

Anne Arundel County, Maryland Department of Public Works *Watershed, Ecosystem, and Restoration Services* 



Aquatic Biological Assessment of the Watersheds of Anne Arundel County, Maryland: 2008



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### Abstract

The Anne Arundel County Department of Public Works (DPW) assesses water resource quality as it relates to the intended uses of the waterbodies and State regulations. One intended use of all waterbodies is the support of aquatic life. Assessment of the ability of a stream to support aquatic life can be accomplished for the entire County through probability-based site selection (stratified random), sampling of the stream biota, and calculation of site-specific and watershed wide indicators. Further, observations of the physical habitat and water quality can help describe conditions that may be contributing to biological degradation. Sampling in five primary sampling units (PSUs) in 2008 partially fulfills the goal of County-wide stream assessment. The PSUs include Sawmill Creek, Rhode River, West River, Rock Branch, and Cabin Branch. The indicators used to assess the support of aquatic life in streams include the Benthic Index of Biological Integrity (B-IBI), the Rapid Bioassessment Protocol (RBP) physical habitat assessment, the MBSS Physical Habitat Index (PHI), and in situ water quality measures (temperature, dissolved oxygen, and specific conductance). Geomorphic conditions were also evaluated using the Rosgen classification of natural rivers. Each of these indicators was compared to established thresholds and the percentage of sites/samples meeting them is used to estimate the extent of biological degradation in the PSU, as well as the extent of physical habitat degradation. For the PSUs, 2% of the B-IBI scores indicated "Good" biological conditions and 8% indicated "Fair" conditions, and 90% of the streams were rated as either "Poor" or "Very Habitat measures using the RBP method indicated "Supporting" and "Partially Poor". Supporting" conditions in 12% and 56% of sites, respectively. The PHI indicated "Minimally Degraded," "Partially Degraded," "Degraded," and "Severely Degraded" conditions in 2%, 48%, 34%, and 8% of sites, respectively. Water quality measurements did not reveal temperature or dissolved oxygen values in non-attainment with state standards, though the sampling period did not coincide with the most stressful summer months. Thresholds for specific conductivity have not been established; however, the majority of values fall within normal ranges. A mix of stable and unstable channel types were observed during this assessment. Thirty-six percent of reaches assessed were classified as E type channels, considered a stable form. Conversely, 32% were classified as G type channels, a highly unstable form. Lesser amounts of B type (12%), C type (10%) and F type (2%) channels also were observed. All channels had sand-dominated bottoms and nearly all had slopes of much less than 2%. For the E types observed, significant differences in ER, Sinuosity, and W/D ratio were observed when compared to reference reach values for E types in the Western Coastal Plain. Water quality degradation is likely depressing biota at a minimum of 24% of sites.

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# Introduction

Anne Arundel County is bordered on the north by the Patapsco River, to the west by the Patuxent River and to the east by the Chesapeake Bay. All streams within the County, whether directly or eventually discharge indirectly, into the Chesapeake Bay. The Chesapeake Bay is the largest estuary in the United States (USEPA 2004) with a drainage area of over 64,000 square miles. It provides ideal habitat for a broad diversity of plant and animal species, and is an important economic and recreational resource for the more than 15 million people who live in its basin. However, rapidly expanding human activity and population in the basin is leading to increasing landscape conversion, rates of new and intensifying point and nonpoint sources of pollutants, and multiple other sources of stressors to environmental conditions. These factors can impair or destroy ecological integrity of stream systems, necessitating ecological restoration.

Broadly defined, ecological restoration is the elimination or buffering of stressors and stressor sources such that the system of interest is restored to some semblance of pre-disturbance conditions. extremely important confirmation One of restoration effectiveness is based on whether or not there is positive change in biological Further, such changes are most conditions. effectively measured at spatial scales above that of individual stream reaches, requiring monitoring in such a way as to allow broad spatial coverage, to minimize bias in the site selection process, and to structure assessments at multiple spatial scales. While it is impossible to know all stressor sources, the results of probability-based monitoring allow the description (with known confidence) of the cumulative effects of multiple sources. This is imperative because habitat fragmentation caused by development or other stressors can often be underestimated at smaller spatial scales (Robinson et al. 1992, Suter 1993). Further, traditional regulatory approaches do not adequately address

the effects of non-point source pollution, such as runoff or nutrient enrichment (USEPA 1996).

In 2004, the Anne Arundel County began a fiveyear, rotating basin sampling effort to assess the ecological condition of streams and watersheds throughout the County (Hill and Stribling 2004). The primary goals of the biomonitoring program are to assess the current ecological status of streams and watersheds of the County and to establish baseline conditions to which future assessments can be compared; to assess the status and trends of the biological stream resources, and to relate them to specific programmatic activities, such as BMP placement, installation, and evaluation (Stribling et al. 2001); stormwater discharge permits; contributing to restorations initiatives (such as DNR's Watershed Restoration Action Strategy [WRAS]); and guidelines for Low Impact Development [LID, PG County 2000).

In the first year of the monitoring program (2004), the Severn River (Severn Run and Lower Severn River), Lower Patapsco River, Middle Patuxent River, and Ferry Branch subwatersheds were assessed (Victoria and Markusic 2007). In 2005, Herring Bay, South River (Upper and Lower), Lyons Creek and Stocketts Run subwatersheds were assessed (Roberts et al. 2006). The third year (2006) addressed the Marley Creek, Bodkin Creek, Upper Magothy River and Hall Creek subwatersheds (Stribling et al. 2008a); and assessments in 2007 focused on the Upper Patuxent River, Little Patuxent River, Piney Run, Magothy River Stony Run. and Lower subwatersheds. The purpose of this report is to present sampling, analysis, and assessment results for the fifth year of sampling (2008), representing the final year of the 5-year, rotating basin biological monitoring and assessment program for Anne Arundel County. Subwatersheds sampled for this effort include the Sawmill Creek, Rhode River, West River, Rock Branch, and Cabin Branch subwatersheds.

# Purpose of Biological and Physical Habitat Assessment

The use of benthic macroinvertebrates as the basis of biological assessments is advantageous because 1) they are ubiquitous and often occur in large numbers; 2) they respond to cumulative effects of physical habitat alteration, point source pollution, non-point source contaminants; 3) they are relatively sedentary; and 4) different aspects of the benthic assemblage change in response to degraded conditions (Barbour et al. 1999).

To supplement biological sample collection, physical habitat quality was also visually assessed at each sampling location (Barbour et al. 1999, Kazvak 2001), which reflects physical complexity of the stream channel, the capacity of the stream to support a "healthy" biota, and potential of the channel to maintain normal rates of erosion and other hydrogeomorphic functions. Moreover, impacts on physical habitat through sustained farming operations, increased housing density, and other urban-suburban developments (highways, schools. shopping centers) can cause sedimentation, degradation of riparian vegetation, and bank instability, potentially leading to reduced overall habitat quality (Richards et al. 1996).

Further factors such as interruption of natural hydrologic regimes, alterations in food/energy sources and water quality, and nonnative invasive species cause the biological condition of a stream to deteriorate (Karr et al. 1986). Potential stressors that cause this type of degradation include nutrient enrichment, toxic spills, flood control engineering, temperature extremes due to depletion of riparian zones or effluent discharge, and elevated levels of suspended sediment due to livestock access, clearing of riparian areas, and/or construction runoff. Sources of these stressors exist throughout Anne Arundel County. However, although biological monitoring is a critical tool for detecting impairment, it cannot identify specific causal relationships between stressors and stressor sources (Norton et al. 2000, USEPA 2000).

Combining results from both biological and physical habitat assessments can provide insight into the potential types of stressors and stressor sources causing observed biological impairment. This allows prioritization of more detailed, diagnostic investigations based on the severity of observed biological responses. This report reflects the current biological, physical, and geomorphological conditions of Sawmill Creek, Rhode River, West River, Rock Branch, and Cabin Branch subwatersheds. (Figure 1), and provides potential reasons for those conditions.

# Methods

# Network Design

#### Summary of Sampling Design

Measurement and data quality objectives (MQOs and DQOs) for the Anne Arundel County biological monitoring program, including the approach for selection of sampling locations and documentation of data quality and performance characteristics, is presented in Hill and Stribling (2004) and Hill et al. (2005).

#### Site Selection

The program is designed so that 10 sites in each of four or five primary sampling units (PSU) are sampled per year, thus totaling 40-50 sites per year. Over the term of the five-year program, during which a total of 24 PSUs have been sampled, spatial allocation of the sampling segments was based on random selection within Strahler (1957) stream orders. Allocation of sample sites among 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> order streams was proportional to the total number of stream channel miles categorized as those orders Final selection and placement of sampling segments was random; stratified by subwatershed and stream order at 1:100,000 scale.

| Original<br>Site | Alternate<br>Site | Reason   |
|------------------|-------------------|--|
| 04-02            | 04-12A            | Dry streambed -BWI   |
| 04-03            | 04-13A            | No stream at location                                      |
| 04-04            | 04-15A            | No stream at location                                      |
| 04-05            | 04-20A            | Dry streambed  |
| 23-08            | 23-13A            | Denied access by landowner                                 |
| 20-09            | 20-11A            | Could not locate landowner                                 |
| 13-01            | 13-11A            | Denied access by landowner                                 |
| 13-02            | 13-12A            | Denied access by landowner                                 |
| 13-09            | 13-13A            | Could not locate<br>landowner - knocked<br>on door 2 times |
| 13-10            | 13-14A            | Denied access by landowner                                 |
| 14-04            | 14-12A            | No good access   |
| 14-05            | 14-14A            | No access - could not<br>locate landowner                  |
| 14-08            | 14-16A            | Dry streambed  |

| Table 1. | Alternate | sites | samp | led. |
|----------|-----------|-------|------|------|
|----------|-----------|-------|------|------|

For 2008, 10 randomly-selected sites were chosen from each PSU (Sawmill Creek [PSU no. 4], Rhode River [13], West River [14], Rock Branch [20], and Cabin Branch [23]) for a total of 50 sites. One site within each PSU was randomly-selected as a duplicate, to be used for quality control (QC), and to allow calculation of measurement (systematic) error, or field sampling precision. The number of repeat samples collected was 10 percent of the total for this sampling event (5 sites randomly selected from list for replication); thus, there were a total of 55 samples collected at 50 sites. Only biology, chemistry, and physical habitat data were collected at the QC sites.

#### Alternate Sites

In addition to the ten randomly selected primary sites, ten alternate sites were also selected. In the event that a primary site could not be sampled (e.g., due to access denial, non-wadeable, or impounded channel), the first alternate site of the same stream order was sampled in its place. This maintains the randomness of the design, while incorporating the flexibility necessary to account for unforeseen circumstances in the field. During the 2008 sampling period, it was necessary to sample 13 alternate sites (**Table 1**).

## Field Sampling and Laboratory Processing

Sites were located in the field using topographic maps and handheld GPS units for navigation to pre-selected coordinates, which mark the midpoint of each site. A 75-meter segment of stream was measured following the thalweg, and both upstream and downstream ends were flagged and labeled. Field data collection was conducted in accordance with the methods described in the *Sampling and Analysis Plan (SAP) for Anne Arundel County Biological Monitoring and Assessment Program* (Tetra Tech 2005), which is summarized below. Field data collection forms are included in *Appendix A*.



Figure 1. Anne Arundel County, Maryland. Sampling units assessed for the fifth year of the County's monitoring program (2008). Numbers are associated with the subwatershed framework of the monitoring design.

#### Benthic Sampling and Processing

Benthic macroinvertebrates were collected over a 75-meter reach by sampling approximately 20 ft<sup>2</sup> of surface area with a D-frame net (595 µm mesh), with an emphasis on the most productive habitat types (e.g., riffles, snags, vegetated banks, sandy bottom) found within the reach. The most productive habitat types, in order of sampling preference, include riffles, gravel/broken peat and/or clay lumps in a run area, snags/logs that create a partial dam or are in a run area, undercut banks and associated root mats in moving water, and detrital/sand areas in moving water. Kazyak (2001) also states that it is appropriate to move outside of the 75m reach if necessary to locate riffle habitat. Samples are primarily collected by jabbing the net into a habitat type (snags, root wads) to dislodge organisms or by disturbing the bottom substrate just upstream of the net allowing organisms to wash into the net. Larger surfaces such as logs or cobbles are often scrubbed by hand to further dislodge organisms. All sampled material (including leaf litter, small woody debris, and sediment) was composited in a 595 µm sieve bucket, placed in one or more one-liter sample containers and preserved in 70 - 80% ethanol. Internal and external labels were completed for each container. Samples were tracked on chainof-custody forms and transported to the laboratory for sorting.

All sorting of the samples and taxonomic identifications were completed by the Aquatic Resources Center (ARC), Nashville, TN. After a sample is collected in the field, it is subsampled to reach a target number of organisms. The subsampling method involved spreading the entire sample on a Caton gridded tray (Caton 1991, Flotemersch et al. 2006) with 30 square grids (6 by 6 cm each), which allows isolation of physically defined amounts of sample material (leaf litter detritus, sticks, substrate particles) from the total sample and the separation/removal of the organisms from that material. A minimum of four grids were selected at random and sorted to completion until the target number of organisms  $(100 \pm 20\%)$  was reached.

#### Benthic Taxonomy

Sample taxonomy using the methods of Boward and Friedman (2000) was performed by ARC, where specimens were identified primarily to genus level. In some cases, e.g., when individuals were early instars or had damaged or missing diagnostic morphological features, identification was left at more coarse levels, such as genusgroup, subfamily, or family level. Taxonomic data were received in Excel spreadsheets and loaded into the Ecological Data Application System, Version 3.2 (EDAS; Tetra Tech 1999). Functional feeding group, habit, and tolerance value designations were assigned to each taxon according to Merritt and Cummins (1996), Barbour et al. (1999), and Stribling et al. (1998). The tolerance value assigned to each taxon is based on its ability to survive and reproduce in the presence of chemical pollution, hydrologic alteration, or habitat degradation (Stribling et al. 1998, Bressler et al. 2005, 2006, Flotemersch et al. 2006).

# *Physical Habitat Rating (Methods for Calculation and Scoring)*

Physical habitat quality was visually assessed at each site using two procedures: the USEPA Rapid Bioassessment Protocol (RBP; Barbour and Stribling 1994; Barbour et al. 1999) and the Maryland Biological Stream Survey (MBSS) Physical Habitat Index (PHI; Paul et al. 2003). The RBP evaluates 10 variables that describe instream physical characteristics. channel morphology, and riparian vegetation and stream bank structure. Each variable was scored as either optimal, suboptimal, marginal, or poor and given a corresponding score based on a 20-point scale (20 = best, 0 = worst), or 10-point scale for individual bank parameters. The following 10 variables were evaluated:

- epifaunal substrate/available cover
- pool substrate characterization
- pool variability
- sediment deposition
- channel flow status
- channel alteration

- channel sinuosity
- bank stability
- vegetative protection
- riparian vegetative zone width

The MBSS PHI is based on the USEPA RBP method but has been revised to incorporate variables that better characterize the physical complexity of Maryland Coastal Plain streams. The PHI evaluates physical habitat quality based on the following variables:

- bank stability
- instream woody debris and rootwads
- instream habitat quality
- epibenthic substrate
- shading
- remoteness

#### Water Quality

Conductivity, dissolved oxygen, pH, and temperature were measured at each site using a YSI 600QS sonde and 650 MDS display unit. This instrument was calibrated according to the specifications provided by the manufacturer, and the readings were recorded on a calibration log sheet.

#### Geomorphic Assessment

Geomorphic surveys were conducted at each site to determine the stream type of each reach as characterized by the Rosgen Stream Classification (Rosgen 1996). Measurements at each site included a pebble count, a cross sectional profile, and a simplified longitudinal profile.

Modified 100-particle Wolman Pebble Counts (Wolman 1954) were performed to determine the particle size distribution of the channel substrate. Ten transects were distributed throughout the 75m reach in proportion to the feature types (pool, glide, run, riffle) present. For example, if a reach was 60% pools and 40% glides, six transects would be allocated to pools while four would be placed in glide features. Each transect begins on one bank at approximate bankfull level and continues across the width of the active channel to

the opposite bankfull width. A total of 10 particles per transect were selected by hand (each particle is defined as a size of geologic substrate material within various classes: silt/clay, sand, gravel, cobble, boulder, and bedrock). To reduce sampler bias, each particle was chosen without the sampler looking in the stream at what was being collected (Harrelson et al. 1994). Each particle was chosen, measured, and recorded at evenly spaced intervals across the channel. If a reach was composed entirely of soft sediment (sand, silt/clay) and exhibited no clear variation in material size, the pebble count was not performed and the percentage of sediment types was visually However, a pebble count was estimated. performed at every fifth site.

Channel cross-sectional surveys were done to provide a coarse characterization of channel crosssectional area and changes to channel dimensions over time. After a thorough visual assessment of the channel characteristics, a representative section of the channel (preferably a transitional zone between feature types) was selected for analysis as the cross-section area. A tape measure was drawn between permanent monuments (4-ft sections of <sup>1</sup>/<sub>2</sub>-inch diameter rebar) that were installed on each side of stream to record the location of each measurement. A GPS reading was taken at the primary monument (typically on the left bank facing downstream) and recorded on the data sheet. Elevation measurements were taken using a survey instrument and survey rod. Numerous measurements were taken across the entire width of the channel with the aim of characterizing as many features along the bank and streambed as possible including:

- Elevation of monuments
- Topography changes
- Top of each channel bank
- Bankfull indicators
- Edges of water
- Thalweg
- Depositional and erosional features

Using the data collected during the cross-sectional survey, a number of additional measures based on

bankfull indicators can be calculated, which allows further measurements to be made. These measures include:

- Bankfull Width  $(W_{bkf})$  the channel width at bankfull elevation
- Bankfull Mean Depth (d<sub>bkf</sub>) the mean depth of the bankfull channel
- Bankfull Cross-Sectional Area (A<sub>bkf</sub>) the product of bankfull depth and bankfull mean depth
- Maximum Depth (d<sub>mbkf</sub>) the maximum depth of the bankfull channel
- Width/Depth Ratio  $(W_{bkf}/d_{bkf})$  the ratio of bankfull width divided by bankfull mean depth

Several additional measurements are then made based on the bankfull measures, which are necessary for determining the stream type of each reach. These measures include:

- Width of Floodprone Area (W<sub>fpa</sub>) width of the channel at flood stage (two times maximum depth)
- Entrenchment Ratio (ER) the ratio of floodprone width divided by bankfull width

Additionally, sinuosity, the ratio of stream length to valley length, was determined by measuring the straight-line distance of the reach using a laser rangefinder or by running a measuring tape.

## Data Analysis

#### Data Structure

Benthic macroinvertebrate, physical habitat, and water quality data were entered into EDAS, Version 3.2 (Tetra Tech 1999). This relational database allows for the management of location and other metadata, taxonomic and count data, raw physical habitat scores, the calculation of metric values, physical habitat and water quality rankings, and B-IBI values.

#### Land Use and Impervious Surface Evaluation

The County has an extensive collection of spatial data that was used to characterize land use and

impervious surface distributions and the age of development occurrence for the areas evaluated during this assessment. All geoprocessing work was done using ArcGIS 9.2. Individual land use coverages were developed for all PSUs for the drainage area upstream of each sampling point using a Countywide land cover coverage. Additionally, shapefiles of impervious surfaces were also created for each PSU and sampling point. This information is summarized for each sample station in *Appendix F*.

Both the impervious coverage and the land use coverage were developed from aerial photography collected in 2007. Both coverages are vector type data and were developed at a map scale of 1:2400.

#### Physical Habitat

The 10 RBP variable scores were summed to obtain a final habitat score. Site habitat condition was determined through comparison to a reference condition score. Because there were no RBP data for reference sites within Anne Arundel County, we compared to a reference condition based on similar studies from Prince George's County (Stribling et al. 1999). Narrative ratings that correspond to final RBP habitat scores (**Table 2**) express the potential of a stream or watershed to support a healthy biological community. These narrative ratings were adapted from Plafkin et al. (1989).

Table 2. EPA RBP Scoring

| Score     | Narrative                      |
|-----------|--------------------------------|
| 151 +     | Comparable (to reference)      |
| 126 - 150 | Supporting (aquatic life uses) |
| 101 – 125 | Partially Supporting           |
| 0 - 100   | Non-Supporting                 |
|           |                                |

From: Stribling et al. 1999

For the PHI, the variables measured in the field were scored on a 100-point scale. Some scores were adjusted for watershed size. The individual scores were then summed and divided by the total number of variables (six) to yield a final PHI score, which was associated with a narrative rating (**Table 3**). Composite scores or values for primary sampling units were presented as means plus/minus a single standard deviation ( $\bar{x} \pm 1$  s.d.).

| Score   | Narrative          |
|---------|--------------------|
| 81-100  | Minimally Degraded |
| 66-80.9 | Partially Degraded |
| 51-65.9 | Degraded           |
| 0-50.9  | Severely Degraded  |
| E D 1 1 |                    |

| Table 3. | MBSS | PHI | Scoring | Ranges. |
|----------|------|-----|---------|---------|
|----------|------|-----|---------|---------|

From: Paul et al. 2003, Boward 2006

#### Biological Index Rating

The biological indicator is based on the Index of Biological Integrity (IBI; Karr et al. 1986) and characteristics uses of the benthic macroinvertebrate assemblage structure and function to assess the overall water resource condition. Benthic IBIs (B-IBI) were developed by the MBSS and calibrated for different geographic areas of Maryland (Stribling et al. In 2005, MBSS revised the B-IBI 1999). (Southerland et al. 2005). The revised benthic metrics calculated in this report were those selected and calibrated specifically for Maryland Coastal Plain streams. The seven metrics of calculated for each the benthic macroinvertebrate samples are:

- 1. *Total number of taxa*. The taxa richness of a community is commonly used as a qualitative measure of stream water and habitat quality. Stream degradation generally causes a decrease in the total number of taxa.
- 2. *Number of EPT taxa*. Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) are generally sensitive to degraded stream conditions. A low number of taxa representing these orders are indicative of stream degradation.
- 3. *Number of Ephemeroptera Taxa.* Mayflies are generally sensitive to pollution and the number of mayfly genera in a sample can be an indicator of stream conditions, generally decreasing with increasing stress.

- 4. *Percent Intolerant to Urban*. This is the percentage of the benthic sample that is intolerant to urban stressors. This metric decreases with increased stream degradation.
- 5. *Percent Ephemeroptera.* The degree to which mayflies dominate the community can indicate the relative success of these generally pollution intolerant individuals in sustaining reproduction. The presence of stresses will reduce the abundance of mayflies relative to other, more tolerant individuals; although, some mayfly groups, such as several genera of the family Baetidae, are known to increase in numbers in cases of nutrient enrichment.
- 6. *Number of Scrapers.* Specialized feeders such as scrapers tend to be species that are more sensitive and are thought to be well represented in healthy streams, and tend to decrease with increasing stressors.
- 7. *Percent Climbers.* This is the percentage of the benthic sample living primarily on stem type surfaces. Climbers tend to decrease with increasing stressors.

Each metric was scored on a 5, 3, 1 basis (5 being the best, 1 being the worst) according to stream health. Metric scoring criteria for the 2005 index are listed in **Table 4**. IBI scores were calculated

Table 4. MBSS BIBI Metrics

| Metric                          | Sco   | ring Thresho   | lds       |
|---------------------------------|-------|----------------|-----------|
|                                 | 1     | 3              | 5         |
| Number of Taxa                  | < 14  | $\geq$ 14 < 22 | $\geq$ 22 |
| Number of EPT<br>Taxa           | < 2   | $\geq 2 < 5$   | ≥ 5       |
| Number of<br>Ephemeroptera Taxa | < 1   | $\geq 1 < 2$   | $\geq 2$  |
| Percent Intolerant to<br>Urban  | <10   | $\geq$ 10 < 28 | ≥28       |
| Percent<br>Ephemeroptera        | < 0.8 | ≥ 0.8 < 11     | ≥11       |
| Number of Scraper<br>Taxa       | < 1   | ≥ 1 < 2        | $\geq 2$  |
| Percent Climbers                | < 0.9 | $\geq$ 0.9 < 8 | $\geq 8$  |

From: Southerland et al. 2005

| Table 5. MBSS BIBI (2005) Scorin |
|----------------------------------|
|----------------------------------|

| BIBI<br>Score | Narrative<br>Ranking | Characteristics  |
|---------------|----------------------|--|
| 4.0 - 5.0     | Good                 | Comparable to reference<br>streams considered<br>minimally impacted,<br>biological metrics fall<br>within the upper 50<br>percent of reference site<br>conditions.   |
| 3.0 - 3.9     | Fair                 | Comparable to reference<br>conditions, but some<br>aspects of biological<br>integrity may not<br>resemble the qualities of<br>minimally impacted<br>streams.   |
| 2.0 - 2.9     | Poor                 | Significantdeviationfromreferenceconditions,indicatingsome degradation.Onaverage,biologicalmetricsfallbelowthe10 <sup>th</sup> percentileofreferencereferencesite values.  |
| 1.0 - 1.9     | Very Poor            | Strong deviation from<br>reference conditions,<br>with most aspects of<br>biological integrity not<br>resembling the qualities<br>of minimally impacted<br>streams, indicating<br>severe degradation. On<br>average, most or all<br>metrics fall below the<br>10 <sup>th</sup> percentile of<br>reference site values. |

by summing the nine metric scores for each site, and dividing by the number of metrics (7). Using the format established by MBSS, the resulting value was then compared to the index scoring criteria for translation into narrative categories (**Table 5**; Southerland et al. 2005). If the total number of organisms in a sample was less than 60, metrics were not calculated (D. Boward, personal communication). Sites with < 60 organisms were rated as "Very Poor" unless there was evidence that this represented a natural condition.

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Composite scores for primary sampling units were presented as means plus/minus a single standard deviation ( $\bar{x} \pm 1$  s.d.).

#### Water Quality

Water quality data were compared to Maryland water quality standards for Use I streams. Use I streams have designated uses for water contact recreation and protection of nontidal warm water aquatic life. Water quality standards for these streams have been established in the Code of Maryland Regulations (COMAR, **Table 6**). Composite values for individual sampling units are means plus/minus a single standard deviation  $(\bar{x} \pm 1 \text{ s.d.})$ .

Table 6.Code of Maryland (COMAR) WaterQuality Standards.

| Parameter                  | Standard  |
|----------------------------|---|
| pH (S. U.)                 | 6.5 to 8.5  |
| Dissolved Oxygen<br>(mg/L) | Minimum of 5 mg/L   |
| Conductivity (µS/cm)       | [No state standard]   |
| Temperature (°C)           | Maximum of 32°C (90°F)<br>or ambient temperature,<br>whichever is greater |

Source: COMAR 26.08.02.03-3

#### Geomorphic Assessment

Geomorphic field data were compared to regional relationships of bankfull channel geometry developed by the USFWS for streams in the Maryland Coastal Plain (McCandless 2003). This comparison is a crucial step in verifying whether bankfull field determined estimates are appropriate or within a range of known values for drainage basins of similar size. Determination of bankfull indicators is difficult in the urbanized sampling units like Sawmill Creek. To be cautious, field staff would typically identify two or more possible topographic features within the cross section as possible bankfull indicators. Occasionally, changes to the field-called bankfull indicator were made in the office if, based upon an inspection of the plotted cross section and photographs, another identified indicator or obvious slope break or other observable feature gave better agreement with the regional relationships that have been well established in this physiographic region. However, no changes to the field-derived call were made if there was no obvious other potential indicator observable in the cross section and only one bankfull indicator was called in the field or if there was reasonable  $(\pm 15\%)$  of the expected value for the drainage area upstream of the sample point) agreement between the original call and the Coastal Plain regional relationships.

After field data were compared to the regional relationships and determined to be accurate estimates of the bankfull channel parameters, the longitudinal profile survey, the cross section survey, and the pebble count data were analyzed for each assessment site. These data were then used to identify each stream reach as one of the stream types categorized by the Rosgen Stream Classification (Rosgen 1996). In this methodology, classification streams are categorized based on their measured field values of entrenchment ratio, width/depth ratio, sinuosity, water surface slope, and channel materials according to the table in *Appendix B*:

*Rosgen Stream Classification*. As shown in Appendix B, the Rosgen Stream Classification categorizes streams into broad stream types, which are identified by the letters, A, G, F, B, E, C, D, and DA. Additionally, when a numeric code for dominant bed material is added, a total of 41 unique types exist in this scheme. Details about the stream types listed here can be found in Rosgen (1996).

The most entrenched streams are the A, G, and F channels. In these streams, flood flows are confined to their channels with little relief provided by a floodplain. Type A streams generally occur in narrow high relief valleys and are generally narrow, deep, confined, and entrenched streams with cascading step-pools and low sinuosity. These streams can be very stable if the bed material consists mainly of bedrock or boulders. Type G streams occur in moderate gradient valleys and are generally narrow and deep. These streams also have step-pool systems, but are generally more sinuous and gully-like than A streams. G streams are considered unstable and commonly have grade control problems and high bank erosion rates. Type F streams occur in more gentle gradients and have higher width/depth ratios than A and G streams. F streams are generally entrenched in highly weathered materials that make these streams laterally unstable. These streams usually have riffle-pool morphologies, greater sinuosity than A and G streams, and high bank erosion rates.

Type B streams are moderately entrenched. These streams have better floodplain connectivity than the entrenched A, G, and F streams. B streams are found in narrow valleys of moderate relief and generally have very stable planforms, profiles, and banks. Riffles and rapids dominate these channels with intermittent pools.

The least entrenched single thread channels are the type E and C streams. Type E streams are commonly narrow and deep but have very wide and well-developed floodplains. These streams are highly sinuous with well-vegetated banks, a riffle-pool morphology, and low gradients; occurring in broad valleys and meadows. Ε streams are generally very stable, efficiently conveying flood flows and transporting sediment. Type C streams have wider and shallower channels with well-developed floodplains and very broad valleys. These streams have riffle-pool morphology, point bar depositional features, and well-defined meandering channels.

Type D and DA streams are multi-thread streams. These stream types are very uncommon in the mid-Atlantic and are very rare in Anne Arundel County. None were observed during this assessment and so are not discussed further.

To facilitate the data analysis and classification work, an Excel spreadsheet developed by the Ohio Department of Fish and Game's Division of Soil and Water Conservation specifically designed for Rosgen stream classification was used to analyze the channel data collected and help classify the stream reaches.

For the E type channels observed during this assessment, it was possible to compare the values of the various parameters measured to the values obtained by Starr et al. (2009) for E type reference reaches in the Western Coastal Plain. A statistical comparison was made using a t-test procedure to compare the mean values of width to depth, entrenchment, and sinuosity of the study group to the reference group.

Because the goal of the geomorphic assessment component of this study is to support the biological assessments, a full set of geomorphic parameters was not collected. Therefore, the data have certain limitations that should be noted:

- An assessment reach length of between 10 and 20 bankfull channel widths is typically required for classification purposes. Depending upon the location of random biological site, some reaches met this criterion while others did not. Consequently, while it is unlikely that a change in stream type would occur using a properly sized assessment reach, any classifications reported here should be considered subject to refinement during future reassessment work.
- Typically, stream classification using the Rosgen methodology (Rosgen 1996) is best performed on riffle or step cross sections. Many of the 75-meter reaches assessed in this study did not contain riffles, although transition reaches between meanders were frequently identified and used for cross section placement.
- Pebble count data were collected for stream classification purposes only and are not appropriate for use in hydraulic calculations of bankfull velocity and discharge. This is particularly the case for the many sand bed channels in the study area, where data on the dune height would be used instead of the 84<sup>th</sup> percentile particle size, or D<sub>84</sub>, in hydraulic calculations. Dune height data were not collected for this study.

• No detailed analyses of stream stability were performed for this study. Statements referring to stream stability are based on observations and assumptions, which were founded on fundamental geomorphic principles. Conclusive evidence of the stability of the sampling units assessed could only be obtained after detailed watershed and stream stability assessments were performed.

A summary of the stream types identified for the streams in this study is included in *Appendix C*.

# **Results and Discussion**

This section first makes comparisons about conditions across all sampling units. Then, each sampling unit is discussed individually. A thorough discussion of data quality pertaining to biological results is included in *Appendix D*. A listing of taxa sampled and their characteristics are in *Appendix E*.

## Comparisons among Sampling Units

The following sections describe biological conditions, habitat quality, and geomorphologic results for selected subwatersheds. The probability-based site selection process (Hill and Stribling 2004) allows use of average results in each PSU to describe typical conditions for all streams within the subwatershed, even in those streams where no data were collected. While individual streams could certainly be found that assess as either better or worse than the typical conditions, probabilistic sampling is the best way to characterize all streams and summarize the results with known uncertainty. Table7 summarizes biological and habitat conditions for each PSU.

#### Biological Assessment Summary

Overall, the BIBI scores throughout the sampling units were variable, with an approximately equal portion of the sites falling within the "Poor" (44%) and "Very Poor" (46%) categories (**Figure 2**). Eight percent of the sites were rated as "Fair," and 2% rated as "Good." Three of the five sampling units had BIBI scores that put them in the "Very

Table 7. Summary of BIBI and habitat scores across sampling units. For each primary sampling unit, N = 10 sites.

| Primary<br>Sampling<br>Unit | Average<br>BIBI Score<br>±SD /<br>Condition<br>Narrative | Average<br>EPA RBP<br>Habitat<br>Score ±SD /<br>Condition<br>Narrative | Average<br>MBSS PHI<br>Score ±SD /<br>Condition<br>Narrative |
|-----------------------------|--|--|--|
| Sawmill<br>Creek            | 1.92±0.37<br>Very Poor                                   | 108.9±18.2<br>Partially<br>Supporting                                  | 57.7±16.3<br>Degraded  |
| Rhode<br>River              | 1.97±0.34<br>Very Poor                                   | 98.5±16.9<br>Partially<br>Supporting                                   | 62.5±9.0<br>Degraded   |
| West<br>River               | 1.86±0.30<br>Very Poor                                   | 114.5±9.8<br>Partially<br>Supporting                                   | 70.1±5.9<br>Partially<br>Degraded                            |
| Rock<br>Branch              | 2.43±0.97<br>Poor  | 104.9±11.4<br>Partially<br>Supporting                                  | 67.8±6.8<br>Partially<br>Degraded                            |
| Cabin<br>Branch             | 2.31±0.51<br>Poor  | 114.3±16.8<br>Partially<br>Supporting                                  | 66.6±6.4<br>Partially<br>Degraded                            |

Poor" category, and the other two, in "Poor" (**Table 7**). Rock Branch and Cabin Branch (PSU-20 and 23, respectively) had the highest mean B-IBI scores, 2.43 and 2.31. The Sawmill Creek, West River, and Rhode River PSUs had the lowest score, all ranging around 1.9. At many of the sites, the benthic macroinvertebrate assemblage was dominated by midges (Diptera: Chironomidae). Blackflies (Diptera: Simuliidae), sowbugs (Isopoda: Asellidae), worms

(Oligochaeta) and riffle beetles (Coleoptera: Elmidae) were also abundant at several of the sites.



#### Habitat Assessment Summary

Across the five sampling units, physical habitat quality was assessed as somewhat degraded. RBP narratives for mean scores were "Partially Supporting" for all PSUs (**Table 7**). Twelve percent of the individual sites sampled had habitat quality capable of "Supporting" aquatic life uses. Mean PHI values classify the Sawmill Creek and Rhode River PSUs as "Degraded" while Cabin Branch, West River, and Rock Branch were judged as "Partially Degraded" (**Table 7**). Over all PSUs, 2% of the individual sites were assessed as having minimal physical habitat disturbance (**Figure 3**).

#### Water Quality Assessment Summary

There were no violations of the COMAR temperature or dissolved oxygen standards, which is not surprising considering the sampling schedule. Temperature observations made in March and April are not likely to show high temperature stress. The highest temperature recorded was 14.6°C, in an unnamed tributary to Cabin Branch. All dissolved oxygen readings were above 5.9 mg/L, which is above the 5 mg/L standard, but which could be expected to be higher in the late winter and early spring.



There is no state standard for conductivity, but only one site had a reading greater than 1000  $\mu$ S/cm, a site on Sawmill Creek. All of the remaining readings were <600  $\mu$ S/cm. More than 80% of the pH readings fell between 6.0 and 7.6, with most of the more acidic values being from the Rhode River.

#### Geomorphic Assessment Summary

The E type and G type stream channels were the dominant stream types found within the sampling 7units. As shown in **Figure 4**, 36% of all sites assessed were classified as E channels while 32% fell into the G classification. B and C channel types both occurred in 12 and 10% of sites,

respectively, while F channels made up 2% of sites assessed. Approximately 8% of the sites were excluded from analysis due to site conditions that violated basic requirements associated with applying the Rosgen classification system.

Stream types were not uniformly distributed over the sampling units, but the E type was present in 4 of 5 units with its most frequent occurrence (70% of sites) in Sawmill Creek. The G type was found most frequently in the Rock Branch (60%) and Cabin Branch (50%) PSUs, but was also observed in Rhode and West River PSUs. The single F type was found in Rock Branch while the B type was mostly found in the West River.

All of the channels had sand substrates with an average D50 observed across the PSUs of 0.26 mm. No clay or gravel-dominated channels were observed. Stream slope was very low in the assessment reaches. The average slopes for all reaches assessed were approximately 0.57%. Slopes were lowest in the Sawmill Creek (0.41%) and highest in the Rock Branch (0.91%) sampling units. Excluding two reaches, all B and G types were of the Bc and Gc type, meaning that these reaches had a slope of less than 2%.



# **Primary Sampling Unit Discussions**

This section summarizes conditions found within each sampling unit. Discussions of potential impacts to observed habitat and biological conditions are discussed here. For site-specific data and assessment results see *Appendix F*.

When appropriate, conditions within individual subwatersheds are discussed. When site-specific data are not available within a unit, the unit-wide results characterize basic conditions of all streams throughout the unit.

#### Sawmill Creek (04)

The Sawmill Creek watershed sampling unit is located in the northern part of the County (**Figure 1**), with site drainage areas ranging in size from 68 – 4,461 acres. The ten sample locations within this PSU (**Figure 5**) are on tributaries to the Sawmill Creek mainstem and the mainstem itself.

#### Aquatic Habitat

Half of the Sawmill Creek streams were rated as "Partially Supporting" by the RBP method, 30% "Non-Supporting", and 20% "Supporting" (Figure 6). The MBSS PHI results showed no (0%) of the streams as "Minimally Degraded," 40% were "Partially Degraded," and 20% as "Degraded" and 30% were "Severely Degraded." The mean RBP habitat score was 108.9±18.2 (Table 7), with individual sites ranging from 69 to Streams with the worst RBP scores had 134. altered channels or unstable banks, as well as sedimentation and disturbed riparian zones. The mean PHI score was 57.7±16.3, with individual sites ranging from 37.3 - 80.4. The site scoring lowest on the PHI had relatively low scores for remoteness, trash, and woody debris. One site was not scored using the PHI.

#### Benthic Macroinvertebrates

Site sampled rated either "Poor" (50%) or "Very Poor" (50%) (**Figure 7**); no sites were rated as either "Good" or "Fair." The mean B-IBI score was  $1.92\pm 0.4$  (**Table 7**), and scores at individual sites ranged from 1.29 (very poor) to 2.43 (poor). The lowest B-IBI scores occurred at two sites: 04-

06 and 04-07. At site 04-06, the sample was dominated by the worm (Enchytraeidae) and the midges (Cricotopus/Orthocladius). Combined, these groups made up 84% of all insects collected in the sample. Similarly, site 04-07 was dominated by stressor tolerant organisms, with worms, nematodes, and midges comprising over 83% of the sample (Enchytraeidae, Nemata, Cricotopus/ Orthocladius, and Tubificinae). The site with the highest B-IBI score, 04-01, was dominated by midges (68%), with <sup>3</sup>/<sub>4</sub> of those being Diplocladius (Chironomidae). However. the sample also exhibited Stenelmis and Caenis, a riffle beetle (Coleoptera: Elmidae) and a mayfly (Ephemeroptera: Caenidae), respectively. For site-specific data and assessment results see Appendix F.

#### Water Quality

All water quality variables were within acceptable ranges for individual site observations and for mean values (**Table 8**). Water temperature ranged from  $4.7-13.5^{\circ}$ C; conductivity from 248-1,147µS/cm; and DO from 7.6-12.5 mg/L.

*Table 8. Average water quality values - Sawmill Creek* 

| Value $\pm$ Standard Deviation                           |  |  |  |  |
|--|--|--|--|--|
| Temperature* Conductivity* D.O.*                         |  |  |  |  |
| $8.6 \pm 2.9 \qquad 465.5 \pm 255.3 \qquad 10.8 \pm 1.4$ |  |  |  |  |
| *Units: Temp. (°C), Cond. (µS/cm), D.O. (mg/L)           |  |  |  |  |

#### Geomorphic Assessment

The E and C stream types were observed in this sampling unit, with the E type being most prevalent at 70% of the total observed. As shown in **Figure 8**, the C type was observed at two sites while one site was not classified due to the wetland nature of the reach.

All of the reaches assessed in this sampling unit had sand bottoms; the average D50 observed for this PSU was 0.27 mm. Slopes ranged from a high of almost 1.2% to a low of 0.02%, with an average of 0.41% across all sites. As in the other sampling units, regardless of stream type, streams here were straighter than expected for particular types.



Figure 5. Sampling locations in the Sawmill Creek primary sampling unit (04).





PSU.



Sinuosities of between 1.0 and 1.2 were common in Sawmill Creek. In general, the E reaches assessed were wider and deeper compared to average values for similar types and occupied more of the valley floor.

Statistical comparisons were made between E type reference reaches as described in Starr et al. (2009) and the E types found in Sawmill. Entrenchment ratios (ERs) for E types in Sawmill were significantly different (p < 0.05), with an average around 10.7 observed in Sawmill compared to reference values of around 23.5. Sinuosity was also very different (p<<0.01) compared to reference values—E types were much straighter in the Sawmill PSU (avg.=1.06 vs. 1.39 at reference sites). There were no significant differences regarding the W/D ratio. However, Rosgen (1996) reports a mean E5 W/D ratio of 5.8 and the average for local E type reference reaches is around 9.2 (Starr et al. 2009), while the E reaches measured in this sampling unit averaged around 13.

Overall, these circumstances may indicate that streams in this PSU are finished incising into their floodplains and are now adjusting laterally. However, from the data collected here it is unclear if the downcutting has ceased. Repeated measurements over time at these sites ultimately would provide insight into the evolutionary trajectory of these streams and the surrounding riparian areas.

#### Rhode River (13)

The Rhode River sampling unit is located in the southeastern part of the County (**Figure 1**), with site drainage areas ranging from 140 - 674 acres. The ten sample locations in the watershed (**Figure 9**) are located on tributaries to the Rhode River.

#### Aquatic Habitat

None of the streams in the Rhode River PSU have physical habitat conditions that are "Comparable" to reference (RBP) and none that are "Minimally Degraded" (PHI) (Figure 10). For the RBP assessment, 60% of the streams were rated "Non-Supporting," and 40% were "Partially Supporting." The PHI further rated 40% "Partially Degraded," 40% as "Degraded," and 10% "Severely Degraded." The mean RBP habitat score was  $98.5 \pm 16.9$ , with individual sites ranging from 68 (Non-Supporting) - 124 (Partially Supporting). The mean PHI rating was  $62.5 \pm 9.0$ , with individual sites ranging from 49.8 (Severely Degraded) to 78.5 (Partially Degraded). One site in this PSU was not evaluated using the PHI.

#### Benthic Macroinvertebrates

All of the sites in the Rhode River Sampling Unit rated as either "Very Poor" or "Poor," (Figure 11). The mean B-IBI score was  $1.97 \pm 0.34$ (Table 7), with scores at individual sites ranging from 1.57 to 2.43. Four of the five sites that rated as "Very Poor" were dominated by midges (Chironomidae), representing 24-78% of the samples; the fifth "Very Poor" site had approximately 9.5% midges, but was dominated instead by the blackfly *Stegopterna* (Diptera: Simuliidae), considered by MBSS to be a relatively stressor-sensitive taxon in urban systems. For site-specific data and assessment results see *Appendix F*.

#### Water Quality

All water quality variables were within acceptable ranges for individual site observations and for mean values (**Table 9**). Water temperature ranged from 3.3 - 13.5 °C; conductivity from 81 - 307 µS/cm; and DO from 8.6-13.8 mg/L.

| Table | 9.   | Average | water | quality | values | - |
|-------|------|---------|-------|---------|--------|---|
| Rhode | Rive | r       |       |         |        |   |

| Value $\pm$ Standard Deviation                 |  |  |  |  |
|--|--|--|--|--|
| Temperature* Conductivity* D.O.*               |  |  |  |  |
| 8.5 $\pm$ 2.6 163.2 $\pm$ 63.8 11.2 $\pm$ 1.6  |  |  |  |  |
| *Units: Temp. (°C), Cond. (µS/cm), D.O. (mg/L) |  |  |  |  |

#### Geomorphic Assessment

E stream types were most frequently observed in this sampling unit, making up 40% of observed channels. Additionally, as shown in **Figure 12**, the G type was observed at 30% of sites while the C type was observed at 20% of reaches. One site (13-07) was not classified due to the highly impacted condition of the reach.

Like the other assessed PSUs in 2008, the Rhode River is dominated by sandy substrates. The average D50 observed was 0.22 mm. Slopes ranged from a high of almost 1% to a low of 0.10%, with an average of 0.46% across all sites.

As in the other sampling units, and regardless of stream type, streams here were frequently straighter than expected for particular types. Reaches assessed in this PSU had an average sinuosity of 1.1.

In general, the G reaches were comparable to mean values from Rosgen (1996). For example, the mean G5 W/D ratio is 7.2 while the average for Rhode River G types was 8.03. Similar agreement was observed for both ER and sinuosity.



Figure 9. Sampling locations in the Rhode River primary sampling unit (13).





Comparisons of the observed E reaches to the reference reach values developed by Starr et al. (2009) showed that significant differences exist in both sinuosity (p<0.001) and width to depth ratio (p~0.05). E reaches were straighter and narrower than expected in comparison to reference conditions. No significant relationship was observed for entrenchment ratio.

Overall, the occurrence of unstable G type reaches coupled with the narrower and straighter E type observed may indicate that streams in this sampling unit are incising into their floodplains in response to historic and/or contemporary perturbations. However, the ultimate evolutionary trajectory of physical condition in this PSU is currently unclear. Repeated measurements over time at these sites ultimately would provide better insight into the evolutionary trajectory of these streams and the surrounding riparian areas.



#### West River (14)

The West River sampling unit is located in the southeastern part of the County (**Figure 1**), with site drainage areas ranging from 80 - 1,390 acres. Nine sample locations in the watershed (**Figure 13**) are on the mainstem or tributaries of the West River.

#### Aquatic Habitat

The RBP physical habitat assessments showed that 80 percent of streams in the West River PSU are "Partially Supporting," with 10 percent rated "Supporting" or "Non-Supporting" (**Figure 14**). The mean RBP habitat score was 114.5±9.8 (**Table 7**), with site-specific scores ranging from 100 to 129 (Partially Supporting). Of the two sites that rated lowest, both had highly disturbed riparian vegetation, lacked instream physical complexity, and apparently had undergone channel straightening

One site (10%) had an MBSS PHI score of "Minimally Degraded" (**Figure 14**). Most sites (60%) were "Partially Degraded" while three (30%) were classified as "Degraded." The mean PHI score was  $70.1\pm5.9$ , and individual sites ranged from 63.9 - 82.2.

#### Benthic Macroinvertebrates

Seventy percent of the sites in the West River PSU rated as "Very Poor," (the highest percentage of all the PSUs assessed) and 30% rated as "Poor" (Figure 15). The mean B-IBI score was  $1.86 \pm$ 0.30 (Table 7)—the lowest observed during this assessment-with scores at individual sites ranging from 1.57 to 2.43. Seven sites rated as "Very Poor"; most were dominated by midges (Chironomidae: Chaetocladius, Diplocladius, Hydrobaenus), blackflies occasionally (Simuliidae: Stegopterna, Prosimulium), segmented worms (Oligochaeta: Enchytraeidae), Although never and nematodes (Nemata). dominant in samples, many of these sites also had stoneflies and caddisflies represented Limnephilidae: Amphinemura; (Nemouridae: Ironoquia). The other three sites, rated as "Poor," had similar sample makeup, but typically a higher dominance of stressor tolerant Chironomidae. For site-specific data and assessment results see *Appendix F*.

#### Water Quality

All water quality variables were within acceptable ranges for individual site observations and for mean values (**Table 10**). Water temperature ranged from  $3.1 - 10.8^{\circ}$ C; conductivity from 56 - 199  $\mu$ S/cm; and DO from 9.2 -13.8 mg/L.

| Table 10.  | Average | water | quality | values | - |
|------------|---------|-------|---------|--------|---|
| West River |         |       |         |        |   |

| Value <u>+</u> Standard Deviation              |                |              |  |  |
|--|----------------|--------------|--|--|
| Temperature* Conductivity* D.O.*               |                |              |  |  |
| 8.1 ± 2.4                                      | $151.2\pm44.2$ | $11.1\pm1.6$ |  |  |
| *Units: Temp. (°C), Cond. (µS/cm), D.O. (mg/L) |                |              |  |  |

#### Geomorphic Assessment

The E stream type was the most prevalent in the West River, found at 40% of assessment reaches in the PSU (**Figure 16**). The B type was observed at 30% of sites while the G type was observed at 20% of sample sites. One site (14-16A) was not included in this analysis due to the presence of culvert comprising approximately half of its length.

Sandy materials made up the stream bottoms in this PSU. The average D50 observed was 0.24 mm. Slopes ranged from a high of 1.6% to a low of 0.06%, with an average of 0.58% across all sites.

In general, the characteristics of the E reaches in this PSU were comparable to the E type reference reach values measured by Starr et al. (2009). No statistical differences were observed in ER and W/D ratios between West River sites and reference reach averages. Only sinuosity showed a



Figure 13. Sampling locations in the West River primary sampling unit (14).







significant difference (p << 0.001) between West River sites (average = 1.06) versus reference reach sites (average = 1.39), meaning that E streams were straighter than expected compared to reference conditions.

The B streams in the West River were somewhat narrower (average W/D ratio = 11.5 versus 16.6 for typical G5 types; Rosgen 1996). Additionally, B types in West River were straighter (average sinuosity = 1.0) than typical B5 channels (Rosgen 1998 = 1.38 for the B4 type—B5 means not provided).

Overall, the prevalence of stable E and B types may mean that streams in this PSU are returning to some type of dynamic equilibrium. However, the ultimate evolutionary trajectory of physical condition in this PSU is currently unclear. Repeated measurements over time at these sites ultimately would provide better insight into the evolutionary trajectory of these streams and the surrounding riparian areas.

#### Rock Branch (20)

The Rock Branch sampling unit is the southwestern part of the County (**Figure 1**), and abuts the Rhode River sampling unit. Sampling sites in Rock Branch have individual drainage areas ranging from 94 - 3,056 acres. The ten sample locations in the watershed (**Figure 17**) are on the mainstem or tributaries of Rock Branch.

#### Aquatic Habitat

The RBP physical habitat quality assessments show 50 percent of the streams in Rock Branch as "Partially Supporting" and 40 percent as "Non-Supporting" (**Figure 18**). The mean RBP value is  $104.9\pm11.4$  (**Table 7**) with values ranging from 91 - 131. Of the sites with "Non-Supporting" habitat, there was consistent channel instability, lack of undisturbed riparian vegetation, and minimal pool complexity and epifaunal substrate. The PHI scored the majority of sites (60%) as "Partially Degraded." while 40% were rated "Degraded." The mean PHI score was  $67.8\pm6.8$ , and the range was from 58.8 - 78.5.

#### Benthic Macroinvertebrates

Forty percent of the sites in the Rock Branch PSU rated as "Very Poor," 30% rated "Poor," 20% "Fair", and 10% "Good" (Figure 19). This PSU had the only site rated "Good" during the 2008 assessment. Rock Branch also had the highest mean B-IBI score at  $2.43 \pm 0.97$  (**Table 7**), with scores at individual sites ranging from 1.29 to 4.43. The one site that rated as "Good", site 20-02, an unnamed tributary to Rock Branch, was dominated by the midge Tanytarsus (Diptera: Chironomidae) and 2 stoneflies, Amphinemura (Plecoptera: Nemouridae, Haploperla and Chloroperlidae). Dominant taxa at the sites rating as "very poor" were midges (Chaetocladius, Diplocladius, Hydrobaenus, and Tvetenia). blackflies (Stegopterna, Prosimulium [Diptera: Simuliidae]). Site 20-06, although rated as "fair" by the B-IBI, had a very diverse sample with 41 taxa, and was dominated by craneflies (Pilaria [Tipulidae]), caddisflies (Diplectrona [Hydropsychidae], and beetles (Anchytarsus [Ptilodactylidae]). For site-specific data and assessment results see Appendix F.

