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.

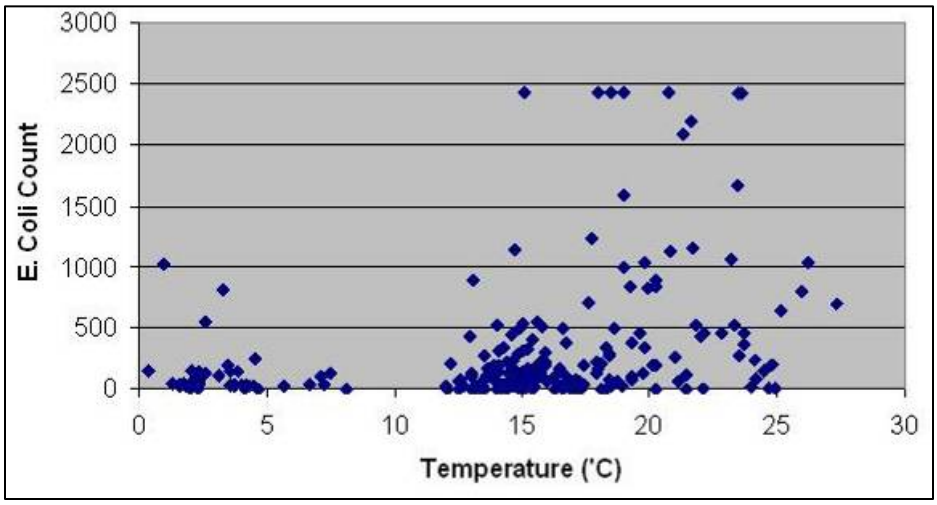

Figure 4: *E. coli* concentrations plotted against water temperature.

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.

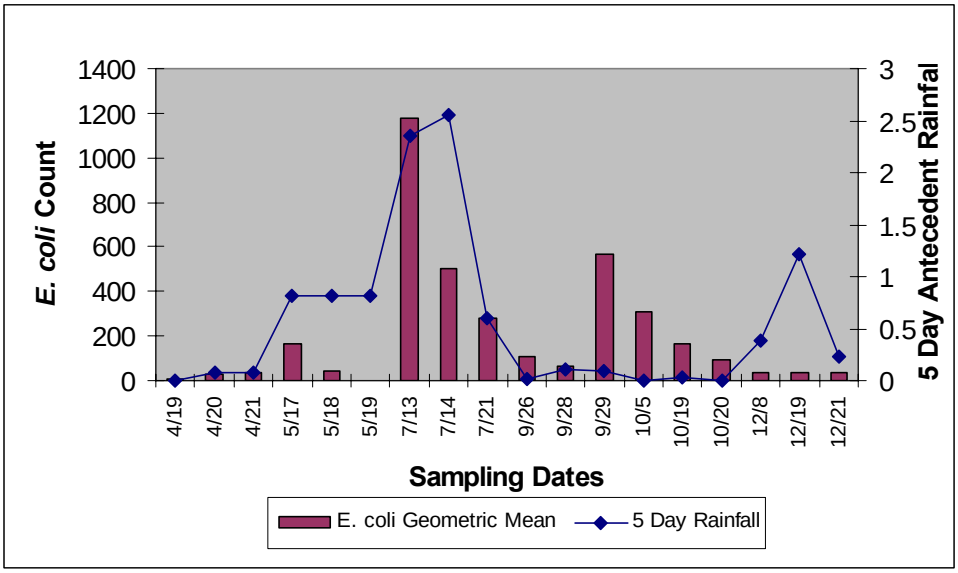

Figure 5: Geometric mean of *E. coli* concentrations versus 5-day antecedent rainfall.

