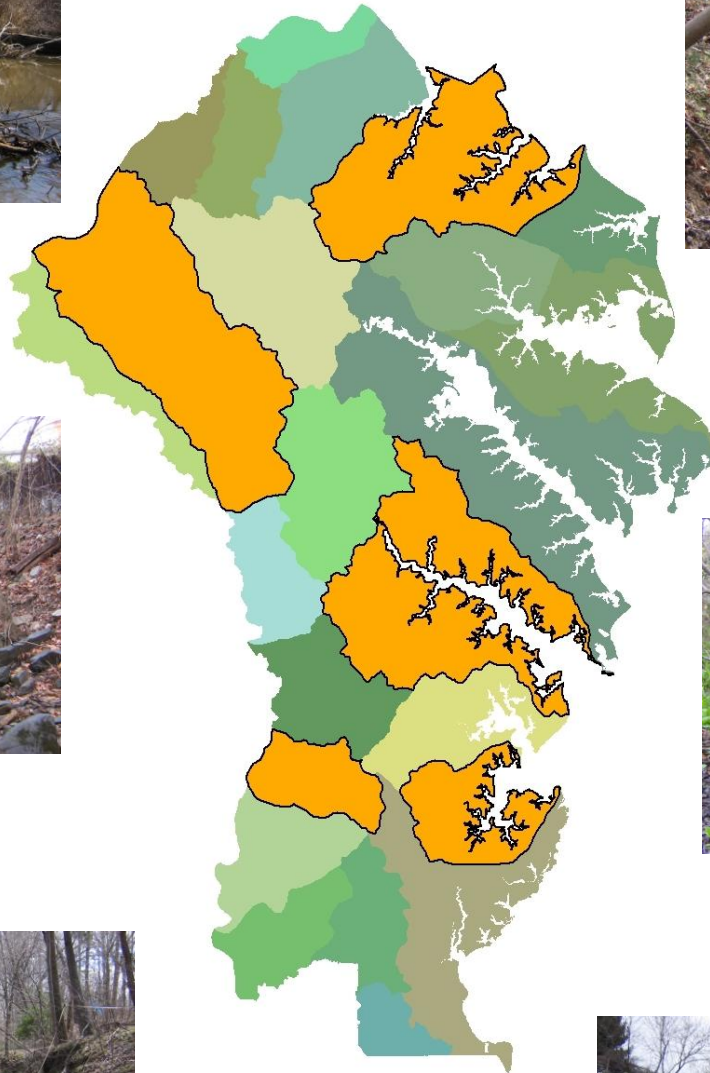




Anne Arundel County, Maryland
Department of Public Works
Watershed, Ecosystem, and Restoration Services

Aquatic Biological Assessment of the Watersheds of Anne Arundel County, Maryland: 2009



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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 watershed support of 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 2009 partially fulfills the goal of County-wide stream assessment. The PSUs include Marley Creek, Lower North River, West River, Little Patuxent River, and Rock 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 subwatershed, as well as the extent of physical habitat degradation. For the PSUs sampled in 2009, 2% of the of the B-IBI scores indicated “Good” biological conditions and 26% indicated “Fair” conditions, while 72% of the streams were rated as either “Poor” or “Very Poor”. Habitat measures using the RBP method indicated “Supporting,” “Partially Supporting,” and “Non Supporting” conditions in 18%, 52%, and 30% of sites, respectively. The PHI indicated “Minimally Degraded,” “Partially Degraded,” and “Degraded,” and “Severely Degraded” conditions in 8%, 46%, 34%, and 12% 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 normally observed ranges. A mix of stable and unstable channel types were observed during this assessment. Twenty-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 (8%), C type (12%) and F type (10%) 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. Degradation of water quality, rather than physical habitat, is likely affecting biota at a minimum of 26% 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 indirectly, eventually discharge 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 rates of landscape conversion, new and intensifying point and nonpoint sources of pollutants, and multiple other sources of stressors to environmental conditions.

Ecological restoration is the elimination or buffering of stressors and stressor sources, *and* confirmation of effectiveness based on whether there is positive change in biological conditions. Further, meaningful change is most 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. It is impossible to know all stressor sources, and 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, Anne Arundel County began a five-year, 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 locating, installation, and evaluation (Stribling et al. 2001); stormwater discharge permits; contributing to restoration initiatives (such as DNR's Watershed Restoration Action Strategy [WRAS]); and guidelines for Low Impact Development [LID, PG County 2000).

The purpose of this report is to present sampling, analysis, and assessment results for the first year (2009) of the second round of biological monitoring and assessment for Anne Arundel County. Areas sampled for this effort include the Marley Creek (05), Lower North River (12), West River (14), Little Patuxent River (17), and Rock Branch (20) 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 visual-assessed at each sampling location (Barbour et al. 1999, Kazyak 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 Marley Creek, Lower North River, West River, Little Patuxent River, and Rock 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 1st, 2nd, and 3rd 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.

For 2009, 10 randomly-selected sites were chosen from each PSU (Marley Creek [5], Lower North River [12], West River [14], Little Patuxent River [17], and Rock Branch [20]) 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. At the duplicate sites, only biology, chemistry, and physical habitat data were collected.

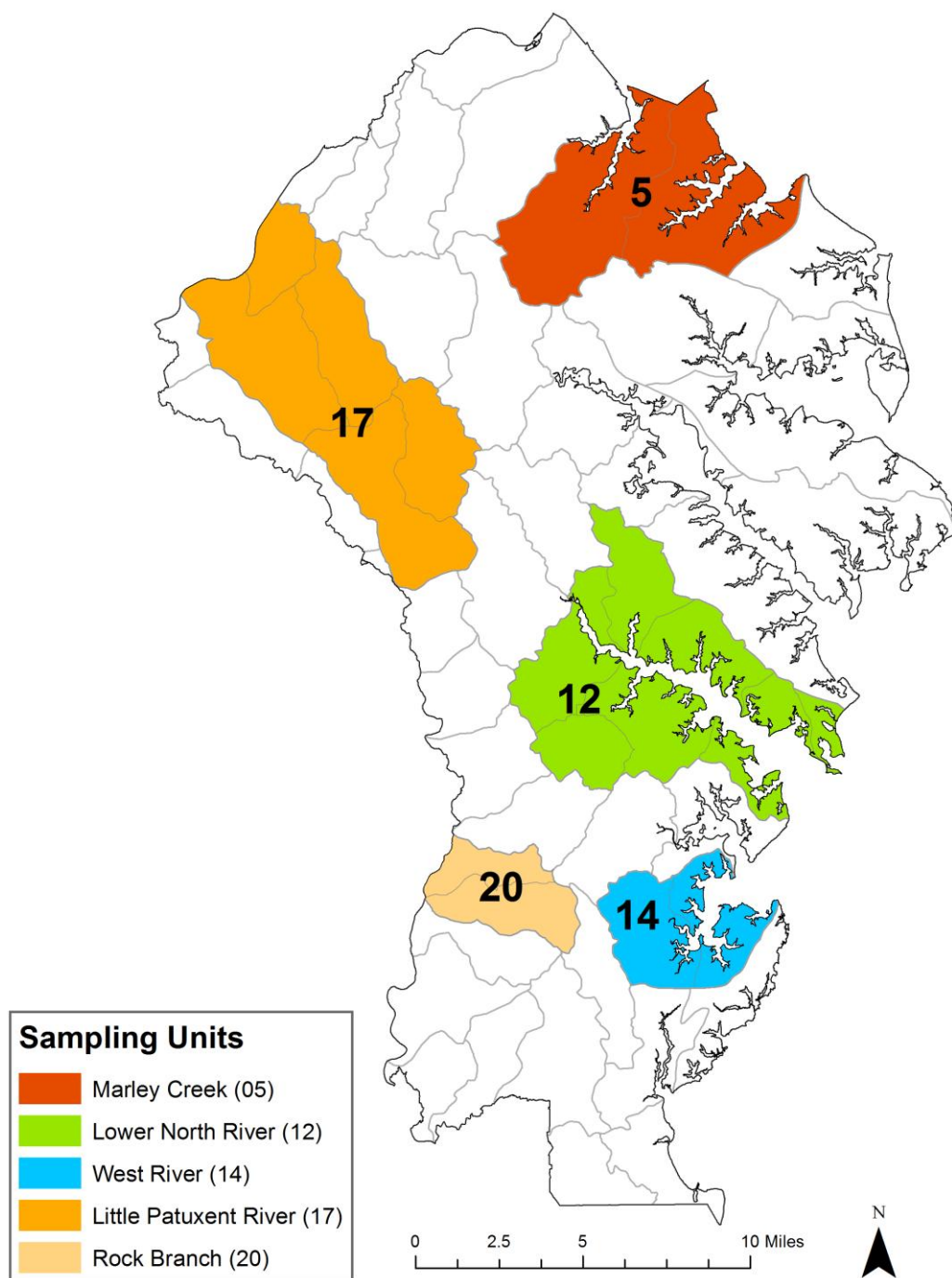


Figure 1. Anne Arundel County, Maryland. Sampling units assessed for the first year of the second round of the County's monitoring program (2009). Numbers are associated with the subwatershed framework of the monitoring design.

Alternate Sites

In addition to the ten randomly-selected primary sites per PSU, 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 2009 sampling period, it was necessary to sample 15 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 mid-point 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. Data sheets are included in **Appendix A**.

Benthic Sampling and Processing

Benthic macroinvertebrates were collected over a 75-meter reach by sampling approximately 20 ft² 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 chain-of-custody forms and transported to the laboratory for sorting.

Table 1. Alternate sites sampled.

Original Site	Alternate Site	Reason
R2-05-06	R2-05-12A	Unsampleable, mostly piped.
R2-05-11A	N/A	Dry stream.
R2-12-05	R2-12-11A	Unsampleable, impounded wetlands.
R2-12-09	R2-12-12A	Landowner denial.
R2-12-10	R2-12-13A	Site overlapped with R2-12-01.
R2-14-01	R2-14-13A	No landowner permission.
R2-14-02	R2-14-14A	No landowner permission.
R2-14-03	R2-14-15A	No landowner permission.
R2-14-09	R2-14-16A	Landowner denial.
R2-14-11A	N/A	Dry streambed.
R2-17-07	R2-17-11A	Gun range, safety issues.
R2-17-08	R2-17-12A	Gun range, safety issues.
R2-20-02	R2-20-11A	Landowner denial.
R2-20-05	R2-20-12A	Landowner denial.
R2-20-06	R2-20-13A	Overlapped with R2-20-01.
R2-20-09	R2-20-14A	Landowner denial.
R2-20-10	R2-20-17A	Landowner denial.
R2-20-15A	N/A	No landowner permission.
R2-20-16A	N/A	Landowner denial.

