Chapter 2
Overview of the Cameron Run Watershed

2.1 WHAT IS THE CAMERON RUN WATERSHED?

The Cameron Run watershed drains a 44-square-mile section of Northern Virginia. Thirty-three square miles of this area lie within the jurisdiction of Fairfax County; the remaining area lies within the cities of Falls Church and Alexandria (Figure 2-1). The western part of the watershed is within the Piedmont physiographic province (i.e., just west of the fall line); the eastern part is in the Coastal Plain. The Piedmont is an area of very old crystalline rocks underlying rolling hills. The Coastal Plain is characterized by a recent series of unconsolidated sedimentary strata (sands) typified by flat lands. Holmes Run is the primary headwater stream of the Cameron Run watershed. The headwaters of Holmes Run lie near the junction of the Capital Beltway (I-495) and I-66, approximately 1.5 miles west of the city of Falls Church. Flowing south and east, Holmes Run drains a portion of the area between Tyson's Corner and the cities of Vienna and Falls Church. The stream crosses beneath four major highways before flowing into Lake Barcroft. Lake Barcroft is located at the confluence of Holmes Run and Tripps Run. Tripps Run drains the southeastern half of the city of Falls Church. Other major tributaries of Cameron Run are Backlick Run, Indian Run, and Pike Branch. Lake Barcroft (137 acres), Fairview Lake (15 acres), and four regional ponds are major waterbodies within the watershed.

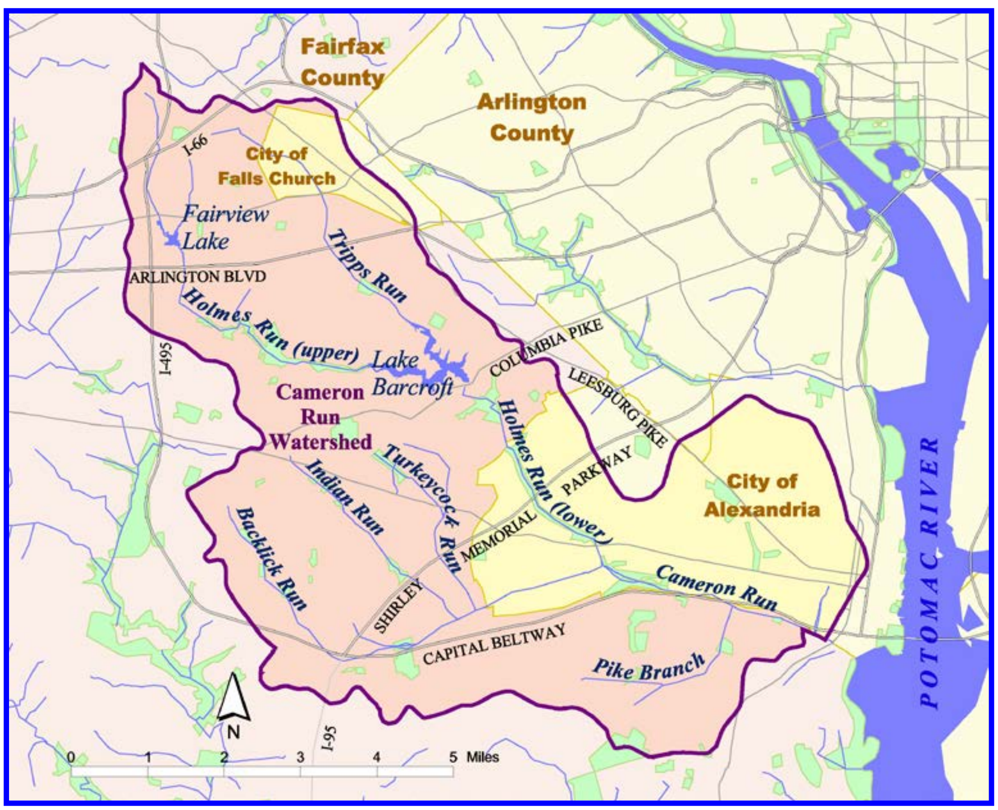


Figure 2-1. Cameron Run watershed

Approximately four miles southeast of Lake Barcroft, Holmes Run meets Backlick Run. Backlick Run and its two major tributaries, Turkeycock Run and Indian Run, drain the south-western portion of the watershed. This area makes up approximately one-third of the watershed and is characterized as a high-density residential area. The headwaters of Backlick Run are located in Annandale and flow in a northeasterly direction to the city of Alexandria, where Backlick Run meets Holmes Run. At the confluence of Backlick Run and Holmes Run the name of the mainstem changes to Cameron Run. In Alexandria, Cameron Run drains the southern and western portions of the city, except areas of Old Town that drain directly to the Potomac River. Cameron Run continues to flow in a southeasterly direction past the point at which Pikes Branch connects with the mainstem. The name of the mainstem changes to Hunting Creek before it reaches the Potomac River.

2.2 HISTORY OF CAMERON RUN WATERSHED

The Cameron Run watershed, like all of eastern North America, was nearly completely forested before the period of human settlement. Until the mid 1600s, the high density of beaver dams and ponds provided a chain of wetlands and ponds that controlled the surfacewater and groundwater in the stream valleys and provided habitat for a wide variety of flora and fauna. Three major plant associations were present in this area. In the northwestern Piedmont part of the watershed, the forest was composed of oaks and hickories. Tripps Run, Lake Barcroft, and much of the Holmes Run and Backlick Run stream corridors are located in the Piedmont. In the southeastern Coastal Plain part, the forest was composed of oaks and pines; in between these areas (i.e., near the fall line) grew American beech forests. Most of the city of Alexandria lies within the Coastal Plain. The Native Americans that lived in this watershed cleared forests and planted crops along the Potomac River. They also hunted game animals in the inland regions, trapped fish, and collected freshwater mussels. When the European settlers arrived, they purchased meat, hides, and crops from the Native Americans. From 1630 to 1650, Europeans hired local Native Americans to trap beaver for pelts. The killings essentially exterminated all beaver, causing the dams to deteriorate and changing the hydrology and ecosystem of the stream valley. As the forest was converted to agriculture, habitats were altered, and many animals disappeared. Around 1723, farms were established that cultivated tobacco, wheat, and corn. In 1850, railroad construction began in the watershed. The first settlement in the watershed was Falls Church in 1699, which became a township in 1875. Fairfax County was formally created in 1742; Alexandria was incorporated in 1779 and became a city in 1852 (Parsons Brinckerhoff 1974).

At the turn of the 20th century, the growth of the federal government in Washington, D.C., expanded into the watershed. Falls Church, Alexandria, and Arlington developed first, and the first subdivision was built by 1891 (Gernand and Netherton 2000). With the development of the watershed came necessary infrastructure such as reservoirs and sewers. Lake Barcroft was created in 1915. The city of Alexandria's increasing need for water led the Alexandria Water Company to build the dam and establish a reservoir to store water from the branches of Holmes Run. In the late 1940s, the reservoir became too small to serve the growing population of Alexandria, and other water sources replaced it. The first sewer lines ran from Falls Church to the Potomac, along Tripps Run, Holmes Run, and Cameron Run. These sewer lines dumped raw sewage into the Potomac until 1954.