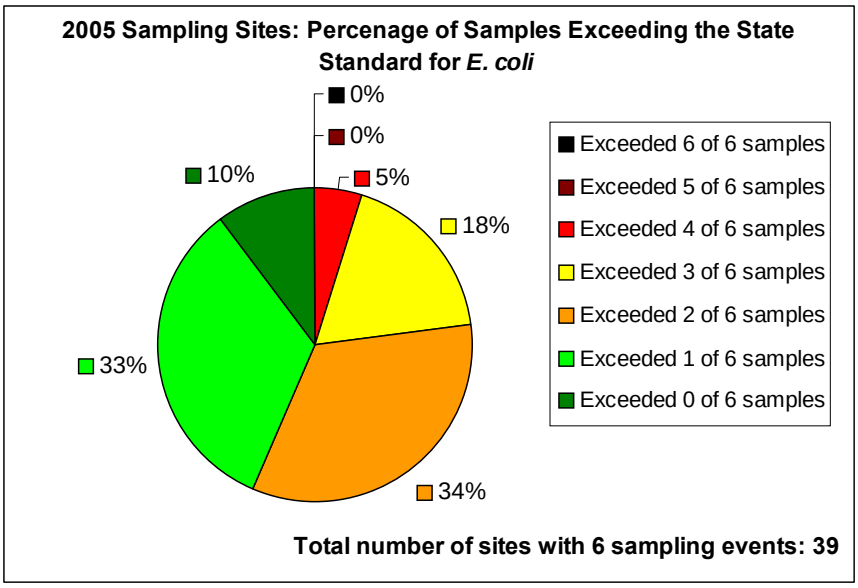

Figure 6: Percentage of sites that exceeded state water quality standard (235 cfu per 100mL) for *E. coli*.

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.

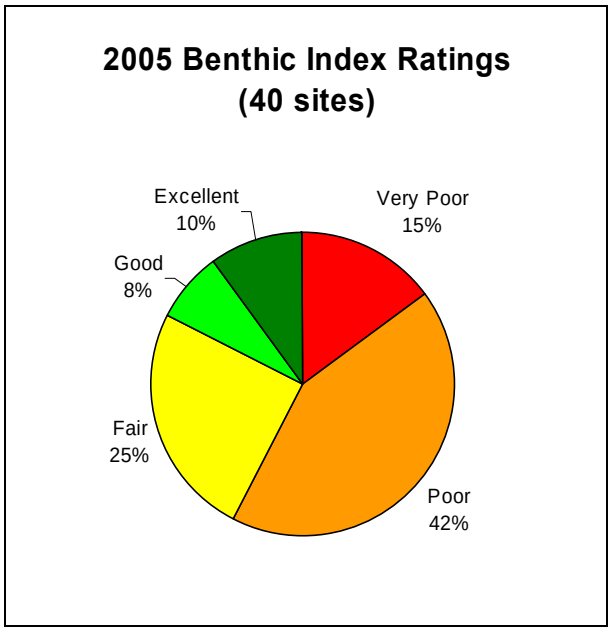

Figure 7: Ratings of 2005 biomonitoring sites based on the Benthic Index of Biotic Integrity

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.

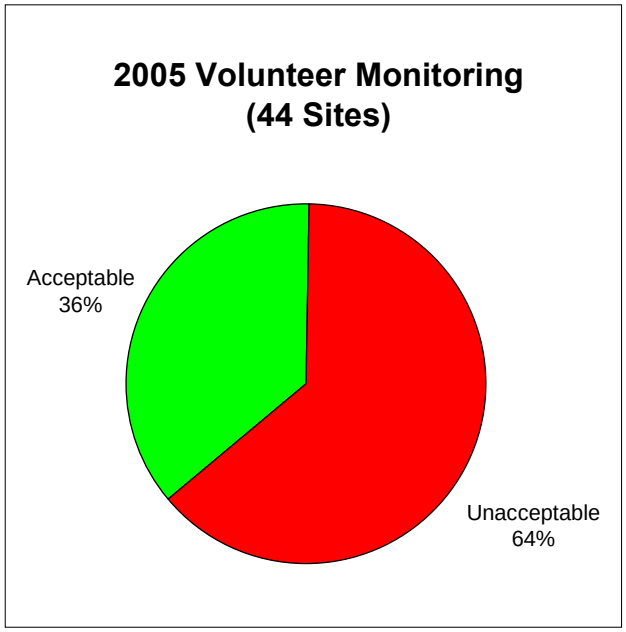

Figure 8: 2005 Site ratings from NVSWCD and ANS volunteer monitors

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.

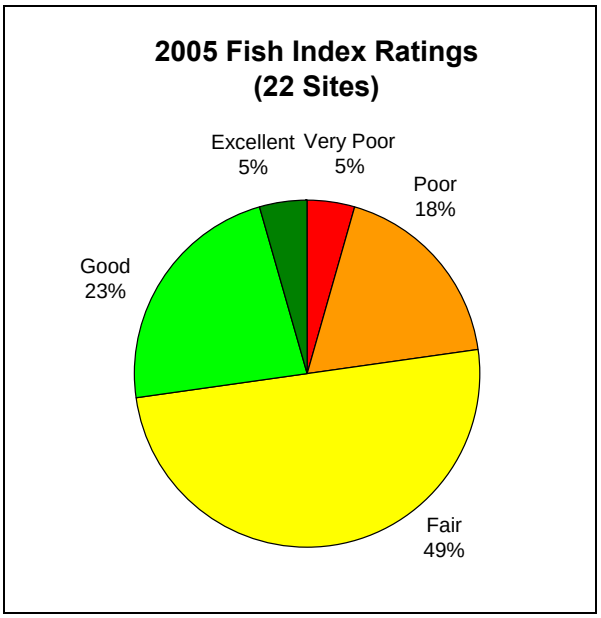

Figure 9: Ratings of 2005 biomonitoring sites based on the Fish Index of Biotic Integrity.