#### Water Quality

In the Rock Branch subwatershed, all water quality variables were within acceptable ranges for individual site observations and for mean values (**Table 11**). Water temperature ranged from  $3.8 - 11.6^{\circ}$ C; conductivity from 78 - 574 µS/cm; and DO from 7.1 - 13.8 mg/L.

| Table  | 11.    | Average | water | quality | values | - |
|--------|--------|---------|-------|---------|--------|---|
| Rock E | Branci | h       |       |         |        |   |

| Value $\pm$ Standard Deviation                 |  |  |  |  |
|--|--|--|--|--|
| Temperature* Conductivity* D.O.*               |  |  |  |  |
| 8.3 $\pm$ 2.4 203.5 $\pm$ 43.2 11.8 $\pm$ 2.0  |  |  |  |  |
| *Units: Temp. (°C), Cond. (µS/cm), D.O. (mg/L) |  |  |  |  |

#### Geomorphic Assessment

The G stream type was the most prevalent in the Rock Branch PSU, found at 60% of assessment reaches. As shown in **Figure 20**, the B type was observed at 20% of sites while the C and F types were observed at 10% of sample sites. No E types were observed in this PSU.

Sand bottom channels dominate in this PSU. The average D50 observed was 0.26 mm. Slopes ranged from a high of 2.8% (at station 20-08, the highest observed amongst all 2008 sites) to a low of 0.28%, with an average of 0.91% across all sites.

In general, the G reaches in this PSU were somewhat different compared to mean values from Rosgen (1996). G streams in Rock Branch were somewhat wider and active channels occupied more of the valley floor than typical G types. For example, the mean G5 W/D ratio is 7.2 while the average for Rock Branch G types was 9.0 (Rosgen 1996). The ER for Rock Branch G streams averaged 1.4 while Rosgen (1998) reports an average of 1.17 for G5 streams. Sinuosity matched fairly well with expected values (1.1 observed versus 1.25 typical).



Figure 17. Sampling locations in the Rock Branch primary sampling unit (20).





Overall, the prevalence of unstable G type may mean that streams are incising into their historic and/or floodplains in response to contemporary perturbations. However, the increased W/D and ER averages suggest that these reaches may have finished downcutting, with lateral adjustments beginning to manifest themselves in these streams. The ultimate evolutionary trajectory of physical condition in this PSU is currently unclear. Repeated measurements over time at these sites ultimately would provide better insight into the evolutionary trajectory of these streams and the surrounding riparian areas.



#### Cabin Branch (23)

The Cabin Branch sampling unit is on the far southwestern border of the County (**Figure 1**). Sampling sites in Cabin Branch have individual drainage areas ranging from 42 - 10,807 acres, and are located on unnamed tributaries to Cabin Branch (**Figure 21**). It should be noted that one site (23-10) has some of its contributing drainage located within Calvert County.

#### Aquatic Habitat

The RBP physical habitat quality assessments show 60 percent of the streams in Cabin Branch as "Partially Supporting" and 20 percent each as "Supporting" and "Non-Supporting" (Figure 22). The mean RBP value is  $114.3 \pm 16.8$  (**Table 7**) with values ranging from 94 - 148. Two of the reaches were rated as having supporting habitat, and showed good habitat complexity with overall channel stability. The other reaches rated as partially "Supporting" and "Non-Supporting" and had strong indications of channel instability, eroding banks, disturbed riparian vegetation, and heavy sediment deposition. The PHI indicated "Partially Degraded" conditions in 40 percent of sites and "Degraded" conditions in an additional 40 percent, with 20% not assessed with this method. The mean PHI score was  $66.6 \pm 6.4$  and the range was from 58.6 - 77.3.

#### Benthic Macroinvertebrates

Sixty percent of the sites in the Cabin Branch PSU rated as "Poor," and 20 percent each rated as "Very Poor" and "Fair" (Figure 23). The mean B-IBI score was  $2.31 \pm 0.51$  (Table 7), with scores at individual sites ranging from 1.57 to 3.29. The lowest B-IBI scores occurred at two sites, 23-03 and 23-07. The former had a B-IBI score of 1.57 and was dominated by worms (Oligochaeta: Nais) and midges (Chironomidae: Diplocladius and Cricotopus/Orthocladius). The latter was also dominated by midges, including the genera mentioned above, plus Chaetocladius. The rest of the sites rated as "Fair" and "Poor" also had high proportions of midges, and numbers for the "Total taxa" metric ranging from 19-38. For sitespecific data and assessment results see Appendix **F**.

#### Water Quality

In the Cabin Branch PSU, all water quality variables were within acceptable ranges for individual site observations and for mean values (**Table 12**). Water temperature ranged from  $7.8 - 14.6^{\circ}$ C; conductivity from 97 - 233 µS/cm; and DO from 6.7 - 11.7 mg/L.

Table 12.Average water quality values -Cabin Branch

| Value $\pm$ Standard Deviation                 |  |  |  |  |
|--|--|--|--|--|
| Temperature* Conductivity* D.O.*               |  |  |  |  |
| $10.2 \pm 2.0$ $172.5 \pm 43.2$ $9.6 \pm 2.4$  |  |  |  |  |
| *Units: Temp. (°C), Cond. (µS/cm), D.O. (mg/L) |  |  |  |  |

#### Geomorphic Assessment

The G stream type was the most frequently observed type in this sampling unit, making up 50% of observed channels. As shown in **Figure 24**, the E type was observed at 30% of sites while the B type was observed at 10% of reaches. One site (23-10) was not classified due to the highly impacted condition of the reach.

Sandy substrates dominated in this PSU. The average D50 observed was 0.29 mm. Slopes ranged from a high of almost 1.5% to a low of 0.05%, with an average of 0.47% across all sites.

As in the other sampling units, regardless of stream type, streams here were frequently straighter than expected for particular types. An average sinuosity of 1.23 was observed in Cabin Branch.

In general, the G reaches were comparable to mean values from Rosgen (1996). For example, the mean G5 W/D ratio is 7.2 (Rosgen 1996) while the average for Cabin Branch G types was also around 7.2. Similar results were observed



Figure 21 - Sampling locations in the Cabin Branch primary sampling unit.







for ER and sinuosity. There were only two E channels observed in this PSU, so no comparisons to the reference reach values developed by Starr et al. (2009) were attempted.

Overall, the prevalence of unstable G type reaches indicates that streams in this sampling unit are incising into their floodplains in response to historic and/or contemporary perturbations. However, the ultimate evolutionary trajectory of physical condition in this PSU is currently unclear. Repeated measurements over time at these sites ultimately would provide better insight into the evolutionary trajectory of these streams and the surrounding riparian areas.
# **Conclusions and Discussion**

As there are typically multiple stressors affecting stream biota, it is often difficult to isolate single stressors that are the direct cause of biological impairment (Norton et al. 2000, USEPA 2000). We do not expect strong correlations of biological condition with any composite measure of physical habitat quality (such as the RBP or the PHI), or individual physical or water chemistry characteristics (such as median substrate particle size, width of undisturbed riparian vegetation, or dissolved oxygen), due to the fact that both synergistic and antagonistic relationships exist among stressors that are not fully understood. For example, two sites, one in the Sawmill Creek PSU (04-12A) and one in the Cabin Branch PSU (23-10), were rated as "Poor" for biology (B-IBI) and "Supporting" for habitat (RBP) (Table 13). This is an indication that stressors unrelated to habitat are causing biological degradation in this sampling unit. Table 14 similarly arranges biological assessment narratives against those for PHI.

Stability and complexity of physical habitat are necessary for a healthy biota, among other factors. Poor water quality, availability of food resources, and invasive species can impair the ability of stream organisms to survive and reproduce. Assuming that physical habitat quality is the principal factor defining the biological potential of a stream, we can make inferences about streams in which the biological indicators are better or worse than expected. Biological signals that are better than expected may be due to something like nutrient enrichment while those that are worse than expected may be depressed by stressors such as water chemistry contaminants.

**Table 15** shows those sites for which the B-IBI is higher or lower than expected for the habitat assessment. Only those sites for which the biology-habitat relationship was true for both habitat quality indicators are shown.

| Table 13.  | Comparison   | of | biological | scores | to | EPA |
|------------|--------------|----|------------|--------|----|-----|
| RBP habita | t condition. |    |            |        |    |     |

| EDA DDD BIBI Score      |       |                 |  |  |  |  |
|-------------------------|-------|-----------------|--|--|--|--|
| Habitat<br>Scores       | Good  | Fair            | Poor   | Very<br>Poor   |  |  |
| Comparable              |       |                 |  |  |  |  |
| Supporting              |       | 20-10<br>23-13A | 04-12A<br>23-10  | 04-20A<br>14-06  |  |  |
| Partially<br>Supporting | 20-02 | 23-01           | 04-10<br>04-15A<br>13-03<br>13-05<br>13-12A<br>14-02<br>14-09<br>14-14A<br>20-05<br>20-07<br>23-02<br>23-04<br>23-05<br>23-06<br>23-09 | 04-07<br>04-08<br>04-13A<br>13-06<br>14-03<br>14-07<br>14-10<br>14-12A<br>14-16A<br>20-01<br>20-03 |  |  |
| Non-<br>Supporting      |       | 20-06           | 04-01<br>04-09<br>13-04<br>13-07<br>20-08  | 04-06<br>13-08<br>13-11A<br>13-13A<br>13-14A<br>14-01<br>20-04<br>20-11A<br>23-03<br>23-07         |  |  |

**Green** cells contain stations where the biological community was less impaired than the habitat scores would predict. **Orange** cells contain stations where biological community matched available habitat.

**Pink** cells contain stations where the biological community was more impaired than the habitat scores would predict.

Sites in **Bold** type have a departure of two or more condition classes from expected outcome (e.g.- "Very Poor" biology found in reach with "Supporting" habitat).

| MRSS PHI              | BIBI Score         |                          |   |   |
|-----------------------|--------------------|--------------------------|---|---|
| Score                 | Good               | Fair                     | Poor  | Very<br>Poor  |
| Minimally<br>Degraded |                    |                          |   | 14-06   |
| Partially<br>Degraded |                    | 20-06<br>20-10<br>23-13A | 04-12A<br>04-15A<br>13-03<br>13-05<br>13-07<br>14-09<br>14-14A<br>20-07<br>23-06<br>23-09 | 04-07<br>04-13A<br>13-14A<br>14-03<br>14-07<br>14-10<br>14-12A<br>14-16A<br>20-01<br>20-03<br>20-04<br>23-07<br>23-04 |
| Degraded              | 20-02              |                          | 04-01<br>13-04<br>14-02<br>20-05<br>20-08<br>23-02<br>23-04<br>23-05<br>23-10             | 04-08<br>13-08<br>13-11A<br>13-13A<br>23-03<br>14-01<br>14-10<br>20-11A   |
| Severely<br>Degraded  | under <b>Tab</b> l | e 13 regardi             | 04-09<br>04-10<br>13-12A  | 04-06   |

Table 14. Comparison of biological scores to MBSSPHI habitat condition.

type. The following stations do not have MPHI scores: 04-20A,13-06,23-01,23-03

Using the criterion described above, nearly one quarter of the sample stations show indications of water quality impairments. In particular, 6 of 10 sites from the relatively undeveloped West River PSU are listed in **Table 15**. In the Sawmill PSU, a highly urbanized watershed, 40% of sites had biota-habitat mismatches.

| Table   | 15.     | Rea    | ches  | for   | wł   | hich  | the   | рa  | iired |
|---------|---------|--------|-------|-------|------|-------|-------|-----|-------|
| assessi | ments   | of     | biol  | logic | al   | con   | ditio | п   | and   |
| physic  | al hab  | itat d | quali | ty in | dice | ate t | he p  | ote | ntial |
| stressc | or type | affec  | ting  | the s | trea | am b  | iota. |     |       |

| <b>Possible Water</b> |            |
|-----------------------|------------|
| Quality               | Possible   |
| Impairment            | Enrichment |
| 04-07                 |            |
| 04-08                 |            |
| 04-12A                |            |
| 04-13A                |            |
| 14-03                 |            |
| 14-06                 | 04-09      |
| 14-07                 | 20-02      |
| 14-10                 |            |
| 14-12A                |            |
| 14-16A                |            |
| 20-01                 |            |
| 20-03                 |            |

Biological conditions are impaired for all five sampling units. Although physical habitat quality is also degraded for the sampling units and for individual streams, the specific stressors causing biological impairment are not necessarily easy to isolate. To more effectively identify the stressors and their sources, it is important to use a more deliberate stressor identification technique (USEPA 2000, Suter et al. 2002, Cormier et al. 2002). There are almost never situations where single, isolated stressors cause biological impairment, most often stressors are multiple and cumulative, both short-term (acute) and longterm (chronic), and they may result from legacy disturbances, such as is the case with many sediment and physical habitat stressors.

Further, our knowledge about the specific modes of action of most stressors is not well tested and there could be both synergistic (two or more stressors amplifying the effects of others) or antagonistic (two or more stressors buffering or reducing the effects of others) effects. The most defensible approach to specifying those stressors that should be reduced or eliminated and their sources that need to be corrected (retrofit, restoration) is a strength-of-evidence process. Data quantity and quality being collected by DPW as part of this program would be sufficient to begin isolating stressor sources, which could then be targeted for correction.

There were no conclusive indications of adverse water quality conditions. Temperature and dissolved oxygen met COMAR standards. There is no state standard for conductivity.

As illustrated in Table 16, E channels in the sampling units have two of three channel characteristics that are significantly different from Western Coastal Plain (WCP) reference conditions (Starr et al. 2009). In general, E channels in the sampling units are straighter than found in stable E reaches, having only 80% of the associated with stable reaches. sinuosity Entrenchment ratios were also relatively low, which means that the reaches found in this year's sampling units occupy more of the stream valley than predicted from stable reference conditions. Regarding width to depth (W/D) ratios, a difference exists between the reference sites and the study sites (p < 0.10), but not at a level of significance typically considered acceptable for scientific publication (p < 0.05). However, the observed narrower W/D ratio indicates that the study reaches are narrower and deeper than expected for stable E channels. These differences from the reference condition are likely indicative of either recovery from instability associated with past development and/or agricultural activities or are associated with on-going adjustment as the reaches evolve toward unstable stream types. The current trajectory for these reaches is unknown at the present time.

In Anne Arundel County and the Maryland Coastal Plain, historical human activities are assumed to have occurred in a similar manner and timeframe as those documented in the Maryland Piedmont physiographic province (Jacobson and Coleman 1986). Jacobson and Coleman cite that human disturbances to land use in the Maryland Piedmont have occurred since

Table 16. Comparison of average E channel dimensionless ratios found in this study to other sources.

| Data<br>Sources                          | Sinuosity | ER    | W/D    | Reference              |
|--|-----------|-------|--------|------------------------|
| General E5<br>stream type                | 2.35      | 39.5  | 5.78   | Rosgen<br>(1996)       |
| E channel<br>WCP<br>reference<br>reaches | 1.39      | 23.5  | 9.2    | Starr et al.<br>(2009) |
| Field data<br>from this<br>assessment    | 1.10*     | 13.5* | 7.90** | _                      |

\* = Significant difference from E channel WCP reference reaches (p < 0.05) \*\* = Significant difference from E channel WCP reference reaches (p < 0.10)

approximately 1730, when European settlement of the area initiated a 200-year period of forest clearing and agricultural activities. Since approximately 1930, much of the acreage of land used for farming has been converted to urban, commercial. suburban. and industrial Consequently, streams in the development. Maryland Piedmont have adjusted to the increased flow and sediment supply by overwidening, deepening, and reworking aggraded floodplain materials in an effort to transition toward a sustainable stable form (Jacobson and Coleman 1986), with determination of the ultimate configuration of this sustainable stream form a matter of active research (Walter and Similar processes also are Merritts 2008). assumed to have occurred in Anne Arundel County's portion of the Western Coastal Plain, and the responses of the County's streams are likely still occurring today.

In the Rosgen classification system, the C, E and B stream types are typically considered evolutionary end points that perturbed systems tend to adjust toward over time (Rosgen 1996). The E type dominated in the Sawmill Creek PSU, despite its high levels of impervious surface. Additionally, the Rhode River and West River sampling units also were dominated by the E, B, and C types, which were found in lesser amounts in the other units. Conversely, unstable types like the F and G types were found in significant percentages in the Cabin Branch and Rock Branch sampling units, despite their relatively low levels of impervious surfaces.

One general trend observed across sampling units and within all stream types is the prevalence of channels that are narrower, deeper, straighter, and occupy more of a given valley floor than typical examples of the type. Conditions for the E type streams are discussed previously. **Table 17** demonstrates that similar patterns exist for other observed types.

Finally, these baseline geomorphic assessment field data can be compared to the Maryland Coastal Plain regional relationships of bankfull channel geometry developed for relatively rural channels (McCandless 2003) and for urbanized watersheds (AADPW 2002) to determine whether bankfull characteristics observed in the field at sites where the discharge is unknown depart from USGS gages where bankfull conditions are known. This comparison is shown in **Figure 25**.

As shown in **Figure 25**, nearly all values fall somewhere between the rural and urban bankfull channel regional curves. The implications of this observation on stream channel evolution in these sampling units is unclear, but it likely means that these reaches are in some state of transition where the dominant process is floodplain incision due to a disturbance in the discharge regime associated with impervious surface occurrence. Typically, lateral adjustment follows such incision as the stream resets itself into an equilibrium condition at a different and lower elevation than it was in the pre-disturbance phase.

Table 17. Comparison of mean observed stream reach characteristics by stream type to mean values typical for the stream type.

| Stream<br>Type | Entrenchment<br>Ratio |      | Width<br>/Depth |      | Sinuosity |      |
|----------------|-----------------------|------|-----------------|------|-----------|------|
| (N*)           | Obs.                  | Тур. | Obs.            | Тур. | Obs.      | Тур. |
| B4** (6)       | 1.73                  | 1.63 | 11.2            | 16.6 | 1.15      | 1.38 |
| C5 (5)         | 6.60                  | 2.96 | 18.8            | 27.0 | 1.14      | 3.45 |
| F5***          | 1.30                  | 1.14 | 15.1            | 21.3 | 1.30      | 1.43 |
| G5 (15)        | 1.37                  | 1.17 | 8.2             | 7.2  | 1.12      | 1.25 |

Typical values from Rosgen (1996). \* N = number of observations. \*\*Summary data for the B5 type not available. \*\*\*Observed values are from the single F type found in 2008.

More detailed watershed assessments would be necessary to determine with greater certainty where these drainage networks are in the evolutionary sequence of adjustment and would be essential for a better understanding of their existing conditions and in the development of management prescriptions to correct unstable reaches as necessary. However, this report provides valuable baseline data that can be compared to data collected in subsequent years and used to generate trend analyses of channel adjustment.



relationships in rural and urban watersheds.

## Recommendations

Based on the sampling and analysis results we make the following recommendations for these sampling units. The ultimate focus of these recommendations is for Anne Arundel County to make progress toward reduction and elimination of stressor sources that are causing biological degradation in County streams and rivers.

**Investigate potential for retrofitting with stormwater best management practices.** As illustrated in **Table 15**, twelve of 50 sites (24%) had biological conditions out of sync with observed habitat that was indicative of possible water quality impairment for the reaches in question. Three of four sampling units have extensive amounts of agricultural land area and one had extensive developed lands. To the extent feasible, BMPs should be installed to improve water quality, particularly in the areas upstream of the sites listed in **Table 15**.

### Perform study to identify specific stressors in

**County watersheds.** As described above, a deliberate stressor identification technique (USEPA 2000, Suter et al. 2002, Cormier et al. 2002) is needed to correctly associate biological stresses with their most probable causes. The stressor identification process can encompass multiple watersheds simultaneously, and the compilation of similar environmental scenarios will strengthen the study. However, individual watershed studies will also be required because each disturbed watershed and stream has unique circumstances.

**Track stream channel evolution and trajectory predictions in subsequent sampling rounds.** Stability assumptions made about particular sites should be validated with repeated measurements and additional assessment work. By verifying these predictions, the County will have a better understanding of how land use changes impact streams over time, which may eventually allow for fine tuning zoning and development regulations toward maximum protection of streams, riparian habitat, and channel stability.

## **Literature Cited**

AADPW. 2002. Cypress Creek Tributary Assessment and Findings Report. Prepared by Bayland Consultants and Designers, Inc., and Clear Creek Consulting. 32 pp, plus Appendices.

Barbour, M.T. and J.B. Stribling. 1994. A technique for assessing stream habitat structure. Pp. 156-178, <u>In</u> Proceedings of "Riparian Ecosystems of the Humid U.S. and Management, Functions, and Values." National Association of Conservation Districts. Washington, DC.

Barbour, M.T., J. Gerritsen, B.D. Snyder, J.B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: Periphyton, benthic macroinvertebrates and fish, 2<sup>nd</sup> edition. EPA841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, DC.

Boward, D. and E. Friedman. 2000. Laboratory methods for benthic macroinvertebrate processing and taxonomy. Maryland Biological Stream Survey, Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment Division. CBWP-MANTA-EA-00-6. Annapolis, Maryland. November.

Boward, D. 2006. Personal communication on 14 March 2006 with C. Victoria.

Bressler, D., Paul, M. and J. Stribling. 2005. DRAFT Development of tolerance values for benthic macroinvertebrates in Maryland. Tetra Tech, Inc.

Bressler, D. R., J. B. Stribling, M. J. Paul, and M. A. Hicks. 2006. Stressor tolerance values for benthic macroinvertebrates in Mississippi. Hydrobiologia 573:155-172.

Caton, L.W. 1991. Improving subsampling methods for the EPA "Rapid Bioassessment"

benthic protocols. Bulletin of the North American Benthological Society 8(3):317-319.

Cormier, S. M., S. B. Norton, G. W. Suter, II, D. Altfater, and B. Counts. 2002. Determining the causes of impairment in the Little Scioto River, Ohio: part II. Characterization of causes. Environmental Toxicology and Chemistry 21:1125-1137.

Flotemersch, J.E., J.B. Stribling, and M.J. Paul. 2006. Concepts and Approaches for the Bioassessment of Non-Wadeable Streams and Rivers. EPA/600/R-06/127. U. S. EPA, Office of Research and Development, Cincinnati, OH

Harrelson, C.C., C.L. Rawlins., and J.P. Potyondy. 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique." <u>U.S. Dept.</u> of Ag., For. Serv., General Technical Report RM-245. Fort Collins, CO.

Hill, C. and J.B. Stribling. 2004. Design of the biological monitoring and assessment program for Anne Arundel County, Maryland. Prepared by Tetra Tech, Inc., Owings Mills, MD, for Anne Arundel County (MD), Office of Environmental and Cultural Resources, Annapolis, MD.

Hill, C.R., J.B. Stribling, and A.C. Gallardo. 2005. Documentation of Method Performance Characteristics for the Anne Arundel County Biological Monitoring Program. Prepared by Tetra Tech, Inc., Owings Mills, MD, for Anne Arundel County (MD), Office of Environmental and Cultural Resources, Annapolis, MD.

Jacobson, R.B. and D.J. Coleman. 1986. Stratigraphy and recent evolution of Maryland Piedmont flood plains. Am. J. Sci. 286: 617-637.

Karr, J. R., K. D. Fausch, P. L. Angermeier, P. R. Yant and I. J. Schlosser. 1986. Assessing biological integrity in running waters. A method and its rationale. Illinois Natural History Survey. Special 36 Publication No. 5. 28 pp. Kazyak, P.F. 2001. Sampling manual. Maryland Biological Stream Survey, Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment Division. Annapolis, MD. February.

Maryland Department of the Environment (MDE). 2000. 2000 Maryland Stormwater Design Manual, Vol. I, II. Prepared by the Center for Watershed Research and the Maryland Department of the Environment, Water Management Division.

McCandless, T.L. 2003. Maryland stream survey: Bankfull discharge and channel characteristics of streams in the Coastal Plain hydrologic region. U.S. Fish and Wildlife Service, Annapolis, MD. CBFO-S03-02.

Merritt, R.W., K.W. Cummins. 1996. An introduction to the aquatic insects of North America. Hunt Publishing Company, Dubuque, Iowa.

Norton, S. B., S. M. Cormier, M. Smith, and R. C. Jones. 2000. Can biological assessment discriminate among types of stress? A case study for the eastern cornbelt plains ecoregion. Environmental Toxicology and Chemistry 19(4):1113-1119.

Paul, M.J., J.B. Stribling, R.J. Klauda, P. F. Kayzak, M.T. Southerland, and N. E. Roth. 2003. A Physical Habitat Index for Wadeable Streams Maryland. Report to Monitoring and Non-Tidal Assessment Division, Maryland Department of Natural Resources, Annapolis, MD.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: Benthic macroinvertebrates and fish. U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, D.C. EPA 440-4-89-001.

Prince George's (PG) County. 2000. Low-Impact Development (LID) design strategies: An integrated design approach. EPA 841-B-00-003. U.S. Environmental Protection Agency, Washington, DC.

Richards, C., L. B. Johnson., and G.E. Host. 1996. Landscape-scale influences on stream habitats and biota. Canadian Journal of Fisheries Aquatic Science 53: 295-311.

Roberts, M., C. Smith, and C. Victoria. 2006. Aquatic Biological Assessment of the Watersheds of Anne Arundel County, Maryland: Year 2. Anne Arundel County, Office of Environmental and Cultural Resources, Annapolis, Maryland.

Robinson, G., R. Holt, M. Gaines, S. Hamburg, M. Johnson, H. Fitch, and E. Martinko. 1992. Diverse and contrasting effects of habitat fragmentation. Science 257:524-526.

Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, CO.

Southerland, M., Rogers, G., Kline, M., Morgan, R., Boward, D., Kazyak, P., Klauda, R., Stranko, S. 2005. New Biological Indicators to Better Assess Maryland Streams. Prepared for Monitoring and Non-Tidal Assessment Division, Maryland Department of Natural Resources.

Starr, R., C. Eng, S. Davis, and M. Secrist. *Western Coastal Plain Reference Reach Survey* – 2010. 2009. U.S. Fish and Wildlife Service. Annapolis, MD. CBFO-S09-02.

Stepenuck, K.F., R.L. Crunkilton, L. Wang (2002) Impacts of urban landuse on macroinvertebrate communities in southeastern Wisconsin streams. Journal of the American Water Resources Association 38 (4):1041–1051.

Strahler, A. N. 1957. Quantitative analysis of watershed geomorphology. American Geophysical Union Transactions 38:913-920.

Stribling, J.B., B.K. Jessup, J.S. White, D. Boward, M. Hurd, 1998. Development of a Benthic Index of Biotic Integrity for Maryland Streams. Report to Monitoring and Non-Tidal Assessment Division, Maryland Department of Natural Resources. CBWP-MANTA-EA-98-3.

Stribling, J.B., B. Jessup, and C.J. Victoria. 2008a. Aquatic Biological Assessment of the Watersheds of Anne Arundel County, Maryland: 2006. Anne Arundel County Department of Public Works, Watershed and Ecosystem Services, Annapolis, Maryland.

Stribling, J.B., B. Jessup, and C.J. Victoria. 2008b. Aquatic Biological Assessment of the Watersheds of Anne Arundel County, Maryland: 2007. Anne Arundel County Department of Public Works, Watershed and Ecosystem Services, Annapolis, Maryland

Stribling, J.B., E.W. Leppo, and C. Daley. 1999. Biological Assessment of the Streams and Watersheds of Prince George's County, Maryland. Spring Index Period 1999. PGDER Report No. 99-1. Prince George's County, Department of Environmental Resources, Programs and Planning Division, Largo, MD.

Stribling, J.B., E.W. Leppo, J.D. Cummins, J. Galli, S. Meigs, L. Coffman, and M.-S. Cheng. 2001. Relating Instream Biological Condition to BMP Activities in Streams and Watersheds. Pages 287-304. In B. R. Urbonas (editor), Proceedings of the United Engineering Foundation Conference, Linking Stormwater BMP Designs and Performance to Receiving Water Impacts Mitigation. August 19-24, 2001. Snowmass Village, Colorado. ISBN 0-7844-0602-2.

Suter, G. W. 1993. Ecological Risk Assessment. Lewis, Boca Raton, FL.

Suter, II, G. W., S. B. Norton, and S. Cormier. 2002. A method for inferring the causes of observed impairments in aquatic ecosystems. Environmental Toxicology and Chemistry 21:1101-1111.

Tetra Tech, Inc. 1999. Ecological Data Application System (EDAS), Version 3.2. Owings Mills, MD. Tetra Tech, Inc. 2005. Sampling and Analysis Plan for Anne Arundel County Biological Monitoring and Assessment Program. Report to Anne Arundel County Office of Environmental and Cultural Resources. Annapolis, MD.

U.S. Environmental Protection Agency (USEPA). 1996. Watershed approach framework. EPA/840/S-96/001. Office of Water, Washington, DC.

U.S. Environmental Protection Agency (USEPA). 2000. Stressor identification guidance document. EPA 822-B-00-025. US Environmental Protection Agency, Office of Water, Washington, DC.

U.S. Environmental Protection Agency (USEPA). 2004. Chesapeake Bay: Introduction to an Ecosystem. Produced by the Chesapeake Bay Program, Annapolis, MD. EPA 903-R-04-003. 34 pp.

Victoria, C.J. and J. Markusic. 2007. Aquatic Biological Assessment of the Watersheds of Anne Arundel County, Maryland: 2004. Produced by the Anne Arundel County Department of Public Works, Watershed and Ecosystem Services Group, Annapolis, Maryland. 31 pp., plus appendixes.

Walter, R.C. and D.J. Merritts. 2008. Natural streams and the legacy of water-powered mills. Science. 319: 299-304.

Wolman, M.G. 1954. A Method of Sampling Coarse River-bed Material. Transactions of American Geophysical Union 35: 951-956.

# **APPENDIX A: SAMPLE FIELD SHEETS**



### Stream Channel Classification and Assessment Form Rosgen Classification System Level II



| Watershed Name:  | Stream/ReachID:                        |                                |
|--|--|--------------------------------|
| Drainage Area:mi <sup>2</sup> /acres/ha  |  |                                |
| Observers:   | _ Date/Time:/                          | Lat:                           |
| GPS []Y [] N Differential Correction   | on? []Y []N Positional Error:ft.       | Lon:                           |
| Location Description:  |  |                                |
| Camera/Film No.  | Weather:                               | Rain in last 24 hrs? [] Y [] N |
| Photo Nos: USDSLB_   | RB                                     |                                |
| Bankfull Width (W):ft.   |  |                                |
| Bankfull Mean Depth (D) :ft.<br>W/D Ratio:   |  |                                |
| W and D checked on Regional Curve?   |  |                                |
|  |  |                                |
| Describe feature(s) used:  |  |                                |
|  |  |                                |
| Thalwag elv.(TE):ft.<br>Bankfull elv.(BFE):ft.<br>Max Bankfull Depth (TE-BFE):<br>2X Max Bankfull Depth (2XMBD):<br>Floodprone Area Elevation (TE-<br>2XMBD):ft.<br>Floodprone Area Width (FPW): | _ft.<br>ft.                            |                                |
| Entrenchment Ratio(FPW/W):   |  |                                |
| usdselelvelvdiWS Elv.(WSE)ftft.Thalwag Elv.(TE)ftft.Valley Elv.(VE)ftft.Assessment Reach Length (ARL):ft.Valley Distance (VD):ft.  | v.<br>iff.<br>ft.<br>ft.<br>ft.<br>ft. |                                |
| WS Slope (WSE/ARL):ft./ft.<br>Valley Slope (VE/VD):ft./ft.<br>Sinuosity (ARD/VD):<br>Meander Length:ft.<br>Belt Width:ft.  |  |                                |

#### CLASSIFICATION (USE ROSGEN KEY OF NATURAL RIVERS):

| Channel Type:                             | Single Thread []    |                          | Multiple Channels [ ] |        |
|---|---------------------|--------------------------|-----------------------|--------|
| Entrenchment Ratio:<br>Width/Depth Ratio: | <1.4 [ ]<br><12 [ ] | 1.4-2.2 [ ]<br>12-40 [ ] | >2.2 [ ]<br>>40 [ ]   | Rosgen |
| Sinuosity:<br>D50:                        | <1.2 []             | 1.2-1.5 [ ]              | >1.5 [ ]              | Type:  |
| Adjustments?                              |                     |                          |                       |        |

Page \_\_\_\_\_ of \_\_\_\_\_

| Habitat Parameter           | Optimal<br>16-20   | Sub-Optimal<br>11-15  | Marginal<br>6-10   | Poor<br>0-5   |
|-----------------------------|--|---|--|---|
| Instream Habitat            | Greater than 50% of a variety of<br>cobble, boulder, submerged logs,<br>undercut banks, snags rootwads,<br>aquatic plants or other stable habitat.   | 30-50% of stable habitat. Adequate habitat.   | 10-30% mix of stable habitat.<br>Habitat availability less than<br>desirable.  | Less than 10% of stable habitat.<br>Lack of habitat is obvious.   |
| Epifaunal Substrate         | Preferred substrate abundant, stable,<br>and at full colonization potential<br>(riffles well developed and<br>dominated by cobble; and/or woody<br>debris prevalent, no new, and not<br>transient) | Abundance of cobble with gravel<br>&/or boulders common; or woody<br>debris, aquatic veg., undercut banks,<br>or other productive common but not<br>prevalent/suited for full colonization. | Large boulders and/or bedrock<br>prevalent; cobble, woody debris,<br>or other preferred surfaces<br>uncommon.                          | Stable substrates lacking; or<br>particles are over 75%<br>surrounded by fine sediment or<br>flocculent material.     |
| Velocity/Depth<br>Diversity | Slow (<0.3 m/s), deep (>0.5m); slow,<br>shallow (<0.5m); fast (>0.3m/s),<br>deep; fast, shallow habitats all<br>present.   | Only 3 of the 4 habitat categories present.   | Only 2 of the 4 habitat categories present.  | Dominated by 1 velocity/depth category (usually pools).   |
| Pool/Glide/Eddy Quality     | Complex cover/&/or depth > 1.5m;<br>both deep (>0.5m)/shallows (<0.2m)<br>present.   | Deep (>0.5m) areas present; but only moderate cover.  | Shallows (<0.2m) prevalent in pool/glide/eddy habitat; little cover.   | Max depth <0.2m in<br>pool/glide/eddy habitat; or<br>absent completely.   |
| Riffle/Run Quality          | Riffle/run depth generally >10 cm,<br>with maximum depth greater than 50<br>cm (maximum score); substrate<br>stable (e.g. cobble, boulder) &<br>variety of current velocities.                     | Riffle/run depth generally 5-10 cm,<br>variety of current velocities.   | Riffle/run depth generally 1-5<br>cm; primarily a single current<br>velocity.  | Riffle/run depth <1 cm; or<br>riffle/run substrates concreted.  |
| Embeddedness                | Percentage that gravel, cobble, and bou  | lder particles are surrounded by line sedin   | nent or flocculent material.   |   |
| Shading                     | Percentage of segment that is shaded (d shaded in summer.  | uration is considered in scoring). 0%= fu   | lly exposed to sunlight all day in sum   | mer; 100% fully and densely   |
| Trash Rating                | Little or no human refuse visible<br>from stream channel or riparian zone.   | Refuse present in minor amounts.  | Refuse present in moderate<br>amounts.   | Refuse abundant and unsightly.  |
| Bank Stability              | Upper banks stable, 0-10% of banks<br>with erosional scars and little<br>potential for future problems.  | Moderately stable. 10-30% of banks<br>with erosional scars, mostly healed<br>over. Slight potential in extreme<br>floods.   | Moderately unstable. 30-60% of<br>banks with erosional scars and<br>high erosion potential during<br>extreme high flow.                | Unstable. Many eroded areas.<br>"Raw" areas frequent along<br>straight sections and bends. Side<br>slopes >60 common. |
| Remoteness                  | Stream segment more than <sup>1</sup> / <sub>4</sub> mile<br>from nearest road; access difficult<br>and little or no evidence of human<br>activity.  | Stream segment within <sup>1</sup> / <sub>4</sub> mile of but<br>not immediately accessible to<br>roadside access by trail; site with<br>moderately wild character.                         | Stream within <sup>1</sup> / <sub>4</sub> mile of<br>roadside and accessible by trail;<br>anthropogenic activities readily<br>evident. | Segment immediately adjacent to<br>roadside access; visual,<br>olfactory, and/or auditory<br>displeasure experienced. |

#### **Vegetation Types**

- G- Grasses/Forbes
- R- Regen Deciduous/Shrubs (<4"DBH)
- Y- Young Deciduous (4-12" DBH)
- M- Mature Deciduous (12-24" DBH)
- O- Old Deciduous (>24" DBH)
- A- Regen Coniferous (<4" DBH)
- B- Young Coniferous (4-12" DBH)
- C- Mature Coniferous (12-24" DBH)
- D- Old Coniferous (>24" DBH)
- L- Lawn

#### **Riparian Buffer Zone/ Adjacent Land Cover Types**

- FR- Forest OF- Old Field EM- Emergent Vegetation LN- Mowed Lawn TG- Tall Grass LO- Logged Area SL- Bare Soil RR- Railroad PV- Paved Road PK- Parking Lot/Industrial/Commercial GR- Gravel Road DI- Dirt Road PA- Pasture OR- Orchard CP- Cropland
- HO-Housing

#### Sampleability Codes

- s- Sampleable
- 1- Dry Stream Bed
- 2- Too Deep
- 3- Marsh, no defined channel
- 4- Excessive Riparian Vegetation
- 5- Impoundment
- 6- Tidally Influenced
- 7- Permissions Denied
- 8- Unsafe (Describe in Comments)
- 9- Beaver 10- Other

#### **Instream Blockage Codes**

DM- Dam PC- Pipe Culvert F- Fishway GW- Guaging Station Weir G- Gabion PX- Pipeline Crossing AC- Arch Culvert BC- Box Culvert TG- Tide Guage

(Note: Height is measured in meters from stream surface to water surface above structure)

#### **Other Notes:**

| naditat assessment field da | HADITAT ASSESSMENT FIELD DATA SHEET-LOW GRADIENT STREAMS (FROMT) |                   |  |  |  |  |
|-----------------------------|--|-------------------|--|--|--|--|
| STREAM NAME                 | LOCATION   |                   |  |  |  |  |
| STATION #                   | STREAM CLASS   |                   |  |  |  |  |
| LAT                         | RIVER BASIN  |                   |  |  |  |  |
| STORET #                    | AGENCY   |                   |  |  |  |  |
| INVESTIGATORS               |  |                   |  |  |  |  |
| FORM COMPLETED BY           | DATE<br>TIME   | REASON FOR SURVEY |  |  |  |  |

|                             | Habitat                                    | Condition Category   |   |   |   |  |  |
|-----------------------------|--|--|---|---|---|--|--|
|                             | Parameter                                  | Optimal  | Suboptimal  | Marginal  | Poor  |  |  |
|                             | 1. Epifaunal Substrate/<br>Available Cover | Greater than 50% of<br>substrate favorable for<br>epifaunal colonization<br>and fish cover; mix of<br>snags, submerged logs,<br>undercut banks, cobble<br>or other stable habitat<br>and at stage to allow full<br>colonization potential<br>(i.e., logs/snags that are<br><u>not</u> new fall and <u>not</u><br>transient). | 30-50% mix of stable<br>habitat; well-suited for full<br>colonization potential;<br>adequate habitat for<br>maintenance of<br>populations; presence of<br>additional substrate in the<br>form of newfall, but not<br>yet prepared for<br>colonization (may rate at<br>high end of scale). | 10-30% mix of stable<br>habitat; habitat availability<br>less than desirable;<br>substrate frequently<br>disturbed or removed.  | Less than 10% stable<br>habitat; lack of habitat is<br>obvious; substrate unstable<br>or lacking.   |  |  |
|                             | SCORE                                      | 20 19 18 17 16   | 15 14 13 12 11  | 10 9 8 7 6  | 5 4 3 2 1 0   |  |  |
|                             | 2. Pool Substrate<br>Characterization      | Mixture of substrate<br>materials, with gravel<br>and firm sand prevalent;<br>root mats and submerged<br>vegetation common.  | Mixture of soft sand, mud,<br>or clay; mud may be<br>dominant; some root mats<br>and submerged vegetation<br>present.   | All mud or clay or sand<br>bottom; little or no root<br>mat; no submerged<br>vegetation.  | Hard-pan clay or bedrock;<br>no root mat or vegetation.   |  |  |
|                             | SCORE                                      | 20 19 18 17 16   | 15 14 13 12 11  | 10 9 8 7 6  | 5 4 3 2 1 0   |  |  |
| ling reach                  | 3. Pool Variability                        | Even mix of large-<br>shallow, large-deep,<br>small-shallow, small-<br>deep pools present.   | Majority of pools large-<br>deep; very few shallow.   | Shallow pools much more prevalent than deep pools.  | Majority of pools small-<br>shallow or pools absent.  |  |  |
| ampl                        | SCORE                                      | 20 19 18 17 16   | 15 14 13 12 11  | 10 9 8 7 6  | 5 4 3 2 1 0   |  |  |
| meters to be evaluated in s | 4. Sediment Deposition                     | Little or no enlargement<br>of islands or point bars<br>and less than <20% of<br>the bottom affected by<br>sediment deposition.  | Some new increase in bar<br>formation, mostly from<br>gravel, sand or fine<br>sediment; 20-50% of the<br>bottom affected; slight<br>deposition in pools.  | Moderate deposition of<br>new gravel, sand or fine<br>sediment on old and new<br>bars; 50-80% of the<br>bottom affected; sediment<br>deposits at obstructions,<br>constrictions, and bends;<br>moderate deposition of<br>pools prevalent. | Heavy deposits of fine<br>material, increased bar<br>development; more than<br>80% of the bottom<br>changing frequently; pools<br>almost absent due to<br>substantial sediment<br>deposition. |  |  |
| Para                        | SCORE                                      | 20 19 18 17 16   | 15 14 13 12 11  | 10 9 8 7 6  | 5 4 3 2 1 0   |  |  |
|                             | 5. Channel Flow Status                     | Water reaches base of<br>both lower banks, and<br>minimal amount of<br>channel substrate is<br>exposed.  | Water fills >75% of the available channel; or <25% of channel substrate is exposed.   | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.   | Very little water in channel<br>and mostly present as<br>standing pools.  |  |  |
|                             | SCORE                                      | 20 19 18 17 16   | 15 14 13 12 11  | 10 9 8 7 6  | 5 4 3 2 1 0   |  |  |

### HABITAT ASSESSMENT FIELD DATA SHEET-LOW GRADIENT STREAMS (FRONT)

| Habitat  | Condition Category   |   |   |  |  |  |  |  |
|--|--|---|---|--|--|--|--|--|
| Parameter  | Optimal  | Suboptimal  | Marginal  | Poor   |  |  |  |  |
| 6. Channel Alteration  | Channelization or dredging<br>absent or minimal; stream<br>with normal pattern.  | Some channelization<br>present, usually in areas of<br>bridge abutments; evidence<br>of past channelization, i.e.,<br>dredging, (greater than past<br>20 yr) may be present, but<br>recent channelization is not<br>present.  | Channelization may be<br>extensive; embankments or<br>shoring structures present<br>on both banks; and 40 to<br>80% of stream reach<br>channelized and disrupted.   | Banks shored with gabion or<br>cement; over 80% of the<br>stream reach channelized<br>and disrupted. Instream<br>habitat greatly altered or<br>removed entirely.   |  |  |  |  |
| SCORE  | 20 19 18 17 16   | 15 14 13 12 11  | 10 9 8 7 6  | 5 4 3 2 1 0  |  |  |  |  |
| 7. Channel Sinuosity   | The bends in the stream<br>increase the stream length 3<br>to 4 times longer than if it<br>was in a straight line. (Note -<br>channel braiding is<br>considered normal in coastal<br>plains and other low-lying<br>areas. This parameter is not<br>easily rated in these areas.)                                   | The bends in the stream<br>increase the stream length 2<br>to 3 times longer than if it<br>was in a straight line.  | The bends in the stream<br>increase the stream length 1<br>to 2 times longer than if it<br>was in a straight line.  | Channel straight; waterway<br>has been channelized for a<br>long distance.   |  |  |  |  |
| SCORE  | 20 19 18 17 16   | 15 14 13 12 11  | 10 9 8 7 6  | 5 4 3 2 1 0  |  |  |  |  |
| 8. Bank Stability<br>(score each bank)   | Banks stable; evidence of<br>erosion or bank failure<br>absent or minimal; little<br>potential for future problems.<br><5% of bank affected.   | Moderately stable;<br>infrequent, small areas of<br>erosion mostly healed over.<br>5-30% of bank in reach has<br>areas of erosion.  | Unstable; many eroded<br>areas; "raw" areas frequent<br>along straight sections and<br>bends; obvious bank<br>sloughing; 60-100% of bank<br>has erosional scars.  |  |  |  |  |  |
| SCORE (LB)   | Left Bank 10 9   | 8 7 6   | 5 4 3   | 2 1 0  |  |  |  |  |
| SCORE (RB)   | Right Bank 10 9  | 8 7 6   | 5 4 3   | 2 1 0  |  |  |  |  |
| 9. Vegetative<br>Protection (score each<br>bank)<br>Note: determine left or<br>right side by facing<br>downstream. | More than 90% of the<br>streambank surfaces and<br>immediate riparian zone<br>covered by native vegetation,<br>including trees, understory<br>shrubs, or nonwoody<br>macrophytes; vegetative<br>disruption through grazing or<br>mowing minimal or not<br>evident; almost all plants<br>allowed to grow naturally. | 70-90% of the streambank<br>surfaces covered by native<br>vegetation, but one class of<br>plants is not well-<br>represented; disruption<br>evident but not affecting<br>full plant growth potential<br>to any great extent; more<br>than one-half of the<br>potential plant stubble<br>height remaining. | 50-70% of the streambank<br>surfaces covered by<br>vegetation; disruption<br>obvious; patches of bare<br>soil or closely cropped<br>vegetation common; less<br>than one-half of the<br>potential plant stubble<br>height remaining. | Less than 50% of the<br>streambank surfaces covered<br>by vegetation; disruption of<br>streambank vegetation is<br>very high; vegetation has<br>been removed to<br>5 centimeters or less in<br>average stubble height. |  |  |  |  |
| SCORE (LB)   | Left Bank 10 9 9   | 8 7 6   | 5 4 3   | 2 1 0  |  |  |  |  |
| SCORE (RB)   | Right Bank 10 9 9  | 8 7 6   | 5 4 3   | 2 1 0  |  |  |  |  |
| <b>10. Riparian</b><br><b>Vegetative Zone</b><br><b>Width</b> (score each<br>bank riparian zone)                   | Width of riparian zone >18<br>meters; human activities (i.e.,<br>parking lots, roadbeds, clear-<br>cuts, lawns, or crops) have<br>not impacted zone.   | Width of riparian zone 12-<br>18 meters; human activities<br>have impacted zone only<br>minimally.  | Width of riparian zone 6-12<br>meters; human activities<br>have impacted zone a great<br>deal.  | 2 Width of riparian zone <6<br>meters: little or no riparian<br>vegetation due to human<br>activities.   |  |  |  |  |
| SCORE (LB)   | Left Bank 10 9   | 8 7 6   | 5 4 3   | 2 1 0  |  |  |  |  |
| SCORE (RB)   | Right Bank 10 9  | 8 7 6   | 5 4 3   | 2 1 0  |  |  |  |  |

### HABITAT ASSESSMENT FIELD DATA SHEET-LOW GRADIENT STREAMS (BACK)

Total Score \_\_\_\_\_

| Benthic Spring Sampling Data Sheet    |   |  |  |  |  |  |
|---------------------------------------|---|--|--|--|--|--|
| SITE                                  | Segment Type Year           Lear         2         0         0         5         Reviewed By: |  |  |  |  |  |
|                                       | Sample Label Verified By: 2nd Reviewer:   |  |  |  |  |  |
| Year Month                            | Day   |  |  |  |  |  |
|                                       | Crew:   |  |  |  |  |  |
|                                       | itary) Project:   |  |  |  |  |  |
| Distance from Nearest Road            | RIPARIAN VEGETATION (facing unstream) WATER OUAL ITY  |  |  |  |  |  |
| to Site (m)                           |   |  |  |  |  |  |
| Remoteness                            | Width (50m max)   |  |  |  |  |  |
| Bank Erosion                          | Adjacent Land Cover   |  |  |  |  |  |
| Left Bank Right Bank                  | Vegetation Type (see back) DO (mg/L)  |  |  |  |  |  |
| Extent                                | Buffer Breaks (Y/N)   |  |  |  |  |  |
| Severtity                             | Buffer Break Types (M=minor; S=severe) pH   |  |  |  |  |  |
| 1=min                                 | Storm Drain   |  |  |  |  |  |
| 2=mod                                 | Tile Drain Cond (ms/cm)   |  |  |  |  |  |
| 3=severe<br>Eroded Area (m2           | Impervious Drainage   |  |  |  |  |  |
| X 10)                                 | Gully Turbidity (NTU)   |  |  |  |  |  |
| Bank Stability                        | Orchard   |  |  |  |  |  |
|                                       | Crop Meter Calibrations by:   |  |  |  |  |  |
|                                       | Pasture Sampleability   |  |  |  |  |  |
| Benthic Habitat Sampled               | New Construction Benthos  |  |  |  |  |  |
| (Square feet; Total = 20 square feet) | Dirt Road Habitat Assessment  |  |  |  |  |  |
|                                       | Gravel Road Water Quality   |  |  |  |  |  |
| Rootwad/Woody Debris                  | Raw Sewage Culvert in Segment2 (y/n)  |  |  |  |  |  |
|                                       | CHANNEL IZATION Sampleable? (v/n)   |  |  |  |  |  |
| Undercut Banks                        | Evidence of Channel Straightening or Dredging (Y/N)   |  |  |  |  |  |
| Other                                 | TYPE EXTENT (m) Width of Culvert (m)  |  |  |  |  |  |
| (Specify)                             | Left Bank Bottom Right Bank Maximum Depth (cm)  |  |  |  |  |  |
|                                       |   |  |  |  |  |  |
| Stream Width (m)                      | Gabion No. Instream Woody Debris  |  |  |  |  |  |
| 0 m                                   | Rip-rap No. of Dewatered  |  |  |  |  |  |
| 75 m                                  | Earthen Berm Woody Debris   |  |  |  |  |  |
| LANDUSE (Y/N)                         | Drege Spoil off Channel No. of Instream Rootwads  |  |  |  |  |  |
| Old Field                             | Pipe Culvert No. of Dewatered Rootwads  |  |  |  |  |  |
| Deciduous Forest                      | HABITAT ASSESSMENT PHOTODOCUMENTATION   |  |  |  |  |  |
| Coniferous Forest                     | Instream Habitat (0-20)   |  |  |  |  |  |
| Wetland                               | Epifaunal Substrate (0-20) Subject  |  |  |  |  |  |
|                                       | Peol/Clide/Eddy Quality (0-20)  |  |  |  |  |  |
| Residential                           | Evtent (0-20)   |  |  |  |  |  |
| Commercial/Industrial                 | Riffle/Run Quality (0-20)   |  |  |  |  |  |
| Cropland                              | Extent (0-20)   |  |  |  |  |  |
| Pasture                               | Embeddedness (%)  |  |  |  |  |  |
| Orchard/Vineyard/Nursery              | Shading (%)   |  |  |  |  |  |
| Golf Course                           | Trash Rating Picture Number Subject   |  |  |  |  |  |
| Site Acces Route                      |   |  |  |  |  |  |
|                                       |   |  |  |  |  |  |
| Sampling Consd (                      | num. Anodes)  |  |  |  |  |  |
|                                       |   |  |  |  |  |  |
| comments                              |   |  |  |  |  |  |

# APPENDIX B: ROSGEN STREAM CLASSIFICATION



Source: Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, CO.