By the end of the 1950s, residential subdivisions covered the northern half of the watershed, and by 1965, most land suitable for development had been built upon. By the 1970s, growth around the watershed was directly attributable to the expansion of federal employment and the growth of service industries that assisted that expansion. Private economic interests also contributed to unprecedented commercial growth in Fairfax County.

As the watershed was developed, the floodplains along the perennial streams were altered. Many of the natural stream channels were piped, resulting in a network of storm sewers and culverts. The effects of urbanization (e.g., impervious surfaces, channelization, and storm sewers) led to frequent flash flooding in the lower portion of the watershed. Highly erodible soils and frequent, intense rainstorms also contributed to the flooding. The county addressed this problem by constructing flood-control channels in lower Holmes Run, lower Backlick Run, and Cameron Run.

Marshes were once extensive in both the Piedmont and Coastal Plain parts of the watershed, but today only a few wetlands remain. Sedges, rushes, cattails, grasses, and aquatic shrubs (e.g., tag alder and buttonbush) can be found along the borders of manmade lakes and where normal drainage is blocked. A natural tidal marsh occurs where the lower Cameron Run mainstem flows into the Potomac River. This marsh consists mainly of the yellow water lily, as well as aquatic species such as pickerel weed, cattail, tuckahoe, tearthumb, and knotweed.

The Virginia Department of Forestry reports a 32% decrease in forest resources in the Cameron Run watershed from 1957 to 1992 (Woodrow Wilson Bridge Project 2001). Remaining forest resources are typically small, fragmented, and associated with riparian corridors. No large forested areas remain in the watershed. Prior to development, the forests provided habitat for a variety of wildlife, including black bear, mountain lion, bison, chipmunks, mice, eagles, wild turkey, and the passenger pigeon (Parsons Brinckerhoff 1974). Since the 1970s, the remaining small areas of undeveloped land, combined with suitable forms of development, have provided only limited wildlife habitat for animals such as deer, foxes, raccoons, muskrat, Canada geese, and ducks. Remnant alluvial forest areas sometimes produce spring wildflowers such as dogtooth violets, spring beauties, yellow violets, and toothworts (Parsons Brinckerhoff 1974).

Today, Fairfax County is nearly fully built out; nevertheless, existing residential and commercial buildings are being expanded regularly, and associated paved surfaces are increasing within those building lots. Poor water quality and flooding became a countywide problem during the 1970s as development increased throughout the county. Through the 1930s, the headwater streams were fishable and swimmable. As the population grew, the streams became degraded and were no longer fishable or swimmable. In Fairfax County, protection of stream corridors began in the 1980s. To improve water quality, Fairfax County implemented BMPs that consisted of low-density residential zoning and the creation or maintenance of vegetated stream buffers for its most threatened watersheds. By 1993, the BMPs were implemented countywide with the designation of stream corridors as Resource Protection Areas (RPAs). In the late 1980s, Fairfax County adopted the Regional Stormwater Management Plan for managing stormwater countywide. The original plan identified 134 sites for building regional ponds that would control stormwater runoff to reduce peak flow rates, prevent erosion and flooding, and improve water quality (Bryant et al. 2003).

Recognizing the need to protect the living environment while planning for the orderly development and redevelopment of the county, Fairfax County has increased its watershed planning efforts. The county initiated the SPS and Stream Physical Assessment (SPA) programs were to assess the health of the streams within the county. Fairfax County developed the SPS program to focus recommendations for protecting and restoring subwatersheds, identify priorities for allocating limited resources, establish a framework for long-term stream quality monitoring, and support overall watershed management (Fairfax County 2001). Currently, Fairfax County is developing comprehensive watershed management plans for each of the county's 30 watersheds.

2.3 SUMMARY OF EXISTING REPORTS AND DATA SOURCES

The following sections summarize information available from 16 watershed assessments and planning efforts in Cameron Run watershed. Where available, the web site for the entire report is provided.

- Environmental Baseline Report
- Immediate Action Plan Report
- Future Basin Plan Report
- Lake Barcroft History
- "UrBIN" Urban Biodiversity Study in the Holmes Run/Cameron Run watershed
- UrBIN Gap Analysis of the Holmes Run/Cameron Run watershed
- UrBIN Stream Flow in the Holmes Run/Cameron Run watershed
- Infill and Residential Development Study
- Low Impact Development (LID) As a Watershed Management Tool
- The Role of Regional Ponds in Fairfax County's Watershed Management
- Perennial Stream Mapping Project
- Stream Water Quality Report
- Annual Report on the Environment 2003
- Fairfax County Park Authority Natural Resource Management Plan, 2004-2008
- Fairfax County Stream Protection Strategy Baseline Study
- Fairfax County Stream Physical Assessment

2.3.1 Environmental Baseline Report

The *Cameron Run Environmental Baseline Report* was written by Parsons, Brinkerhoff, Quade, and Douglas in April 1974. The report presented a comprehensive view of the environmental baseline conditions for the watershed. Development dominated the watershed when this report was written and still does today. The report predicted an increase in stream flow as development density increased and, therefore, the need for on-site stormwater detention. These predictions accurately reflect the condition of the Cameron Run watershed today.

2.3.2 Immediate Action Plan Report

The *Immediate Action Plan Report for the Cameron Run Watershed* was written by Parsons Brinckerhoff, Quade, and Douglas in December 1977. The report identified 40 projects for the Cameron Run watershed at an estimated cost of $7,537,000. The various projects included the replacement of culverts, installation of riprap and gabions along streambanks, and construction of earthen berms. The purposes of these projects included both controlling erosion and protecting houses and roads from flooding. To date, approximately 10% of these projects have been implemented.

2.3.3 Future Basin Plan Report

The *Future Basin Plan Report for the Cameron Run Watershed* was written by Parsons Brinckerhoff, Quade, and Douglas in December 1977. This report, in conjunction with the Immediate Action Plan, specified the watershed's projected needs up to the year 2000. Recommended programs included installation of sanitary sewer lines, channelization, bank protection, stormwater detention, and flood proofing. These programs were estimated to cost $3,831,000.

2.3.4 Lake Barcroft History

This document provided a detailed history of Lake Barcroft and its community. The Barcroft community was named in memory of Dr. John W. Barcroft, who built his home there and operated a mill. Lake Barcroft was created in 1915 in response to the city of Alexandria's increasing demand for water. Construction of the dam began in 1913 and resulted in a 135-acre reservoir. The community surrounding Lake Barcroft was one of the first major real-estate developments in Fairfax County. On February 23, 1954, the residents of Lake Barcroft approved the bylaws of their homeowners association, officially launching the Lake Barcroft Community Association (LABARCA). This association brought the homeowners together to protect their community and the lake. In June of 1972, hurricane Agnes caused a breach in the Lake Barcroft dam, causing the lake to empty. A Watershed Improvement District (WID), a Virginia government agency, was then created in 1973 in an effort to gather funding and staff resources needed to repair the dam and preserve the surrounding land. The WID was able to levy taxes and issue bonds needed to restore the lake. Today, WID taxes are still being used to maintain Lake Barcroft. Recent activities include WID's six-year EPA 319 Grant, which committed $800,000 to identifying and demonstrating stormwater management BMPs. WID has published a 72-page book about BMPs for watersheds and lakes.