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 cm x 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 genus-group, subfamily, or family. 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 75-m 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 estimated. However, a pebble count was performed at every fifth site.

Channel cross-sectional surveys were done to provide a coarse characterization of channel cross-sectional 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 ½-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_{bkf}) – the mean depth of the bankfull channel
- Bankfull Cross-Sectional Area (A_{bkf}) – the product of bankfull depth and bankfull mean depth
- Maximum Depth (d_{mbkf}) – 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 Flood-prone Area (W_{fpa}) – 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 and for the drainage area upstream of each sampling point from a countywide coverage. Additionally, shapefiles of impervious surfaces were 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 Physical Habitat 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.).

Table 3. MBSS PHI Scoring Ranges.

Score	Narrative
81-100	Minimally Degraded
66-80.9	Partially Degraded
51-65.9	Degraded
0-50.9	Severely Degraded

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 uses characteristics 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. 1999). In 2005, MBSS revised the B-IBI (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 calculated for each of 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 is 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 more sensitive species 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 by summing the seven metric scores for each site, and dividing by the number of metrics (7).

Table 4. MBSS BIBI Metrics.

Metric	Scoring Thresholds		
	1	3	5
Number of Taxa	< 14	$\geq 14 < 22$	≥ 22
Number of EPT Taxa	< 2	$\geq 2 < 5$	≥ 5
Number of Ephemeroptera Taxa	< 1	$\geq 1 < 2$	≥ 2
Percent Intolerant to Urban	<10	$\geq 10 < 28$	≥ 28
Percent Ephemeroptera	< 0.8	$\geq 0.8 < 11$	≥ 11
Number of Scraper Taxa	< 1	$\geq 1 < 2$	≥ 2
Percent Climbers	< 0.9	$\geq 0.9 < 8$	≥ 8

From: Southerland et al. 2005

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. Composite scores for primary sampling units were presented as means plus/minus a single standard deviation ($\bar{x} \pm 1$ s.d.). Finally, mean Round 1 and Round 2 PSU BIBIs were compared to each other using statistical methods described in Roth et al. (2005).

Table 5. MBSS BIBI (2005) Scoring.

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

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 ($\bar{x} \pm 1$ s.d.).

Table 6. Code of Maryland (COMAR) Water Quality Standards.

Parameter	Standard
pH (S. U.)	6.5 to 8.5
Dissolved Oxygen (mg/L)	Minimum of 5 mg/L
Conductivity (µS/cm)	[No state standard]
Temperature (°C)	Maximum of 32°C (90°F) or ambient temperature, 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 field determined bankfull 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 classification methodology, 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. E 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. The D type is typically found in broad alluvial valleys comprised of materials ranging from cobbles to clay soils and is usually considered an unstable stream type. The DA type is an equilibrium channel that is best described as a stream-wetland complex found in broad, unconfined valleys. These stream types are very uncommon in the mid-Atlantic and are very rare in Anne Arundel County.

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 an unequal variance *t*-test procedure (Ruxton 2006) to compare the mean values of width to depth, entrenchment, and

sinuosity of the study group to the reference group. On occasion, for other stream types, a single sample t-test was performed comparing the mean values of observed for a given stream type to the mean values for that type reported in Rosgen (1998).

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 cross sections. Many of the 75-meter reaches assessed in this study did not contain well defined 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 84th percentile particle size, or D_{84} , 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 results with statistically known uncertainty. **Table 7** presents biological and habitat conditions for each PSU.

Biological Assessment Summary

Overall, the BIBI scores throughout the sampling units were variable, with a little less than three-quarters of the sites (72%) falling within the “Poor” (60%) and “Very Poor” (12%) categories (**Figure 2**). Twenty-six 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 “Poor” category (**Table 7**). West River and Rock Branch (PSU 14 and 20, respectively) had the highest mean B-IBI scores, 2.89 and 3.03 respectively. Marley Creek, and the Lower North and Little Patuxent Rivers had the lowest scores, ranging from 1.83-2.60. 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.

Table 7. Summary of BIBI and habitat scores across sampling units.

<i>Primary Sampling Unit¹</i>	<i>Average BIBI Score \pmSD / Condition Narrative</i>	<i>Average EPA RBP Habitat Score \pmSD / Condition Narrative</i>	<i>Average MBSS PHI Score \pmSD / Condition Narrative</i>
Marley Creek	1.83 \pm 0.47 Very Poor	103.0 \pm 30.2 Partially Supporting	60.5 \pm 12.0 Degraded
Lower North River	2.60 \pm 0.59 Poor	110.0 \pm 16.4 Partially Supporting	66.3 \pm 10.8 Partially Degraded
West River	2.89 \pm 0.53 Poor	108.2 \pm 9.3 Partially Supporting	67.3 \pm 12.8 Partially Degraded
Little Patuxent River	2.34 \pm 0.27 Poor	113.5 \pm 18.9 Partially Supporting	67.0 \pm 12.4 Partially Degraded
Rock Branch	3.03 \pm 0.74 Fair	105.4 \pm 18.1 Partially Supporting	69.5 \pm 10.3 Partially Degraded

N = 10 for each unit.

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**). Eighteen percent of the sites had habitat quality considered capable of “Supporting” aquatic life uses (**Figure 3**). No sites sampled in 2009 had habitat conditions considered “Comparable” to reference conditions. Mean PHI values classified the Marley Creek PSU as “Degraded” while Lower North, West River, Little Patuxent, and Rock Branch were judged as “Partially Degraded” (**Table 7**). Over all PSUs, 8% 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 12.9°C, in Lower North River. Dissolved oxygen readings ranged from 10.6-11.3 mg/L. There is no state standard for conductivity, but Marley Creek exhibited the widest range of readings, from 322-8,313 μ S/cm. All of the remaining readings in the other PSU were <1,613 μ S/cm, the majority <300. All PSUs except Marley Creek had at least some sites with pH values less than 6.5. In the Lower North River, 60% of sites had pH values less than 6.5 while 80% of West River sites fell into this category. The most acidic reading by far (pH 3.7) came from an unnamed tributary to Rock Branch (R2-20-13A).

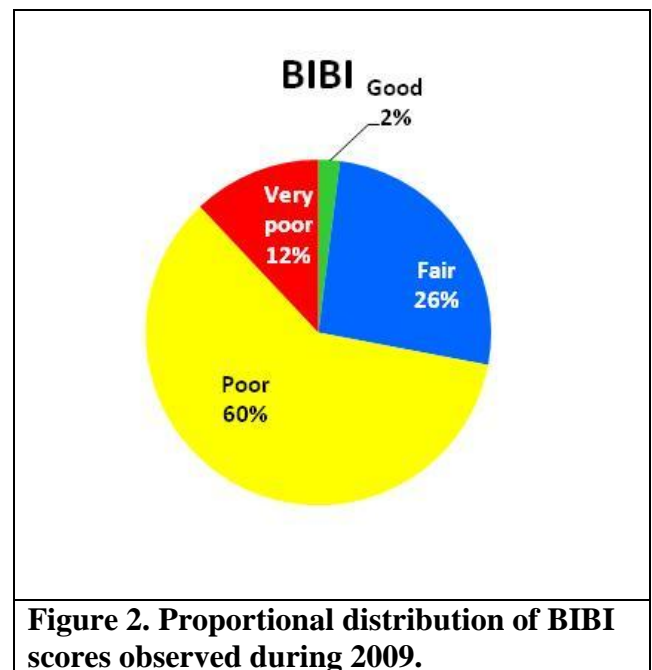
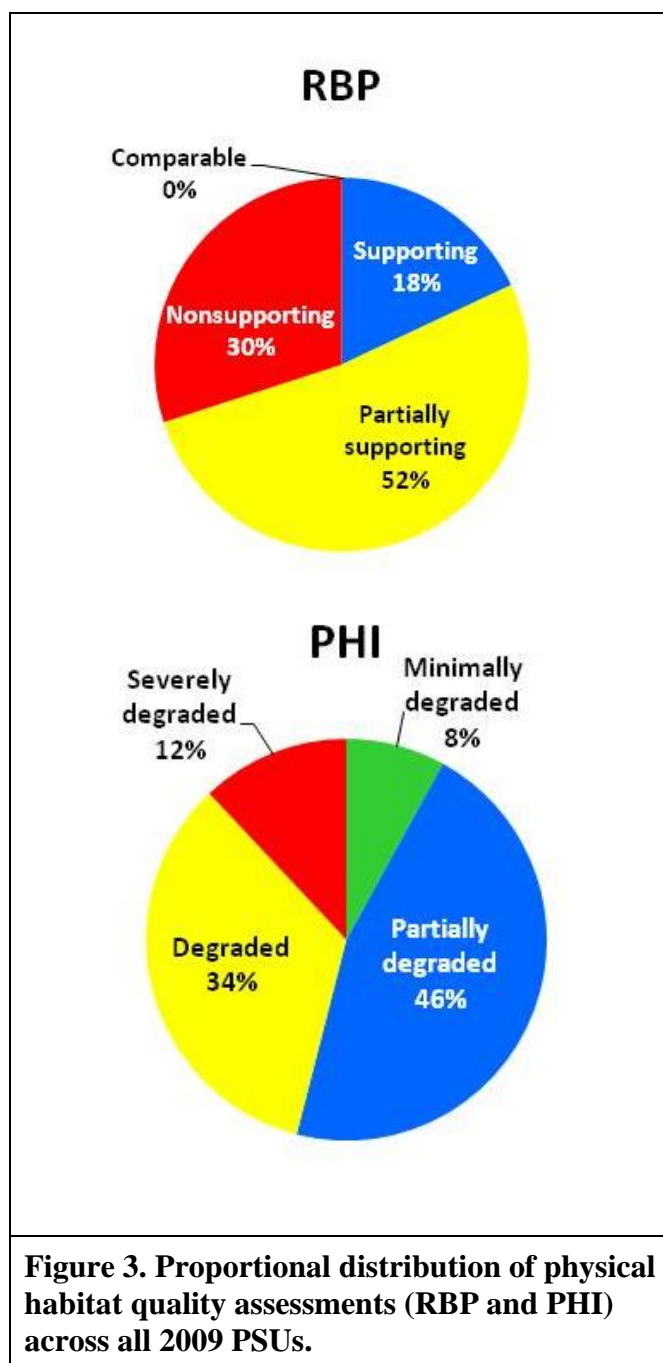


Figure 2. Proportional distribution of BIBI scores observed during 2009.