# APPENDIX C: GEOMORPHIC ASSESSMENT RESULTS

| Site<br>ID | Drainage<br>Area<br>(mi <sup>2</sup> ) | $\mathbf{Axs} \\ (ft^2)$ | Wbf<br>(ft) | Dbf<br>(ft) | W/D<br>(ft/ft) | Wfp<br>(ft) | ER<br>( <i>ft/ft</i> ) | Slope<br>% | Sin.<br>( <i>ft/ft</i> ) | D50<br>( <i>mm</i> ) | Adjustments? | Rosgen<br>Stream<br>Type |
|------------|--|--------------------------|-------------|-------------|----------------|-------------|------------------------|------------|--------------------------|----------------------|--------------|--------------------------|
| 04-01      | 0.51                                   | 8.9                      | 8.7         | 1.0         | 8              | 108         | 12.5                   | 1.18       | 1.0                      | 0.45                 | ↑Sin         | E5                       |
| 04-06      | 1.95                                   | 17.0                     | 14.5        | 1.2         | 12             | 80          | 5.5                    | 0.28       | 1.0                      | 0.25                 | ↑Sin         | C5                       |
| 04-07      | 0.11                                   | 15.8                     | 13.5        | 1.2         | 12             | 150         | 11.1                   | 0.10       | 1.0                      | 0.26                 | ↑Sin         | E5                       |
| 04-08      | 0.64                                   | 13.7                     | 11.0        | 1.2         | 9              | 25          | 2.2                    | 0.25       | 1.2                      | 0.36                 | ↑Sin         | E5                       |
| 04-09      | 5.10                                   | 23.9                     | 24.9        | 1.0         | 26             | 229         | 9.2                    | 0.08       | 1.0                      | 0.13                 | ↑Sin         | C5                       |
| 04-10      | -                                      | -                        | -           | -           | -              | -           |                        | _          | -                        | -                    | _            | Not<br>Classified        |
| 04-12A     | 1.84                                   | 17.4                     | 9.8         | 1.8         | 6              | 245         | 25.1                   | 0.42       | 1.1                      | 0.25                 | ↑Sin         | E5                       |
| 04-13A     | 0.80                                   | 4.1                      | 7.1         | 0.6         | 12             | 47          | 6.7                    | 0.54       | 1.0                      | 0.25                 | ↑Sin         | E5                       |
| 04-15A     | 0.37                                   | 10.1                     | 7.8         | 1.3         | 6              | 56          | 7.1                    | 0.84       | 1.0                      | 0.25                 | ↑Sin         | E5                       |
| 04-20A     | 6.97                                   | 41.5                     | 16.7        | 2.5         | 7              | 170         | 10.2                   | 0.02       | 1.1                      | 0.25                 | ↑Sin         | E5                       |
| 13-03      | 0.75                                   | 8.9                      | 15.2        | 0.6         | 26             | 115         | 7.5                    | 0.10       | 1.1                      | 0.25                 | ↑Sin         | C5                       |
| 13-04      | 0.63                                   | 11.4                     | 13.8        | 0.8         | 17             | 106         | 7.6                    | 0.10       | 1.1                      | 0.25                 | ↑Sin         | C5                       |
| 13-05      | 0.38                                   | 4.0                      | 5.7         | 0.7         | 8              | 125         | 21.8                   | 0.95       | 1.3                      | 0.25                 | ↑Sin         | E5                       |
| 13-06      | 0.35                                   | 5.9                      | 5.6         | 1.1         | 5              | 38          | 6.8                    | 0.35       | 1.1                      | 0.15                 | ↑Sin         | E5                       |
| 13-07      | _                                      | -                        | _           | _           | _              | -           | -                      | _          | -                        | -                    | _            | Not<br>Classified        |
| 13-08      | 0.22                                   | 4.7                      | 6.9         | 0.7         | 10             | 10          | 1.4                    | 1.00       | 1.0                      | 0.25                 | ↓ER          | G5                       |
| 13-11A     | 1.10                                   | 15.1                     | 12.6        | 1.2         | 10             | 278         | 22.1                   | 0.15       | 1.0                      | 0.25                 | ↑Sin         | E5                       |
| 13-12A     | 0.66                                   | 16.0                     | 6.4         | 2.5         | 3              | 18          | 2.8                    | 0.58       | 1.1                      | 0.25                 | ↑Sin         | E5                       |
| 13-13A     | 0.37                                   | 10.3                     | 7.0         | 1.5         | 5              | 8           | 1.1                    | 0.46       | 1.0                      | 0.25                 | ↑Sin         | G5c                      |
| 13-14A     | 0.29                                   | 3.9                      | 6.0         | 0.7         | 9              | 8           | 1.3                    | 0.47       | 1.0                      | 0.12                 | ↑Sin         | G5c                      |
| 14-01      | 0.25                                   | 3.0                      | 5.3         | 0.6         | 10             | 9           | 1.6                    | 0.55       | 1.0                      | 0.25                 | †Sin, ↓ER    | G5c                      |
| 14-02      | 0.73                                   | 7.0                      | 10.5        | 0.7         | 16             | 17          | 1.6                    | 0.47       | 1.0                      | 0.25                 | ↑Sin         | B5c                      |
| 14-03      | 0.28                                   | 6.6                      | 8.2         | 0.8         | 10             | 14          | 1.7                    | 0.28       | 1.0                      | 0.25                 | †Sin, †W/D   | B5c                      |
| 14-06      | 0.22                                   | 4.2                      | 6.0         | 0.7         | 9              | 10          | 1.7                    | 0.43       | 1.0                      | 0.25                 | †Sin, †W/D   | B5c                      |
| 14-07      | 0.38                                   | 19.6                     | 12.0        | 1.6         | 7              | 143         | 11.9                   | 0.47       | 1.1                      | 0.19                 | ↑Sin         | E5                       |
| 14-09      | 0.13                                   | 3.6                      | 5.6         | 0.6         | 9              | 155         | 27.8                   | 1.60       | 1.0                      | 0.25                 | ↑Sin         | E5                       |

| Site<br>ID | Drainage<br>Area<br>(mi <sup>2</sup> ) | $\mathbf{Axs} \\ (ft^2)$ | Wbf<br>(ft) | Dbf<br>(ft) | W/D<br>(ft/ft) | Wfp<br>(ft) | ER<br>( <i>ft/ft</i> ) | Slope<br>% | Sin.<br>( <i>ft/ft</i> ) | D50<br>( <i>mm</i> ) | Adjustments? | Rosgen<br>Stream<br>Type |
|------------|--|--------------------------|-------------|-------------|----------------|-------------|------------------------|------------|--------------------------|----------------------|--------------|--------------------------|
| 14-10      | 2.20                                   | 15.8                     | 12.5        | 1.3         | 10             | 100         | 8.0                    | 0.32       | 1.0                      | 0.25                 | ↑Sin         | E5                       |
| 14-12A     | 1.08                                   | 13.7                     | 11.1        | 1.2         | 9              | 156         | 14.1                   | 0.06       | 1.2                      | 0.25                 | ↑Sin         | E5                       |
| 14-14A     | 0.89                                   | 10.2                     | 8.6         | 1.2         | 7              | 10          | 1.2                    | 1.04       | 1.5                      | 0.25                 | None         | G5c                      |
| 14-16A     | —                                      | _                        | _           | _           | -              | -           | _                      | _          | _                        | -                    | _            | Not<br>Classified        |
| 20-01      | 3.13                                   | 22.8                     | 17.2        | 1.3         | 13             | 20          | 1.2                    | 0.42       | 1.1                      | 0.17                 | ↑Sin         | G5c                      |
| 20-02      | 1.90                                   | 43.2                     | 23.8        | 1.8         | 13             | 75          | 3.2                    | 0.32       | 1.5                      | 0.47                 | None         | C5                       |
| 20-03      | 0.03                                   | 3.7                      | 6.0         | 0.6         | 10             | 12          | 2.0                    | 1.60       | 1.2                      | 0.25                 | ↑W/D         | B5c                      |
| 20-04      | 0.18                                   | 3.7                      | 6.8         | 0.5         | 13             | 9           | 1.3                    | 0.58       | 1.2                      | 0.18                 | ↓W/D         | G5c                      |
| 20-05      | 0.89                                   | 8.9                      | 7.6         | 1.2         | 7              | 11          | 1.4                    | 0.62       | 1.2                      | 0.25                 | ↓ER          | G5c                      |
| 20-06      | 0.50                                   | 26.7                     | 12.9        | 2.1         | 6              | 20          | 1.6                    | 0.80       | 1.1                      | 0.27                 | ↓ER, †Sin    | G5c                      |
| 20-07      | 0.22                                   | 7.0                      | 7.2         | 1.0         | 7              | 9           | 1.3                    | 0.52       | 1.0                      | 0.19                 | ↑Sin         | G5c                      |
| 20-08      | 0.64                                   | 14.9                     | 12.1        | 1.2         | 10             | 21          | 1.7                    | 2.80       | 1.1                      | 0.20                 | ↑Sin, ↑W/D   | B5                       |
| 20-10      | 4.80                                   | 39.5                     | 24.4        | 1.6         | 15             | 31          | 1.3                    | 0.28       | 1.3                      | 0.40                 | None         | F5                       |
| 20-11A     | 0.15                                   | 3.3                      | 5.1         | 0.6         | 8              | 8           | 1.5                    | 1.14       | 1.2                      | 0.25                 | ↓ER          | G5c                      |
| 23-01      | 1.00                                   | 10.4                     | 11.8        | 0.9         | 13             | 21          | 1.7                    | 0.24       | 1.6                      | 0.31                 | None         | B5c                      |
| 23-02      | 1.48                                   | 15.9                     | 12.3        | 1.3         | 10             | 154         | 12.6                   | 0.05       | 1.2                      | 0.25                 | ↑Sin         | E5                       |
| 23-03      | 0.69                                   | 19.4                     | 13.0        | 1.5         | 9              | 18          | 1.4                    | 0.47       | 1.0                      | 0.31                 | †Sin, ↓ER    | G5c                      |
| 23-04      | 2.10                                   | 30.2                     | 14.1        | 2.2         | 6              | 20          | 1.4                    | 0.41       | 1.5                      | 0.30                 | None         | G5c                      |
| 23-05      | 2.10                                   | 18.3                     | 11.4        | 1.6         | 7              | 16          | 1.4                    | 0.36       | 1.4                      | 0.25                 | None         | G5c                      |
| 23-06      | 1.30                                   | 29.8                     | 15.0        | 2.0         | 8              | 18          | 1.2                    | 0.62       | 1.0                      | 0.30                 | None         | G5c                      |
| 23-07      | 0.07                                   | 8.8                      | 7.6         | 1.2         | 7              | 12          | 1.6                    | 1.45       | 1.1                      | 0.25                 | ↓ER          | G5c                      |
| 23-09      | 3.00                                   | 30.6                     | 13.1        | 2.3         | 6              | 30          | 2.3                    | 0.19       | 1.0                      | 0.36                 | ↓ER          | E5                       |
| 23-10      | _                                      | _                        | _           | _           | -              | _           | _                      | _          | -                        | _                    | _            | Not<br>Classified        |
| 23-13A     | 0.68                                   | 9.8                      | 8.0         | 1.2         | 7              | 300         | 37.5                   | 0.07       | 1.3                      | 0.22                 | ↑Sin         | E5                       |

# APPENDIX D: QUALITY CONTROL SUMMARY

## **QUALITY CONTROL**

Three aspects of data quality were addressed for the biological components of this dataset. They include field sampling precision (repeatability), laboratory sorting and subsampling bias, and taxonomic precision (consistency) (Flotemersch et al. 2006, Stribling et al. 2008).

<u>Field sampling precision</u> was calculated using results from 5 sample pairs for the revised B-IBI (Southerland et al. 2005), including individual metrics (**Table D-1**). The MQO for the B-IBI is 15%, 10%, and  $\pm 0.5$  for median relative percent difference (RPD), coefficient of variability (CV), and 90 percent confidence interval, respectively. Results for the 2008 data in this dataset were 14, 11.6, and  $\pm 0.39$ . Somewhat of note here is that there were no (zero) mayflies found in any of the replicated samples, resulting in zero values for two of the metrics, and contributing to the zero value in another.

| Index and metrics | mean | avgRPD | medRPD | MSE    | RMSE  | CV   | <b>CI90</b> |
|-------------------|------|--------|--------|--------|-------|------|-------------|
| B-IBI             | 2.1  | 14.3   | 14     | 0.06   | 0.24  | 0.12 | 0.4         |
| Total Taxa        | 20.4 | 26.2   | 12.5   | 12.60  | 3.55  | 0.17 | 5.8         |
| EPT Taxa          | 2.9  | 35.4   | 28.6   | 1.10   | 1.05  | 0.36 | 1.7         |
| Ephemeroptera     |      |        |        |        |       |      |             |
| Taxa              | 0    | 0      | 0      | 0      | 0     | 0    | 0           |
| % Intolerant-     |      |        |        |        |       |      |             |
| Urban             | 32.3 | 100.7  | 86.6   | 278.19 | 16.68 | 0.52 | 27.4        |
| % Ephemeroptera   | 0    | 0      | 0      | 0      | 0     | 0    | 0           |
| Scraper Taxa      | 0    | 0      | 0      | 0      | 0     | 0    | 0           |
| % climbers        | 2.8  | 0      | 0      | 1.40   | 1.18  | 0.43 | 1.9         |

**Table D-1**. Precision statistics for field sampling (n = 10 [5 sample pairs]).

mRPD is mean relative percent difference, MSE is mean square error, RMSE is root MSE, CV is coefficient of variability, and CI90 is the 90% confidence interval. "na" is not applicable, and in this application indicates that the value for the denominator was zero (0).

<u>Laboratory sorting and subsampling bias</u> was tested by an external laboratory for five sort residue samples (**Table D-2**). All five samples passed the measurement quality objective of PSE > 90%. For these samples, PSE ranged from 94.1 to 99.0%.

| it the the |           |            |       |      |
|------------|-----------|------------|-------|------|
| Station    | No. orgs  | No.        | Total |      |
| ID         | (primary) | recoveries | No.   | PSE  |
| 04-06      | 100       | 4          | 104   | 96.2 |
| 04-10      | 100       | 1          | 101   | 99   |
| 13-03      | 104       | 8          | 112   | 92.9 |
| 13-07      | 112       | 7          | 119   | 94.1 |
| 14-07      | 111       | 3          | 114   | 97.4 |
| 20-07      | 120       | 2          | 122   | 98.4 |

**Table D2**. QC results from external laboratory sort residue

 re-checks.

<u>Taxonomic precision</u> was tested by using an independent taxonomist (from a separate laboratory) to re-identify a randomly-selected subset of six samples, and then quantifying differences. The most important result is that of PTD, for which the measurement quality objective (MQO) is 15%. All six sample comparisons fell well below the MQO, with an overall mean of 6.3 (s.d. 4.5), with values ranging from 0.9-14.7 (**Table D-3**). There were very few straight disagreements, and the dominant error type with all comparisons was hierarchical and mostly arising from how worm (Oligochaeta) fragments were counted and recorded. No corrective actions were necessary. **Table D-4** provides a summary comparison of QC results with programmatic MQO. For detailed results, contact Chris Victoria, and request the 2008 taxonomic QC report (Tetra Tech 1008).

**Table D-3**. QC results from taxonomic re-identification of randomly selected samples. Abbreviations: PDE, percent difference in enumeration; PTD, percent taxonomic disagreement; PTC (absDIFF), percent taxonomic completeness (absolute difference); PDEm, PDE midges only; PTDm, PTD midges only.

|            | PDE |      | РТС       |
|------------|-----|------|-----------|
| Sample ID* |     | PTD  | (absDIFF) |
| 04-09      | 0   | 14.7 | 8.3       |
| 04-13A     | 0.9 | 6.3  | 2.6       |
| 13-13A QC  | 0   | 0.9  | 0.0       |
| 14-16A     | 0   | 5.7  | 2.9       |
| 20-03      | 2.4 | 5.6  | 1.1       |
| 20-05 QC   | 0.5 | 4.8  | 13.5      |
| mean       | 0.6 | 6.3  | 3.0       |
| sd         | 1.0 | 4.5  | 3.2       |

**Table D-4**. Summary of QC results and measurement quality objectives. MQO are taken from Hill et al. 2005; result values are from this dataset, with field sampling values based on the 2005 benthic index.

| Activity                    | Performance<br>indicator   | Term                                   | MQO    | Result |
|-----------------------------|----------------------------|--|--------|--------|
| A. Field sampling           | Precision                  | Median relative pct. difference (mRPD) | <15    | 14     |
|                             |                            | Root mean square error (RMSE)          | na     | 0.24   |
|                             |                            | Coefficient of variability (CV)        | <10    | 12.0   |
|                             |                            | 90% confidence interval (CI90)         | < 0.60 | 0.4    |
| B. Sorting/<br>subsampling  | Bias                       | Pct. sorting efficiency (PSE)          | >90    | 99.4   |
| C. Taxonomic identification | Precision<br>(consistency) | Pct. difference in enumeration (PDE)   | <5     | 0.6    |
|                             |                            | Pct. taxonomic disagreement (PTD)      | <15    | 1.0    |

### Citations:

Flotemersch, J.E., J.B. Stribling, and M.J. Paul. 2006. Concepts and Approaches for the Bioassessment of Non-Wadeable Streams and Rivers. EPA/600/R-06/127. U. S. EPA, Office of Research and Development, Cincinnati, OH.

Hill, C.R., J.B. Stribling, and A.C. Gallardo. 2005. Documentation of Method Performance Characteristics for the Anne Arundel County Biological Monitoring Program. Prepared by Tetra Tech, Inc., Owings Mills, MD, for Anne Arundel County (MD), Office of Environmental and Cultural Resources, Annapolis, MD.

Southerland, M., Rogers, G., Kline, M., Morgan, R., Boward, D., Kazyak, P., Klauda, R., Stranko, S. 2005. New Biological Indicators to Better Assess Maryland Streams. Prepared for Monitoring and Non-Tidal Assessment Division, Maryland Department of Natural Resources.

Stribling, J. B., B. K. Jessup, and D. L. Feldman. 2008. Precision of benthic macroinvertebrate indicators of stream condition in Montana. Journal of the North American Benthological Society 27(1): 58-67.

Tetra Tech, Inc. 2009. *Taxonomic Data Quality Control Report*. <u>Prepared for</u>: Anne Arundel County (MD), Department of Public Works; Watersheds, Ecosystems, and Restoration Services, Annapolis, MD. <u>Prepared by</u>: Tetra Tech, Inc., Center for Ecological Sciences, 400 Red Brook Blvd., Suite 200, Owings Mills, MD. (*For further information, contact Chris Victoria 410-222-4240, pwvict16@aacounty.org*).



COUNTY EXECUTIVE, JOHN R. LEOPOLD

DEPARTMENT OF PUBLIC WORKS BUREAU OF ENGINEERING WATERSHED AND ECOSYSTEM SERVICES GROUP 2664 RIVA ROAD / MS 6402 ANNAPOLIS, MD 21401

March 27, 2008

| TO:      | Sam Stribling, Chris Millard  |
|----------|---|
| FROM:    | Chris Victoria  |
| SUBJECT: | Quality Control Field Audit of Tetra Tech, Inc., performance in the |
|          | geomorphologic assessment work as part of the Countywide Biological |
|          | Monitoring Program  |

On March 24, 2008, I evaluated the field activities of a Tetra Tech crew as they collected the required geomorphologic data as part of the Countywide Biological Monitoring Program. Work at two sites (20-01 and 20-08) was evaluated. This short report describes my findings.

OFFICE WORK. For each site, the drainage area was determined before going to the field, but the crew did not have the information with them in the field. The survey instrument was a rental unit and the crew chief did not know the last time it had been calibrated. The crew had all necessary equipment and supplies before going to the field. None of the crew has had training in geomorphic assessment techniques in general or the Rosgen methodology in particular, although the crew was experienced in performing a variety of habitat assessment methodologies.

REACH RECONNAISSANCE. At one site (20-01), the geomorphic reach was co-located with the bioreach while at 20-08 the site was located just upstream of the upstream end of the biological assessment reach. For 20-01, the cross section was located near the upstream end of the reach away from the confluence of a large tributary that intersected the reach near the midpoint. For 20-08 the section was located just upstream of the upstream end of the assessment reach due to site conditions (culvert and road crossing ~100 feet downstream of downstream end of reach) and was located in a proper stream feature (i.e.- a riffle, transition or straight run and not on a meander bend). For both sites, the bankfull indicator was determined for the entire reach and found in the cross section.

CROSS SECTION MEASUREMENT. At both reaches the zero point was set on the left bank / down stream. Monuments were properly installed and marked. A GPS was taken and the location was properly described. Proper photos were taken. All necessary measurements were made on the cross section. Data were properly recorded on the appropriate data sheets.

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Floodprone width calculations were made in the field and the final FPW was measured using a handheld range finder.

PEBBLE COUNT. At both sites, full pebble counts were performed. At both sites, the transects were properly distributed by feature prevalence in the reach. Particles, when found, were properly measured along the intermediate axis. Particle selection was properly distributed along individual transects, although the technician collecting the pebbles was cautioned not to look at the bottom when reaching for samples. Data were properly recorded on the data sheet.

REACH SLOPE MEASUREMENT. The measurement was collected over sufficient distance. The survey instrument was set up properly. A feature-to-feature measurement was made and data collection was consistent in that bankfull indicators, the edge of water and the thalweg were all measured everywhere any of these measurements was collected.

OVERALL COMMENTS. In most cases, the geomorphic data collection activities are being properly executed. The following corrections were made:

1. The team was instructed to bring the drainage area vs. channel geometry information to the field. A discussion of the utility of this information took place.

2. The team was cautioned to not look at the stream bottom when grabbing samples for the pebble count.

Other than the above-described corrections, the work is being performed properly according to published SOPs and should result in the collection of satisfactory data.



# APPENDIX E: MASTER TAXA LIST

| Taxonomic Group         | Individuals | % Observed |
|-------------------------|-------------|------------|
| Diplocladius            | 707         | 12.3       |
| Hydrobaenus             | 532         | 9.3        |
| Stegopterna             | 499         | 8.7        |
| Chaetocladius           | 372         | 6.5        |
| Orthocladius/Cricotopus | 360         | 6.3        |
| Nais                    | 245         | 4.3        |
| Prosimulium             | 244         | 4.3        |
| Enchytraeidae           | 186         | 3.2        |
| Tanytarsus              | 161         | 2.8        |
| Tubificinae             | 155         | 2.7        |
| Nemouridae              | 140         | 2.4        |
| Gammarus                | 109         | 1.9        |
| Tvetenia                | 103         | 1.8        |
| Caecidotea              | 96          | 1.7        |
| Pisidiidae              | 91          | 1.6        |
| Rheocricotopus          | 80          | 1.4        |
| Polypedilum             | 76          | 1.3        |
| Simuliidae              | 73          | 1.3        |
| Paranemoura             | 72          | 1.3        |
| Amphinemura             | 66          | 1.2        |
| Parametriocnemus        | 64          | 1.1        |
| Eukiefferiella          | 61          | 1.1        |
| Limnephilidae           | 50          | 0.9        |
| Ironoquia               | 49          | 0.9        |
| Nemata                  | 47          | 0.8        |
| Simulium                | 46          | 0.8        |
| Corynoneura             | 45          | 0.8        |
| Limnodrilus             | 43          | 0.7        |
| Synurella               | 42          | 0.7        |
| Thienemannimyia genus   | 41          |            |
| group                   |             | 0.7        |
| Culicoides              | 33          | 0.6        |
| Zavrelimyia             | 33          | 0.6        |
| Smittia                 | 27          | 0.5        |
| Rheotanytarsus          | 26          | 0.5        |
| Physa                   | 25          | 0.4        |
| Pisidium                | 25          | 0.4        |
| Neophylax               | 23          | 0.4        |
| Orthocladius            | 21          | 0.4        |
| Haploperla              | 20          | 0.3        |

| Taxonomic Group   | Individuals | % Observed |
|-------------------|-------------|------------|
| Nemoura           | 19          | 0.3        |
| Paratendipes      | 18          | 0.3        |
| Phaenopsectra     | 18          | 0.3        |
| Tipula            | 17          | 0.3        |
| Ancyronyx         | 16          | 0.3        |
| Pilaria           | 16          | 0.3        |
| Stenelmis         | 16          | 0.3        |
| Bezzia/Palpomyia  | 15          | 0.3        |
| Nanocladius       | 14          | 0.2        |
| Hydroporinae      | 13          | 0.2        |
| Macronychus       | 12          | 0.2        |
| Orthocladiinae    | 12          | 0.2        |
| Ablabesmyia       | 11          | 0.2        |
| Allocapnia        | 11          | 0.2        |
| Diplectrona       | 11          | 0.2        |
| Hexatoma          | 11          | 0.2        |
| Lebertia          | 11          | 0.2        |
| Erioptera         | 10          | 0.2        |
| Lumbricidae       | 10          | 0.2        |
| Paraphaenocladius | 10          | 0.2        |
| Cheumatopsyche    | 9           | 0.2        |
| Stempellinella    | 9           | 0.2        |
| Anchytarsus       | 8           | 0.1        |
| Argia             | 8           | 0.1        |
| Crangonyx         | 8           | 0.1        |
| Gyraulus          | 8           | 0.1        |
| Oulimnius         | 8           | 0.1        |
| Pseudorthocladius | 8           | 0.1        |
| Thienemanniella   | 8           | 0.1        |
| Calopteryx        | 7           | 0.1        |
| Chrysops          | 7           | 0.1        |
| Dicrotendipes     | 7           | 0.1        |
| Limnophyes        | 7           | 0.1        |
| Neoporus          | 7           | 0.1        |
| Nigronia          | 7           | 0.1        |
| Pseudosmittia     | 7           | 0.1        |
| Cladopelma        | 6           | 0.1        |
| Dasyhelea         | 6           | 0.1        |
| Hemerodromia      | 6           | 0.1        |
| Ilyodrilus        | 6           | 0.1        |
| Taxonomic Group     | Individuals | % Observed |
|---------------------|-------------|------------|
| Lumbriculidae       | 6           | 0.1        |
| Natarsia            | 6           | 0.1        |
| Ormosia             | 6           | 0.1        |
| Paratanytarsus      | 6           | 0.1        |
| Taenionema          | 6           | 0.1        |
| Brachycera          | 5           | 0.1        |
| Ceratopogon         | 5           | 0.1        |
| Cricotopus          | 5           | 0.1        |
| Dero                | 5           | 0.1        |
| Lymnaeidae          | 5           | 0.1        |
| Acerpenna           | 4           | 0.1        |
| Agabus              | 4           | 0.1        |
| Aulodrilus          | 4           | 0.1        |
| Ephemerella         | 4           | 0.1        |
| Helichus            | 4           | 0.1        |
| Heterotrissocladius | 4           | 0.1        |
| Hydatophylax        | 4           | 0.1        |
| Mallochohelea       | 4           | 0.1        |
| Spirosperma         | 4           | 0.1        |
| Stenochironomus     | 4           | 0.1        |
| Stictochironomus    | 4           | 0.1        |
| Tubifex             | 4           | 0.1        |
| Zalutschia          | 4           | 0.1        |
| Brillia             | 3           | 0.1        |
| Chloroperlidae      | 3           | 0.1        |
| Copelatus           | 3           | 0.1        |
| Culiseta            | 3           | 0.1        |
| Dubiraphia          | 3           | 0.1        |
| Hydropsyche         | 3           | 0.1        |
| Krenopelopia        | 3           | 0.1        |
| Paracladopelma      | 3           | 0.1        |
| Parakiefferiella    | 3           | 0.1        |
| Planariidae         | 3           | 0.1        |
| Pristina            | 3           | 0.1        |
| Prostoma            | 3           | 0.1        |
| Pycnopsyche         | 3           | 0.1        |
| Sciaridae           | 3           | 0.1        |
| Slavina             | 3           | 0.1        |
| Stilocladius        | 3           | 0.1        |
| Alluaudomyia        | 2           |            |

| Taxonomic Group          | Individuals | % Observed |
|--------------------------|-------------|------------|
| Caenis                   | 2           |            |
| Dixella                  | 2           |            |
| Endochironomus           | 2           |            |
| Fossaria                 | 2           |            |
| Gomphidae                | 2           |            |
| Gonomyia                 | 2           |            |
| Larsia                   | 2           |            |
| Leptoceridae             | 2           |            |
| Menetus                  | 2           |            |
| Paramerina               | 2           |            |
| Perlodidae               | 2           |            |
| Potthastia               | 2           |            |
| Pseudolimnophila         | 2           |            |
| Tipulidae                | 2           |            |
| Tribelos                 | 2           |            |
| Aedes                    | 1           |            |
| Antocha                  | 1           |            |
| Apsectrotanypus          | 1           |            |
| Aquarius                 | 1           |            |
| Baetidae                 | 1           |            |
| Baetis                   | 1           |            |
| Bittacomorpha            | 1           |            |
| Boyeria                  | 1           |            |
| Calopterygidae           | 1           |            |
| Cambarinae               | 1           |            |
| Cecidomyiidae            | 1           |            |
| Chelifera                | 1           |            |
| Chironomus               | 1           |            |
| Cordulegaster            | 1           |            |
| Corduliinae/Libellulinae | 1           |            |
| Cryptotendipes           | 1           |            |
| Culicidae                | 1           |            |
| Dineutus                 | 1           |            |
| Diptera                  | 1           |            |
| Dolichopodidae           | 1           |            |
| Eccoptura                | 1           |            |
| Enallagma                | 1           |            |
| Ferrissia                | 1           |            |
| Gomphus                  | 1           |            |
| Helisoma                 | 1           |            |

| Taxonomic Group     | Individuals | % Observed |
|---------------------|-------------|------------|
| Hydrobiidae         | 1           |            |
| Isoperla            | 1           |            |
| Labrundinia         | 1           |            |
| Micropsectra        | 1           |            |
| Musculium/Sphaerium | 1           |            |
| Oligostomis         | 1           |            |
| Paralauterborniella | 1           |            |
| Peltodytes          | 1           |            |
| Physidae            | 1           |            |
| Polycentropus       | 1           |            |
| Procladius          | 1           |            |
| Ptilostomis         | 1           |            |
| Quistradrilus       | 1           |            |
| Rheosmittia         | 1           |            |
| Saetheria           | 1           |            |
| Sialis              | 1           |            |
| Sphaeromias         | 1           |            |
| Stygobromus         | 1           |            |
| Veliidae            | 1           |            |
| TOTAL               | 5737        |            |

Note: only those taxa for which at least 0.1% occurrence was observed have a % Observed value presented here.

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# **APPENDIX F: INDIVIDUAL SITE SUMMARIES**

Note: A map showing the location of the sample sites in each PSU precedes each collection of individual site summaries.

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**Location/Site Access**: Located at Arundel Golf Park Latitude/Longitude: 39.16283/-76.65556

#### Land Use Analysis:

| Land Use         | Acres | % Area |
|------------------|-------|--------|
| Airport          | 95.2  | 29.1   |
| Commercial       | 4.7   | 1.4    |
| Open Space       | 183.5 | 56.1   |
| Residential 1/8- |       |        |
| acre             | 0.2   | 0.1    |
| Transportation   | 7.1   | 2.2    |
| Water            | 0.6   | 0.2    |
| Woods            | 35.4  | 10.8   |
| Grand Total      | 326.7 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 84.7       | 326.7      | 25.9       |

#### **Results:**

- Biological condition "Poor"
- Habitat scores "Non Supporting" and "Degraded"
- Habitat assessment results indicate degraded conditions at this site, but the biological community shows high diversity and is not as impaired as expected based on the observed habitat quality.
- Bank, riparian, and sediment conditions are mostly marginal. The channel is highly accessible to public parklands.
- Sample dominated by worms (*Limnodrilus*)
- Stream type was identified as an E5, slope was 1.18 percent, and the median channel substrate was medium sand
- Typically, E channels are stable. The high exposure and landscape management of the riparian area may contribute to poor biological conditions

- Protect the riparian area. Naturalize if feasible.
- Determine need, feasibility of BMP retrofits on airport property.

# Sawmill Creek Sampling Unit

| <b>IBI and Metric Scores</b>   |   |
|--|---|
| Narrative Rating   | Poor  |
| Overall Index  | 2.43  |
| Total Taxa Score   | 5   |
| EPT Taxa Score   | 1   |
| Ephemeroptera Taxa Score   | 3   |
| Intolerant Urban % Score   | 1   |
| Ephemeroptera % Score  | 3   |
| Scraper Taxa Score   | 1   |
| % Climbers   | 3   |
| Calculated Metric Values   |   |
| Total Taxa   | 32  |
| EPT Taxa   | 1   |
| Ephemeroptera Taxa   | 1   |
| Intolerant Urban %   | 3.96  |
| Ephemeroptera %  | 0.99  |
| Scraper Taxa   | 0   |
| % Climbers   | 2 97  |
| 70 Chinocis  | 2.91  |
| Pisidiidae<br>Macronychus<br>Orthocladiinae<br>Paramerina<br>Parametriocnemus<br>Paraphaenocladius<br>Paratanytarsus<br>Thienemannimyia genus group<br>Pseudolimnophila<br>Lymnaeidae<br>Stegopterna<br>Stenelmis<br>Tanytarsus                                    | 1<br>1<br>2<br>2<br>4<br>2<br>2<br>4<br>1<br>1<br>2<br>6  |
| Tipula<br>Tipula<br>Tribelos<br>Tubificinae<br>Hydroporinae<br>Cambarinae<br>Polypedilum<br>Enchytraeidae<br>Ablabesmyia<br>Nemata<br>Lumbricidae<br>Aulodrilus<br>Enallagma<br>Chaetocladius<br>Chironomus<br>Culicoides<br>Diplocladius<br>Limnodrilus<br>Caenis | $     \begin{array}{c}       1 \\       2 \\       1 \\       5 \\       1 \\       1 \\       1 \\       1 \\       1 \\       1 \\       1 \\       1 \\       1 \\       1 \\       4 \\       42 \\       1     \end{array} $ |
| Total Individuals  | 101   |

| <u>Physical Habitat</u>             |    |   |     |
|-------------------------------------|----|---|-----|
| EPA Rapid Bioassessment             |    |   |     |
| Bank Stability- Left Bank           | 5  | Pool Variability                              | 8   |
| Bank Stability- Right Bank          | 5  | Riparian Vegetative<br>Zone Width- Left Bank  | 5   |
| Channel Alteration                  | 8  | Riparian Vegetative<br>Zone Width- Right Bank | 5   |
| Channel Flow Status                 | 17 | Sediment Deposition                           | 8   |
| Channel Sinuosity                   | 7  | Vegetative Protection (Left Bank)             | 6   |
| Epifaunal Substrate/Available Cover | 10 | Vegetative Protection (Right Bank)            | 6   |
| Pool Substrate Characterization     | 10 |   |     |
|                                     |    | EPA Habitat Score                             | 100 |
|                                     |    | EPA Narrative Ranking                         | NS  |

#### Maryland Biological Stream Survey PHI

| Drainage area (acres)   | 326.7 | Instream Wood Debris               | 5     |
|-------------------------|-------|------------------------------------|-------|
| Remoteness              | 0     | Bank Stability                     | 10    |
| Shading                 | 65    |                                    |       |
| Epifaunal Substrate     | 6     | PHI Score                          | 55.92 |
| Instream Habitat        | 10    | PHI Narrative Ranking              | D     |
| Water Chemistry         |       |                                    |       |
| Dissolved Oxygen (mg/L) | 9.37  | Specific Conductance ( $\mu$ S/cm) | 322   |
| pH                      | 6.98  | Temperature (°C)                   | 7.55  |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 0.51 | Cross Sectional Area (ft <sup>2</sup> ) | 8.9   |
|----------------------------------|------|---|-------|
| Bankfull Width (ft)              | 8.7  | Water Surface Slope (%)                 | 1.18  |
| Mean Bankfull Depth (ft)         | 1.0  | Sinuosity                               | 1.0   |
| Floodprone Width (ft)            | 108  | D50 (mm)                                | 0.45  |
| Entrenchment Ratio               | 12.5 | Adjustments?                            | ↑ Sin |
| Width to Depth Ratio             | 8.4  | Rosgen Stream Type                      | E5    |





**Location/Site Access**: Located at Mead Rd Crossing Latitude/Longitude: 39.19957/-76.6301

#### Land Use Analysis:

| Land Use         | Acres  | % Area |
|------------------|--------|--------|
| Airport          | 110.7  | 8.9    |
| Commercial       | 102.1  | 8.2    |
| Industrial       | 67.6   | 5.4    |
| Open Space       | 155.3  | 12.4   |
| Residential 1/4- |        |        |
| acre             | 413.1  | 33.1   |
| Residential 1/8- |        |        |
| acre             | 86.2   | 6.9    |
| Residential 1-   |        |        |
| acre             | 10.0   | 0.8    |
| Residential 2-   |        |        |
| acre             | 4.7    | 0.4    |
| Transportation   | 71.8   | 5.8    |
| Utility          | 23.2   | 1.9    |
| Water            | 3.4    | 0.3    |
| Woods            | 200.6  | 16.1   |
| Grand Total      | 1248.7 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 520.8      | 1248.7     | 41.7       |

#### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Non Supporting" and "Severely Degraded"
- Biological community condition is appropriate for the habitat quality observed.
- All habitat features have marginal or poor ratings
- Sample dominated by worms (*Enchytraeidae*) and midges (*Orthocladius/Cricotopus*)
- Stream type was identified as an C5, slope was 0.278 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, C channels are stable, though habitat ratings related to channel stability indicate that this reach is degraded
- Conductivity was higher at this site than any other site sampled in 2008

#### **Recommendations:**

• Investigate possibilities for restoring habitat features, including management of runoff that may be associated with high imperviousness

# Sawmill Creek Sampling Unit

| IBI and Metric Scores   |   |
|---|---|
| Narrative Rating  | Very Poor   |
| Overall Index   | 1.29  |
| Total Taxa Score  | 3   |
| EPT Taxa Score  | 1   |
| Ephemeroptera Taxa Score  | 1   |
| Intolerant Urban % Score  | 1   |
| Ephemeroptera % Score   | 1   |
| Scraper Taxa Score  | 1   |
| % Climbers  | 1   |
| Calculated Metric Values  |   |
| Total Taxa  | 15  |
| EPT Taxa  | 0   |
| Ephemeroptera Taxa  | 0   |
| Intolerant Urban %  | 1   |
| Ephemeroptera %   | 0   |
| Scraper Taxa  | 0   |
| % Climbers  | 0   |
| Nemata<br>Tubifex<br>Culicoides<br>Lumbricidae<br>Zavrelimyia<br>Tipula<br>Stegopterna<br>Pseudosmittia<br>Physa<br>Ormosia<br>Copelatus<br>Orthocladius/Cricotopus<br>Aulodrilus<br>Enchytraeidae<br>Cecidomyiidae | 4<br>1<br>2<br>6<br>1<br>1<br>1<br>1<br>1<br>3<br>3<br>15<br>1<br>59<br>1 |
|   |   |
| Total Individuals   | 100   |

| Physical Habitat                    |          |   |       |
|-------------------------------------|----------|---|-------|
| EPA Rapid Bioassessment             |          |   |       |
| Bank Stability- Left Bank           | 3        | Pool Variability                              | 8     |
| Bank Stability- Right Bank          | 3        | Riparian Vegetative<br>Zone Width- Left Bank  | 2     |
| Channel Alteration                  | 8        | Riparian Vegetative<br>Zone Width- Right Bank | 2     |
| Channel Flow Status                 | 10       | Sediment Deposition                           | 5     |
| Channel Sinuosity                   | 3        | Vegetative Protection (Left Bank)             | 4     |
| Epifaunal Substrate/Available Cover | 7        | Vegetative Protection (Right Bank)            | 4     |
| Pool Substrate Characterization     | 10       |   |       |
|                                     |          | EPA Habitat Score                             | 69    |
|                                     |          | EPA Narrative Ranking                         | NS    |
|                                     |          |   |       |
| Maryland Biological Stream          | Survey I | PHI   |       |
| Drainage area (acres)               | 1248.7   | Instream Wood Debris                          | 8     |
| Remoteness                          | 2        | Bank Stability                                | 6     |
| Shading                             | 40       |   |       |
| Epifaunal Substrate                 | 3        | PHI Score                                     | 40.82 |
| Instream Habitat                    | 7        | PHI Narrative Ranking                         | SD    |
| Water Chemistry                     |          |   |       |
| Dissolved Oxygen (mg/L)             | 11.8     | Specific Conductance (µS/cm)                  | 1147  |
| рН                                  | 7.4      | Temperature (°C)                              | 5.9   |
|                                     |          |   |       |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 1.95 |
|----------------------------------|------|
| Bankfull Width (ft)              | 14.5 |
| Mean Bankfull Depth (ft)         | 1.2  |
| Floodprone Width (ft)            | 80   |
| Entrenchment Ratio               | 5.5  |
| Width to Depth Ratio             | 12.3 |

| 2.3 | Rosgen Stream Type                      | C5    |
|-----|---|-------|
| 5.5 | Adjustments?                            | ↑Sin  |
| 80  | D50 (mm)                                | 0.25* |
| 1.2 | Sinuosity                               | 1.0*  |
| 4.5 | Water Surface Slope (%)                 | 0.278 |
| .95 | Cross Sectional Area (ft <sup>2</sup> ) | 17.0  |
|     |   |       |

#### \*=estimated





**Location/Site Access**: Located at Andover Park horse farm Latitude/Longitude: 39.19495/76.66482

#### Land Use Analysis:

| Land Use         | Acres | % Area |
|------------------|-------|--------|
| Commercial       | 13.9  | 20.5   |
| Open Space       | 34.3  | 50.8   |
| Residential 1/4- |       |        |
| acre             | 5.9   | 8.8    |
| Residential 1-   |       |        |
| acre             | 1.8   | 2.7    |
| Transportation   | 1.7   | 2.6    |
| Woods            | 9.9   | 14.6   |
| Grand Total      | 67.6  | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 16.2       | 67.6       | 24.0       |

#### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- While habitat is significantly impaired, biological community is in worse condition than would be expected for available habitat quality.
- Pool variability and substrate are degraded. Most other habiat features are sub-optimal.
- Sample dominated by worms (*Enchytreaidae*) and *Nemata*
- Stream type was identified as an E5, slope was 0.095 percent, and the median channel substrate was medium sand
- Typically, E channels are stable. This channel may be stable, though there may be excess fine sediments, which reduce pool quality.

- Maintain the protection of the riparian area
- Determine whether excess fine sediments can be managed
- Look for stormwater management opportunities on developed lands in basin.

## Sawmill Creek Sampling Unit

Pool Variability

**EPA Narrative Ranking** 

7

PS

| <b>IBI and Metric Scores</b>  |   |
|---|---|
| Narrative Rating  | Very Poor   |
| Overall Index   | 1.29  |
| Total Taxa Score  | 3   |
| EPT Taxa Score  | 1   |
| Ephemeroptera Taxa Score  | 1   |
| Intolerant Urban % Score  | 1   |
| Ephemeroptera % Score   | 1   |
| Scraper Taxa Score  | 1   |
| % Climbers  | 1   |
| Calculated Metric Values  |   |
| Total Taxa  | 14  |
| EPT Taxa  | 1   |
| Ephemeroptera Taxa  | 0   |
| Intolerant Urban %  | 0   |
| Ephemeroptera %   | 0   |
| Scraper Taxa  | 0   |
| % Climbers  | 0   |
| Tubificinae<br>Tubifex<br>Pseudosmittia<br>Physa<br>Orthocladius/Cricotopus<br>Nemata<br>Nais<br>Limnephilidae<br>Diplocladius<br>Culicoides<br>Enchytraeidae<br>Corynoneura<br>Ormosia | 15<br>3<br>1<br>2<br>15<br>26<br>2<br>1<br>3<br>4<br>27<br>2<br>1 |
| Total Individuals   | 103   |

#### **Physical Habitat EPA Rapid Bioassessment** Bank Stability- Left Bank

|                                     |    | EPA Habitat Score                             | 114 |
|-------------------------------------|----|---|-----|
| Pool Substrate Characterization     | 7  |   |     |
| Epifaunal Substrate/Available Cover | 11 | Vegetative Protection (Right Bank)            | 7   |
| Channel Sinuosity                   | 6  | Vegetative Protection (Left Bank)             | 7   |
| Channel Flow Status                 | 15 | Sediment Deposition                           | 9   |
| Channel Alteration                  | 17 | Riparian Vegetative<br>Zone Width- Right Bank | 10  |
| Bank Stability- Right Bank          | 6  | Riparian Vegetative<br>Zone Width- Left Bank  | 6   |
| Bank Stability- Left Bank           | 6  | Pool Variability                              | 7   |

#### Maryland Biological Stream Survey PHI

| Drainage area (acres)   | 67.6  | Instream Wood Debris         | 5     |
|-------------------------|-------|------------------------------|-------|
| Remoteness              | 5     | Bank Stability               | 12    |
| Shading                 | 80    |                              |       |
| Epifaunal Substrate     | 3     | PHI Score                    | 69.44 |
| Instream Habitat        | 11    | PHI Narrative Ranking        | PD    |
| Water Chemistry         |       |                              |       |
| Dissolved Oxygen (mg/L) | 11.29 | Specific Conductance (µS/cm) | 432   |
| pH                      | 7.5   | Temperature (°C)             | 4.69  |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 0.106 |
|----------------------------------|-------|
| Bankfull Width (ft)              | 13.5  |
| Mean Bankfull Depth (ft)         | 1.2   |
| Floodprone Width (ft)            | 150*  |
| Entrenchment Ratio               | 11.1  |
| Width to Depth Ratio             | 11.5  |
|                                  |       |

| .5  | <b>Rosgen Stream Type</b>               | E5    |
|-----|---|-------|
| .1  | Adjustments?                            | ↑W/D  |
| 0*  | D50 (mm)                                | 0.26  |
| .2  | Sinuosity                               | 1.0*  |
| 8.5 | Water Surface Slope (%)                 | 0.095 |
| 06  | Cross Sectional Area (ft <sup>2</sup> ) | 15.8  |

#### \*=estimated





**Location/Site Access**: Missing information Latitude/Longitude: 39.18064/76.63432

#### Land Use Analysis:

| Land Use         | Acres | % Area |
|------------------|-------|--------|
| Commercial       | 15.8  | 3.8    |
| Industrial       | 4.7   | 1.1    |
| Open Space       | 24.5  | 5.9    |
| Residential 1/4- |       |        |
| acre             | 131.1 | 31.8   |
| Residential 1/8- |       |        |
| acre             | 176.2 | 42.7   |
| Residential 1-   |       |        |
| acre             | 9.4   | 2.3    |
| Transportation   | 27.0  | 6.5    |
| Water            | 0.2   | 0.0    |
| Woods            | 23.7  | 5.7    |
| Grand Total      | 412.4 | 100.0  |

| Impervious<br>(acres) | Total Area<br>Above site | %<br>Impervious |
|-----------------------|--------------------------|-----------------|
| 171.8                 | 412.4                    | 41.7            |
|                       |                          |                 |

#### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Biological community is in worse condition than would be expected for available habitat quality.
- Except for an adequate riparian zone width on the left bank, all bank and riparian measures show degradation. Sediment deposition is also marginal.
- Sample dominated by midges (*Tvetnia*) and worms (*Nais*)
- Stream type was identified as an E5, slope was 0.245 percent, and the median channel substrate was fine sand
- Typically, E channels are stable. The "Very Poor" biological ratings along with marginal habitat ratings related to bank stability and substrates indicate that this reach is unstable

- Protect the riparian area.
- Determine adequacy of runoff management for the highly impervious areas in the catchment.

# Sawmill Creek Sampling Unit

| IBI and Metric Scores       |           |
|-----------------------------|-----------|
| Narrative Rating            | Very Poor |
| Overall Index               | 1.86      |
| Total Taxa Score            | 5         |
| EPT Taxa Score              | 1         |
| Ephemeroptera Taxa Score    | 1         |
| Intolerant Urban % Score    | 1         |
| Enhemerontera % Score       | 1         |
| Scraper Taxa Score          | 1         |
|                             | 1         |
| % Climbers                  | 3         |
| Calculated Metric Values    |           |
| Total Taxa                  | 24        |
| EPT Taxa                    | 1         |
| Ephemeroptera Taxa          | 0         |
| Intolerant Urban %          | 1.8       |
| Ephemeroptera %             | 0         |
| Scraper Taxa                | 0         |
| % Climbers                  | 7.21      |
| Taxa List                   | ,         |
| Caecidotea                  | 2         |
| Corynoneura                 | 2         |
| Gammarus                    | 1         |
| Helichus                    | 1         |
| Hemerodromia                | 1         |
| Hydropsyche                 | 2         |
| Nois                        | 12        |
| Nemata                      | 12        |
| Orthocladius/Cricotopus     | 3         |
| Paracladopelma              | 1         |
| Physa                       | 6         |
| Enchytraeidae               | 2         |
| Polypedilum                 | 6         |
| Prostoma                    | 1         |
| Pisidiidae                  | 2         |
| Tanytarsus                  | 2         |
| Thienemanniella             | 1         |
| Tipula<br>Tyotopia          | 3         |
| Tubificinae                 | 44        |
| Thienemannimyia genus group | 3         |
| Phaenopsectra               | 3         |
| Crangonyx                   | 3         |
|                             |           |

**Total Individuals** 

111

| Physical Habitat                    |          |   |       |
|-------------------------------------|----------|---|-------|
| EPA Rapid Bioassessment             |          |   |       |
| Bank Stability- Left Bank           | 3        | Pool Variability                              | 10    |
| Bank Stability- Right Bank          | 4        | Riparian Vegetative<br>Zone Width- Left Bank  | 9     |
| Channel Alteration                  | 13       | Riparian Vegetative<br>Zone Width- Right Bank | 1     |
| Channel Flow Status                 | 17       | Sediment Deposition                           | 8     |
| Channel Sinuosity                   | 9        | Vegetative Protection (Left Bank)             | 4     |
| Epifaunal Substrate/Available Cover | 14       | Vegetative Protection (Right Bank)            | 5     |
| Pool Substrate Characterization     | 13       |   |       |
|                                     |          | EPA Habitat Score                             | 110   |
|                                     |          | EPA Narrative Ranking                         | PS    |
| Maryland Biological Stream          | Survey I | PHI   |       |
| Drainage area (acres)               | 412.4    | Instream Wood Debris                          | 7     |
| Remoteness                          | 0        | Bank Stability                                | 7     |
| Shading                             | 30       |   |       |
| Epifaunal Substrate                 | 11       | PHI Score                                     | 57.10 |
| Instream Habitat                    | 14       | PHI Narrative Ranking                         | D     |
| Water Chemistry                     |          |   |       |

#### D

| Dissolved Oxygen (mg/L) | 10.57 | Specific Conductance ( $\mu$ S/cm) | 387   |
|-------------------------|-------|------------------------------------|-------|
| pH                      | 6.86  | Temperature (°C)                   | 13.17 |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 0.64 | Cross Sectional Area (ft <sup>2</sup> ) | 13.7  |
|----------------------------------|------|---|-------|
| Bankfull Width (ft)              | 11.0 | Water Surface Slope (%)                 | 0.245 |
| Mean Bankfull Depth (ft)         | 1.2  | Sinuosity                               | 1.2   |
| Floodprone Width (ft)            | 24.5 | D50 (mm)                                | 0.36  |
| Entrenchment Ratio               | 2.2  | Adjustments?                            | ↑Sin  |
| Width to Depth Ratio             | 8.8  | Rosgen Stream Type                      | E5    |





**Location/Site Access**: Missing information Latitude/Longitude: 39.17198/76.6271

#### Land Use Analysis:

| Land Use             | Acres  | % Area |
|----------------------|--------|--------|
| Airport              | 133.7  | 4.1    |
| Commercial           | 126.5  | 3.9    |
| Industrial           | 170.5  | 5.2    |
| Open Space           | 737.3  | 22.5   |
| Residential 1/2-acre | 27.4   | 0.8    |
| Residential 1/4-acre | 20.5   | 0.6    |
| Residential 1/8-acre | 442.2  | 13.5   |
| Residential 1-acre   | 90.7   | 2.8    |
| Residential Woods    | 38.5   | 1.2    |
| Row Crops            | 4.8    | 0.1    |
| Transportation       | 201.2  | 6.1    |
| Utility              | 20.4   | 0.6    |
| Water                | 5.4    | 0.2    |
| Woods                | 1035.0 | 31.6   |
| Grand Total          | 3273.3 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 787.1      | 3273.3     | 24.0       |

#### **Results:**

- Biological condition "Poor"
- Habitat scores "Non Supporting" and "Severely Degraded"
- Biological conditions are somewhat better than expected in relation to the level of observed habitat quality.
- Habitat ratings related to bank conditions and substrates were marginal and poor, except for one intact riparian zone
- Sample dominated by amphipods (*Gammarus*), worms (*Tubificinae*), and clams (*Pisidiidae*)
- Stream type was identified as an C5, slope was 0.075 percent, and the median channel substrate was fine sand
- Typically, C channels are stable, though marginal and poor habitat ratings related to bank conditions indicate that this reach is unstable

#### **Recommendations:**

• Investigate possibilities for restoring habitat features, including improved management of runoff from impervious surfaces

### Sawmill Creek Sampling Unit

| Narrative Rating            | Poor  |
|-----------------------------|-------|
| Overall Index               | 2.14  |
| Total Taxa Score            | 5     |
| EPT Taxa Score              | 1     |
| Ephemeroptera Taxa Score    | 1     |
| Intolerant Urban % Score    | 1     |
| Enhancement of Score        | 1     |
| Epnemeroptera % Score       | 1     |
| Scraper Taxa Score          | 1     |
| % Climbers                  | 5     |
| Calculated Metric Values    |       |
| Total Taxa                  | 26    |
| EPT Taxa                    | 0     |
| Ephemeroptera Taxa          | 0     |
| Intolerant Urban %          | 0     |
| Enhemerontera %             | 0     |
| Scraper Taxa                | 0     |
|                             | 11.01 |
| % Climbers                  | 11.0  |
| Taxa List                   | 10    |
| Iubificinae                 | 12    |
| Labortio                    | 2     |
|                             | 1     |
|                             | 1     |
| Remerodromia                | 3     |
| Gammarus                    | 28    |
| Cricotopus                  | 4     |
| Calopteryx                  | 5     |
| Argia                       | 4     |
| Apsectrotanypus             | 1     |
| Alluaudomyia                | 1     |
| Nanocladius                 | 1     |
| Hydroporinae                | 2     |
| Corynoneura                 | 3     |
| Tvetenia                    | 3     |
| Tanytarsus                  | 3     |
| Pisidiidae                  | 11    |
| Orthocladius/Cricotopus     | 4     |
| Slavina                     | 1     |
| Rheotanytarsus              | 4     |
| Polypedilum                 | 4     |
| Planariidae                 | 1     |
| Parametriocnemus            | 6     |
| Thienemannimyia genus group | 1     |
|                             |       |

Physical Habitat **EPA Rapid Bioassessment** Bank Stability- Left Bank Pool Variability 3 5 **Riparian** Vegetative Bank Stability- Right Bank 5 Zone Width- Left Bank 10 Riparian Vegetative Channel Alteration Zone Width- Right Bank 16 1 Channel Flow Status Sediment Deposition 18 5 Channel Sinuosity Vegetative Protection (Left Bank) 5 3 Epifaunal Substrate/Available Cover Vegetative Protection (Right Bank) 10 5 Pool Substrate Characterization 11 EPA Habitat Score 97 EPA Narrative Ranking NS **Maryland Biological Stream Survey PHI** Drainage area (acres) Instream Wood Debris 3273.3 9 Remoteness Bank Stability 1 1 Shading 15 PHI Score Epifaunal Substrate 2 34.85 Instream Habitat **PHI Narrative Ranking** 10 SD Water Chemistry Dissolved Oxygen (mg/L) Specific Conductance (µS/cm) 11.3 292 pН Temperature (°C) 7.18 7.53

#### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 5  |
|----------------------------------|----|
| Bankfull Width (ft)              | 24 |
| Mean Bankfull Depth (ft)         | 1  |
| Floodprone Width (ft)            | 2  |
| Entrenchment Ratio               | 9  |
| Width to Depth Ratio             | 2  |
|                                  |    |

| .1  | Cross Sectional Area (ft <sup>2</sup> ) | 23.9  |
|-----|---|-------|
| 4.9 | Water Surface Slope (%)                 | 0.075 |
| .0  | Sinuosity                               | 1.0*  |
| 29  | D50 (mm)                                | 0.13  |
| .2  | Adjustments?                            | ↑Sin  |
| 26  | Rosgen Stream Type                      | C5    |
|     |   |       |

#### \*=estimated



**Total Individuals** 



**Location/Site Access**: Missing information Latitude/Longitude: 39.17305/76.62378

#### Land Use Analysis:

| Land Use             | Acres  | % Area |
|----------------------|--------|--------|
| Airport              | 458.3  | 10.5   |
| Commercial           | 201.4  | 4.6    |
| Industrial           | 282.1  | 6.5    |
| Open Space           | 968.1  | 22.3   |
| Residential 1/2-acre | 27.4   | 0.6    |
| Residential 1/4-acre | 117.6  | 2.7    |
| Residential 1/8-acre | 508.3  | 11.7   |
| Residential 1-acre   | 109.6  | 2.5    |
| Residential 2-acre   | 221.5  | 5.1    |
| Residential Woods    | 47.0   | 1.1    |
| Row Crops            | 4.9    | 0.1    |
| Transportation       | 241.2  | 5.5    |
| Utility              | 21.2   | 0.5    |
| Water                | 6.9    | 0.2    |
| Woods                | 1132.4 | 26.0   |
| Grand Total          | 4347.9 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 1340       | 4347.9     | 31.0       |

#### **Results:**

- Biological condition "Poor"
- Habitat scores "Partially Supporting" and "Severely Degraded"
- Habitat assessment results were mixed for this site, but biological community observed is trending toward less than expected impairment based on the observed habitat quality.
- This reach has marginal bank stability and pool variability. The riparian zone is intact.
- Sample dominated by amphipods (*Gammarus*) and midges (*Tanytarsus*)
- Stream type was not identified, slope was 0.428 percent, and the median channel substrate was fine sand
- This channel was not classified as to type, but it is a shallow channel in a broad and accessible floodplain. It therefore has wetland features and may not be susceptible to erosion.