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.

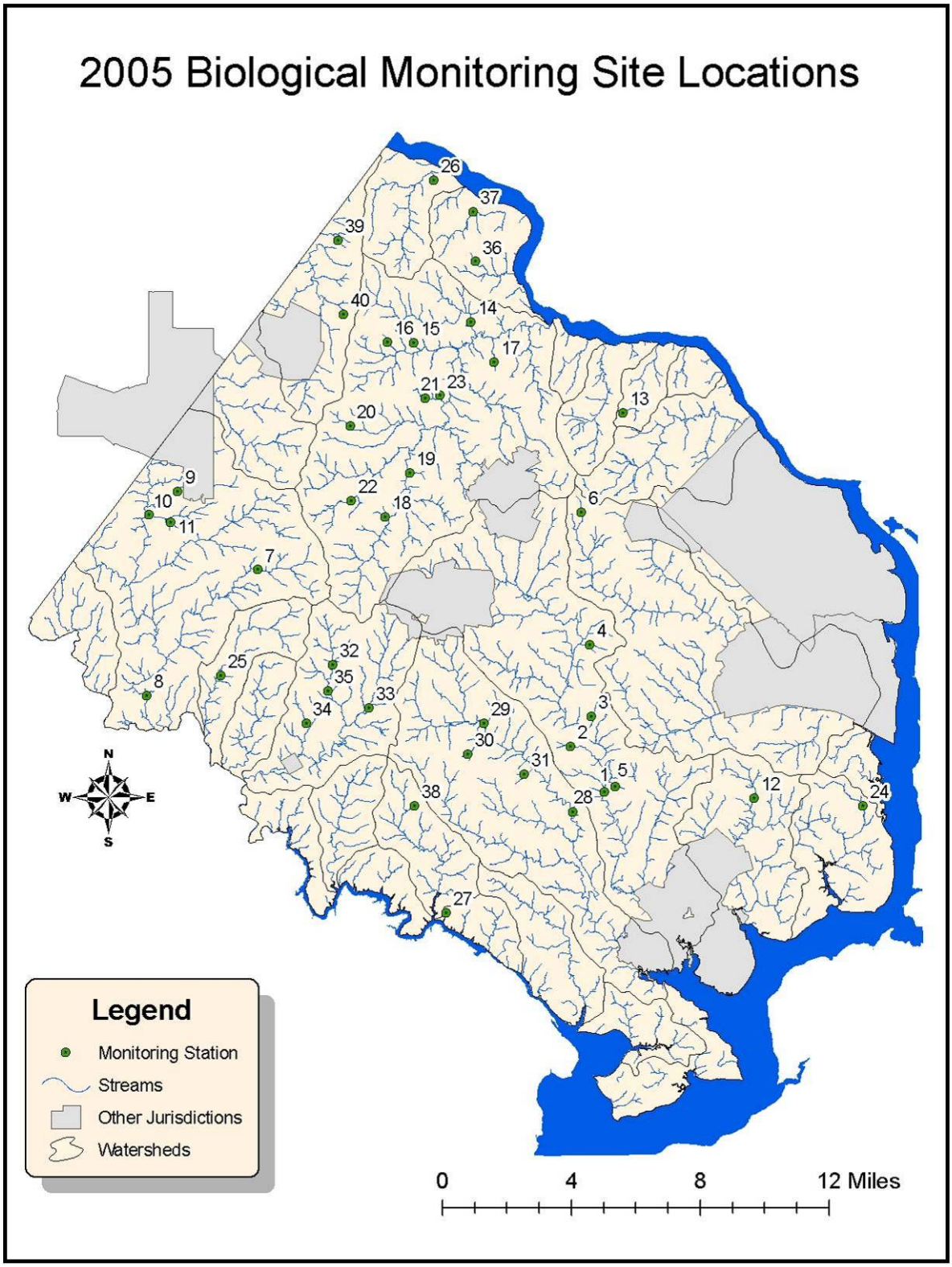

Figure 10: Locations of randomly-selected monitoring sites (biological and bacteriological) for 2005 sample year.

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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