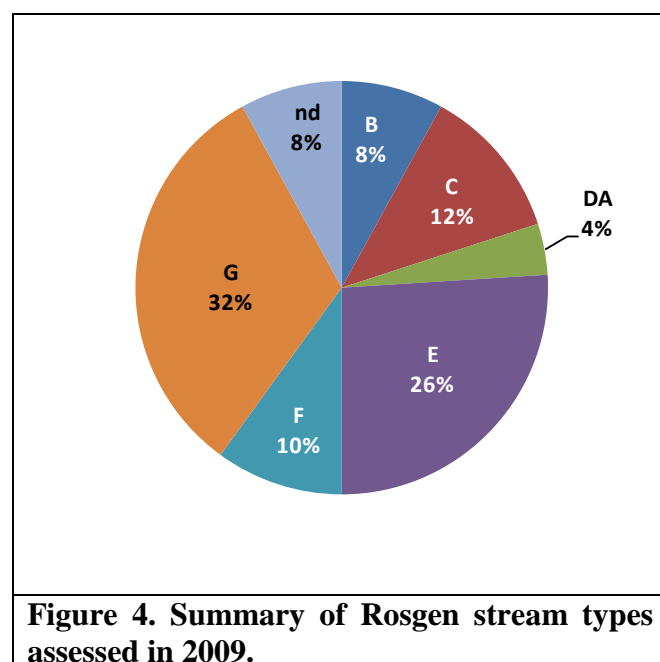


Geomorphic Assessment Summary

The E type and G type stream channels were the dominant stream types found within these sampling units, 26% and 32%, respectively (**Figure 4**). C, F, and B channel types occurred in 12, 10, and 8% of the sites, respectively, while DA channels made up 2% of sites assessed. Furthermore, the DA stream type was not observed at any of the 185 Round One sites where geomorphic assessment work was performed and these stream reaches are likely artifacts of the

high levels of disturbance found in the contributing drainage areas. 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 all 5 units with its most frequent occurrence in Marley Creek and Little Patuxent River (40% of sites). The G type was found most frequently in the Rock Branch (50%) and Lower North River (50%) PSUs, but was also observed in the other PSUs at lower frequencies. Two DA type streams were found in Marley Creek, while the B and C types were found in 3 and 4 of the PSUs, respectively.



Sand substrates were dominant among the majority of channels. The average D50 observed was 1.03 mm, but there were a few sites with median particle sizes of silt/clay (primarily in Marley Creek and Lower North River PSU), as well as others of medium gravel (primarily, in the Little Patuxent River PSU). Stream slope was very low in the assessment reaches. The average slopes for all reaches assessed were approximately 0.61%. The largest slopes were observed in Rock Branch (0.89%) and the Little Patuxent River (0.67%); the smallest was Marley Creek (0.32%).

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.

Marley Creek (05)

The Marley Creek watershed sampling unit is located in the northern part of the County (**Figure 1**), with site drainage areas ranging in size from 212 – 4,490 acres. The ten sample locations within this PSU (**Figure 5**) are on unnamed tributaries to the Marley Creek mainstem and the mainstem itself.

Aquatic Habitat

Forty percent of the Marley Creek streams were rated as “Non-Supporting” by the RBP method, 30% “Partially Supporting” and 30% “Supporting” (**Figure 6**). The MBSS PHI results showed no streams (0%) as “Minimally Degraded,” 50% as “Degraded,” and 30% as “Partially Degraded” and 20% were “Severely Degraded.” The mean RBP habitat score was 103.0 ± 30.2 (**Table 7**), with individual sites ranging from 55 to 143. Streams with the worst RBP scores had altered channels or unstable banks, as well as sedimentation and disturbed riparian zones. The mean PHI score was 60.5 ± 12.0 , with individual sites ranging from 35.8 – 77.3. The site scoring lowest for the PHI had very low scores for remoteness, trash, and woody debris, and shading.

Benthic Macroinvertebrates

Sites in the PSU were rated as either “Poor” (50%) or “Very Poor” (50%) (**Figure 7**); no sites were rated as either “Good” or “Fair.” The mean B-IBI score was 1.83 ± 0.47 (**Table 7**), and scores at

individual sites ranged from 1.00 (very poor) to 2.43 (poor). The lowest B-IBI score occurred at site R2-05-07, an unnamed tributary to Marley Creek, which produced a sample overwhelmingly dominated by worms (Annelida: Oligochaeta) and pea clams (Pisidiidae). Combined, these groups made up 99% of all organisms collected in the sample. The site with the highest B-IBI score, R2-05-09, was dominated by midges (61%), with most of those being *Rheotanytarsus* and *Cricotopus/Orthocladius* (Chironomidae). However, the sample also produced three genera of riffle beetles (*Ancyronyx*, *Dubiraphia*, and *Macronychus* [Coleoptera: Elmidae]) and a caddisfly (Ephemeroptera: Hydropsychidae: *Cheumatopsyche*). 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 6.2-11.1°C, conductivity from 332-8,313µS/cm, DO from 6.8-13.2 mg/L, and pH from 6.8-7.4.

Table 8. Average water quality values - Marley Creek.

Value \pm Standard Deviation			
Temperature*	Conductivity*	D.O.*	pH*
8.6 ± 2.9	465.5 ± 255.3	10.8 ± 1.4	7.1 ± 0.2

*Units: Temp. (°C), Cond. (µS/cm), D.O. (mg/L), pH (standard units)

Geomorphic Assessment

The E stream type was the most frequently observed type in this sampling unit, making up 40% of observed channels. As shown in **Figure 8**, the C and D/DA types were observed at 20% of sites while the G type was observed at 10% of reaches. One site (R2-05-04) was not classified due to the highly impacted condition of the reach.

Sandy substrates dominated in this PSU. The average D50 observed was 0.23 mm. Slopes ranged from a high of 0.75% to a low of 0.021%, with an average of 0.32% across all sites, the lowest of all PSUs sampled during this assessment.

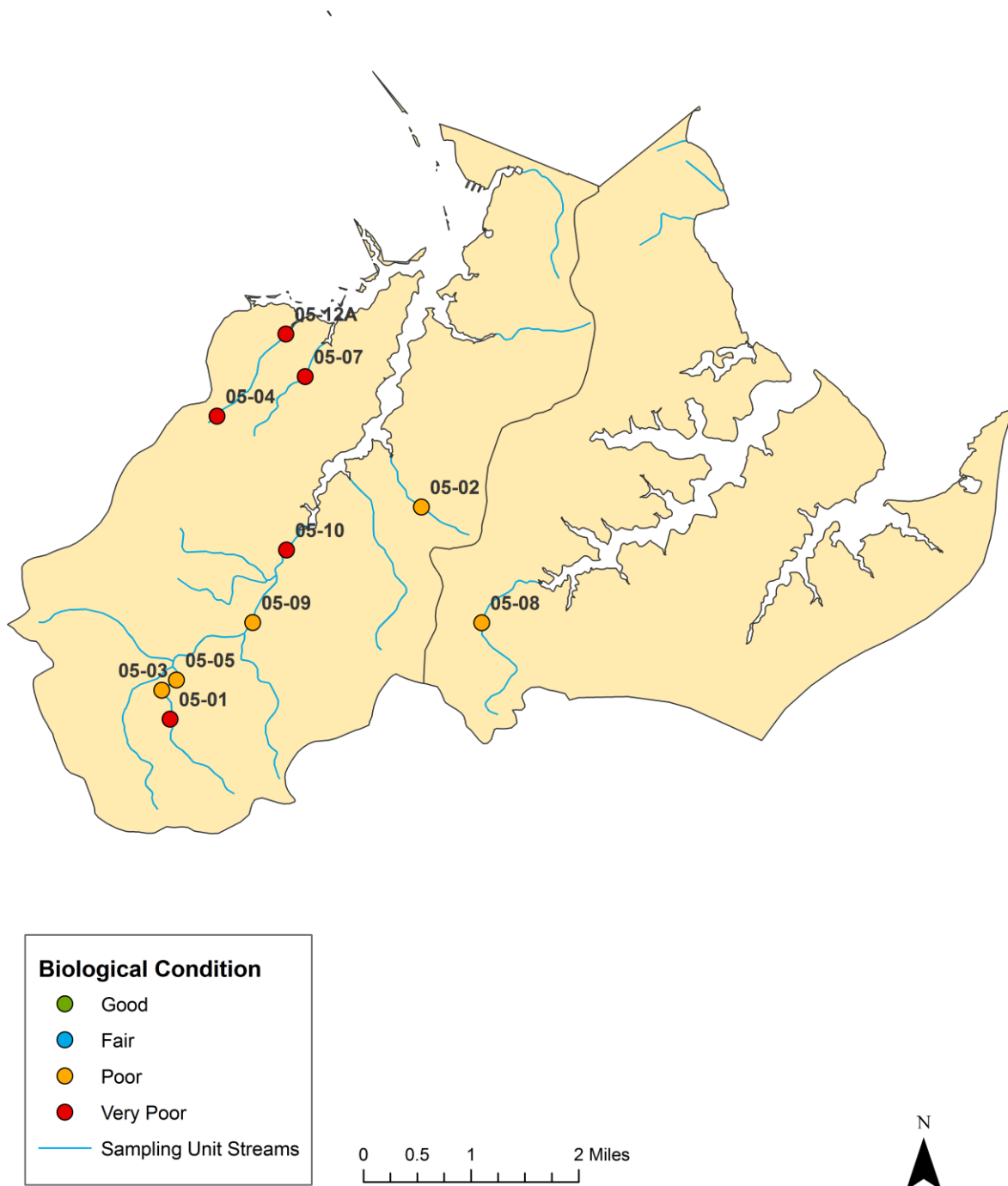


Figure 5. Sampling locations in the Marley Creek primary sampling unit.

