Annual Report on Fairfax County's Streams

October 2006

Prepared by:

Stormwater Planning Division
Department of Public Works and Environmental Services

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http://www.fairfaxcounty.gov/dpwes/stormwater/streams/assessment.htm

http://www.fairfaxcounty.gov/dpwes/stormwater/resources.htm

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Executive Summary

This Annual Report on Fairfax County's Streams presents a summary of water quality data and an assessment of current stream conditions and trends countywide. Several data sources were used to prepare this report, including monitoring data collected by staff of the Department of Public Works and Environmental Services (DPWES), the Virginia Department of Environmental Quality (VDEQ), and volunteer monitors with the Northern Virginia Soil and Water Conservation District and the Audubon Naturalist Society. This report documents overall stream conditions based on the abundance and diversity of fish and benthic macroinvertebrate (aquatic insect) communities. In addition, the potential human health risk associated with wading or swimming in streams is assessed based on fecal-associated bacteria.

The monitoring program is intended to serve the needs of the stormwater management program and to support various initiatives, including the Board of Supervisors' *Environmental Excellence for Fairfax County; a 20-year Vision* (Environmental Agenda), by providing a comprehensive analysis of stream conditions throughout the county, while simultaneously addressing requirements and/or needs set forth in local, state, and federal regulations, including the:

- Chesapeake Bay 2000 Agreement Initiative – Virginia's Tributary Strategies.
- Municipal Separate Storm Sewer System (MS4) Permit for Fairfax County - under the Virginia Pollutant Discharge Elimination System (VPDES) established by the Clean Water Act and administered by the Virginia DCR.
- Total Maximum Daily Load allocations (TMDLs) established by the VDEQ

Results

Bacteria Monitoring: As recommended by the EPA and the Virginia Department of Environmental Quality (VDEQ), Fairfax County completed its two-year transition in 2005 to using *E. coli* instead of fecal coliform as the indicator of possible fecal contamination in stream water. Fewer sites violated the water quality standard for *E. coli* in 2005 than in the previous year (Figure E1). However, Fairfax County concurs with officials from VDEQ and the Virginia Department of Health, who caution that ***it is impossible to guarantee that any natural body of water is free of risk from disease-causing organisms or injury***.

Based on historical and ongoing bacteria monitoring data, the Fairfax County Health Department issues the following statement related to the use of streams for contact recreation:

> *"In summary, any open, unprotected body of water is subject to pollution from indiscriminate dumping of litter and waste products, sewer line breaks and contamination from runoff of pesticides, herbicides, and waste from domestic and wildlife animals. Therefore, the use of streams for*

contact recreational purposes, such as swimming, wading, etc., which could cause ingestion of stream water or possible contamination of an open wound by stream water, should be avoided."

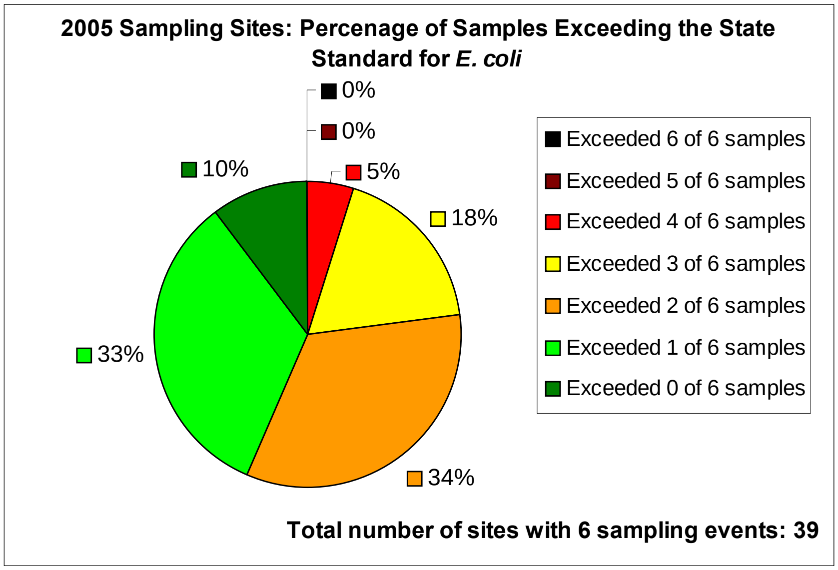


Figure E1: Percentage of sites with exceedences of the state's water quality standard for *E. coli* (235 cfu per 100mL).

Additional information related to the use of streams for contact recreation is available on the Health Department's Web site at:

www.fairfaxcounty.gov/service/hd/resourcewater.htm

Biological Monitoring: Results from the fish and benthic macroinvertebrate monitoring in 2005, by both county staff and volunteers, are similar to previous years' results. Most streams are in "fair" to "very poor" condition or "unacceptable" (Figure E2). These three lowest rating classes (as well as the "unacceptable" from the volunteer data) for the macroinvertebrate indices, generally correspond to the VDEQ "impaired waters" classification - which indicates the State's minimum water quality standards are not being met . The percentage of sites classified as "good" and "excellent" again showed a very slight decline this year. These sites typically would be considered "unimpaired" by the state's aquatic life use standard. In 2005, more sites were found to be in better condition with respect to fish communities. However, strong conclusions cannot be drawn from short-term, relatively minor changes in biological communities. Small fluctuations in countywide stream conditions are typical from one year to the next and may not constitute true trends. True and meaningful trends can be confidently inferred only after several years' data have been compiled. It can be inferred, however, that approximately three quarters of the stream ecosystems in the county are currently impacted or impaired.

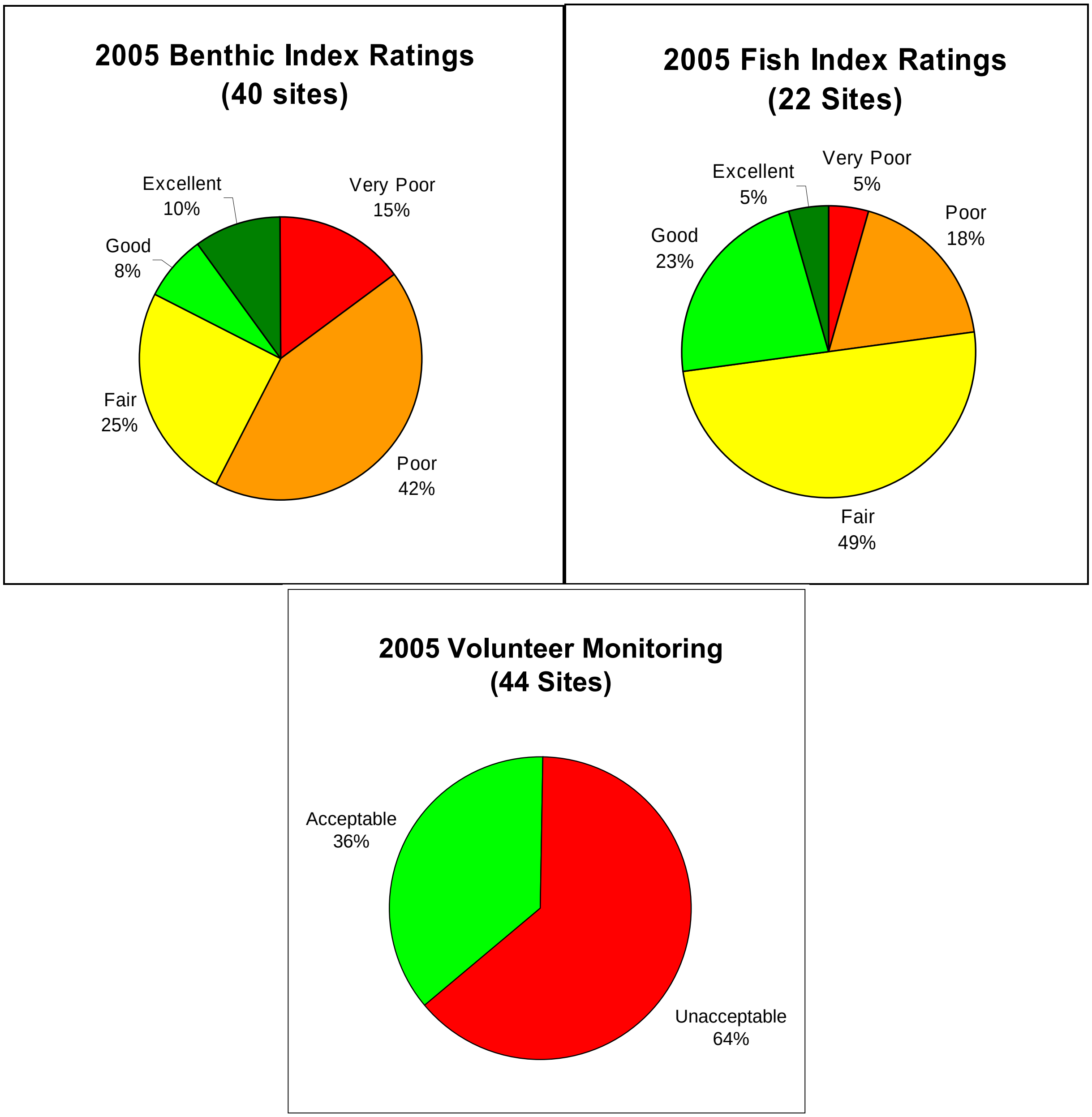


Figure E2: Ratings of 2005 biomonitoring sites based on the Fish and Benthic Index of Biotic Integrity and volunteer monitoring (benthics).

<u>Countywide Stream Quality Index:</u> A stream quality index (SQI) was developed to establish a performance measure for a key natural resource (streams) that is visible and of great interest to the public. The index, which is based on benthic macroinvertebrate data and spans a possible range from 1 to 5, suggests a small increase in overall stream quality from 2004. Nevertheless, it still is below the value for the baseline study data from 1999 (Table E1) and again, it is imprudent to make broad statements about trends on so few years' data.

Table E1: Stream quality index (SQI) values for sampling completed in 1999, 2004 and 2005.

Sampling Year	Percentage of Total Sites					Index Value
	Very Poor	Poor	Fair	Good	Excellent	
1999	11	34	32	14	9	2.76
2004	23	40	17	13	7	2.41
2005	15	43	25	8	10	2.55

Virginia DEQ list of Impaired Waters: A summary of the Virginia Department of Environmental Quality's Draft 2006 Water Quality Assessment and Impaired Waters Report is included in Section 5. VDEQ identifies streams that are in poor quality (impaired), which do not meet state water quality standards and are not suitable for their intended uses such as swimming, fishing, or aquatic life. The 2006 draft report lists 32 water bodies with a total of 101 impairments within or bordering Fairfax County. Many of these water bodies are listed for multiple impairments based on elevated levels of pollutants, high levels of contaminants in fish, or a reduced number of aquatic organisms (aquatic plants, macroinvertebrates and/or fish). The number of stream segments and overall impairments has increased significantly since the last published report in 2004. Once a water body is listed as impaired, the state (VDEQ and DCR) goes through a process to identify pollutant sources within the watershed and develops implementation plans to reduce pollutants and meet water quality standards. The implementation plans can require VPDES permittees, including the county, to implement additional stormwater controls and management practices to reduce pollutants discharging to a water body from the municipal separate stormwater sewer system.

Waters listed as impaired for aquatic life uses typically exhibit substantially suppressed ecosystems. Scores for biological integrity indices of these waters rank at or below 50% of the scores for natural (unimpaired) reference waters. This impaired condition is analogous to "very poor," "poor" and many of the "fair" streams as rated by the macroinvertebrate index used in this annual report.

Additional information on DEQ's water quality program and the 2006 report are available at:

http://www.deq.state.va.us/water/

This Annual Report, past Annual Reports (including past Health Department stream reports), appendices and protocols are available on the stream quality assessment program page located at:

http://www.fairfaxcounty.gov/dpwes/stormwater/streams/assessment.htm

1 Introduction

The *2006 Annual Report on Fairfax County's Streams* presents the results of monitoring efforts conducted throughout calendar year 2005 for biological, bacteriological, physical, and chemical stream characteristics, including:

- Bacteria levels (fecal-related)
- Benthic macroinvertebrates
- Fish communities
- Water chemistry

A small stream cascading into the floodplain of Pohick Creek

This data will be used to support watershed planning, project implementation, permit requirements, educational efforts, detection of pollution sources and more.

Previous years' data are used for comparison purposes and baseline information. Prior annual stream monitoring reports are available on Fairfax County's web site at:

http://www.fairfax.va.us/dpwes/stormwater/streams/assessment.htm

1.1 Report and Program Goals

The goal of the *Annual Report on Fairfax County's Streams* is to present the results of Fairfax County's annual stream water quality monitoring efforts. The results are used to determine the county's Stream Quality Index (SQI) - a numerical indicator ranging from 1 to 5 - of the overall health of Fairfax County's waterways. It is envisioned that future reports will serve as a central repository for information and data related to the biological, chemical and physical conditions of the county's waterways, collected through various county agencies and local organizations.

The long-term biological and bacteriological monitoring program supports the Board of Supervisor's *Environmental Excellence for Fairfax County; a 20-year Vision* (Environmental Agenda), by providing a comprehensive, ongoing analysis of stream conditions throughout the county, while simultaneously meeting or exceeding the requirements set forth in the Municipal Separate Storm Sewer System (MS4) Permit issued by the State under the Virginia Pollutant Discharge Elimination System (VPDES), pursuant to the goals and mandates of the Federal Clean Water Act.

While supporting these requirements and initiatives, the program will also develop a substantial dataset. Over time, this dataset will provide essential data to determine the overall rate of change or trends in the conditions of Fairfax County's streams, providing a basis for targeting and prioritizing implementation measures, as well as other opportunities to help restore and protect the county's streams and watersheds.

1.2 Study Area Overview

Fairfax County is located in the northeastern part of the state of Virginia, bordering the Potomac River (Figure 1). The county is bordered by Arlington County and the cities of Falls Church and Alexandria on the northeast. The Potomac River borders the county on the north and southeast. The border with Loudon County lies to the north and west, and the Bull Run/Occoquan Rivers form the southern border with Prince William County. Within the borders of Fairfax County are three incorporated towns, Vienna, Herndon and Clifton, and one city, Fairfax City. Two large federal reservations also lie within Fairfax County, Dulles International Airport, which straddles the western border with Loudon County, and Fort Belvoir, a large US Army base situated in the southeastern portion of Fairfax. Several smaller federal reservations also lie within the county's borders, CIA-Langley, a US Coast Guard Station, USGS Headquarters in Reston and Mason Neck National Wildlife Refuge. Waters on federal, state lands (including preserves and parks) are not under county authority or purview.

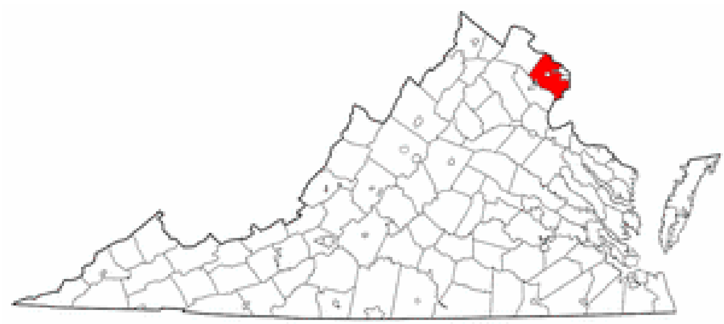


Figure 1: Location of Fairfax County in the State of Virginia.

Fairfax County today is highly urbanized and approaching ultimate build-out conditions, as envisioned in the county's Comprehensive Plan. The total land area of Fairfax County, including incorporated towns is 395 square miles. It is the most populous jurisdiction in Virginia as well the Washington D.C. metropolitan area, with the 2005 population estimated to be 1,047,500 with 387,700 households. Land use is primarily residential, with smaller areas in commercial, recreational, and open-land uses (industrial use areas are present in small pockets).

The county lies within the Chesapeake Bay Watershed. There are approximately 850 miles of stream channels with perennial streamflow draining 30 designated major watersheds (drainage basins), with 23 watersheds falling entirely within the county's borders (Figure 2). The 30 watersheds drain either to the north and east to the Potomac River, or to the south into the Bull Run/Occoquan river, which eventually outlets into the Potomac. The 30 major watersheds within the county range in size from the two square mile Turkey Run drainage to the 58 square mile Difficult Run basin. The mouths of the streams draining the far southeastern portion of the county are influenced by the tidal rhythm of the Lower Potomac.

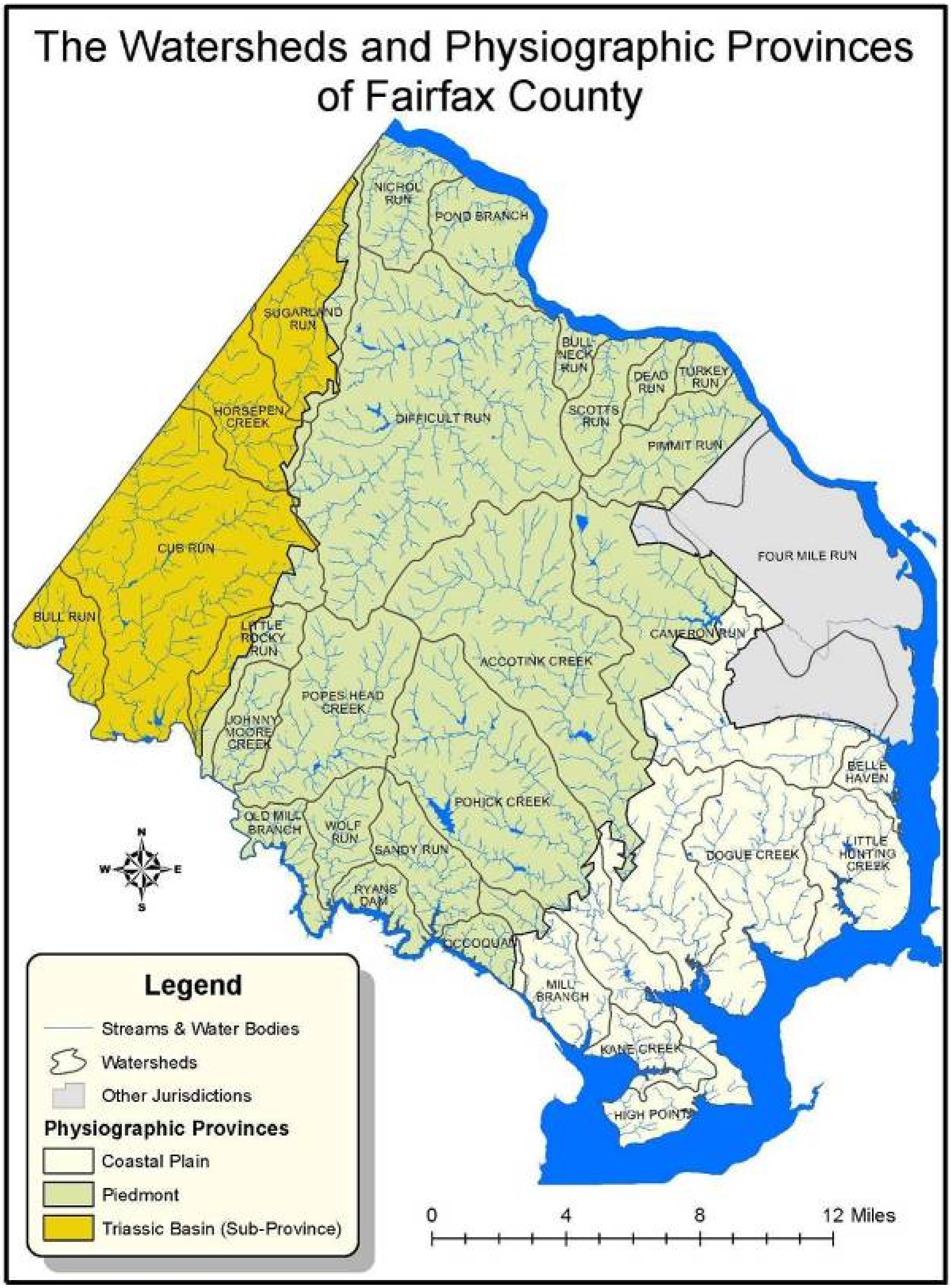


Figure 2: The 30 watersheds and two physiographic provinces in Fairfax County, Virginia.

The major lakes throughout the county are all man-made impoundments and were designed for municipal water supply, stormwater control, and/or recreational and aesthetic purposes.

The Occoquan River is impounded just upstream of where it passes under Route 123. The reservoir was created when the river was dammed in 1950, and then enlarged in 1957 by the county to provide a source of drinking water for residents within the region. In July 1982, the Fairfax County Board of Supervisors voted to restrict development on 41,000 of the 64,500 acres within Fairfax County draining to the reservoir. The resultant "down-zoning" limited the number of residences to one home per five acres in a successful effort to improve the quality of stream water draining into the drinking water reservoir.