2.3.5 Urban Biodiversity Study in the Holmes Run/Cameron Run Watershed

This study was developed for the Urban Biodiversity Information Node Pilot (UrBIN), part of the National Biological Information Infrastructure (NBII) coordinated by the U.S. Geological Survey's Biological Resource Division. UrBIN aims to provide communities with the information and decision-support tools needed to manage urban natural resources proactively. The purpose of the Holmes Run/Cameron Run pilot study was to develop and test a framework for facilitating access to existing data about biodiversity, conservation, and natural resources, but the study also highlighted gaps in knowledge about the watershed. The report was divided into four parts. Part 1 discussed urban biodiversity and contained a description of the watershed and its history and a summary of Virginia's Chesapeake Bay regulations. These regulations were the impetus for much of the natural resource planning in the region. Part 2 contained an inventory of physical and biological resources and analyses of land use and land cover. Part 3 addressed considerations for planning to enhance biodiversity. Part 4 contained reflections on this phase of the UrBIN pilot project.

The study concluded with several findings regarding biodiversity in the Cameron Run watershed:

1. Riparian areas and stream corridors associated with floodplains, parks, and Chesapeake Bay RPAs serve as the main habitats and corridors.
2. Upland habitats are very limited; consequently, those that remain are important.
3. Local jurisdictions have sophisticated planning staffs with a strong interest in environmental protection.
4. Local stakeholders (members of nonprofit organizations and residents) also have a strong interest in environmental protection and apply this interest in advocacy and volunteer activities.
5. A unique set of integrated tools and programs exist that have helped protect the remaining habitats and corridors. These include Chesapeake Bay programs, flood plain management, environmental quality corridors, parks and recreation, the Lake Barcroft WID, land conservation by land trusts and local governments, and citizen volunteer programs.
6. In this highly urbanized watershed, most opportunities for enhancing biodiversity must come from ecological restoration and redevelopment. These activities should focus on remaining habitats and corridors, mainly stream channels, streambanks, riparian areas, and BMP retrofits. De-armoring selected sections of stream and connecting fragmented riparian corridors should be considered.

2.3.6 UrBIN Gap Analysis of the Holmes Run/Cameron Run Watershed

This project was initiated to compile information about biodiversity within the Holmes Run/Cameron Run watershed in Northern Virginia. The UrBIN Gap Analysis Project (GAP) was funded by the National Gap Analysis Program (NGAP) to provide additional biodiversity information to supplement the information compiled in UrBIN. The UrBIN GAP was a cooperative effort between the NGAP and the NBII UrBIN.

The major objective of this project was to apply gap analysis to the Holmes Run/Cameron Run watershed. Sub-objectives of this project were (1) to produce GIS-databases describing the actual kinds of land cover, predicted distributions of terrestrial vertebrates, and land-management status at a target scale of 1:24,000; (2) to identify kinds of land cover and terrestrial vertebrate species that are not represented or are underrepresented in areas managed for biodiversity (i.e., "gaps"); and (3) to facilitate cooperative development and use of information to help institutions, agencies, and private landowners become more effective stewards of natural resources. This project was a preliminary step toward the more detailed efforts and studies needed for long-term planning for biodiversity within Virginia's increasingly urban landscape.

The results emphasized the importance of parks for conserving species within the watershed. Without these refuges, some species may be lost from the watershed. Most parks within the watershed are managed for recreation rather than biodiversity; therefore, the potential for increasing biodiversity protection within the watershed is great.

2.3.7 UrBIN Stream Flow in the Holmes Run/Cameron Run Watershed

This report was prepared by Virginia Tech to support the UrBIN pilot biodiversity study in the Holmes Run/Cameron Run watershed (Estes 2003). The drainage area extending to the dam at Lake Barcroft and the area extending to the USGS gauge station on Cameron Run were analyzed to characterize streamflow and runoff in the watershed. The Lake Barcroft watershed is approximately 15 square miles, or 36 percent of the Fairfax County portion of the Holmes Run/Cameron Run watershed. This area is not as highly urbanized as the southern areas of the watershed. Flow data for Cameron Run are recorded at USGS gauge station 01653000, Cameron Run, at Alexandria, VA. The drainage area to the gauge is 33.7 miles, or 80 percent of the total Holmes Run/Cameron Run watershed. The period of record for flow data at this gauge is June 1, 1955, to the present, with occasional missing dates.

The water level at Lake Barcroft dam is controlled by a bascule gate, a hinged device that is counterbalanced so that when one end is lowered, the other is raised. The gate is operated by a digital controller that receives signals from a lake-level instrument and a gate-position detector. The controller also records the lake level and gate position at constant time increments, thus providing data for calculating the discharge from the dam. A Fortran program was created to convert the data from the controller into usable discharge data (Estes undated). The period of record for the raw data was October 1, 1991, to the present.

Analysis of the period of record indicated an increase in flow over time that was independent of precipitation. The study concluded that the increase in flow probably was due to a significant increase in development within the watershed since 1970. The increase in impervious area in the urban watershed resulted in increased runoff and increased stream flow. The researchers tested for a correlation between recorded flow at the Lake Barcroft Dam and at the USGS gauge on Cameron Run. The correlation was not as high as expected, but the relationship can be used to obtain a reasonable prediction of flow at either location.

2.3.8 Infill and Residential Development Study

The combination of the development patterns in Fairfax County and a growing concern over water quality issues led the Board of Supervisors to request the *Infill and Residential Development Study* in May of 1999. The Board accepted the final recommendations of that study at a public hearing on January 22, 2001. The study included the following recommendations related to stormwater management:

- Improve, in the erosion and sedimentation control process, the awareness, planning, and financial resolution capability of the County for land disturbing projects upstream of sensitive sites in order to reduce impacts.

- Enhance, during the erosion and sedimentation control inspection and enforcement process, the enforcement of violations including, in certain egregious instances, revoking of land disturbing permits.

- Enhance, through education programs, the knowledge and awareness of staff, the development industry, and citizens regarding the importance and capabilities of an erosion and sedimentation (E&S) control program, as well as create an E&S Hotline to improve program responsiveness.

- Improve the design and installation of erosion and sedimentation control silt fences and super silt fences by improving the design standards of the County's regulations.

- Improve the effectiveness of temporary erosion and sedimentation inlet controls on construction sites by reducing the allowable area that may be drained to them, therefore increasing the number of these control devices and improving sediment control.

- Allow the use of an optional Faircloth Floating Skimmer as a dewatering device in temporary sediment traps to increase sediment removal efficiency.

- Allow the use of chemical erosion prevention products on exposed and highly sensitive soils at construction sites in order to reduce erosion which may occur between the time that the exposed area is seeded and mulched and when the grass is fully established.

- Allow the use of bonded fiber matrix products on exposed highly sensitive soils on steep slopes at construction sites in order to reduce erosion which may occur between the time that the exposed area is seeded and mulched and when the grass is fully established.

- Where storm water detention/water quality waivers are deemed appropriate for development projects with proposed land disturbing activities, require conditions as necessary to avoid adverse impacts to downstream properties.

- Require reports to demonstrate adequacy of E&S measures to protect downstream properties.

- Enhance water quality controls and best management practices to maintain good ecological health in the County's streams by enhancing current practice in a variety of ways detailed in this recommendation.