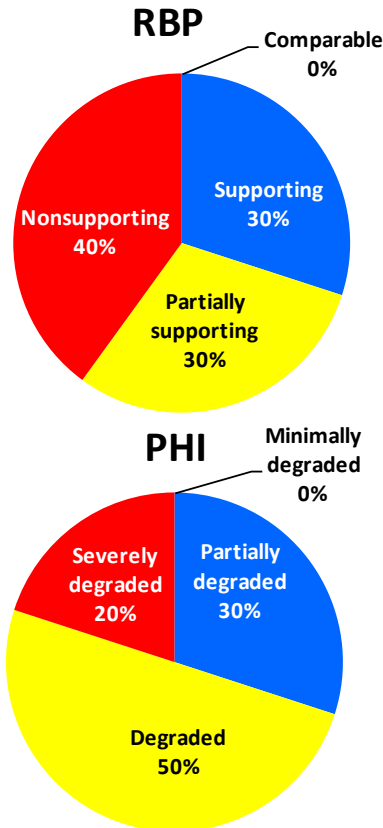


Figure 6. Proportional distribution of physical habitat quality assessments (RBP and MPH) for the Marley Creek PSU.

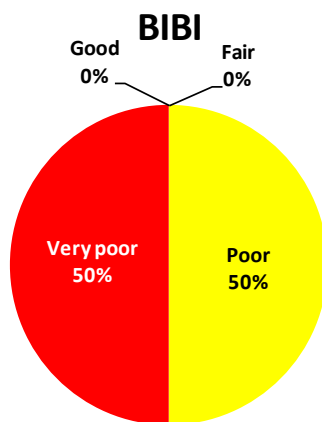


Figure 7. Proportional distribution of B-IBI assessment results for the Marley Creek PSU.

As in the other sampling units, regardless of stream type, streams here were frequently straighter than expected for particular types. An average sinuosity of 1.20 was observed in Marley Creek.

In comparison to stable reference reach E type streams, only entrenchment ratio showed a significant departure from reference conditions (Starr et al. 2009). The average entrenchment ratio observed at E types in this PSU was 5.7 while the reference reach average was 23.5. Otherwise, E types in this PSU were not statistically different regarding slope, sinuosity, or width to depth ratio. Overall, these circumstances may indicate that E streams in this sampling unit occupy more of the valleys through which they flow. Whether or not they are now about to begin a period of lateral adjustment is an open question

Overall, stable types (C and E types represent 60% of all reaches) dominate in this PSU. 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.

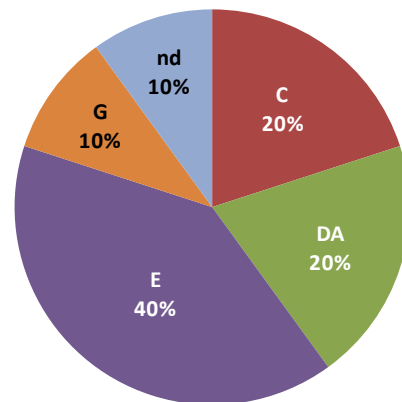


Figure 8. Summary of Rosgen stream types in the Marley Creek PSU.

Lower North River (12)

The Lower North River sampling unit is located in the east central part of the County (**Figure 1**), with site drainage areas ranging from 130 – 2,594 acres. The ten sample locations in the watershed (**Figure 9**) are all located on unnamed tributaries to the Lower North River.

Aquatic Habitat

None of the streams in the Lower North River sub-watershed have physical habitat conditions that are “Comparable” to reference (RBP) (**Figure 10**). For the RBP assessment, 50% of the streams were rated as “Partially Supporting,” 30% as “Non-Supporting,” and 20% as “Supporting.” The PHI further rated 50% as “Partially Degraded,” 30% as “Degraded,” and 10% each as “Minimally Degraded” and “Severely Degraded.” The mean RBP habitat score was 110.0 ± 16.4 , with individual sites ranging from 90 (Non-Supporting) - 145 (Supporting). The mean PHI rating was 66.3 ± 10.8 , with individual sites ranging from 47.9 (Severely Degraded) to 83.5 (Minimally Degraded).

Benthic Macroinvertebrates

Fifty percent of the sites in the Lower North River PSU rated as “Poor,” 40% as “Fair,” and 10% as “Very Poor” (**Figure 11**). The mean B-IBI score was 2.60 ± 0.59 (**Table 7**), with scores at individual sites ranging from 1.29 to 3.29. The one site that rated as “Very Poor” (R2-12-06) was dominated by non-insects (worms [Oligochaeta], scud and sowbugs [Crustacea], peaclams [Pisidiidae], and flatworms, [Planariidae]), representing 73% of the sample. Four sites rated as “Fair,” one of which was also numerically-dominated by non-insects, but had a much greater taxonomic diversity of insects. 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 5.9 – 13.3 °C; conductivity from 253 – 1,447 $\mu\text{S}/\text{cm}$; DO from 8.3 – 11.7 mg/L; and pH from 6.1 – 6.7.

Geomorphic Assessment

The unstable G type dominated in this PSU, with 50% of reaches classified as this type. The C and E types made up 20 and 10%, respectively. One site (R2-12-01) was not classified due to its classification as a wetland and not as a defined stream channel.

The average D50 observed was 0.17 mm, solidly in the sand category and the lowest observed in all the PSUs sampled during this assessment. Slopes ranged from a high of 1.1% to a low of 0.22%, with an average of 0.5% across all sites.

For the G type streams in this PSU, the ER was significantly larger than the average reported in Rosgen (1998) for the G5 type. There were no significant differences observed in width to depth or sinuosity between G types in this PSU and those reported in Rosgen (1996).

Table 9. Average water quality values - Lower North River.

Value \pm Standard Deviation			
Temperature*	Conductivity*	D.O.*	pH*
9.3 \pm 2.7	411.9 \pm 366.7	10.6 \pm 1.0	6.3 \pm 0.2

**Units: Temp. (°C), Cond. ($\mu\text{S}/\text{cm}$), D.O. (mg/L), pH (standard units)*

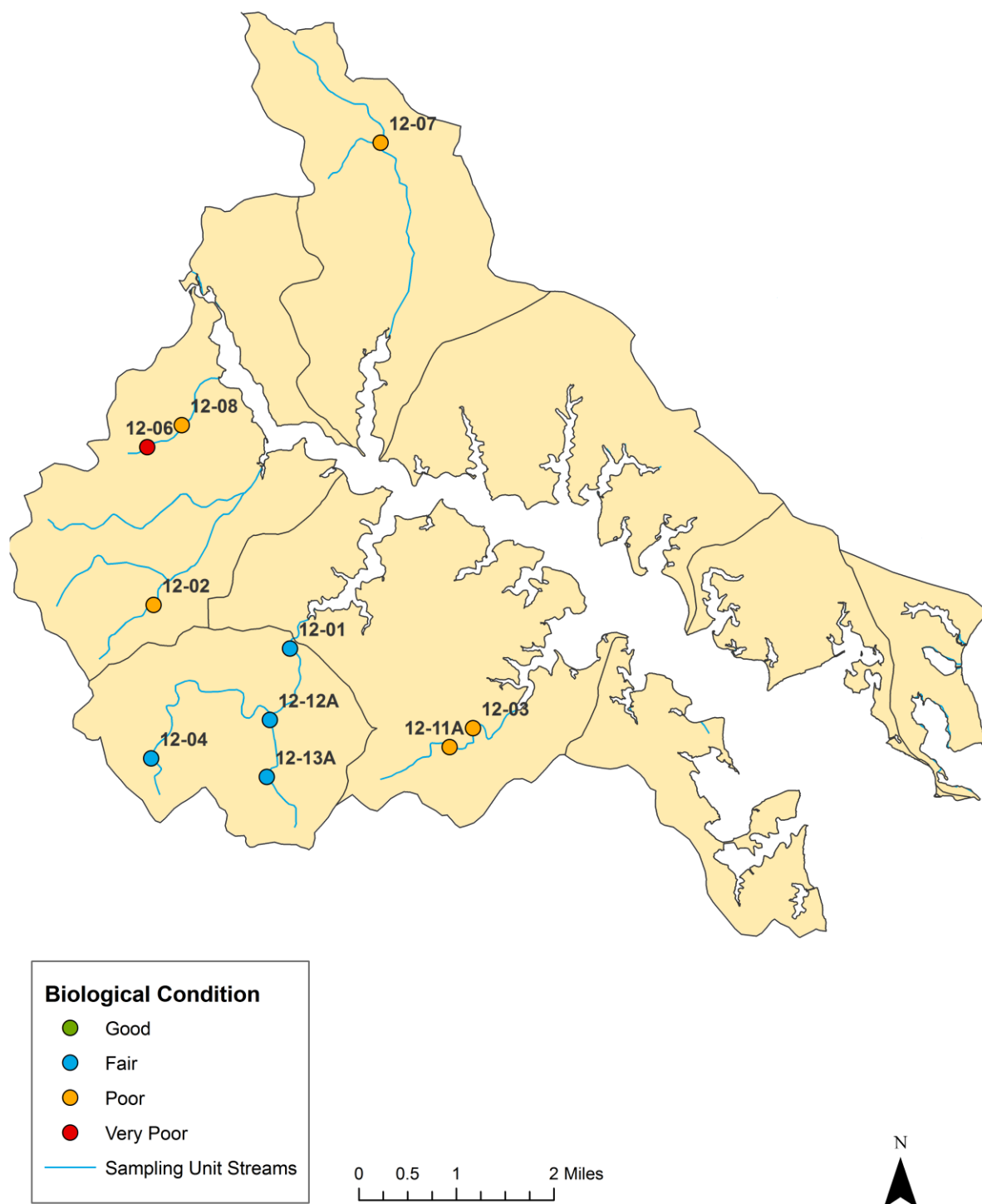


Figure 9. Lower North Creek sampling stations.