Fairfax County at a Glance

*Total area…………………………….....400 mi^{2}**

Total land area..………………………....395 mi^{2}

Population in 2005 (estimated)…...1,047,500

Number of households ……………. 387,700

Number of incorporated towns and cities ……………………….....………. 4
Towns of Vienna, Herndon, and Clifton
Fairfax City

Number of designated watersheds …….. 30

Largest watershed …. Difficult Run, 58 mi^{2}
Smallest watershed ….. Turkey Run, 2 mi^{2}

Length of perennial streams.……. 850 miles

Physiographic Provinces (and sub-Provinces)

Piedmont land area ……..……..... 243 mi^{2}
Triassic Basin land area ………….. 69 mi^{2}
Coastal Plain land area …………… 83 mi^{2}

* mi^{2} = square miles

Fairfax County lies within two major physiographic provinces, the Coastal Plain and Piedmont (Figure 2). Physiographic provinces are areas that have common geology, surface processes, and landscape history having characteristic landforms and environments. Each province comprises areas with similar terrestrial and aquatic floral and faunal ecosystems, including certain communities which may be unique to those provinces. These provinces are the basic landscape units by which biological communities can be evaluated and compared.

The Piedmont province covers 60 percent of the county (243 mi^{2}) and is typified by gently rolling landscapes, deeply weathered bedrock/soils and a relatively low occurrence of solid outcrop. The Triassic basin, which overlies the far western portion of Fairfax County, is a subset of the larger Piedmont province and covers 17 percent of the county (69 square miles). The Triassic basin is actually the remains of a huge prehistoric lake bottom that covered portions of western Northern Virginia and Maryland. It is typically much flatter and has unique lake sediment type soils as compared to the encompassing Piedmont province.

The Coastal Plain province spans the eastern portion of the county and bounds the Piedmont along the fall line. The fall line is a low east-facing cliff paralleling the Atlantic coastline from New Jersey to the Carolinas. It marks the boundary between the hard Paleozoic metamorphic rocks of the Piedmont (to the west) from the softer, flatter Mesozoic and Tertiary sedimentary rocks of the Coastal Plain. To the west of this line, the streams are typified by greater-sloping channel bottoms and the resultant higher velocity riffle-run habitats. East of this line, in the Coastal Plain, the landscape generally has much gentler slopes, and results in water bodies dominated by lower velocity pool-and-glide habitats. Historically, this fall line presented an obstacle to further upstream navigation to early European settlers in boats and thus is the location of many major mid-Atlantic cities such as Philadelphia, Baltimore, Washington D.C., and Richmond. Interstate 95 generally traverses this geologic feature through Northern Virginia.

2 Monitoring and Sampling Methods

The fundamental principle of ecology is that everything is interrelated within an ecosystem. This principle is especially important when determining the health of a stream because the composition of the biological communities, chemistry of the water, and characteristics of the surrounding environment must all be considered. Bioassessments (evaluating biological communities to indicate overall ecosystem health) are used in concert with abiotic assessments such as habitat quality, water chemistry and contributing watershed characterizations, to reveal the overall picture of water quality and watershed health. Fairfax County's monitoring methodologies are modifications of the Environmental Protection Agency's Rapid Bioassessment Protocols (RBP) (Barbour et al. 1999). These monitoring methods and site selection criteria are fully detailed in Stormwater Planning Division's Standard Operating Procedures Manual for the Biological Stream Monitoring Program. This can be found online at:

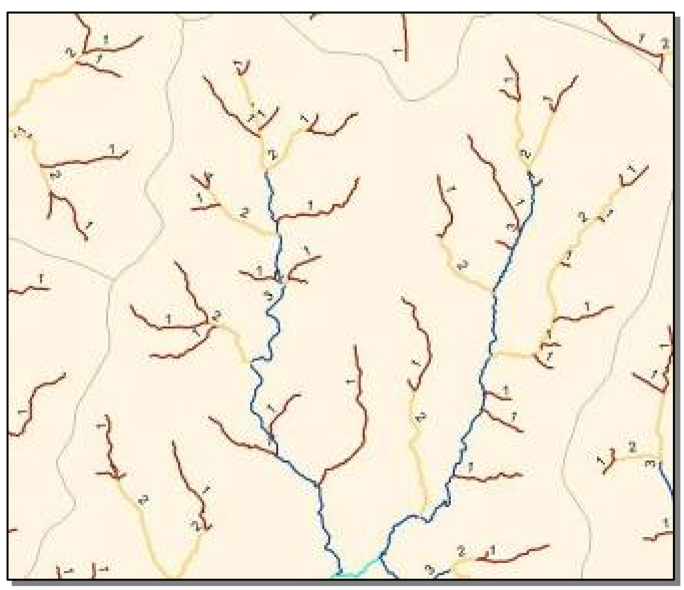
A typical piedmont stream

http://www.fairfaxcounty.gov/dpwes/stormwater/streams/assessment.htm

2.1 Site Selection

Fairfax County's monitoring sites are randomly selected using a probability-based stratification model, otherwise known as a stratified random approach, which employs two primary steps. First, streams are grouped into like classes called "strata" so that similar environments are directly compared. Secondly, sampling sites are randomly selected within each of these strata. This commonly-used approach, which also is employed by VDEQ, eliminates any site selection bias and is an accurate and cost-effective way to derive statistically defensible determinations of stream conditions on a countywide scale.

A "sampling frame" is the set of all potential sampling locations and is created using a synthetic stream layer derived from the county's Digital Elevation Model (DEM) using Geographic Information Systems (GIS). This highly accurate layer is used to stratify all streams into segments of varying lengths based on their Strahler stream order (Strahler, 1952). Stream orders range from the numerous small first order headwaters tributaries to the larger fifth order



Example of an ordered stream network in Fairfax County.

channels such as the main stem of Difficult Run. Streams with drainage areas less than 50 acres are assumed not to sustain perennial streamflow and thus are not included in the sample frame.

A two-stage site selection technique is used. Within each stratum (group of all streams of the same order), a stream segment is first selected at random. Next, a 100-meter sampling location is randomly selected within this segment, then field checked to ensure access and minimum site requirements are met. Sample reaches are allocated in a proportional manner according to the total stream length in each stratum (Table 1). In 2005, forty site locations from five strata were selected for the annual sampling campaign. A map depicting the locations of the 40 randomly-selected sites is shown in Figure 3.

Table 1: Distribution of 40 sample sites across 5 strata.

Stream Order	Total Length (miles)	Percentage of Total (%)	Number of Sampling Locations in the County
1	526.5	52.9	20
2	221.8	22.3	9
3	144.1	14.5	6
4	85.4	8.6	4
5	17.0	1.7	1

Pohick Creek – 4th Order Stream.

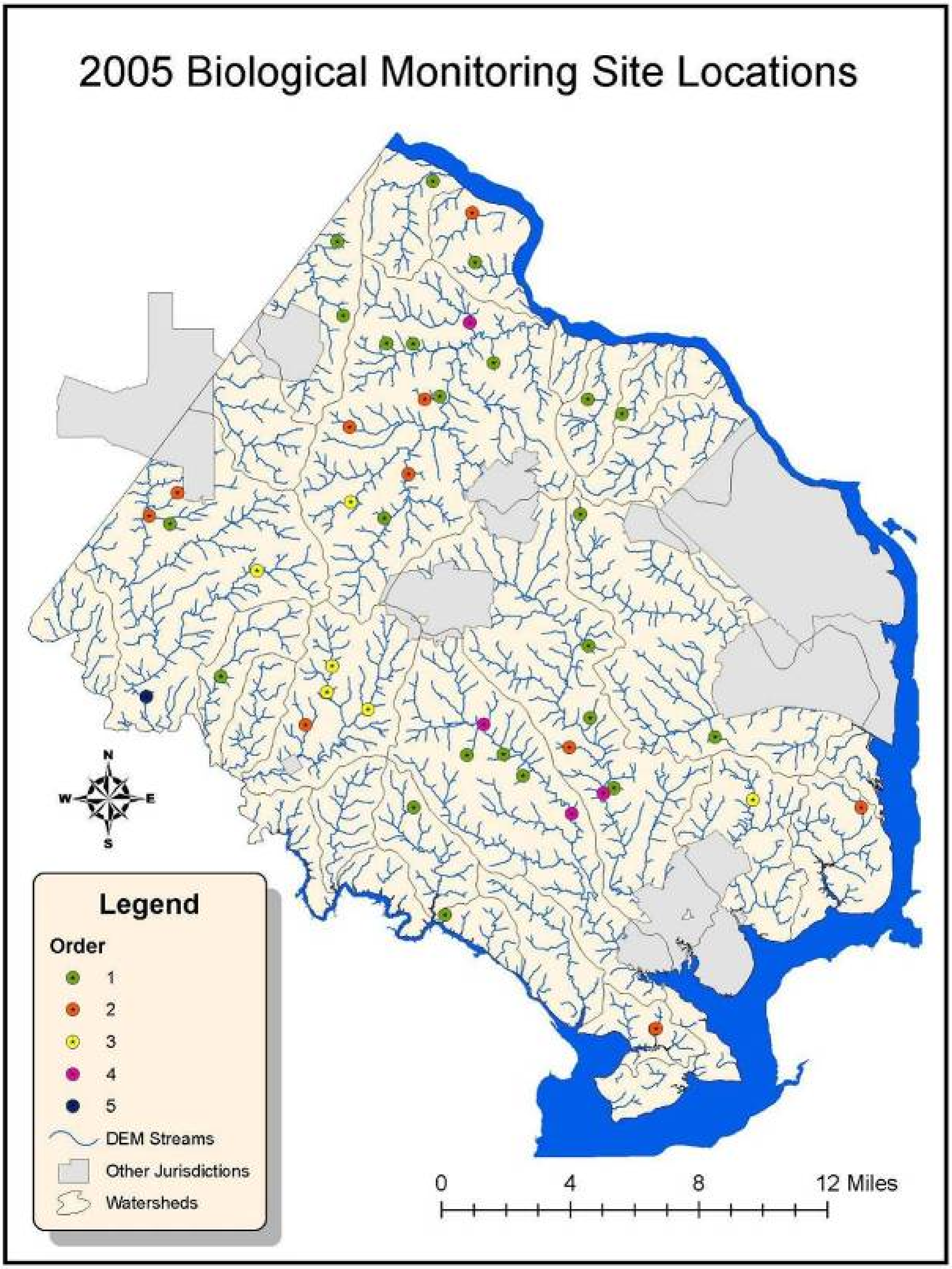


Figure 3: Locations of randomly-selected monitoring sites (biological and bacteriological) for 2005 sample year.

2.2 Bacteria and Water Chemistry

Escherichia coli (*E. coli*) is a type of bacteria commonly used as a water quality indicator because it is found in the intestines and waste of warm blooded animals. Alone, this bacterium in surface waters is generally not harmful to humans, and may exhibit broad natural variability in abundance. However, it may indicate the possible presence of pathogenic (disease-causing) bacteria and viruses. The level of *E. coli* in streams is used by localities to determine if primary recreational contact, such as swimming, fishing and boating, is safe in local and state waterways.

Collecting water samples

To determine the concentration of *E. coli* in streams and to continually screen for possible sewage contaminations, bacteria sampling is conducted at the randomly-selected biological monitoring locations throughout the county. Grab samples of stream water are collected twice each season, starting in the spring. Water chemistry parameters also are measured including nitrate and total phosphorous concentrations, pH, specific conductance, dissolved oxygen along with water temperature. The sampling program was initiated in 1969 by the Fairfax County Health Department (then known as the Department of Health's Division of Environmental Health) to monitor the water quality of the streams in the county. The Stormwater Planning Division assumed the program 2003 in an effort to consolidate stream sampling efforts.

E. coli, nitrate and total phosphorous samples are processed at the Fairfax County Health Department Laboratory, using the Colilert® Quanti Tray/2000 by Idexx and Skalar San++ Analyzer, respectively. The remaining chemical parameters are recorded in the field using a hand-held YSI meter.

2.3 Benthic Macroinvertebrates

Benthic macroinvertebrates are aquatic organisms found living on the bottom of the streambed (benthic), are visible without the use of a microscope (macro), and do not have a backbone (invertebrate). Benthic macroinvertebrates include aquatic snails, water mites, worms, leeches, crustaceans, and insects. In fact, the majority of them are aquatic insects or the larval forms of many common terrestrial insects such as black flies, mayflies, dragonflies, crane flies, stoneflies, beetles, waterbugs, and others.

A stonefly larvae

Benthic macroinvertebrates are diverse organisms with varying tolerances for toxic, nutrient, and sediment pollution, making them well suited as indicators for determining stream health and water quality. The benthic macroinvertebrates also play a critical role in the aquatic food web, by forming the core diet of many stream fishes and amphibians, as well as playing an essential role in many stream functions and processes. As such, they are excellent indicators of the health and integrity of the stream ecosystem and can help reveal specific stressors on the system (if present).

Benthic samples are collected every spring, between mid-March and mid-April, using the "20-jab" multi-habitat sampling technique. This method involves taking 20 separate "jabs" or collections from different habitat types, such as: undercut banks, aquatic vegetation, riffles and snags. Preserved samples are taken to a county laboratory where the macroinvertebrates are separated from vegetative and inorganic debris and identified to the genus taxonomic level with the aid of microscopes.

Collecting a benthic sample using the 20-Jab method

A multi-metric index is used to categorize the condition of the benthic community. This index employs the numerical combination of several individual metrics based on the tolerance, community composition, habit type, and trophic (feeding) structure of the sample. Each metric is scored and then combined into the overall index score called the Index of Biotic Integrity (IBI). Separate indices are used for the Piedmont samples and Coastal Plain samples, as the benthic communities found in each region are markedly different. The Coastal Plain index consists of five separate metrics, while the Piedmont index is composed of ten metrics. The ultimate ratings compare sites to a reference or "least disturbed" condition which then allows them to be categorized as "excellent," "good," "fair," "poor" and "very poor". Details on the index can be found in the Fairfax County Stream Protection Strategy Baseline Study Appendix or the current Standard Operating Procedures manual (see section 6).

2.4 Fish Community

A balanced and diverse fish community is indicative of good stream health.

Collecting a fish sample using the electro-fisher (upper right)

Fish are very sensitive to both natural and human-induced changes within a given stream system and its surrounding watershed.

A backpack electro-fisher unit is used to send electricity into the water, stunning the fish momentarily, allowing for easy collection with a net. Once collected, the fish are identified to the species taxonomic level, counted to track their respective populations within each sampled reach, then released. Any unusual appearance or anomalies on the fish, such as fin and eye deformations, hemorrhages, parasites and/or tumors also are recorded. The fish are then released back into the water.

A multi-metric index called the Fish Index of Biotic Integrity (F-IBI) is used to categorize the condition of the fish community for each site. This index employs the numerical combination of several individual metrics based on the tolerance, trophic (feeding) structure, or diversity of the sample. Each metric is scored and then combined into the overall index score. Separate indices are used for the Piedmont samples and Coastal Plain samples, as the fish communities found in each region are markedly different. The Coastal Plain index consists of five separate metrics, while the Piedmont index is composed of 10 metrics. The ultimate ratings compare sites to a reference or "least disturbed" condition which then allows them to be categorized as "excellent", "good", "fair," "poor" and "very poor." Details on the index can be found in the 2005 Annual Report on Fairfax County's Streams and in the Standard Operating Procedures manual (see references section).

2.5 Volunteer Monitoring

Two volunteer stream monitoring programs are coordinated independently by the Audubon Naturalist Society (ANS) and Northern Virginia Soil and Water Conservation District (NVSWCD). Volunteers monitor targeted stream sites for habitat quality, water chemistry and benthic macroinvertebrate community composition, usually once each season.


Volunteer monitors inspecting a kick-net seine sample

Benthic macroinvertebrate samples are collected using kick-net sampling techniques, in riffle and pool habitats. Samples are processed in the field and benthic macroinvertebrates are identified to the order (NVSWCD) and family (ANS) taxonomic levels.

Turbidity and nitrate/nitrite water quality parameters are measured at the time of the sample. The physical condition of the stream is also visually assessed for substrate composition, embeddedness, turbidity, bank cover, canopy cover and other features.

Volunteer data is being used to supplement county collected data in evaluating general trends and identifying areas in need of more monitoring. In working together with volunteer monitoring organizations, such as ANS and NVSWCD, the county effectively doubles the number of sites it monitors in a given year. Although these taxonomic identifications are not as high resolution as the county's, they greatly augment the stream monitoring efforts of the county. Volunteer data is collected and evaluated using the modified Virginia Save Our Streams (VASOS) protocols (see references) and rated "acceptable" or "unacceptable." The rating of acceptable corresponds well with the county's "excellent" and "good" ratings, while the "unacceptable" generally corresponds to the county's ratings of "fair," "poor" and "very poor".

2.6 Project Specific Monitoring

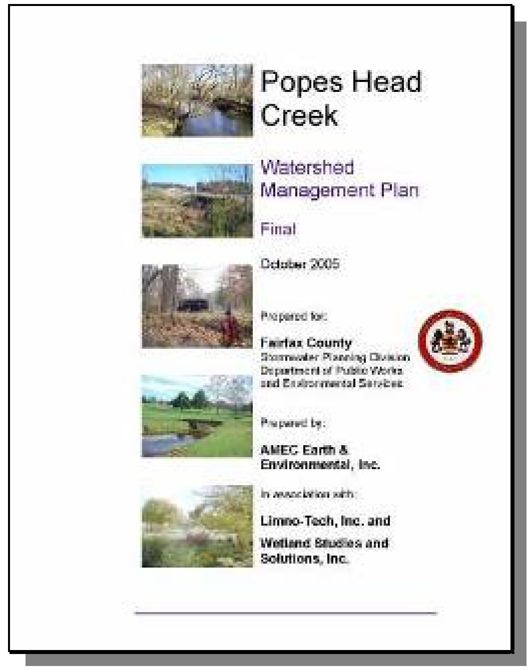
Currently the Stormwater Planning Division is completing stream restoration designs for Poplar Springs Court (Burke), Runnymeade subdivision (Franconia), and Bridle Path Lane (McLean). Last year, benthic macroinvertebrate samples were taken at each of these sites in Pohick Creek, Cameron Run, and Scotts Run, respectively. All three of the sites were rated as "very poor", because the samples collected did not even yield the minimum number of organisms required to conduct the analysis. Samples will continue to be taken after restoration activities are completed in order to evaluate the effectiveness of the projects and to assess how quickly biological communities recover.

Kingstowne stream before restoration

The Kingstowne stream restoration project was a joint effort completed by Fairfax County, Northern Virginia Soil and Water Conservation District, Natural Resource Conservation Service, Citizens Alliance to Save Huntley, and Friends of Huntley Meadows Park. Construction was completed on the project in 1999. Since that time, volunteers have taken macroinvertebrate samples in the restored section. In a sample taken one year after the completion of construction, one midge larvae and one worm were found. This gave the reach a score of "unacceptable." Three samples were taken in 2005 and more organisms were found, including crayfish, mayflies, dragonflies, damselflies and caddisflies. In January 2006, the restored reach was again sampled by volunteers and it scored "acceptable" for the first time. It is anticipated that projects increasingly will be monitored before and after construction to evaluate the effectiveness of the project, in hopes that other stream restoration projects will yield results similar to the Kingstowne stream. It should be noted that this positive response in the aquatic community took 7 years, which is not an atypical response time.

Kingstowne stream after restoration

Project sites that are being evaluated for sampling in 2006 include: Hope Park Road floodplain/stream restoration and Mount Vernon National Park stream restoration, in the Popes Head Creek and Little Hunting Creek watersheds, respectively. These projects were identified in their respective watershed management plans. More restoration opportunities will be identified as watershed management plans are completed for the remaining watersheds in Fairfax County. It is envisioned that as more restoration efforts are undertaken, the habitat and, ultimately, the biological communities of these localized stream segments may be afforded the ability to rebound from their impacted states. Annual Biological monitoring at selected project sites will continue to be used to document changes.



3 Results: 2005 Monitoring Data

The 2005 countywide monitoring data yielded similar findings as in previous years. Bacteria levels found in the majority of streams render them potentially unsafe for recreational contact such as swimming and wading. The benthic macroinvertebrate communities lack many sensitive species, which are indicators of good water quality, and are frequently dominated by tolerant species that are characteristic of degraded streams. The fish community is dominated by habitat generalists, omnivores, and non-native species, which is indicative of disturbed systems.