- Maintain the protection of the riparian area.
- Identify runoff management opportunities associated with upstream impervious areas.

## Sawmill Creek Sampling Unit

| IBI and Metric Scores       |         |
|-----------------------------|---------|
| Narrative Rating            | Poor    |
| Overall Index               | 2.14    |
| Total Taxa Score            | 5       |
| EPT Taxa Score              | 1       |
| Ephemeroptera Taxa Score    | 1       |
| Intolerant Urban % Score    | 1       |
| Enhemerontera % Score       | 1       |
| Soraper Taxa Soore          | 1       |
| % Climber                   | 1<br>2  |
| Colculated Matrie Values    | 3       |
|                             | 27      |
| Total Taxa                  | 27      |
| EPT Taxa                    | 1       |
| Ephemeroptera Taxa          | 0       |
| Intolerant Urban %          | 0       |
| Ephemeroptera %             | 0       |
| Scraper Taxa                | 0       |
| % Climbers                  | 19      |
| Taxa List                   |         |
| Helisoma                    | 1       |
| l'vetenia<br>Phooteputersus | 4       |
| Cheotanytarsus              | 5       |
| Macronychus                 | 1       |
| Slavina                     | 2       |
| Polypedilum                 | 2       |
| Pisidiidae                  | 7       |
| Fanytarsus                  | 16      |
| Orthocladius/Cricotopus     | 3       |
| Paraphaenocladius           | 1       |
| Nais                        | 2       |
| Limnodrilus                 | 1       |
|                             | 5<br>1  |
| Fubificinae                 | 1<br>Q  |
| Thienemannimyia genus group | 5       |
| Ancyronyx                   | 1       |
| Argia                       | 4       |
| Planariidae                 | 1       |
| Enchytraeidae               | 1       |
| Chelifera                   | 1       |
| Cheumatopsyche              | 6       |
| Corynoneura                 | 1       |
| rossaria                    | 1       |
| Jammarus                    | 1/<br>1 |
|                             | 1       |
|                             |         |
| fotal Individuals           | 100     |

| Physical Habitat                    |        |   |       |
|-------------------------------------|--------|---|-------|
| EPA Rapid Bioassessment             |        |   |       |
| Bank Stability- Left Bank           | 4      | Pool Variability                              | 5     |
| Bank Stability- Right Bank          | 4      | Riparian Vegetative<br>Zone Width- Left Bank  | 10    |
| Channel Alteration                  | 20     | Riparian Vegetative<br>Zone Width- Right Bank | 10    |
| Channel Flow Status                 | 17     | Sediment Deposition                           | 8     |
| Channel Sinuosity                   | 7      | Vegetative Protection (Left Bank)             | 5     |
| Epifaunal Substrate/Available Cover | 10     | Vegetative Protection (Right Bank)            | 5     |
| Pool Substrate Characterization     | 12     |   |       |
|                                     |        | EPA Habitat Score                             | 117   |
|                                     |        | EPA Narrative Ranking                         | PS    |
| Maryland Biological Stream          | Survey | PHI   |       |
| Drainage area (acres)               | 4347.9 | Instream Wood Debris                          | 3     |
| Remoteness                          | 5      | Bank Stability                                | 8     |
| Shading                             | 20     |   |       |
| Epifaunal Substrate                 | 5      | PHI Score                                     | 38.97 |
| Instream Habitat                    | 11     | PHI Narrative Ranking                         | SD    |

#### Water Chemistry Dissolved Oxygen (mg/L) Specific Conductance ( $\mu$ S/cm) 11.65 459 pН Temperature (°C) 7.23 10.04

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

19.4

0.428 1.0\*

0.21

--Not

Classified

| Drainage Area (mi <sup>2</sup> ) | 6.8  | Cross Sectional Area (ft <sup>2</sup> ) |
|----------------------------------|------|---|
| Bankfull Width (ft)              | 29.1 | Water Surface Slope (%)                 |
| Mean Bankfull Depth (ft)         | 0.7  | Sinuosity                               |
| Floodprone Width (ft)            | 392  | D50 (mm)                                |
| Entrenchment Ratio               | 13.5 | Adjustments?                            |
| Width to Depth Ratio             | 43.7 | <b>Rosgen Stream Type</b>               |
| *=estimated                      |      |   |



### 04-12A

### **Sawmill Creek Sampling Unit**



**Location/Site Access**: Missing information Latitude/Longitude: 39.15493/76.65805

#### Land Use Analysis:

| Land Use             | Acres  | % Area |
|----------------------|--------|--------|
| Commercial           | 41.7   | 3.5    |
| Industrial           | 55.4   | 4.7    |
| Open Space           | 160.9  | 13.7   |
| Residential 1/2-acre | 15.1   | 1.3    |
| Residential 1/4-acre | 5.6    | 0.5    |
| Residential 1/8-acre | 162.6  | 13.8   |
| Residential 1-acre   | 46.2   | 3.9    |
| Residential 2-acre   | 187.0  | 15.9   |
| Row Crops            | 4.8    | 0.4    |
| Transportation       | 50.8   | 4.3    |
| Utility              | 3.0    | 0.3    |
| Water                | 3.0    | 0.3    |
| Woods                | 442.1  | 37.5   |
| Grand Total          | 1178.2 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 215.8      | 1178.2     | 18.3       |

#### **Results:**

- Biological condition "Poor"
- Habitat scores "Supporting" and "Partially Degraded"
- Biological community is in worse condition than would be expected for available habitat quality.
- The riparian zone is intact, but banks are only marginally stable and sediment and pool features are also marginal
- Sample dominated by midges (Parametriocnemus, Tanytarsus, Rheotanytarsus)
- Stream type was identified as an E5, slope was 0.419 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, E channels are stable, though this one is only marginally stable.

- Maintain the protection of the riparian area.
- Plan to manage any hydrologic effects associated with potential development
- Investigate potential sources of water quality problems

# 04-12A

# Sawmill Creek Sampling Unit

| IBI and Metric Scores      |       |
|----------------------------|-------|
| Narrative Rating           | Poor  |
| Overall Index              | 2.14  |
| Total Taxa Score           | 5     |
| EPT Taxa Score             | 1     |
| Ephemeroptera Taxa Score   | 1     |
| Intolerant Urban % Score   | 1     |
| Enhamerontera % Score      | 1     |
|                            | 1     |
| scraper Taxa Score         | 1     |
| % Climbers                 | 5     |
| Calculated Metric Values   |       |
| Total Taxa                 | 27    |
| EPT Taxa                   | 1     |
| Ephemeroptera Taxa         | 0     |
| Intolerant Urban %         | 6.86  |
| Ephemeroptera %            | 0     |
| Scraper Taxa               | 0     |
| % Climbers                 | 27.45 |
| Taxa List                  |       |
| Corynoneura                | 2     |
| Polypedilum                | 5     |
| Adiadesmyia<br>Zavrelimvia | 2     |
| Rheocricotopus             | 2     |
| Rheotanytarsus             | 11    |
| Pisidiidae                 | 3     |
| Stegopterna                | 3     |
| Stempellinella             | 7     |
| Steneshironomus            | 1     |
| Stilocladius               | 1     |
| Synurella                  | 2     |
| Tanytarsus                 | 15    |
| Alluaudomyia               | 1     |
| Tvetenia                   | 4     |
| Ancyronyx                  | 1     |
| Paratendines               | 3     |
| Parametriocnemus           | 27    |
| Paralauterborniella        | 1     |
| Nigronia                   | 1     |
| Macronychus                | 3     |
| Leptoceridae               | 1     |
| Gomphidae                  | 1     |
| Thienemanniella            | 1     |
|                            | 2     |
| Total Individuals          | 102   |

| 5      | Pool Variability  | 10  |
|--------|---|---|
| 5      | Riparian Vegetative<br>Zone Width- Left Bank  | 10  |
| 19     | Riparian Vegetative<br>Zone Width- Right Bank   | 10  |
| 18     | Sediment Deposition   | 8   |
| 10     | Vegetative Protection (Left Bank)   | 5   |
| 16     | Vegetative Protection (Right Bank)  | 5   |
| 9      |   |   |
|        | EPA Habitat Score   | 130   |
|        | EPA Narrative Ranking   | S   |
|        |   |   |
| Survey | PHI   |   |
| 1178.2 | Instream Wood Debris  | 8   |
| 9      | Bank Stability  | 10  |
| 100    |   |   |
| 12     | PHI Score   | 76.91   |
| 16     | PHI Narrative Ranking   | PD  |
|        |   |   |
|        |   |   |
| 11.1   | Specific Conductance (µS/cm)  | 248   |
| 6.64   | Temperature (°C)  | 6.59  |
|        | 5<br>19<br>18<br>10<br>16<br>9<br><b>Survey</b><br>1178.2<br>9<br>100<br>12<br>16<br>11.1<br>6.64 | 5       Pool Variability<br>Riparian Vegetative         5       Zone Width- Left Bank<br>Riparian Vegetative         19       Zone Width- Right Bank         18       Sediment Deposition         10       Vegetative Protection (Left Bank)         16       Vegetative Protection (Right Bank)         9       EPA Habitat Score         EPA Narrative Ranking         Survey PHI         1178.2       Instream Wood Debris         9       Bank Stability         100       12         12       PHI Score         16       PHI Narrative Ranking         11.1       Specific Conductance (µS/cm)         6.64       Temperature (°C) |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 1 |
|----------------------------------|---|
| Bankfull Width (ft)              | Ģ |
| Mean Bankfull Depth (ft)         |   |
| Floodprone Width (ft)            | 2 |
| Entrenchment Ratio               | 2 |
| Width to Depth Ratio             | 4 |

| .84 | Cross Sectional Area (ft <sup>2</sup> ) | 17.4  |
|-----|---|-------|
| 9.8 | Water Surface Slope (%)                 | 0.419 |
| .8  | Sinuosity                               | 1.1   |
| 45  | D50 (mm)                                | 0.25* |
| 5.1 | Adjustments?                            | ↑Sin  |
| 5.5 | Rosgen Stream Type                      | E5    |

#### \*=estimated





**Location/Site Access**: Missing information Latitude/Longitude: 39.16358/-76.6451

#### Land Use Analysis:

| Land Use             | Acres | % Area |
|----------------------|-------|--------|
| Airport              | 95.9  | 18.7   |
| Commercial           | 14.2  | 2.8    |
| Open Space           | 224.1 | 43.7   |
| Residential 1/2-acre | 7.4   | 1.4    |
| Residential 1/8-acre | 0.3   | 0.1    |
| Residential 2-acre   | 8.0   | 1.6    |
| Transportation       | 13.6  | 2.7    |
| Water                | 0.6   | 0.1    |
| Woods                | 148.8 | 29.0   |
| Grand Total          | 512.9 | 100.0  |

| bove site | Impervious         |
|-----------|--------------------|
| 512.9     | 20.4               |
|           | bove site<br>512.9 |

#### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Biological community is in worse condition than would be expected for available habitat quality.
- Many habitat features are marginal, including bank stability and sediment deposition
- Sample dominated by crane flies (*Tipula*) and worms (*Lumbriculidae*)
- Stream type was identified as an E5, slope was 0.536 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, E channels are stable. The "Very Poor" biological ratings along with marginal habitat ratings related to bank stability and substrates indicate that this reach is unstable

- Maintain and enhance the protection of the riparian area.
- Find opportunities to manage sources of fine sediments and excess runoff.

# 04-13A

# Sawmill Creek Sampling Unit

| IBI and Metric Scores       |           |
|-----------------------------|-----------|
| Narrative Rating            | Very Poor |
| Overall Index               | 1.86      |
| Total Taxa Score            | 5         |
| EPT Taxa Score              | 1         |
| Ephemeroptera Taxa Score    | 1         |
| Intolerant Urban % Score    | 1         |
| Ephemeroptera % Score       | 1         |
| Scraper Taxa Score          | 1         |
| % Climbers                  | 3         |
| Calculated Metric Values    |           |
| Total Taxa                  | 24        |
| EPT Taxa                    | 1         |
| Ephemeroptera Taxa          | 0         |
| Intolerant Urban %          | 1.8       |
| Ephemeroptera %             | 0         |
| Scraper Taxa                | 0         |
| % Climbers                  | 7.2       |
| Taxa List                   |           |
| Caecidotea                  | 2         |
| Enchytraeidae               | 2         |
| Corynoneura                 | 2         |
| Crangonyx                   | 3         |
| Gammarus                    | 1         |
| Helichus                    | 1         |
| Hemerodromia                | 1         |
| Hydropsyche                 | 2         |
| Lumbriculidae               | 2         |
| Nais                        | 12        |
| Nemata                      | 1         |
| Orthocladius/Cricotopus     | 3         |
| Paracladopelma              | 1         |
| Phaenopsectra               | 3         |
| Physa                       | 6         |
| Polypedilum                 | 6         |
| Prostoma                    | 1         |
| Pisidiidae                  | 2         |
| Tanytarsus                  | 2         |
| Thienemanniella             | 1         |
| Tipula                      | 3         |
| I vetenia                   | 44        |
| Tublicinae                  | 1         |
| i menemanimiyia genus group | 3         |

**Total Individuals** 

111

| <u>Physical Habitat</u><br>EPA Rapid Bioassessment |        |   |       |
|--|--------|---|-------|
| Bank Stability- Left Bank                          | 4      | Pool Variability                              | 5     |
| Bank Stability- Right Bank                         | 6      | Riparian Vegetative<br>Zone Width- Left Bank  | 9     |
| Channel Alteration                                 | 13     | Riparian Vegetative<br>Zone Width- Right Bank | 6     |
| Channel Flow Status                                | 18     | Sediment Deposition                           | 8     |
| Channel Sinuosity                                  | 6      | Vegetative Protection (Left Bank)             | 5     |
| Epifaunal Substrate/Available Cover                | 13     | Vegetative Protection (Right Bank)            | 6     |
| Pool Substrate Characterization                    | 9      |   |       |
|  |        | EPA Habitat Score                             | 108   |
|  |        | EPA Narrative Ranking                         | PS    |
| Maryland Biological Stream                         | Survey | PHI   |       |
| Drainage area (acres)                              | 512.9  | Instream Wood Debris                          | 16    |
| Remoteness   | 1      | Bank Stability                                | 10    |
| Shading  | 90     |   |       |
| Epifaunal Substrate                                | 9      | PHI Score                                     | 70.44 |
| Instream Habitat                                   | 13     | PHI Narrative Ranking                         | PD    |
| Water Chemistry                                    |        |   |       |
| Dissolved Oxygen (mg/L)                            | 12.45  | Specific Conductance ( $\mu$ S/cm)            | 548   |
| pH   | 7.12   | Temperature (°C)                              | 8.63  |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 0.80 |
|----------------------------------|------|
| Bankfull Width (ft)              | 7.   |
| Mean Bankfull Depth (ft)         | 0.0  |
| Floodprone Width (ft)            | 47.  |
| Entrenchment Ratio               | 6.′  |
| Width to Depth Ratio             | 12.  |

| 301 | Cross Sectional Area (ft <sup>2</sup> ) | 4.1   |
|-----|---|-------|
| .1  | Water Surface Slope (%)                 | 0.536 |
| .6  | Sinuosity                               | 1.0   |
| 7.4 | D50 (mm)                                | 0.25* |
| .7  | Adjustments?                            | ↑Sin  |
| 2.2 | Rosgen Stream Type                      | E5    |





### 04-15A

### **Sawmill Creek Sampling Unit**



**Location/Site Access**: Located at end of Jones Rd. -7 0.18 km northwest Latitude/Longitude: 39.15566/-76.65801

#### Land Use Analysis:

| Land Use             | Acres | % Area |
|----------------------|-------|--------|
| Airport              | 11.9  | 5.0    |
| Commercial           | 1.5   | 0.6    |
| Industrial           | 64.7  | 27.2   |
| Open Space           | 55.3  | 23.3   |
| Residential 1/4-acre | 4.6   | 1.9    |
| Residential 1/8-acre | 6.5   | 2.7    |
| Residential 2-acre   | 0.7   | 0.3    |
| Transportation       | 18.0  | 7.6    |
| Water                | 1.5   | 0.6    |
| Woods                | 73.2  | 30.8   |
| Grand Total          | 237.9 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 84.2       | 237.9      | 35.4       |

#### **Results:**

- Biological condition "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality.
- This site has marginal bank stability, sediment deposition, and pool variability.
- Sample dominated by midges (*Corynoneura* and *Parametriocnemus*)
- Stream type was identified as an E5, slope was 0.844 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, E channels are stable. The marginal habitat ratings related to bank stability and substrates indicate that this reach is somewhat unstable

- Protect the riparian area
- Investigate BMP retrofits to manage runoff from impervious areas

# 04-15A

### Sawmill Creek Sampling Unit

| <b>IBI and Metric Scores</b> |      |
|------------------------------|------|
| Narrative Rating             | Poor |
| Overall Index                | 2.14 |
| Total Taxa Score             | 5    |
| EPT Taxa Score               | 3    |
| Ephemeroptera Taxa Score     | 1    |
| Intolerant Urban % Score     | 1    |
| Enhomenenters % Score        | 1    |
| Ephemeroptera % Score        | 1    |
| Scraper Taxa Score           | 1    |
| % Climbers                   | 3    |
| Calculated Metric Values     |      |
| Total Taxa                   | 31   |
| EPT Taxa                     | 2    |
| Ephemeroptera Taxa           | 0    |
| Intolerant Urban %           | 5.71 |
| Enhemerontera %              | 0    |
| Soropor Taxo                 | 0    |
|                              | 0    |
| % Climbers                   | 6.67 |
| Taxa List                    | 1    |
| Polycentropus                | 1    |
| Phaenopsectra                | 3    |
| Peltodytes                   | 1    |
| Orthocladius/Cricotopus      | 8    |
| Nigronia                     | 3    |
| Nanocladius                  | 6    |
| Parametriocnemus             | 10   |
| Pheotapytarsus               | 5    |
| Stepelmis                    | 1    |
| Stenochironomus              | 2    |
| Tanytarsus                   | 3    |
| Tvetenia                     | 4    |
| Zavrelimyia                  | 4    |
| Bezzia/Palpomyia             | 1    |
| Nais                         | 7    |
| Helichus                     | 3    |
| Hydroporinae                 | l    |
| Polypedilum                  | 0    |
| Ablabesmvia                  | 1    |
| Micropsectra                 | 1    |
| Boyeria                      | 1    |
| Brillia                      | 2    |
| Cheumatopsyche               | 1    |
| Corynoneura                  | 17   |
| Gompnus<br>Labrundinia       | 1    |
| Macronychus                  | 3    |
| Larsia                       | 1    |
| Total Individuals            | 105  |

| <u>Physical Habitat</u><br>EPA Rapid Bioassessment |          |   |       |
|--|----------|---|-------|
| Bank Stability- Left Bank                          | 4        | Pool Variability                              | 8     |
| Bank Stability- Right Bank                         | 4        | Riparian Vegetative<br>Zone Width- Left Bank  | 2     |
| Channel Alteration                                 | 17       | Riparian Vegetative<br>Zone Width- Right Bank | 9     |
| Channel Flow Status                                | 19       | Sediment Deposition                           | 8     |
| Channel Sinuosity                                  | 7        | Vegetative Protection (Left Bank)             | 5     |
| Epifaunal Substrate/Available Cover                | 12       | Vegetative Protection (Right Bank)            | 5     |
| Pool Substrate Characterization                    | 10       |   |       |
|  |          | EPA Habitat Score                             | 110   |
|  |          | EPA Narrative Ranking                         | PS    |
| Maryland Biological Stream                         | Survey 1 | PHI   |       |
| Drainage area (acres)                              | 237.9    | Instream Wood Debris                          | 9     |
| Remoteness   | 6        | Bank Stability                                | 8     |
| Shading  | 85       |   |       |
| Epifaunal Substrate                                | 12       | PHI Score                                     | 74.68 |
| Instream Habitat                                   | 12       | PHI Narrative Ranking                         | PD    |
| Water Chemistry                                    |          |   |       |
| Dissolved Oxygen (mg/L)                            | 7.63     | Specific Conductance (µS/cm)                  | 372   |
| pH   | 6.93     | Temperature (°C)                              | 13.51 |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | ( |
|----------------------------------|---|
| Bankfull Width (ft)              |   |
| Mean Bankfull Depth (ft)         |   |
| Floodprone Width (ft)            |   |
| Entrenchment Ratio               |   |
| Width to Depth Ratio             |   |

#### Cross Sectional Area (ft<sup>2</sup>) 0.37 10.1 7.8 Water Surface Slope (%) 0.844 1.3 Sinuosity 1.0 D50 (mm) 0.25\* 56 7.1 Adjustments? ↑Sin 6.1 **Rosgen Stream Type** E5

#### \*=estimated



### 04-20A

### **Sawmill Creek Sampling Unit**



**Location/Site Access**: Located at 0.2 miles behind 8th Ave. Latitude/Longitude: 39.17875/76.62132

#### Land Use Analysis:

| Land Use             | Acres  | % Area |
|----------------------|--------|--------|
| Airport              | 458.3  | 10.3   |
| Commercial           | 260.1  | 5.8    |
| Industrial           | 293.3  | 6.6    |
| Open Space           | 982.8  | 22.0   |
| Residential 1/2-acre | 27.4   | 0.6    |
| Residential 1/4-acre | 121.4  | 2.7    |
| Residential 1-acre   | 111.3  | 2.5    |
| Residential 1/8 acre | 508.5  | 11.4   |
| Residential 2-acre   | 221.5  | 5.0    |
| Residential Woods    | 47.0   | 1.1    |
| Row Crops            | 4.9    | 0.1    |
| Transportation       | 253.2  | 5.7    |
| Utility              | 21.2   | 0.5    |
| Water                | 6.9    | 0.2    |
| Woods                | 1143.5 | 25.6   |
| Grand Total          | 4461.2 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 1418.8     | 4461.2     | 31.8       |

#### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Supporting" (PHI habitat assessment was incomplete)
- Biological community is in worse condition than would be expected for available habitat quality.
- Habitat features are mostly sub-optimal. Some substrate ratings indicate excess fine sediments.
- Sample dominated by worms (*Nais*), amphipods (*Gammarus*), and midges (*Orthocladius/Cricotopus*)
- Stream type was identified as an E5, slope was 0.016 percent, and the median channel substrate was fine to medium sand
- Typically, E channels are stable, as this one appears to be. The "Very Poor" biological ratings may be due to conditions other than habitat.

- Maintain the protection of the riparian area
- Investigate possible sources of water quality problems
- Ensure adequate management of runoff from impervious areas

## 04-20A

## Sawmill Creek Sampling Unit

| IBI and Metric Scores    |           |
|--------------------------|-----------|
| Narrative Rating         | Very Poor |
| Overall Index            | 1.86      |
| Total Taxa Score         | 3         |
| EPT Taxa Score           | 1         |
| Ephemeroptera Taxa Score | 1         |
| Intolerant Urban % Score | 1         |
| Ephemeroptera % Score    | 1         |
| Scraper Taxa Score       | 3         |
| % Climbers               | 3         |
| Calculated Metric Values |           |
| Total Taxa               | 21        |
| EPT Taxa                 | 1         |
| Ephemeroptera Taxa       | 0         |
| Intolerant Urban %       | 9.09      |
| Ephemeroptera %          | 0         |
| Scraper Taxa             | 1         |
| % Climbers               | 5.45      |

#### Taxa List

| Tanytarsus                  |
|-----------------------------|
| Orthocladius/Cricotopus     |
| Gammarus                    |
| Hydrobaenus                 |
| Lebertia                    |
| Macronychus                 |
| Nais                        |
| Nanocladius                 |
| Oulimnius                   |
| Phaenopsectra               |
| Polypedilum                 |
| Dubiraphia                  |
| Rheotanytarsus              |
| Enchytraeidae               |
| Thienemannimyia genus group |
| Potthastia                  |
| Cricotopus                  |
| Chaetocladius               |
| Ancyronyx                   |
| Dicrotendipes               |
| Cheumatopsyche              |

#### **Physical Habitat** EPA Rapid Bioassessment

| Bank Stability- Left Bank           | 6  |
|-------------------------------------|----|
| Bank Stability- Right Bank          | 7  |
| Channel Alteration                  | 20 |
| Channel Flow Status                 | 19 |
| Channel Sinuosity                   | 9  |
| Epifaunal Substrate/Available Cover | 12 |
| Pool Substrate Characterization     | 15 |

| EPA Narrative Ranking               |    |
|-------------------------------------|----|
| EPA Habitat Score                   | 13 |
| vegetative i fotection (Kight Bank) |    |
| Vagatative Protection (Pight Bank)  |    |
| Vegetative Protection (Left Bank)   |    |
| Sediment Deposition                 |    |
| Zone Width- Right Bank              | 1  |
| Riparian Vegetative                 |    |
| Zone Width- Left Bank               |    |
| Riparian Vegetative                 |    |
| Pool Variability                    |    |

#### **Maryland Biological Stream Survey PHI**

| Drainage area (acres)   | 4461.2 | Instream Wood Debris               |         |
|-------------------------|--------|------------------------------------|---------|
| Remoteness              | 7      | Bank Stability                     | 12      |
| Shading                 | 60     |                                    |         |
| Epifaunal Substrate     | 5      | PHI Score                          | MISSING |
| Instream Habitat        | 17     | PHI Narrative Ranking              | MISSING |
| Water Chemistry         |        |                                    |         |
| Dissolved Oxygen (mg/L) | 7.63   | Specific Conductance ( $\mu$ S/cm) | 372     |
| рН                      | 6.93   | Temperature (°C)                   | 13.51   |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 6. |
|----------------------------------|----|
| Bankfull Width (ft)              | 16 |
| Mean Bankfull Depth (ft)         | 2  |
| Floodprone Width (ft)            | 1  |
| Entrenchment Ratio               | 1( |
| Width to Depth Ratio             | 6  |

| 6.7  | Rosgen Stream Type                      | E5    |
|------|---|-------|
| 0.2  | Adjustments?                            | ↑Sin  |
| 170  | D50 (mm)                                | 0.25  |
| 2.5  | Sinuosity                               | 1.1   |
| 6.7  | Water Surface Slope (%)                 | 0.016 |
| 5.97 | Cross Sectional Area (ft <sup>2</sup> ) | 41.5  |





**Total Individuals** 

# Rhode River Sampling Unit



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### **Rhode River Sampling Unit**



**Location/Site Access**: Located at SERC property Latitude/Longitude: 38.89299/-76.55795

### Land Use Analysis:

| Land Use         | Acres | % Area |
|------------------|-------|--------|
| Open Space       | 62.0  | 12.9   |
| Pasture/Hay      | 12.3  | 2.6    |
| Residential 1/2- | 7.6   | 1.6    |
| acre             |       |        |
| Residential 1-   | 14.2  | 3.0    |
| acre             |       |        |
| Residential 2-   | 87.5  | 18.2   |
| acre             |       |        |
| Row Crops        | 0.2   | 0.0    |
| Transportation   | 12.6  | 2.6    |
| Water            | 1.1   | 0.2    |
| Woods            | 283.9 | 59.0   |
| Grand Total      | 481.4 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 23.6       | 481.4      | 4.9        |

#### **Results:**

- Biological condition "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality.
- Bank and riparian features are largely intact, but substrate and pool features are degraded
- Sample dominated by stoneflies (*Paranemoura*) and isopods (*Caecidotea*)
- Stream type was identified as an C5, slope was 0.099 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, C channels are stable, as this one appears to be. However, there are excess fine sediments, possibly originating upstream

- Maintain the protection of the riparian area.
- Investigate upstream sources of fine sediments.
- Determine need, feasibility of stormwater management on upstream developed lands.

# **Rhode River Sampling Unit**

| <b>IBI and Metric Scores</b> |       |
|------------------------------|-------|
| Narrative Rating             | Poor  |
| Overall Index                | 2.14  |
| Total Taxa Score             | 3     |
| EPT Taxa Score               | 3     |
| Ephemeroptera Taxa Score     | 1     |
| Intolerant Urban % Score     | 5     |
| Ephemeroptera % Score        | 1     |
| Scraper Taxa Score           | 1     |
| % Climbers                   | 1     |
| Calculated Metric Values     |       |
| Total Taxa                   | 19    |
| EPT Taxa                     | 2     |
| Ephemeroptera Taxa           | 0     |
| Intolerant Urban %           | 64.08 |
| Ephemeroptera %              | 0     |
| Scraper Taxa                 | 0     |
| % Climbers                   | 0     |
|                              |       |
| Taxa List                    |       |
| Paraphaenocladius            | 1     |
| Tubificinae                  | 8     |
| Limnodrilus                  | 1     |
| Paranemoura                  | 34    |
| Synurella                    | 8     |
| Stegopterna                  | 4     |
| Pisidiidae                   | 1     |

#### Physical Habitat

| I II yolcul Hubitut                                 |                         |   |       |
|---|-------------------------|---|-------|
| EPA Rapid Bioassessment                             |                         |   |       |
| Bank Stability- Left Bank                           | 8                       | Pool Variability                              | 7     |
| Bank Stability- Right Bank                          | 8                       | Riparian Vegetative<br>Zone Width- Left Bank  | 10    |
| Channel Alteration                                  | 20                      | Riparian Vegetative<br>Zone Width- Right Bank | 10    |
| Channel Flow Status                                 | 16                      | Sediment Deposition                           | 7     |
| Channel Sinuosity                                   | 2                       | Vegetative Protection (Left Bank)             | 8     |
| Epifaunal Substrate/Available Cover                 | 11                      | Vegetative Protection (Right Bank)            | ) 8   |
| Pool Substrate Characterization                     | 9                       |   |       |
|   |                         | EPA Habitat Score                             | 124   |
|   |                         | EPA Narrative Ranking                         | PS    |
| Maryland Biological Stream<br>Drainage area (acres) | <b>1 Surve</b><br>481.4 | y PHI<br>Instream Wood Debris                 | 5     |
| Remoteness  | 13                      | Bank Stability                                | 16    |
| Shading   | 85                      |   |       |
| Epifaunal Substrate                                 | 3                       | PHI Score                                     | 70.42 |
| Instream Habitat                                    | 11                      | PHI Narrative Ranking                         | PD    |
| Water Chemistry                                     |                         |   |       |
| Dissolved Oxygen (mg/L)                             | 13.81                   | Specific Conductance (µS/cm)                  | 113   |
| pH  | 5 78                    | Temperature (°C)                              | 0.53  |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

5.78

9.53

|       |         |                           | ,      |      |           |              |              |
|-------|---------|---------------------------|--------|------|-----------|--------------|--------------|
| Dr    | ainag   | e Area (mi <sup>2</sup> ) |        | 0.75 | Cross Se  | ctional Area | $(ft^2)$ 8.9 |
| Ba    | nkful   | l Width (ft)              |        | 15.2 | Water Su  | irface Slope | (%) 0.099    |
| M     | ean Ba  | ankfull Dept              | h (ft) | 0.6  | Sinuosity | 7            | 1.1*         |
| Fle   | oodpro  | one Width (f              | t)     | 115  | D50 (mm   | ı)           | 0.25*        |
| En    | trencl  | nment Ratio               |        | 7.5  | Adjustme  | ents?        | ↑ Sin        |
| W     | idth to | Depth Ratio               | C      | 25.8 | Rosgen S  | Stream Type  | e C5         |
| *=    | Estim   | ated                      |        |      |           |              |              |
|       |         |                           |        |      | 13-03, Ri | ffe          |              |
|       | -1      | 5                         | 10     | , t  | 5 20      | ) 25         | 30           |
|       | -2      |                           |        |      |           |              |              |
| ation | -3      |                           |        |      |           |              |              |
| Beva  | -4      | f                         | -      |      |           |              |              |
|       | -5      | •                         |        |      |           |              |              |
|       | -6      |                           |        |      | 4 ·       |              |              |
|       | -7 -    |                           |        |      |           |              |              |

Width

**Total Individuals** 

Simuliidae

Fossaria

Sciaridae

Nemata

Pseudosmittia Orthocladius/Cricotopus

Orthocladiinae Hydrobaenus

Enchytraeidae

Amphinemura

Diplocladius

Caecidotea

1 2 3

2

1

1

1

1

5 15

5 9

### **Rhode River Sampling Unit**



**Location/Site Access**: Located at Rt 468 and Collins Rd Latitude/Longitude: 38.891/-76.56569

### Land Use Analysis:

| Land Use         | Acres | % Area |
|------------------|-------|--------|
| Open Space       | 45.2  | 11.2   |
| Pasture/Hay      | 3.2   | 0.8    |
| Residential 1/2- | 2.2   | 0.5    |
| acre             |       |        |
| Residential 1-   | 6.0   | 1.5    |
| acre             |       |        |
| Residential 2-   | 123.3 | 30.6   |
| acre             |       |        |
| Row Crops        | 32.6  | 8.1    |
| Transportation   | 8.3   | 2.1    |
| Water            | 1.2   | 0.3    |
| Woods            | 180.9 | 44.9   |
| Grand Total      | 402.9 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 21.9       | 402.9      | 5.4        |

#### **Results:**

- Biological condition "Poor"
- Habitat scores "Not Supporting" and "Degraded"
- Habitat assessment results were mixed for this site, but biological community observed is trending toward less than expected impairment based on the observed habitat quality.
- Bank and substrate conditions are marginal, at best, despite relatively low land use pressures
- Sample dominated by midges (*Hydrobaenus*) and blackflies (*Stegopterna*)
- Stream type was identified as an C5, slope was 0.096 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, C channels are stable.

- Maintain the protection of the riparian areas.
- Plan to manage effects of increased imperviousness, if development is pending.
- Treat existing developed lands as necessary and feasible.

### **Rhode River Sampling Unit**

| Narrative Rating         | Poor  |
|--------------------------|-------|
| Overall Index            | 2.43  |
| Total Taxa Score         | 3     |
| EPT Taxa Score           | 3     |
| Ephemeroptera Taxa Score | 1     |
| Intolerant Urban % Score | 5     |
| Ephemeroptera % Score    | 1     |
| Scraper Taxa Score       | 1     |
| % Climbers               | 3     |
| Calculated Metric Values |       |
| Total Taxa               | 17    |
| EPT Taxa                 | 3     |
| Ephemeroptera Taxa       | 0     |
| Intolerant Urban %       | 37.14 |
| Ephemeroptera %          | 0     |
| Scraper Taxa             | 0     |
| % Climbers               | 0.95  |

#### Taxa List

| Hydrobaenus             |
|-------------------------|
| Limnephilidae           |
| Nanocladius             |
| Nemouridae              |
| Orthocladius/Cricotopus |
| Gonomyia                |
| Stegopterna             |
| Pilaria                 |
| Synurella               |
| Tanytarsus              |
| Paranemoura             |
| Tubificinae             |
| Pisidiidae              |
| Enchytraeidae           |
| Caecidotea              |
| Spirosperma             |
| Diplocladius            |
|                         |

### Physical Habitat EPA Rapid Bioassessment Bank Stability- Left Bank Bank Stability- Right Bank

| Channel Alteration                  | 20 |  |
|-------------------------------------|----|--|
| Channel Flow Status                 | 19 |  |
| Channel Sinuosity                   | 3  |  |
| Epifaunal Substrate/Available Cover | 6  |  |
| Pool Substrate Characterization     | 8  |  |

| Vegetative Protection (Right Bank) | 3   |
|------------------------------------|---|
| Vegetative Protection (Left Bank)  | 3   |
| Sediment Deposition                | 5   |
| Zone Width- Right Bank             | 4   |
| Zone Width- Left Bank              | 10  |
| Riparian Vegetative                | -   |
| Pool Variability                   | 5   |
|                                    | Pool Variability<br>Riparian Vegetative<br>Zone Width- Left Bank<br>Riparian Vegetative<br>Zone Width- Right Bank<br>Sediment Deposition<br>Vegetative Protection (Left Bank)<br>Vegetative Protection (Right Bank) |

| EPA Narrative Ranking | NS |
|-----------------------|----|

#### Maryland Biological Stream Survey PHI

| Drainage area (acres)   | 402.9 | Instream Wood Debris         | 6     |
|-------------------------|-------|------------------------------|-------|
| Remoteness              | 5     | Bank Stability               | 6     |
| Shading                 | 100   |                              |       |
| Epifaunal Substrate     | 2     | PHI Score                    | 55.76 |
| Instream Habitat        | 6     | PHI Narrative Ranking        | D     |
| Water Chemistry         |       |                              |       |
| Dissolved Oxygen (mg/L) | 12.06 | Specific Conductance (µS/cm) | 197   |
| pH                      | 5.91  | Temperature (°C)             | 6.94  |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) |
|----------------------------------|
| Bankfull Width (ft)              |
| Mean Bankfull Depth (ft)         |
| Floodprone Width (ft)            |
| Entrenchment Ratio               |
| Width to Depth Ratio             |



#### \*=Estimated



**Total Individuals** 

1 1 1

8 13

1

2

3

1 7

### **Rhode River Sampling Unit**



**Location/Site Access**: Located at SERC Property back road Latitude/Longitude: 38.8912/-76.58152

#### Land Use Analysis:

| Land Use         | Acres | % Area |
|------------------|-------|--------|
| Commercial       | 1.9   | 0.8    |
| Open Space       | 21.0  | 8.5    |
| Pasture/Hay      | 0.4   | 0.2    |
| Residential 1/2- |       |        |
| acre             | 2.1   | 0.9    |
| Residential 1-   |       |        |
| acre             | 13.0  | 5.3    |
| Residential 2-   |       |        |
| acre             | 45.1  | 18.3   |
| Row Crops        | 2.5   | 1.0    |
| Transportation   | 5.8   | 2.4    |
| Water            | 0.9   | 0.4    |
| Woods            | 153.6 | 62.3   |
| Grand Total      | 246.5 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 14.2       | 246.5      | 5.8        |

#### **Results:**

- Biological condition "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality.
- The riparian zone is intact at the site, but bank stability, sediment deposition, and pool characteristics are marginal
- Sample dominated by blackflies (*Stegopterna*)
- Stream type was identified as an E5, slope was 0.95 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, E channels are stable. The marginal habitat ratings related to bank stability and substrates indicate that this reach is unstable

- Maintain the protection of the riparian area.
- Plan for hydrologic effects of increased imperviousness
- Determine need, feasibility of BMP retrofits on existing developed lands.

# **Rhode River Sampling Unit**

| IBI and Metric Scores   |  |
|---|--|
| Narrative Rating  | Poor   |
| Overall Index   | 2.14   |
| Total Taxa Score  | 3  |
| EPT Taxa Score  | 3  |
| Ephemeroptera Taxa Score  | 1  |
| Intolerant Urban % Score  | 5  |
| Ephemeroptera % Score   | 1  |
| Scraper Taxa Score  | 1  |
| % Climbers  | 1  |
| Calculated Metric Values  |  |
| Total Taxa  | 14   |
| EPT Taxa  | 3  |
| Ephemeroptera Taxa  | 0  |
| Intolerant Urban %  | 86.79  |
| Ephemeroptera %   | 0  |
| Scraper Taxa  | 0  |
| % Climbers  | 0  |
| Pisidiidae<br>Enchytraeidae<br>Hydrobaenus<br>Ironoquia<br>Parakiefferiella<br>Simuliidae<br>Caecidotea<br>Spirosperma<br>Stegopterna<br>Synurella<br>Paranemoura<br>Prosimulium<br>Diplocladius<br>Amphinemura | 3<br>1<br>4<br>2<br>1<br>1<br>3<br>1<br>62<br>2<br>11<br>7<br>2<br>6 |
| Total Individuals   | 106  |

| Physical Habitat<br>EPA Rapid Bioassessment |        |   |       |
|---|--------|---|-------|
| Bank Stability- Left Bank                   | 5      | Pool Variability                              | 7     |
| Bank Stability- Right Bank                  | 5      | Riparian Vegetative<br>Zone Width- Left Bank  | 10    |
| Channel Alteration                          | 20     | Riparian Vegetative<br>Zone Width- Right Bank | 10    |
| Channel Flow Status                         | 16     | Sediment Deposition                           | 10    |
| Channel Sinuosity                           | 9      | Vegetative Protection (Left Bank)             | 5     |
| Epifaunal Substrate/Available Cover         | 13     | Vegetative Protection (Right Bank)            | 5     |
| Pool Substrate Characterization             | 3      |   |       |
|   |        | EPA Habitat Score                             | 118   |
|   |        | EPA Narrative Ranking                         | PS    |
| Maryland Biological Stream                  | n Surv | ey PHI  |       |
| Drainage area (acres)                       | 246.5  | Instream Wood Debris                          | 10    |
| Remoteness                                  | 14     | Bank Stability                                | 10    |
| Shading                                     | 85     |   |       |
| Epifaunal Substrate                         | 4      | PHI Score                                     | 76.61 |
| Instream Habitat                            | 13     | PHI Narrative Ranking                         | PD    |
| Water Chemistry                             |        |   |       |
| Dissolved Oxygen (mg/L)                     | 8.62   | Specific Conductance (µS/cm)                  | 228   |
| pH  | 6.12   | Temperature (°C)                              | 8.98  |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 0. |
|----------------------------------|----|
| Bankfull Width (ft)              | 5  |
| Mean Bankfull Depth (ft)         | 0  |
| Floodprone Width (ft)            | 1  |
| Entrenchment Ratio               | 2  |
| Width to Depth Ratio             | 8  |
|                                  |    |

| 38       | Cross Sectional Area (ft <sup>2</sup> ) | 4.0   |
|----------|---|-------|
| 7        | Water Surface Slope (%)                 | 0.95  |
| .,<br>.7 | Sinuosity                               | 1.3   |
| 25       | D50 (mm)                                | 0.25* |
| 1.8      | Adjustments?                            | ↑Sin  |
| .3       | <b>Rosgen Stream Type</b>               | E5    |
|          |   |       |

#### \*=Estimated


## **Rhode River Sampling Unit**



**Location/Site Access**: Located at Muddy Creek Road Latitude/Longitude: 38.89965/-76.56567

#### Land Use Analysis:

| Land Use                 | Acres | % Area |
|--------------------------|-------|--------|
| Open Space               | 41.4  | 18.4   |
| Pasture/Hay              | 11.8  | 5.3    |
| Residential 1/2-<br>acre | 2.9   | 1.3    |
| Residential 1-<br>acre   | 7.1   | 3.2    |
| Residential 2-<br>acre   | 60.1  | 26.7   |
| Row Crops                | 0.2   | 0.1    |
| Transportation           | 5.4   | 2.4    |
| Water                    | 1.1   | 0.5    |
| Woods                    | 94.8  | 42.2   |
| Grand Total              | 224.7 | 100.0  |

| Impervious<br>(acres) | Total Area<br>Above site | %<br>Impervious |
|-----------------------|--------------------------|-----------------|
| 13.2                  | 224.7                    | 5.9             |
| 13.2                  | 224.7                    | 5.9             |

#### **Results:**

- Biological condition "Very Poor"
- RBP habitat score "Partially Supporting" (PHI measures were incomplete)
- Biological indicator shows more impairment than would be expected based on habitat conditions alone.
- The riparian zone is intact, but bank, pool, and substrate conditions are poor or marginal
- Sample heavily dominated by blackflies (*Stegopterna*)
- Stream type was identified as an E5, slope was 0.349 percent, and the median channel substrate was fine sand
- Typically, E channels are not stable. The "Very Poor" biological ratings along with marginal habitat ratings related to bank stability and substrates indicate that this reach is unstable

- Maintain the protection of the riparian area.
- Restore habitat features
- Investigate possible water quality impacts associated with land uses upstream and correct as necessary and feasible.

# **Rhode River Sampling Unit**

| Narrative Rating                | Very Poor |
|---------------------------------|-----------|
| Overall Index                   | 1.57      |
| Total Taxa Score                | 1         |
| EPT Taxa Score                  | 1         |
| Ephemeroptera Taxa Score        | 1         |
| Intolerant Urban % Score        | 5         |
| Ephemeroptera % Score           | 1         |
| Scraper Taxa Score              | 1         |
| % Climbers                      | 1         |
| <b>Calculated Metric Values</b> |           |
| Total Taxa                      | 6         |
| EPT Taxa                        | 1         |
| Ephemeroptera Taxa              | 0         |
| Intolerant Urban %              | 89.52     |
| Ephemeroptera %                 | 0         |
| Scraper Taxa                    | 0         |
| % Climbers                      | 0         |

#### Taxa List

| Diplocladius |  |
|--------------|--|
| Simuliidae   |  |
| Caecidotea   |  |
| Paranemoura  |  |
| Synurella    |  |
| Stegopterna  |  |
|              |  |

### Total Individuals

105

| EPA Rapid Bioassessment             |    |  |     |
|-------------------------------------|----|--|-----|
| Bank Stability- Left Bank           | 5  | Pool Variability                             | 2   |
| Bank Stability- Right Bank          | 5  | Riparian Vegetative<br>Zone Width- Left Bank | 10  |
| Channel Alteration                  | 20 | Zone Width- Right Bank                       | 10  |
| Channel Flow Status                 | 18 | Sediment Deposition                          | 9   |
| Channel Sinuosity                   | 7  | Vegetative Protection (Left Bank)            | 6   |
| Epifaunal Substrate/Available Cover | 8  | Vegetative Protection (Right Bank)           | 6   |
| Pool Substrate Characterization     | 8  |  |     |
|                                     |    | EPA Habitat Score                            | 114 |
|                                     |    | EPA Narrative Ranking                        | PS  |

#### Maryland Biological Stream Survey PHI

| Drainage area (acres)   | 224.7 | Instream Wood Debris               |       |
|-------------------------|-------|------------------------------------|-------|
| Remoteness              | 13    | Bank Stability                     | 10    |
| Shading                 | 100   |                                    |       |
| Epifaunal Substrate     | 4     | PHI Score (INCOMPLETE)             |       |
| Instream Habitat        | 8     | PHI Narrative Ranking              |       |
| Water Chemistry         |       |                                    |       |
| Dissolved Oxygen (mg/L) | 9.71  | Specific Conductance ( $\mu$ S/cm) | 178   |
| pH                      | 5.8   | Temperature (°C)                   | 13.47 |

### **Geomorphic Assessments**

### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 0.351 | Cross Sectional Area (ft <sup>2</sup> ) | 5.9   |
|----------------------------------|-------|---|-------|
| Bankfull Width (ft)              | 5.6   | Water Surface Slope (%)                 | 0.349 |
| Mean Bankfull Depth (ft)         | 1.1   | Sinuosity                               | 1.1*  |
| Floodprone Width (ft)            | 38    | D50 (mm)                                | 0.15  |
| Entrenchment Ratio               | 6.8   | Adjustments?                            | ↑Sin  |
| Width to Depth Ratio             | 5.3   | Rosgen Stream Type                      | E5    |
| *=Estimated                      |       |   |       |



## **Rhode River Sampling Unit**



**Location/Site Access**: Located at SERC property road crossing Latitude/Longitude: 38.89057/-76.55767

### Land Use Analysis:

| Land Use                 | Acres | % Area |
|--------------------------|-------|--------|
| Commercial               | 1.1   | 0.2    |
| Open Space               | 63.5  | 11.7   |
| Pasture/Hay              | 12.3  | 2.3    |
| Residential 1/2-<br>acre | 7.7   | 1.4    |
| Residential 1-<br>acre   | 14.6  | 2.7    |
| Residential 2-<br>acre   | 87.1  | 16.1   |
| Row Crops                | 0.2   | 0.0    |
| Transportation           | 12.7  | 2.4    |
| Water                    | 3.4   | 0.6    |
| Woods                    | 337.9 | 62.5   |
| Grand Total              | 540.5 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 24.6       | 540.5      | 4.6        |

#### **Results:**

- Biological condition "Poor"
- Habitat scores "Non Supporting" and "Partially Degraded"
- Habitat conditions are mixed for this site, with one assessment method indicating impairment and one indicating some kind of enrichment.
- Riparian zones are inadequate and vegetative protection was poor on the right bank.
- Sample dominated by blackflies (*Simuliidae* and *Stegopterna*) and isopods (*Caecidotea*)
- The stream site was highly disturbed and classification by stream type was not possible
- pH is lower in this stream than in any other stream sampled in 2008

- Implement restoration and protection of the riparian area.
- Determine reason for stream acidity and mitigate if the source is unnatural
- Determine need, feasibility of BMP retrofits on developed lands.