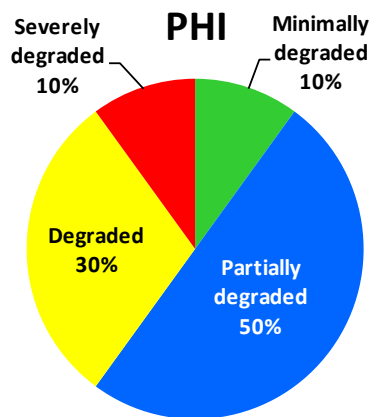
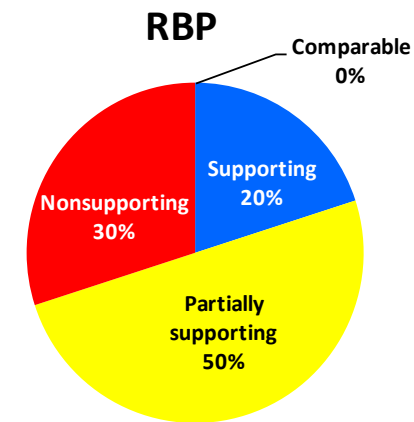


Figure 11. Proportional distribution of physical habitat quality assessments (RBP and MPHI) for the Lower North River PSU.

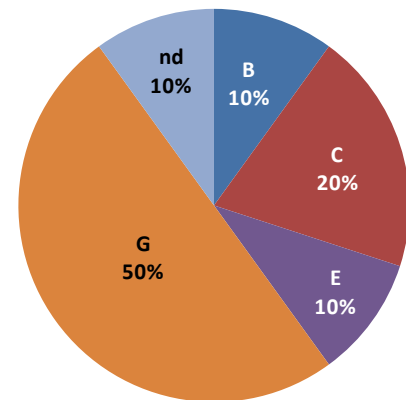


Figure 12. Summary of Rosgen stream types found in the Lower North River PSU.

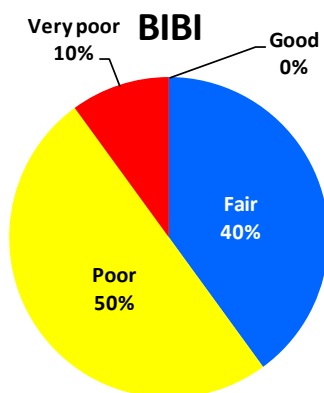


Figure 10. Proportional distribution of B-IBI assessment results for the Lower North River PSU.

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 57 – 1,388 acres. Seven of the sites are unnamed tributaries to Smith Creek, and three are unnamed tributaries to the West River mainstem (**Figure 13**).

Aquatic Habitat

The RBP physical habitat assessments showed that 80 percent of streams in the West River PSU are “Partially Supporting,” with 20 percent rated as “Non-Supporting” (**Figure 14**). The mean RBP habitat score was 108.2 ± 9.3 (**Table 7**), with site-specific scores ranging from 95 to 124 (Non Supporting to 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

The MBSS PHI showed a full range of scores, including 10% that were “Minimally Degraded” and 10% “Severely Degraded” (**Figure 14**). The largest proportion of sites (50%) was “Partially Degraded,” while 30% of the sites were scored as “Degraded.” The mean PHI score was 67.3 ± 12.8 , and range from 50.5 – 89.9.

Benthic Macroinvertebrates

Half of the sites (50%) each were rated as “Fair” and “Poor” (**Figure 15**). The mean B-IBI score was 2.89 ± 0.53 (**Table 7**), with scores at individual sites ranging from 2.43 to 3.29. Most of these sites had relatively strong diversity of taxa other than Chironomidae, including stoneflies (Plecoptera: Nemouridae: *Amphinemura*, *Paranemoura*), and caddisflies (Trichoptera: Philopotamidae, Limnephilidae, Hydropsychidae). There were also substantial numbers of blackflies (Diptera: Simuliidae: *Stegopterna*) found at many of the sites. 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 5.8 – 13.0°C, conductivity from 122 - 170 $\mu\text{S/cm}$, DO from 9.7 - 12.4 mg/L, and pH from 6.2 - 6.7.

Table 10. Average water quality values - West River.

Value \pm Standard Deviation			
Temperature*	Conductivity*	D.O.*	pH*
9.7 ± 2.8	146.3 ± 17.0	10.6 ± 0.8	6.4 ± 0.2
*Units: Temp. (°C), Cond. ($\mu\text{S/cm}$), D.O. (mg/L), pH (standard units)			

Geomorphic Assessment

It the West River PSU, the G type was the most prevalent stream type observed (**Figure 16**) with 40% of the sites receiving this classification. The E type made up 30% of all reaches measured while the F, C, and B types were also observed in this PSU.

The average D50 observed was 0.19 mm, while stream slopes ranged from a high of around 1% to a low of 0.15%, with an average of 0.61% across all sites.

For the G type streams in this PSU, the sinuosity was significantly smaller than the average reported in Rosgen (1998) for the G5 type. There were no significant differences observed in average width to depth or ER between G types in this PSU and the G5 averages reported in Rosgen (1996).

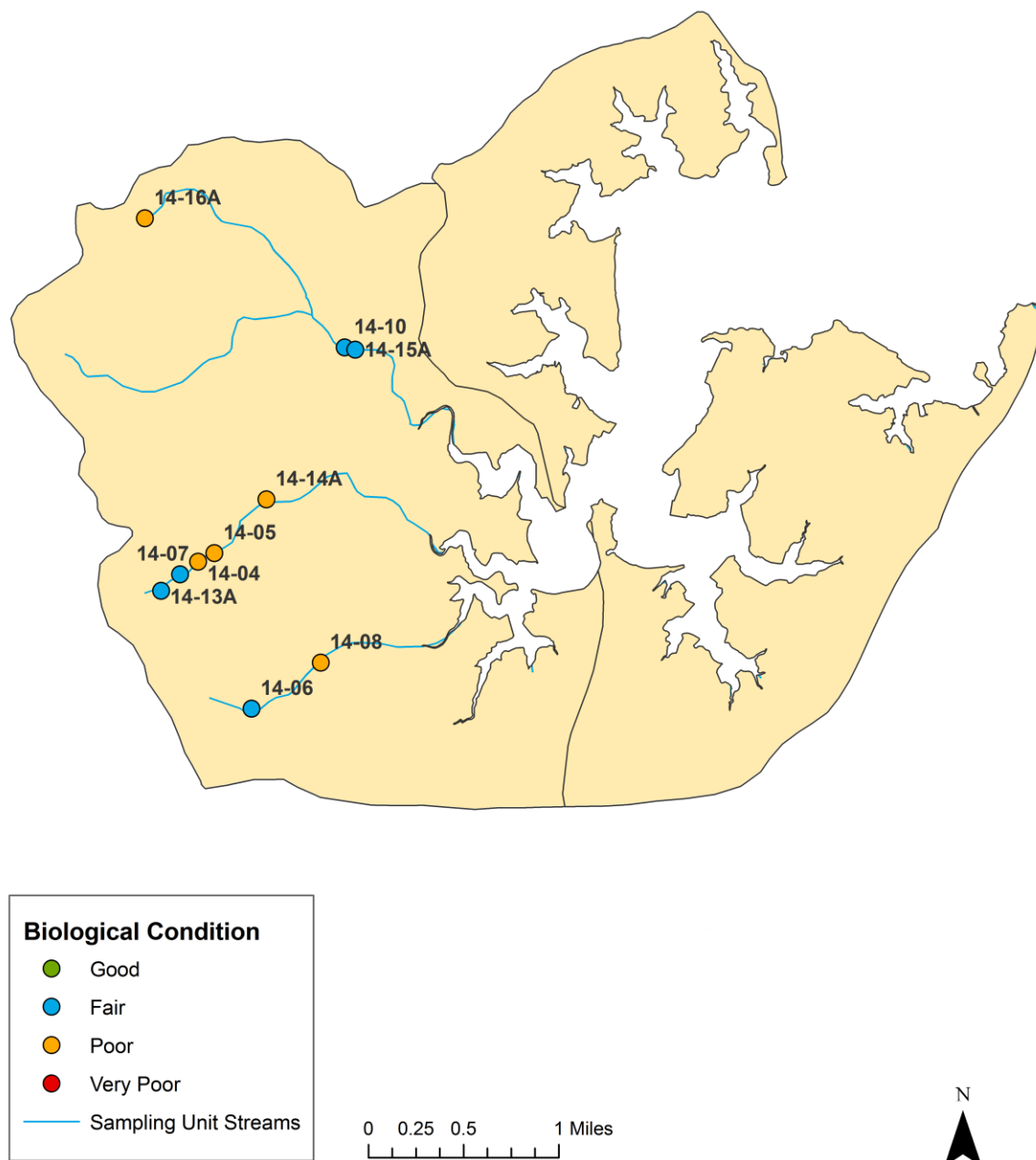


Figure 13. Sampling locations in the West River primary sampling unit.

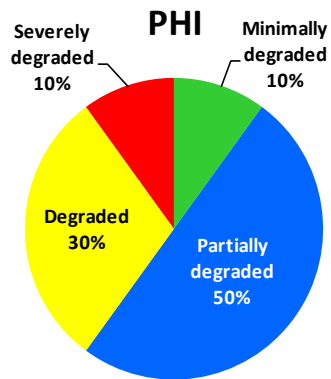
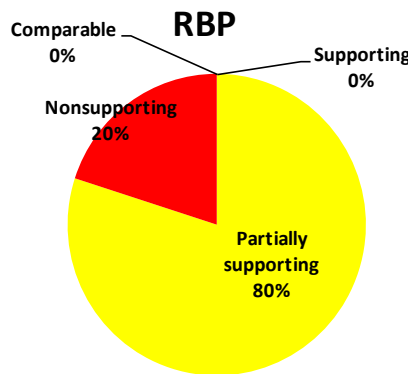


Figure 14. Proportional distribution of physical habitat quality assessments (RBP and MPHI) for the West River PSU.

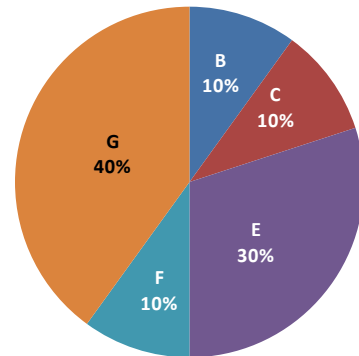


Figure 16. Summary of Rosgen stream types in the West River PSU.