3.1 Bacteria Monitoring Data

As recommended by the EPA and the Virginia Department of Environmental Quality (VDEQ), Fairfax County completed its transition in 2005 to using *E. coli* instead of fecal coliform as the indicator of possible fecal contamination. The basis for this change stems from the 1986 EPA findings that *E. coli* exhibits a stronger correlation to water-borne illnesses for humans than does fecal coliform. Thus, by changing indicators, sounder recommendations can be made regarding the safety of our waters for recreational uses.

Water Chemistry Results

Temperature (◦C)
- Minimum………0.4
- Maximum……..27.3
- Average ………14.7

Dissolved Oxygen (mg/L)
- Minimum………2.7
- Maximum……..22.5
- Average ………10.1

Specific Conductance (μs/cm)
- Minimum………15.4
- Maximum……..1333
- Average ………263.3

pH
- Minimum………5.90
- Maximum……..8.81
- Average ………6.68

Nitrate (mg/L)
- Minimum………0.1
- Maximum……..8.4
- Average ………1.3

Total Phosphorous (mg/L)
- Minimum………<0.1
- Maximum……..0.15
- Average ………<0.1

According to VDEQ, the following standard now applies for primary contact recreation to all surface water:

⇒ E. coli *shall not exceed a geometric mean of 126 colony forming units, or cfu, per 100 ml of water or exceed an instantaneous value of 235 cfu per 100 ml of water.*

Since bacteria sampling in the county is conducted only on a bi-quarterly basis, the geometric mean standard cannot be applied to the data. Therefore, the county's analysis is based on the frequency that the level of *E. coli* is above 235 cfu (at any one instance) in our waterways.

Additionally, in 2005, the Fairfax County Health Department updated its procedure to determine the concentration of *E. coli* from the modified *E. coli* method which was a membrane filter technique, to the Colilert® Quanti Tray/2000 by Idexx. This new testing method increases the precision of the results and reduces the amount of human-based error. Although the new method is more accurate, the upper limit of detection is reduced from 6000 cfu to 2420 cfu.

In addition to testing for *E. coli* levels, total phosphorous and nitrate levels continue to be examined. It should be noted that since all testing for fecal contamination in 2005 was done using *E. coli* instead of fecal coliform, it is not possible to compare this year's results to past years'. Nevertheless, if the sample exceeds the upper limits of the *E. coli* test, then it generally will exceed the upper limits for the fecal coliform test also.

In 2005, SWPD dropped the original Fairfax County Health Department site locations in favor of probability-based site selection. The original 80 sites were selected based on ease of access and magisterial district representation rather than on a scientific basis. By adopting the new site selection method, a better understanding of the county's water quality is achieved and a more statistically defensible approach is utilized. The 2005 sampling year included 38 sites across 14 watersheds. Each of the 38 sites was visited twice per season starting in the spring, for a total of six visits.

Factors affecting the increase or decrease in the amount of bacteria in stream waters include, but are not limited to, rainfall and water temperature. Both of these factors are noted in past Health Department stream water quality reports as environmental conditions affecting the bacteria results. Plots of *E. coli* concentration counts versus temperature (Figure 4) and *E. coli* geometric means (of all sites for a given sample date) versus five-day antecedent rainfall (Figure 5) suggest a closer correlation to water temperature. The geometric means are calculated from all sites sampled on a given date.

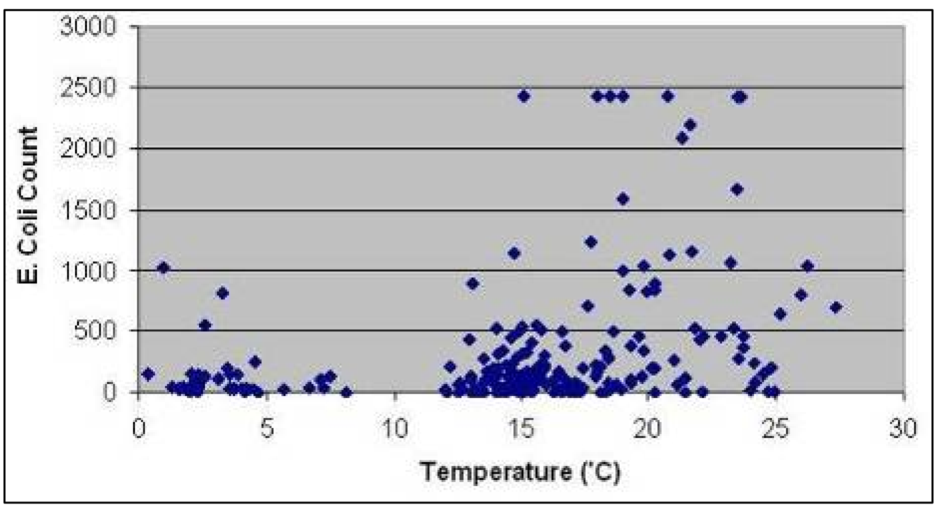


Figure 4: *E. coli* concentrations plotted against water temperature.

The breakdown of the percentage of sites that exceeded VDEQ's instantaneous value of 235 cfu per 100mL of water is displayed in Figure 6. In 2005, 10 percent of the bacteria monitoring locations reported concentrations that were consistently below VDEQ standards. Although this may seem an improvement over the 2004 data which showed no stream locations reporting concentrations consistently below the VDEQ fecal coliform standard of 400 cfu per 100 mL of water, county staff concurs with VDEQ and the Virginia Department of Health, who caution that ***it is impossible to guarantee that any natural body of water is free of risk from disease-causing organisms or injury***. Additionally, the laboratory procedure was modified and the total number of samples increased, which may account for the relative differences between years.

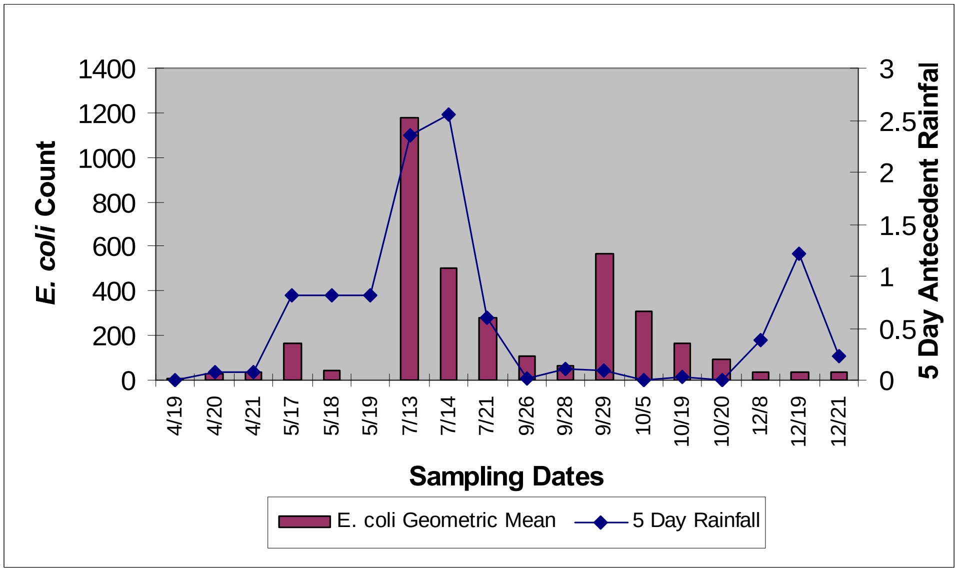


Figure 5: Geometric mean of *E. coli* concentrations versus 5-day antecedent rainfall.

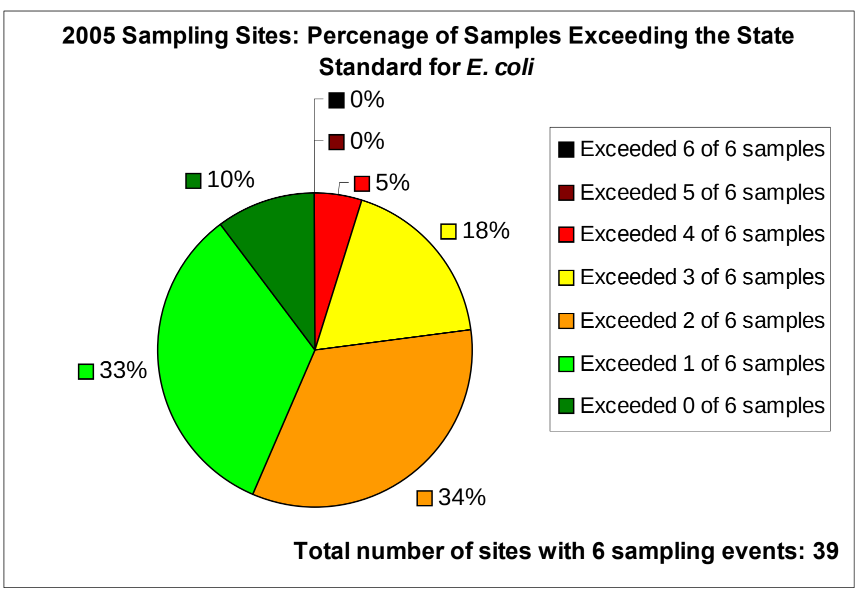


Figure 6: Percentage of sites that exceeded state water quality standard (235 cfu per 100mL) for *E. coli*.

3.2 Benthic Macroinvertebrate Data

All forty monitoring sites were sampled for benthic macroinvertebrates. As in the 2005 stream report and the 1999 countywide Baseline Study, the majority of the streams (82 percent) are in "fair" to "very poor" condition based on the Benthic Index of Biotic Integrity (Figure 7). These three lowest rating classes generally correspond to the VDEQ's "impaired" classification for aquatic life uses - which indicates the State's minimum water quality standards are not being met. The 1999 Baseline Study showed that approximately 77 percent of streams were in this range, and the 2004 annual stream report showed that 80 percent of the streams sampled fell into this range. These data appear to indicate that fewer streams each year are classified as "good" or "excellent", most likely due to ongoing conversion of natural areas to more intensive land uses (i.e.: commercial and/or residential development). Three of the four sites that scored "excellent" in 2005 were located in watersheds with limited residential growth (Nichol Run, Occoquan and Popes Head Creek) with the other located on a small stream located in a relatively undisturbed portion of Difficult Run.

This macroinvertebrate is a case-building caddisfly. Most caddisfly larvae construct portable homes from surrounding materials to help protect them from predators. Eventually they will develop wings and emerge from the water as mature adults ready to breed.

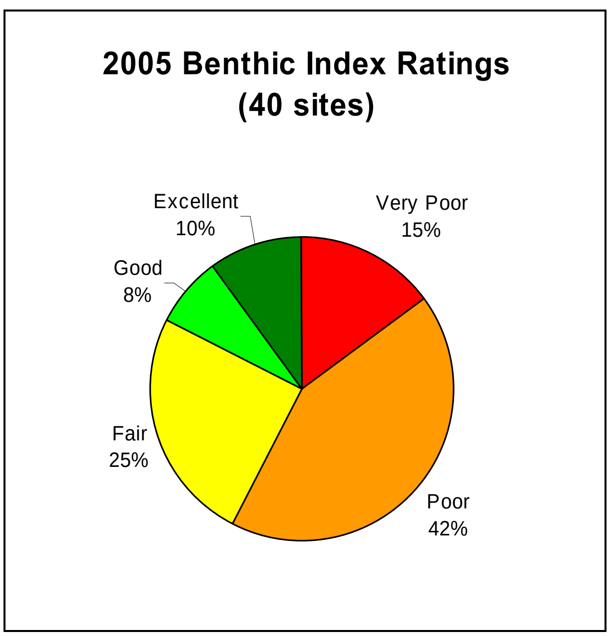


Figure 7: Ratings of 2005 biomonitoring sites based on the Benthic Index of Biotic Integrity

Table 2 shows a simple breakdown of the benthic IBI scores for the 2005 sites by stream order class. Although general condition ratings of "Excellent" through "Very Poor" can be given to each individual site or class of sites (as shown), it is important to note where that score falls numerically within the rating category. For example, all 2005 sites, when combined, received a rating of "Fair" based on their average benthic IBI score (40.2). However, that rating was only narrowly achieved by two tenths (0.2) of a point. Scoring ranges for each condition rating category are provided on the far right of Table 2 below.

Table 2: Statistics for county Benthic IBI scores from 2005 sampling and score ranges for rating categories.

Stream Order	Number of Samples	Minimum Score	Maximum Score	Standard Deviation	Mean B-IBI Score	Rating
1	20	14.0	91.7	22.3	37.6	Poor
2	9	22.6	88.5	24.1	44.2	Fair
3	6	3.0	71.5	20.9	42.6	Fair
4th and 5th	5	29.2	51.2	11.8	40.2	Fair
ALL	40	3.0	91.7	21.7	40.2	Fair

Rating Category	Score Range
Excellent	80 - 100
Good	60 - 79.9
Fair	40 - 59.9
Poor	20 - 39.9
Very Poor	0 - 19.9

The Watershed Planning and Assessment Branch received data for 44 sites monitored by volunteers in 2005. Four sites were administered through ANS and 40 through NVSWCD. Overall, 64% of these sites were rated as "unacceptable," while 36% were rated "acceptable" (Figure 8). All four of the ANS sites were in the acceptable category. Of the NVSWCD sites, 12 were in the "acceptable" range and 28 were considered "unacceptable." Because these sites are not randomly selected, they may not be representative of countywide conditions as a whole.

In general, the benthic ratings for the volunteer sites corresponded with the ratings for the county sites in the same area (upstream or downstream). Volunteer results from 2005 were also compared with countywide results from 1999, 2001, 2004, and 2005 (see maps in section 4- Watershed Conditions). By combining all these results, a larger, more encompassing picture of stream conditions countywide is revealed.

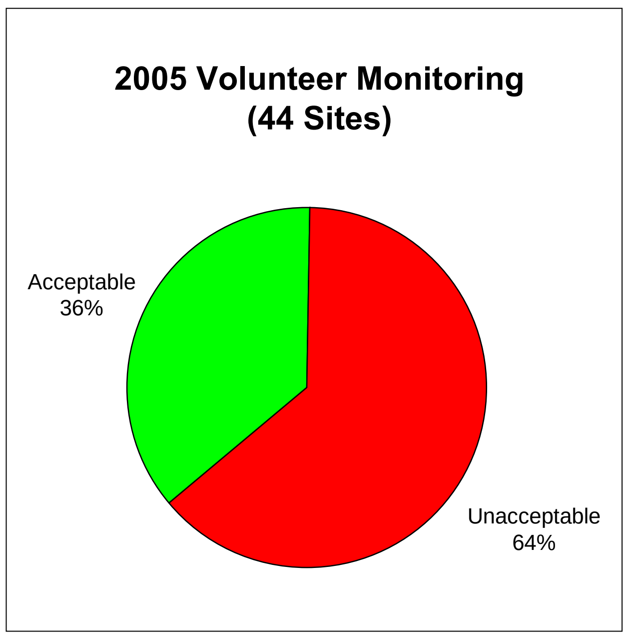


Figure 8: 2005 Site ratings from NVSWCD and ANS volunteer monitors

3.3 Fish Sampling Data

All second through fifth order streams and a few of the largest first order streams (>300 acres drainage) were sampled for fish during 2005 for a total of twenty-two sites being surveyed. Using the Fish Index of Biotic Integrity (F-IBI), the majority of sites were rated in the “fair” category (49 percent) (Figure 9). One site was rated “excellent” and another site was rated “very poor,” both located in the Cub Run watershed. The site rated “excellent” was in the Bull Run Regional Park, while the site rated “very poor” was located in the Westfields office complex. The data appear to indicate that the fish communities are more resilient to impacts than are the macroinvertebrate communities. Comparing this year to last, more sites were found to be in better condition with respect to the fish community. In sample year 2004, no sites were ranked good or excellent, while the remaining sites were fairly evenly split between the 3 lowest categories. One explanation of increased scores for the fish community this year may be the overall increase in the number of sites sampled. While 14 sites were sampled in 2004, 22 sites were sampled in 2005, thus potentially yielding more representative results of fish communities countywide. Many factors in the urban environment can affect fish communities including seasonal precipitation fluctuations, physical barriers to fish movement/migration, introduction of exotic species, stocking of lakes for sport fishing purposes, and predation from humans, to name just a few. As more years’ data is compiled, a greater understanding of the dynamics exhibited by these communities will be gained.

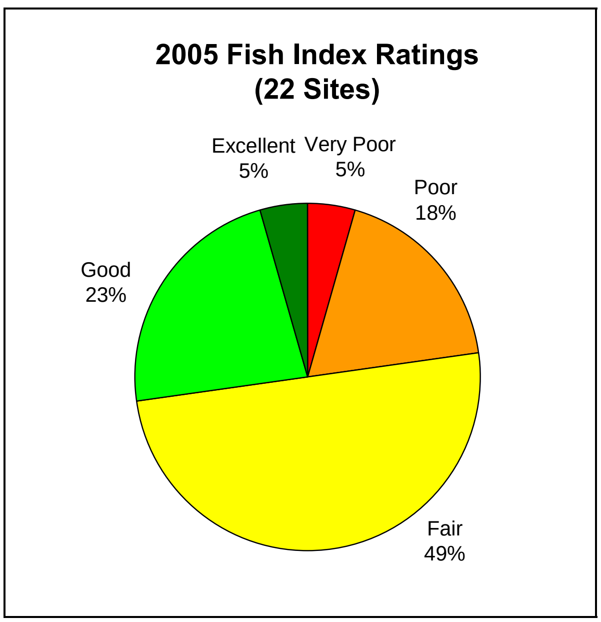


Figure 9: Ratings of 2005 biomonitoring sites based on the Fish Index of Biotic Integrity.

A Margined Madtom (Noturus insignis) infected with parasites. A large number of diseased specimens is an indication of poor water quality.

3.4 Stream Quality Index

A number of key indicators have been developed to support the environmental portions of the Fairfax County Vision. Among them is an indicator used to measure watershed and stream quality. Benthic macroinvertebrate data from the biological monitoring program were used to develop that watershed and stream quality indicator.

The number of sites placed in each of the five rating categories ("excellent," "good," "fair," "poor," and "very poor" based on the benthic macroinvertebrate monitoring data) was used to develop a stream quality index value of overall stream conditions countywide. This index value is computed by multiplying the fraction of total sites rated "excellent" by 5, those rated "good" by 4, those rated "fair" by 3, those rated "poor" by 2, and those rated "very poor" by 1. These values are then summed, resulting in a single numeric index ranging from 1 to 5, with a higher value indicating better stream biological conditions. Thus, an index value of 5 would correspond to all streams countywide as being rated "excellent." Likewise, an index of 2.5 would indicate conditions intermediate between "fair" and "poor," and an index score of 1 corresponds to "very poor" stream conditions countywide. This watershed and stream quality indicator meets a number of criteria. An indicator must:

- ⇒ Be a measurable index calculated from data which can be collected annually.
- ⇒ Be derived primarily from direct measurement of a key natural resource, the county's receiving waters, which is visible and of great importance to the public.
- ⇒ Support the long-term trend analysis of stream conditions.
- ⇒ Be used to measure progress or success of watershed restoration efforts.

The stream quality index values for the 1999 baseline study data, the 2004 stratified random sampling, and the 2005 stratified random sampling, are shown in Table 3. The 2005 stream quality index shows a small increase in overall stream quality from 2004, but is still below the value from 1999. However, it is difficult to make any broad statements about trends based on data from three sampling years. This index will be reported annually to evaluate trends in the overall health of streams countywide. As more data is reported annually, emerging trends can be identified with greater certainty.

A stream segment in Difficult Run showing significant erosion to the stream banks and inadequate riparian buffer.

Table 3: Stream quality index values for sampling completed in 1999, 2004 and 2005.

Sampling Year	Percentage of Total Sites					Index Value
	Very Poor	Poor	Fair	Good	Excellent	
1999	11	34	32	14	9	2.76
2004	23	40	17	13	7	2.41
2005	15	43	25	8	10	2.55

3.5 2005 Monitoring Station Data

Sample data collected at each of the 40 sites in the 2005 sample year is provided in this section. The data is shown in Table 4. Each site is given a “map code” in the first column of the table, which can be used to determine the location of the site using the map in Figure 10.