# **Rhode River Sampling Unit**

| Narrative Rating<br>Overall Index<br>Total Taxa Score<br>EPT Taxa Score<br>Ephemeroptera Taxa Score<br>Ephemeroptera Taxa Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values<br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Ironoquia<br>Limnodrilus<br>Pseudosmittia<br>Nemoura<br>Neoporus<br>Hydrobaenus   | Poor<br>2.14<br>3<br>3<br>1<br>5<br>1<br>1<br>1<br>1<br>1<br>1<br>2<br>0<br>58.93<br>0<br>0<br>0<br>0<br>1 |
|---|--|
| Overall Index         Total Taxa Score         EPT Taxa Score         Ephemeroptera Taxa Score         Intolerant Urban % Score         Scraper Taxa Score         % Climbers         Calculated Metric Values         Total Taxa         EPT Taxa         Ephemeroptera Taxa         Intolerant Urban %         Ephemeroptera Taxa         Intolerant Urban %         Ephemeroptera %         Scraper Taxa         % Climbers         Taxa List         Ironoquia         Limnodrilus         Pseudosmittia         Nemoura         Neoporus         Hydrobaenus         Prosimulium | 2.14<br>3<br>3<br>1<br>5<br>1<br>1<br>1<br>1<br>1<br>7<br>2<br>0<br>58.93<br>0<br>0<br>0<br>0<br>1         |
| Total Taxa Score<br>EPT Taxa Score<br>Ephemeroptera Taxa Score<br>Intolerant Urban % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br><b>Calculated Metric Values</b><br>Total Taxa<br>EPT Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Ironoquia<br>Limnodrilus<br>Pseudosmittia<br>Nemoura<br>Neoporus<br>Hydrobaenus  | 3<br>3<br>1<br>5<br>1<br>1<br>1<br>1<br>1<br>7<br>2<br>0<br>58.93<br>0<br>0<br>0<br>0                      |
| EPT Taxa Score<br>Ephemeroptera Taxa Score<br>Intolerant Urban % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br><b>Calculated Metric Values</b><br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Ironoquia<br>Limnodrilus<br>Pseudosmittia<br>Nemoura<br>Neoporus<br>Hydrobaenus  | 3<br>1<br>5<br>1<br>1<br>1<br>17<br>2<br>0<br>58.93<br>0<br>0<br>0<br>0<br>1                               |
| Ephemeroptera Taxa Score<br>Intolerant Urban % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br><b>Calculated Metric Values</b><br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Ironoquia<br>Limnodrilus<br>Pseudosmittia<br>Nemoura<br>Neoporus<br>Hydrobaenus  | 1<br>5<br>1<br>1<br>1<br>1<br>7<br>2<br>0<br>58.93<br>0<br>0<br>0<br>0                                     |
| Intolerant Urban % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values<br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Ironoquia<br>Limnodrilus<br>Pseudosmittia<br>Nemoura<br>Neoporus<br>Hydrobaenus  | 5<br>1<br>1<br>1<br>17<br>2<br>0<br>58.93<br>0<br>0<br>0<br>0  |
| Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values<br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Ironoquia<br>Limnodrilus<br>Pseudosmittia<br>Nemoura<br>Neoporus<br>Hydrobaenus  | 1<br>1<br>17<br>2<br>0<br>58.93<br>0<br>0<br>0<br>0  |
| Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values<br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Ironoquia<br>Limnodrilus<br>Pseudosmittia<br>Nemoura<br>Neoporus<br>Hydrobaenus<br>Prosimulium  | 1<br>17<br>2<br>0<br>58.93<br>0<br>0<br>0  |
| % Climbers<br>Calculated Metric Values<br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Ironoquia<br>Limnodrilus<br>Pseudosmittia<br>Nemoura<br>Neoporus<br>Hydrobaenus<br>Prosimulium  | 1<br>17<br>2<br>0<br>58.93<br>0<br>0<br>0<br>0   |
| Calculated Metric Values<br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Ironoquia<br>Limnodrilus<br>Pseudosmittia<br>Nemoura<br>Neoporus<br>Hydrobaenus<br>Prosimulium  | 17<br>2<br>0<br>58.93<br>0<br>0<br>0   |
| Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Ironoquia<br>Limnodrilus<br>Pseudosmittia<br>Nemoura<br>Neoporus<br>Hydrobaenus<br>Prosimulium  | 17<br>2<br>0<br>58.93<br>0<br>0<br>0   |
| EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Ironoquia<br>Limnodrilus<br>Pseudosmittia<br>Nemoura<br>Neoporus<br>Hydrobaenus<br>Prosimulium   | 2<br>0<br>58.93<br>0<br>0<br>0   |
| Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Ironoquia<br>Limnodrilus<br>Pseudosmittia<br>Nemoura<br>Neoporus<br>Hydrobaenus<br>Prosimulium  | 0<br>58.93<br>0<br>0<br>0  |
| Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Ironoquia<br>Limnodrilus<br>Pseudosmittia<br>Nemoura<br>Neoporus<br>Hydrobaenus<br>Prosimulium  | 58.93<br>0<br>0<br>0   |
| Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Ironoquia<br>Limnodrilus<br>Pseudosmittia<br>Nemoura<br>Neoporus<br>Hydrobaenus<br>Prosimulium  | 0 0 0 0  |
| Scraper Taxa<br>% Climbers<br>Taxa List<br>Ironoquia<br>Limnodrilus<br>Pseudosmittia<br>Nemoura<br>Neoporus<br>Hydrobaenus<br>Prosimulium   | 0  |
| % Climbers<br><b>Taxa List</b><br>Ironoquia<br>Limnodrilus<br>Pseudosmittia<br>Nemoura<br>Neoporus<br>Hydrobaenus<br>Prosimulium  | 0  |
| Taxa List<br>Ironoquia<br>Limnodrilus<br>Pseudosmittia<br>Nemoura<br>Neoporus<br>Hydrobaenus<br>Prosimulium   | 1  |
| Caecidotea<br>Simulidae<br>Stegopterna<br>Synurella<br>Tvetenia<br>Tubificinae<br>Pisidium<br>Diplocladius<br>Agabus<br>Erioptera   | 2<br>1<br>6<br>1<br>3<br>3<br>21<br>31<br>31<br>5<br>1<br>1<br>2<br>1<br>1<br>1                            |

| <u>Physical Habitat</u><br>EPA Rapid Bioassessment |         |   |       |
|--|---------|---|-------|
| Bank Stability- Left Bank                          | 7       | Pool Variability                              | 8     |
| Bank Stability- Right Bank                         | 7       | Riparian Vegetative<br>Zone Width- Left Bank  | 2     |
| Channel Alteration                                 | 7       | Riparian Vegetative<br>Zone Width- Right Bank | 2     |
| Channel Flow Status                                | 15      | Sediment Deposition                           | 12    |
| Channel Sinuosity                                  | 5       | Vegetative Protection (Left Bank)             | 6     |
| Epifaunal Substrate/Available Cover                | 8       | Vegetative Protection (Right Bank)            | 6     |
| Pool Substrate Characterization                    | 3       |   |       |
|  |         | EPA Habitat Score                             | 88    |
|  |         | EPA Narrative Ranking                         | NS    |
| Maryland Biological Stream                         | 1 Surve | y PHI   |       |
| Drainage area (acres)                              | 540.5   | Instream Wood Debris                          | 5     |
| Remoteness   | 8       | Bank Stability                                | 14    |
| Shading  | 85      |   |       |
| Epifaunal Substrate                                | 8       | PHI Score                                     | 66.49 |
| Instream Habitat                                   | 8       | PHI Narrative Ranking                         | PD    |
| Water Chemistry                                    |         |   |       |
| Dissolved Oxygen (mg/L)                            | 10.68   | Specific Conductance (µS/cm)                  | 147   |
| pH   | 4.94    | Temperature (°C)                              | 9.3   |
|  |         |   |       |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | Cross Sectional Area (ft <sup>2</sup> ) |
|----------------------------------|---|
| Bankfull Width (ft)              | Water Surface Slope (%)                 |
| Mean Bankfull Depth (ft)         | Sinuosity                               |
| Floodprone Width (ft)            | D50 (mm)                                |
| Entrenchment Ratio               | Adjustments?                            |
| Width to Depth Ratio             | Rosgen Stream Type                      |
|                                  |   |

Due to highly disturbed conditions, no geomorphic assessment work was performed at this location.

**Total Individuals** 

112

## **Rhode River Sampling Unit**



**Location/Site Access**: Located at 3782 Hardesty Road Latitude/Longitude: 38.90108/-76.57753

#### Land Use Analysis:

| Land Use                 | Acres | % Area |
|--------------------------|-------|--------|
| Open Space               | 34.0  | 24.2   |
| Residential 1/2-<br>acre | 0.3   | 0.2    |
| Residential 2-<br>acre   | 58.7  | 41.7   |
| Row Crops                | 1.2   | 0.9    |
| Transportation           | 4.6   | 3.2    |
| Woods                    | 42.0  | 29.9   |
| Grand Total              | 140.7 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 9.7        | 140.7      | 7.0        |

#### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Not Supporting" and "Degraded"
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality
- .Many of the habitat ratings are in the marginal range, including ratings related to bank stability and substrates
- Sample dominated by blackflies (*Stegopterna*) and midges (*Diplocladius*)
- Stream type was identified as an G5, slope was estimated as 1.0 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, G channels are not stable. The "Very Poor" biological ratings along with marginal habitat ratings related to bank stability and substrates indicate that this reach is unstable

- Protect the riparian area
- Restore habitat features, if feasible
- Determine feasibility, need of installing BMPs on residential lands upstream.

# **Rhode River Sampling Unit**

| IBI and Metric Scores    |           |
|--------------------------|-----------|
| Narrative Rating         | Very Poor |
| Overall Index            | 1.57      |
| Total Taxa Score         | 1         |
| EPT Taxa Score           | 1         |
| Ephemeroptera Taxa Score | 1         |
| Intolerant Urban % Score | 5         |
| Ephemeroptera % Score    | 1         |
| Scraper Taxa Score       | 1         |
| % Climbers               | 1         |
| Calculated Metric Values |           |
| Total Taxa               | 11        |
| EPT Taxa                 | 1         |
| Ephemeroptera Taxa       | 0         |
| Intolerant Urban %       | 49.06     |
| Ephemeroptera %          | 0         |
| Scraper Taxa             | 0         |
| % Climbers               | 0         |
|                          |           |
| Taxa List                |           |
| Ironoquia                | 1         |
| Enchytraeidae            | 2         |
| Chaetocladius            | 5         |
| Erioptera                | 1         |
| Limnodrilus              | 1         |
| Stegopterna              | 51        |
| Nais                     | 6         |
| Tubificinae              | 1         |
| Nemata                   | 1         |
| Prosimulium              | 1         |

#### **Total Individuals**

Diplocladius

106

36

| <u>Physical Habitat</u><br>EPA Rapid Bioassessment |       |   |       |
|--|-------|---|-------|
| Bank Stability- Left Bank                          | 3     | Pool Variability                              | 3     |
| Bank Stability- Right Bank                         | 3     | Riparian Vegetative<br>Zone Width- Left Bank  | 2     |
| Channel Alteration                                 | 18    | Riparian Vegetative<br>Zone Width- Right Bank | 6     |
| Channel Flow Status                                | 15    | Sediment Deposition                           | 8     |
| Channel Sinuosity                                  | 6     | Vegetative Protection (Left Bank)             | 3     |
| Epifaunal Substrate/Available Cover                | 10    | Vegetative Protection (Right Bank)            | 3     |
| Pool Substrate Characterization                    | 8     |   |       |
|  |       | EPA Habitat Score                             | 88    |
|  |       | EPA Narrative Ranking                         | NS    |
| Maryland Biological Stream                         | Surve | y PHI<br>Instraam Wood Dahris                 |       |
| Drainage area (acres)                              | 140.7 | Del Colline                                   | 13    |
| Remoteness   | 6     | Bank Stability                                | 6     |
| Shading  | 80    |   |       |
| Epifaunal Substrate                                | 3     | PHI Score                                     | 65.45 |
| Instream Habitat                                   | 10    | PHI Narrative Ranking                         | D     |
| Water Chemistry                                    |       |   |       |
| Dissolved Oxygen (mg/L)                            | 10.65 | Specific Conductance (µS/cm)                  | 116   |
| pH   | 5.76  | Temperature (°C)                              | 8.6   |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 0.22 | Cross Sectional Area (ft <sup>2</sup> ) | 4.7       |
|----------------------------------|------|---|-----------|
| Bankfull Width (ft)              | 6.9  | Water Surface Slope (%)                 | 1.0*      |
| Mean Bankfull Depth (ft)         | 0.7  | Sinuosity                               | 1.0*      |
| Floodprone Width (ft)            | 9.8  | D50 (mm)                                | 0.25*     |
| Entrenchment Ratio               | 1.4  | Adjustments?                            | ↓ER       |
| Width to Depth Ratio             | 10.2 | <b>Rosgen Stream Type</b>               | <b>G5</b> |
|                                  |      |   |           |





# 13-11A

## **Rhode River Sampling Unit**



**Location/Site Access**: Located at End of Collins Road straight ahead (southwest) Latitude/Longitude: 38.88725/-76.56444

#### Land Use Analysis:

| Land Use         | Acres | % Area |
|------------------|-------|--------|
| Commercial       | 5.5   | 0.8    |
| Open Space       | 50.8  | 7.5    |
| Pasture/Hay      | 22.3  | 3.3    |
| Residential 1/2- |       |        |
| acre             | 5.9   | 0.9    |
| Residential 1-   |       |        |
| acre             | 25.3  | 3.7    |
| Residential 2-   |       |        |
| acre             | 132.9 | 19.7   |
| Row Crops        | 7.9   | 1.2    |
| Transportation   | 18.2  | 2.7    |
| Water            | 0.9   | 0.1    |
| Woods            | 404.4 | 60.0   |
| Grand Total      | 674.2 | 100.0  |

| Impervious<br>(acres) | Total Area<br>Above site | %<br>Impervious |
|-----------------------|--------------------------|-----------------|
| 34.6                  | 674.2                    | 5.1             |
| 0.110                 | 07.112                   | 0.11            |

#### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Not Supporting" and "Degraded"
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality.
- The riparian zone was intact only on the left side. Bank and sediment ratings indicate degraded habitat conditions.
- Sample dominated by midges (*Hydrobaenus* and *Orthocladius/Cricotopus*)
- Stream type was identified as an E5, slope was 0.153 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, E channels are stable. The "Very Poor" biological ratings along with marginal habitat ratings related to bank stability and substrates indicate that this reach is unstable

- Implement restoration and protection of the riparian area.
- Restore instream habitat features, if feasible.
- Investigate need, feasibility of developed land stormwater BMP retrofits.

# 13-11A

# **Rhode River Sampling Unit**

| IBI and Metric Scores  |   |
|--|---|
| Narrative Rating   | Very Poor   |
| Overall Index  | 1.86  |
| Total Taxa Score   | 3   |
| EPT Taxa Score   | 3   |
| Ephemeroptera Taxa Score   | 1   |
| Intolerant Urban % Score   | 3   |
| Ephemeroptera % Score  | 1   |
| Scraper Taxa Score   | 1   |
| % Climbers   | 1   |
| <b>Calculated Metric Values</b>  |   |
| Total Taxa   | 18  |
| EPT Taxa   | 3   |
| Ephemeroptera Taxa   | 0   |
| Intolerant Urban %   | 10.38   |
| Ephemeroptera %  | 0   |
| Scraper Taxa   | 0   |
| % Climbers   | 0   |
| Taxa List<br>Neoporus<br>Krenopelopia<br>Hydroporinae<br>Tubificinae<br>Synurella<br>Pisidiidae<br>Physa<br>Parakiefferiella<br>Orthocladius/Cricotopus<br>Allocapnia<br>Lymnaeidae<br>Caecidotea<br>Hydrobaenus<br>Diplocladius<br>Dero<br>Enchytraeidae<br>Nemoura<br>Nemouridae | $ \begin{array}{c} 2\\1\\1\\1\\1\\1\\1\\1\\3\\1\\4\\49\\1\\1\\1\\1\\1\\4\end{array} $ |
| Total Individuals  | 106   |

| EPA Rapid Bioassessment  |   |  |  |
|--|---|--|--|
| Bank Stability- Left Bank  | 3   | Pool Variability   | 7                                      |
| Bank Stability- Right Bank   | 4   | Riparian Vegetative<br>Zone Width- Left Bank   | 10                                     |
| Channel Alteration   | 18  | Zone Width- Right Bank   | 3                                      |
| Channel Flow Status  | 19  | Sediment Deposition  | 6                                      |
| Channel Sinuosity  | 6   | Vegetative Protection (Left Bank)  | 3                                      |
| Epifaunal Substrate/Available Cove   | er 8  | Vegetative Protection (Right Bank)   | 4                                      |
| Pool Substrate Characterization  | 8   |  |  |
|  |   |  | 00                                     |
|  |   | EPA Habitat Score  | <u> 99</u>                             |
|  |   | EPA Habitat Score EPA Narrative Ranking  | NS                                     |
| Maryland Biological Strea<br>Drainage area (acres)   | <b>m Surve</b><br>674.2                               | EPA Habitat Score<br>EPA Narrative Ranking<br>y PHI<br>Instream Wood Debris  | 8                                      |
| Maryland Biological Strea<br>Drainage area (acres)<br>Remoteness   | <b>m Surve</b><br>674.2<br>2                          | EPA Habitat Score<br>EPA Narrative Ranking<br>y PHI<br>Instream Wood Debris<br>Bank Stability  | 8<br>7                                 |
| <b>Maryland Biological Strea</b><br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate  | <b>m Surve</b><br>674.2<br>2<br>90<br>2               | EPA Habitat Score<br>EPA Narrative Ranking<br>y PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score   | 93<br>NS<br>8<br>7<br>52.79            |
| Maryland Biological Strea<br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat   | <b>m Surve</b><br>674.2<br>2<br>90<br>2<br>8          | EPA Habitat Score<br>EPA Narrative Ranking<br>A PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score<br>PHI Narrative Ranking                                  | 8<br>7<br>52.79<br>D                   |
| Maryland Biological Strea<br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat<br>Water Chemistry                            | <b>m Surve</b><br>674.2<br>2<br>90<br>2<br>8          | EPA Habitat Score<br>EPA Narrative Ranking<br>by PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score<br>PHI Narrative Ranking                                 | 8<br>7<br>52.79<br>D                   |
| Maryland Biological Strea<br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat<br>Water Chemistry<br>Dissolved Oxygen (mg/L) | <b>m Surve</b><br>674.2<br>2<br>90<br>2<br>8<br>11.51 | EPA Habitat Score<br>EPA Narrative Ranking<br>by PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score<br>PHI Narrative Ranking<br>Specific Conductance (µS/cm) | 93<br>NS<br>8<br>7<br>52.79<br>D<br>96 |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 1.1  | Cross Sectional Area (ft <sup>2</sup> ) | 15.1  |
|----------------------------------|------|---|-------|
| Bankfull Width (ft)              | 12.6 | Water Surface Slope (%)                 | 0.153 |
| Mean Bankfull Depth (ft)         | 1.2  | Sinuosity                               | 1.0*  |
| Floodprone Width (ft)            | 278  | D50 (mm)                                | 0.25* |
| Entrenchment Ratio               | 22.1 | Adjustments?                            | ↑Sin  |
| Width to Depth Ratio             | 10.4 | <b>Rosgen Stream Type</b>               | E5    |
|                                  |      |   |       |

#### \*=Estimated



# 13-12A

## **Rhode River Sampling Unit**



**Location/Site Access**: Located at Wharthon Road crossing, powerline R.O.W. Latitude/Longitude: 38.86711/-76.6043

#### Land Use Analysis:

| Land Use                 | Acres | % Area |
|--------------------------|-------|--------|
| Commercial               | 11.0  | 2.6    |
| Open Space               | 47.1  | 11.1   |
| Residential 1/2-<br>acre | 1.1   | 0.3    |
| Residential 1-<br>acre   | 5.8   | 1.4    |
| Residential 2-<br>acre   | 101.4 | 24.0   |
| Row Crops                | 4.4   | 1.0    |
| Transportation           | 12.1  | 2.9    |
| Utility                  | 23.7  | 5.6    |
| Woods                    | 216.8 | 51.2   |
| Grand Total              | 423.4 | 100.0  |

| Impervious<br>(acres) | Total Area<br>Above site | %<br>Impervious |
|-----------------------|--------------------------|-----------------|
| 30.9                  | 423.4                    | 7.2             |
| 30.9                  | 423.4                    | 1.2             |

### **Results:**

- Biological condition "Poor"
- Habitat scores "Partially Supporting" and "Severely Degraded"
- Habitat assessment results were mixed for this site, but biological community observed is trending toward less than expected impairment based on the observed habitat quality.
- Many habitat ratings were marginal
- Sample dominated by blackflies, midges, isopods, and snails
- Stream type was identified as an E5, slope was 0.579 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, E channels are stable, but this channel was rated with only marginal bank stability. Fine sediments contribute to marginal epifaunal substrate. Has low ER for E type.

- Protect the riparian area.
- Allow the channel to stabilize on its own.
- Determine if riparian management associated with the power lines is undermining natural channel evolution.
- Determine need, feasibility of installing stormwater management on developed lands upstream.

# 13-12A

# **Rhode River Sampling Unit**

| IBI and Metric Scores  |  |
|--|--|
| Narrative Rating   | Poor   |
| Overall Index  | 2.43   |
| Total Taxa Score   | 5  |
| EPT Taxa Score   | 1  |
| Ephemeroptera Taxa Score   | 1  |
| Intolerant Urban % Score   | 5  |
| Ephemeroptera % Score  | 1  |
| Scraper Taxa Score   | 1  |
| % Climbors   | 2  |
| Colculated Matrie Values   | 5  |
|  | 25   |
|  | 25   |
| EPTTaxa  | 1  |
| Ephemeroptera Taxa   | 0  |
| Intolerant Urban %   | 31.43  |
| Ephemeroptera %  | 0  |
| Scraper Taxa   | 0  |
| % Climbers   | 0.95   |
| Taxa List<br>Tvetenia<br>Pilaria<br>Planariidae<br>Prosimulium<br>Pisidiidae<br>Stenelmis<br>Tanytarsus<br>Tipula<br>Physa<br>Tubificinae<br>Thienemanniella<br>Corynoneura<br>Pisidium<br>Ancyronyx<br>Paraphaenocladius<br>Dasyhelea<br>Diplocladius<br>Gammarus<br>Lumbricidae<br>Lymnaeidae<br>Nais<br>Neophylax<br>Orthocladius/Cricotopus<br>Parametriocnemus<br>Limnodrilus | $ \begin{array}{c} 1\\ 1\\ 1\\ 27\\ 1\\ 1\\ 1\\ 1\\ 1\\ 2\\ 1\\ 1\\ 2\\ 3\\ 5\\ 6\\ 14\\ 1\\ 1 \end{array} $ |
| Total Individuals  | 105  |

| Physical Habitat   |   |   |                                     |
|--|---|---|-------------------------------------|
| EPA Rapid Bioassessment  |   |   |                                     |
| Bank Stability- Left Bank  | 4   | Pool Variability  | 3                                   |
| Bank Stability- Right Bank   | 4   | Riparian Vegetative<br>Zone Width- Left Bank  | 4                                   |
| Channel Alteration   | 17  | Riparian Vegetative<br>Zone Width- Right Bank   | 7                                   |
| Channel Flow Status  | 18  | Sediment Deposition   | 9                                   |
| Channel Sinuosity  | 9   | Vegetative Protection (Left Bank)   | 7                                   |
| Epifaunal Substrate/Available Cove   | er 7  | Vegetative Protection (Right Bank)  | 7                                   |
| Pool Substrate Characterization  | 8   |   |                                     |
|  |   | FPA Habitat Score   | 104                                 |
|  |   | El A Habitat Score  |                                     |
|  |   | EPA Narrative Ranking   | PS                                  |
| Maryland Biological Strea  | m Surve   | PA Narrative Ranking      PHI      Instream Wood Debris   | PS                                  |
| Maryland Biological Strea<br>Drainage area (acres)<br>Remoteness   | <b>m Surve</b><br>423.4                               | y PHI<br>Instream Wood Debris<br>Bank Stability   | PS 13                               |
| <b>Maryland Biological Strea</b><br>Drainage area (acres)<br>Remoteness<br>Shading   | <b>m Surve</b><br>423.4<br>5<br>20                    | y PHI<br>Instream Wood Debris<br>Bank Stability   | PS<br>13<br>9                       |
| <b>Maryland Biological Strea</b><br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate  | <b>m Surve</b><br>423.4<br>5<br>20<br>3               | PA Narrative Ranking      PHI     Instream Wood Debris     Bank Stability      PHI Score  | PS<br>13<br>9<br>49.80              |
| <b>Maryland Biological Strea</b><br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat  | <b>m Surve</b><br>423.4<br>5<br>20<br>3<br>7          | y PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score<br>PHI Narrative Ranking   | PS<br>13<br>9<br>49.80<br>SD        |
| Maryland Biological Strea<br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat<br>Water Chemistry                            | <b>m Surve</b><br>423.4<br>5<br>20<br>3<br>7          | PA Narrative Ranking      PHI     Instream Wood Debris     Bank Stability      PHI Score     PHI Narrative Ranking  | PS<br>13<br>9<br>49.80<br>SD        |
| Maryland Biological Strea<br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat<br>Water Chemistry<br>Dissolved Oxygen (mg/L) | <b>m Surve</b><br>423.4<br>5<br>20<br>3<br>7<br>13.47 | <ul> <li>EPA Narrative Ranking</li> <li>PHI         Instream Wood Debris         Bank Stability     </li> <li>PHI Score      <li>PHI Narrative Ranking     </li> <li>Specific Conductance (µS/cm)</li> </li></ul> | PS<br>13<br>9<br>49.80<br>SD<br>307 |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 0.66 |
|----------------------------------|------|
| Bankfull Width (ft)              | 6.4  |
| Mean Bankfull Depth (ft)         | 2.5  |
| Floodprone Width (ft)            | 18   |
| Entrenchment Ratio               | 2.8  |
| Width to Depth Ratio             | 2.5  |

| 6 | Cross Sectional Area (ft <sup>2</sup> ) | 16.0  |
|---|---|-------|
| 1 | Water Surface Slope (%)                 | 0.579 |
| 5 | Sinuosity                               | 1.1   |
| 3 | D50 (mm)                                | 0.25* |
| 3 | Adjustments?                            | ↑Sin  |
| 5 | Rosgen Stream Type                      | E5    |

#### \*=Estimated



# 13-13A

## **Rhode River Sampling Unit**



**Location/Site Access**: Located at 3782 Hardesty Road Latitude/Longitude: 38.89928/-76.57619

### Land Use Analysis:

| Land Use         | Acres | % Area |
|------------------|-------|--------|
| Open Space       | 38.9  | 16.5   |
| Pasture/Hay      | 1.0   | 0.4    |
| Residential 1/2- | 03    | 0.1    |
| acre             | 0.5   | 0.1    |
| Residential 2-   | 96.3  | 40.7   |
| acre             | 90.5  | 40.7   |
| Row Crops        | 17.3  | 7.3    |
| Transportation   | 4.7   | 2.0    |
| Woods            | 78.0  | 33.0   |
| Grand Total      | 236.5 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 14.7       | 236.5      | 6.2        |

#### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Not Supporting" and "Degraded"
- Biological community is appropriate for observed habitat quality.
- All riparian and bank measures are rated as poor. However, the channel alteration rating indicates that the channel form is somewhat natural
- Sample dominated by worms (*Nais*), midges (*Diplocladius*), and clams (*Pisidiidae*)
- Stream type was identified as an G5c, slope was 0.463 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, G channels are not stable. The "Very Poor" biological ratings along with poor habitat ratings related to bank stability and substrates indicate that this reach is unstable

- Restore and protect riparian areas.
- Allow the channel to stabilize naturally.
- Investigate possible upstream stressor inputs.

# 13-13A

# **Rhode River Sampling Unit**

| <b>IBI and Metric Scores</b>   |  |
|--|--|
| Narrative Rating   | Very Poor  |
| Overall Index  | 1.86   |
| Total Taxa Score   | 3  |
| EPT Taxa Score   | 1  |
| Ephemeroptera Taxa Score   | 1  |
| Intolerant Urban % Score   | 3  |
| Ephemeroptera % Score  | 1  |
| Scraper Taxa Score   | 1  |
| % Climbers   | 3  |
| <b>Calculated Metric Values</b>  |  |
| Total Taxa   | 20   |
| EPT Taxa   | 0  |
| Ephemeroptera Taxa   | 0  |
| Intolerant Urban %   | 11.3   |
| Ephemeroptera %  | 0  |
| Scraper Taxa   | 0  |
| % Climbers   | 1.74   |
|  |  |
| Taxa List<br>Polypedilum   | 2  |
| Pristina   | 1  |
| Prosimulium  | 1  |
| Rheocricotopus   | 1  |
| Pisidiidae   | 9  |
| Stegopterna  | 11   |
| Synurella<br>Culicoides  | 1  |
| Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Polypedilum<br>Pristina<br>Prosimulium<br>Rheocricotopus<br>Pisidiidae<br>Stegopterna<br>Synurella<br>Culicoides | 0<br>0<br>1.74<br>2<br>1<br>1<br>1<br>9<br>11<br>1<br>1<br>1 |

| Stegopterna             |
|-------------------------|
| Synurella               |
| Culicoides              |
| Tubificinae             |
| Tipula                  |
| Hydrobaenus             |
| Paraphaenocladius       |
| Orthocladius/Cricotopus |
| Nemata                  |
| Nais                    |
| Limnophyes              |
| Limnodrilus             |
| Enchytraeidae           |
| Diplocladius            |
| Pisidium                |
| Polypedilum             |

### Physical Habitat

| EPA Rapid Bloassessment             |    |
|-------------------------------------|----|
| Bank Stability- Left Bank           | 2  |
| Bank Stability- Right Bank          | 2  |
| Channel Alteration                  | 18 |
| Channel Flow Status                 | 15 |
| Channel Sinuosity                   | 3  |
| Epifaunal Substrate/Available Cover | 5  |
| Pool Substrate Characterization     | 5  |

| Zone Width- Right Bank<br>Sediment Deposition<br>Vegetative Protection (Left Bank)<br>Vegetative Protection (Right Bank) | 2<br>6<br>3<br>3  |
|--|---|
| Zone Width- Right Bank<br>Sediment Deposition<br>Vegetative Protection (Left Bank)<br>Vegetative Protection (Right Bank) | 2<br>6<br>3<br>3  |
| Zone Width- Right Bank<br>Sediment Deposition<br>Vegetative Protection (Left Bank)                                       | 2<br>6<br>3   |
| Sediment Deposition  | 2<br>6  |
| Zone Width- Right Bank   | 2   |
| 7 W' 145 D' -1-4 D1-   | 2   |
| Riparian Vegetative  | -   |
| Riparian Vegetative<br>Zone Width- Left Bank   | 1   |
| Pool Variability   | 3   |
|  | Pool Variability<br>Riparian Vegetative<br>Zone Width- Left Bank<br>Riparian Vegetative |

NS

EPA Narrative Ranking

#### Maryland Biological Stream Survey PHI

| Drainage area (acres)   | 236.5 | Instream Wood Debris               | 9     |
|-------------------------|-------|------------------------------------|-------|
| Remoteness              | 9     | Bank Stability                     | 4     |
| Shading                 | 75    |                                    |       |
| Epifaunal Substrate     | 3     | PHI Score                          | 57.25 |
| Instream Habitat        | 5     | PHI Narrative Ranking              | D     |
| Water Chemistry         |       |                                    |       |
| Dissolved Oxygen (mg/L) | 10.98 | Specific Conductance ( $\mu$ S/cm) | 169   |
| рН                      | 5.83  | Temperature (°C)                   | 7.01  |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | ( |
|----------------------------------|---|
| Bankfull Width (ft)              |   |
| Mean Bankfull Depth (ft)         |   |
| Floodprone Width (ft)            |   |
| Entrenchment Ratio               |   |
| Width to Depth Ratio             |   |
|                                  |   |



#### \*=Estimated



6 1

1 1

1

1

34

1 8

4

21 9

2

## 13-14A

## **Rhode River Sampling Unit**



**Location/Site Access**: Located at Grey Beech Court, 0.15m North Latitude/Longitude: 38.89111/-76.58776

#### Land Use Analysis:

| Land Use       | Acres | % Area |
|----------------|-------|--------|
| Commercial     | 1.9   | 1.0    |
| Open Space     | 20.2  | 11.0   |
| Pasture/Hay    | 0.4   | 0.2    |
| Residential 1- | 13.0  | 71     |
| acre           | 15.0  | /.1    |
| Residential 2- | 39.2  | 21.3   |
| acre           | 57.2  | 21.5   |
| Row Crops      | 2.5   | 1.4    |
| Transportation | 5.9   | 3.2    |
| Water          | 0.9   | 0.5    |
| Woods          | 99.7  | 54.3   |
| Grand Total    | 183.7 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 12.9       | 183.7      | 7.0        |

#### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Not Supporting" and "Partially Degraded"
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality.
- The riparian zone is intact at this site, but bank stability and pool characteristic ratings are poor
- Sample dominated by midges (*Diplocladius*, *Rheocricotopus*, *Corynoneura*)
- Stream type was identified as an G5c, slope was 0.469 percent, and the median channel substrate was fine sand
- Typically, G channels are not stable. The "Very Poor" biological ratings along with poor habitat ratings related to bank stability and substrates indicate that this reach is unstable.

- Maintain the protection of the riparian area.
- Investigate inconsistencies between poor biological and habitat ratings and the remoteness and low imperviousness of the site
- Determine need, feasibility of adding stormwater management on developed lands.

# 13-14A

# **Rhode River Sampling Unit**

| IBI and Metric Scores    |           |
|--------------------------|-----------|
| Narrative Rating         | Very Poor |
| Overall Index            | 1.57      |
| Total Taxa Score         | 3         |
| EPT Taxa Score           | 3         |
| Ephemeroptera Taxa Score | 1         |
| Intolerant Urban % Score | 1         |
| Ephemeroptera % Score    | 1         |
| Scraper Taxa Score       | 1         |
| % Climbers               | 1         |
| Calculated Metric Values |           |
| Total Taxa               | 20        |
| EPT Taxa                 | 3         |
| Ephemeroptera Taxa       | 0         |
| Intolerant Urban %       | 6.6       |
| Ephemeroptera %          | 0         |
| Scraper Taxa             | 0         |
| % Climbers               | 0         |
|                          |           |
| Taxa List                |           |
| Limnephilidae            | 9         |
| Parametriocnemus         | 2         |
| Prosimulium              | 1         |
| Rheocricotopus           | 25        |
| Simuliidae               | 1         |
| Pisidiidae               | 2         |
| Stegopterna              | 2         |
| Paranemoura              | 1         |
| Gammarus                 | 1         |
| Zavrelimyia              | 4         |
| Chaetocladius            | 1         |
| Agabus                   | 1         |
| Krenopelopia             | 1         |
| Caecidotea               | 2         |
| Ironoquia                | 2         |
| Chrysops                 | 1         |

| <u>Physical Habitat</u>    |  |  |
|----------------------------|--|--|
| EPA Rapid Bioassessment    |  |  |
| Bank Stability- Left Bank  |  |  |
| Bank Stability- Right Bank |  |  |

| Channel Alteration                  | 20 |  |
|-------------------------------------|----|--|
| Channel Flow Status                 | 10 |  |
| Channel Sinuosity                   | 6  |  |
| Epifaunal Substrate/Available Cover | 8  |  |
| Pool Substrate Characterization     | 3  |  |

|    | EPA Habitat Score                  | 90 |
|----|------------------------------------|----|
| 3  |                                    |    |
| 8  | Vegetative Protection (Right Bank) | 2  |
| 6  | Vegetative Protection (Left Bank)  | 2  |
| 10 | Sediment Deposition                | 10 |
| 20 | Zone Width- Right Bank             | 10 |
| 2  | Zone Width- Left Bank              | 10 |
|    | Riparian Vegetative                |    |
| 2  | Pool Variability                   | 5  |
|    |                                    |    |

EPA Narrative Ranking

NS

3.9 0.469

1.0

0.12

↑Sin

G5c

### Maryland Biological Stream Survey PHI

| . 8                     | •     |                              |       |
|-------------------------|-------|------------------------------|-------|
| Drainage area (acres)   | 183.7 | Instream Wood Debris         | 7     |
| Remoteness              | 13    | Bank Stability               | 4     |
| Shading                 | 100   |                              |       |
| Epifaunal Substrate     | 3     | PHI Score                    | 68.25 |
| Instream Habitat        | 8     | PHI Narrative Ranking        | PD    |
| Water Chemistry         |       |                              |       |
| Dissolved Oxygen (mg/L) | 10.31 | Specific Conductance (µS/cm) | 81    |
| pH                      | 6.58  | Temperature (°C)             | 8.48  |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 0.29 | Cross Sectional Area (ft <sup>2</sup> ) |
|----------------------------------|------|---|
| Bankfull Width (ft)              | 6.0  | Water Surface Slope (%)                 |
| Mean Bankfull Depth (ft)         | 0.7  | Sinuosity                               |
| Floodprone Width (ft)            | 7.8  | D50 (mm)                                |
| Entrenchment Ratio               | 1.3  | Adjustments?                            |
| Width to Depth Ratio             | 9.1  | <b>Rosgen Stream Type</b>               |



**Total Individuals** 

Corynoneura

Culicoides

Dasyhelea

Diplocladius

11

1

1

37

# West River Sampling Unit



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## West River Sampling Unit



**Location/Site Access**: Located at Missing information Latitude/Longitude: 38.86187/-76.57823

#### Land Use Analysis:

| Land Use       | Acres | % Area |
|----------------|-------|--------|
| Open Space     | 11.8  | 7.3    |
| Pasture/Hay    | 3.5   | 2.2    |
| Residential 1- | 44    | 27     |
| acre           |       | 2.1    |
| Residential 2- | 23.5  | 14.6   |
| acre           |       | 1.10   |
| Row Crops      | 50.4  | 31.2   |
| Transportation | 2.0   | 1.2    |
| Utility        | 10.6  | 6.6    |
| Water          | 0.1   | 0.1    |
| Woods          | 55.2  | 34.1   |
| Grand Total    | 161.7 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 4.8        | 161.7      | 3.0        |

### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Not Supporting" and "Degraded"
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality.
- Riparian features are intact, but bank, substrate, and pool features are degraded
- Sample heavily dominated by midges (*Chaetocladius*) and worms (*Enchytraeidae*)
- Stream type was identified as an G5c, slope was 0.55 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, G channels are not stable. This channel has marginal and poor bank conditions and excess fine sediments, indicating possible instability

- Maintain the protection of the riparian area.
- Investigate upstream sources of fine sediments.
- Plan for hydrologic stability with potential increases in imperviousness.
- Determine need, feasibility of BMP implementation on agricultural, developed lands.

# West River Sampling Unit

Pool Variability

| Very Poor   |
|---|
| 1.57  |
| 3   |
| 3   |
| 1   |
| 1   |
| 1   |
| 1   |
| 1   |
|   |
| 15  |
| 3   |
| 0   |
| 1.92  |
| 0   |
| 0   |
| 0   |
| $ \begin{array}{c} 1 \\ 4 \\ 2 \\ 1 \\ 2 \\ 1 \\ 4 \\ 2 \\ 1 \\ 5 \\ 62 \\ 16 \\ 1 \\ 1 \end{array} $ |
|   |

### Physical Habitat EPA Rapid Bioassessment Bank Stability- Left Bank

| Bank Stability- Right Bank          | 3  | Riparian Vegetative<br>Zone Width- Left Bank  |
|-------------------------------------|----|---|
| Channel Alteration                  | 20 | Riparian Vegetative<br>Zone Width- Right Bank |
| Channel Flow Status                 | 14 | Sediment Deposition                           |
| Channel Sinuosity                   | 5  | Vegetative Protection (Left Bank)             |
| Epifaunal Substrate/Available Cover | 7  | Vegetative Protection (Right Bank)            |
| Pool Substrate Characterization     | 8  |   |

2

| EPA Habitat Score     | 100 |
|-----------------------|-----|
| EPA Narrative Ranking | NS  |

5

10

10 11

2

3

#### Maryland Biological Stream Survey PHI

| Drainage area (acres)   | 161.7 | Instream Wood Debris         | 8     |
|-------------------------|-------|------------------------------|-------|
| Remoteness              | 8     | Bank Stability               | 5     |
| Shading                 | 100   |                              |       |
| Epifaunal Substrate     | 3     | PHI Score                    | 64.81 |
| Instream Habitat        | 7     | PHI Narrative Ranking        | D     |
| Water Chemistry         |       |                              |       |
| Dissolved Oxygen (mg/L) | 13.03 | Specific Conductance (µS/cm) | 151   |
| pH                      | 6.17  | Temperature (°C)             | 6.85  |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi2)      | 0.25 | Cross Sectional Area (ft <sup>2</sup> ) | 3.0       |
|--------------------------|------|---|-----------|
| Bankfull Width (ft)      | 5.3  | Water Surface Slope (%)                 | 0.55      |
| Mean Bankfull Depth (ft) | 0.6  | Sinuosity                               | 1.04      |
| Floodprone Width (ft)    | 8.7  | D50 (mm)                                | 0.25*     |
| Entrenchment Ratio       | 1.6  | Adjustments?                            | ↓ER, ↑Sin |
| Width to Depth Ratio     | 9.6  | Rosgen Stream Type                      | G5c       |
| *=Estimated              |      |   |           |



**Total Individuals** 

## West River Sampling Unit



**Location/Site Access**: Located at six mile Horse Farm Latitude/Longitude: 38.852078/-76.572066

#### Land Use Analysis:

| Land Use                 | Acres | % Area |
|--------------------------|-------|--------|
| Commercial               | 0.4   | 0.1    |
| Open Space               | 21.2  | 4.5    |
| Pasture/Hay              | 37.9  | 8.1    |
| Residential 1/2-<br>acre | 6.5   | 1.4    |
| Residential 1-<br>acre   | 4.2   | 0.9    |
| Residential 2-<br>acre   | 39.4  | 8.4    |
| Row Crops                | 39.6  | 8.5    |
| Transportation           | 6.0   | 1.3    |
| Utility                  | 16.8  | 3.6    |
| Woods                    | 294.3 | 63.1   |
| Grand Total              | 466.2 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 9.9        | 466.2      | 2.1        |

#### **Results:**

- Biological condition "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Biological community is appropriate for observed habitat quality.
- Riparian features are largely intact, but substrate and pool features are marginal
- Sample dominated by midges (*Hydrobaenus*) and stoneflies (*Nemouridae*)
- Stream type was identified as an B5c, slope was 0.47 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, B channels are stable. However, this channel has only marginal bank, substrate, and pool features, indicating that some instability exists

- Maintain protection of the riparian area.
- Investigate upstream sources of fine sediments.
- Plan for hydrologic stability with potential increases in imperviousness.
- Determine need, feasibility of BMP installation on agricultural, developed lands upstream.

# West River Sampling Unit

| Narrative Rating   | Poor  |
|--|---|
| Overall Index  | 2.14  |
| Total Taxa Score   | 3   |
| EPT Taxa Score   | 3   |
| Ephemeroptera Taxa Score   | 1   |
| Intolerant Urban % Score   | 5   |
| Ephemeroptera % Score  | 1   |
| Scraper Taxa Score   | 1   |
| % Climbers   | 1   |
| Calculated Metric Values   |   |
| Total Taxa   | 17  |
| EPT Taxa   | 4   |
| Ephemeroptera Taxa   | 0   |
| Intolerant Urban %   | 487   |
| Ephemeroptera %  | 0   |
| Scraper Taxa   | 0   |
| % Climbers   | 0   |
| 70 Chinders  | 0   |
| Taxa List<br>Orthocladiinae<br>Orthocladius/Cricotopus<br>Rheocricotopus<br>Nemouridae<br>Tubificinae<br>Orthocladius<br>Stegopterna<br>Limnephilidae<br>Ironoquia<br>Hydrobaenus<br>Diplocladius<br>Chaetocladius<br>Enchytraeidae<br>Caecidotea<br>Amphinemura<br>Limnodrilus<br>Prosimulium | 1<br>5<br>1<br>25<br>1<br>2<br>16<br>1<br>2<br>36<br>3<br>5<br>1<br>3<br>1<br>1<br>11 |

| <u>Physical Habitat</u><br>EPA Rapid Bioassessment |        |   |         |
|--|--------|---|---------|
| Bank Stability- Left Bank                          | 5      | Pool Variability                              | 4       |
| Bank Stability- Right Bank                         | 6      | Riparian Vegetative<br>Zone Width- Left Bank  | 10      |
| Channel Alteration                                 | 20     | Riparian Vegetative<br>Zone Width- Right Bank | 10      |
| Channel Flow Status                                | 13     | Sediment Deposition                           | 10      |
| Channel Sinuosity                                  | 2      | Vegetative Protection (Left Bank)             | 5       |
| Epifaunal Substrate/Available Cover                | · 7    | Vegetative Protection (Right Bank)            | 6       |
| Pool Substrate Characterization                    | 6      |   |         |
|  |        | EPA Habitat Score                             | 104     |
|  |        | EPA Narrative Ranking                         | PS      |
| Maryland Biological Stream                         | n Surv | 7 <b>ey PHI</b><br>Instream Wood Debris       | 5       |
| Remoteness   | 400.2  | Bank Stability                                | )<br>11 |
| Shading  | 100    |   | 11      |
| Epifaunal Substrate                                | 3      | PHI Score                                     | 66.00   |
| Instream Habitat                                   | 7      | PHI Narrative Ranking                         | D       |
| Water Chemistry                                    |        |   |         |
| Dissolved Oxygen (mg/L)                            | 11.35  | Specific Conductance (µS/cm)                  | 154     |
| pH   | 6.17   | Temperature (°C)                              | 10.68   |
|  |        |   |         |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

7.0

0.47 1.0\*

0.25\*

†Sin

B5c

| Drainage Area (mi <sup>2</sup> ) | 0.73 | Cross Sectional Area (ft <sup>2</sup> ) |
|----------------------------------|------|---|
| Bankfull Width (ft)              | 10.5 | Water Surface Slope (%)                 |
| Mean Bankfull Depth (ft)         | 0.7  | Sinuosity                               |
| Floodprone Width (ft)            | 17   | D50 (mm)                                |
| Entrenchment Ratio               | 1.6  | Adjustments?                            |
| Width to Depth Ratio             | 15.8 | Rosgen Stream Type                      |
|                                  |      |   |





**Total Individuals** 

## West River Sampling Unit



**Location/Site Access**: Located at at Rollbys Run Road crossing Latitude/Longitude: 38.86032/76.57635

#### Land Use Analysis:

| Land Use       | Acres | % Area |
|----------------|-------|--------|
| Open Space     | 11.8  | 6.7    |
| Pasture/Hay    | 3.5   | 2.0    |
| Residential 1- |       |        |
| acre           | 4.4   | 2.5    |
| Residential 2- |       |        |
| acre           | 25.4  | 14.5   |
| Row Crops      | 53.2  | 30.3   |
| Transportation | 2.0   | 1.1    |
| Utility        | 10.6  | 6.0    |
| Water          | 0.1   | 0.1    |
| Woods          | 64.5  | 36.7   |
| Grand Total    | 175.7 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 5.1        | 175.7      | 2.9        |

#### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Biological community is in worse condition than would be expected for available habitat quality.
- Riparian features are largely intact, but substrate and pool features are marginal
- Sample heavily dominated by midges (*Chaetocladius*)
- Stream type was identified as an B5c, slope was 0.276 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, B channels are stable. This channel appears to be reasonably stable. Low W/D ratio for a B type.

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Determine need, feasibility of BMP installation or retrofits on developed and agricultural lands.

# West River Sampling Unit

EPA Narrative Ranking

5

10

10

13

6

8

122

PS

| Narrative Rating               | Very Poor |
|--------------------------------|-----------|
| Overall Index                  | 1.57      |
| Total Taxa Score               | 1         |
| EPT Taxa Score                 | 3         |
| Ephemeroptera Taxa Score       | 1         |
| Intolerant Urban % Score       | 1         |
| Ephemeroptera % Score          | 1         |
| Scraper Taxa Score             | 1         |
| % Climbers                     | 3         |
| Calculated Metric Values       |           |
| Total Taxa                     | 13        |
| EPT Taxa                       | 3         |
| Ephemeroptera Taxa             | 0         |
| Intolerant Urban %             | 3.6       |
| Ephemeroptera %                | 0         |
| Scraper Taxa                   | 0         |
| % Climbers                     | 0.9       |
|                                |           |
| Taxa List                      |           |
| Paranemoura                    | 1         |
| Tanytarsus                     | 1         |
| Stegopterna                    | 1         |
| Smittia                        | 2         |
| Rheocricotopus                 | 8         |
| Orthocladius/Cricotopus        | 2         |
| Ironoquia                      | 6         |
| Diplocladius                   | 3         |
| Chaetocladius                  | 72        |
|                                | 3         |
| Enchytraeidae                  |           |
| Enchytraeidae<br>Limnephilidae | 8         |

| <u>Physical Habitat</u>   |
|---------------------------|
| EPA Rapid Bioassessment   |
| Bank Stability- Left Bank |

| Bank Stability- Left Bank           | 6  | Pool Variability                              |
|-------------------------------------|----|---|
| Bank Stability- Right Bank          | 7  | Riparian Vegetative<br>Zone Width- Left Bank  |
| Channel Alteration                  | 19 | Riparian Vegetative<br>Zone Width- Right Bank |
| Channel Flow Status                 | 18 | Sediment Deposition                           |
| Channel Sinuosity                   | 3  | Vegetative Protection (Left Bank)             |
| Epifaunal Substrate/Available Cover | 9  | Vegetative Protection (Right Bank)            |
| Pool Substrate Characterization     | 8  |   |
|                                     |    | EPA Habitat Score                             |

#### Maryland Biological Stream Survey PHI

| Drainage area (acres)   | 175.7 | Instream Wood Debris               | 4     |
|-------------------------|-------|------------------------------------|-------|
| Remoteness              | 5     | Bank Stability                     | 13    |
| Shading                 | 100   |                                    |       |
| Epifaunal Substrate     | 6     | PHI Score                          | 69.62 |
| Instream Habitat        | 9     | PHI Narrative Ranking              | PD    |
| Water Chemistry         |       |                                    |       |
| Dissolved Oxygen (mg/L) | 12.27 | Specific Conductance ( $\mu$ S/cm) | 138   |
| pH                      | 6.29  | Temperature (°C)                   | 3.61  |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Kosgen Level II Classification Data                |      |   |            |  |
|--|------|---|------------|--|
| Drainage Area (mi <sup>2</sup> )                   | 0.28 | Cross Sectional Area (ft <sup>2</sup> ) | 6.6        |  |
| Bankfull Width (ft)                                | 8.2  | Water Surface Slope (%)                 | 0.276      |  |
| Mean Bankfull Depth (ft)                           | 0.8  | Sinuosity                               | 1.0*       |  |
| Floodprone Width (ft)                              | 13.8 | D50 (mm)                                | 0.25*      |  |
| Entrenchment Ratio                                 | 1.7  | Adjustments?                            | †Sin, †W/D |  |
| Width to Depth Ratio                               | 10.1 | Rosgen Stream Type                      | B5c        |  |
| *=Estimated  |      |   |            |  |
| 0  |      | 14-03, Glide                            |            |  |
| -1<br>-2<br>-3<br>-3<br>-5<br>-4<br>-7<br>-8<br>-9 | 15   | 20 25 30 35                             | 40<br>•    |  |

Width

**Total Individuals** 

## West River Sampling Unit



**Location/Site Access**: Located at Powerline R.O.W on Sudley Ave. - 0.35 miles southeast Latitude/Longitude: 38.84791/-76.58669

#### Land Use Analysis:

| Land Use         | Acres | % Area |
|------------------|-------|--------|
| Open Space       | 8.6   | 6.2    |
| Pasture/Hay      | 12.2  | 8.7    |
| Residential 1/2- |       |        |
| acre             | 5.2   | 3.7    |
| Residential 1-   |       |        |
| acre             | 1.2   | 0.8    |
| Residential 2-   |       |        |
| acre             | 26.6  | 19.0   |
| Row Crops        | 7.5   | 5.4    |
| Transportation   | 4.5   | 3.2    |
| Utility          | 6.4   | 4.6    |
| Woods            | 67.7  | 48.4   |
| Grand Total      | 140.0 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 6.3        | 140.0      | 4.5        |

#### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Supporting" and "Minimally Degraded"
- Biological community is in worse condition than would be expected for available habitat quality.
- Habitat ratings related to the banks and riparian zone are optimal. Pool and substrate measures are not.
- Sample dominated by midges (*Diplocladius* and *Chaetocladius*)
- Stream type was identified as an B5c, slope was 0.428 percent, and the median channel substrate was estimated as fine or medium sand
- This channel appears to have stable banks and somewhat stable streambed. Pools and channel sinuosity are marginal.