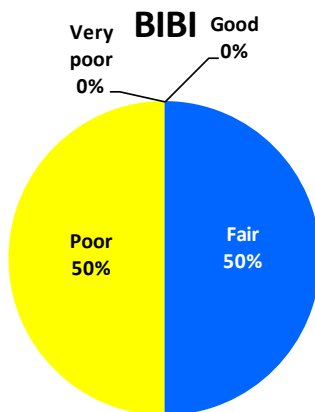


Figure 15. Proportional distribution of B-IBI assessment results for the West River PSU.

Little Patuxent River (17)

The Little Patuxent River PSU is in the northwestern part of the County (**Figure 1**), and is one of the larger subwatersheds of the County. Sampling sites in the Little Patuxent River have individual drainage areas ranging from 82 – 1,886 acres. The ten sample locations in the watershed (**Figure 17**) are on tributaries to the mainstem, and to North River.

Aquatic Habitat

The RBP physical habitat quality assessments show 50 percent of the streams in Little Patuxent River as “Partially Supporting” and 30 percent as “Supporting” (**Figure 18**). The mean RBP value is 113.5 ± 18.9 (**Table 7**) with values ranging from 77 - 139. Of the sites with “Non-Supporting” habitat (20%), there was consistent channel instability, lack of undisturbed riparian vegetation, and minimal pool complexity and epifaunal substrate. The PHI scored the majority of sites (40% each) as “Partially Degraded” and “Degraded.” One site was judged “Minimally Degraded” and one was judged “Severely Degraded.” The mean PHI score was 67.0 ± 12.4 , and the range was from 43.8 – 83.1.

Benthic Macroinvertebrates

Ninety percent of the sites in the Little Patuxent River PSU rated as “Poor,” and 10% as “Fair” (**Figure 19**). There were no sites rated as either “Good” or “Very Poor.” The mean B-IBI score was 2.34 ± 0.27 (**Table 7**), with scores at individual sites ranging from 2.14 to 3.00. Samples from these sites were largely dominated by midges (Chironomidae) and worms (Oligochaeta), with fewer numbers of taxa and individuals of stoneflies and caddisflies (Plecoptera and Trichoptera) than in some of the other PSU. For site-specific data and assessment results see **Appendix F**.

Water Quality

In the Little Patuxent River 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°C; conductivity from 78 - 574 $\mu\text{S}/\text{cm}$; and DO from 7.1 – 13.8 mg/L.

Table 11. Average water quality values - Lower Patuxent River.

Value \pm Standard Deviation			
Temperature*	Conductivity*	D.O.*	pH*
9.7 \pm 2.1	540.3 \pm 425.4	11.1 \pm 1.3	7.0 \pm 0.4
*Units: Temp. (°C), Cond. ($\mu\text{S}/\text{cm}$), D.O. (mg/L), pH (standard units)			

Geomorphic Assessment

The E type was the most prevalent stream type in this PSU (**Figure 20**), with 40% of the sites receiving this classification. The F type made up 20% of all reaches measured while the G and C types were also observed in this PSU. Additionally, 20% of reaches could not be classified due to site constraints.

The average D50 observed was 3.87 mm, while stream slopes ranged from a high of around 1.4% to a low of 0.37%, with an average of 0.67% across all sites.

For the E type streams in this PSU, there are significant differences when compared to reference reach conditions (Starr et al. 2009). Both entrenchment and width to depth ratios were significantly lower in E types found here than in E types found at reference sites. Conversely, there were no significant differences observed in sinuosity between the two groups.



Figure 17. Sampling locations in the Little Patuxent River primary sampling unit.

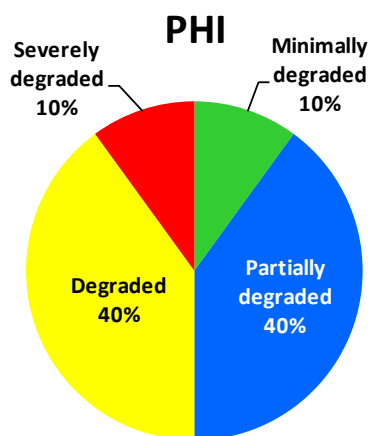
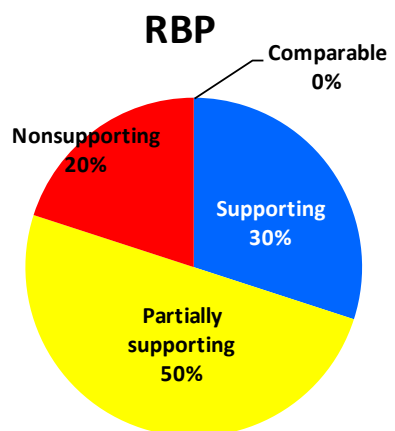


Figure 19. Proportional distribution of physical habitat quality assessments (RBP and PHI) for the Little Patuxent River PSU.

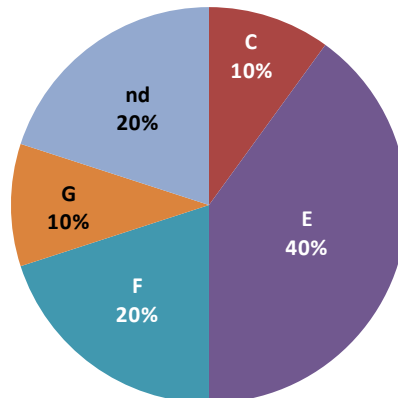


Figure 20. Summary of Rosgen stream types in the Little Patuxent River PSU.

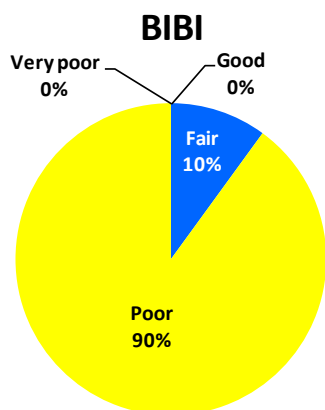


Figure 18. Proportional distribution of B-IBI assessment results for the Little Patuxent River PSU.

Rock Branch (20)

The Rock Branch sampling unit is on the far southwestern border of the County (**Figure 1**). Sampling sites in Rock Branch have individual drainage areas ranging from 17.5 – 3,358 acres, and are located on unnamed tributaries to Rock Branch and on the mainstem itself (**Figure 21**).

Aquatic Habitat

The RBP physical habitat quality assessments rated 90 percent of the streams in Rock Branch as either “Partially Supporting” (50%) or “Non Supporting” (40%). The remainder, 10%, classified as “Supporting” (**Figure 22**). The mean RBP value is 105.4 ± 18.1 (**Table 7**) with values ranging from 77 - 139. Prevalent issues with most of these reaches included bank instability, minimal complexity of epifaunal substrate and instream habitat, heavy sedimentation, and lack of bank vegetation. The PHI indicated “Partially Degraded” conditions in 60 percent of sites, “Degraded” conditions in 20 percent, and 10 percent each for “Minimally Degraded” and “Severely Degraded.” The mean PHI score was 69.5 ± 10.3 and the range was from 46.1 – 81.7.

Benthic Macroinvertebrates

Sixty percent of the sites in the Rock Branch PSU rated as “Poor,” 30 percent each rated as “Fair”, and 10 percent as “Good” (**Figure 23**). The mean B-IBI score was 3.03 ± 0.74 (**Table 7**), with scores at individual sites ranging from 2.14 to 4.14. Although the site scoring highest (R2-20-14A) had 74 midges (Chironomidae), they were distributed among 17 different genera. That site also produced a stonefly (Plecoptera: Chloroperlidae: *Haploperla*), and limnephilid caddisflies (Trichoptera: *Ironoquia* and *Pycnopsyche*). Midges and worms dominated the “Poor” and “Fair” sites, but did not exhibit as much diversity as R2-20-14A. For site-specific data and assessment results see **Appendix F**.

Water Quality

In the Rock Branch PSU, all water quality variables were within acceptable ranges for individual site observations and for mean values

(**Table 12**). However, more stressful temperature and dissolved oxygen conditions might be expected at other times than during the March sampling period. Water temperature ranged from 7.8 – 14.6°C; conductivity from 97 - 233 $\mu\text{S}/\text{cm}$; and DO from 6.7 – 11.7 mg/L.

Table 12. Average water quality values - Rock Branch.

Value \pm Standard Deviation			
Temperature*	Conductivity*	D.O.*	pH*
9.0 \pm 3.5	220.7 \pm 59.7	11.3 \pm 1.6	6.7 \pm 1.1
*Units: Temp. (°C), Cond. ($\mu\text{S}/\text{cm}$), D.O. (mg/L), pH (standard units)			

Geomorphic Assessment

In this PSU, 50% of all streams were of the G type, the B and F types were both found at 20% of reaches measured, and the E type was observed at one site (**Figure 24**).

The average D50 observed was 1.13 mm, the largest of all the PSUs sampled in 2009, and ranged from silt-clay dominated substrates to 9.4 mm gravel. Stream slopes ranged from a high of around 2.4% to a low of 0.25%, with an average of 0.89% across all sites, the steepest of the five units sampled in this assessment.

For the G type streams in this PSU, there are significant differences for some parameters when compared to mean averages for this type (Rosgen 1998). The entrenchment ratio was significantly higher in G types found here than in G types presented in Rosgen (1996) while sinuosity was less than expected. Conversely, there were no significant differences observed in width to depth ratio between the two groups. This means that G types in Rock Branch are straighter and have a larger amount of active channel occupying the valley floor than typically found in G stream systems.