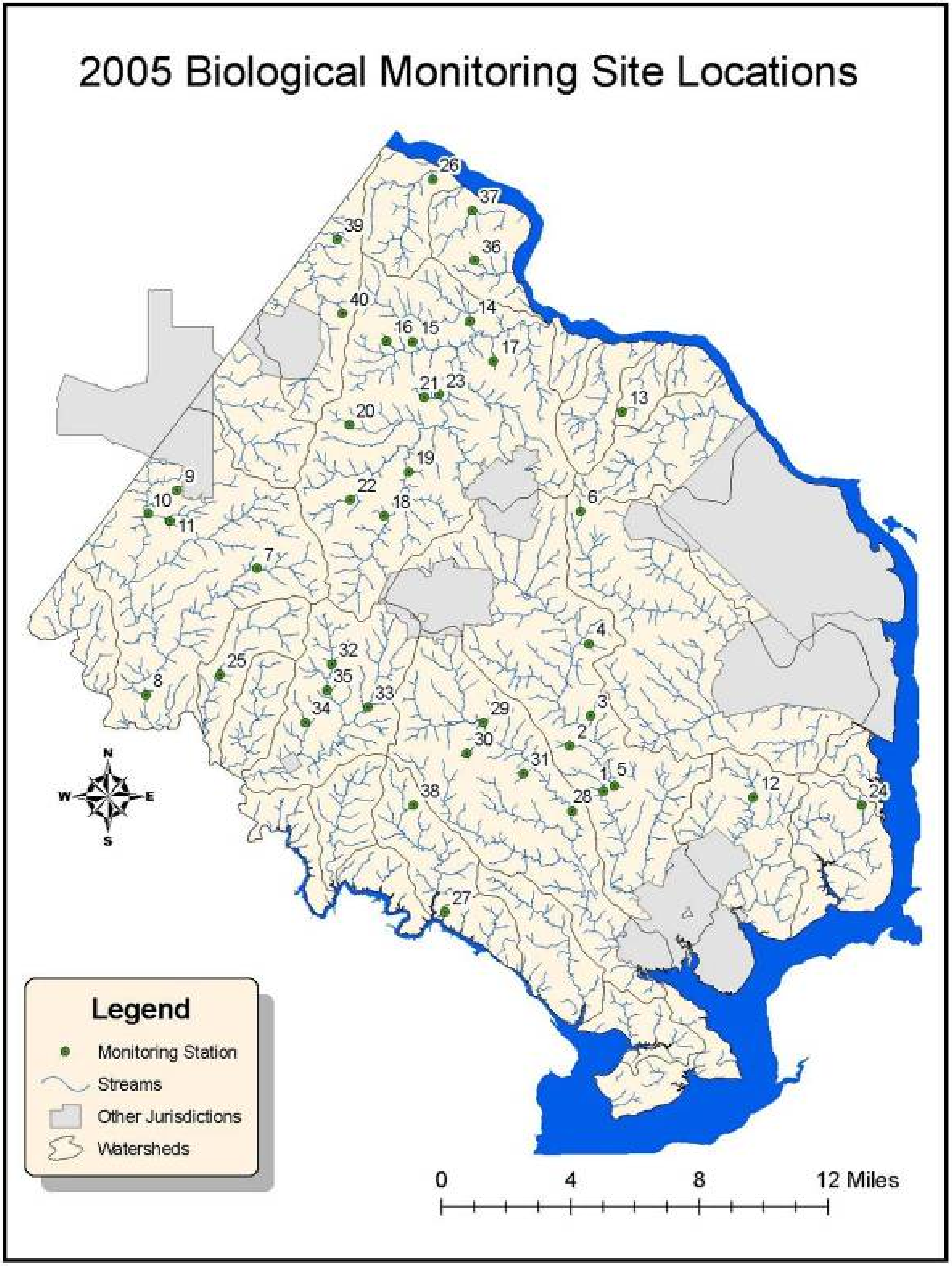


Figure 10: Locations of randomly-selected monitoring sites (biological and bacteriological) for 2005 sample year.

Table 4: Site data and monitoring results for 2005 sample year sites

Map Code	SiteID	Watershed	Physiographic Province	Stream Order	Drainage Area		Benthics		Fish		Bacteria
					Acres	Miles^2	IBI	Rating	IBI	Rating	Samples Exceeding
1	AC0501	Accotink Creek	Piedmont	4	22,749.3	35.55	45	Fair	25	Fair	4 of 6
2	AC0502	Accotink Creek	Piedmont	2	253.1	0.40	29	Poor	23	Poor	2 of 5
3	AC0503	Accotink Creek	Piedmont	1	312.8	0.49	10	Very Poor	27	Fair	3 of 6
4	AC0504	Accotink Creek	Piedmont	1	158.9	0.25	10	Very Poor	N/A		3 of 6
5	AC0505	Accotink Creek	Piedmont	1	55.1	0.09	33	Poor	N/A		0 of 6
6	CA0501	Cameron Run	Piedmont	1	206.4	0.32	40	Poor	31	Good	3 of 6
7	CU0501	Cub Run	Piedmont	3	2,134.7	3.34	0	Very Poor	27	Fair	2 of 6
8	CU0502	Cub Run	Piedmont	5	32,893.0	51.40	29	Poor	35	Excellent	1 of 6
9	CU0503	Cub Run	Piedmont	2	1,059.2	1.65	42	Fair	19	Very Poor	1 of 6
10	CU0504	Cub Run	Piedmont	2	1,124.5	1.76	23	Poor	21	Poor	4 of 6
11	CU0505	Cub Run	Piedmont	1	131.2	0.21	49	Fair	N/A		1 of 5
12	DC0501	Dogue Creek	Coastal Plain	3	1,168.1	1.83	31	Poor	16	Fair	0 of 6
13	DE0501	Dead Run	Piedmont	1	52.6	0.08	32	Poor	N/A		N/A
14	DF0501	Difficult Run	Piedmont	4	4,183.5	6.54	38	Poor	31	Good	0 of 6
15	DF0502	Difficult Run	Piedmont	1	129.0	0.20	22	Poor	N/A		3 of 6
16	DF0503	Difficult Run	Piedmont	1	114.6	0.18	14	Very Poor	N/A		2 of 6
17	DF0504	Difficult Run	Piedmont	1	101.4	0.16	41	Fair	N/A		1 of 6
18	DF0505	Difficult Run	Piedmont	1	112.3	0.18	22	Poor	N/A		1 of 6
19	DF0506	Difficult Run	Piedmont	2	230.8	0.36	81	Excellent	29	Fair	2 of 6
20	DF0507	Difficult Run	Piedmont	2	405.6	0.63	28	Poor	23	Poor	2 of 6
21	DF0508	Difficult Run	Piedmont	2	214.4	0.33	45	Fair	29	Fair	2 of 6
22	DF0509	Difficult Run	Piedmont	3	1,051.7	1.64	44	Fair	31	Good	3 of 6
23	DF0510	Difficult Run	Piedmont	1	72.4	0.11	58	Fair	N/A		1 of 6
24	LH0501	Little Hunting Creek	Coastal Plain	2	782.7	1.22	32	Poor	12	Poor	2 of 5
25	LR0501	Little Rocky Run	Piedmont	1	105.2	0.16	23	Poor	N/A		1 of 5
26	NI0501	Nichol Run	Piedmont	1	59.0	0.09	85	Excellent	N/A		1 of 6
27	OC0501	Occoquan	Piedmont	1	71.5	0.11	92	Excellent	N/A		2 of 4
28	PC0501	Pohick Creek	Piedmont	4	9,757.6	15.25	37	Poor	29	Fair	0 of 6
29	PC0502	Pohick Creek	Piedmont	4	5,143.4	8.04	51	Fair	29	Fair	2 of 6
30	PC0503	Pohick Creek	Piedmont	1	92.3	0.14	18	Very Poor	N/A		3 of 4
31	PC0504	Pohick Creek	Piedmont	1	88.3	0.14	14	Very Poor	N/A		1 of 4
32	PH0501	Popes Head Creek	Piedmont	3	1,717.2	2.68	71	Good	27	Fair	3 of 6
33	PH0502	Popes Head Creek	Piedmont	3	2,802.1	4.38	29	Poor	25	Fair	2 of 6
34	PH0503	Popes Head Creek	Piedmont	2	486.9	0.76	88	Excellent	31	Good	2 of 5
35	PH0504	Popes Head Creek	Piedmont	3	2,468.4	3.86	71	Good	29	Fair	2 of 6
36	PN0501	Pond Branch	Piedmont	1	186.9	0.29	44	Fair	N/A		1 of 5
37	PN0502	Pond Branch	Piedmont	2	940.2	1.47	31	Poor	31	Good	1 of 6
38	SA0501	Sandy Run	Piedmont	1	108.6	0.17	47	Fair	N/A		1 of 4
39	SU0501	Sugarland Run	Piedmont	1	79.9	0.12	61	Good	N/A		1 of 6
40	SU0502	Sugarland Run	Piedmont	1	65.1	0.10	37	Poor	N/A		2 of 5

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4 Watershed Conditions: 1999 - 2005

The following series of maps summarizes biological monitoring data results based on the benthic macroinvertebrate data collected from the original 1999 baseline study through 2005. Countywide, more than 230 sites have been monitored over this time period, including the 114 original baseline study sites. The 44 volunteer monitoring sites sampled in 2005 also are included on these maps. Combining this data on a single map provides a picture of the range of conditions within and across watersheds. It also allows one to view stream conditions in their own backyard, community or favorite stream valley park.

The Watershed Condition Map Series is organized as follows:

- Index map of the 30 county watersheds
- County map of staff and volunteer monitored sites
- Nichol Run and Pond Branch Watersheds
- Difficult Run Watershed
- Bull Neck, Scotts, Dead, Turkey and Pimmit Run Watersheds
- Cameron and Four Mile Run Watersheds
- Dogue Creek, Little Hunting Creek, and Belle Haven Watersheds
- Accotink Creek Watershed
- Pohick Creek Watersheds
- Mill Branch, Kane Creek, and High Point Watersheds
- Old Mill Branch, Wolf Run, Ryans Dam, Sandy Run and Occoquan Watersheds
- Popes Head Creek Watershed
- Little Rocky Run and Johnny Moore Watersheds
- Cub Run and Bull Run Watersheds

Fairfax County's program for assessing stream conditions over multiple years is similar to the Virginia Department of Environmental Quality's (VDEQ) method for determining which streams are poor quality, referred to as impaired, and not suitable for their primary uses including swimming or fishing. DEQ publishes a water quality report every two years that summarizes monitoring data and lists which streams and lakes are impaired. Monitoring data from a five year period is generally used for these assessments. For example, VDEQ's 2006 water quality report uses data from 2001 through 2005. Additional information on VDEQ's monitoring program and results for Fairfax County is presented in Section 5.

Next year's annual report on Fairfax County streams will include summaries of watershed conditions based on the most recent three years of data (2004 - 2006). Approximately 120 sites will have been sampled during this period, providing a good basis for assessing individual watershed conditions, as well as comparing them to the original 114 baseline study sites sampled in 1999. This will help in assessing long term trends in water quality, evaluating stormwater management conditions and targeting watershed plan implementations.

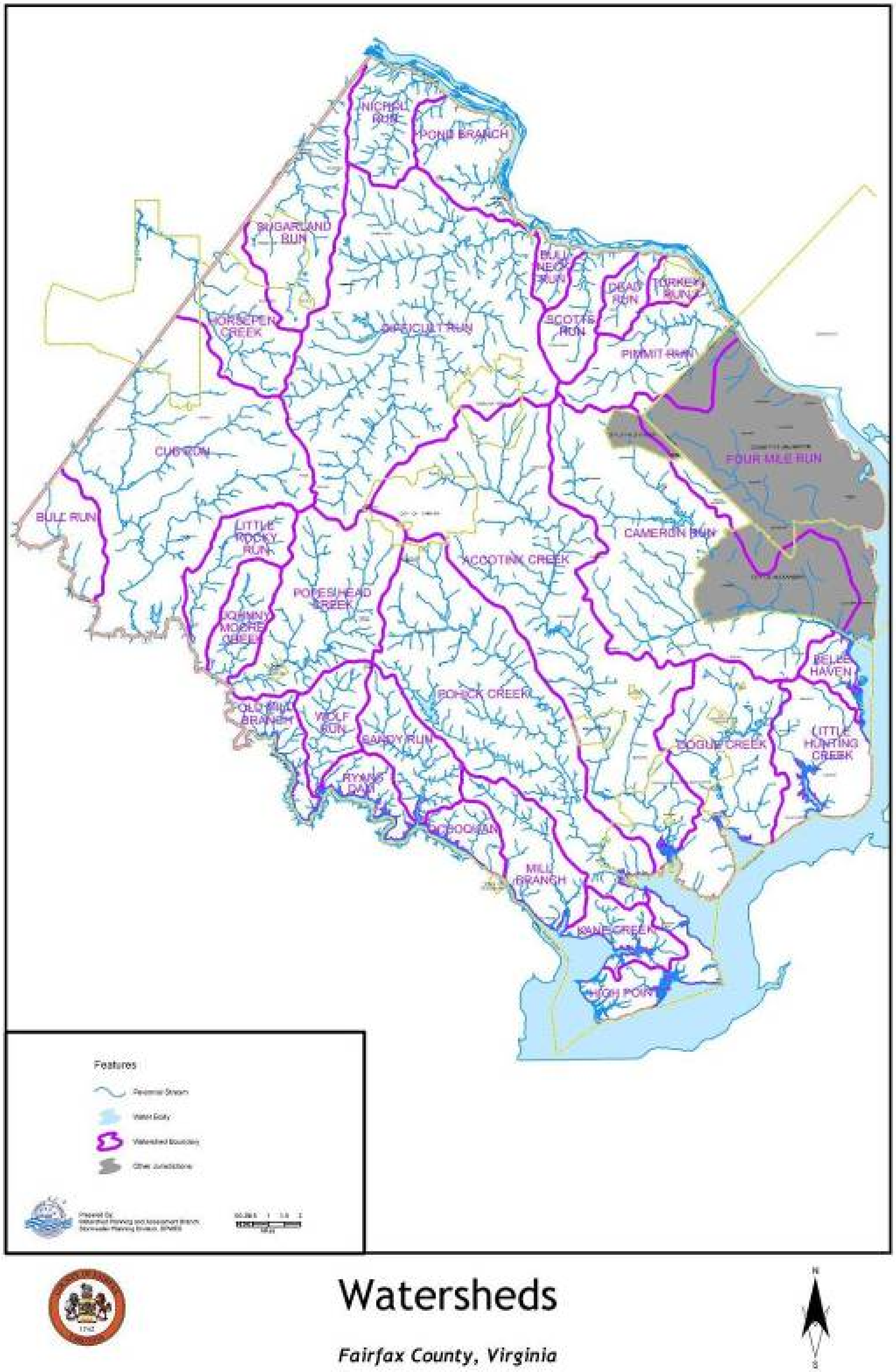

Figure 10: The 30 watersheds in Fairfax County

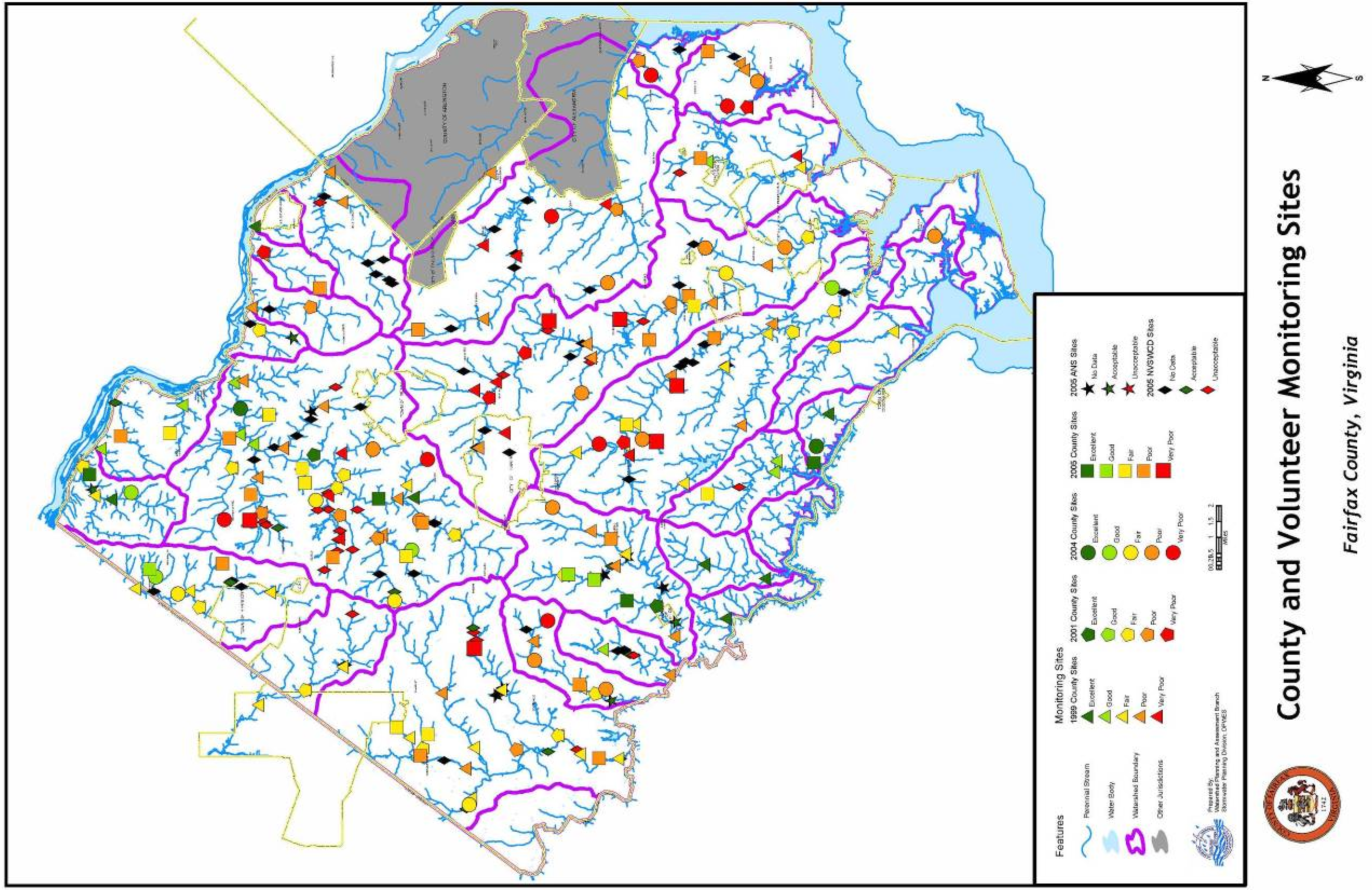

Figure 11: County and volunteer stream monitoring sites countywide

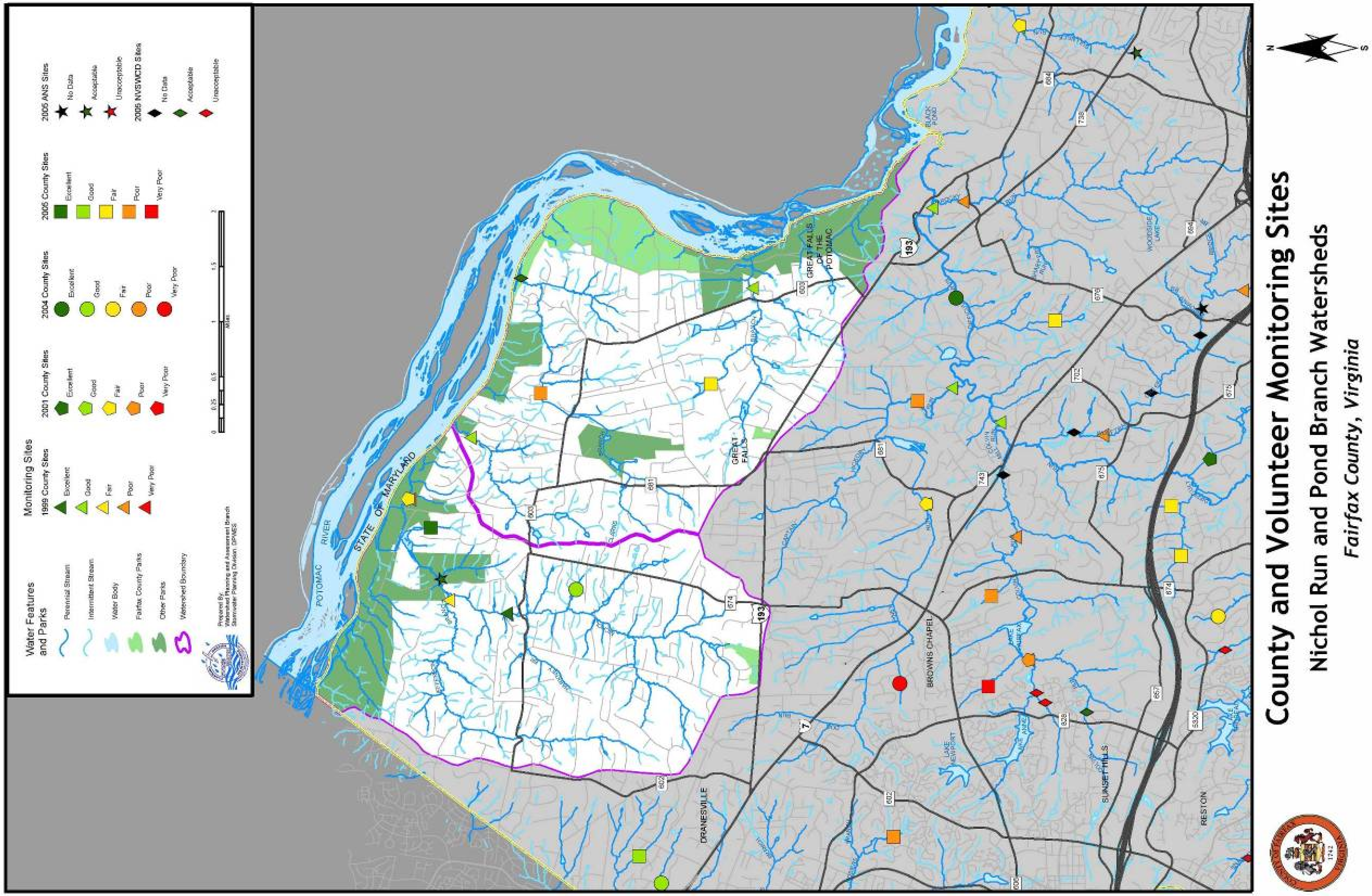

Figure 12: County and volunteer stream monitoring sites: Nichol Run and Pond Branch Watersheds