- Amend the current language of the Public Facilities Manual regarding definitions of terms and requirements for adequate outfall analysis; to give the Director of DPWES discretion regarding additional measures where there will be discharge into an inadequate channel; to better define the design procedure for pipe outlets; and to allow consideration of the recent Virginia Dept. of Conservation and Recreation proposal pertaining to hydrologic stormwater design.

- Modify requirements and procedures as they relate to the consideration of stormwater management during the zoning process to include amending submission requirements for residential zoning applications regarding adequate outfall; to provide for more direct DPWES involvement in the zoning process for residential applications; to seek commitments for SWM facility sizes.

Most of these recommendations have been implemented or addressed. The Land Development Services, Department of Public Works and Environmental Services, is tracking the status and disposition of specific recommendations.

2.3.9 Low Impact Development (LID) As a Watershed Management Tool

Two letters on the use of BMPs were sent to all architects, builders, developers, engineers, and surveyors practicing in the county, one in 2001, the other in 2002. These letters were an initial step in adopting and encouraging the use of LID techniques for improving water quality in the county. Procedures for requests to use innovative BMPs in Fairfax County were defined in a letter dated October 2, 2001. This letter detailed the application procedure, discussed the general design standards and application conditions, provided a list of innovative BMPs, and included an Innovative BMP Tracking Form. The second letter, *Innovative BMPs – 3.07 Enhanced Extended Detention Dry Ponds Now Acceptable for Public Maintenance in Residential Areas and on Governmental Sites*, was sent on May 14, 2002. This document provides a comprehensive overview of the application of LID in Fairfax County (see http://www.fairfaxcounty.gov/dpwes/watersheds/rpr/rpr_k-n.pdf).

2.3.10 The Role of Regional Ponds in Fairfax County's Watershed Management

On January 28, 2002, the Board of Supervisors directed county staff to form a multi-agency committee to develop a unified position on the use of regional ponds and other kinds of storm-water controls as watershed management tools. During 2003, the Regional Pond Subcommittee provided recommendations regarding the use of regional ponds and other innovative and nonstructural techniques as part of watershed management. The focus of the effort was to evaluate, deliberately and comprehensively, the potential benefits of modifying watershed management practices, policies, and regulations. A comprehensive list of issues was organized into the following ten categories: ecology; economics; local, state, and federal permits; regulations and policies; hydrology and design; land use and watershed management; parks and recreation; health and safety; aesthetics; construction planning and phasing; and public participation, outreach, and support. Representatives of business, industry, and the public were asked to review and comment on this process.

After much deliberation, research, and consultation with the public and stakeholders, the Subcommittee identified 61 recommendations to improve Fairfax County's stormwater management program and to clarify the role of regional ponds in that program. The general consensus was that regional ponds play a role in the county's stormwater management program, but that they should be designed to address several ecological, economic, and social concerns and should work in concert with better site designs and LID practices. The Subcommittee is coordinating the development of an implementation plan for all recommendations, including a time line and assignments. Several of the recommendations address the need to modify the county's Public Facilities Manual (PFM), stormwater policies, codes, and ordinances (see http://www.fairfaxcounty.gov/dpwes/stormwater/).

2.3.11 Perennial Stream Mapping Project

A project to identify perennial streams was initiated in September of 2001 in response to the Fairfax County Board of Supervisors' direction implementing an Environmental Quality Advisory Council (EQAC) resolution concerning mapping and protecting additional stream segments within the county under the Chesapeake Bay Preservation Ordinance (BPO). A perennial stream is a flowing system that is continuously recharged by groundwater or surface runoff, regardless of weather conditions. Under the Virginia Chesapeake Bay Preservation Act (CBPA), areas designated as RPAs include tidal wetlands, non-tidal wetlands connected by surface flow to tidal wetlands or tributary streams, tidal shores, tributary streambeds (not owned by the Commonwealth of Virginia), and stream buffer areas 100 feet in width. Resource Management Areas (RMAs) include land that has a potential for causing degradation of water quality or of an RPA if it is not used properly. RPAs are defined by the regulation; RMAs are determined by local discretion. Amendments to Chapter 118 of the county's BPO changed the definition of an RPA from "tributary streams" to "water bodies with perennial flow." These amendments included a requirement to identify water bodies with perennial flow by using a scientifically valid method to conduct site-specific surveys. Perennial stream protocols were developed by the county and approved by the state; the county then embarked on a survey of the headwater reaches of streams to designate perennial streams upstream of existing RPAs. The Board of Supervisors adopted the results of the survey as amendments to the county's BPO in November 2003. This extensive perennial stream survey identified an additional 330 miles of perennial streams, a 52% increase (from 638 to 968 miles). This increase in stream miles established 17.06 square miles (or 10,921.57 acres) of new RPAs in the county, an increase of 31% (from 55.3 to 72.3 square miles, http://www.fairfaxcounty.gov/dpwes/stormwater/).

2.3.12 Stream Water Quality Report

The Fairfax County Health Department monitors stream water quality at 84 sampling sites throughout the county (http://www.fairfaxcounty.gov/hd/strannualrpt.htm). The program was introduced at the Fairfax Fair in June 1989 in response to EQAC's recommendations to promote citizens' awareness of the potential hazards of recreational usage of streams and to provide the Health Department with citizen surveillance and reporting of possible pollution problems. The program was awarded the National Association of Counties 1991 Achievement Award and the Virginia Municipal League's 1991 award for Environmental Quality. Seven monitoring sites are shown in Figure 2-2. Site 12-04 is located on Tripps Run. Sites 12-15 and 12-05 are located on Upper Holmes Run. Site 12-07 is located on Lower Holmes Run. Site 12-12 is located on Turkeycock Run, and sites 12-14 and 12-13 are located at the confluence on the Cameron Run mainstem. No samples were taken at site 12-15 in 2002. In 2002, these sites were sampled for fecal coliform, dissolved oxygen, nitrate nitrogen, pH, total phosphorous, and temperature. These parameters indicate the amount of pollution contributed from manmade sources and help to evaluate the quality of the aquatic environment.

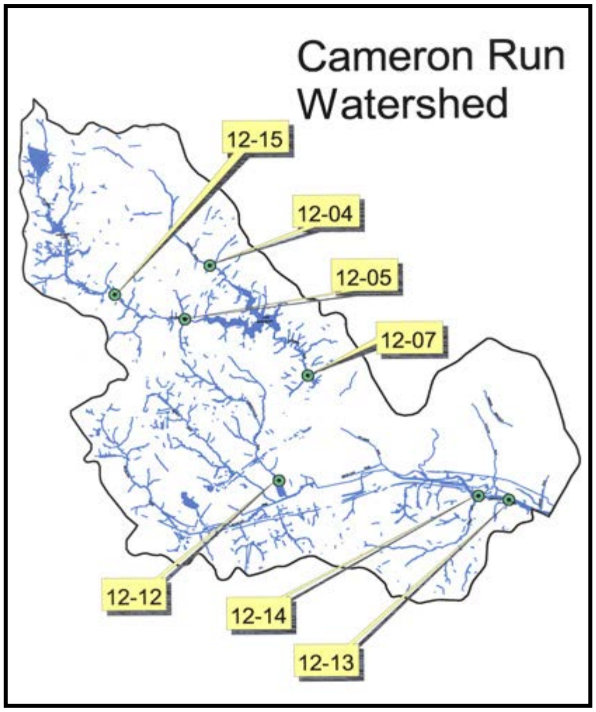


Figure 2-2. Water quality sampling sites located in the Cameron Run watershed

Water quality standards include standards for concentrations of fecal coliform bacteria. These "indicator organisms," although not necessarily harmful themselves, are found in the intestinal tracts of warm-blooded animals, including humans, and can indicate fecal contamination and the possible presence of pathogenic organisms. In surface waters, fecal coliform bacteria should not exceed a geometric mean of 200 fecal coliform bacteria per 100 ml of water. Table 2-1 shows the results of fecal coliform sampling. For each sampling site, more than 70% of the samples had fecal coliform counts greater than 200/100ml.