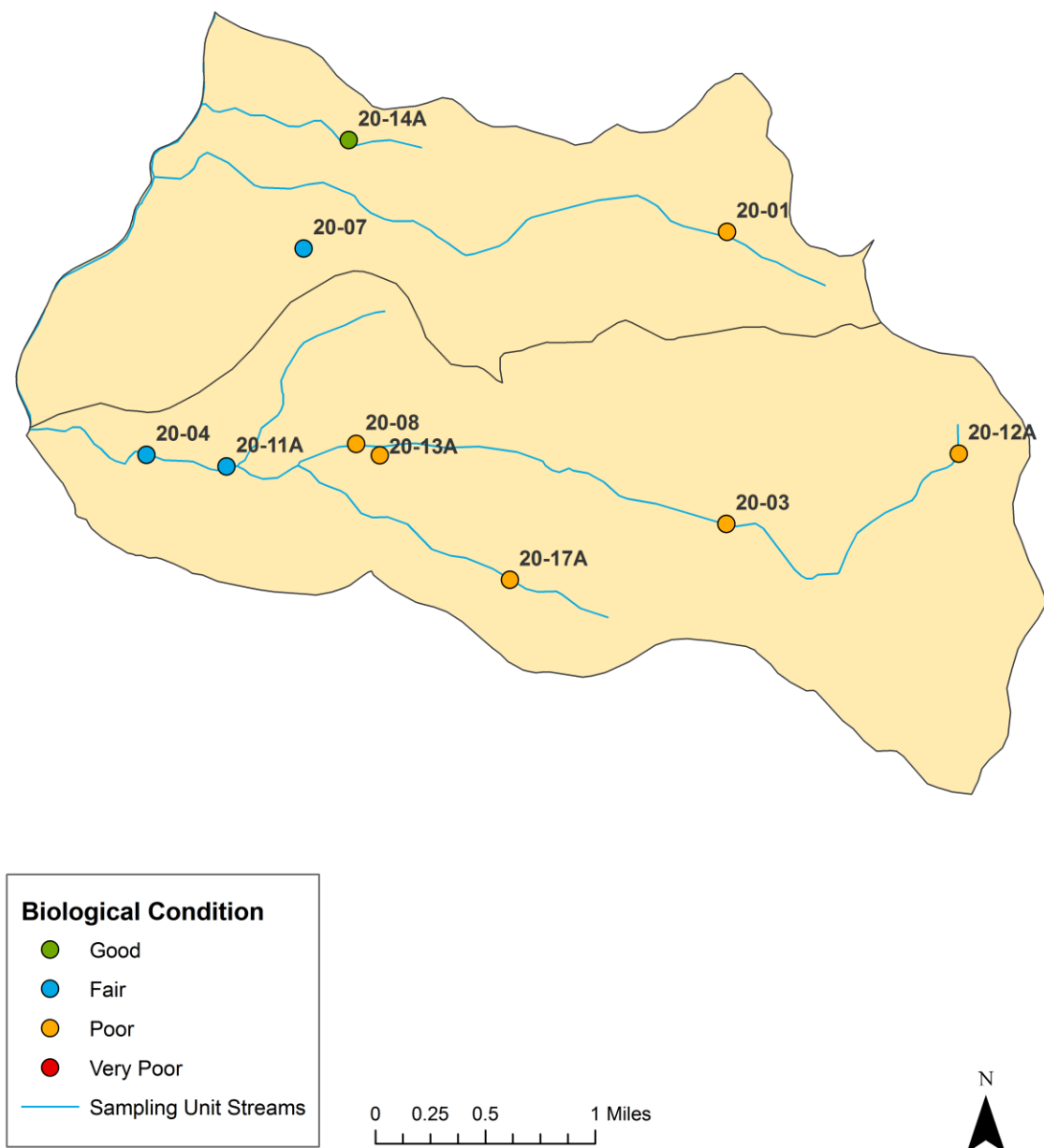
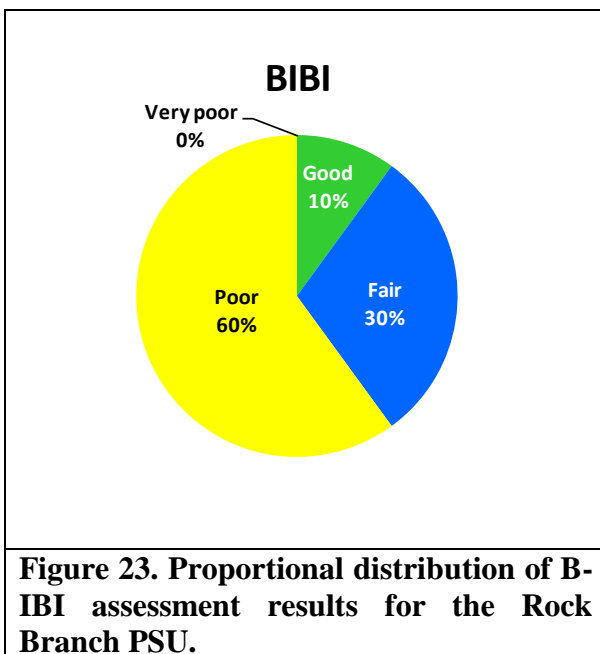
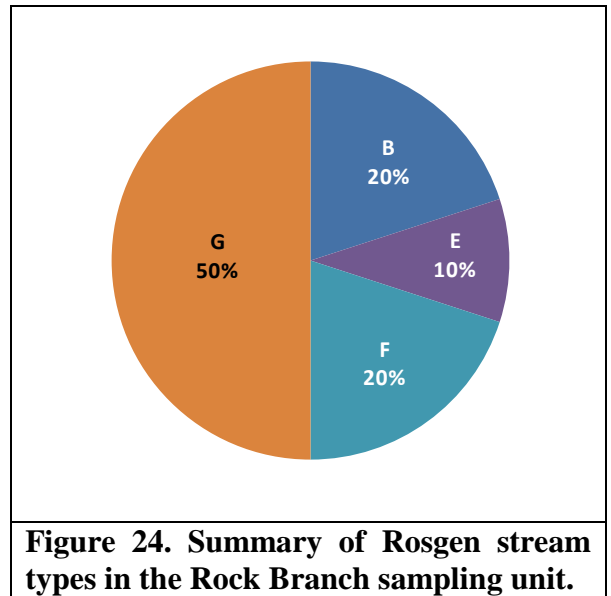
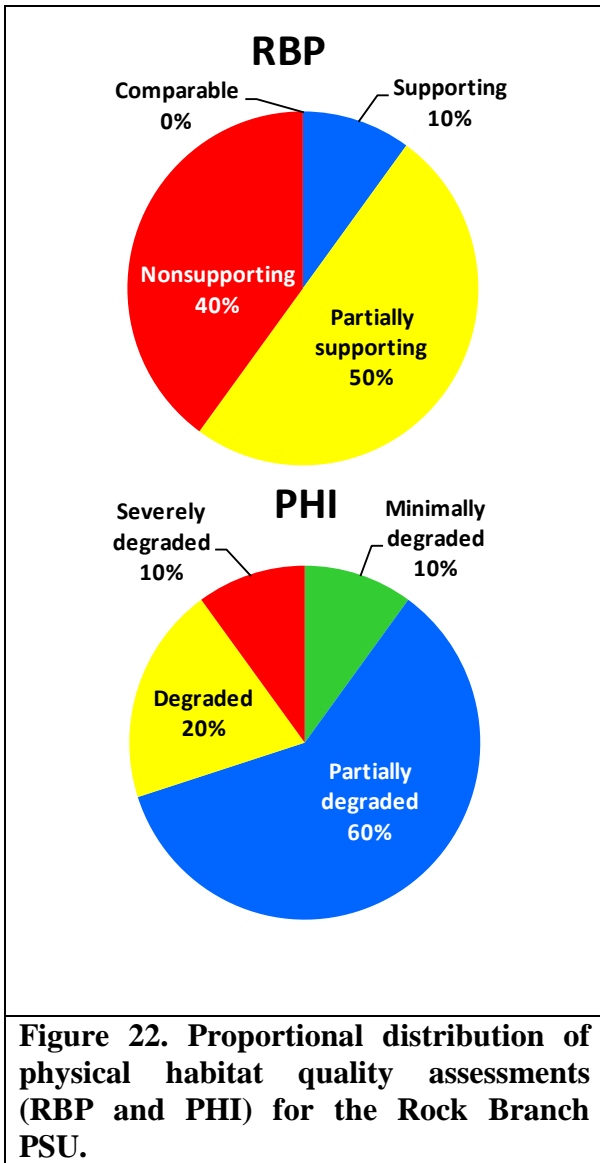


Figure 21. Sampling locations in the Rock Branch primary sampling unit.



Conclusions and Discussion

In this section, the condition data collected in these PSUs is analyzed in two basic ways. First, data collected in 2009 is analyzed and discussed. Second, a brief comparison is made between the results obtained in 2009 and the results first observed during Round 1 sampling.

Current Assessment 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). This is largely due to the fact that there are both synergistic and antagonistic relationships among stressors that are not fully understood. For example, six sites in Marley Creek, Lower North River and Little Patuxent River, 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 13. Comparison of biological scores to EPA RBP habitat condition.

EPA RBP Habitat Scores	BIBI Score			
	Good	Fair	Poor	Very Poor
Comparable				
Supporting		20-04	05-09 12-07 17-05 12-03 17-09 17-11A	05-12A 05-10
Partially Supporting	20-14A	12-01 12-04 14-07 14-10 14-13A 14-15A 20-11A	05-02 05-03 05-08 12-02 12-08 14-04 14-05 14-14A 14-16A 17-01 17-02 17-03 17-04 17-06 20-01 20-08 20-13A	12-06
Non- Supporting		12-12A 12-13A 14-06 17-10 20-07	05-05 12-11A 14-08 17-12A 20-03 20-12A 20-17A	05-01 05-04 05-07

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).

Note that site numbers do not have the leading “R2” modifier denoting them as second round sites.

Table 14. Comparison of biological scores to MBSS PHI habitat conditions.

MBSS PHI Score	BIBI Score			
	Good	Fair	Poor	Very Poor
Minimally Degraded		14-13A	12-07 17-05 20-13A	
Partially Degraded	20-14A	12-04 12-13A 17-10 14-07 20-04 20-11A 20-07	12-03 05-02 05-08 12-02 14-04 14-05 14-14A 14-16A 17-03 17-09 17-11A 20-17A 20-01	05-10 12-06
Degraded		12-12A 14-06 14-10 14-15A	05-09 05-05 12-11A 05-03 12-08 17-01 17-02 17-04 20-03 20-12A 17-06	05-12A 05-07
Severely Degraded		12-01	14-08 17-12A 20-08	05-01 05-04

Refer to notes under Table 13 regarding cell shading and bold type
Note that the site names do not have the "R2" modifier denoting them as Round 2 sites.