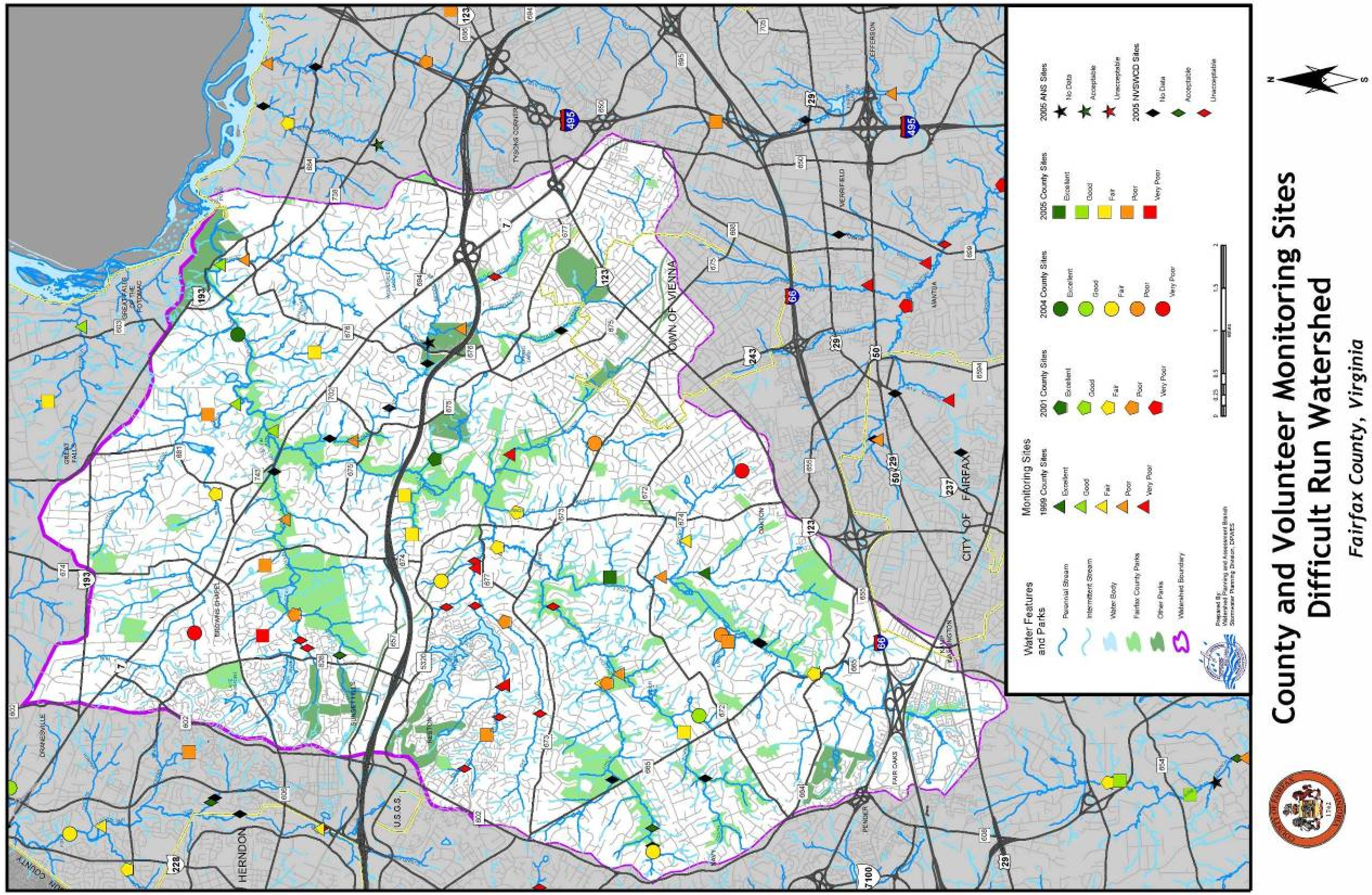

Figure 13: County and volunteer stream monitoring sites: Difficult Run Watershed

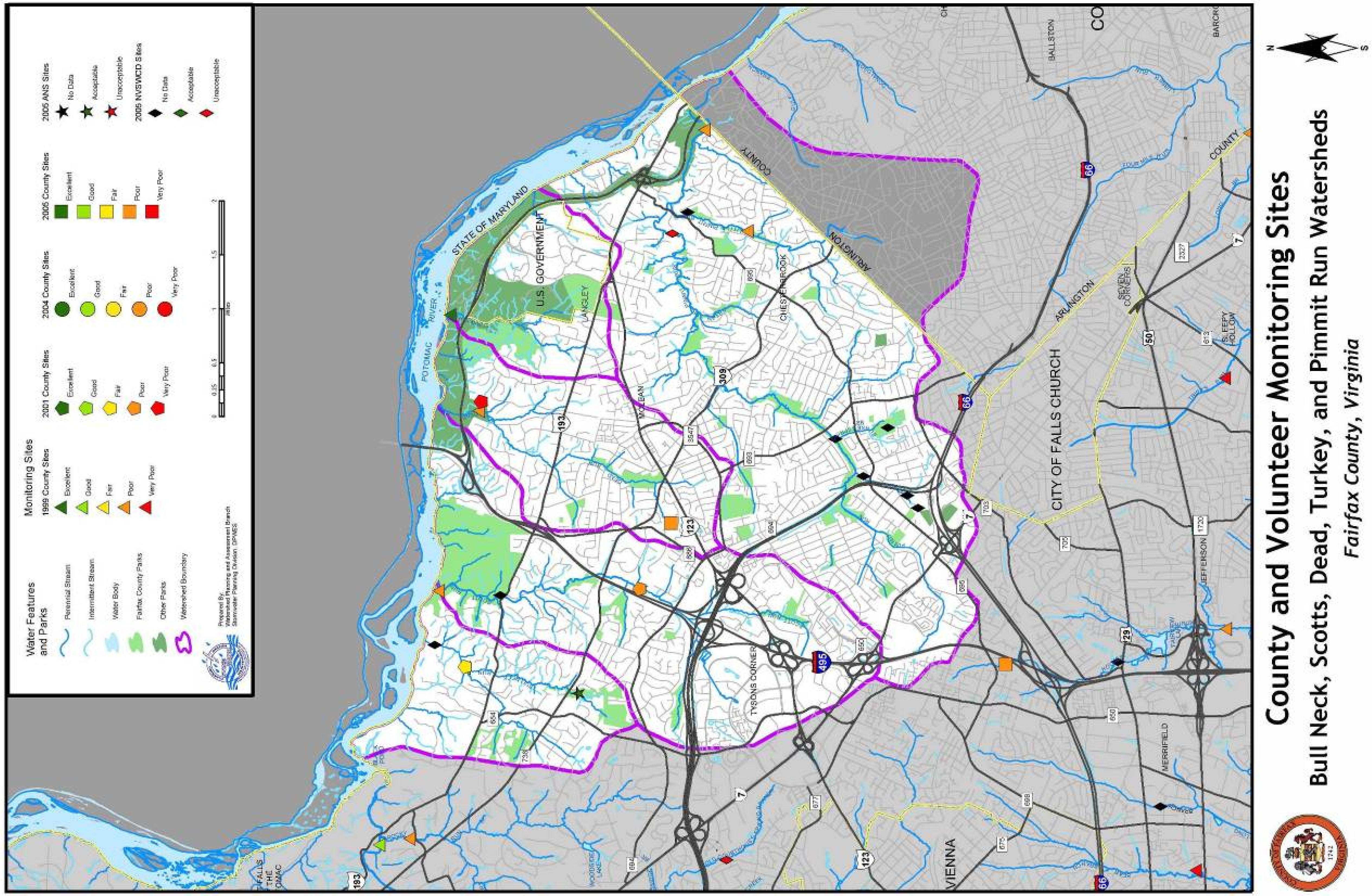

Figure 14: County and volunteer stream monitoring sites: Bull Neck, Scotts, Dead, Turkey and Pimmit Run Watersheds

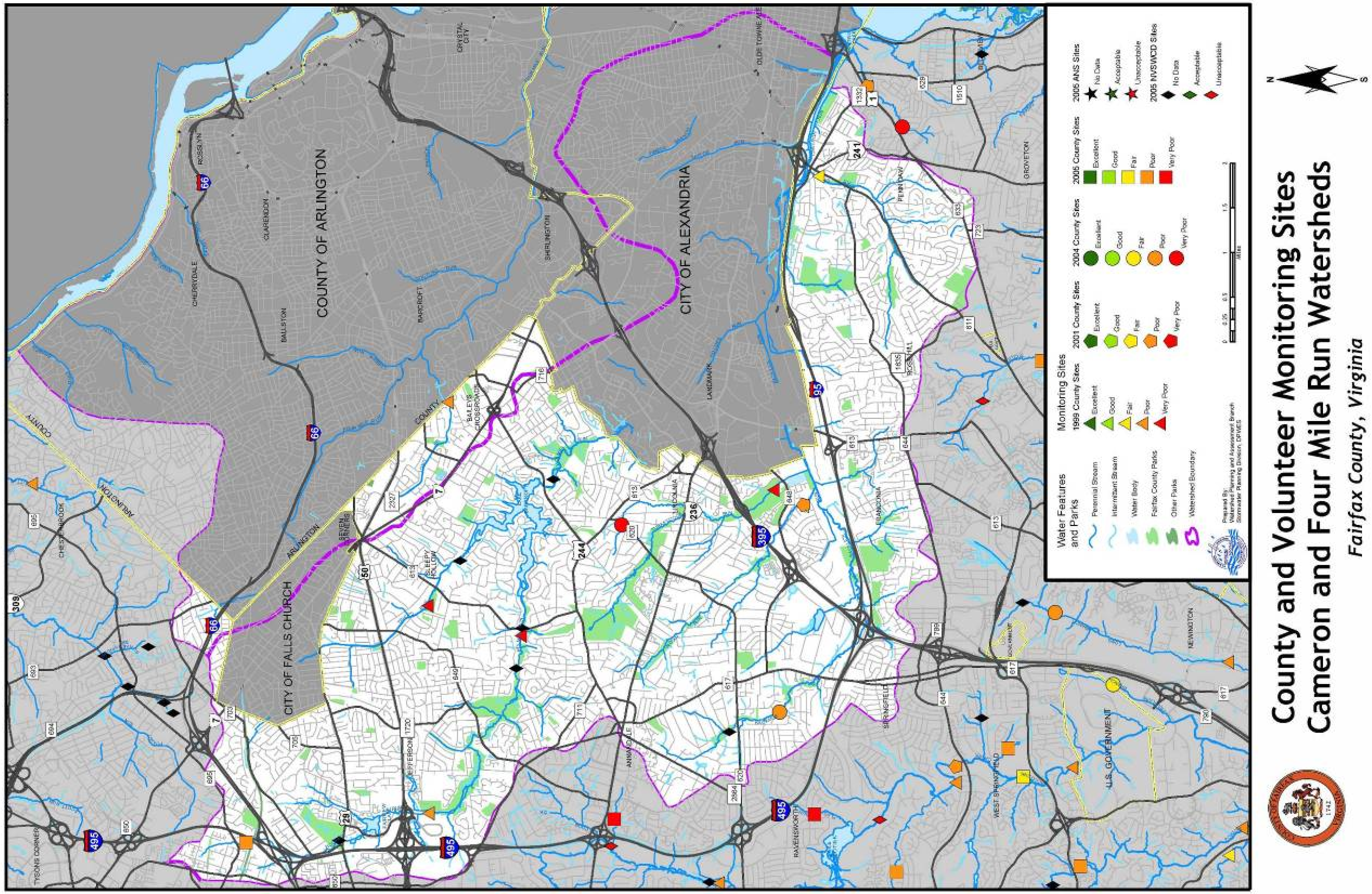

Figure 15: County and volunteer stream monitoring sites: Cameron and Four Mile Run Watersheds

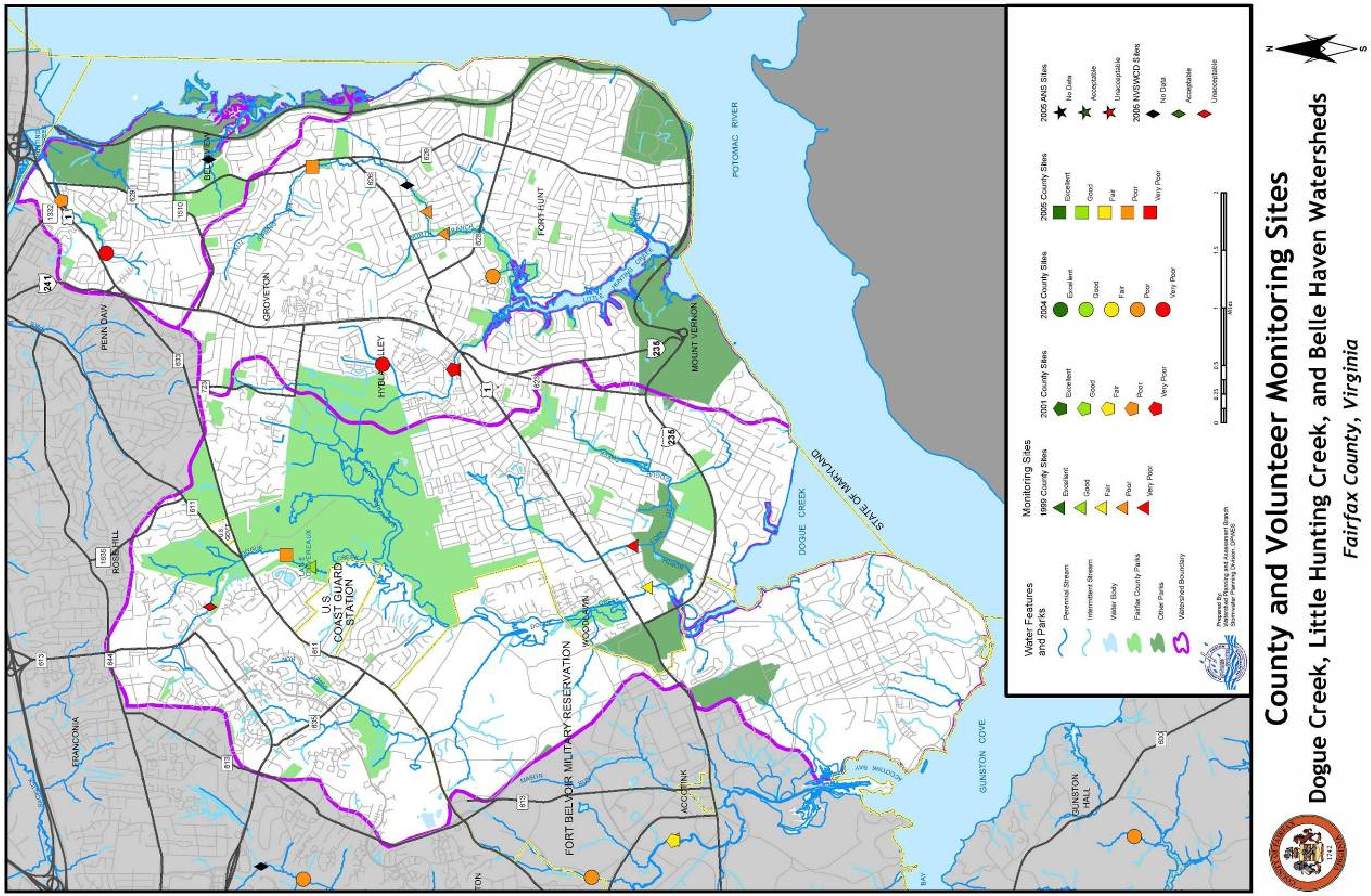

Figure 16: County and volunteer stream monitoring sites: Dogue, Little Hunting Creek and Belle Haven Watersheds

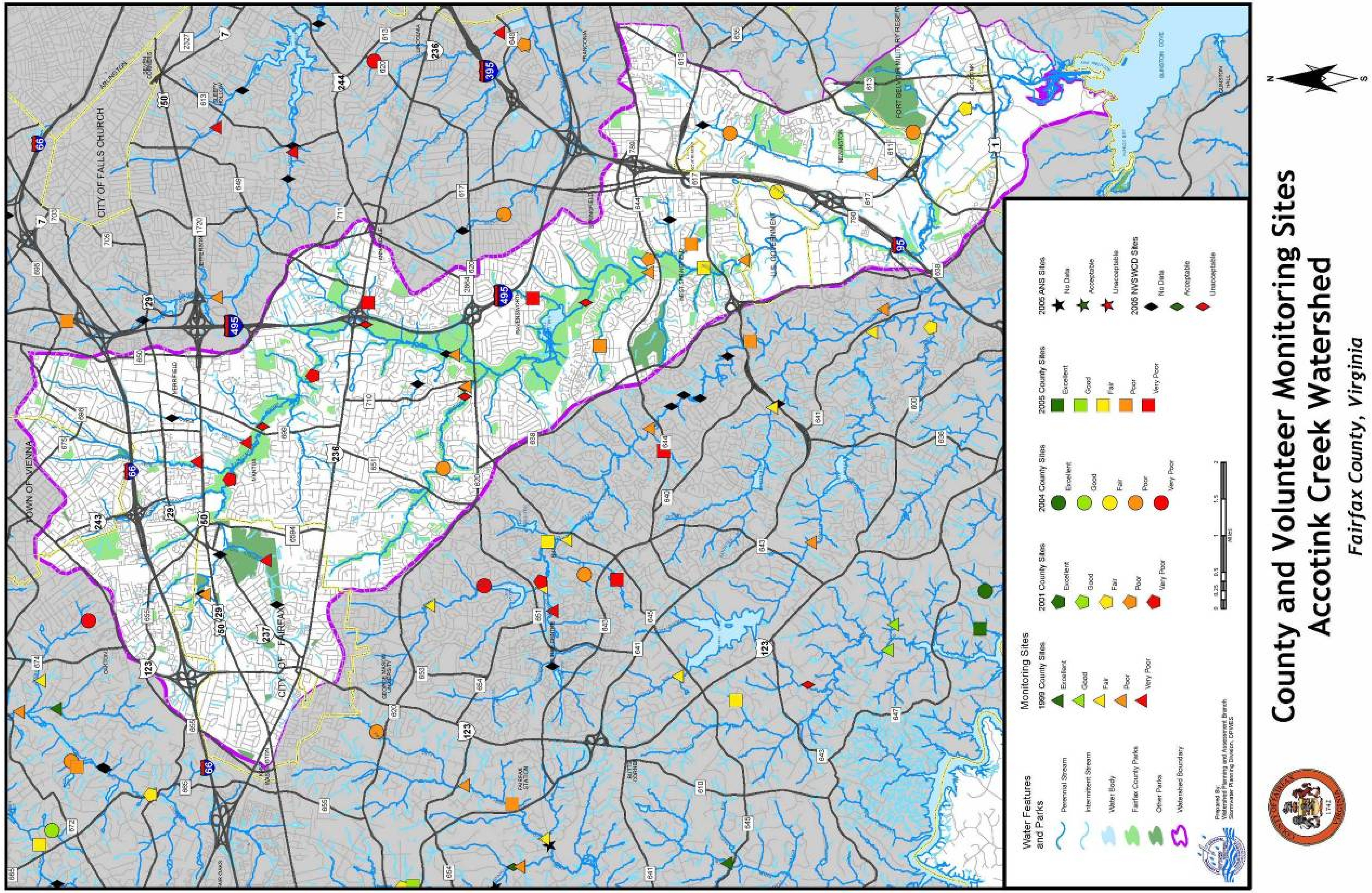

Figure 17: County and volunteer stream monitoring sites: Accotink Creek Watershed