Table 2-1. Fecal coliform (F.C./100ml)			
Sample Station	**Total Samples Collected**	**Number of Samples with <200/100ml**	**Number of Samples with >200/100ml**
12-04	12	3	9
12-05	12	1	11
12-07	13	2	11
12-12	18	3	15
12-13	16	2	14
12-14	18	3	15

The presence of dissolved oxygen (DO) in water is essential for aquatic life, and the structure of the aquatic community depends to a large extent on the concentration of dissolved oxygen available in the water. Dissolved oxygen standards are established to ensure the growth and propagation of aquatic ecosystems. The minimum standard for dissolved oxygen is 4.0 mg/l. The average dissolved oxygen for each site in the Cameron Run watershed was above the minimum standard. Sampling sites 12-04 and 12-13 exhibited 14.3 and 23.8 percent of samples with less than 4.0 mg/l respectively (Table 2-2).

Table 2-2. Dissolved oxygen (mg/l)			
Sample Station	**Total Samples Collected**	**Average Dissolved Oxygen**	**Percentage of Samples less than 4.0 mg/l**
12-04	14	7.5	14.3
12-05	14	7.7	0
12-07	15	8.2	0
12-12	21	9.1	0
12-13	21	6.9	23.8
12-14	21	8.4	0

Nitrate nitrogen is usually the most prevalent form of nitrogen in water because it is the end product of the aerobic decomposition of organic nitrogen. Nitrate from natural sources is attributed to the oxidation of nitrogen in the air by bacteria and to the decomposition of organic material in the soil. Nitrate concentrations can range from a few tenths of a milligram to several hundred milligrams per liter. In unpolluted water, nitrate seldom exceeds 10 mg/l. Nitrate is a major component of human and animal wastes, and abnormally high concentrations suggest pollution from these sources. Table 2-3 shows the average nitrate nitrogen values at the sampling sites.

Sample Station	Average Nitrate Nitrogen (mg/l)	Average pH	Average Total Phosphorus (mg/l)
12-04	1.0	7.0	0.1
12-05	0.5	7.2	0.1
12-07	0.6	7.0	0.1
12-12	0.5	6.8	0.1
12-13	0.4	6.8	0.1
12-14	0.6	7.1	0.1

Table 2-3. Average nitrate nitrogen (mg/l), pH, and total phosphorus (mg/l)

Stream pH is an important factor in aquatic systems. Biological productivity, stream diversity, metal solubility, the toxicity of certain chemicals, and important chemical and biological activity are strongly related to pH. The pH range of 6.0 to 8.5 generally provides adequate protection for aquatic life and for recreational use of streams. Average pH values for all of the sampling sites were within the range for aquatic life (Table 2-3).

Phosphorus is found naturally in water in the form of various types of phosphates. Phosphorus is essential to the growth of organisms and can be the nutrient that limits the growth that a body of water can support. There is no established limit for total phosphorus content in stream water. Significant increases in total phosphorus may indicate increasing amounts of contaminants entering the stream. The average total phosphorus values for each site are shown in Table 2-3.

2.3.13 Annual Report on the Environment

The *Annual Report on the Environment*, which is an update on the condition of the county's environment, serves a threefold purpose. First, it is intended to assist the Board of Supervisors in evaluating ongoing environmental programs and to provide the basis for proposing new programs. The document also aids public agencies in coordinating programs to jointly address environmental issues. In addition, the report is directed to citizens who are concerned with environmental issues. The report contains chapters on major environmental topics including water resources; air quality; ecological resources; wildlife management; solid waste; hazardous materials; noise, light, and visual pollution; and land use and transportation. Each chapter discusses environmental issues, summarizes relevant data, and identifies applicable government programs. Discussions of legislative issues are provided, where relevant. Most of the chapters conclude with recommendations that identify additional actions that EQAC believes are necessary to address environmental issues. Annual reports from 2001 through 2006 are available on the county's website (see http://www.fairfaxcounty.gov/dpz/eqac/report/).

2.3.14 Fairfax County Park Authority Natural Resource Management Plan, 2004 – 2008

The purpose of this document is to coordinate efforts to achieve the Fairfax County Park Authority's (FCPA) vision for preserving resources. The plan creates a systemwide approach necessary to achieve the Park Authority's goals (http://www.fairfaxcounty.gov/parks/ nrmp.htm). The plan contains seven elements: Natural Resource Management Planning, Vegetation, Wildlife, Water Resources, Air Quality, Human Impact on Parklands, and Education. Each of these elements includes a background section to introduce the topic, as well as the plan's issues and strategies.

FCPA is the county's largest landowner. FCPA's lands represent 8.6% of Fairfax County's total land area of 262,400 acres. Combined with other public parks in Fairfax County, FCPA's holdings represent more than 15% of the county's landmass. Key recommendations of this plan include the following:

- Conduct an inventory of existing vegetative communities, including plants that are designated as threatened, endangered, or of special concern at the federal, state, or local level.

- Develop an FCPA policy to address the planting and cultivation of native plants, and the removal of invasive plants on parkland.

- Assess stream valleys within parks at stormwater outflows to identify sites where corrective actions are needed most urgently.

2.3.15 Fairfax County 2001 Stream Protection Strategy Baseline Study

This study rated four components of stream/watershed condition including benthic macro-invertebrate community integrity, vegetation and instream features, fish taxonomy richness, and percent impervious cover. The 2001 SPS Baseline Study established three broad management categories, Watershed Protection, Watershed Restoration Level I, and Watershed Restoration Level II, for future watershed protection and restoration efforts, based primarily on overall stream rankings of biological quality and projected development. Subwatersheds that fall into the Watershed Protection category tend to be areas of low-density development with biological communities that are relatively healthy. The primary goal of this category is to preserve biological integrity by taking active measures to identify and protect, as much as possible, the conditions responsible for the current high quality rating of these streams. The primary goal of the Watershed Restoration Level I category is to re-establish healthy biological communities by taking active measures to identify and remedy causes of stream degradation, both broad-scale and site-specific. These watersheds generally have fair biological conditions and are in areas of substantial and continuing development, but still hold potential for significant enhancement of stream quality. High development density, significantly degraded instream habitat conditions, and substantially impacted biological communities generally characterize subwatersheds in the Watershed Restoration Level II category. The primary goal for this category is to maintain areas to prevent further degradation and to take active measures to improve water quality.

The study showed that the Cameron Run watershed has substantially degraded biological and habitat integrity (Fairfax County 2001). The Cameron Run watershed was classified as a Watershed Restoration II Area. A summary of 2001 SPS Baseline Study data for Cameron Run watershed is shown in Table 2-4.