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Determine if water quality impacts are occurring due to developed, agricultural lands upstream and remedy as needed or feasible with BMPs.

# West River Sampling Unit

| Narrative Rating  | Very Poor  |
|---|--|
| Overall Index   | 1.86   |
| Total Taxa Score  | 3  |
| EPT Taxa Score  | 3  |
| Ephemeroptera Taxa Score  | 1  |
| Intolerant Urban % Score  | 3  |
| Ephemeroptera % Score   | 1  |
| Scraper Taxa Score  | 1  |
| % Climbers  | 1  |
| <b>Calculated Metric Values</b>   |  |
| Total Taxa  | 16   |
| EPT Taxa  | 2  |
| Ephemeroptera Taxa  | 0  |
| Intolerant Urban %  | 13.76  |
| Ephemeroptera %   | 0  |
| Scraper Taxa  | 0  |
| % Climbers  | 0  |
| Taxa List<br>Orthocladius/Cricotopus<br>Tubificinae<br>Tipula<br>Stegopterna<br>Pisidiidae<br>Rheocricotopus<br>Prosimulium<br>Diplocladius<br>Pseudorthocladius<br>Chaetocladius<br>Limnephilidae<br>Limnodrilus<br>Limnophyes<br>Nemouridae<br>Orthocladius | 5<br>1<br>1<br>2<br>4<br>12<br>40<br>2<br>33<br>1<br>3<br>1<br>1<br>1<br>1 |

#### Physical Habitat EPA Rapid Bioassessment Bank Stability- Left Bank Bank Stability- Right Bank

| Bank Subinty Right Bank             | 7  |
|-------------------------------------|----|
| Channel Alteration                  | 20 |
| Channel Flow Status                 | 17 |
| Channel Sinuosity                   | 6  |
| Epifaunal Substrate/Available Cover | 12 |
| Pool Substrate Characterization     | 10 |

| 8  | Pool Variability                   | 5  |
|----|------------------------------------|----|
|    | Riparian Vegetative                |    |
| 7  | Zone Width- Left Bank              | 10 |
|    | Riparian Vegetative                |    |
| 20 | Zone Width- Right Bank             | 10 |
| 17 | Sediment Deposition                | 9  |
| 6  | Vegetative Protection (Left Bank)  | 8  |
| 12 | Vegetative Protection (Right Bank) | 7  |
| 10 |                                    |    |
|    |                                    |    |

| EPA Habitat Score     | 129 |
|-----------------------|-----|
| EPA Narrative Ranking | S   |

#### Maryland Biological Stream Survey PHI

| Drainage area (acres)   | 140.0 | Instream Wood Debris         | 10    |
|-------------------------|-------|------------------------------|-------|
| Remoteness              | 13    | Bank Stability               | 15    |
| Shading                 | 95    |                              |       |
| Epifaunal Substrate     | 3     | PHI Score                    | 81.67 |
| Instream Habitat        | 12    | PHI Narrative Ranking        | MD    |
| Water Chemistry         |       |                              |       |
| Dissolved Oxygen (mg/L) | 13.81 | Specific Conductance (µS/cm) | 199   |
| pH                      | 6.64  | Temperature (°C)             | 7.85  |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> )<br>Bankfull Width (ft)<br>Mean Bankfull Depth (ft)<br>Floodprone Width (ft)<br>Entrenchment Ratio<br>Width to Depth Ratio | 0.219<br>6.0<br>0.7<br>10.4<br>1.7<br>8.6 | Cross Sectional Area (ft <sup>2</sup> )<br>Water Surface Slope (%)<br>Sinuosity<br>D50 (mm)<br>Adjustments?<br><b>Rosgen Stream Type</b> | 4.2<br>0.428<br>1.0*<br>0.25*<br>↑Sin, ↑W/D<br><b>B5c</b> |
|--|---|--|---|
| *=Estimated  |   |  |   |
| 0<br>-2 0 5 10   | 15  | 14-06, Glide<br>20 25 30 35  | 40  |
| -4<br>-5<br>-6<br>-10<br>-12   |   |  | \$<br>  |
|  |   | Width  |   |

**Total Individuals** 

## West River Sampling Unit



**Location/Site Access**: Located at Bollesy Lane, crossing, ~ 140m. Upstream Latitude/Longitude: 38.8588/-76.57385

#### Land Use Analysis:

| Land Use       | Acres | % Area |
|----------------|-------|--------|
| Open Space     | 11.8  | 4.9    |
| Pasture/Hay    | 3.7   | 1.5    |
| Residential 1- |       |        |
| acre           | 4.4   | 1.8    |
| Residential 2- |       |        |
| acre           | 72.3  | 29.9   |
| Row Crops      | 53.0  | 21.9   |
| Transportation | 3.1   | 1.3    |
| Utility        | 10.6  | 4.4    |
| Water          | 0.1   | 0.1    |
| Woods          | 82.8  | 34.2   |
| Grand Total    | 242.0 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 13.0       | 242.0      | 5.4        |

#### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Biological community is in worse condition than would be expected for available habitat quality.
- Riparian features are largely intact, but pool features are marginal at best
- Sample dominated by midges (*Hydrobaenus*) and blackflies (*Prosimulium*)
- Stream type was identified as an E5, slope was 0.47 percent, and the median channel substrate was fine sand
- Typically, E channels are stable. However, this channel has suboptimal bank and substrate features, and may be unstable

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Evaluate possible water quality impacts from existing agricultural, developed lands in basin and treat as necessary and feasible with appropriate management techniques.

# West River Sampling Unit

| IBI and Metric Scores    |           |
|--------------------------|-----------|
| Narrative Rating         | Very Poor |
| Overall Index            | 1.86      |
| Total Taxa Score         | 3         |
| EPT Taxa Score           | 3         |
| Ephemeroptera Taxa Score | 1         |
| Intolerant Urban % Score | 3         |
| Ephemeroptera % Score    | 1         |
| Scraper Taxa Score       | 1         |
| % Climbers               | 1         |
| Calculated Metric Values |           |
| Total Taxa               | 17        |
| EPT Taxa                 | 3         |
| Ephemeroptera Taxa       | 0         |
| Intolerant Urban %       | 17.24     |
| Ephemeroptera %          | 0         |
| Scraper Taxa             | 0         |
| % Climbers               | 0         |
|                          |           |
| Taxa List                |           |
| Enchytraeidae            | 1         |
| Orthocladiinae           | 1         |
| Culiseta                 | 3         |
| Stegopterna              | 6         |
| Rheocricotopus           | 1         |
| Pseudorthocladius        | 1         |

### **Physical Habitat EPA Rapid Bioassessment** Bank Stability- Left Bank Bank Stability- Right Bank

| Channel Alteration                  | 2  |
|-------------------------------------|----|
| Channel Flow Status                 | 1  |
| Channel Sinuosity                   | ,  |
| Epifaunal Substrate/Available Cover | 12 |
| Pool Substrate Characterization     | ,  |

| 6  | Pool Variability                   | 4  |
|----|------------------------------------|----|
|    | Riparian Vegetative                |    |
| 5  | Zone Width- Left Bank              | 10 |
|    | Riparian Vegetative                |    |
| 20 | Zone Width- Right Bank             | 10 |
| 17 | Sediment Deposition                | 11 |
| 7  | Vegetative Protection (Left Bank)  | 6  |
| 12 | Vegetative Protection (Right Bank) | 5  |
| 7  |                                    |    |
|    |                                    |    |

| EPA Habitat Score     | 120 |
|-----------------------|-----|
| EPA Narrative Ranking | PS  |

#### Maryland Biological Stream Survey PHI

| Drainage area (acres)   | 242.0 | Instream Wood Debris               | 9     |
|-------------------------|-------|------------------------------------|-------|
| Remoteness              | 6     | Bank Stability                     | 11    |
| Shading                 | 100   |                                    |       |
| Epifaunal Substrate     | 4     | PHI Score                          | 71.24 |
| Instream Habitat        | 12    | PHI Narrative Ranking              | PD    |
| Water Chemistry         |       |                                    |       |
| Dissolved Oxygen (mg/L) | 11.7  | Specific Conductance ( $\mu$ S/cm) | 197   |
| pH                      | 6.03  | Temperature (°C)                   | 5.03  |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| 0. |
|----|
| 12 |
| 1  |
| 14 |
| 11 |
| 7  |
|    |

| 7.3   | Rosgen Stream Type                      | E5   |
|-------|---|------|
| 11.9* | Adjustments?                            | ↑Sin |
| 143*  | D50 (mm)                                | 0.19 |
| 1.6   | Sinuosity                               | 1.1  |
| 12.0  | Water Surface Slope (%)                 | 0.47 |
| 0.38  | Cross Sectional Area (ft <sup>2</sup> ) | 19.6 |

#### \*=Estimated



**Total Individuals** 

Prosimulium

Chaetocladius

Culicidae

Brachycera Nemouridae

Diplocladius

Hydrobaenus

Erioptera

Ironoquia Limnephilidae

Orthocladius/Cricotopus

13

6

4 1

5

1

3

5 53

5 7

## West River Sampling Unit



**Location/Site Access**: Located at 5207 Sudley Road, West 0.25 miles Latitude/Longitude: 38.82271/-76.57481

#### Land Use Analysis:

| Land Use       | Acres | % Area |
|----------------|-------|--------|
| Open Space     | 4.9   | 6.2    |
| Residential 2- |       |        |
| acre           | 12.2  | 15.3   |
| Row Crops      | 4.3   | 5.4    |
| Transportation | 1.1   | 1.4    |
| Woods          | 57.4  | 71.8   |
| Grand Total    | 79.9  | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 1.9        | 79.9       | 2.4        |

#### **Results:**

- Biological condition "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Biological community observed is trending toward more than expected impairment based on the observed habitat quality.
- Most habitat features are intact, but pool and substrate features are marginal at best. This site has one of the worst ratings for channel flow status of all sites sampled in 2008.
- Sample evenly dominated by midges (*Smittia* and *Diplocladius*), stoneflies (*Nemouridae*) and amphipods (*Caecidotea*)
- Stream type was identified as an E5, slope was 1.6 percent, and the median channel substrate was estimated as fine or medium sand
- This channel appears to be stable, perhaps due to the small catchment and low % imperviousness. **Recommendations:**
- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Ascertain that this is a truly perennial stream before applying index ratings

# West River Sampling Unit

| <b>IBI and Metric Scores</b> |      |
|------------------------------|------|
| Narrative Rating             | Poor |
| Overall Index                | 2.43 |
| Total Taxa Score             | 3    |
| EPT Taxa Score               | 3    |
| Ephemeroptera Taxa Score     | 1    |
| Intolerant Urban % Score     | 5    |
| Ephemeroptera % Score        | 1    |
| Scraper Taxa Score           | 1    |
| % Climbers                   | 3    |
| Calculated Metric Values     |      |
| Total Taxa                   | 17   |
| EPT Taxa                     | 3    |
| Ephemeroptera Taxa           | 0    |
| Intolerant Urban %           | 40   |
| Ephemeroptera %              | 0    |
| Scraper Taxa                 | 0    |
| % Climbers                   | 1    |
|                              |      |
| Taxa List                    |      |
| Rheocricotopus               | 1    |
| Stygobromus                  | 1    |
| Zalutschia                   | 3    |
| Tvetenia                     | 1    |

### **Physical Habitat EPA Rapid Bioassessment** Bank Stability- Left Bank Bank Stability- Right Bank Channel Alteration

| Channel Alteration                  | 20 |
|-------------------------------------|----|
| Channel Flow Status                 | 8  |
| Channel Sinuosity                   | 5  |
| Epifaunal Substrate/Available Cover | 4  |
| Pool Substrate Characterization     | 8  |

|    | EPA Habitat Score                  | 122 |
|----|------------------------------------|-----|
| 8  |                                    |     |
| 4  | Vegetative Protection (Right Bank) | 10  |
| 5  | Vegetative Protection (Left Bank)  | 10  |
| 8  | Sediment Deposition                | 14  |
| 20 | Zone Width- Right Bank             | 10  |
| 9  | Zone Width- Left Bank              | 10  |
|    | Riparian Vegetative                |     |
| 9  | Pool Variability                   | 5   |
|    |                                    |     |

PS

3.6

1.6

1.0\*

0.25\*

↑Sin E5

EPA Narrative Ranking

#### **Maryland Biological Stream Survey PHI**

| Drainage area (acres)   | 79.9 | Instream Wood Debris               | 12     |
|-------------------------|------|------------------------------------|--------|
| Remoteness              | 14   | Bank Stability                     | 18     |
| Shading                 | 100  |                                    |        |
| Epifaunal Substrate     | 2    | PHI Score                          | 77.933 |
| Instream Habitat        | 4    | PHI Narrative Ranking              | PD     |
| Water Chemistry         |      |                                    |        |
| Dissolved Oxygen (mg/L) | 9.15 | Specific Conductance ( $\mu$ S/cm) | 111    |
| pH                      | 5.71 | Temperature (°C)                   | 8.55   |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 0.125 | Cross Sectional Area (ft <sup>2</sup> ) |
|----------------------------------|-------|---|
| Bankfull Width (ft)              | 5.6   | Water Surface Slope (%)                 |
| Mean Bankfull Depth (ft)         | 0.6   | Sinuosity                               |
| Floodprone Width (ft)            | 155   | D50 (mm)                                |
| Entrenchment Ratio               | 27.8  | Adjustments?                            |
| Width to Depth Ratio             | 8.7   | Rosgen Stream Type                      |
|                                  |       |   |





**Total Individuals** 

Synurella

Smittia

Stegopterna

Hydrobaenus

Oligostomis

Neoporus

Caecidotea

Limnephilidae

Enchytraeidae Diplocladius

Chaetocladius

Orthocladius/Cricotopus

Nemouridae

4

1

18

2

1

1

16

3

7

18

4

18

1

## West River Sampling Unit



**Location/Site Access**: Located at Route 255 Pull-off Latitude/Longitude: 38.84992/-76.5629

### Land Use Analysis:

| Land Use         | Acres  | % Area |
|------------------|--------|--------|
| Commercial       | 3.9    | 0.3    |
| Open Space       | 56.3   | 4.1    |
| Pasture/Hay      | 148.7  | 10.7   |
| Residential 1/2- |        |        |
| acre             | 5.2    | 0.4    |
| Residential 1-   |        |        |
| acre             | 37.0   | 2.7    |
| Residential 2-   |        |        |
| acre             | 149.2  | 10.7   |
| Row Crops        | 219.9  | 15.8   |
| Transportation   | 23.6   | 1.7    |
| Utility          | 40.7   | 2.9    |
| Water            | 0.5    | 0.0    |
| Woods            | 704.9  | 50.7   |
| Grand Total      | 1389.9 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 38.6       | 1389.9     | 2.8        |

#### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Biological community is in worse condition than would be expected for available habitat quality.
- Riparian areas are highly disturbed. Most other habitat features are suboptimal or worse.
- Sample dominated by blackflies (*Steegopterna*), midges (*Orthocladius/Cricotopus* and *Hydrobaenus*), and stoneflies (*Nemouridae*)
- Stream type was identified as an E5, slope was 0.322 percent, and the median channel substrate was estimated as fine or medium sand
- This channel is in reasonable condition for the degree of disturbance in the riparian area

- Protect the riparian area by establishing buffers.
- Plan for hydrologic stability with potential increases in imperviousness.
- Determine impact on water quality of existing agricultural, developed lands and correct as necessary and feasible with appropriate BMPs.

# West River Sampling Unit

| IBI and Metric Scores   |   |
|---|---|
| Narrative Rating  | Very Poor   |
| Overall Index   | 1.86  |
| Total Taxa Score  | 1   |
| EPT Taxa Score  | 1   |
| Ephemeroptera Taxa Score  | 1   |
| Intolerant Urban % Score  | 5   |
| Ephemeroptera % Score   | 1   |
| Scraper Taxa Score  | 1   |
| % Climbers  | 3   |
| Calculated Metric Values  |   |
| Total Taxa  | 11  |
| EPT Taxa  | 1   |
| Ephemeroptera Taxa  | 0   |
| Intolerant Urban %  | 68.32   |
| Ephemeroptera %   | 0   |
| Scraper Taxa  | 0   |
| % Climbers  | 0.99  |
| Tubificinae<br>Tanytarsus<br>Stegopterna<br>Pisidiidae<br>Orthocladius/Cricotopus<br>Limnodrilus<br>Hydrobaenus<br>Diplocladius<br>Ancyronyx<br>Prosimulium | 1<br>1<br>53<br>1<br>13<br>1<br>13<br>1<br>1<br>3 |
|   |   |

#### **Physical Habitat EPA Rapid Bioassessment**

|                                     |    | EPA Narrative Ranking                         | PS  |
|-------------------------------------|----|---|-----|
|                                     |    | EPA Habitat Score                             | 113 |
| Pool Substrate Characterization     | 12 |   |     |
| Epifaunal Substrate/Available Cover | 14 | Vegetative Protection (Right Bank)            | 6   |
| Channel Sinuosity                   | 5  | Vegetative Protection (Left Bank)             | 7   |
| Channel Flow Status                 | 16 | Sediment Deposition                           | 11  |
| Channel Alteration                  | 20 | Riparian Vegetative<br>Zone Width- Right Bank | 1   |
| Bank Stability- Right Bank          | 6  | Riparian Vegetative<br>Zone Width- Left Bank  | 0   |
| Bank Stability- Left Bank           | 7  | Pool Variability                              | 8   |

#### Maryland Biological Stream Survey PHI

| Drainage area (acres)   | 1389.9 | Instream Wood Debris         | 12    |
|-------------------------|--------|------------------------------|-------|
| Remoteness              | 11     | Bank Stability               | 13    |
| Shading                 | 45     |                              |       |
| Epifaunal Substrate     | 7      | PHI Score                    | 65.77 |
| Instream Habitat        | 14     | PHI Narrative Ranking        | D     |
| Water Chemistry         |        |                              |       |
| Dissolved Oxygen (mg/L) | 9.78   | Specific Conductance (µS/cm) | 155   |
| pH                      | 6.22   | Temperature (°C)             | 7.67  |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 2.2  |
|----------------------------------|------|
| Bankfull Width (ft)              | 12.5 |
| Mean Bankfull Depth (ft)         | 1.3  |
| Floodprone Width (ft)            | 100* |
| Entrenchment Ratio               | 8*   |
| Width to Depth Ratio             | 9.9  |

|    | Shubbilication Data                     |       |
|----|---|-------|
| 2  | Cross Sectional Area (ft <sup>2</sup> ) | 15.8  |
| 5  | Water Surface Slope (%)                 | 0.322 |
| 3  | Sinuosity                               | 1.0*  |
| )* | D50 (mm)                                | 0.25* |
| <  | Adjustments?                            | ↑Sin  |
| )  | Rosgen Stream Type                      | E5    |

#### \*=Estimated



**Total Individuals** 

## 14-12A

## West River Sampling Unit



**Location/Site Access**: Located at Six- mile Horse farm Latitude/Longitude: 38.8519/-76.57355

#### Land Use Analysis:

| Land Use         | Acres | % Area |
|------------------|-------|--------|
| Commercial       | 2.2   | 0.3    |
| Open Space       | 23.7  | 3.4    |
| Pasture/Hay      | 84.4  | 12.2   |
| Residential 1/2- |       |        |
| acre             | 5.2   | 0.8    |
| Residential 1-   |       |        |
| acre             | 7.1   | 1.0    |
| Residential 2-   |       |        |
| acre             | 56.1  | 8.1    |
| Row Crops        | 56.8  | 8.2    |
| Transportation   | 11.6  | 1.7    |
| Utility          | 30.1  | 4.3    |
| Water            | 0.4   | 0.1    |
| Woods            | 414.9 | 59.9   |
| Grand Total      | 692.6 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 15.7       | 692.6      | 2.3        |

#### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Biological community is in worse condition than would be expected for available habitat quality.
- Riparian features are largely intact, but pool and substrate features are marginal at best
- Sample dominated by midges (*Hydrobaenus*) and stoneflies (*Nemouridae*)
- Stream type was identified as an E5, slope was 0.058 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, E channels are stable. However, this channel has suboptimal bank and substrate features, and may be unstable

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Determine if upstream agricultural, developed lands are adversely impacting water quality and, if so, correct with appropriate BMPs as feasible.

# 14-12A

# West River Sampling Unit

Pool Variability

EPA Narrative Ranking

5

10

10

10

5

6

118

PS

13.7

0.058

1.2

0.25\*

↑Sin

E5

| <b>IBI and Metric Scores</b>  |   |
|---|---|
| Narrative Rating  | Very Poor   |
| Overall Index   | 1.57  |
| Total Taxa Score  | 1   |
| EPT Taxa Score  | 3   |
| Ephemeroptera Taxa Score  | 1   |
| Intolerant Urban % Score  | 3   |
| Ephemeroptera % Score   | 1   |
| Scraper Taxa Score  | 1   |
| % Climbers  | 1   |
| Calculated Metric Values  |   |
| Total Taxa  | 13  |
| EPT Taxa  | 3   |
| Ephemeroptera Taxa  | 0   |
| Intolerant Urban %  | 13.46   |
| Ephemeroptera %   | 0   |
| Scraper Taxa  | 0   |
| % Climbers  | 0   |
| Caecidotea<br>Smittia<br>Sciaridae<br>Orthocladius/Cricotopus<br>Orthocladiinae<br>Limnephilidae<br>Ironoquia<br>Hydrobaenus<br>Diplocladius<br>Crangonyx<br>Enchytraeidae<br>Chaetocladius | 1<br>1<br>1<br>1<br>1<br>1<br>2<br>2<br>5<br>60<br>4<br>1<br>1<br>2 |
|   |   |

**Total Individuals** 

### **Physical Habitat EPA Rapid Bioassessment** Bank Stability- Left Bank

| Bank Stability- Right Bank          | 6  | Riparian Vegetative<br>Zone Width- Left Bank  |
|-------------------------------------|----|---|
| Channel Alteration                  | 20 | Riparian Vegetative<br>Zone Width- Right Bank |
| Channel Flow Status                 | 15 | Sediment Deposition                           |
| Channel Sinuosity                   | 8  | Vegetative Protection (Left Bank)             |
| Epifaunal Substrate/Available Cover | 10 | Vegetative Protection (Right Bank)            |
| Pool Substrate Characterization     | 8  |   |
|                                     |    | EPA Habitat Score                             |

5

#### Maryland Biological Stream Survey PHI

| Drainage area (acres)   | 692.6 | Instream Wood Debris         | 10    |
|-------------------------|-------|------------------------------|-------|
| Remoteness              | 9     | Bank Stability               | 11    |
| Shading                 | 100   |                              |       |
| Epifaunal Substrate     | 3     | PHI Score                    | 66.69 |
| Instream Habitat        | 10    | PHI Narrative Ranking        | PD    |
| Water Chemistry         |       |                              |       |
| Dissolved Oxygen (mg/L) | 9.44  | Specific Conductance (µS/cm) | 152   |
| рН                      | 5.98  | Temperature (°C)             | 9.61  |

### **Geomorphic Assessments**

104

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 1.08  | Cross Sectional Area (ft <sup>2</sup> ) |
|----------------------------------|-------|---|
| Bankfull Width (ft)              | 11.1  | Water Surface Slope (%)                 |
| Mean Bankfull Depth (ft)         | 1.2   | Sinuosity                               |
| Floodprone Width (ft)            | 156*  | D50 (mm)                                |
| Entrenchment Ratio               | 14.1* | Adjustments?                            |
| Width to Depth Ratio             | 9.0   | Rosgen Stream Type                      |
| *=Estimated                      |       |   |



## 14-14A

## West River Sampling Unit



**Location/Site Access**: MISSING INFORMATION Latitude/Longitude: 38.83887/-76.5676

#### Land Use Analysis:

| Land Use       | Acres | % Area |
|----------------|-------|--------|
| Commercial     | 1.3   | 0.2    |
| Open Space     | 5.8   | 1.0    |
| Pasture/Hay    | 4.7   | 0.8    |
| Residential 1- |       |        |
| acre           | 1.9   | 0.3    |
| Residential 2- |       |        |
| acre           | 31.9  | 5.6    |
| Row Crops      | 57.7  | 10.1   |
| Transportation | 4.5   | 0.8    |
| Woods          | 463.9 | 81.1   |
| Grand Total    | 571.8 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 5.9        | 571.8      | 1.0        |

#### **Results:**

- Biological condition "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Biological community observed is trending toward more than expected impairment based on the observed habitat quality.
- Riparian features are intact, but bank, substrate, and pool features are marginal
- Sample dominated by midges (*Hydrobaenus*), stoneflies (*Nemouridae*), and worms (*Enchytraeidae*)
- Stream type was identified as an G5c, slope was 1.04 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, G channels are not stable. This channel has marginal bank and substrate features, and may be unstable

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Investigate cause of poor biological condition and partial degradation of habitat features despite predominantly natural land uses

# 14-14A

# West River Sampling Unit

| Narrative Rating<br>Overall Index<br>Total Taxa Score<br>EPT Taxa Score<br>Ephemeroptera Taxa Score<br>Ephemeroptera % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values<br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Amphinemura<br>Tubificinae<br>Nemouridae  | Poor<br>2.14<br>3<br>3<br>1<br>5<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>7<br>3<br>0<br>41.58<br>0<br>0<br>0<br>0<br>0 |
|--|--|
| Overall Index         Total Taxa Score         EPT Taxa Score         Ephemeroptera Taxa Score         Intolerant Urban % Score         Ephemeroptera % Score         Scraper Taxa Score         % Climbers         Calculated Metric Values         Total Taxa         EPT Taxa         Ephemeroptera Taxa         Intolerant Urban %         Ephemeroptera Taxa         Scraper Taxa         Scraper Taxa         Phemeroptera %         Scraper Taxa         Molerant Urban %         Ephemeroptera %         Scraper Taxa         % Climbers | 2.14<br>3<br>3<br>1<br>5<br>1<br>1<br>1<br>17<br>3<br>0<br>41.58<br>0<br>0<br>0<br>0                                 |
| Total Taxa Score<br>EPT Taxa Score<br>Ephemeroptera Taxa Score<br>Intolerant Urban % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values<br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Amphinemura<br>Tubificinae<br>Nemouridae  | 3<br>3<br>1<br>5<br>1<br>1<br>1<br>1<br>1<br>7<br>3<br>0<br>41.58<br>0<br>0<br>0<br>0                                |
| EPT Taxa Score<br>Ephemeroptera Taxa Score<br>Intolerant Urban % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br><b>Calculated Metric Values</b><br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Amphinemura<br>Tubificinae<br>Nemouridae  | 3<br>1<br>5<br>1<br>1<br>1<br>1<br>7<br>3<br>0<br>41.58<br>0<br>0<br>0<br>0  |
| Ephemeroptera Taxa Score<br>Intolerant Urban % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br><b>Calculated Metric Values</b><br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Amphinemura<br>Tubificinae<br>Nemouridae  | 1<br>5<br>1<br>1<br>1<br>1<br>7<br>3<br>0<br>41.58<br>0<br>0<br>0<br>0   |
| Intolerant Urban % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br><u>% Climbers</u><br><b>Calculated Metric Values</b><br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br><u>% Climbers</u><br><b>Taxa List</b><br>Amphinemura<br>Tubificinae<br>Nemouridae  | 5<br>1<br>1<br>17<br>3<br>0<br>41.58<br>0<br>0<br>0<br>0   |
| Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values<br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Amphinemura<br>Tubificinae<br>Nemouridae  | 1<br>1<br>17<br>3<br>0<br>41.58<br>0<br>0<br>0<br>0  |
| Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values<br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Amphinemura<br>Tubificinae<br>Nemouridae   | 1<br>17<br>3<br>0<br>41.58<br>0<br>0<br>0<br>0   |
| % Climbers<br>Calculated Metric Values<br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Amphinemura<br>Tubificinae<br>Nemouridae   | 1<br>17<br>3<br>0<br>41.58<br>0<br>0<br>0  |
| Calculated Metric Values<br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Amphinemura<br>Tubificinae<br>Nemouridae   | 17<br>3<br>0<br>41.58<br>0<br>0<br>0   |
| Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Amphinemura<br>Tubificinae<br>Nemouridae  | 17<br>3<br>0<br>41.58<br>0<br>0<br>0   |
| EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Amphinemura<br>Tubificinae<br>Nemouridae  | 3<br>0<br>41.58<br>0<br>0<br>0   |
| Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Amphinemura<br>Tubificinae<br>Nemouridae  | 0<br>41.58<br>0<br>0<br>0  |
| Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Amphinemura<br>Tubificinae<br>Nemouridae   | 41.58<br>0<br>0<br>0   |
| Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Amphinemura<br>Tubificinae<br>Nemouridae  | 0<br>0<br>0  |
| Scraper Taxa<br>% Climbers<br>Taxa List<br>Amphinemura<br>Tubificinae<br>Nemouridae  | 0  |
| % Climbers<br><b>Taxa List</b><br>Amphinemura<br>Tubificinae<br>Nemouridae   | 0  |
| <b>Taxa List</b><br>Amphinemura<br>Tubificinae<br>Nemouridae   | 0  |
| Synurella<br>Stegopterna<br>Pisidiidae<br>Rheocricotopus<br>Orthocladius/Cricotopus<br>Caecidotea<br>Nais<br>Chaetocladius<br>Diplocladius<br>Hydrobaenus<br>Ironoquia<br>Limnodrilus<br>Limnophyes<br>Enchytraeidae   | 4<br>1<br>21<br>7<br>8<br>1<br>1<br>5<br>2<br>1<br>2<br>6<br>3<br>3<br>1<br>14                                       |

| Physical Habitat                    |          |   |       |
|-------------------------------------|----------|---|-------|
| EPA Rapid Bioassessment             |          |   |       |
| Bank Stability- Left Bank           | 5        | Pool Variability                              | 7     |
| Bank Stability- Right Bank          | 4        | Riparian Vegetative<br>Zone Width- Left Bank  | 10    |
| Channel Alteration                  | 20       | Riparian Vegetative<br>Zone Width- Right Bank | 10    |
| Channel Flow Status                 | 16       | Sediment Deposition                           | 9     |
| Channel Sinuosity                   | 10       | Vegetative Protection (Left Bank)             | 5     |
| Epifaunal Substrate/Available Cover | 8        | Vegetative Protection (Right Bank)            | 4     |
| Pool Substrate Characterization     | 8        |   |       |
|                                     |          | EPA Habitat Score                             | 116   |
|                                     |          | EPA Narrative Ranking                         | PS    |
|                                     |          |   |       |
| Maryland Biological Stream          | Survey 1 | PHI   |       |
| Drainage area (acres)               | 571.8    | Instream Wood Debris                          | 10    |
| Remoteness                          | 14       | Bank Stability                                | 9     |
| Shading                             | 100      |   |       |
| Epifaunal Substrate                 | 5        | PHI Score                                     | 70.98 |
| Instream Habitat                    | 8        | PHI Narrative Ranking                         | PD    |
| Water Chemistry                     |          |   |       |
| Dissolved Oxygen (mg/L)             | 9.31     | Specific Conductance (µS/cm)                  | 56    |
| pH                                  | 6.16     | Temperature (°C)                              | 10.12 |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 0.89 |
|----------------------------------|------|
| Bankfull Width (ft)              | 8.6  |
| Mean Bankfull Depth (ft)         | 1.2  |
| Floodprone Width (ft)            | 10.1 |
| Entrenchment Ratio               | 1.2  |
| Width to Depth Ratio             | 7.2  |



#### \*=Estimated



**Total Individuals** 

101

## 14-16A

## West River Sampling Unit



**Location/Site Access**: Located at Charles Gift Court Crossing Latitude/Longitude: 38.86008/-76.5761

#### Land Use Analysis:

| Land Use       | Acres | % Area |
|----------------|-------|--------|
| Open Space     | 11.8  | 6.5    |
| Pasture/Hay    | 3.5   | 1.9    |
| Residential 1- |       |        |
| acre           | 4.4   | 2.4    |
| Residential 2- |       |        |
| acre           | 29.1  | 16.0   |
| Row Crops      | 53.2  | 29.2   |
| Transportation | 2.1   | 1.1    |
| Utility        | 10.6  | 5.8    |
| Water          | 0.1   | 0.1    |
| Woods          | 67.1  | 36.9   |
| Grand Total    | 182.0 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 5.6        | 182.0      | 3.1        |

#### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Biological community is in worse condition than would be expected for available habitat quality.
- Bank and riparian conditions are sub-optimal, and substrate conditions are marginal
- Sample dominated by midges (*Chaetocladius*) and caddisflies (*Ironoquia*)
- Channel morphology was not assessed, because the nearby culvert may alter natural channel evolution

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Investigate very poor biological conditions and partially degraded habitat conditions despite low imperviousness in the catchment.
- Determine if water quality impairments are due to agricultural activities in this basin and correct with appropriate BMPs as necessary and feasible.

# 14-16A

# West River Sampling Unit

| <b>IBI and Metric Scores</b>   |  |
|--|--|
| Narrative Rating   | Very Poor  |
| Overall Index  | 1.57   |
| Total Taxa Score   | 3  |
| EPT Taxa Score   | 3  |
| Ephemeroptera Taxa Score   | 1  |
| Intolerant Urban % Score   | 1  |
| Ephemeroptera % Score  | 1  |
| Scraper Taxa Score   | 1  |
| % Climbers   | 1  |
| Calculated Metric Values   |  |
| Total Taxa   | 15   |
| EPT Taxa   | 3  |
| Ephemeroptera Taxa   | 0  |
| Intolerant Urban %   | 9.52   |
| Ephemeroptera %  | 0  |
| Scraper Taxa   | 0  |
| % Climbers   | 0  |
| Taxa List<br>Gonomyia<br>Nemoura<br>Tubificinae<br>Stegopterna<br>Pisidiidae<br>Simuliidae<br>Rheocricotopus<br>Ironoquia<br>Diplocladius<br>Chaetocladius<br>Enchytraeidae<br>Caecidotea<br>Amphinemura<br>Aedes<br>Limnodrilus | 1<br>4<br>2<br>8<br>1<br>9<br>10<br>2<br>56<br>2<br>1<br>3<br>1<br>1 |
| Total Individuals  | 105  |

| Physical Habitat                    |        |   |       |
|-------------------------------------|--------|---|-------|
| EPA Rapid Bioassessment             |        |   |       |
| Bank Stability- Left Bank           | 8      | Pool Variability                              | 6     |
| Bank Stability- Right Bank          | 7      | Riparian Vegetative<br>Zone Width- Left Bank  | 6     |
| Channel Alteration                  | 11     | Riparian Vegetative<br>Zone Width- Right Bank | 6     |
| Channel Flow Status                 | 14     | Sediment Deposition                           | 9     |
| Channel Sinuosity                   | 6      | Vegetative Protection (Left Bank)             | 8     |
| Epifaunal Substrate/Available Cover | 7      | Vegetative Protection (Right Bank)            | 7     |
| Pool Substrate Characterization     | 6      |   |       |
|                                     |        | EPA Habitat Score                             | 101   |
|                                     |        | EPA Narrative Ranking                         | PS    |
|                                     |        |   |       |
| Maryland Biological Stream          | Survey | PHI   |       |
| Drainage area (acres)               | 182.0  | Instream Wood Debris                          | 6     |
| Remoteness                          | 6      | Bank Stability                                | 15    |
| Shading                             | 90     |   |       |
| Epifaunal Substrate                 | 3      | PHI Score                                     | 66.14 |

## Water Chemistry

| Dissolved Oxygen (mg/L) | 11.26 | Specific Conductance (µS/cm) | 199   |
|-------------------------|-------|------------------------------|-------|
| рH                      | 6.48  | Temperature (°C)             | 10.76 |

7

PHI Narrative Ranking

PD

### **Geomorphic Assessments**

Instream Habitat

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | Cross Sectional Area (ft <sup>2</sup> ) |
|----------------------------------|---|
| Bankfull Width (ft)              | Water Surface Slope (%)                 |
| Mean Bankfull Depth (ft)         | Sinuosity                               |
| Floodprone Width (ft)            | D50 (mm)                                |
| Entrenchment Ratio               | Adjustments?                            |
| Width to Depth Ratio             | Rosgen Stream Type                      |
|                                  |   |

\*=Estimated

No assessment due to culvert present in reach.


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## **Rock Branch Sampling Unit**



**Location/Site Access**: Located at MISSING INFORMATION Latitude/Longitude: 38.85168/-76.64574

### Land Use Analysis:

| Land Use         | Acres  | % Area |
|------------------|--------|--------|
| Commercial       | 14.9   | 0.7    |
| Open Space       | 105.6  | 5.3    |
| Pasture/Hay      | 195.3  | 9.8    |
| Residential 1/2- |        |        |
| acre             | 16.5   | 0.8    |
| Residential 1-   |        |        |
| acre             | 70.5   | 3.5    |
| Residential 2-   |        |        |
| acre             | 261.3  | 13.1   |
| Row Crops        | 353.4  | 17.7   |
| Transportation   | 29.2   | 1.5    |
| Water            | 1.5    | 0.1    |
| Woods            | 951.6  | 47.6   |
| Grand Total      | 1999.8 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 79.0       | 1999.8     | 4.0        |

### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Biological community is in worse condition than would be expected for available habitat quality.
- Riparian features are intact, but bank, substrate, and pool features are marginal
- Sample heavily dominated by blackflies (*Prosimulium*) and by midges (*Diplocladius*)
- Stream type was identified as an G5c, slope was 0.415 percent, and the median channel substrate was fine sand
- Typically, G channels are unstable. This channel has marginal bank and substrate features, and may be unstable.

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Investigate very poor biological condition and partially degraded habitat conditions despite predominantly natural land uses
- Investigate need, feasibility of BMP retrofits on agricultural, developed lands upstream of site.

## **Rock Branch Sampling Unit**

| Narrative RatingVery PoorOverall Index1.86Total Taxa Score1EPT Taxa Score3Ephemeroptera Taxa Score1Intolerant Urban % Score5Ephemeroptera % Score1Scraper Taxa Score1% Climbers1Calculated Metric Values1Total Taxa12EPT Taxa3Ephemeroptera %0Intolerant Urban %71.57Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0Noterature %0Scraper Taxa1Moriant Urban %1Scraper Taxa0% Climbers0Taxa List1Ironoquia1Amphinemura1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius1Hydrobaenus1Chaetocladius1  | Narrative RatingVery PoorOverall Index1.86Total Taxa Score3EphT Taxa Score3Ephemeroptera Taxa Score1Intolerant Urban % Score1Scraper Taxa Score1% Climbers1Calculated Metric Values1Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0Molerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Scraper Taxa0% Climbers1Tonoquia1Amphinemura1Simulidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius1Hydrobaenus1Hydrobaenus1Chaetocladius1 | IBI and Metric Scores   |  |
|---|--|---|--|
| Overall Index1.86Total Taxa Score1EPT Taxa Score3Ephemeroptera Taxa Score1Intolerant Urban % Score5Ephemeroptera % Score1Scraper Taxa Score1% Climbers1Calculated Metric ValuesTotal Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Scraper Taxa1Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa1Intolicitat Urban %71.57Ephemeroptera %0Scraper Taxa1Yorinoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1 | Overall Index1.86Total Taxa Score1EPT Taxa Score3Ephemeroptera Taxa Score1Intolerant Urban % Score5Ephemeroptera % Score1% Climbers1% Climbers1Total Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0Mclimbers0Scraper Taxa0% Climbers0Scraper Taxa0% Climbers0Scraper Taxa1Ironoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius1Hydrobaenus1Chaetocladius1                             | Narrative Rating  | Very Poor  |
| Total Taxa Score1EPT Taxa Score3Ephemeroptera Taxa Score1Intolerant Urban % Score5Ephemeroptera % Score1Scraper Taxa Score1% Climbers1Calculated Metric ValuesTotal Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0Molerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Taxa List1Ironoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius1Hydrobaenus1Chaetocladius1   | Total Taxa Score1EPT Taxa Score3Ephemeroptera Taxa Score1Intolerant Urban % Score5Ephemeroptera % Score1Scraper Taxa Score1% Climbers1Calculated Metric ValuesTotal Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera Taxa0Scraper Taxa0% Climbers0Scraper Taxa0% Climbers0Scraper Taxa1Nonoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius1Hydrobaenus1Chaetocladius1   | Overall Index   | 1.86   |
| EPT Taxa Score3Ephemeroptera Taxa Score1Intolerant Urban % Score5Ephemeroptera % Score1Scraper Taxa Score1% Climbers1Calculated Metric ValuesTotal Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera Taxa0Scraper Taxa0Scraper Taxa0% Climbers0Scraper Taxa0% Climbers0Taxa List1Ironoquia1Amphinemura1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1  | EPT Taxa Score3Ephemeroptera Taxa Score1Intolerant Urban % Score5Ephemeroptera % Score1Scraper Taxa Score1% Climbers1Calculated Metric ValuesTotal Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Scraper Taxa0% Climbers0Scraper Taxa1Inolerant Urban %71.57Ephemeroptera %0% Climbers0% Climbers0Taxa List1Ironoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius1Hydrobaenus1Chaetocladius1                          | Total Taxa Score  | 1  |
| Ephemeroptera Taxa Score1Intolerant Urban % Score5Ephemeroptera % Score1Scraper Taxa Score1% Climbers1Calculated Metric ValuesTotal Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Scraper Taxa0% Climbers0Taxa List1Ironoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1   | Ephemeroptera Taxa Score1Intolerant Urban % Score5Ephemeroptera % Score1Scraper Taxa Score1% Climbers1Calculated Metric ValuesTotal Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Scraper Taxa0% Climbers0Scraper Taxa0% Climbers0Taxa List1Ironoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1  | EPT Taxa Score  | 3  |
| Intolerant Urban % Score5Ephemeroptera % Score1Scraper Taxa Score1% Climbers1Calculated Metric ValuesTotal Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Scraper Taxa0% Climbers0Taxa List1Ironoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1  | Intolerant Urban % Score5Ephemeroptera % Score1Scraper Taxa Score1% Climbers1Calculated Metric ValuesTotal Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0% Climbers0Total Taxa1Ironoquia1Amphinemura1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius1Hydrobaenus1Chaetocladius1   | Ephemeroptera Taxa Score  | 1  |
| Ephemeroptera % Score1Scraper Taxa Score1% Climbers1Calculated Metric ValuesTotal Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0% Climbers0Taxa List1Ironoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1  | Ephemeroptera % Score1Scraper Taxa Score1% Climbers1Calculated Metric ValuesTotal Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0% Climbers0Taxa List1Ironoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius1Hydrobaenus1Chaetocladius1   | Intolerant Urban % Score  | 5  |
| Scraper Taxa Score1% Climbers1Calculated Metric ValuesTotal Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Market Metric Mathematication1Tonoquia1Amphinemura1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1  | Scraper Taxa Score1% Climbers1Calculated Metric ValuesTotal Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Taxa ListIronoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius1Hydrobaenus1Chaetocladius1   | Ephemeroptera % Score   | 1  |
| % Climbers1Calculated Metric ValuesTotal Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Taxa ListIronoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1   | % Climbers1Calculated Metric ValuesTotal Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Taxa ListIronoquia1Amphinemura1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1  | Scraper Taxa Score  | 1  |
| Calculated Metric ValuesTotal Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Taxa ListIronoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1  | Calculated Metric ValuesTotal Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Taxa ListIronoquia1Amphinemura1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1   | % Climbers  | 1  |
| Total Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Taxa ListIronoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1  | Total Taxa12EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Taxa ListIronoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1   | Calculated Metric Values  |  |
| EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Taxa ListIronoquia1Amphinemura1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1  | EPT Taxa3Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Taxa ListIronoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1   | Total Taxa  | 12   |
| Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Taxa ListIronoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1   | Ephemeroptera Taxa0Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Taxa ListIronoquia1Amphinemura1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1  | EPT Taxa  | 3  |
| Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Taxa List1Ironoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1   | Intolerant Urban %71.57Ephemeroptera %0Scraper Taxa0% Climbers0Taxa ListIronoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1   | Ephemeroptera Taxa  | 0  |
| Ephemeroptera %0Scraper Taxa0% Climbers0Taxa ListIronoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1   | Ephemeroptera %0Scraper Taxa0% Climbers0Taxa ListIronoquiaIronoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1   | Intolerant Urban %  | 71.57  |
| Scraper Taxa0% Climbers0Taxa ListIronoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1   | Scraper Taxa0% Climbers0Taxa ListIIronoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1   | Ephemeroptera %   | 0  |
| % Climbers0Taxa List1Ironoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1   | % Climbers0Taxa ListIronoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1   | Scraper Taxa  | 0  |
| Taxa ListIronoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1   | Taxa ListIronoquia1Amphinemura1Tubificinae1Simuliidae1Prosimulium72Orthocladius/Cricotopus4Eukiefferiella5Diplocladius12Enchytraeidae2Allocapnia1Hydrobaenus1Chaetocladius1  | % Climbers  | 0  |
|   |  | Simuliidae<br>Prosimulium<br>Orthocladius/Cricotopus<br>Eukiefferiella<br>Diplocladius<br>Enchytraeidae<br>Allocapnia<br>Hydrobaenus<br>Chaetocladius | 1<br>1<br>72<br>4<br>5<br>12<br>2<br>1<br>1<br>1 |
|   |  | Chaetocladius   | 1  |
|   |  |   |  |
|   |  |   |  |
|   |  |   |  |

| Physical Habitat                    |        |   |       |
|-------------------------------------|--------|---|-------|
| EPA Rapid Bioassessment             |        |   |       |
| Bank Stability- Left Bank           | 5      | Pool Variability                              | 9     |
| Bank Stability- Right Bank          | 4      | Riparian Vegetative<br>Zone Width- Left Bank  | 10    |
| Channel Alteration                  | 20     | Riparian Vegetative<br>Zone Width- Right Bank | 10    |
| Channel Flow Status                 | 11     | Sediment Deposition                           | 7     |
| Channel Sinuosity                   | 6      | Vegetative Protection (Left Bank)             | 5     |
| Epifaunal Substrate/Available Cover | 13     | Vegetative Protection (Right Bank)            | 4     |
| Pool Substrate Characterization     | 9      |   |       |
|                                     |        | EPA Habitat Score                             | 113   |
|                                     |        | EPA Narrative Ranking                         | PS    |
| Maryland Biological Stream          | Survey | PHI   |       |
| Drainage area (acres)               | 1999.8 | Instream Wood Debris                          | 14    |
| Remoteness                          | 14     | Bank Stability                                | 9     |
| Shading                             | 100    |   |       |
| Epifaunal Substrate                 | 12     | PHI Score                                     | 78.50 |
| Instream Habitat                    | 13     | PHI Narrative Ranking                         | PD    |
|                                     |        |   |       |

#### Water Chemistry Dissolved Oxygen (mg/L) Specific Conductance (µS/cm) 13.78 150 pН Temperature (°C) 6.51 5.29

## **Geomorphic Assessments**

### **Rosgen Level II Classification Data**

| 8                                |       |   |            |
|----------------------------------|-------|---|------------|
| Drainage Area (mi <sup>2</sup> ) | 3.125 | Cross Sectional Area (ft <sup>2</sup> ) | 22.8       |
| Bankfull Width (ft)              | 17.2  | Water Surface Slope (%)                 | 0.415      |
| Mean Bankfull Depth (ft)         | 1.3   | Sinuosity                               | 1.1*       |
| Floodprone Width (ft)            | 20    | D50 (mm)                                | 0.17       |
| Entrenchment Ratio               | 1.2   | Adjustments?                            | †Sin, ↓W/D |
| Width to Depth Ratio             | 13    | Rosgen Stream Type                      | G5c        |
| *=Estimated                      |       |   |            |
| <u>.</u>                         |       | 20-01, Glide                            |            |
| 2 0 10 20                        |       | 30 40 50                                | 60         |
| -4                               |       |   |            |
| <u>5</u> 6                       |       |   |            |
|                                  |       |   |            |
|                                  |       |   |            |

Width

**Total Individuals** 

102

-10

-12



**Location/Site Access**: Located at end of Conservation Lane, 0.15m west Latitude/Longitude: 38.87129/-76.66612

### Land Use Analysis:

| Land Use         | Acres  | % Area |
|------------------|--------|--------|
| Commercial       | 4.3    | 0.4    |
| Open Space       | 57.9   | 4.8    |
| Pasture/Hay      | 86.7   | 7.2    |
| Residential 1/2- |        |        |
| acre             | 1.2    | 0.1    |
| Residential 1-   |        |        |
| acre             | 43.1   | 3.6    |
| Residential 2-   |        |        |
| acre             | 232.5  | 19.3   |
| Row Crops        | 232.3  | 19.3   |
| Transportation   | 17.8   | 1.5    |
| Woods            | 526.4  | 43.8   |
| Grand Total      | 1202.0 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 46.8       | 1202.0     | 3.9        |

#### **Results:**

- Biological condition "Good"
- Habitat scores "Partially Supporting" and "Degraded"
- Biological community is in better condition than expected for measured level of habitat quality.
- Riparian features are intact, but bank and pool features are marginal
- Sample dominated by midges (*Tanytarsus*) and stoneflies (*Haploperla*)
- Stream type was identified as an C5, slope was 0.32 percent, and the median channel substrate was medium sand
- Typically, C channels are stable. However, this channel has marginal bank features and excessive sediment deposition, and may be moving toward an unstable form.

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.