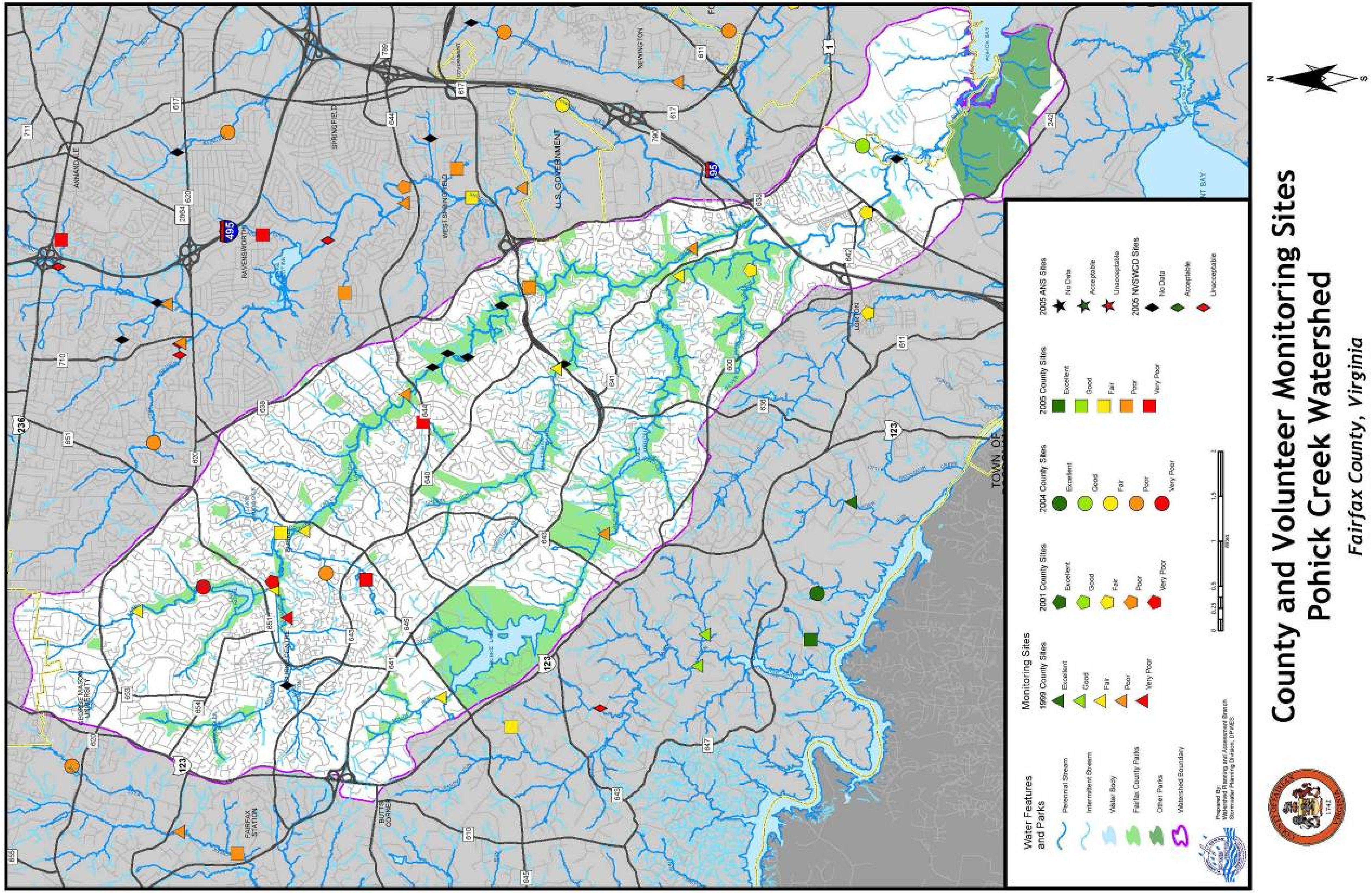

Figure 18: County and volunteer stream monitoring sites: Pohick Creek Watershed

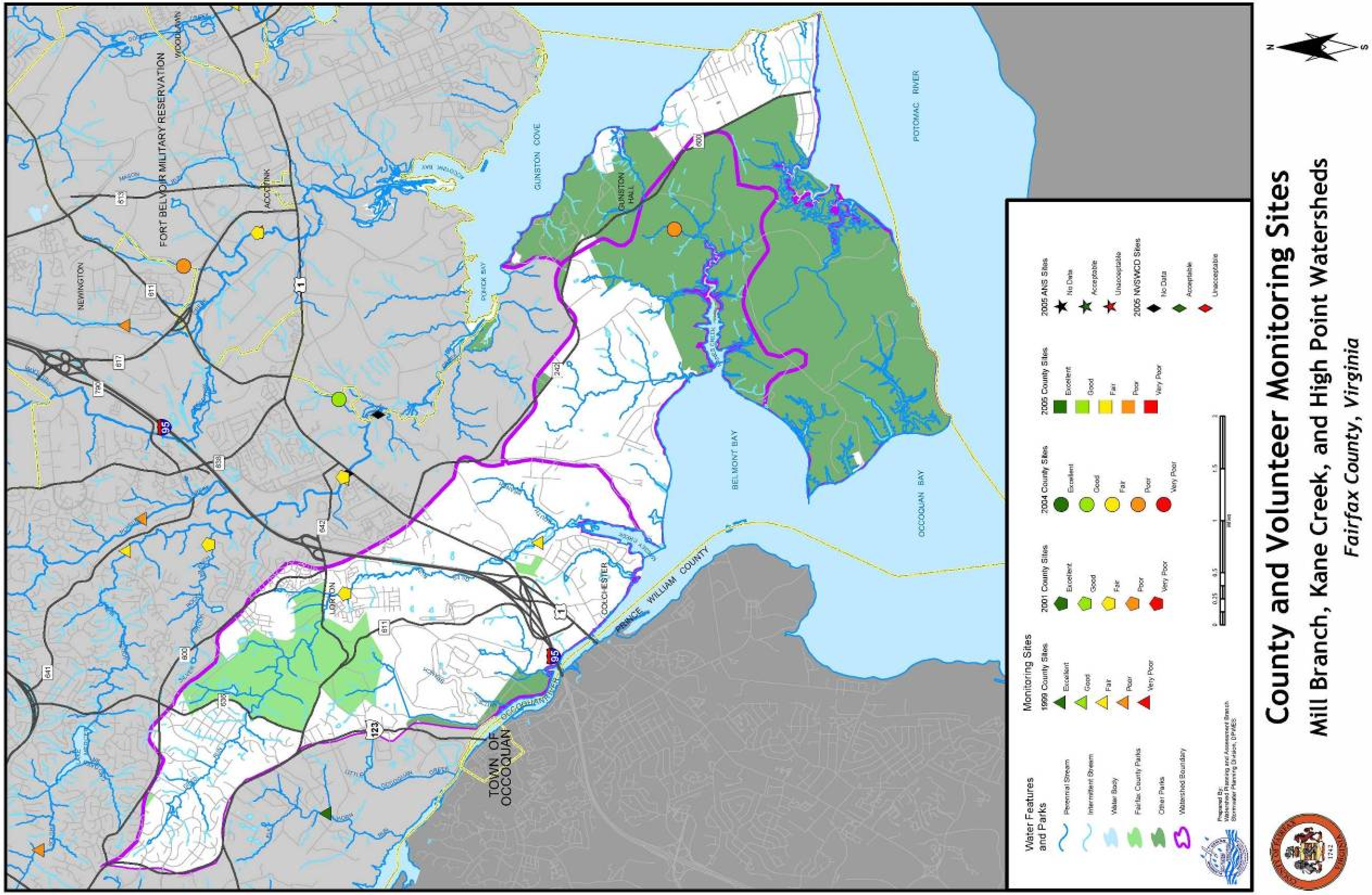

Figure 19: County and volunteer stream monitoring sites: Mill Branch, Kane Creek and High Point Watersheds

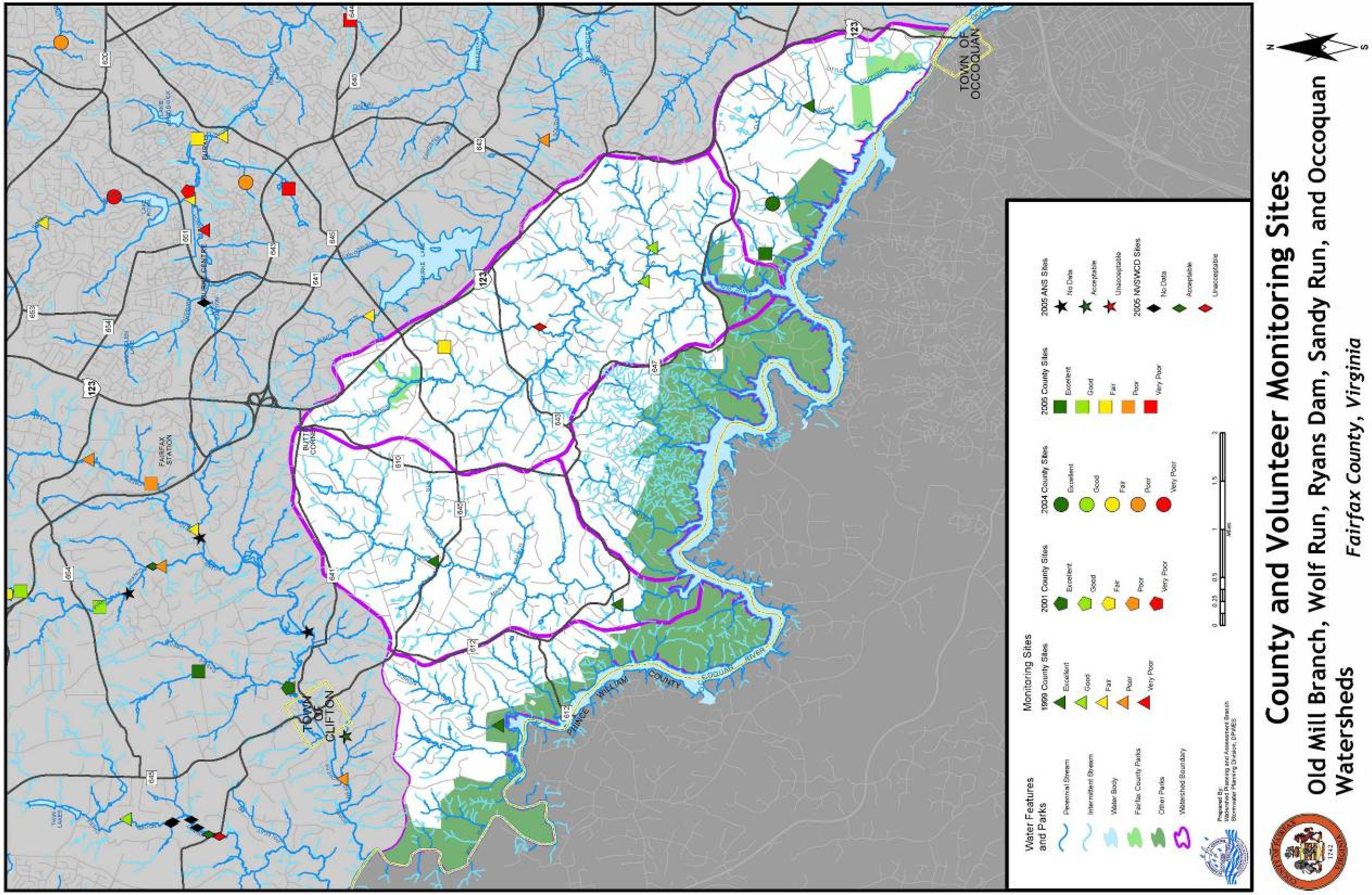

Figure 20: County and volunteer stream monitoring sites: Old Mill, Wolf Run, Ryan’s Dam, Sandy Run and Occoquan Watersheds

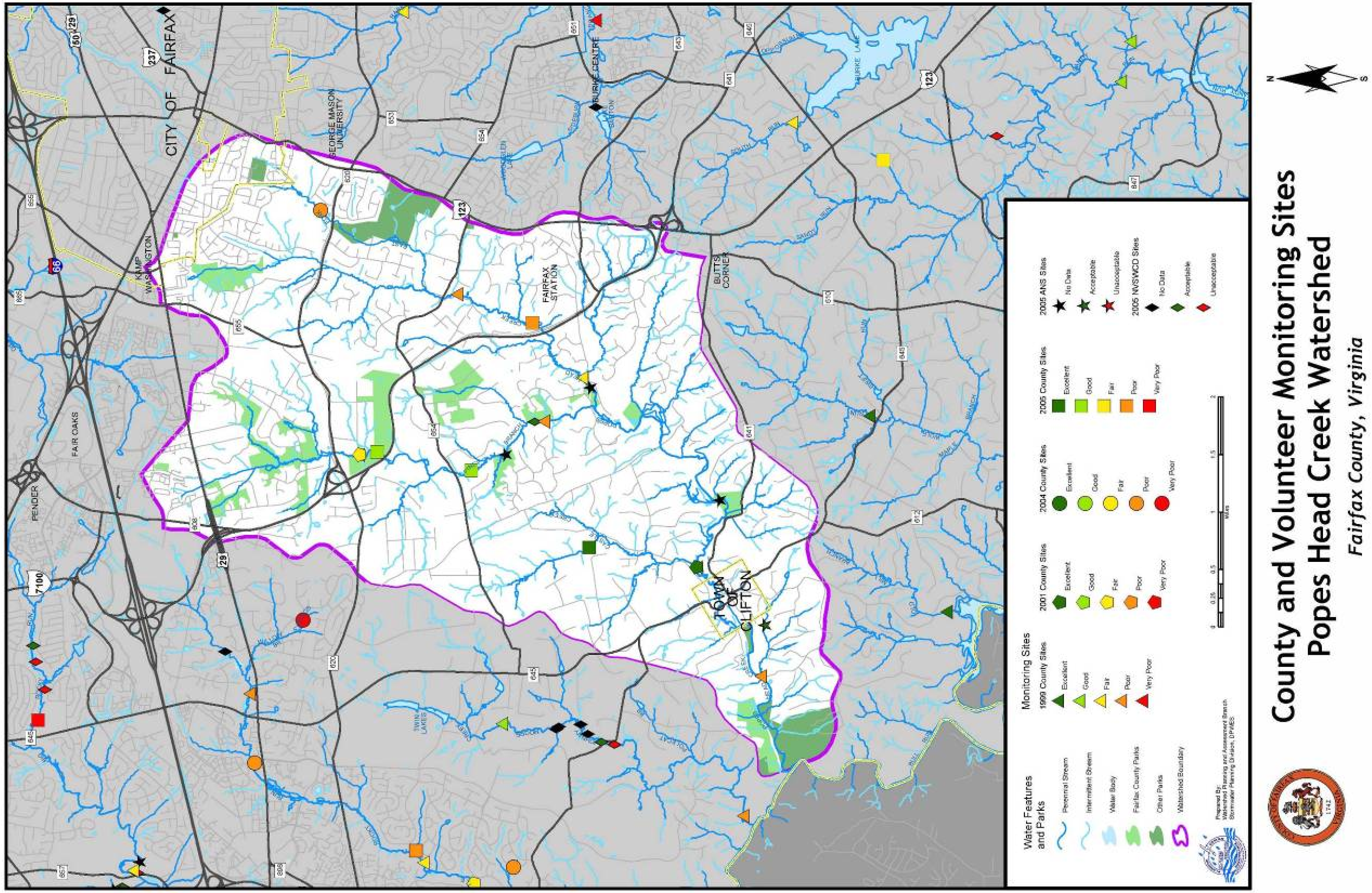

Figure 21: County and volunteer stream monitoring sites: Popes Head Creek Watershed

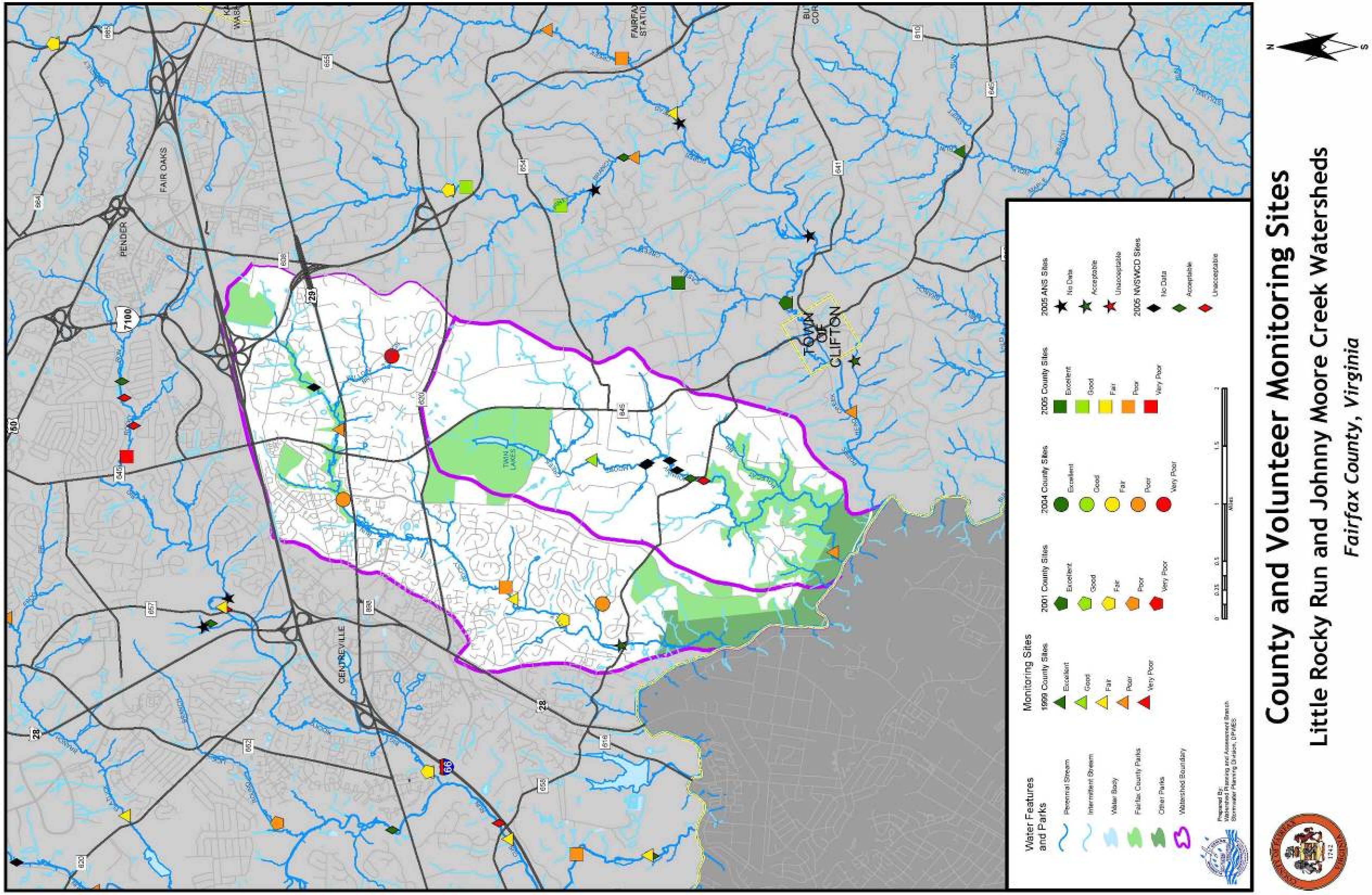

Figure 22: County and volunteer stream monitoring sites: Little Rocky Run and Johnny Moore Watersheds