Table 2-4. Summary of 2001 SPS Baseline Study data for Cameron Run watershed							
	Tripps Run	**Holmes Run Upper**	**Holmes Run Lower**	**Turkeycock Run**	**Indian Run**	**Backlick Run**	**Pike Branch**
Condition Rating	Very Poor	Very Poor	Very Poor	Poor	Very Poor	Very Poor	Very Poor
Index of Biotic Integrity Score	Very Poor	Very Poor	Fair	Very Poor	Fair	Poor	Fair
Habitat Score	Very Poor	Poor	Very Poor	Fair	Poor	Very Poor	Very Poor
Fish Taxa Richness	Very Low	Variable	Low	Low	Very Low	Low	Very Low

2.3.16 Fairfax County Stream Physical Assessment

The SPA study provided information about the condition of habitats, specific infrastructure and problem areas, and general characteristics of streams throughout the watershed and a geomorphic classification of stream type (CH2M Hill 2004). Based on a length-weighted habitat score of 92, Cameron Run watershed is one of the poorest watersheds in the county. Approximately 6 miles of stream were categorized as having very poor habitat conditions, 23 miles as poor, 17 miles as fair, and 2 miles as good. A summary of SPA data for Cameron Run watershed is shown in Table 2-5. Analysis of the results indicates that the Cameron Run watershed has few adequate riparian buffers, with more than 40 acres of deficient buffer per 10 miles.

Table 2-5. Summary of SPA data for Cameron Run watershed							
	Tripps Run	**Holmes Run Upper**	**Holmes Run Lower**	**Turkeycock Run**	**Indian Run**	**Backlick Run**	**Pike Branch**
Inadequate Buffers (ft.)	37,850	93,950	10,300	51,615	42,850	70,485	27,450
Eroded Streambanks (ft.)	0	4,590	0	4,295	4,840	3,725	75
Stormdrain Pipes	18	124	10	36	25	2	29
Dumping Sites	0	6	0	1	0	1	1
Headcuts	0	0	0	2	0	2	0
Exposed Utilities	2	11	1	4	6	4	2
Obstructions	0	26	1	11	9	7	5
Road Crossings	25	68	3	38	29	59	13

2.4 ISSUES IN THE CAMERON RUN WATERSHED

The Advisory Committee initially identified 16 issues of concern (i.e., watershed problems) in the Cameron Run watershed. For simplicity, the 16 issues were combined into 10 broader issues (Table 2-6). These issues were the starting point for the Cameron Run Watershed Plan and were refined within the Committee and through public involvement. The sources and environmental effects associated with each issue are described in the sections below.

Table 2-6. Cameron Run watershed issues	
10 Primary Issues	**16 Component Issues**
Bank Erosion and Sedimentation	• Bank erosion including infrastructure impacts and channel instability • Sediment loading to watershed and accumulation in streams
Impervious Surfaces	• Impervious surfaces and loss of tree cover • Decreased infiltration and increased runoff
Loss of Riparian Buffer and Wetlands	• Loss or degradation of riparian buffers along streams and shorelines • Loss of wetlands in watershed
Irregular Stream Flows	• Higher peak flows • Lower low flows • Direct inflow from stormwater systems into streams
Loss of Stream Habitat and Stream Life	• Loss or degradation of habitats and biological communities
Pollution	• Discharge or runoff of toxic pollution into streams and lakes • Nutrients loading into watershed
Bacteria	• Bacteria and pathogens in streams and lakes
Flooding	• Flooding of property
Stream Channel Alteration	• Channel alteration of streams • Obstructions to flow and fish passage in streams
Trash	• Dumping and accumulation of trash in streams and lakes

2.4.1 Bank Erosion and Sedimentation


Streambank erosion at Lower Holmes Run

Streambank erosion and the transport of sediment results from the force of water flowing through a stream channel. In undeveloped landscapes, natural streams still erode and alter their course, but this process generally occurs over very long time periods or only during very heavy storms. Urbanization has magnified this erosion and channel alteration process to occur even during light storms as impervious surfaces increase the volume and frequency of stormwater flows. Excessive erosion and the transport of eroded sediment downstream affect streams in a number of ways. Physical effects include degradation of the streambank (e.g., bank erosion, slumping) and changes in the stream channel (e.g., incision or downcutting). As stormwater flows tear away the soil, excess sediment is mobilized, and the natural ability of the stream to transport and store the sediment is overwhelmed. Consequently, sediment is deposited on the bottom, filling in critical habitats for aquatic fish and invertebrates. Large gravel and sediment bars may be formed that deflect stream flow against the streambank, resulting in more erosion. This cycle of erosion degrades the streambank structure until it collapses, introducing additional sediment into the stream. This process can threaten the structural integrity of bridges, buildings, roads, sewer and water pipelines, or other human structures located nearby.

Stream channels and stream life are adapted to natural levels of sediment. Excessive amounts of sediment and particles of certain kinds and sizes (commonly fine silt and clay) disrupt the stream ecosystem. In particular, fine sediment settles into the spaces between the gravel and rock substrate. Insects and small fish need those spaces to graze algae, hide from predators, hunt prey, and shelter themselves from the faster currents above. Sediment accumulating in these spaces may bury plants and animals alive or reduce the amount of living space available for these organisms. As the native species disappear, other more tolerant species that prefer the altered habitat move in.

In addition to affecting the amount and quality of stream habitat, excess sediment can also directly impact the health of aquatic insects and fish. Many fish and insects rely on their vision to detect prey and help avoid predators. As increasing levels of suspended sediment reduce visibility through the water, organisms become less able to find food and avoid being eaten. Fish and many kinds of insects breathe underwater by using gills to gather dissolved oxygen from the water. Gills are sensitive organs, and suspended sediment can clog them, making it harder for the organism to breathe. These organisms are also subject to abrasion from sediment particles. Just as sand can abrade your car's windshield, it can pound and grind down the scales of fish and the shells of insects, as well as their softer, less protected body parts. These physical effects are likely to make it harder for organisms to find food, eat, and grow normally. Organisms that are not growing normally may not have the energy to fight off disease or to reproduce; thus, populations of native species dwindle or disappear from their historical numbers and ranges.

2.4.2 Impervious Surfaces

The primary effect of urbanization (the development of natural or agricultural landscapes) is to convert forests, wetlands, meadows, and farm fields into buildings and other impervious surfaces. Water cannot infiltrate these surfaces as it can natural soils. Common examples of impervious surfaces in urban areas are rooftops, driveways, roads, parking lots, and sidewalks. Compacted soils and lawns also are generally impervious.

Highly developed Seven Corners area

This shift from natural soils and vegetation to impervious surfaces drastically changes the hydrology of an area. In a natural area, only a small amount of rainfall runs off; most is absorbed into the soil. In urbanized areas, the increase in impervious area produces large amounts of stormwater runoff because infiltration is limited. As a result, runoff from the urban landscape conveys a large volume of water to streams in a short time period. The increase in the frequency and magnitude of runoff adversely affects the stability of streams, and ultimately their health.

Natural soil infiltration contributes to recharging groundwater, which helps sustain stream flow between periods of rain. Streams are especially dependant on the influx of groundwater to maintain surface flow and health during summer months. Because urban areas are largely impervious, there is little recharge of the groundwater upon which the streams depend for summer flow. Without an adequate groundwater supply, stream flows in summer may become very low or nonexistent. Such low flows reduce stream habitat available to aquatic communities and may lower water quality (e.g., the amount of dissolved oxygen in the water).