# **Rock Branch Sampling Unit**

| IBI and Metric Scores         |        |
|-------------------------------|--------|
| Narrative Rating              | Good   |
| Overall Index                 | 4.43   |
| Total Taxa Score              | 5      |
| FPT Taxa Score                | 5      |
| Enhemerontera Tava Score      | 3      |
| Intelerent Urban % Score      | 5      |
| Enhamanatan % Score           | 3      |
| Ephemeroptera % Score         | 3      |
| Scraper Taxa Score            | 5      |
| % Climbers                    | 5      |
| Calculated Metric Values      |        |
| Total Taxa                    | 31     |
| EPT Taxa                      | 8      |
| Ephemeroptera Taxa            | 1      |
| Intolerant Urban %            | 47.62  |
| Ephemeroptera %               | 3.81   |
| Scraper Taxa                  | 2      |
| % Climbers                    | 20.95  |
|                               |        |
| Taxa List                     |        |
| Tanytarsus                    | 21     |
| Orthocladiinae                | 1      |
| Orthociadius                  | 1      |
| Parametriocnemus              | 3      |
| Paratendipes                  | 1      |
| Prosimulium                   | 2      |
| Prostoma                      | 1      |
| Stilocladius                  | 1      |
| Taenionema                    | 2      |
| Bezzia/Palpomyia              | 1      |
| Mallochohelea                 | 1      |
| Neophylax                     | 5      |
| Synurella                     | 1      |
| Diplocladius                  | 2      |
| Amphinemura                   | 12     |
| Antocha<br>En shartan si da s | 1      |
| Corvinoneura                  | 1      |
| Nemata                        | 1      |
| Eccoptura                     | 1      |
| Ephemerella                   | 4      |
| Eukiefferiella                | 3      |
| Gomphidae                     | 1      |
| Haploperla                    | 19     |
| Hydrobaenus                   | 5<br>8 |
| Leptoceridae                  | 1      |
| Menetus                       | 1      |
| Cheumatopsyche                | 1      |
| Total Individuals             | 105    |

| Physical Habitat                    |          |   |       |
|-------------------------------------|----------|---|-------|
| EFA Kapiu bioassessment             |          | <b>N</b>                                      |       |
| Bank Stability- Left Bank           | 3        | Pool Variability                              | 9     |
| Bank Stability- Right Bank          | 5        | Riparian Vegetative<br>Zone Width- Left Bank  | 10    |
| Channel Alteration                  | 20       | Riparian Vegetative<br>Zone Width- Right Bank | 10    |
| Channel Flow Status                 | 11       | Sediment Deposition                           | 7     |
| Channel Sinuosity                   | 9        | Vegetative Protection (Left Bank)             | 3     |
| Epifaunal Substrate/Available Cover | 12       | Vegetative Protection (Right Bank)            | 5     |
| Pool Substrate Characterization     | 7        |   |       |
|                                     |          | EPA Habitat Score                             | 111   |
|                                     |          | EPA Narrative Ranking                         | PS    |
| Maryland Biological Stream          | Survey ] | PHI   |       |
| Drainage area (acres)               | 1202.0   | Instream Wood Debris                          | 6     |
| Remoteness                          | 8        | Bank Stability                                | 8     |
| Shading                             | 95       |   |       |
| Epifaunal Substrate                 | 6        | PHI Score                                     | 64.17 |
| Instream Habitat                    | 12       | PHI Narrative Ranking                         | D     |
| Water Chemistry                     |          |   |       |

| water Chemistry         |       |                                    |     |
|-------------------------|-------|------------------------------------|-----|
| Dissolved Oxygen (mg/L) | 13.12 | Specific Conductance ( $\mu$ S/cm) | 153 |
| рН                      | 6.85  | Temperature (°C)                   | 3.8 |

## **Geomorphic Assessments**

## **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) |
|----------------------------------|
| Bankfull Width (ft)              |
| Mean Bankfull Depth (ft)         |
| Floodprone Width (ft)            |
| Entrenchment Ratio               |
| Width to Depth Ratio             |

| 1.9  | Cross Sectional Area (ft <sup>2</sup> ) | 43.2 |
|------|---|------|
| 23.8 | Water Surface Slope (%)                 | 0.32 |
| 1.8  | Sinuosity                               | 1.5  |
| 75   | D50 (mm)                                | 0.47 |
| 3.2  | Adjustments?                            | None |
| 13.1 | Rosgen Stream Type                      | C5   |





**Location/Site Access**: Located at Anne Arundel Golf Course Latitude/Longitude: 38.85295/-76.65797

### Land Use Analysis:

| Land Use    | Acres | % Area |
|-------------|-------|--------|
| Row Crops   | 11.6  | 65.9   |
| Woods       | 6.0   | 34.1   |
| Grand Total | 17.6  | 100    |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 0.36       | 17.6       | 2.0        |

### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- The biological community is in worse condition than expected for the habitat quality
- Riparian features are intact, but pool and substrate features are poor, and flow conditions are marginal
- Sample heavily dominated by midges (*Diplocladius* and *Chaetocladius*)
- Stream type was identified as an B5c, slope was 1.6 percent, and the median channel substrate was fine to medium sand
- Typically, B channels are stable. However, this channel has suboptimal bank and substrate features, and may be unstable

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Investigate possible causes of biological degradation, such as intermittent flow

## **Rock Branch Sampling Unit**

Pool Variability

EPA Habitat Score

EPA Narrative Ranking

3

10

10

13

6

6

102

PS

| IBI and Metric Scores    |           |
|--------------------------|-----------|
| Narrative Rating         | Very Poor |
| Overall Index            | 1.29      |
| Total Taxa Score         | 3         |
| EPT Taxa Score           | 1         |
| Ephemeroptera Taxa Score | 1         |
| Intolerant Urban % Score | 1         |
| Ephemeroptera % Score    | 1         |
| Scraper Taxa Score       | 1         |
| % Climbers               | 1         |
| Calculated Metric Values |           |
| Total Taxa               | 18        |
| EPT Taxa                 | 1         |
| Ephemeroptera Taxa       | 0         |
| Intolerant Urban %       | 2.5       |
| Ephemeroptera %          | 0         |
| Scraper Taxa             | 0         |
| % Climbers               | 0.83      |
|                          |           |
| Taxa List                |           |
| Allocapnia               | 1         |
| Diplocladius             | 65        |
| Bittacomorpha            | 1         |
| Pisidiidae               | 8         |
| Charte de disc           | 2         |
| Culiacidas               | 12        |
| Tubificingo              | 1         |
| Hydrobaenus              | 0         |
| Corduliinae/Libellulinae | 4         |
| Zavrelimvia              | 5         |
| Synurella                | 3         |
| Rheocricotopus           | 3         |
| Pisidium                 | 3         |

## Physical Habitat EPA Rapid Bioassessment Bank Stability- Left Bank Bank Stability- Right Bank

| Bank Stability- Right Bank          | 6  | Riparian Vegetative<br>Zone Width- Left Bank  |
|-------------------------------------|----|---|
| Channel Alteration                  | 20 | Riparian Vegetative<br>Zone Width- Right Bank |
| Channel Flow Status                 | 7  | Sediment Deposition                           |
| Channel Sinuosity                   | 9  | Vegetative Protection (Left Bank)             |
| Epifaunal Substrate/Available Cover | 3  | Vegetative Protection (Right Bank)            |
| Pool Substrate Characterization     | 3  |   |

6

### Maryland Biological Stream Survey PHI

| Drainage area (acres)   | 17.6 | Instream Wood Debris               | 8     |
|-------------------------|------|------------------------------------|-------|
| Remoteness              | 8    | Bank Stability                     | 12    |
| Shading                 | 100  |                                    |       |
| Epifaunal Substrate     | 2    | PHI Score                          | 72.95 |
| Instream Habitat        | 3    | PHI Narrative Ranking              | PD    |
| Water Chemistry         |      |                                    |       |
| Dissolved Oxygen (mg/L) | 7.09 | Specific Conductance ( $\mu$ S/cm) | 191   |
| pH                      | 5.34 | Temperature (°C)                   | 8.46  |

## **Geomorphic Assessments**

### **Rosgen Level II Classification Data**

| 0.03 | Cross Sectional Area (ft <sup>2</sup> ) | 3.7  |
|------|---|--|
| 6.0  | Water Surface Slope (%)                 | 1.6  |
| 0.6  | Sinuosity                               | 1.2  |
| 12   | D50 (mm)                                | 0.25   |
| 2.0  | Adjustments?                            | ↑W/D   |
| 10   | <b>Rosgen Stream Type</b>               | B5c  |
|      | 0.03<br>6.0<br>0.6<br>12<br>2.0<br>10   | <ul> <li>0.03 Cross Sectional Area (ft<sup>2</sup>)</li> <li>6.0 Water Surface Slope (%)</li> <li>0.6 Sinuosity</li> <li>12 D50 (mm)</li> <li>2.0 Adjustments?</li> <li>10 Rosgen Stream Type</li> </ul> |



**Total Individuals** 

Orthocladiinae

Limnodrilus Polypedilum

Nais

1

2 1

1



**Location/Site Access**: Located at Polling House Rd. Anne Arundel Manor Golf Course Latitude/Longitude: 38.86217/-76.66261

### Land Use Analysis:

| Land Use       | Acres | % Area |
|----------------|-------|--------|
| Open Space     | 1.0   | 0.8    |
| Residential 1- |       |        |
| acre           | 6.4   | 5.4    |
| Residential 2- |       |        |
| acre           | 21.8  | 18.6   |
| Row Crops      | 48.0  | 41.0   |
| Transportation | 1.3   | 1.1    |
| Woods          | 38.7  | 33.0   |
| Grand Total    | 117.1 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 2.7        | 117.1      | 2.3        |

#### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Not Supporting" and "Partially Degraded"
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality.
- Several habitat features are marginal and poor
- Sample dominated by blackflies (*Stegopterna*) and midges (*Hydrobaenus* and *Tvetenia*)
- Stream type was identified as an G5s, slope was 0.584 percent, and the median channel substrate was fine sand
- This channel has unstable banks, excessive fine sediments, and marginal pool quality, all of which indicate channel instability.

- Protect the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Determine need, feasibility of BMP installation on agricultural, developed lands upstream of site.
- Investigate possible causes of channel instability

## **Rock Branch Sampling Unit**

| Narrative Rating         | Very Poo |
|--------------------------|----------|
| Overall Index            | 1.86     |
| Total Taxa Score         | 3        |
| EPT Taxa Score           | 1        |
| Ephemeroptera Taxa Score | 1        |
| Intolerant Urban % Score | 5        |
| Ephemeroptera % Score    | 1        |
| Scraper Taxa Score       | 1        |
| % Climbers               | 1        |
| Calculated Metric Values |          |
| Total Taxa               | 15       |
| EPT Taxa                 | 1        |
| Ephemeroptera Taxa       | 0        |
| Intolerant Urban %       | 43.59    |
| Ephemeroptera %          | 0        |
| Scraper Taxa             | 0        |
| % Climbers               | 0        |
| Taxa List                |          |
| Hydrobaenus              | 20       |
| Simulium                 | 1        |
| Tubificinae              | 3        |
| Zalutschia               | 1        |
| Tvetenia                 | 19       |
| Stegopterna              | 36       |
| Spirosperma              | 2        |
| Orthocladius/Cricotopus  | 2        |
| Nemata                   | 1        |
| Diplociadius             | 2        |
| Chastagladius            |          |
| Enchytraeidae            | 07       |
| Agabus                   | /        |
| Azabus                   | 1        |

| Total In | dividuals |
|----------|-----------|
|----------|-----------|

117

| <u>Physical Habitat</u>             |        |  |    |
|-------------------------------------|--------|--|----|
| EPA Rapid Bioassessment             |        |  |    |
| Bank Stability- Left Bank           | 3      | Pool Variability                             | 7  |
| Bank Stability- Right Bank          | 4      | Riparian Vegetative<br>Zone Width- Left Bank | 10 |
| Channel Alteration                  | 19     | Zone Width- Right Bank                       | 1  |
| Channel Flow Status                 | 11     | Sediment Deposition                          | 8  |
| Channel Sinuosity                   | 3      | Vegetative Protection (Left Bank)            | 3  |
| Epifaunal Substrate/Available Cover | 9      | Vegetative Protection (Right Bank)           | 4  |
| Pool Substrate Characterization     | 9      |  |    |
|                                     |        | EPA Habitat Score                            | 91 |
|                                     |        | EPA Narrative Ranking                        | NS |
|                                     |        |  |    |
| Maryland Biological Stream S        | Survey | PHI  |    |
|                                     | -      |  |    |

#### Drainage area (acres) Instream Wood Debris 117.1 12 Remoteness Bank Stability 11 7 Shading 95 Epifaunal Substrate 3 PHI Score 73.80 PHI Narrative Ranking Instream Habitat 9 PD Water Chemistry

| Dissolved Oxygen (mg/L) | 10.32 | Specific Conductance (µS/cm) | 78   |
|-------------------------|-------|------------------------------|------|
| рН                      | 5.61  | Temperature (°C)             | 9.43 |

3.7

0.584 1.2\* 0.18 ↓W/D

G5c

## **Geomorphic Assessments**

### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 0.18 | Cross Sectional Area (ft <sup>2</sup> ) |
|----------------------------------|------|---|
| Bankfull Width (ft)              | 6.8  | Water Surface Slope (%)                 |
| Mean Bankfull Depth (ft)         | 0.5  | Sinuosity                               |
| Floodprone Width (ft)            | 9.2  | D50 (mm)                                |
| Entrenchment Ratio               | 1.3  | Adjustments?                            |
| Width to Depth Ratio             | 12.7 | Rosgen Stream Type                      |
|                                  |      |   |

#### \*Estimated





**Location/Site Access**: Located at 4440 Windsor Farm Road Latitude/Longitude: 38.86958/-76.6395

### Land Use Analysis:

| Land Use         | Acres | % Area |
|------------------|-------|--------|
| Commercial       | 4.7   | 0.8    |
| Open Space       | 29.0  | 5.2    |
| Pasture/Hay      | 63.0  | 11.2   |
| Residential 1/2- | 13    | 0.2    |
| acre             | 1.5   | 0.2    |
| Residential 1-   | 20.1  | 3.6    |
| acre             | 20.1  | 5.0    |
| Residential 2-   | 130.8 | 23.3   |
| acre             | 150.0 | 23.5   |
| Row Crops        | 56.8  | 10.1   |
| Transportation   | 11.0  | 2.0    |
| Woods            | 245.2 | 43.6   |
| Grand Total      | 561.9 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 31.5       | 561.9      | 5.6        |

### **Results:**

- Biological condition "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Biological community is appropriate for observed habitat quality.
- Riparian features are intact, but bank features are poor and other features are marginal
- Sample dominated by blackflies (*Prosimulium* and *Simuliidae*) and midges (*Diplocladius*)
- Stream type was identified as an G5c, slope was 0.616 percent, and the median channel substrate was estimated as fine or medium sand
- This channel has failing banks and excessive sediment deposition, indicating channel instability

- Maintain protection of the riparian area.
- Determine if water quality impacts are associated with residential, agricultural lands—correct as necessary and feasible.
- Plan for hydrologic stability with potential increases in imperviousness.

## **Rock Branch Sampling Unit**

| Narrative Rating<br>Overall Index<br>Total Taxa Score<br>EPT Taxa Score<br>Ephemeroptera Taxa Score<br>Intolerant Urban % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values | Poor<br>2.14<br>3<br>3<br>1<br>5<br>1<br>1 |
|--|--|
| Overall IndexTotal Taxa ScoreEPT Taxa ScoreEphemeroptera Taxa ScoreIntolerant Urban % ScoreEphemeroptera % ScoreScraper Taxa Score% ClimbersCalculated Metric Values   | 2.14<br>3<br>1<br>5<br>1<br>1              |
| Total Taxa Score<br>EPT Taxa Score<br>Ephemeroptera Taxa Score<br>Intolerant Urban % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values                                      | 3<br>3<br>1<br>5<br>1<br>1                 |
| EPT Taxa Score<br>Ephemeroptera Taxa Score<br>Intolerant Urban % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values  | 3<br>1<br>5<br>1<br>1                      |
| Ephemeroptera Taxa Score<br>Intolerant Urban % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values  | 1<br>5<br>1<br>1                           |
| Intolerant Urban % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values  | 5<br>1<br>1                                |
| Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values  | 1  |
| Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values   | 1  |
| % Climbers Calculated Metric Values  |  |
| Calculated Metric Values   | 1  |
|  |  |
| Total Taxa   | 15   |
| EPT Taxa   | 4  |
| Ephemeroptera Taxa   | 0  |
| Intolerant Urban %   | 51   |
| Ephemeroptera %  | 0  |
| Scraper Taxa   | 0  |
| % Climbers   | 0  |
| Taxa List  | 0  |
| Neophylax  | 3  |
| Stegopterna  | 9  |
| Paranemoura  | 2  |
| Simuliidae   | 10   |
| Pseudorthocladius  | 1  |
| Prosimulium  | 34   |
| Orthocladius/Cricotopus  | 4  |
| Diplocladius   | 23   |
| Limnodrilus  | 1  |
| Ironoquia  | 1  |
| Hydrobaenus  | 5  |
| Eukiefferiella   | 1  |
| Enchytraeidae  | 2  |
| Dolichopodidae   | 1  |
| Nemouridae   | 3  |

#### **Physical Habitat** EPA Ranid Riggson

| EPA Rapid Bloassessment             |    |      |
|-------------------------------------|----|------|
| Bank Stability- Left Bank           | 2  | Pool |
| Bank Stability- Right Bank          | 3  | Ripa |
| Channel Alteration                  | 3  | Ripa |
| Channel Alteration                  | 20 | Zone |
| Channel Flow Status                 | 10 | Sedi |
| Channel Sinuosity                   | 7  | Veg  |
| Epifaunal Substrate/Available Cover | 11 | Veg  |
| Pool Substrate Characterization     | 9  |      |
|                                     |    |      |

.....

| Riparian Vegetative<br>Zone Width- Left Bank | 1  |
|--|----|
| Riparian Vegetative                          | -  |
| Zone Width- Right Bank                       | 1  |
| Sediment Deposition                          |    |
| Vegetative Protection (Left Bank)            |    |
| Vegetative Protection (Right Bank)           |    |
| EPA Habitat Score                            | 10 |
| EPA Narrative Ranking                        | Р  |

#### Maryland Biological Stream Survey PHI

| Drainage area (acres)   | 561.9 | Instream Wood Debris               | 7     |
|-------------------------|-------|------------------------------------|-------|
| Remoteness              | 6     | Bank Stability                     | 5     |
| Shading                 | 85    |                                    |       |
| Epifaunal Substrate     | 4     | PHI Score                          | 58.79 |
| Instream Habitat        | 11    | PHI Narrative Ranking              | D     |
| Water Chemistry         |       |                                    |       |
| Dissolved Oxygen (mg/L) | 12.55 | Specific Conductance ( $\mu$ S/cm) | 210   |
| pH                      | 6.73  | Temperature (°C)                   | 11.09 |

## **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> )  | 0.89 | Cross Sectional Area (ft <sup>2</sup> ) | 8.9   |
|---|------|---|-------|
| Bankfull Width (ft)   | 7.6  | Water Surface Slope (%)                 | 0.616 |
| Mean Bankfull Depth (ft)  | 1.2  | Sinuosity                               | 1.2   |
| Floodprone Width (ft)   | 10.9 | D50 (mm)                                | 0.25* |
| Entrenchment Ratio  | 1.4  | Adjustments?                            | ↓ER   |
| Width to Depth Ratio  | 6.5  | Rosgen Stream Type                      | G5c   |
| *Estimated  |      |   |       |
|   |      | 20-05, Riffle                           |       |
| $ \begin{array}{c} 0 \\ -1 \\ -2 \\ -2 \\ -2 \\ -2 \\ -2 \\ -1 \\ -5 \\ -10 \\ -5 \\ -10 \\ -5 \\ -10 \\ -5 \\ -10 \\ -5 \\ -10 \\ -5 \\ -5 \\ -10 \\ -5 \\ -5 \\ -5 \\ -5 \\ -5 \\ -5 \\ -5 \\ -5$ | 20   | 25 30 35 40                             | 45    |

\**ле**.н.

\*Est



**Total Individuals** 



**Location/Site Access**: Located at Anne Arundel Manor Golf Course Latitude/Longitude: 38.85619/-76.66975

### Land Use Analysis:

| Land Use       | Acres | % Area |
|----------------|-------|--------|
| Industrial     | 25.8  | 9.0    |
| Open Space     | 5.4   | 1.9    |
| Residential 1- |       |        |
| acre           | 7.4   | 2.6    |
| Residential 2- |       |        |
| acre           | 34.6  | 12.0   |
| Row Crops      | 103.0 | 35.8   |
| Transportation | 1.3   | 0.5    |
| Water          | 0.3   | 0.1    |
| Woods          | 109.6 | 38.1   |
| Grand Total    | 287.5 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 4.4        | 287.5      | 1.5        |

### **Results:**

- Biological condition "Fair"
- Habitat scores "Non Supporting" and "Partially Degraded"
- Habitat assessment results were mixed for this site, but biological community observed is better than expected for the observed habitat quality.
- Riparian features are intact, but bank, substrate, and pool features are marginal at best
- Sample is biologically diverse and dominated by crane flies (*Pilaria*) and caddisflies (*Diplectrona*)
- Stream type was identified as an G5c, slope was 0.8 percent, and the median channel substrate was medium sand
- This channel is unstable, as indicated by bank and substrate habitat features

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Determine need, feasibility of stormwater management on residential, agricultural lands
- Restore habitat features, if feasible

## **Rock Branch Sampling Unit**

| IBI and Metric Scores       |        |
|-----------------------------|--------|
| Narrative Rating            | Fair   |
| Overall Index               | 3.57   |
| Total Taxa Score            | 5      |
| EPT Taxa Score              | 5      |
| Ephemeroptera Taxa Score    | 5      |
| Intolerant Urban % Score    | 3      |
| Ephemeroptera % Score       | 3      |
| % Climbers                  | 1<br>3 |
| Calculated Metric Values    |        |
| Total Taxa                  | 41     |
| EPT Taxa                    | 6      |
| Ephemeroptera Taxa          | 2      |
| Enhemerontera %             | 22     |
| Scraper Taxa                | 0      |
| % Climbers                  | 3      |
| Taxa List                   |        |
| Nigronia                    | 1      |
| Pilaria                     | 13     |
| Paratendipes                | 1      |
| Parametriocnemus            | 1      |
| Parakiefferiella            | 1      |
| Paraciadopeima              | 1      |
| Ormosia                     | 1      |
| Tipula                      | 3      |
| Orthocladius/Cricotopus     | 1      |
| Pycnopsyche                 | 1      |
| Sialis                      | 1      |
| Pisidiidae                  | 2      |
| Stenelmis                   | 4      |
| Bezzia/Paipomyia            | 5      |
| Thienemannimyia genus group | 6      |
| Hydrobaenus                 | 1      |
| Nemata                      | 2      |
| Stempellinella              | 1      |
| Chaetocladius               | 1      |
| Natarsia                    | 5      |
| Nais<br>A quarius           | 1      |
| Baetis                      | 1      |
| Caenis                      | 1      |
| Chloroperlidae              | 3      |
| Cordulegaster               | 1      |
| Culicoides                  | 1      |
| Diplectrona                 | 10     |
| Eukieneriella<br>Gammarus   | 3      |
| Hemerodromia                | 1      |
| Heterotrissocladius         | 2      |
| Hexatoma                    | 1      |
| Hydatophylax                | 4      |
| Anchytarsus                 | 7      |
| Diplocladius                | 5      |
| Adiabesmyia                 | 2      |
| Limnodrilus                 | 1      |
|                             | -      |
| Total Individuals           | 100    |

| FPA Ranid Bioassessment   |   |   |   |
|---|---|---|---|
| Bank Stability- Left Bank   | 2   | Pool Variability  | 5   |
| Bank Stability- Right Bank  | 4   | Riparian Vegetative<br>Zone Width- Left Bank  | 10  |
| Channel Alteration  | 20  | Riparian Vegetative<br>Zone Width- Right Bank   | 10  |
| Channel Flow Status   | 9   | Sediment Deposition   | 7   |
| Channel Sinuosity   | 9   | Vegetative Protection (Left Bank)   | 3   |
| Epifaunal Substrate/Available Cover   | 9   | Vegetative Protection (Right Bank)  | 4   |
| Pool Substrate Characterization   | 5   |   |   |
|   |   |   | 00  |
|   |   | EPA Habitat Score   | 98  |
|   | a   | EPA Habitat Score EPA Narrative Ranking   | 98<br>NS                                  |
| <b>Maryland Biological Stream</b><br>Drainage area (acres)  | 287.5   | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris   | 98<br>NS<br>10                            |
| Maryland Biological Stream<br>Drainage area (acres)<br>Remoteness   | 287.5   | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability   | 98<br>NS<br>10<br>7                       |
| Maryland Biological Stream<br>Drainage area (acres)<br>Remoteness<br>Shading  | <b>Survey</b><br>287.5<br>8<br>100                    | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability   | 98<br>NS<br>10<br>7                       |
| <b>Maryland Biological Stream</b><br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate  | <b>Survey</b><br>287.5<br>8<br>100<br>4               | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score  | 98<br>NS<br>10<br>7<br>67.45              |
| <b>Maryland Biological Stream</b><br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat  | <b>Survey</b><br>287.5<br>8<br>100<br>4<br>9          | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score<br>PHI Narrative Ranking                                 | 98<br>NS<br>10<br>7<br>67.45<br>PD        |
| Maryland Biological Stream<br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat<br>Water Chemistry                            | <b>Survey</b><br>287.5<br>8<br>100<br>4<br>9          | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score<br>PHI Narrative Ranking                                 | 98<br>NS<br>10<br>7<br>67.45<br>PD        |
| Maryland Biological Stream<br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat<br>Water Chemistry<br>Dissolved Oxygen (mg/L) | <b>Survey</b><br>287.5<br>8<br>100<br>4<br>9<br>11.24 | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score<br>PHI Narrative Ranking<br>Specific Conductance (µS/cm) | 98<br>NS<br>10<br>7<br>67.45<br>PD<br>574 |

## **Geomorphic Assessments**

### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) |
|----------------------------------|
| Bankfull Width (ft)              |
| Mean Bankfull Depth (ft)         |
| Floodprone Width (ft)            |
| Entrenchment Ratio               |
| Width to Depth Ratio             |
|                                  |

| 6.2  | Rosgen Stream Type                      | G5c       |
|------|---|-----------|
| 1.6  | Adjustments?                            | ↓ER, †Sin |
| 20.1 | D50 (mm)                                | 0.27      |
| 2.1  | Sinuosity                               | 1.1       |
| 12.9 | Water Surface Slope (%)                 | 0.8       |
| 0.50 | Cross Sectional Area (ft <sup>2</sup> ) | 26.7      |
|      |   |           |

\*Estimated





**Location/Site Access**: Located behind 4433 Cobalt Drive Latitude/Longitude: 38.86607/-76.62983

### Land Use Analysis:

| Land Use       | Acres | % Area |
|----------------|-------|--------|
| Commercial     | 4.6   | 3.3    |
| Open Space     | 14.2  | 10.2   |
| Pasture/Hay    | 20.4  | 14.6   |
| Residential 1- |       |        |
| acre           | 3.1   | 2.2    |
| Residential 2- |       |        |
| acre           | 34.5  | 24.8   |
| Row Crops      | 13.0  | 9.4    |
| Transportation | 3.5   | 2.5    |
| Woods          | 45.7  | 32.9   |
| Grand Total    | 139.0 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 10.9       | 139.0      | 7.8        |

### **Results:**

- Biological condition "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality.
- Riparian features are intact, but bank, substrate, and pool features are marginal at best
- Sample is dominated by midges (*Diplocladius* and *Orthocladius/Cricotopus*)
- Stream type was identified as an G5c, slope was 0.524 percent, and the median channel substrate was fine sand
- Typically, G channel are not stable. Marginal bank and substrate features indicate that this channel may be unstable

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Determine if existing residential, agricultural lands are impacting water quality and correct as necessary and feasible.

## **Rock Branch Sampling Unit**

| IBI and Metric Scores       |      |
|-----------------------------|------|
| Narrative Rating            | Poor |
| Overall Index               | 2.14 |
| Total Taxa Score            | 5    |
| EPT Taxa Score              | 3    |
| Ephemeroptera Taxa Score    | 1    |
| Intolerant Urban % Score    | 1    |
| Ephemeroptera % Score       | 1    |
| Scraper Taxa Score          | 1    |
| % Climbers                  | 3    |
| Calculated Metric Values    |      |
| Total Taxa                  | 24   |
| EPT Taxa                    | 4    |
| Ephemeroptera Taxa          | 0    |
| Intolerant Urban %          | 9.17 |
| Ephemeroptera %             | 0    |
| Scraper Taxa                | 0    |
| % Climbers                  | 1.67 |
| Taxa List                   |      |
| Thienemannimyia genus group | 1    |
| Pisidium                    | 1    |
| Prosimulium                 | 1    |
| Pisidiidae                  | 3    |
| Tanytarsus                  | 2    |
| Tipula                      | 1    |
| Zavrelimyia                 | 2    |
| Paranemoura                 | 2    |
| Physidae                    | 1    |
| Simuliidae                  | 4    |
| Bezzia/Palpomyia            | 1    |
| Diplocladius                | 48   |
| Parametriocnemus            | 1    |
| Stegopterna                 | 7    |
| Dasyhelea                   | 1    |
| Gammarus                    | 1    |
| Ironoquia                   | 3    |
| Limnephilidae               | 6    |
| Limnodrilus                 | 1    |
| Nais                        | 9    |
| Nemouridae                  | 1    |
| Orthocladius                | 4    |
| Orthocladius                |      |
| Culiagidas                  | 10   |
| Cuncoldes                   | 2    |

| <u>Physical Habitat</u>             |          |  |       |
|-------------------------------------|----------|--|-------|
| EPA Rapid Bioassessment             |          |  |       |
| Bank Stability- Left Bank           | 5        | Pool Variability                             | 3     |
| Bank Stability- Right Bank          | 5        | Riparian Vegetative<br>Zone Width- Left Bank | 10    |
| Channel Alteration                  | 20       | Zone Width- Right Bank                       | 10    |
| Channel Flow Status                 | 12       | Sediment Deposition                          | 9     |
| Channel Sinuosity                   | 4        | Vegetative Protection (Left Bank)            | 6     |
| Epifaunal Substrate/Available Cover | 9        | Vegetative Protection (Right Bank)           | 6     |
| Pool Substrate Characterization     | 8        |  |       |
|                                     |          | EPA Habitat Score                            | 107   |
|                                     |          | EPA Narrative Ranking                        | PS    |
| Maryland Biological Stream          | Survey I | PHI  |       |
| Drainage area (acres)               | 139.0    | Instream Wood Debris                         | 8     |
| Remoteness                          | 8        | Bank Stability                               | 10    |
| Shading                             | 100      |  |       |
| Epifaunal Substrate                 | 4        | PHI Score                                    | 68.62 |
| Instream Habitat                    | 9        | PHI Narrative Ranking                        | PD    |
| Water Chemistry                     |          |  |       |
| Dissolved Oxygen (mg/L)             | 12.86    | Specific Conductance (µS/cm)                 | 159   |
| pH                                  | 6.75     | Temperature (°C)                             | 8.05  |
|                                     |          |  |       |

## **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

## Drainage Area (mi<sup>2</sup>) Bankfull Width (ft) Mean Bankfull Depth (ft) Floodprone Width (ft) Entrenchment Ratio Width to Depth Ratio

| 0.22 | Cross Sectional Area (ft <sup>2</sup> ) | 7.0   |
|------|---|-------|
| 7.2  | Water Surface Slope (%)                 | 0.524 |
| 1.0  | Sinuosity                               | 1.0*  |
| 9.2  | D50 (mm)                                | 0.19  |
| 1.3  | Adjustments?                            | ↑Sin  |
| 7.4  | Rosgen Stream Type                      | G5c   |

#### \*Estimated



**Total Individuals** 



**Location/Site Access**: Located at Polling House Road Crossing ~40m US Latitude/Longitude: 38.85086/-76.66547

### Land Use Analysis:

| Land Use       | Acres | % Area |
|----------------|-------|--------|
| Commercial     | 0.6   | 0.1    |
| Open Space     | 14.1  | 3.4    |
| Pasture/Hay    | 15.5  | 3.8    |
| Residential 1- |       |        |
| acre           | 25.2  | 6.1    |
| Residential 2- |       |        |
| acre           | 51.2  | 12.4   |
| Row Crops      | 112.9 | 27.4   |
| Transportation | 7.4   | 1.8    |
| Water          | 0.6   | 0.2    |
| Woods          | 184.4 | 44.8   |
| Grand Total    | 412.0 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 12.3       | 412.0      | 3.0        |

### **Results:**

- Biological condition "Poor"
- Habitat scores "Non Supporting" and "Degraded"
- The biological community observed is trending toward less than expected impairment based on the observed habitat quality.
- Riparian features are intact, but bank, substrate, and pool features are generally marginal
- Sample is dominated by midges (*Hydrobaenus*, *Diplocladius*, *Tanytarsus*, and *Eukiefferiella*)
- Stream type was identified as an B5, slope was 2.8 percent, and the median channel substrate was fine sand
- Typically, B channels are stable. However, this channel has suboptimal bank and substrate features, and may be unstable

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Determine need, feasibility of stormwater management on residential, agricultural lands upstream of site.

## **Rock Branch Sampling Unit**

| IBI and Metric Scores    |       |
|--------------------------|-------|
| Narrative Rating         | Poor  |
| Overall Index            | 2.43  |
| Total Taxa Score         | 3     |
| EPT Taxa Score           | 3     |
| Ephemeroptera Taxa Score | 1     |
| Intolerant Urban % Score | 3     |
| Ephemeroptera % Score    | 1     |
| Scraper Taxa Score       | 1     |
| % Climbers               | 5     |
| Calculated Metric Values |       |
| Total Taxa               | 17    |
| EPT Taxa                 | 3     |
| Ephemeroptera Taxa       | 0     |
| Intolerant Urban %       | 10.89 |
| Ephemeroptera %          | 0     |
| Scraper Taxa             | 0     |
| % Climbers               | 13.86 |
| Taxa List                |       |
| Parametriocnemus         | 2     |
| Bezzia/Palpomyia         | 2     |
| Tvetenia                 | 1     |
| Thienemanniella          | 4     |
| Tanytarsus               | 11    |
| Taenionema               | 1     |
| Pisidiidae               | 1     |
| Polypedilum              | 3     |
| Orthocladius/Cricotopus  | 5     |
| Nais                     | 14    |
| Hydrobaenus              | 19    |
| Eukiefferiella           | 10    |
| Diplocladius             | 15    |
| Corynoneura              | 1     |
| Amphinemura              | 9     |
| Paratendipes             | 1     |
| Perlodidae               | 2     |

**Total Individuals** 

| <u>Physical Habitat</u>             |          |   |       |
|-------------------------------------|----------|---|-------|
| EPA Rapid Bioassessment             |          |   |       |
| Bank Stability- Left Bank           | 7        | Pool Variability                              | 5     |
| Bank Stability- Right Bank          | 2        | Riparian Vegetative<br>Zone Width- Left Bank  | 9     |
| Channel Alteration                  | 18       | Riparian Vegetative<br>Zone Width- Right Bank | 10    |
| Channel Flow Status                 | 10       | Sediment Deposition                           | 9     |
| Channel Sinuosity                   | 8        | Vegetative Protection (Left Bank)             | 7     |
| Epifaunal Substrate/Available Cover | 7        | Vegetative Protection (Right Bank)            | 2     |
| Pool Substrate Characterization     | 5        |   |       |
|                                     |          | EPA Habitat Score                             | 99    |
|                                     |          | EPA Narrative Ranking                         | NS    |
| Maryland Biological Stream          | Survey ] | РНІ   |       |
| Drainage area (acres)               | 412.0    | Instream Wood Debris                          | 8     |
| Remoteness                          | 2        | Bank Stability                                | 8     |
| Shading                             | 100      |   |       |
| Epifaunal Substrate                 | 5        | PHI Score                                     | 59.20 |
| Instream Habitat                    | 7        | PHI Narrative Ranking                         | D     |
| Water Chemistry                     |          |   |       |
| Dissolved Oxygen (mg/L)             | 12.86    | Specific Conductance (µS/cm)                  | 190   |
| pH                                  | 6.44     | Temperature (°C)                              | 8.92  |
|                                     |          |   |       |

## **Geomorphic Assessments**

## **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 0.6 |
|----------------------------------|-----|
| Bankfull Width (ft)              | 12. |
| Mean Bankfull Depth (ft)         | 1.2 |
| Floodprone Width (ft)            | 20. |
| Entrenchment Ratio               | 1.7 |
| Width to Depth Ratio             | 9.8 |
|                                  |     |

| 9.8  | Rosgen Stream Type                      | B5         |
|------|---|------------|
| 1.7  | Adjustments?                            | ↑W/D, ↑Sin |
| 20.8 | D50 (mm)                                | 0.2        |
| 1.2  | Sinuosity                               | 1.1        |
| 12.1 | Water Surface Slope (%)                 | 2.8        |
| 0.64 | Cross Sectional Area (ft <sup>2</sup> ) | 14.9       |

#### \*Estimated





**Location/Site Access**: Located at Anne Arundel Manor Golf Course Latitude/Longitude: 38.85157-76.67261

### Land Use Analysis:

| Land Use         | Acres  | % Area |
|------------------|--------|--------|
| Commercial       | 17.8   | 0.6    |
| Industrial       | 10.7   | 0.3    |
| Open Space       | 126.2  | 4.1    |
| Pasture/Hay      | 210.9  | 6.9    |
| Residential 1/2- |        |        |
| acre             | 18.6   | 0.6    |
| Residential 1-   |        |        |
| acre             | 122.2  | 4.0    |
| Residential 2-   |        |        |
| acre             | 352.9  | 11.5   |
| Row Crops        | 656.6  | 21.5   |
| Transportation   | 46.6   | 1.5    |
| Water            | 7.4    | 0.2    |
| Woods            | 1486.4 | 48.6   |
| Grand Total      | 3056.3 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 102.6      | 3056.3     | 3.4        |

### **Results:**

- Biological condition "Fair"
- Habitat scores "Supporting" and "Partially Degraded"
- Biological condition is in sync with available habitat quality.
- Riparian features are intact, and most other habitat features are in the sub-optimal range
- Sample is dominated by midges (*Tanytarsus* and *Hydrobaenus*)
- Stream type was identified as an F5, slope was 0.283 percent, and the median channel substrate was medium sand
- This channel has suboptimal bank and substrate features, and may be sensitive to increased hydrologic disturbance

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Determine need, feasibility of BMP retrofits to control stormwater runoff from agricultural, residential lands.

# **Rock Branch Sampling Unit**

| IBI and Metric Scores       |        |
|-----------------------------|--------|
| Narrative Rating            | Fair   |
| Overall Index               | 3.00   |
| Total Taxa Score            | 5      |
| EPT Taxa Score              | 3      |
| Ephemeroptera Taxa Score    | 3      |
| Intolerant Urban % Score    | 1      |
| Ephemeroptera % Score       | 3      |
| Scraper Taxa Score          | 1      |
| % Climbers                  | 5      |
| Calculated Metric Values    |        |
| Total Taxa                  | 26     |
| EPT Taxa                    | 4      |
| Enhemerontera Taxa          | 1      |
| Intolerant Urban %          | 7 56   |
| Enhemerontera %             | 2.50   |
| Scraper Taxa                | 0      |
| % Climbors                  | 42.7   |
| % Climbers                  | 43.7   |
| Taxa List                   | 2      |
| Prosimulium                 | 3      |
| Stepelmis                   | 1      |
| Stilocladius                | 1      |
| Synurella                   | 1      |
| Taenionema                  | 3      |
| Tanytarsus                  | 52     |
| Tribelos                    | 1      |
| Bezzia/Palpomvia            | 1      |
| Thienemannimyia genus group | 1      |
| Parametriocnemus            | 1      |
| Mallochohelea               | 1      |
| Dubiraphia                  | 1      |
| Paratanytarsus              | 2      |
| Pisidium                    | 6      |
| Allocapnia                  | 1      |
| Diplocladius                | 8      |
| Eukiefferiella              | 2      |
| Gyraulus                    | 8      |
| Hemerodromia                | 1      |
| Hexatoma                    | 1      |
| Hydrobaenus                 | 13     |
| A component                 | 4      |
| Ablabesmyia                 | 5<br>1 |
| Diplectrona                 | 1      |
| 1                           | -      |

| Total | Individuals |
|-------|-------------|
|-------|-------------|

119

| Physical Habitat                    |          |  |       |
|-------------------------------------|----------|--|-------|
| EPA Rapid Bioassessment             |          |  |       |
| Bank Stability- Left Bank           | 6        | Pool Variability                             | 12    |
| Bank Stability- Right Bank          | 6        | Riparian Vegetative<br>Zone Width- Left Bank | 10    |
| Channel Alteration                  | 20       | Zone Width- Right Bank                       | 10    |
| Channel Flow Status                 | 11       | Sediment Deposition                          | 7     |
| Channel Sinuosity                   | 10       | Vegetative Protection (Left Bank)            | 6     |
| Epifaunal Substrate/Available Cover | 15       | Vegetative Protection (Right Bank)           | 6     |
| Pool Substrate Characterization     | 12       |  |       |
|                                     |          | EPA Habitat Score                            | 131   |
|                                     |          | EPA Narrative Ranking                        | S     |
| Maryland Biological Stream          | Survey ] | PHI  |       |
| Drainage area (acres)               | 3056.3   | Instream Wood Debris                         | 7     |
| Remoteness                          | 10       | Bank Stability                               | 12    |
| Shading                             | 100      |  |       |
| Epifaunal Substrate                 | 12       | PHI Score                                    | 73.05 |
| Instream Habitat                    | 15       | PHI Narrative Ranking                        | PD    |
| Water Chemistry                     |          |  |       |
| Dissolved Oxygen (mg/L)             | 12.36    | Specific Conductance (µS/cm)                 | 160   |
| pH                                  | 6.79     | Temperature (°C)                             | 6.33  |
|                                     |          |  |       |

## **Geomorphic Assessments**

### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 4  |
|----------------------------------|----|
| Bankfull Width (ft)              | 24 |
| Mean Bankfull Depth (ft)         | 1  |
| Floodprone Width (ft)            | 31 |
| Entrenchment Ratio               | 1  |
| Width to Depth Ratio             | 15 |
|                                  |    |

| 4.8  | Cross Sectional Area (ft <sup>-</sup> ) | 39.5  |
|------|---|-------|
| 24.4 | Water Surface Slope (%)                 | 0.283 |
| 1.6  | Sinuosity                               | 1.3   |
| 31.1 | D50 (mm)                                | 0.4   |
| 1.3  | Adjustments?                            | None  |
| 15.1 | Rosgen Stream Type                      | F5    |

### \*Estimated



## 20-11A

## **Rock Branch Sampling Unit**



**Location/Site Access**: Located at 4752 S. Polling House Road : Behind House Latitude/Longitude: 38.84806/-76.63237

## Land Use Analysis:

| Land Use         | Acres | % Area |
|------------------|-------|--------|
| Open Space       | 2.3   | 2.5    |
| Residential 1/2- | 0.5   | 0.5    |
| acre             | 0.5   | 0.5    |
| Residential 1-   | 03    | 03     |
| acre             | 0.5   | 0.5    |
| Residential 2-   | 16.1  | 17.1   |
| acre             | 10.1  | 17.1   |
| Row Crops        | 26.2  | 27.8   |
| Transportation   | 1.7   | 1.8    |
| Woods            | 47.1  | 50.0   |
| Grand Total      | 94.2  | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 3.8        | 94.2       | 4.0        |

### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Non Supporting" and "Degraded"
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality.
- Riparian features are largely intact, but bank features are poor and substrate features are marginal
- Sample is heavily dominated by midges (*Chaetocladius* and *Hydrobaenus*)
- Stream type was identified as an G5c, slope was 1.14 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, G channels are not stable. This channel has poor bank conditions, and is apparently unstable

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Restore habitat stability and diversity, if feasible
- Determine need, feasibility of stormwater management on residential, agricultural lands upstream

## 20-11A

## **Rock Branch Sampling Unit**

| IBI and Metric Scores    |           |
|--------------------------|-----------|
| Narrative Rating         | Very Poor |
| Overall Index            | 1.57      |
| Total Taxa Score         | 1         |
| EPT Taxa Score           | 3         |
| Ephemeroptera Taxa Score | 1         |
| Intolerant Urban % Score | 3         |
| Ephemeroptera % Score    | 1         |
| Scraper Taxa Score       | 1         |
| % Climbers               | 1         |
| Calculated Metric Values |           |
| Total Taxa               | 12        |
| EPT Taxa                 | 3         |
| Ephemeroptera Taxa       | 0         |
| Intolerant Urban %       | 16        |
| Ephemeroptera %          | 0         |
| Scraper Taxa             | 0         |
| % Climbers               | 0         |
| Taxa List                |           |
| Diplocladius             | 6         |
| Orthocladius/Cricotopus  | 4         |
| Synurella                | 1         |
| Stegopterna              | 8         |
| Smittia                  | 1         |
| Prosimulium              | 3         |
| Hydrobaenus              | 27        |
| Chaetocladius            | 43        |
| Enchytraeidae            | 2         |
| Amphinemura              | 3         |
| Allocapnia               | 1         |
| Nemouridae               | 1         |

**Total Individuals** 

100

| <u>Physical Habitat</u>             |          |   |       |
|-------------------------------------|----------|---|-------|
| EPA Rapid Bioassessment             |          |   |       |
| Bank Stability- Left Bank           | 2        | Pool Variability                              | 5     |
| Bank Stability- Right Bank          | 2        | Riparian Vegetative<br>Zone Width- Left Bank  | 10    |
| Channel Alteration                  | 19       | Riparian Vegetative<br>Zone Width- Right Bank | 8     |
| Channel Flow Status                 | 14       | Sediment Deposition                           | 9     |
| Channel Sinuosity                   | 7        | Vegetative Protection (Left Bank)             | 3     |
| Epifaunal Substrate/Available Cover | 7        | Vegetative Protection (Right Bank)            | 3     |
| Pool Substrate Characterization     | 7        |   |       |
|                                     |          | EPA Habitat Score                             | 96    |
|                                     |          | EPA Narrative Ranking                         | NS    |
| Maryland Biological Stream          | Survey F | PHI   |       |
| Drainage area (acres)               | 94.2     | Instream Wood Debris                          | 5     |
| Remoteness                          | 2        | Bank Stability                                | 4     |
| Shading                             | 100      |   |       |
| Epifaunal Substrate                 | 5        | PHI Score                                     | 61.53 |
| Instream Habitat                    | 7        | PHI Narrative Ranking                         | D     |
| Water Chemistry                     |          |   |       |
| Dissolved Oxygen (mg/L)             | 10.48    | Specific Conductance (µS/cm)                  | 199   |
| pH                                  | 6.24     | Temperature (°C)                              | 11.57 |
|                                     |          |   |       |

## **Geomorphic Assessments**

### **Rosgen Level II Classification Data**

## Drainage Area (mi<sup>2</sup>) Bankfull Width (ft) Mean Bankfull Depth (ft) Floodprone Width (ft) Entrenchment Ratio Width to Depth Ratio



**Rosgen Stream Type** G5c

\*Estimated



## Cabin Branch Sampling Unit



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**Location/Site Access**: Located at Upper Pindell Road Latitude/Longitude: 38.7755/-76.67653

### Land Use Analysis:

| Land Use         | Acres | % Area |
|------------------|-------|--------|
| Commercial       | 0.6   | 0.1    |
| Open Space       | 17.9  | 2.8    |
| Pasture/Hay      | 69.3  | 10.8   |
| Residential 1/2- |       |        |
| acre             | 22.7  | 3.6    |
| Residential 1-   |       |        |
| acre             | 26.2  | 4.1    |
| Residential 2-   |       |        |
| acre             | 21.8  | 3.4    |
| Row Crops        | 119.3 | 18.6   |
| Transportation   | 32.3  | 5.0    |
| Woods            | 330.3 | 51.6   |
| Grand Total      | 640.4 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 30.7       | 640.4      | 4.7        |

### **Results:**

- Biological condition "Fair"
- Habitat scores "Partially Supporting" and incomplete
- Biological community is in better condition than expected for measured level of habitat quality.
- Riparian features are intact, but bank, substrate, and pool features are marginal or suboptimal
- Sample is dominated by midges (*Eukiefferiella*, *Diplocladius*, and *Hydrobaenus*)
- Stream type was identified as an B5c, slope was 0.238 percent, and the median channel substrate was medium sand
- Typically, B channels are stable. However, this channel has marginal conditions along the left bank and excess sediment deposition, and may be unstable

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness
- Determine need, feasibility of runoff management on residential, agricultural lands upstream of site.

## **Cabin Branch Sampling Unit**

| IBI and Metric Scores       |       |
|-----------------------------|-------|
| Narrative Rating            | Fair  |
| Overall Index               | 3     |
| Total Taxa Score            | 5     |
| EPT Taxa Score              | 5     |
| Ephemeroptera Taxa Score    | 1     |
| Intolerant Urban % Score    | 3     |
| Ephemeroptera % Score       | 1     |
| Scraper Taxa Score          | 1     |
| % Climbers                  | 5     |
| Calculated Metric Values    |       |
| Total Taxa                  | 22    |
| EPT Taxa                    | 6     |
| Ephemeroptera Taxa          | 0     |
| Intolerant Urban %          | 12.38 |
| Ephemeroptera %             | 0     |
| Scraper Taxa                | 0     |
| % Climbers                  | 10.48 |
| Taxa List                   |       |
| Thienemannimyia genus group | 1     |
| Orthocladius/Cricotopus     | 8     |
| Parametriocnemus            | 5     |
| Pilaria                     | 1     |
| Polypedilum                 | 1     |
| Simulium                    | 1     |
| Tanytarsus                  | 9     |
| Nigronia                    | 1     |
| Dixella                     | 2     |
| Stegopterna                 | 3     |
| Diplocladius                | 18    |
| Hydrobaenus                 | 10    |
| Neophylax                   | 3     |
| Amphinemura                 | 5     |
| Calopteryx                  | 1     |
| Allocapnia                  | 1     |
| Eukiefferiella              | 21    |
| Nais                        | 1     |
| Nemoura                     | 1     |
| Ancyronyx                   | 1     |
|                             | -     |

| EPA Rapid Bioassessment   |   |  |                |
|---|---|--|----------------|
| Bank Stability- Left Bank   | 6   | Pool Variability   | 11             |
| Bank Stability- Right Bank  | 3   | Riparian Vegetative<br>Zone Width- Left Bank   | 10             |
| Channel Alteration  | 20  | Zone Width- Right Bank   | 10             |
| Channel Flow Status   | 13  | Sediment Deposition  | 7              |
| Channel Sinuosity   | 11  | Vegetative Protection (Left Bank)  | 6              |
| Epifaunal Substrate/Available Cover   | 13  | Vegetative Protection (Right Bank)   | 3              |
| Pool Substrate Characterization   | 8   |  |                |
|   |   |  |                |
|   |   | EPA Habitat Score  | 121            |
| Marvland Biological Stream  | Survey  | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI  | 121<br>PS      |
| Maryland Biological Stream  | Survey  | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris  | 121<br>PS      |
| <b>Maryland Biological Stream</b><br>Drainage area (acres)<br>Remoteness  | 640.4   | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability  | 121<br>PS      |
| <b>Maryland Biological Stream</b><br>Drainage area (acres)<br>Remoteness<br>Shading   | <b>Survey</b><br>640.4<br>9<br>90             | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability  | 121<br>PS<br>9 |
| <b>Maryland Biological Stream</b><br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate  | <b>Survey</b><br>640.4<br>9<br>90<br>9        | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score (INCOMPLETE)  | 121<br>PS<br>9 |
| <b>Maryland Biological Stream</b><br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat  | <b>Survey</b><br>640.4<br>9<br>90<br>9<br>13  | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score (INCOMPLETE)<br>PHI Narrative Ranking                                 | 121<br>PS<br>9 |
| Maryland Biological Stream<br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat<br>Water Chemistry                            | <b>Survey</b><br>640.4<br>9<br>90<br>9<br>13  | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score (INCOMPLETE)<br>PHI Narrative Ranking                                 | 121<br>PS<br>9 |
| Maryland Biological Stream<br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat<br>Water Chemistry<br>Dissolved Oxygen (mg/L) | Survey<br>640.4<br>9<br>90<br>9<br>13<br>6.82 | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score (INCOMPLETE)<br>PHI Narrative Ranking<br>Specific Conductance (µS/cm) | 121<br>PS<br>9 |

## **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) |
|----------------------------------|
| Bankfull Width (ft)              |
| Mean Bankfull Depth (ft)         |
| Floodprone Width (ft)            |
| Entrenchment Ratio               |
| Width to Depth Ratio             |
|                                  |

| 1.0  | Cross Sectional Area (ft <sup>2</sup> ) | 10.4  |
|------|---|-------|
| 11.8 | Water Surface Slope (%)                 | 0.238 |
| 0.9  | Sinuosity                               | 1.6   |
| 20.6 | D50 (mm)                                | 0.31  |
| 1.7  | Adjustments?                            | None  |
| 13.3 | Rosgen Stream Type                      | B5c   |

#### \*Estimated



**Total Individuals** 

## **Cabin Branch Sampling Unit**



**Location/Site Access**: Located at MISSING DATA Latitude/Longitude: 38.7621/-76.68803

### Land Use Analysis:

| Land Use         | Acres | % Area |
|------------------|-------|--------|
| Commercial       | 0.6   | 0.1    |
| Open Space       | 19.8  | 2.1    |
| Pasture/Hay      | 83.7  | 8.8    |
| Residential 1/2- |       |        |
| acre             | 23.7  | 2.5    |
| Residential 1-   |       |        |
| acre             | 56.4  | 5.9    |
| Residential 2-   |       |        |
| acre             | 39.6  | 4.2    |
| Row Crops        | 169.3 | 17.8   |
| Transportation   | 41.8  | 4.4    |
| Woods            | 515.9 | 54.3   |
| Grand Total      | 950.8 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 36.8       | 950.8      | 3.9        |

### **Results:**

- Biological condition "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Biological conditions agree with observed habitat quality.
- Riparian features are intact, but bank and substrate features are marginal
- Sample is heavily dominated by midges (*Diplocladius*) and blackflies (*Simulium*)
- Stream type was identified as an E5, slope was 0.048 percent, and the median channel substrate was estimated as fine or medium sand
- Typically, E channels are stable. This channel has marginal bank and substrate conditions, and may be unstable

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Determine need, feasibility of stormwater management on agricultural, residential lands upstream.