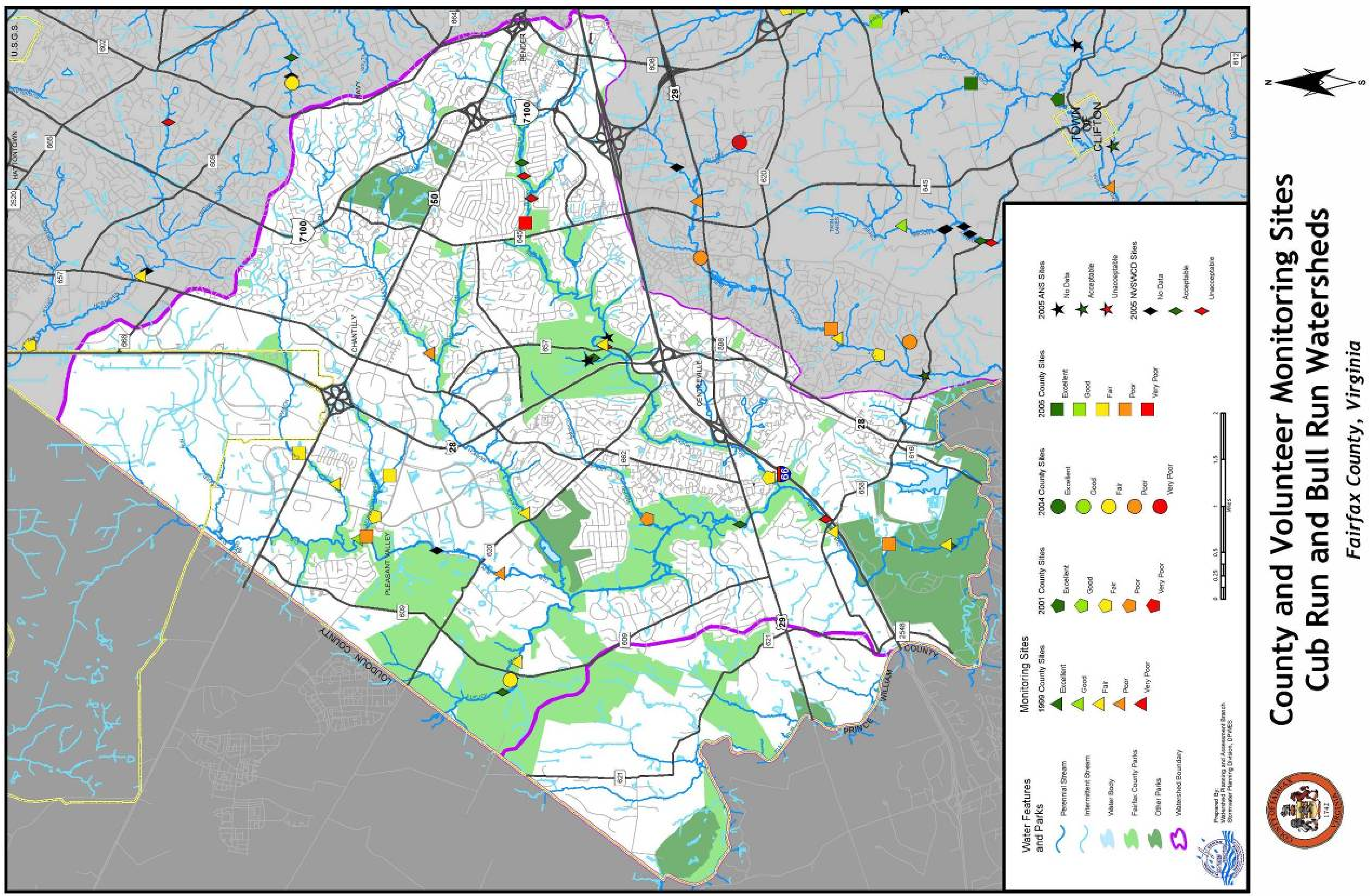

Figure 23: County and volunteer stream monitoring sites: Bull Run and Cub Run Watersheds

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5 Virginia Department of Environmental Quality 2006 Draft Impaired Waters Listings for Fairfax County

In August, the Virginia Department of Environmental Quality (VDEQ) released the draft 2006 Water Quality Assessment Integrated Report, which is a summary of the water quality conditions in Virginia from January 1, 2000, to December 31, 2004. The goals of Virginia's water quality assessment program are to determine whether water bodies meet water quality standards and then design and implement a plan to restore waters with impaired water quality. Water quality standards designate uses for waters and define the water quality needed to support each use. There are six designated uses for surface waters in Virginia: aquatic life, fish consumption, shellfish consumption, swimming, public water supplies (where applicable), and wildlife. Several new subcategories of the aquatic life use have been adopted for estuarine waters of the Chesapeake Bay and its tidal tributaries. If a water body contains more contamination than allowed by water quality standards, it will not support one or more of its designated uses. Such waters have "impaired" water quality and are listed on Virginia's 303(d) list as required under the Clean Water Act.

Once a water body has been listed as impaired, a Total Maximum Daily Load (TMDL) report identifying the sources causing the water quality problem and the reductions needed to resolve it must be developed by VDEQ and submitted to the United States Environmental Protection Agency (EPA) for approval. Upon approval, state law requires the Virginia Department of Conservation and Recreation (DCR) to develop a TMDL Implementation Plan outlining both point and non-point source controls needed to restore water quality. These specific controls may be incorporated into any Virginia Pollutant Discharge Elimination System (VPDES) permits identified as contributing to the water quality impairment. These permits are issued by VDEQ under the VPDES system and are used to regulate the inputs of pollution into receiving waters. The county holds a Municipal Separate Storm Sewer System (MS4) permit, which regulates the non-point source pollution entering receiving water bodies through the county's storm sewer system. Once specific controls are incorporated into a VPDES permit, these controls become mandatory.

The assessment and listing processes are based on water quality monitoring, which has been ongoing in Virginia for decades. In 1997, the Virginia General Assembly enacted the Water Quality Monitoring, Information, and Restoration Act (WQMIRA), which provides the VDEQ with a mandate to perform a minimum amount of water quality monitoring. The development and implementation of the Water Quality Monitoring Strategy in 2000 and its revision in 2004 have transformed Virginia's ambient monitoring program into a multilayered monitoring network that is designed to produce representative, high-quality data to support the evaluation, restoration, and protection of water quality for the purposes of fishing, swimming, boating, drinking, and the propagation and growth of a balanced, indigenous, healthy, natural ecosystem.

In order to achieve this goal, VDEQ has established a series of specific objectives to identify and define the diverse functions of its Water Quality Monitoring Program. These objectives include:

1. Assessment and remediation objectives to support the characterization of existing conditions, the identification and remediation of impaired waters, and the assessment and forecasting of trends in water quality.

2. Permit objectives to allow the calculation of permit limits and the evaluation of permit compliance.

3. Efficiency objectives to minimize any duplication of effort, increase the use of biological monitoring, investigate, identify and characterize additional avenues of water quality impairment, and guarantee adequate Quality Assurance/Quality Control (QA/QC) procedures.

4. Research objectives to provide data to validate special stream or site designations, evaluate new sampling methodologies, and provide data for other research objectives.

Virginia's monitoring network and special studies includes the following programs:

- WATERSHED (AW): VDEQ's ambient watershed network of stations represents the largest single section of the monitoring program.

- COASTAL 2000 (C2): Coastal 2000 is the federally funded tidal probabilistic program designed by U.S. EPA and sampled by VDEQ staff.

- CHESAPEAKE BAY (CB): Chesapeake Bay Program designed through the Federal Interstate Chesapeake Bay Program and encompassing a multi-state water quality characterization effort.

- CITIZEN MONITORING (CM): These stations are monitored due to specific requests from the public, usually as a result of local concerns.

- FACILITY INSPECTION (FI): Facility inspections are not specifically identified in the water quality monitoring strategy but are integral to determining compliance with discharge limits.

- FRESHWATER PROBABILISTIC (FP): The freshwater probabilistic monitoring program covers the non-tidal, free-flowing waters of the state and is designed to help determine the overall water quality of free flowing streams in Virginia.

- FISH TISSUE (FT): The fish tissue and sediment monitoring program is conducted by central office staff from the Office of Water Quality Standards.

- MERCURY (HG): The mercury Special Study Program is paid for by the responsible parties.

- POLLUTION COMPLAINTS (PC): Pollution complaints are special samples collected generally as a result of a petroleum spill.

- INCIDENT RESPONSE (IR): Incident response samples are the same as PC but are non-petroleum in origin.

- REGIONAL BIOLOGICAL (RB): The biological monitoring program focuses on the analysis of the benthic macroinvertebrate community as a tool to detect water quality conditions.

- RESERVOIR MONITORING (RL): Reservoir monitoring is described in the Lake Monitoring Guidance 3 available at http://www.deq.virginia.gov/waterguidance/pdf/022004.pdf.

- SPECIAL STUDIES (SS): Special studies are identified by individual project plans and are generally specialized intensive targeted monitoring efforts designed to answer specific hypotheses related to water quality conditions.

- TMDL (TM): TMDL monitoring stations are those stations associated with the development of a TMDL and subsequent implementation plan for segments listed as impaired.

- TREND (TR): Trend stations are long term stations sited for permanent monitoring for the purpose of detecting water quality trends for a wide variety of environmentally important water quality parameters.

- CARRYOVER (TW): Carryover stations have insufficient data for assessment and will be sampled until sufficient data is available to determine the water quality conditions.

A summary of the number of water bodies identified as impaired for both the 2004 and 2006 assessment periods is presented in Table 5. Table 6 presents more detail on the 2006 list of impaired waters, including the impacted use and related water quality standard for each water body. Figure 24 shows the location of all impaired water bodies within Fairfax County. Figures 25, 26 and 27 show the location of impairments based on the impacted designated use including aquatic life, fish consumption and recreational contact impairments.

Additional information on VDEQ's water quality program and 2006 report is available at:

http://www.deq.state.va.us/water/

Table 5: Summary of Impaired Waters in Fairfax County for 2004 and 2006

WATER TYPE	WATER NAME	NUMBER OF IMPAIRMENTS IN 2004	NUMBER OF NEW IMPAIRMENTS IN 2006	TOTAL NUMBER OF IMPAIRMENTS IN 2006
Estuarine	Accotink Bay	1	2	3
	Belmont Bay	1	2	3
	Belmont Bay (Occoquan River)		3	3
	Dogue Creek	1	3	4
	Four Mile Run	3	2	5
	Gunston Cove	1	2	3
	Hunting Creek/Potomac River/Belle Haven	1	3	4
	Little Hunting Creek	1	3	4
	Occoquan Bay	2	4	6
	Occoquan Bay/Belmont Bay	2	4	6
	Occoquan River	2	2	4
	Pohick Bay	2	6	8
	Total Estuarine Waters	11	1	12
	Total Estuarine Impairments	17	36	53
Reservoir	Occoquan Reservoir	1		1
Riverine	Accotink Creek	3		3
	Backlick Run	1		1
	Broad Run		4	4
	Bull Run	3	3	6
	Cameron Run/Hunting Creek		1	1
	Cub Run		1	1
	Difficult Run	2	4	6
	Elklick Run		2	2
	Holmes Run	2		2
	Indian Run		1	1
	Mills Branch	1		1
	Mine Run		1	1
	Pimmit Run	3	4	7
	Pohick Creek	2	2	4
	Popes Head Creek	1	1	2
	Snakeden Branch		1	1
	Sugarland Run		2	2
	Tripps Run	1		1
	Wolf Run		1	1
	Total Riverine Waters	10	9	19
	Total Riverine Impairments	19	28	47
Total Waters With Impairments		22	10	32
Total Impairments		37	64	101

Table 6: Summary of 2006 VDEQ list of impaired waters in Fairfax County

WATER TYPE	WATER BODY NAME	SEGMENT ID	Aquatic Life: Sub-merged Aquatic Plants	Aquatic Life: Benthic	Aquatic Life: Estuarine Bio-Assessment	Aquatic Life: Dissolved Oxygen	Aquatic Life: pH	Fish Consumption: Benzo[k] fluor-anthene	Fish Consumption: Chlor-dane	Fish Consumption: Hepta-chlor epoxide	Fish Consumption: PCB in Fish Tissue	Recreation: E. coli	Recreation: Fecal Coliform	Total	Units
Estuarine	Accotink Bay	VAN-A15E_ACO01A06	0.3								0.3			0.3	Sq. Mi.
	Belmont Bay	VAN-A25E_OCC04A02	0.4								0.4			0.4	Sq. Mi.
	Belmont Bay (Occoquan I	VAN-A25E_OCC03A04	0.4		0.4									0.4	Sq. Mi.
	Dogue Creek	VAN-A14E_DOU01A00	0.7								0.7		0.7	0.7	Sq. Mi.
	Fourmile Run	VAN-A12E_FOU01A00	0.1								0.1	0.1	0.1	0.1	Sq. Mi.
	Gunston Cove	VAN-A15E_POH01A00	1.5								1.5			1.5	Sq. Mi.
	Hunting Creek/Potomac F	VAN-A13E_HUT01A02	1.3								1.3	1.3		1.3	Sq. Mi.
	Little Hunting Creek	VAN-A14E_LIF01A00	0.2								0.2	0.2		0.2	Sq. Mi.
	Occoquan Bay	VAN-A25E_OCC01A04	0.5								0.5			0.5	Sq. Mi.
		VAN-A25E_OCC02A00	0.6				0.6							0.6	Sq. Mi.
	Occoquan Bay/Belmont B	VAN-A25E_OCC20A02	5.4								5.4			5.4	Sq. Mi.
		VAN-A25E_POT20A02	0.2								0.2			0.2	Sq. Mi.
	Occoquan River	VAN-A25E_OCC05A02	0.1								0.1		0.1	0.1	Sq. Mi.
	Pohick Bay	VAN-A15E_POH02A00	0.6								0.6		0.6	0.6	Sq. Mi.
		VAN-A16E_POH01A06	0.3								0.3		0.3	0.3	Sq. Mi.
Estuarine Total			12.6	0.0	0.4	0.0	0.6	0.0	0.0	0.0	11.7	1.6	1.7	12.6	Sq. Mi.
Reservoir	Occoquan Reservoir	VAN-A24L_OCC01A02				1,327.5								1,327.5	Acres
Reservoir Total			0.0	0.0	0.0	1,327.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,327.5	Acres
Riverine	Accotink Creek	VAN-A15R_ACO01A00		7.9									7.9	7.9	Miles
		VAN-A15R_ACO04A02										1.2		1.2	Miles
	Backlick Run	VAN-A13R_BAL01A00											6.5	6.5	Miles
	Broad Run	VAN-A09R_BRB01A00		2.9							2.9			2.9	Miles
		VAN-A09R_BRB02A06									2.2			2.2	Miles
		VAN-A09R_BRB03A06									1.1			1.1	Miles
	Bull Run	VAN-A21R_BUL01A06									0.2			0.2	Miles
		VAN-A21R_BUL01B06									2.5			2.5	Miles
		VAN-A23R_BUL01B04									0.9			0.9	Miles
		VAN-A23R_BUL02A02		4.8							4.8		4.8	4.8	Miles
	Cameron Run/Hunting Cr	VAN-A13R_CAM01A04										2.0		2.0	Miles
	Cub Run	VAN-A22R_CUB01A00										6.7		6.7	Miles
	Difficult Run	VAN-A11R_DIF01A00		2.9						2.9	2.9	2.9		2.9	Miles
		VAN-A11R_DIF01B06									1.0			1.0	Miles
		VAN-A11R_DIF03A02										3.2		3.2	Miles
	Elklick Run	VAN-A22R_ELC01A04										2.2	2.2	2.2	Miles
	Holmes Run	VAN-A13R_HOR01A00											3.6	3.6	Miles
		VAN-A13R_HOR01B00		5.8										5.8	Miles
	Indian Run	VAN-A14R_INA01A06									2.9			2.9	Miles
	Mills Branch	VAN-A25R_WLB01A02											1.7	1.7	Miles
	Mine Run	VAN-A11R_MNR01A04										0.9		0.9	Miles
	Pimmit Run	VAN-A12R_PIM01A00							1.6	1.6	1.6		1.6	1.6	Miles
		VAN-A12R_PIM02A00									2.5		2.5	2.5	Miles
		VAN-A12R_PIM02B06											3.3	3.3	Miles
	Pohick Creek	VAN-A16R_POH01A00						3.2			3.2	3.2		3.2	Miles
		VAN-A16R_POH03A04										1.5		1.5	Miles
	Popes Head Creek	VAN-A23R_POE01A00		4.9								4.9		4.9	Miles
	Snakeden Branch	VAN-A11R_SNA01A02										0.8		0.8	Miles
	Sugarland Run	VAN-A10R_SUG01A00										4.7		4.7	Miles
		VAN-A10R_SUG01B06										1.0		1.0	Miles
	Tripps Run	VAN-A13R_TRI01A00		2.2										2.2	Miles
	Wolf Run	VAN-A24R_WOL01A06										2.3		2.3	Miles
Riverine Total			0.0	31.5	0.0	0.0	0.0	3.2	1.6	4.6	28.8	37.7	34.1	91.4	Miles

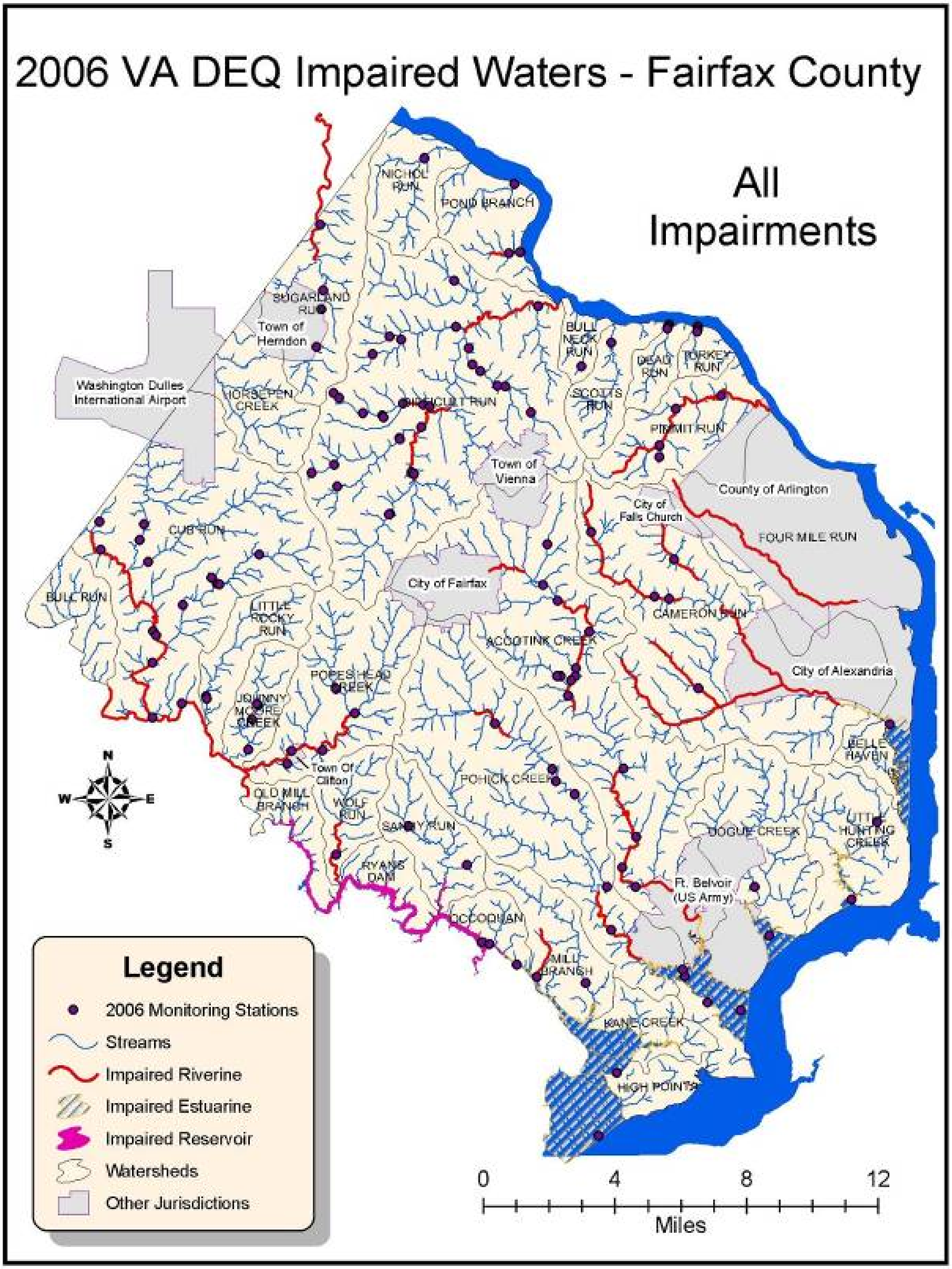

Figure 24: All Impaired waters within Fairfax County as listed on the State of Virginia's 2006 draft 303(d) report to US EPA - per the Clean Water Act mandate(s)