Impervious surfaces also affect stream ecology by increasing water temperature. As rainfall hits asphalt on a hot summer day, the temperature of the rainwater rises before it reaches the stream. Even small temperature changes can affect the activity and life cycles of stream organisms.

2.4.3 Loss of Riparian Buffer and Wetlands

The riparian buffer is the vegetated area along a stream where development is restricted or prohibited. The buffer's primary use is to physically protect and separate the stream from future disturbance or human encroachment. If properly designed, buffers can provide stormwater management benefits, such as reducing property damage from flooding. Additional benefits of riparian buffers include:

- separating the stream from impervious cover
- protecting the streambank from erosion
- shading and reducing stream warming
- reducing the inflow of nutrients and other pollutants to the stream
- providing habitat and migration corridors for fish and wildlife

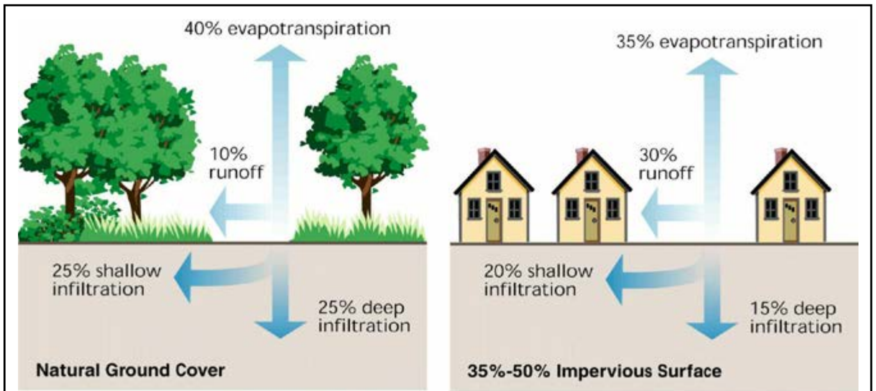
Riparian buffers may be vegetated with grass, shrubs, or forest. The more completely and densely vegetated the buffer is, the more benefits it will provide. Wetlands also act as buffers along streams. Wetlands include marshes, swamps, and bogs, and may be either forested or open. The root systems of wetland plants can hold streambanks and shorelines, while their stems and trunks can reduce erosion by absorbing the energy of the water currents. This energy would otherwise carry soil particles away from the streambank or shoreline.

Riparian buffers are critical to healthy stream ecosystems because they provide space for natural stream dynamics that is physically separated from humans and their structures. Specifically, buffers help contain floodwaters, thereby reducing risks to property and providing storage of flow that would otherwise cause erosion. Wetlands are particularly good at providing temporary storage of floodwaters. Because wetlands typically form in low-lying areas, they often are the first areas to receive water when flooding occurs. Wetland vegetation slows the movement of the floodwaters and acts as a natural sediment trap, as suspended sediment is deposited in the calm water.

Riparian buffers and wetlands can be conserved or restored to protect stream corridors, lakes, and coastal areas. Creating buffers is typically a low-cost means for meeting many stormwater management goals, improving water quality, and providing wildlife habitat. Riparian buffers and wetlands can fit into many different kinds of physical and political landscapes.

2.4.4 Irregular Stream Flows

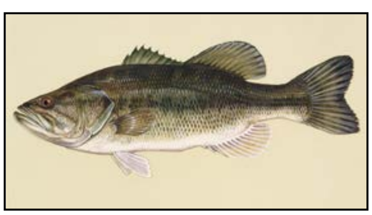
The change in landscape from a natural area to an urban area drastically changes the hydrology of a watershed, resulting in flashy streams: ones that have higher maximum and lower minimum flows. The fast flow of the stormwater downstream may result in too little water upstream to sustain aquatic habitats, while the increased amount of water downstream stresses the habitats and aquatic organisms there.



In Stream Corridor Restoration: Principles, Processes, and Practices (10/98).
By the Federal Interagency Stream Restoration Working Group (FISRWG) (15 Federal agencies of the U.S.)

In natural landscapes such as forests and wetlands, rainwater and snowmelt slowly filter into the ground. The infiltration, or absorption of water into the soil, recharges the groundwater supply. In the summer, streams depend on groundwater to prevent them from running dry. In urban areas much of the natural landscape is converted to impervious surfaces such as rooftops and roads. These impervious surfaces prevent rain and snowmelt from infiltrating the ground. Most of the rainfall and snowmelt remains above the surface, where it runs off rapidly. This runoff enters the storm drain system and eventually empties into a stream. The loss of infiltration in urban areas may reduce the amount of groundwater and cause low or nonexistent flows in the stream during the dry summer months. In addition to lower permanent or "base" flows, the large amount of impervious surface in urban areas directs large volumes of water to streams in a short period of time. The increase in the frequency and magnitude of runoff adversely affects the stability of streams, and ultimately their health.

2.4.5 Loss of Stream Habitat and Stream Life



Stream ecosystems and the plant and animal communities they sustain depend upon a wide range of physical and biological factors. Because streams collect water from their watersheds, activities that take place in the watershed can negatively affect the quality of the water entering the stream. If the stream receives poor quality water, then the organisms that live in or use the stream will be adversely affected. Stream organisms, such as fish, salamanders, and invertebrates, have adapted to natural stream conditions and depend upon these conditions for their survival. Natural stream habitats involve clean water, steady and adequate flows, and diverse structures on the bottom and banks. If one or more factors are missing, then stream organisms either will have difficulty surviving, or will not be able to survive at all.

Degradation of stream habitats and ultimately of biological communities results from the well-known list of stresses common in urban areas: bank erosion and sedimentation, irregular stream flows, loss of riparian buffer and wetlands, pollution, and stream alteration. Each of these watershed problems acts to change the natural conditions and degrade or eliminate stream habitats. In the urban setting, stream channelization that replaces natural habitat with concrete channels is the most extreme form of habitat loss. More pervasive, and probably more important, are the bank erosion, sedimentation, and irregular stream flows that result from increases in impervious throughout the watershed. By increasing the volume and frequency of stormwater runoff, impervious surfaces cause erosion and scouring in the stream. Stormwater runoff also picks up pollutants and increases in temperature as it runs across asphalt and concrete before entering the stream or lake. Because the rapid runoff of storm flows depletes groundwater, stream flows in summer may be very small or nonexistent. Obviously, without water, aquatic organisms cannot live.

2.4.6 Pollution

Streams and lakes collect the water that falls as precipitation and flows over and through the land surfaces of the watershed. In urban watersheds, the quality of the water in streams is determined by the pollutants carried in stormwater as it runs off the land and its impervious surfaces. The amounts and kinds of pollutants carried in stormwater reflect the activities occurring within the watershed. Common household activities that affect water quality include automobile maintenance (washing your car and changing the oil), lawn care, and walking your pet. Pollutants generated by these activities wash off the surface into the stormdrain system and end up, untreated, in our streams and lakes.

Outdoor car washing has the potential to contribute a high load of nutrients, metals, and hydrocarbons to the water body. The detergent-rich water used to wash dirty cars flows down the street and into the storm drain to be discharged into the stream. More than 50% of households wash their own cars.

