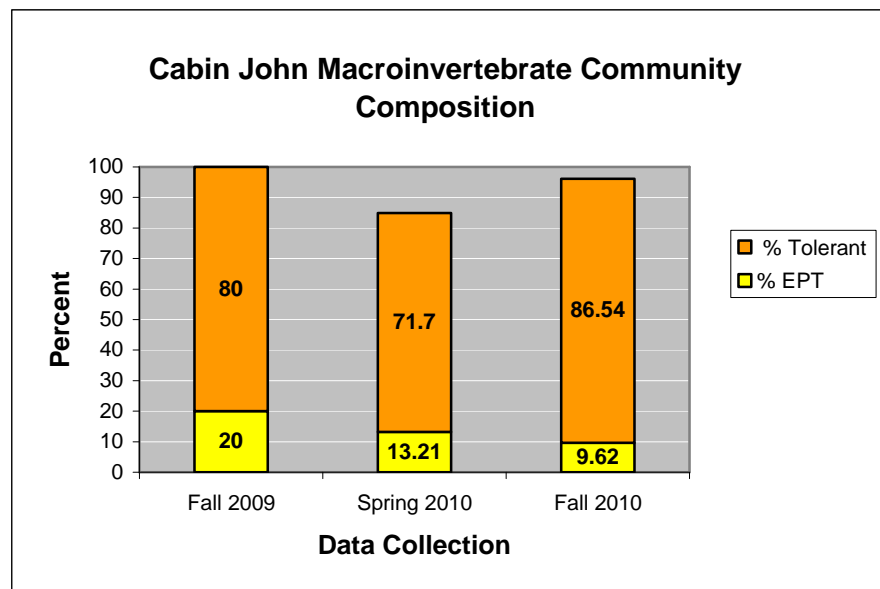
All three streams sites monitored in Rockville had fewer total aquatic species and less variety of species than the reference streams. This finding is consistent with increased disturbance to habitats associated with highly developed watersheds such as those in Rockville. Since the fall of 2009, Taxa Richness has remained relatively consistent within each stream-monitoring site.

Macroinvertebrate Community Composition

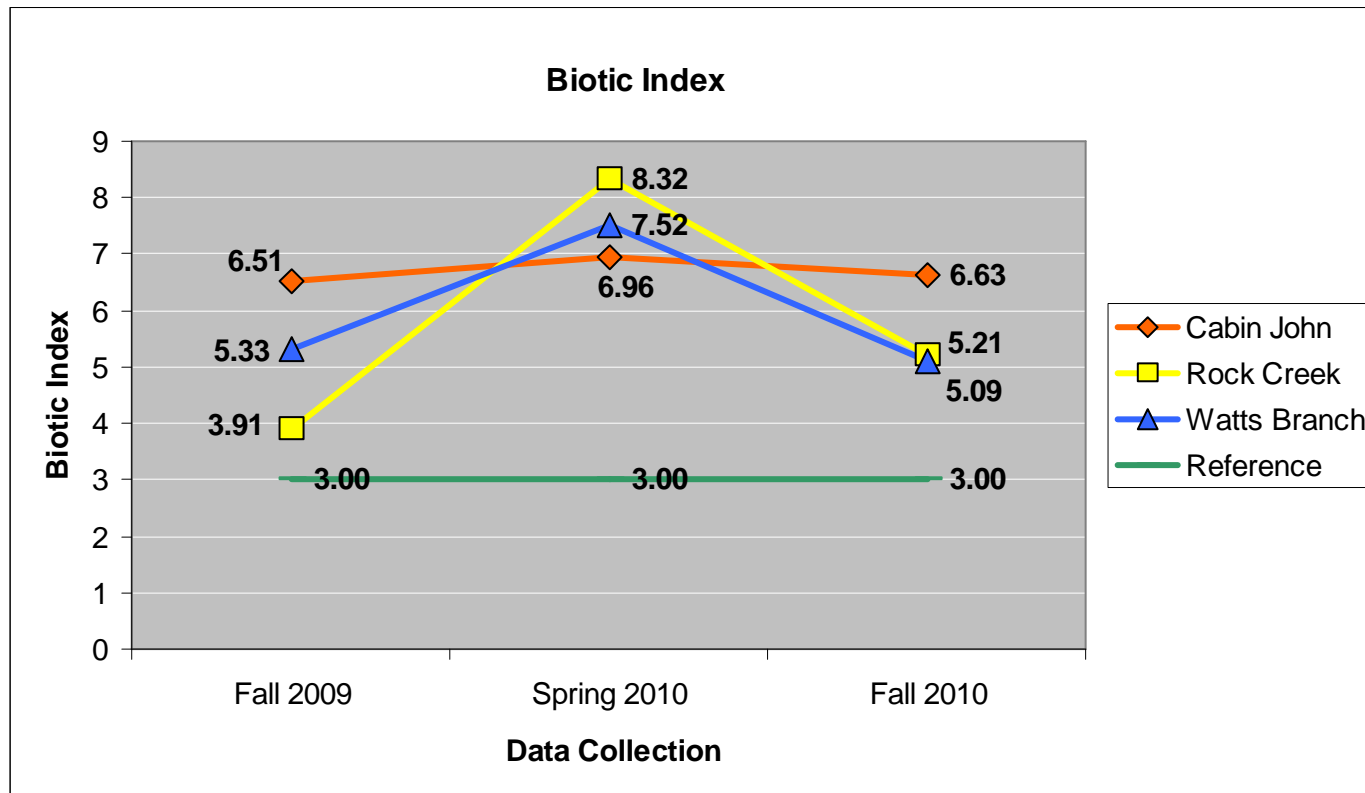
Data can also be analyzed by reviewing tolerance levels associated with the macroinvertebrate community. Percent EPT (less tolerant to pollution/disturbance) is predicted to decrease with disturbance while Percent Tolerant (percent of the total number of organisms in the sample with a tolerance level of ≥ 7) is expected to increase. Due to the association of tolerance levels to organisms, these graphs may not add to 100 percent for each season.