## **Cabin Branch Sampling Unit**

| IBI and Metric Scores    |      |
|--------------------------|------|
| Narrative Rating         | Poor |
| Overall Index            | 2.14 |
| Total Taxa Score         | 5    |
| EPT Taxa Score           | 3    |
| Ephemeroptera Taxa Score | 1    |
| Intolerant Urban % Score | - 1  |
| Enhemerontera % Score    | - 1  |
| Scraper Taya Score       | 1    |
| % Climbers               | 3    |
| Calculated Matria Values | 5    |
| Tatal Taxa               | 21   |
|                          | 51   |
| EPI Iaxa                 | 4    |
| Epnemeroptera Taxa       | 0    |
| Intolerant Urban %       | 4    |
| Ephemeroptera %          | 0    |
|                          | 0    |
| % Climbers               | 5    |
| Taxa List                | 1    |
| Polypedilum<br>Pisidium  | 1    |
| Simulium                 | 10   |
| Ptilostomis              | 1    |
| Rheocricotopus           | 2    |
| Sciaridae                | 1    |
| Pisidiidae<br>Stanolmia  | 3    |
| Tanytarsus               | 1    |
| Tipulidae                | 1    |
| Tubificinae              | 4    |
| Bezzia/Palpomyia         | 1    |
| Phaenopsectra            | 1    |
| Zavrelimyia              | 6    |
| Orthocladius/Cricotopus  | 9    |
| Hydroporinae             | 2    |
| Ceratopogon              | 1    |
| Chaetocladius            | 1    |
| Culicoides               | 1    |
| Diplociadius             | 24   |
| Heterotrissocladius      | 1    |
| Orthocladius             | 3    |
| Limnephilidae            | 3    |
| Limnodrilus              | 1    |
| Lumbriculidae            | 1    |
| Nemoura                  | 5    |
| Nemouridae               | 1    |
| Hydrobaenus              | 3    |
|                          |      |
| Total Individuals        | 100  |

| EPA Rapid Bioassessment   |  |   |                                    |
|---|--|---|------------------------------------|
| Bank Stability- Left Bank   | 5  | Pool Variability  | 10                                 |
| Bank Stability- Right Bank  | 5  | Riparian Vegetative<br>Zone Width- Left Bank  | 10                                 |
| Channel Alteration  | 20   | Zone Width- Right Bank  | 10                                 |
| Channel Flow Status   | 15   | Sediment Deposition   | 8                                  |
| Channel Sinuosity   | 9  | Vegetative Protection (Left Bank)   | 6                                  |
| Epifaunal Substrate/Available Cover   | 10   | Vegetative Protection (Right Bank)  | 6                                  |
| Pool Substrate Characterization   | 10   |   |                                    |
|   |  |   |                                    |
|   |  | EPA Habitat Score   | 124                                |
| Marvland Biological Stream  | Survey   | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI   | 124<br>PS                          |
| Maryland Biological Stream<br>Drainage area (acres)   | <b>Survey</b><br>950.8                         | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris   | 124<br>PS<br>8                     |
| <b>Maryland Biological Stream</b><br>Drainage area (acres)<br>Remoteness  | <b>Survey</b><br>950.8<br>6                    | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability   | 124<br>PS<br>8<br>10               |
| <b>Maryland Biological Stream</b><br>Drainage area (acres)<br>Remoteness<br>Shading   | <b>Survey</b><br>950.8<br>6<br>100             | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability   | 124<br>PS<br>8<br>10               |
| <b>Maryland Biological Stream</b><br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate  | <b>Survey</b><br>950.8<br>6<br>100<br>3        | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score  | 124<br>PS<br>8<br>10<br>60.95      |
| <b>Maryland Biological Stream</b><br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat  | Survey<br>950.8<br>6<br>100<br>3<br>10         | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score<br>PHI Narrative Ranking                                 | 124<br>PS<br>8<br>10<br>60.95<br>D |
| Maryland Biological Stream<br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat<br>Water Chemistry                            | Survey<br>950.8<br>6<br>100<br>3<br>10         | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score<br>PHI Narrative Ranking                                 | 124<br>PS<br>8<br>10<br>60.95<br>D |
| Maryland Biological Stream<br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat<br>Water Chemistry<br>Dissolved Oxygen (mg/L) | Survey<br>950.8<br>6<br>100<br>3<br>10<br>7.97 | EPA Habitat Score<br>EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score<br>PHI Narrative Ranking<br>Specific Conductance (µS/cm) | 124<br>PS<br>8<br>10<br>60.95<br>D |

## **Geomorphic Assessments**

### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) |
|----------------------------------|
| Bankfull Width (ft)              |
| Mean Bankfull Depth (ft)         |
| Floodprone Width (ft)            |
| Entrenchment Ratio               |
| Width to Depth Ratio             |
|                                  |

| 1.48 | Cross Sectional Area (ft <sup>2</sup> ) | 15.9  |
|------|---|-------|
| 12.3 | Water Surface Slope (%)                 | 0.048 |
| 1.3  | Sinuosity                               | 1.2   |
| 154  | D50 (mm)                                | 0.25* |
| 12.6 | Adjustments?                            | ↑Sin  |
| 9.5  | Rosgen Stream Type                      | E5    |

### \*Estimated



## **Cabin Branch Sampling Unit**



**Location/Site Access**: Located at 5935 Tablot Road 0.15 Miles NE Latitude/Longitude: 38.78633/-76.65512

### Land Use Analysis:

| Land Use                 | Acres | % Area |
|--------------------------|-------|--------|
| Commercial               | 1.9   | 0.4    |
| Open Space               | 25.8  | 5.9    |
| Pasture/Hay              | 28.1  | 6.4    |
| Residential 1/2-<br>acre | 16.8  | 3.8    |
| Residential 1-<br>acre   | 22.0  | 5.0    |
| Residential 2-<br>acre   | 10.0  | 2.3    |
| Row Crops                | 97.9  | 22.2   |
| Transportation           | 7.9   | 1.8    |
| Woods                    | 230.1 | 52.2   |
| Grand Total              | 440.5 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 10.3       | 440.5      | 2.3        |

### **Results:**

- Biological condition "Very Poor"
- Habitat scores were "Partially Supporting" and incomplete
- In general, the habitat features are marginal, with one bank showing disruptive pressure.
- Biological conditions were generally impaired in comparison to observed habitat levels.
- Sample is heavily dominated by worms (*Nais*) and midges (*Orthocladius/Cricotopus* and *Diplocladius*)
- Stream type was identified as an G5c, slope was 0.474 percent, and the median channel substrate was medium sand
- Typically, G channels are not stable. This channel has poor bank conditions on one bank, may be vulnerable to erosion

- Protect the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Restore habitat features on the right bank, if feasible
- Determine need, feasibility of stormwater management on agricultural lands upstream of sites

## **Cabin Branch Sampling Unit**

3

103 PS

11

154

9

| IBI and Metric Scores    |           |
|--------------------------|-----------|
| Narrative Rating         | Very Poor |
| Overall Index            | 1.57      |
| Total Taxa Score         | 3         |
| EPT Taxa Score           | 1         |
| Ephemeroptera Taxa Score | 1         |
| Intolerant Urban % Score | 1         |
| Ephemeroptera % Score    | 1         |
| Scraper Taxa Score       | 1         |
| % Climbers               | 3         |
| Calculated Metric Values |           |
| Total Taxa               | 14        |
| EPT Taxa                 | 1         |
| Ephemeroptera Taxa       | 0         |
| Intolerant Urban %       | 4.9       |
| Ephemeroptera %          | 0         |
| Scraper Taxa             | 0         |
| % Climbers               | 4.9       |
| Taxa List                |           |
| Stenelmis                | 1         |
| Neophylax                | 1         |
| Tanytarsus               | 5         |
| Stegopterna              | 3         |
| Pseudolimnophila         | 1         |
| Orthocladius/Cricotopus  | 15        |
| Limnodrilus              | 1         |
| Diplocladius             | 24        |
| Dero                     | 2         |
| Culicoides               | 2         |
| Chaetocladius            | 4         |
| Enchytraeidae            | 2         |
| Agabus                   | 1         |
| Nais                     | 40        |

| 8          | Pool Variability   |
|------------|--|
| 3          | Riparian Vegetative<br>Zone Width- Left Bank   |
| 20         | Zone Width- Right Bank   |
| 13         | Sediment Deposition  |
| 6          | Vegetative Protection (Left Bank)  |
| 11         | Vegetative Protection (Right Bank)   |
| 8          |  |
|            | EPA Habitat Score  |
|            | EPA Narrative Ranking  |
| n Survey l | РНІ  |
| 440.5      | Instream Wood Debris   |
| 8          | Bank Stability   |
| 70         |  |
| 6          | PHI Score (INCOMPLETE)   |
| 11         | PHI Narrative Ranking  |
| 67         | Specific Conductance (uS/cm)   |
|            | 8<br>3<br>20<br>13<br>6<br>11<br>8<br><b>A Survey</b><br>440.5<br>8<br>70<br>6<br>11 |

## **Geomorphic Assessments**

**Physical Habitat** 

### **Rosgen Level II Classification Data**

6.5

## Drainage Area (mi<sup>2</sup>) Bankfull Width (ft) Mean Bankfull Depth (ft) Floodprone Width (ft) Entrenchment Ratio Width to Depth Ratio



Temperature (°C)

#### \*Estimated

pН



**Total Individuals** 

## **Cabin Branch Sampling Unit**



Location/Site Access: MISSING INFORMATION Latitude/Longitude: 38.78706-76.65057

### Land Use Analysis:

| Land Use                 | Acres  | % Area |
|--------------------------|--------|--------|
| Commercial               | 3.1    | 0.2    |
| Open Space               | 20.6   | 1.6    |
| Pasture/Hay              | 189.6  | 14.3   |
| Residential 1/2-<br>acre | 71.1   | 5.4    |
| Residential 1-<br>acre   | 117.7  | 8.9    |
| Residential 2-<br>acre   | 92.5   | 7.0    |
| Row Crops                | 347.6  | 26.2   |
| Transportation           | 22.2   | 1.7    |
| Water                    | 1.7    | 0.1    |
| Woods                    | 462.4  | 34.8   |
| Grand Total              | 1328.6 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 49.2       | 1328.6     | 3.7        |

### **Results:**

- Biological condition "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Biological community is appropriate for observed habitat quality.
- Most habitat features show some sign of degradation
- Sample is heavily dominated by midges (*Orthocladius/Cricotopus*, *Diplocladius* and *Hydrobaenus*)
- Stream type was identified as an G5c, slope was 0.405 percent, and the median channel substrate was medium sand
- Typically, G channels are not stable. This channel has sub-optimal and poor bank and substrate conditions, and is vulnerable to further erosion

- Protect the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Examine need for stormwater management on residential, agricultural lands, if feasible.

## **Cabin Branch Sampling Unit**

| IBI and Metric Scores                     |        |
|---|--------|
| Narrative Rating                          | Poor   |
| Overall Index                             | 2.14   |
| Total Taxa Score                          | 3      |
| EPT Taxa Score                            | 3      |
| Ephemeroptera Taxa Score                  | 1      |
| Intolerant Urban % Score                  | 3      |
| Ephemeroptera % Score                     | 1      |
| Scraper Taxa Score                        | 1      |
| % Climbers                                | 3      |
| Calculated Metric Values                  | 0      |
| Total Taxa                                | 20     |
| FDT Taxa                                  | 20     |
| En la | 2      |
| Intelement Urban 0/                       | 165    |
| Enhomerentere %                           | 10.5   |
| Ephemeroptera %                           | 0      |
|   | 0      |
| % Climbers                                | 1.94   |
| Taxa List                                 |        |
| Tubificinae                               | l<br>F |
| Amphinomura                               | 5      |
| Deremetricenemus                          | 1      |
| Polynedilum                               | 1      |
| Prosimulium                               | 4      |
| Simuliidae                                |        |
| Zavrelimvia                               | 2      |
| Nemata                                    | 1      |
| Stegopterna                               | 2      |
| Enchytraeidae                             | 1      |
| Nais                                      | 4      |
| Limnodrilus                               | 1      |
| Hydrobaenus                               | 14     |
| Hexatoma                                  | 1      |
| Eukiefferiella                            | 7      |
| Diplocladius                              | 23     |
| Chrysops                                  | 2      |
| Nanocladius                               | 1      |
| Orthocladius/Cricotopus                   | 27     |

| <u>Physical Habitat</u><br>EPA Rapid Bioassessment |    |
|--|----|
| Bank Stability- Left Bank                          | 5  |
| Bank Stability- Right Bank                         | 6  |
| Channel Alteration                                 | 20 |
| Channel Flow Status                                | 9  |
| Channel Sinuosity                                  | 8  |
| Epifaunal Substrate/Available Cover                | 11 |
| Pool Substrate Characterization                    | 8  |

| EPA Narrative Ranking              | PS  |
|------------------------------------|-----|
| EPA Habitat Score                  | 107 |
| Vegetative Protection (Right Bank) | 6   |
|                                    | 5   |
| Vegetative Protection (Left Bank)  | 5   |
| Sediment Deposition                | 5   |
| Zone Width- Right Bank             | 10  |
| Riparian Vegetative                |     |
| Zone Width- Left Bank              | 5   |
| Riparian Vegetative                |     |
| Pool Variability                   | 9   |

### Maryland Biological Stream Survey PHI

| Drainage area (acres)   | 1328.6 | Instream Wood Debris               | 14    |
|-------------------------|--------|------------------------------------|-------|
| Remoteness              | 5      | Bank Stability                     | 11    |
| Shading                 | 85     |                                    |       |
| Epifaunal Substrate     | 6      | PHI Score                          | 63.28 |
| Instream Habitat        | 11     | PHI Narrative Ranking              | D     |
| Water Chemistry         |        |                                    |       |
| Dissolved Oxygen (mg/L) | 13.1   | Specific Conductance ( $\mu$ S/cm) | 181   |
| рН                      | 6.83   | Temperature (°C)                   | 12.88 |

## **Geomorphic Assessments**

### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 2.1  | Cross Sectional Area (ft <sup>2</sup> ) | 30.2  |
|----------------------------------|------|---|-------|
| Bankfull Width (ft)              | 14.1 | Water Surface Slope (%)                 | 0.405 |
| Mean Bankfull Depth (ft)         | 2.2  | Sinuosity                               | 1.5   |
| Floodprone Width (ft)            | 20.0 | D50 (mm)                                | 0.3   |
| Entrenchment Ratio               | 1.4  | Adjustments?                            | None  |
| Width to Depth Ratio             | 6.4  | <b>Rosgen Stream Type</b>               | G5c   |
| *Estimated                       |      |   |       |



## **Cabin Branch Sampling Unit**



**Location/Site Access:** MISSING INFORMATION Latitude/Longitude: 38.7879/-76.65064

### Land Use Analysis:

| Land Use                 | Acres  | % Area |
|--------------------------|--------|--------|
| Commercial               | 3.1    | 0.2    |
| Open Space               | 20.6   | 1.6    |
| Pasture/Hay              | 189.6  | 14.3   |
| Residential 1/2-<br>acre | 71.1   | 5.4    |
| Residential 1-<br>acre   | 117.7  | 8.9    |
| Residential 2-<br>acre   | 91.3   | 6.9    |
| Row Crops                | 347.6  | 26.2   |
| Transportation           | 22.2   | 1.7    |
| Water                    | 1.7    | 0.1    |
| Woods                    | 462.2  | 34.8   |
| Grand Total              | 1327.3 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 1327.3     | 49.1       | 3.7        |

### **Results:**

- Biological condition "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Biological community is appropriate for observed habitat quality.
- All habitat features (except channel alteration) show signs of degradation
- Sample is heavily dominated by midges (*Diplocladius* and *Orthocladius/Cricotopus*)
- Stream type was identified as an G5c, slope was 0.361 percent, and the median channel substrate was fine or medium sand
- Typically, G channels are not stable. This channel is apparently vulnerable to continued erosion

- Protect the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Restore habitat stability and diversity, if feasible
- Examine need, feasibility of stormwater management on residential and agricultural lands upstream of site.

# **Cabin Branch Sampling Unit**

| Poor   |
|--|
| 2.14   |
| 3  |
| 5  |
| 1  |
| 1  |
| 1  |
| 1  |
| 3  |
|  |
| 19   |
| 5  |
| 0  |
| 9.9  |
| 0  |
| 0  |
| 1.98   |
| $ \begin{array}{c} 1\\ 1\\ 2\\ 5\\ 1\\ 32\\ 1\\ 1\\ 1\\ 1\\ 1\\ 2\\ 33\\ 6\\ 4\\ 1\\ 2\\ 5\\ \end{array} $ |
|  |

| EPA Rapid Bioassessmen   | t   |  |                                   |
|--|---|--|-----------------------------------|
| Bank Stability- Left Bank  | 5   | Pool Variability   | 7                                 |
| Bank Stability- Right Bank   | 4   | Riparian Vegetative<br>Zone Width- Left Bank   | 2                                 |
| Channel Alteration   | 20  | Riparian Vegetative<br>Zone Width- Right Bank  | ç                                 |
| Channel Flow Status  | 10  | Sediment Deposition  | 6                                 |
| Channel Sinuosity  | 10  | Vegetative Protection (Left Bank)  | 5                                 |
| Epifaunal Substrate/Available Co   | ver 12  | Vegetative Protection (Right Bank)   | 2                                 |
| Pool Substrate Characterization  | 8   |  |                                   |
|  |   | EPA Habitat Score  | 104                               |
|  |   |  |                                   |
| Maryland Biological Stre   | am Survey   | EPA Narrative Ranking PHI  | PS                                |
| Maryland Biological Stre   | am Survey   | EPA Narrative Ranking PHI  | PS                                |
| Maryland Biological Stree<br>Drainage area (acres)   | am Survey<br>1327.3                                       | EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability   | PS<br>7                           |
| Maryland Biological Strea<br>Drainage area (acres)<br>Remoteness   | <b>am Survey</b><br>1327.3<br>8                           | EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability   | PS<br>7                           |
| <b>Maryland Biological Stre</b><br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate   | <b>am Survey</b><br>1327.3<br>8<br>85                     | EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score  | PS                                |
| Maryland Biological Strea<br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>nstream Habitat  | <b>am Survey</b><br>1327.3<br>8<br>85<br>6<br>12          | EPA Narrative Ranking PHI Instream Wood Debris Bank Stability PHI Score PHI Narrative Ranking                              | PS<br>7<br>9<br>62.27             |
| <b>Maryland Biological Stre</b><br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>nstream Habitat  | <b>am Survey</b><br>1327.3<br>8<br>85<br>6<br>12          | EPA Narrative Ranking PHI Instream Wood Debris Bank Stability PHI Score PHI Narrative Ranking                              | PS<br>7<br>9<br>62.27<br>E        |
| Maryland Biological Stree<br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat<br>Water Chemistry                            | <b>am Survey</b><br>1327.3<br>8<br>85<br>6<br>12          | EPA Narrative Ranking<br>PHI<br>Instream Wood Debris<br>Bank Stability<br>PHI Score<br>PHI Narrative Ranking               | PS                                |
| Maryland Biological Strea<br>Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat<br>Water Chemistry<br>Dissolved Oxygen (mg/L) | <b>am Survey</b><br>1327.3<br>8<br>85<br>6<br>12<br>11.39 | EPA Narrative Ranking PHI Instream Wood Debris Bank Stability PHI Score PHI Narrative Ranking Specific Conductance (µS/cm) | PS<br>7<br>9<br>62.27<br>0<br>187 |

## **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) |
|----------------------------------|
| Bankfull Width (ft)              |
| Mean Bankfull Depth (ft)         |
| Floodprone Width (ft)            |
| Entrenchment Ratio               |
| Width to Depth Ratio             |
|                                  |



\*Estimated



**Total Individuals** 

## **Cabin Branch Sampling Unit**



**Location/Site Access**: Located at Orchard .... Latitude/Longitude: 38.76291-76.68264

### Land Use Analysis:

| Land Use         | Acres | % Area |
|------------------|-------|--------|
| Commercial       | 0.6   | 0.1    |
| Open Space       | 19.4  | 2.3    |
| Pasture/Hay      | 83.6  | 9.9    |
| Residential 1/2- | 23.0  | 28     |
| acre             | 23.9  | 2.0    |
| Residential 1-   | 52.9  | 63     |
| acre             | 52.7  | 0.5    |
| Residential 2-   | 32.6  | 39     |
| acre             | 52.0  | 5.7    |
| Row Crops        | 143.0 | 17.0   |
| Transportation   | 38.2  | 4.5    |
| Woods            | 448.4 | 53.2   |
| Grand Total      | 842.7 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 842.7      | 34.6       | 4.1        |

### **Results:**

- Biological condition "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Biological community observed is trending toward more than expected impairment based on the observed habitat quality.
- Riparian features are intact, but bank features are sub-optimal and sediment deposition is marginal
- Sample is heavily dominated by midges (*Hydrobaenus*, *Diplocladius*, and *Orthocladius/Cricotopus*) and blackflies (*Simulium*)
- Stream type was identified as an G5c, slope was 0.624 percent, and the median channel substrate was medium sand
- Typically, G channels are not stable and this channel has is vulnerable to erosion on both banks

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Restore habitat stability and diversity, if feasible
- Investigate need for stormwater management on residential, agricultural lands upstream.

## **Cabin Branch Sampling Unit**

| IBI and Metric Scores           |       |
|---------------------------------|-------|
| Narrative Rating                | Poor  |
| Overall Index                   | 2.43  |
| Total Taxa Score                | 5     |
| EPT Taxa Score                  | 3     |
| Ephemeroptera Taxa Score        | 1     |
| Intolerant Urban % Score        | 3     |
| Ephemeroptera % Score           | 1     |
| Scraper Taxa Score              | 1     |
| % Climbers                      | 3     |
| Calculated Metric Values        | -     |
| Total Taxa                      | 23    |
|                                 | 3     |
| Er Franze<br>Enhemeroptera Taxa | 0     |
| Intelerant Urban %              | 18.63 |
| Ephemeroptera %                 | 18.05 |
| Scraper Taxa                    | 0     |
| % Climbor                       | 2.04  |
| Town List                       | 2.94  |
| Tubificinae                     | 1     |
| Parametriocnemus                | 2     |
| Polypedilum                     | 3     |
| Prosimulium                     | 4     |
| Rheocricotopus                  | 1     |
| Simuliidae                      | 7     |
| Hydroporinae                    | 1     |
| Stegopterna                     | 2     |
| Orthocladius/Cricotopus         | 10    |
| Nemata                          | 1     |
| Simulium                        | 17    |
| Diplocladius                    | 14    |
| Amphinemura                     | 7     |
| Orthocladius                    | 1     |
| Cnrysops<br>Eulriofforialla     | 1     |
| Hevetoma                        | 1     |
| Hydrobaenus                     | 19    |
| Isoperla                        | 1     |
| Limnodrilus                     | 1     |
| Nais                            | 3     |
| Neophylax                       | 2     |
| Ancyronyx                       | 1     |
|                                 |       |

| L HJURCHI HAUTHU   |                 |  |                    |
|--|-----------------|--|--------------------|
| EPA Rapid Bioassessment  |                 |  |                    |
| Bank Stability- Left Bank  | 6               | Pool Variability   | 9                  |
| Bank Stability- Right Bank   | 5               | Riparian Vegetative<br>Zone Width- Left Bank                       | 10                 |
| Channel Alteration   | 20              | Riparian Vegetative<br>Zone Width- Right Bank                      | 10                 |
| Channel Flow Status  | 12              | Sediment Deposition  | 6                  |
| Channel Sinuosity  | 6               | Vegetative Protection (Left Bank)                                  | 6                  |
| Epifaunal Substrate/Available Cover  | 14              | Vegetative Protection (Right Bank)                                 | 5                  |
| Pool Substrate Characterization  | 9               |  |                    |
|  |                 | EPA Habitat Score  | 118                |
|  |                 | EPA Narrative Ranking  | PS                 |
| Drainage area (acres)  | 842.7           | Instream Wood Debris   | 16                 |
| Drainage area (acres)  | 842 7           | Instream Wood Debris   | 16                 |
| Remoteness   | 8               | Bank Stability   | 11                 |
| Shading  | 100             |  |                    |
| -  |                 |  |                    |
| Epifaunal Substrate  | 9               | PHI Score  | 77.34              |
| Epifaunal Substrate<br>Instream Habitat  | 9<br>14         | PHI Score<br>PHI Narrative Ranking                                 | 77.34<br>PD        |
| Epifaunal Substrate<br>Instream Habitat<br><b>Water Chemistry</b>                            | 9<br>14         | PHI Score<br>PHI Narrative Ranking                                 | 77.34<br>PD        |
| Epifaunal Substrate<br>Instream Habitat<br><b>Water Chemistry</b><br>Dissolved Oxygen (mg/L) | 9<br>14<br>7.68 | PHI Score<br>PHI Narrative Ranking<br>Specific Conductance (µS/cm) | 77.34<br>PD<br>210 |

## **Geomorphic Assessments**

### **Rosgen Level II Classification Data**

## Drainage Area (mi<sup>2</sup>) Bankfull Width (ft) Mean Bankfull Depth (ft) Floodprone Width (ft) Entrenchment Ratio Width to Depth Ratio



#### \*Estimated

![](_page_179_Figure_9.jpeg)

**Total Individuals**
### **Cabin Branch Sampling Unit**



**Location/Site Access**: Located at 5727 Courtney Lane Latitude/Longitude: 38.78733/-76.67767

### Land Use Analysis:

| Land Use         | Acres | % Area |
|------------------|-------|--------|
| Pasture/Hay      | 2.2   | 5.4    |
| Residential 1/2- |       |        |
| acre             | 3.5   | 8.3    |
| Residential 2-   |       |        |
| acre             | 1.3   | 3.1    |
| Row Crops        | 7.6   | 18.1   |
| Woods            | 27.2  | 65.1   |
| Grand Total      | 41.7  | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 0.55       | 41.7       | 1.3        |

#### **Results:**

- Biological condition "Very Poor"
- Habitat scores "Non Supporting" and "Partially Degraded"
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality.
- Riparian features are intact, but bank, pool, and substrate features are marginal
- Sample is heavily dominated by midges (*Chaetocladius* and *Diplocladius*)
- Stream type was identified as an G5c, slope was 1.45 percent, and the median channel substrate was estimated as fine or medium sand
- This channel has poor bank conditions, and may be unstable. However, it has a small catchment and low imperviousness; factors that suggest low vulnerability to excessive hydrologic channel erosion.

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Determine need, feasibility of stormwater management on residential and agricultural lands upstream.

### 23-07

# **Cabin Branch Sampling Unit**

| IBI and Metric Scores               |           |
|-------------------------------------|-----------|
| Narrative Rating                    | Very Poor |
| Overall Index                       | 1.86      |
| Total Taxa Score                    | 3         |
| EPT Taxa Score                      | 3         |
| Ephemeroptera Taxa Score            | 1         |
| Intolerant Urban % Score            | 1         |
| Ephemeroptera % Score               | 1         |
| Scraper Taxa Score                  | 1         |
| % Climbers                          | 3         |
| <b>Calculated Metric Values</b>     |           |
| Total Taxa                          | 20        |
| EPT Taxa                            | 2         |
| Ephemeroptera Taxa                  | 0         |
| Intolerant Urban %                  | 3.96      |
| Ephemeroptera %                     | 0         |
| Scraper Taxa                        | 0         |
| % Climbers                          | 0.99      |
| Tava List                           |           |
| Rheocricotopus                      | 2         |
| Neophylax                           | 1         |
| Musculium/Sphaerium                 | 1         |
| Hydroporinae                        | 1         |
| Bezzia/Palpomvia                    | 1         |
| Veliidae                            | 1         |
| Tanytarsus                          | 1         |
| Pisidiidae                          | 6<br>47   |
| Caecidotea                          | 3         |
| Enchytraeidae                       | 1         |
| Limnodrilus                         | 5         |
| Krenopelopia<br>Ironoguia           | 1         |
| Diplocladius                        | 22        |
| Culicoides                          | 2         |
| Corynoneura                         | 1         |
| Orthocladius/Cricotopus<br>Pristina | 1         |
| Tistila                             | 1         |
|                                     |           |
|                                     |           |
|                                     |           |
|                                     |           |
|                                     |           |
|                                     |           |
|                                     |           |
|                                     |           |
|                                     |           |
|                                     |           |
|                                     |           |
|                                     |           |
|                                     |           |

| Physical Habitat   |                            |  |                              |
|--|----------------------------|--|------------------------------|
| EPA Rapid Bioassessment  |                            |  |                              |
| Bank Stability- Left Bank  | 4                          | Pool Variability   | 4                            |
| Bank Stability- Right Bank   | 5                          | Riparian Vegetative<br>Zone Width- Left Bank   | 1(                           |
| Channel Alteration   | 20                         | Zone Width- Right Bank   | 10                           |
| Channel Flow Status  | 8                          | Sediment Deposition  | ç                            |
| Channel Sinuosity  | 5                          | Vegetative Protection (Left Bank)  | 4                            |
| Epifaunal Substrate/Available Cover  | 5                          | Vegetative Protection (Right Bank)   | 4                            |
| Pool Substrate Characterization  | 6                          |  |                              |
|  |                            | EPA Habitat Score  | 95                           |
|  |                            | EPA Narrative Ranking  | NS                           |
| Maryland Biological Stream   | Survey                     | PHI  |                              |
| Drainage area (acres)  | 41.7                       | Instream Wood Debris   | ç                            |
| Drainage area (acres)<br>Remoteness  | 41.7<br>8                  | Instream Wood Debris<br>Bank Stability   | ç                            |
| Drainage area (acres)<br>Remoteness<br>Shading   | 41.7<br>8<br>100           | Instream Wood Debris<br>Bank Stability   | ç                            |
| Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate  | 41.7<br>8<br>100<br>3      | Instream Wood Debris<br>Bank Stability<br>PHI Score  | 9<br>9<br>71.63              |
| Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat  | 41.7<br>8<br>100<br>3<br>5 | Instream Wood Debris<br>Bank Stability<br>PHI Score<br>PHI Narrative Ranking                                 | 9<br>9<br>71.63<br>PE        |
| Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat<br><b>Water Chemistry</b>                            | 41.7<br>8<br>100<br>3<br>5 | Instream Wood Debris<br>Bank Stability<br>PHI Score<br>PHI Narrative Ranking                                 | 9<br>9<br>71.63<br>PE        |
| Drainage area (acres)<br>Remoteness<br>Shading<br>Epifaunal Substrate<br>Instream Habitat<br><b>Water Chemistry</b><br>Dissolved Oxygen (mg/L) | 41.7<br>8<br>100<br>3<br>5 | Instream Wood Debris<br>Bank Stability<br>PHI Score<br>PHI Narrative Ranking<br>Specific Conductance (µS/cm) | 9<br>9<br>71.63<br>PD<br>102 |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) |
|----------------------------------|
| Bankfull Width (ft)              |
| Mean Bankfull Depth (ft)         |
| Floodprone Width (ft)            |
| Entrenchment Ratio               |
| Width to Depth Ratio             |

|       | _                                       |       |
|-------|---|-------|
| 0.065 | Cross Sectional Area (ft <sup>2</sup> ) | 8.8   |
| 7.6   | Water Surface Slope (%)                 | 1.45  |
| 1.2   | Sinuosity                               | 1.1   |
| 11.8  | D50 (mm)                                | 0.25* |
| 1.6   | Adjustments?                            | ↓ER   |
| 6.5   | Rosgen Stream Type                      | G5c   |
|       |   |       |

#### \*Estimated



**Total Individuals** 

101

### **Cabin Branch Sampling Unit**



**Location/Site Access**: formerly Talbot Road Crossing Latitude/Longitude: 38.7744/-76.65144

#### Land Use Analysis:

| Land Use         | Acres  | % Area |
|------------------|--------|--------|
| Commercial       | 5.0    | 0.2    |
| Open Space       | 57.5   | 2.5    |
| Pasture/Hay      | 242.9  | 10.5   |
| Residential 1/2- |        |        |
| acre             | 122.3  | 5.3    |
| Residential 1-   |        |        |
| acre             | 162.2  | 7.0    |
| Residential 2-   |        |        |
| acre             | 142.7  | 6.2    |
| Row Crops        | 565.8  | 24.5   |
| Transportation   | 33.8   | 1.5    |
| Water            | 1.7    | 0.1    |
| Woods            | 971.2  | 42.1   |
| Grand Total      | 2305.2 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 76.7       | 2305.2     | 3.3        |

### **Results:**

- Biological condition "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Biological community observed is trending toward more than expected impairment based on the observed habitat quality.
- All habitat features show some signs of degradation, particularly sediment deposition
- Sample is heavily dominated by midges (*Orthocladius/Cricotopus*, *Diplocladius*, and Hydrobaenus) and worms (*Nais*)
- Stream type was identified as an E5, slope was 0.188 percent, and the median channel substrate was medium sand
- Bank and substrate conditions in this channel indicate apparent instability

- Protect the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Investigate need, feasibility of stormwater management on agricultural, residential lands upstream of site.

### 23-09

## **Cabin Branch Sampling Unit**

| IBI and Metric Scores             |      |
|-----------------------------------|------|
| Narrative Rating                  | Poor |
| Overall Index                     | 2.43 |
| Total Taxa Score                  | 3    |
| EPT Taxa Score                    | 1    |
| Ephemeroptera Taxa Score          | 3    |
| Intolerant Urban % Score          | 1    |
| Ephemeroptera % Score             | 3    |
| Scraper Taxa Score                | 3    |
| % Climbers                        | 3    |
| Calculated Metric Values          |      |
| Total Taxa                        | 20   |
| EPT Taxa                          | 1    |
| Ephemeroptera Taxa                | 1    |
| Intolerant Urban %                | 1.68 |
| Ephemeroptera %                   | 0.84 |
| Scraper Taxa                      | 1    |
| % Climbers                        | 1.68 |
| Taxa List                         |      |
| Orthocladius/Cricotopus           | 27   |
| Prosimulium                       | 1    |
| Simulium                          | 3    |
| Stictochironomus                  | 4    |
| Tubificinae                       | 3    |
| Menetus                           | 1    |
| Thienemannimyia genus group       | 2    |
| Nais                              | 24   |
| Hydroporinae<br>En shattas side s | 1    |
| Balymadilum                       | 1    |
| Limpodrilus                       | 2    |
| Destides                          | 2    |
| Corumonouro                       | 1    |
| Culiacidas                        | 1    |
| Diplocladius                      | 22   |
| Fukiefferiella                    | 1    |
| Gammarus                          | 3    |
| Hydrobaenus                       | 18   |
| Ablabesmyia                       | 1    |
| <b>J</b> ···                      |      |

| <u>Physical Habitat</u>   |  |
|---------------------------|--|
| EPA Rapid Bioassessment   |  |
| Bank Stability- Left Bank |  |

| ··· ··· ··· ··                      | -  |
|-------------------------------------|----|
| Bank Stability- Right Bank          | 6  |
| Channel Alteration                  | 13 |
| Channel Flow Status                 | 11 |
| Channel Sinuosity                   | 6  |
| Epifaunal Substrate/Available Cover | 14 |
| Pool Substrate Characterization     | 9  |

| EPA Narrative Ranking              | PS  |
|------------------------------------|-----|
| EPA Habitat Score                  | 104 |
| Vegetative Protection (Right Bank) | 6   |
| vegetative Protection (Left Bank)  | 4   |
| Sediment Deposition                | 6   |
| Zone Width- Right Bank             | 8   |
| Riparian Vegetative                | 0   |
| Zone Width- Left Bank              | 8   |
| Riparian Vegetative                |     |
| Pool Variability                   | 9   |

#### Maryland Biological Stream Survey PHI

| Drainage area (acres)   | 2305.2 | Instream Wood Debris         | 10    |
|-------------------------|--------|------------------------------|-------|
| Remoteness              | 10     | Bank Stability               | 10    |
| Shading                 | 85     |                              |       |
| Epifaunal Substrate     | 9      | PHI Score                    | 68.32 |
| Instream Habitat        | 14     | PHI Narrative Ranking        | PD    |
| Water Chemistry         |        |                              |       |
| Dissolved Oxygen (mg/L) | 13.28  | Specific Conductance (µS/cm) | 154   |
| pH                      | 6.78   | Temperature (°C)             | 9.54  |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

Drainage Area (mi<sup>2</sup>) Bankfull Width (ft) Mean Bankfull Depth (ft) Floodprone Width (ft) Entrenchment Ratio Width to Depth Ratio

| 3.0  | Cross Sectional Area (ft <sup>2</sup> ) | 30.6  |
|------|---|-------|
| 13.1 | Water Surface Slope (%)                 | 0.188 |
| 2.3  | Sinuosity                               | 1.0   |
| 30   | D50 (mm)                                | 0.36  |
| 2.3  | Adjustments?                            | ↓ER   |
| 5.6  | Rosgen Stream Type                      | E5    |

\*Estimated



**Total Individuals** 

### **Cabin Branch Sampling Unit**



**Location/Site Access**: Located at 6207 Mallard Court, 0.17 miles East Latitude/Longitude: 38.75679-76.66938

#### Land Use Analysis:

| Land Has             | A       | 0/ 1   |
|----------------------|---------|--------|
| Land Use             | Acres   | % Area |
| Commercial           | 90.0    | 1.0    |
| Industrial           | 8.4     | 0.1    |
| Open Space           | 412.4   | 4.5    |
| Open Wetland         | 4.0     | 0.0    |
| Pasture/Hay          | 745.9   | 8.1    |
| Residential 1-acre   | 681.5   | 7.4    |
| Residential 1/8-acre | 57.7    | 0.6    |
| Residential 1-acre   | 655.3   | 7.1    |
| Residential 2-acre   | 245.2   | 3.7    |
| Row Crops            | 2097.5  | 22.7   |
| Transportation       | 197.2   | 2.1    |
| Water                | 9.1     | 0.1    |
| Woods                | 3928.7  | 42.6   |
| Unknown              | 1574.5  | 17.1   |
| Grand Total          | 9232.8* | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 464.3      | 9232.8*    | 5.0        |

\* Land use statistics are based on the portion of the catchment that lies within Anne Arundel County

#### **Results:**

- Biological condition "Poor"
- Habitat scores "Supporting" and "Degraded"
- Habitat assessment results were mixed for this site, but biological community observed is trending toward more than expected impairment based on the observed habitat quality.
- Substrate features received the worst ratings in both habitat assessments.
- Sample is heavily dominated by worms (*Tubificinae*) and various midges
- No cross sectional profile was done due to depth, turbidity and beaver modifications.

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Determine need, feasibility of stormwater management on developed and agricultural lands, coordinating with Calvert County as necessary.

## 23-10

## **Cabin Branch Sampling Unit**

| Narrative RatingOverall IndexTotal Taxa ScoreEPT Taxa ScoreEphemeroptera Taxa ScoreIntolerant Urban % ScoreEphemeroptera % ScoreScraper Taxa Score% ClimbersCalculated Metric ValuesTotal TaxaEPT TaxaEphemeroptera TaxaIntolerant Urban %Ephemeroptera TaxaØ ClimbersTotal TaxaEPT TaxaEphemeroptera TaxaIntolerant Urban %Ephemeroptera %Scraper Taxa% ClimbersTaxa ListOrthocladius/CricotopusProcladiusParatanytarsusParatendipesPhaenopsectra | Poor<br>2.14<br>5<br>1<br>1<br>1<br>1<br>1<br>1<br>5<br>26<br>0<br>0<br>9.26<br>0             |
|--|---|
| Overall IndexTotal Taxa ScoreEPT Taxa ScoreEphemeroptera Taxa ScoreIntolerant Urban % ScoreScraper Taxa Score% ClimbersCalculated Metric ValuesTotal TaxaEPT TaxaEphemeroptera TaxaIntolerant Urban %Scraper Taxa Score% ClimbersData TaxaEPT TaxaEphemeroptera TaxaIntolerant Urban %Ephemeroptera %Scraper Taxa% ClimbersTaxa ListOrthocladius/CricotopusProcladiusParatanytarsusParatendipesPhaenopsectra                                       | 2.14<br>5<br>1<br>1<br>1<br>1<br>1<br>5<br>26<br>0<br>0<br>9.26<br>0                          |
| Total Taxa Score<br>EPT Taxa Score<br>Ephemeroptera Taxa Score<br>Intolerant Urban % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br><b>Calculated Metric Values</b><br>Total Taxa<br>EPT Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Orthocladius/Cricotopus<br>Procladius<br>Paratanytarsus<br>Paratendipes<br>Phaenopsectra      | 5<br>1<br>1<br>1<br>1<br>1<br>5<br>26<br>0<br>0<br>9.26<br>0                                  |
| EPT Taxa Score<br>Ephemeroptera Taxa Score<br>Intolerant Urban % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values<br>Total Taxa<br>EPT Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Orthocladius/Cricotopus<br>Procladius<br>Paratanytarsus<br>Paratendipes<br>Phaenopsectra  | $ \begin{array}{c} 1 \\ 1 \\ 1 \\ 1 \\ 5 \\ \hline 26 \\ 0 \\ 9.26 \\ 0 \\ 0 \\ \end{array} $ |
| Ephemeroptera Taxa Score<br>Intolerant Urban % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br><b>Calculated Metric Values</b><br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Orthocladius/Cricotopus<br>Procladius<br>Paratanytarsus<br>Paratendipes<br>Phaenopsectra  | $ \begin{array}{c} 1 \\ 1 \\ 1 \\ 5 \\ \hline 26 \\ 0 \\ 9.26 \\ 0 \\ 0 \\ \end{array} $      |
| Intolerant Urban % Score<br>Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values<br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Orthocladius/Cricotopus<br>Procladius<br>Paratanytarsus<br>Paratendipes<br>Phaenopsectra  | 1<br>1<br>5<br>26<br>0<br>0<br>9.26<br>0  |
| Ephemeroptera % Score<br>Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values<br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Orthocladius/Cricotopus<br>Procladius<br>Paratanytarsus<br>Paratendipes<br>Phaenopsectra  | 1<br>1<br>5<br>26<br>0<br>0<br>9.26<br>0  |
| Scraper Taxa Score<br>% Climbers<br>Calculated Metric Values<br>Total Taxa<br>EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br>Taxa List<br>Orthocladius/Cricotopus<br>Procladius<br>Paratanytarsus<br>Paratendipes<br>Phaenopsectra   | 1<br>5<br>26<br>0<br>0<br>9.26<br>0   |
| % Climbers         Calculated Metric Values         Total Taxa         EPT Taxa         Ephemeroptera Taxa         Intolerant Urban %         Ephemeroptera %         Scraper Taxa         % Climbers         Taxa List         Orthocladius/Cricotopus         Procladius         Paratanytarsus         Paratendipes         Phaenopsectra   | 26<br>0<br>9.26<br>0  |
| Calculated Metric Values         Total Taxa         EPT Taxa         Ephemeroptera Taxa         Intolerant Urban %         Ephemeroptera %         Scraper Taxa         % Climbers         Taxa List         Orthocladius/Cricotopus         Procladius         Paratanytarsus         Paratendipes         Phaenopsectra  | 26<br>0<br>9.26<br>0  |
| Carculated Metric VallesTotal TaxaEPT TaxaEphemeroptera TaxaIntolerant Urban %Ephemeroptera %Scraper Taxa% ClimbersTaxa ListOrthocladius/CricotopusProcladiusParatanytarsusParatendipesPhaenopsectra   | 26<br>0<br>9.26<br>0  |
| EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Orthocladius/Cricotopus<br>Procladius<br>Paratanytarsus<br>Paratendipes<br>Phaenopsectra  | 26<br>0<br>9.26<br>0  |
| EPT Taxa<br>Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Orthocladius/Cricotopus<br>Procladius<br>Paratanytarsus<br>Paratendipes<br>Phaenopsectra  | 0<br>0<br>9.26<br>0   |
| Ephemeroptera Taxa<br>Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Orthocladius/Cricotopus<br>Procladius<br>Paratanytarsus<br>Paratendipes<br>Phaenopsectra  | 0<br>9.26<br>0  |
| Intolerant Urban %<br>Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Orthocladius/Cricotopus<br>Procladius<br>Paratanytarsus<br>Paratendipes<br>Phaenopsectra  | 9.26<br>0   |
| Ephemeroptera %<br>Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Orthocladius/Cricotopus<br>Procladius<br>Paratanytarsus<br>Paratendipes<br>Phaenopsectra  | 0   |
| Scraper Taxa<br>% Climbers<br><b>Taxa List</b><br>Orthocladius/Cricotopus<br>Procladius<br>Paratanytarsus<br>Paratendipes<br>Phaenopsectra   | 0   |
| % Climbers<br><b>Taxa List</b><br>Orthocladius/Cricotopus<br>Procladius<br>Paratanytarsus<br>Paratendipes<br>Phaenopsectra   | 0   |
| Taxa List<br>Orthocladius/Cricotopus<br>Procladius<br>Paratanytarsus<br>Paratendipes<br>Phaenopsectra  | 9.26  |
| Orthocladius/Cricotopus<br>Procladius<br>Paratanytarsus<br>Paratendipes<br>Phaenopsectra   |   |
| Procladius<br>Paratanytarsus<br>Paratendipes<br>Phaenopsectra  | 2   |
| Paratanytarsus<br>Paratendipes<br>Phaenopsectra  | 1   |
| Paratendipes<br>Phaenopsectra  | 1   |
| Phaenopsectra  | 1   |
| D I I'I  | 3   |
| Polypedilum  | 8   |
| Simulum  | 2<br>1  |
| Spineronnas<br>Stanoshironomus   | 1   |
| Topytorsus   | 1   |
| Quistradrilus  | 2   |
| Hydrobiidae  | 1   |
| Tubificinae  | 38  |
| Ceratopogon  | 1   |
| Limnodrilus  | 3   |
| Nais   | 5   |
| Endochironomus   | 2   |
| Cladopelma   | 6   |
| Cryptotendipes   | 1   |
| Culicoides   | 6   |
| Dicrotendipes  | 3   |
| Dubiraphia   | 1   |
| Gammarus   | 4   |
| Caecidotea   | 8   |
| Ilyodrilus   | 5   |
| Ancyronyx  | 1   |
| Απογιοπγχ  | 1   |

| Total Individuals | Fotal | ividuals |
|-------------------|-------|----------|
|-------------------|-------|----------|

| <u>Physical Habitat</u>             |          |  |       |
|-------------------------------------|----------|--|-------|
| EPA Rapid Bioassessment             |          |  |       |
| Bank Stability- Left Bank           | 9        | Pool Variability                             | 13    |
| Bank Stability- Right Bank          | 9        | Riparian Vegetative<br>Zone Width- Left Bank | 10    |
| Channel Alteration                  | 20       | Zone Width- Right Bank                       | 10    |
| Channel Flow Status                 | 18       | Sediment Deposition                          | 7     |
| Channel Sinuosity                   | 5        | Vegetative Protection (Left Bank)            | 9     |
| Epifaunal Substrate/Available Cover | 16       | Vegetative Protection (Right Bank)           | 9     |
| Pool Substrate Characterization     | 13       |  |       |
|                                     |          | EPA Habitat Score                            | 148   |
|                                     |          | EPA Narrative Ranking                        | S     |
| Maryland Biological Stream          | Survey P | HI   |       |
| Drainage area (acres)               | 10807.3  | Instream Wood Debris                         | 13    |
| Remoteness                          | 14       | Bank Stability                               | 18    |
| Shading                             | 20       |  |       |
| Epifaunal Substrate                 | 6        | PHI Score                                    | 58.58 |
| Instream Habitat                    | 16       | PHI Narrative Ranking                        | D     |
| Water Chemistry                     |          |  |       |
| Dissolved Oxygen (mg/L)             | 9.04     | Specific Conductance (µS/cm)                 | 173   |
| рН                                  | 6.7      | Temperature (°C)                             | 9.51  |

### **Geomorphic Assessments**

Geomorphic analysis was not completed at this site due to water depth, turbidity, and beaver modifications.

## 23-13A

### **Cabin Branch Sampling Unit**



**Location/Site Access**: Located at Pindell Bluff Trail 0.3 miles S/SW to site Latitude/Longitude: 38.77251/-76.69601

#### Land Use Analysis:

| Land Use         | Acres | % Area |
|------------------|-------|--------|
| Open Space       | 1.3   | 0.3    |
| Pasture/Hay      | 6.6   | 1.5    |
| Residential 1/2- |       |        |
| acre             | 3.2   | 0.7    |
| Residential 1-   |       |        |
| acre             | 2.5   | 0.6    |
| Residential 2-   |       |        |
| acre             | 38.4  | 8.8    |
| Row Crops        | 99.0  | 22.7   |
| Transportation   | 9.0   | 2.1    |
| Woods            | 275.3 | 63.3   |
| Grand Total      | 435.2 | 100.0  |

| Impervious | Total Area | %          |
|------------|------------|------------|
| (acres)    | Above site | Impervious |
| 8.6        | 435.2      | 2.0        |

#### **Results:**

- Biological condition "Fair"
- Habitat scores "Supporting" and "Partially Degraded"
- Biological health matches observed habitat quality.
- Riparian and bank features are largely intact, but substrate features are marginal
- Sample is diverse, but dominated by midges (*Polypedilum*) and amphipods (*Gammarus*)
- Stream type was identified as an E5, slope was 0.067 percent, and the median channel substrate was fine sand
- This channel has sub-optimal bank conditions, but predominantly fine sediments and marginal pool conditions

- Maintain protection of the riparian area.
- Plan for hydrologic stability with potential increases in imperviousness.
- Investigate sources of deposited sediments
- Investigate need, feasibility of stormwater management BMP installation to protect current high quality biological community.

## 23-13A

## **Cabin Branch Sampling Unit**

9

10

10

9

7

7

128 S

| IBI and Metric Scores        |        |
|------------------------------|--------|
| Narrative Rating             | Fair   |
| Overall Index                | 3.29   |
| Total Taxa Score             | 5      |
| EPT Taxa Score               | 3      |
| Ephemeroptera Taxa Score     | 3      |
| Intolerant Urban % Score     | 1      |
| Ephemeroptera % Score        | 3      |
| Scraper Taxa Score           | 3      |
| % Climbers                   | 5      |
| Calculated Metric values     | 29     |
| EPT Taxa                     | 30     |
| Ephemeroptera Taxa           | 1      |
| Intolerant Urban %           | 8.74   |
| Ephemeroptera %              | 0.97   |
| Scraper Taxa                 | 1      |
| % Climbers                   | 20.39  |
|                              |        |
| Taxa List                    | ~      |
| Zavrelimyia                  | 2      |
| Orthocladius/Cricotopus      | 1      |
| Paraphaenocladius            | 1      |
| Paratendipes                 | 4      |
| Polypedilum                  | 20     |
| Pristina                     | 1      |
| Pseudorthocladius            | 4      |
| Orthocladius                 | 4      |
| Rheosmittia                  | 1      |
| Pisidiidae<br>Stempellinella | 1      |
| Orthocladiinae               | 1      |
| Tvetenia                     | 2      |
| Pseudosmittia                | 2      |
| Bezzia/Palpomyia             | 2      |
| Thienemannimyia genus group  | 1      |
| Synurella                    | 1      |
| Ceratopogon                  | 1      |
| Ormosia                      | 1      |
| Acerpenna                    | 1      |
| Amphinemura                  | 2      |
| Enchytraeidae                | 2      |
| Chrysops                     | 1      |
| Corynoneura                  | 1      |
| Culicoides                   | 1      |
| Dintera                      | 1      |
| Ferrissia                    | 1      |
| Gammarus                     | 20     |
| Haploperla                   | 1      |
| Hexatoma                     | 1      |
| Hydrobaenus                  | 3      |
| Dipiocladius                 | 2      |
| rvars<br>Caecidotea          | 2<br>1 |
| Limnophyes                   | 3      |
|                              | -      |
| Total Individuals            | 103    |
|                              |        |

| <u>Physical Habitat</u><br>EPA Rapid Bioassessment |    |   |
|--|----|---|
| Bank Stability- Left Bank                          | 8  | Pool Variability                              |
| Bank Stability- Right Bank                         | 8  | Riparian Vegetative<br>Zone Width- Left Bank  |
| Channel Alteration                                 | 20 | Riparian Vegetative<br>Zone Width- Right Bank |
| Channel Flow Status                                | 16 | Sediment Deposition                           |
| Channel Sinuosity                                  | 10 | Vegetative Protection (Left Bank)             |
| Epifaunal Substrate/Available Cover                | 7  | Vegetative Protection (Right Bank)            |
| Pool Substrate Characterization                    | 7  |   |
|  |    | EPA Habitat Score                             |
|  |    | EPA Narrative Ranking                         |

#### Maryland Biological Stream Survey PHI

| •                          | 0                    | •     |                              |        |
|----------------------------|----------------------|-------|------------------------------|--------|
| Drainage area (a           | cres)                | 435.2 | Instream Wood Debris         | 3      |
| Remoteness                 |                      | 14    | Bank Stability               | 18     |
| Shading                    |                      | 95    |                              |        |
| Epifaunal Subst            | rate                 | 3     | PHI Score                    | 71.553 |
| Instream Habita            | t                    | 7     | PHI Narrative Ranking        | PD     |
| Water Ch<br>Dissolved Oxyg | emistry<br>en (mg/L) | 11.67 | Specific Conductance (µS/cm) | 97     |
| pН                         |                      | 7.01  | Temperature (°C)             | 9.15   |

### **Geomorphic Assessments**

#### **Rosgen Level II Classification Data**

| Drainage Area (mi <sup>2</sup> ) | 0.6 |
|----------------------------------|-----|
| Bankfull Width (ft)              | 9.  |
| Mean Bankfull Depth (ft)         | 1.  |
| Floodprone Width (ft)            | 30  |
| Entrenchment Ratio               | 37. |
| Width to Depth Ratio             | 6.  |
|                                  |     |

| .5  | Rosgen Stream Type                      | E5    |
|-----|---|-------|
| .5* | Adjustments?                            | ↑Sin  |
| 0*  | D50 (mm)                                | 0.22  |
| .2  | Sinuosity                               | 1.3   |
| .8  | Water Surface Slope (%)                 | 0.067 |
| 580 | Cross Sectional Area (ft <sup>2</sup> ) | 9.8   |

#### \*Estimated