Automobile maintenance generates significant amounts of hydrocarbons, trace metals, and other pollutants that can reach stormwater. Kinds of waste include solvents (paints and paint thinners), antifreeze, brake fluid, batteries, motor oils, fuels, and lubricating grease. Dumping automotive fluids down storm drains is the same as dumping them into the stream.

Lawn care often includes the application of fertilizers and pesticides. Excess fertilizers and pesticides applied to lawns and gardens wash off and pollute streams. Fertilizers contribute a significant amount of phosphorus and nitrogen to water bodies. Even very low levels of insecticides and certain herbicides can be harmful to aquatic life. The major source of pesticides in urban streams is home applications used to kill insects and weeds in the lawn and garden.

Pet waste can be a major source of bacteria and excess nutrients in water bodies. Failure to clean up after your dog can cause water quality problems. A single gram of dog feces can contain 23 million fecal coliform bacteria.

The runoff of nutrients into a waterbody can cause eutrophication (i.e., the proliferation of algae and aquatic weeds that ultimately die and consume dissolved oxygen from the water). The result can be oxygen shortages that cause fish kills. Eutrophication can significantly reduce aquatic biodiversity and interfere with use of the water for fisheries, recreation, industry, agriculture, and drinking. The runoff of toxic chemicals, such as pesticides, can kill small aquatic organisms (such as worms, crustaceans, and insect larvae) or build up in the bodies of larger animals that eat them. When toxic chemicals "bioaccumulate" in fish, ducks, and other food sources, they pose a threat to human health.

2.4.7 Bacteria

Bacteria are single-celled organisms that can cause diseases. High bacteria counts often lead to beach closures during the summer. Bacteria can pollute streams and lakes, making them unsafe for contact and recreation. Fecal coliform, a kind of bacteria, are typically found within the digestive systems of warm-blooded animals. Fecal coliform in water is an indicator that disease-carrying bacteria may be present; therefore, streams are regularly monitored for the presence of bacteria to avoid risks to public health. During storms, fecal coliform are washed off the land into rivers, streams, lakes, or groundwater. Sources of fecal coliform include leaking sewer lines, failing septic systems, coliform-laden sediment in stormdrain pipes, livestock, wildlife, waterfowl, and pets.

2.4.8 Flooding

Floods are natural events that occur when rainfall exceeds the capacity of the streambanks at a given location. In a natural area, rainfall is absorbed by the surrounding vegetation and soil. During the heaviest rains, the floodplain adjacent to the stream stores the excess flow. In urban areas, much of the natural soil and vegetation has been replaced with impervious surfaces in the forms of structures and compacted soils. When rainfall hits an impervious surface, it cannot be absorbed, so it flows downhill toward a waterbody. Curbs and gutters, stormwater drainage pipes, ditches, catch basins, and other drainage systems are designed to convey stormwater directly into receiving waters.

If the amount of rain and flow from upstream exceeds the capacity of the stormwater conveyance system, it overflows, leading to flooding in streets, basements, and backyards. During such flooding, streams may overtop their banks, drainage systems may back up (especially if they are blocked by trash or debris), and sewers may overflow. Human alterations of the landscape in urban areas result in increased frequency and severity of floods. Urban areas typically have few natural floodplains, high-density development, and more paved areas such as roads and rooftops.

Channelized streams generally are wider and straighter than natural stream channels, and they are disconnected from the floodplain. Floodwaters that normally soak into floodplain soils and recharge groundwater are rapidly exported downstream in channelized streams. Because there is less groundwater, stream flows in the summer may be low or nonexistent. Such low flows not only limit habitat for aquatic communities but may also stress or deplete the vegetation that grows alongside the stream.

Natural streams are adapted to the frequency and severity of flooding in undeveloped landscapes. Floods naturally rearrange streambed habitats, uproot aquatic or riparian plants, and increase the drift of aquatic insects. Adaptations of stream inhabitants include sheltering behind rocks or snags, burrowing into the streambed and banks, moving to slower water along the stream's edges and in backwaters, or by having life cycles that are terrestrial or aerial during flood-prone seasons. The more frequent and severe flooding that occurs in developed areas often exceeds the ability of aquatic organisms to survive. Floods also act as a cue for spawning or migration in some fish. When floods occur during the wrong season, spawning may fail, and fish populations can crash.

2.4.9 Stream Channel Alteration

Historically, the reasons for channelizing river systems have included flood control, wetland drainage, erosion prevention, and navigation improvement. In urban environments, channels are usually altered to drain wetland areas and move water away from buildings and infrastructure. These alterations generally produce wide, straight channels with steep streambanks that are disconnected from the floodplain.

Several methods are used to channelize rivers and streams. One method, called re-sectioning, makes rivers wider or deeper to contain water that naturally would spread onto the floodplain. In addition, the slope of the streambank may be altered to increase the volume of water the channel can hold, which helps to accommodate the increased stormwater runoff from urban developments. Another method, realignment, involves straightening a river's channel. Straightening shortens the channel and results in a faster flow downstream. This faster flow removes potentially flood-level flows from one area, but transmits them downstream, where the frequency of flooding may increase.

The banks of altered channels often need to be stabilized to enable them to withstand the erosive forces of the large volumes of water and strong flow in the new channel. Bank stabilization involves protecting streambanks with various materials. Riprap, consisting of large broken rocks piled against the bank, is commonly used reduce the erosive force of water in drainage channels and on steep banks. Gabion baskets, another method of bank stabilization, are wire mesh containers filled with tightly packed rocks. In addition, concrete, vegetation, wood, or other structural materials can be used to protect against erosion.


Channelized section of Tripps Run

Streams that have been channelized offer many fewer habitats for communities of aquatic plants and animal. Habitat diversity is important because organisms use the distinct resources in different habitats to meet their complex life-cycle needs. For example, alternating riffle-pool habitats are important to fish species, because they provide areas for feeding, breeding, and shelter.

2.4.10 Trash

Improper disposal of trash is evident across the landscape. Single littering events accumulate into large "trash areas" when litter is washed into streams and lakes. Trash enters the stream environment from a number of sources, including inadequately treated wastewater, recreation activities, littering, and dumping. During a storm, trash from all sources is carried through the stormwater conveyance system to the local stream.


Trash skimmer on Tripps Run before it enters Lake Barcroft

Illegal dumping to avoid disposal fees at landfills or recycling facilities often occurs in or near streams. Illegal dumping occurs in all settings in all geographic regions but is especially common near abandoned industrial, commercial, or residential buildings; vacant lots; and poorly lit areas such as rural roads and railway lines. The effects of illegal dumping may be more pronounced in areas with heavy rainfall (i.e., where there is a greater volume of runoff). In urban areas, illegal dumping may result from the inaccessibility of recycling centers or solid-waste disposal facilities, which often are located on the suburban-rural fringe.

Dumping sites may contain a wide variety of kinds of trash, depending on how long the site has been used. Manmade materials that float or are suspended in water are especially apparent. These include plastic bags, six-pack rings, bottles, yard waste, and cigarette butts. Once in the stream, the trash can choke, suffocate, or disable aquatic animals such as ducks, fish, turtles, and birds. It also degrades the aesthetic quality of a stream valley or lake, and limits the enjoyment and recreational experience of the community. Collection and disposal of the trash is a burden on the community.

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