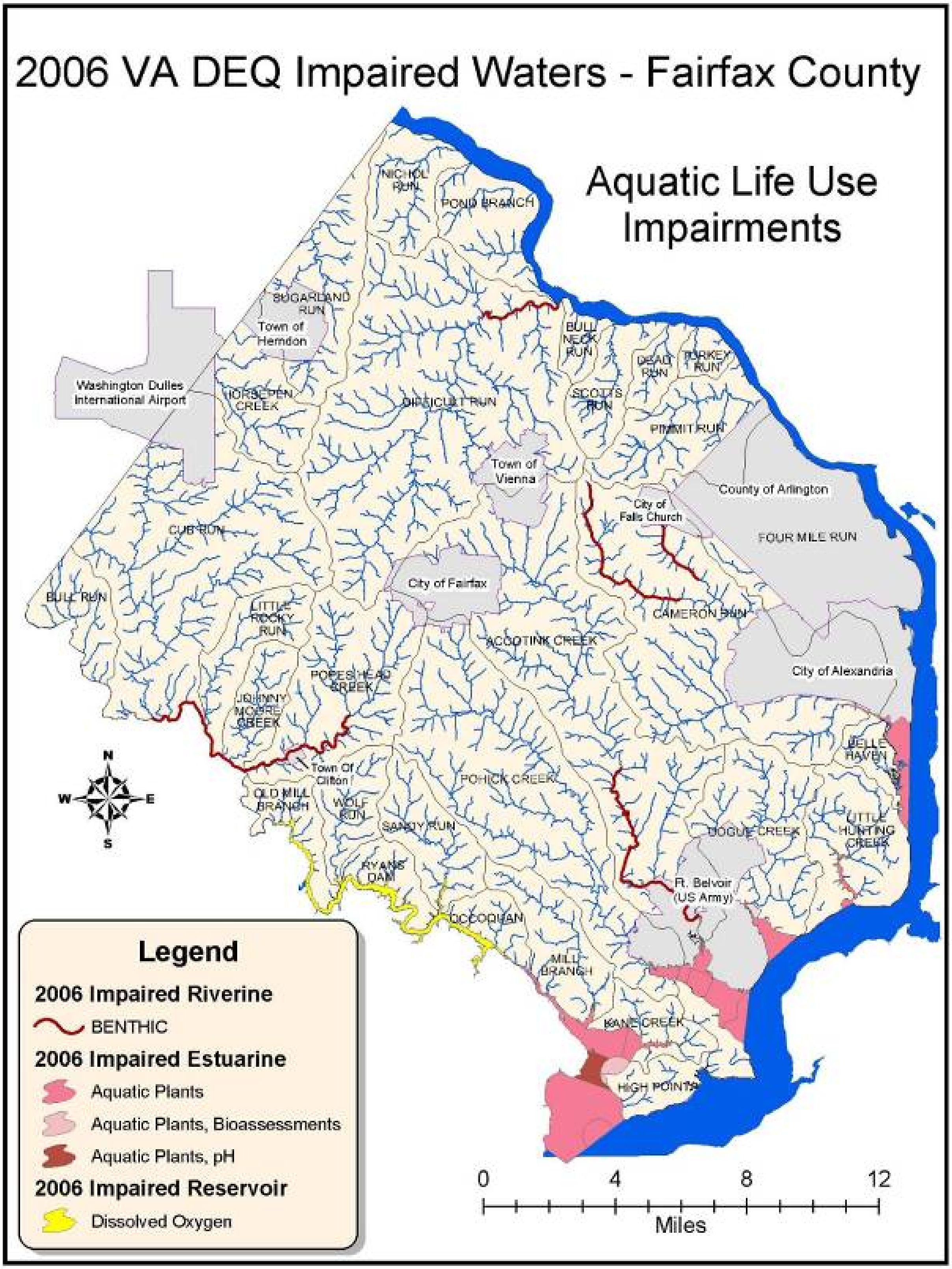

Figure 25: Waters designated as impaired for aquatic life uses within Fairfax County (as listed on the State of Virginia's 2006 draft 303(d) report to US EPA)

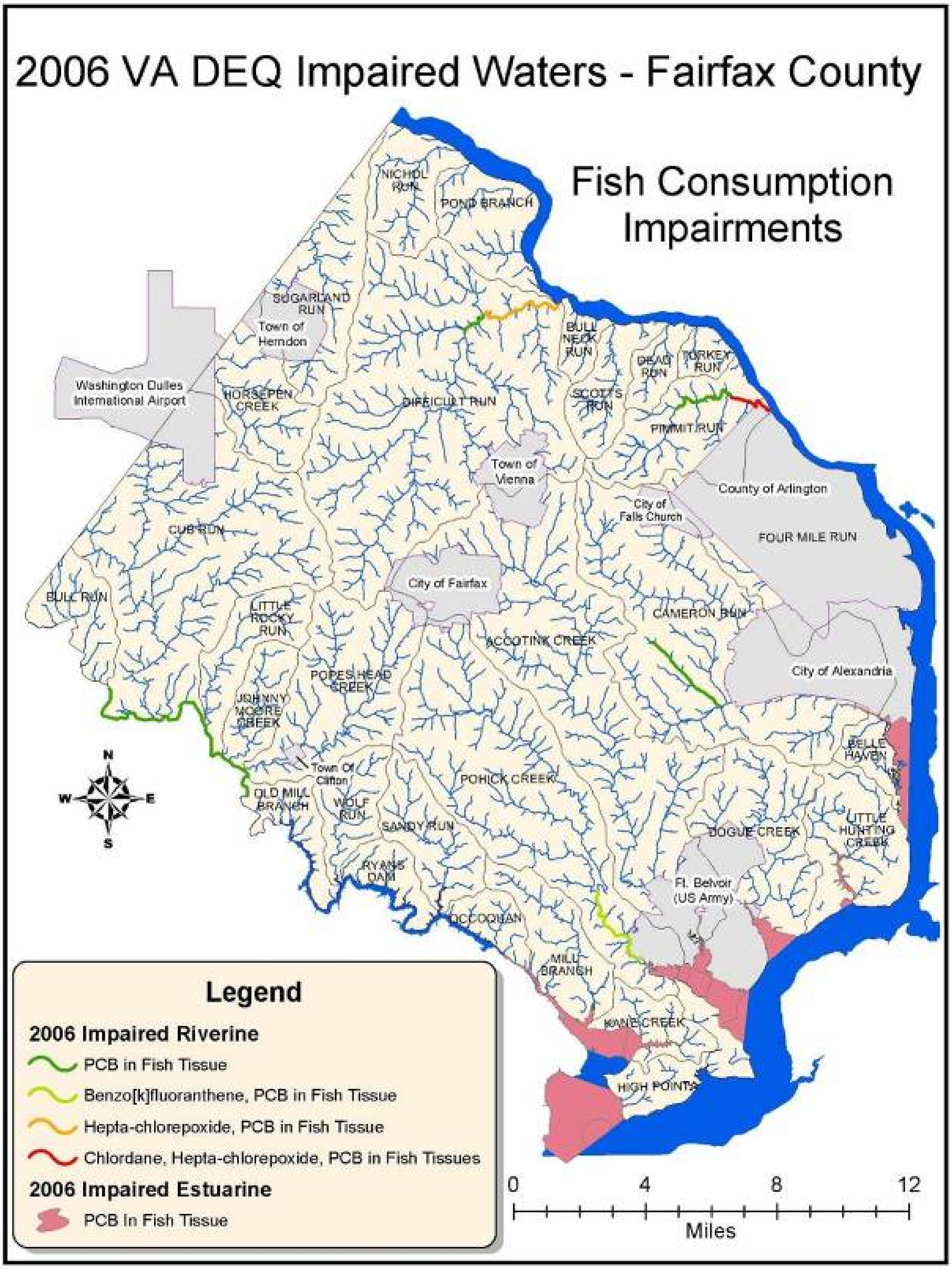

Figure 26: Fairfax County waters designated as impaired for fish consumption use (as listed on the State of Virginia's 2006 draft 303(d) report to US EPA)

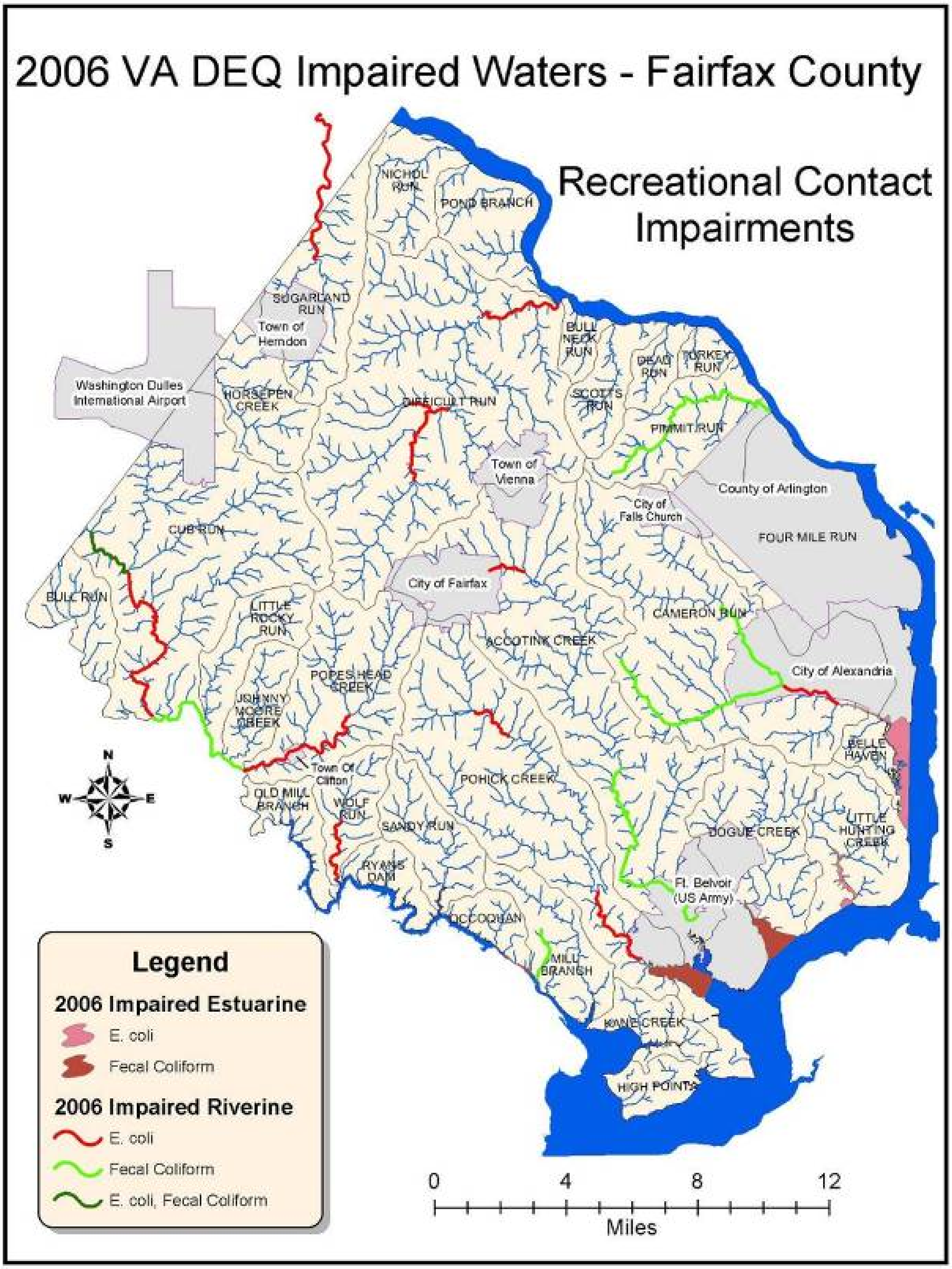

Figure 27: Fairfax County waters designated as impaired for recreational contact use (as listed on the State of Virginia's 2006 draft 303(d) report to US EPA)

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7 Glossary

B

Baseline Monitoring: Data collection intended to define existing biological conditions and to set up a framework for long-term study.

Benthic: That portion of the aquatic environment inhabited by organisms which live permanently in or on the bottom.

Benthic Macroinvertebrate: An aquatic animal lacking a backbone and generally visible to the unaided eye.

Biomonitoring: The use of living organisms to assess environmental conditions.

C

Canopy Cover: The amount of cover provided by trees and shrubs.

Clean Water Act: A law enacted by the United States Congress in 1972 and enforced by the Environmental Protection Agency on the national level and the Georgia Environmental Protection Division on the local level. The Clean Water Act established three main goals: "zero discharge" also known as the elimination of polluting discharges to the nation's waters by 1985; "fishable and swimmable waters" also known as the restoration and protection of water quality and wildlife habitat; and "no toxins in toxic amounts" or the prohibition of the discharge of toxic pollutants in amounts that are toxic to the environment or life.

Coastal Plain: The physiographic province that lies along the Atlantic coast and extends inland to the Piedmont physiographic province. This area is generally characterized by low gradient, meandering streams with mobile sand/silt or gravel substrates.

Community: This is a group of organisms living together.

D

Dissolved Oxygen: The amount of oxygen freely available in water and necessary for aquatic life and the oxidation of organic materials.

E

***E. coli*:** A species of fecal coliform bacteria that is specific to fecal material from humans and other warm-blooded animals. The EPA states that E. *coli* is the best indicator of health risk from water contact in recreational waters.

Ecosystem: All of the component organisms of a community and their environment that, together, form an interacting system.

Electrofishing: Fish sampling method using electrical currents to temporarily stun fish to facilitate capture. Fish species help indicate stream water quality.

Embeddedness: Refers to the extent to which stream substrate (gravel, cobble, boulders and snags) is filled and/or covered with silt, sand, or mud.

F

Fecal Coliform Bacteria: A group of organisms common to the intestinal tracts of humans and of animals. The presence of fecal coliform bacteria in water is an indicator of pollution and of potentially dangerous bacterial contamination.

Fish Index of Biotic Integrity (F-IBI): A stream assessment tool that evaluates the biological integrity of streams based on various characteristics of the fish community at a site.

G

Genus: A taxonomic category.

Geographic Information System (GIS): A method of overlaying spatial land and land use data of different kinds. The data are referenced to a set of geographical coordinates and encoded in a computer software system. GIS is used by many localities to map utilities and sewer lines and to delineate zoning areas.

Glide: Section of a stream with a relatively high velocity and with little or no turbulence on the surface of the water.

H

Habitat: The environment in which an organism lives.

Habitat Generalists: Organisms that are not bound to one particular type of habitat in order to exist and thrive. Systems with degraded habitat are dominated by these organisms. These, therefore, make good indicators for assessing habitat quality.

I

Impervious Cover: A surface composed of any material that significantly impedes or prevents natural infiltration of water into soil (e.g. sidewalks, houses, parking lots, roofs, and streets).

Imperviousness: The percentage of impervious cover within a defined area.

Impoundment: A body of water contained by a barrier such as a dam.

Index of Biotic Integrity (IBI): A multi-parameter assessment tool that evaluates the biological integrity of stream ecosystems based on characteristics of the fish or benthic macroinvertebrate community at a site.

Intolerant Species: Populations of animals and/or plants that are adversely affected by low levels of degradation or disturbance to habitat and/or water quality.

M

Metric: A characteristic of a habitat or biological community structure that changes in some predictable way with increased disturbance or divergence from normal, natural conditions. Several metrics are aggregated to form the Index of Biological Integrity

N

Native Species: A species that exists naturally in an area. It is not introduced.

Nitrate: A form of nitrogen which is found in several different forms in terrestrial and aquatic ecosystems. Sources of nitrates include wastewater treatment plants; runoff from fertilized lawns and cropland; failing on-site septic systems; runoff from animal manure storage areas; and industrial discharges that contain corrosion inhibitors.

Non-native species: Species that have been introduced into an area by man. Typically these organisms disturb the ecosystem by out competing the native inhabitants. Usually the degree of ecosystem disturbance is directly related to the proportion of non-native species to the native inhabitants.

Nonpoint Source Pollution (NPS): Contaminants such as sediment, nitrogen, phosphorous, hydrocarbons, heavy metals, and other toxins whose sources cannot be pinpointed but rather are washed from the land surface in a diffuse manner by stormwater runoff.

O

Omnivores: An animal that feeds on a variety of foods. Typically, these organisms are more successful in degraded environments due to their diverse diet as opposed to species that have very specific diet dependencies.

P

Perennial Streams: A body of water that normally flows year-round in a defined channel or bed, and is capable, in the absence of pollution or other manmade stream disturbances, of supporting bottom dwelling aquatic animals.

Pervious: Any material that allows for the passage of liquid through it. Any surface area that allows infiltration.

pH: 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.

Phosphate: A form of phosphorus, which is found in terrestrial and aquatic systems.

Physiographic Provinces: A region whose pattern of relief features or landforms differs significantly from that of adjacent regions.

Piedmont: This physiographic province bordered by the Atlantic Coastal Plain to the east and the Appalachian Mountains to the west and is generally characterized by rolling terrain with streams of moderate gradient and cobble/gravel substrates.

Point Source: Any discernible, confined conveyance, including but not limited to, any pipe, ditch, channel, tunnel, well, concentrated animal feeding operation, landfill leachate collection system, or floating craft from which pollutants are discharged. This term does not include return flows from irrigated agriculture or agricultural storm water runoff.

Pollutant: Any substance introduced to water that degrades its physical, chemical, or biological quality.

Pool: The reach of a stream between two *riffles*; a small and relatively deep body of quiet water in a stream or river. Natural streams often consist of a succession of pools and riffles.

Q

Quality Assurance/Quality Control (QA/QC): A system of procedures, checks, audits, and corrective actions to ensure that research design and performance, environmental monitoring and sampling, and other technical and reporting activities are of the highest achievable quality.

R

Rapid Bioassessment Protocol (RBP): A synthesis of techniques and methodologies for quickly assessing habitat and biological conditions in stream systems.

Reference Conditions: Conditions (i.e. habitat, chemical, biological) that reflect least impaired or best attainable conditions in a given area.

Reference Streams: Streams which exhibit highest quality or least impaired habitat conditions that are used as a standard to which all other streams are compared.

Resource Protection Area (RPA): That component of the Chesapeake Bay Preservation Area comprised of lands at or near the shoreline of water bodies that have an intrinsic water quality value due to the ecological and biological processes they perform or are sensitive to impacts which may result in significant degradation to the quality of state waters. Inversely, all other land outside RPAs within Fairfax County is considered Resource Management Areas (RMA).

Restoration: Improving conditions within a natural system so that its functional characteristics are comparable to its original, unaltered state.

Riffle: A reach of stream that is characterized by shallow, fast moving water broken by the presence of rocks and boulders.

Riparian Buffer: A transitional area around a stream, lake, or wetland left in a natural state to protect the water body from runoff pollution. Development is often restricted within such zones.

S

Specific Conductance: The ability of water to pass an electrical current while taking into account temperature and pressure, both factors which may affect the conductivity of a sample.

Stormwater Runoff: That portion of precipitation that is discharged across the land surface or through conveyances to one or more waterways.

Subwatershed: A defined land area within a watershed drained by a river, stream or drainage way, or system of connecting rivers, streams, or drainage ways such that all surface water within the area flows through a specific point.

T

Taxonomic: Relating to a category or group, such as a phylum, order, family, genus, or species within the Linnaeus biological classification system of nomenclature used to distinguish different levels of relationships between living organisms.

Tolerant Species: Animals and/or plants that can withstand high levels of degradation.

Total Maximum Daily Load (TMDL): The maximum levels of a particular pollutant that a water body can receive in a given day without violating pre-established water quality standards. Total Maximum Daily Loads are the sum of point and nonpoint source loads.

Triassic Basin: This physiographic province is a subprovince of the Piedmont Upland. The geology consists largely of red sedimentary (sandstone, siltstone, shale, and conglomerate) rocks characterized by wide and gently rolling hilltops, with long gently sloping sideslopes and nearly level areas.

Trophic: This term is related to an animal's feeding preferences.

Turbidity: A measure of the suspended solids in a liquid.

V

Virginia Pollutant Discharge Elimination System (VPDES): Mandated by Congress under the Clean Water Act, a two-phased national program administered by the state of Virginia to address nonagricultural sources of non point-source pollution and prevent harmful pollutants from being washed into local water bodies via stormwater runoff.

W

Watershed: A discrete unit of land drained by a river, stream, drainage way or system of connecting rivers, streams or drainage ways such that all surface water within the area flows through a single outlet.

Wetland: Land that is saturated with water and which contains plants and animals that are adapted to living on, near, or in water. Wetlands have hydric soils and are usually located between a body of water and land.