The findings indicate that Cabin John may be more polluted/disturbed than Rock Creek and Watts Branch as this site has consistently supported more tolerant organisms since 2009.

In the spring of 2010, a significant decrease in the percentage of EPT was observed in Rock Creek and Watts Branch. In Rock Creek the Habitat Score dropped more than 20 points between the fall of 2009 and spring 2010. A degraded habitat may be the cause for the larger portion of pollution tolerant organisms. In Watts Branch, the Habitat Score remained consistent between the fall of 2009 and the spring of 2010. It is unclear what factors may have impacted the macroinvertebrate community composition at this site.



Macroinvertebrate Biotic Index



The Biotic Index uses tolerance values to weight abundance in an estimate of overall pollution/degradation. This is calculated by taking into account the total number of organisms sampled and scoring these based on assigned tolerance values. In this metric the biotic index is expected to increase with disturbance. A lower score is more favorable. The reference streams have a biotic index of 3.00. All of the stream-monitoring sites had a higher biotic index than the reference condition.

The biotic index for Cabin John has remained consistent over the last three monitoring seasons. Rock Creek and Watts Branch revealed a much higher biotic index in the spring of 2010, indicating increased disturbance. Both of these stream-monitoring sites appear to have improved since the spring. The cause of the higher biotic index found in the spring is unknown at this time. It will be important to examine future data collected in the spring season in order to identify potential reasons for the increased biotic index in Rock Creek and Watts Branch.

Water Chemistry

In accordance with the Federal Clean Water Act, the State of Maryland designates use classifications for all water bodies in the state. These uses include standards for water chemistry parameters. The table below indicates the measured values collected by SOS members and Maryland water quality standards (MD WQS). All three of Rockville's streams were within MD Water Quality Standard limits for their designated uses on all parameters assessed. Measured values for air temperature are also included as it is a function of water temperature, pH and dissolved oxygen. Salinity, Total Dissolved Solids, and Conductivity values have also been included below.

| Cabin John Water Chemistry Parameters | | | | | | | |
|--|---------------------|---------|-------------------------|-------------------|------------------|-------------------------------------|-------------------|
| | Water Temperature c | pH | Dissolved Oxygen (mg/L) | Air Temperature c | Salinity (ppm S) | Total Dissolved Solids (TDS) (mg/L) | Conductivity (μS) |
| Fall 2009 | 12.1 | 7.48 | 10 | 17.8 | 290 | 408 | 583 |
| Spring 2010 | 12.2 | 8 | 9 | 12.0 | 259 | 360 | 545 |
| Fall 2010 | 10.1 | 7.61 | 8 | 12.9 | 246 | 347 | 496 |
| MD WQ Standard | ≤32 | 6.5-8.5 | >5 | N/A | N/A | N/A | N/A |

| Rock Creek Water Chemistry Parameters | | | | | | | |
|--|---------------------|---------|-------------------------|-------------------|------------------|-------------------------------------|-------------------|
| | Water Temperature c | pH | Dissolved Oxygen (mg/L) | Air Temperature c | Salinity (ppm S) | Total Dissolved Solids (TDS) (mg/L) | Conductivity (μS) |
| Fall 2009 | 14.4 | 6.93 | 9 | 13.6 | 418 | 660 | 848 |
| Spring 2010 | 12.9 | 7.38 | 12 | 20.5 | 311 | 438 | 620 |
| Fall 2010 | 14.2 | 7.81 | 7 | 11.6 | 242 | 343 | 488 |
| MD WQ Standard | ≤20 | 6.5-8.5 | >5 | N/A | N/A | N/A | N/A |

| Watts Branch Water Chemistry Parameters | | | | | | | |
|--|---------------------|---------|-------------------------|-------------------|------------------|-------------------------------------|-------------------|
| | Water Temperature c | pH | Dissolved Oxygen (mg/L) | Air Temperature c | Salinity (ppm S) | Total Dissolved Solids (TDS) (mg/L) | Conductivity (μS) |
| Fall 2009 | 10.0 | 6.9 | 10 | 11.7 | 270 | 387 | 572 |
| Spring 2010 | 13.0 | 8.01 | 12 | 17.3 | 34.4* | 50.6* | 68.4* |
| Fall 2010 | 17.2 | 7.92 | 9 | 22.3 | 270 | 431 | 645 |
| MD WQ Standard | ≤32 | 6.5-8.5 | >5 | N/A | N/A | N/A | N/A |

* This value deviates significantly from what would be expected and may be attributed to human or instrumentation error.

Conclusion

Data collected by volunteer monitors indicate that all three Rockville waterways (at monitoring sites) show signs of degradation commonly associated with urban watersheds. The data collected at the Cabin John stream-monitoring site has shown more consistency than the other two monitoring sites. Cabin John rated suboptimal for habitat score and poor for stream score for the last three monitoring seasons. This site appears to support mostly tolerant organisms, which contributes to the poor stream score rating.

It is interesting to note the large drop in stream scores for the Rock Creek and Watts Branch stream-monitoring sites in the spring of 2010. The habitat score for the Rock Creek site also took a large dip in the spring of 2010. The macroinvertebrate community composition for both of these sites seemed to change considerably in the spring of 2010 to a system supporting mostly tolerant organisms. In contrast to the spring data, both fall monitoring sessions in Rock Creek and Watts Branch depict a system that supports a majority of organisms that are very sensitive to pollution and/or disturbance.

As illustrated in the section of this document titled *Why Biological Monitoring*, it is difficult to parse out the true cause of a stream's impairment. Current data indicates degraded waterways, but cannot identify a cause. Over time and with greater exploration of additional parameters, trends may become apparent and help explain or at least suggest relationships between specific stressors and stream degradation.

Future Endeavors

In the future, the SOS program will expand, measuring turbidity and stream velocity and will utilize an outside laboratory to analyze nutrients, bacterial contaminants and other chemical constituents. The most common nutrients expected in our streams are nitrogen and phosphorus as they are the main components of plant fertilizers commonly used on lawns. Also of concern are bacterial contaminants. Fecal coliform bacteria may be present in Rockville streams as these bacteria are often detected in surrounding Montgomery County streams. Specifically, periodic sewage spills and leaks could be introducing *E. coli* into Rockville's surface waters. Aging sanitary sewer lines in densely developed areas, tree roots and grease blockages are all threats to the city's streams. Additionally, pet waste and an overabundance of wildlife contribute to fecal coiliform counts in Rockville steams.

The information in this report would not be possible with the help of individual volunteer monitors and the Watersheds Committee of the Environment Commission. The Environmental Management Division thanks them for their time, dedication, expertise and effort.

Glossary of Terms

Bank stability parameter evaluates whether the stream banks are eroded (or have the potential for erosion).

Biotic index is the total tolerance score (number of organisms per group multiplied by their respective tolerance value) divided by total number of organisms in the sample.

Embeddedness refers to the extent to which rocks (gravel, cobble, and boulders) are surrounded by, covered, or sunken into the silt, sand, or mud of the stream bottom.

EPT Taxa richness is the number of 3 pollution sensitive taxa: Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (Caddisflies) found in the sample. Increasing numbers of these orders correlates with increasing health of the sample suggesting that niche space, habitat, and food sources are adequate to support these species.

Hydrology is the science of the origins and processes of water, its properties, phenomena, and distribution as affected by nature and as modified by people.

Nutrient loading is the total amount of nitrogen or phosphorus entering the water during a given time, such as “tons of nitrogen per year.” Nutrients may enter the water from runoff, groundwater, or the air in the form of rain or snow or dry deposition.

Percent shade cover estimates the amount of shaded area over the stream. Shade cover is important because it keeps the stream protected from temperature changes due to excess sun exposure.

Riparian buffer width is an estimate of the width of natural vegetation from the edge of the stream bank out through the riparian zone

Taxa richness is the number of distinct taxa (i.e., class, order, family) found in the sample, or more simply stated the total number of families (SOS nomenclature = “kinds”) collected. Richness measures reflect the diversity of the aquatic life in a sample. Increasing diversity correlates with increasing health of the sample suggesting that niche space, habitat, and food sources are adequate to support many species.

Tolerance/Intolerance measures may be representative of relative sensitivity to perturbation (non-specific to type of stressor) and here includes percent of pollution intolerant and tolerant taxa composition.

- **Percent EPT** is the total number of organisms within the orders Ephemeroptera, Plecoptera and Trichoptera divided by the total number of organisms in the sample.
- **Percent Tolerant** is the total number of organisms with a tolerance of ≥ 7 divided by the total number of organisms in the sample.

Both results are multiplied by 100 to determine the percentage

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