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. For those sites possibly experiencing water quality impairments, there are many contaminants delivered to streams that could be possible stressors. The data collected here are not sufficient to identify specific contaminants. Regarding possible enrichment, sites that have biological conditions better than expected habitat could be experiencing nutrient enrichment from

urban or agricultural runoff. Such runoff can alter the biological communities in subtle ways that do not always lead to degraded BIBI scores by, for example, shifting the types of organisms from one feeding group to another and increasing overall biomass at an impacted site (Stone et al. 2005) or influence community composition by shifting the community to organisms that are better able to compete in these enriched conditions (Evans-White et al. 2009). It should be noted, however, that no water quality samples were collected during this assessment, so no data exist to confirm or refute possible the existence of eutrophic conditions at the sites in question.

Table 15. Reaches for which the paired assessments of biological condition and physical habitat quality indicate the potential stressor type affecting the stream biota.

Possible Water Quality Impairment	Possible Over Enrichment
05-10 12-03 12-07 05-12A 17-05 17-09 17-11A	12-01 12-12A 14-06 14-08 14-10 14-15A 17-12A 20-14A

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 long-term (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.

Excluding conductivity, there were no conclusive indications of adverse water quality conditions. Temperature and dissolved oxygen met COMAR standards. There is no state standard for conductivity and measured values can show wide variability, but studies have shown that typical values in Maryland Coastal Plain streams average between 150 and 200 $\mu\text{S}/\text{cm}$. (Janicki and Cummins 1983, Janicki 1991). To account for this variability, a threshold of 500 $\mu\text{S}/\text{cm}$ was used to evaluate conductivity values. This level of conductivity has been shown to negatively impact stream macroinvertebrate assemblages, albeit in cold water stream systems (Wang and Kanehl 2003). Twenty two percent of 2009 stations, which were located overwhelmingly in the Marley Creek and Little Patuxent PSUs (11 of 12 sites observed), had conductivity values greater than the threshold. In urban and urbanizing watersheds, it is assumed that road salts applied after snowfalls drive elevated conductivity values, but other factors like temperature may impact invertebrate responses (Benbow and Merritt 2004). However, no snow was present at these sites during this assessment. Consequently, it is unclear what is causing these elevated conductivity values.

Stream geomorphology within these sampling units presents a somewhat complicated picture. 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 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, suburban, commercial, and industrial development. Consequently, streams in the 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 Merritts 2008). Similar processes also are 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.

Like geomorphic assessment work done in past years, a variety of different Rosgen stream types were observed. The C, E, and B stream types are typically considered potential evolutionary end points in the Rosgen classification system that perturbed systems described above might adjust toward over time (Rosgen 1996). The E type dominated in the Marley Creek PSU, despite its high levels of impervious surface. The E type was also found in Little Patuxent PSU along with unstable G and F types. Conversely, unstable types like the F and G types were found in significant percentages in the West River, Lower North River, and Rock Branch sampling units, despite their relatively low levels of impervious surfaces.

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

Data Sources ¹	Sinuosity	ER	W/D	Reference
General E5 stream type	2.35	39.5	5.78	Rosgen (1996)
E channel WCP reference reaches	1.39	23.5	9.2	Starr et al. (2009) N = 8
All E type streams measured in 2009	1.19*	13.5*	7.26*	N = 13
Little Patuxent PSU E types	1.28	4.9*	9.21*	N = 4
Marley Creek PSU E types	1.20	8.78*	8.85	N = 4
West River PSU E types	1.13	9.0	8.23	N = 3

1) Not enough E types for statistical analysis in Lower North River, Rock Branch PSUs.

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

As illustrated in **Table 16**, E channels in the sampling units are significantly different from Western Coastal Plain (WCP) reference conditions (Starr et al. 2009) when analyzed as a group. Collectively, E channels measured during 2009 are straighter than E type reference reaches, having only 80% of the sinuosity associated with stable reaches. Entrenchment ratios were also significantly lower, which means that the reaches found in this year's sampling units occupy more of the stream valley than predicted from stable reference conditions. Finally, the observed narrower W/D ratio of 2009 reaches 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. However, one general trend observed across sampling units and within all stream types is the prevalence of channels that are narrower, deeper, and straighter 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.

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

Stream Type (N*)	Entrenchment Ratio		Width /Depth		Sinuosity	
	Obs.	Typ.	Obs.	Typ.	Obs.	Typ.
B4** (6)	1.80	1.63	12.4	16.6	1.11	1.38
C5 (6)	10.45	2.96	15.5	27.0	1.27	3.45
F4 [#] (5)	1.24	1.18	15.1	28.2	1.30	1.74
G5 ⁺ (7)	1.37	1.17	7.7	7.2	1.12	1.25

Typical values from Rosgen (1996). * N = number of observations.

**Summary data for the B5 type not available. [#]Obs. values include 2 F5 types. ⁺Obs. values include G5 and G5c 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 (AAC 2002) in order 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

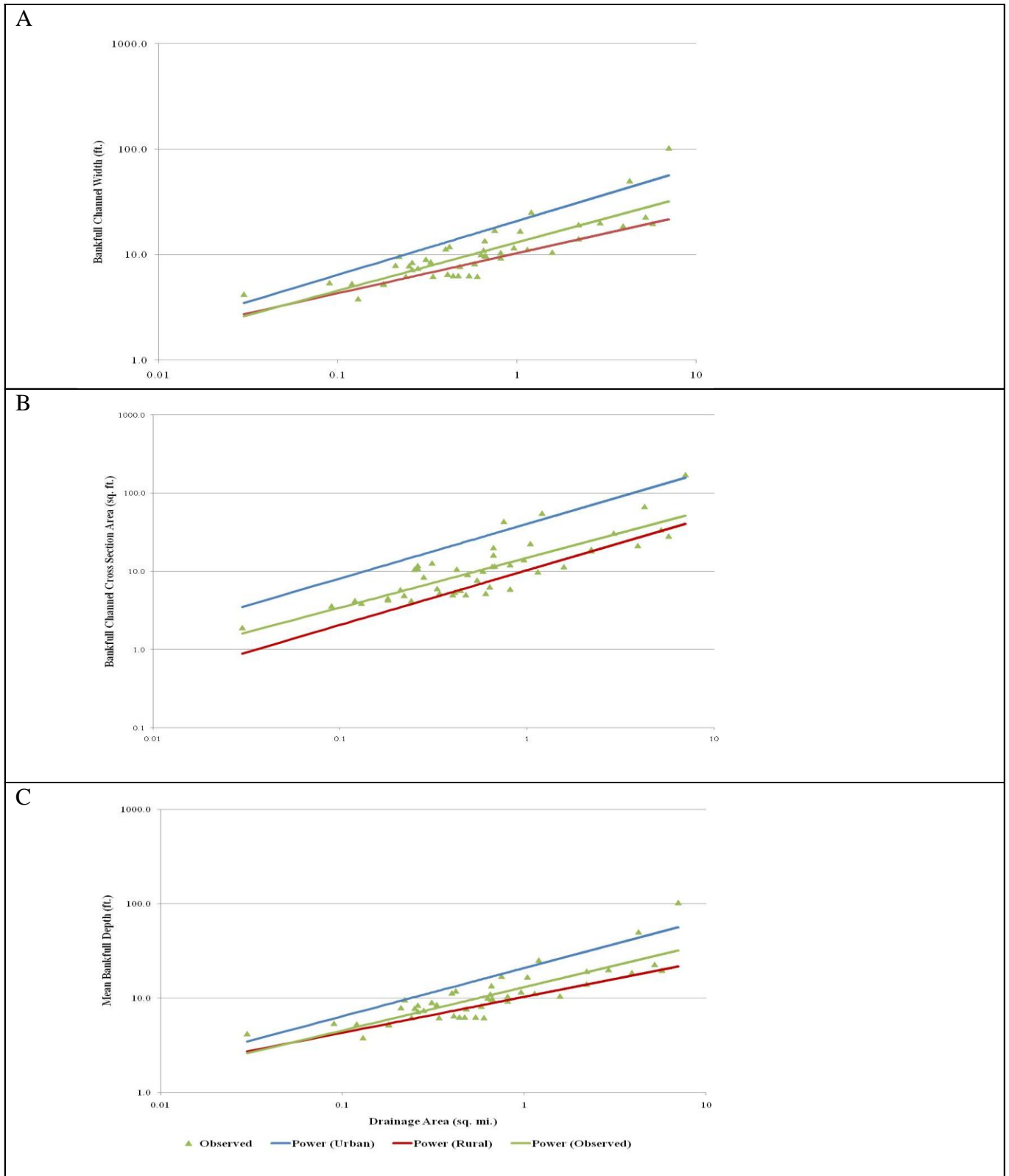


Figure 25. Comparison of 2009 PSU sample sites A) bankfull channel widths, B) bankfull channel areas, and C) bankfull channel mean depths with Coastal Plain regional relationships developed for Rural and Urban watersheds.

equilibrium condition at a different and lower elevation than it was in the pre-disturbance phase. 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.

Round 1 and Round 2 Results Comparison

Biological Conditions

With the first year of Round 2 completed, it is now possible to start comparing conditions between PSUs over time. Using statistical methods described in Roth et al. (2005), the mean BIBI scores for Round 1 and Round 2 were evaluated for the five sampling units assessed during the reporting period. As shown in **Table 18**, the Marley Creek PSU shows degradation in biological conditions, from “Poor” to “Very Poor.” Conversely, the West River PSU’s condition improved from “Very Poor” to “Poor” between sampling rounds. The other resampled PSUs showed no statistically significant change in condition. The Rock Branch PSU switched condition classes, moving from “Poor” to “Fair”, but the difference between the Round 1 and Round 2 mean BIBIs was not significant.

It should be noted that these trends, where they exist, are preliminary since they are based upon only two data points. Continued sampling over the long term (15-20 years) will provide insight into the ultimate trajectory of conditions in the watersheds of the County. As work continues during the next reporting period, additional analysis of Round 1 data will be performed to better understand conditions in benthic community health between and within PSUs.

Table 18. Comparison of BIBI average scores for Sampling Units in Round 1 versus Round 2.

Primary Sampling Unit (Round 1 Sampling Year)	Round 1 BIBI±1SD (Narrative Condition)	Round 2 BIBI±1SD (Narrative Condition)	Condition Trend
Marley Creek (2006)	2.57±0.54 (Poor)	1.83±0.48 (Very Poor)	Downward*
Lower North River (2005)	2.63 ±0.54 (Poor)	2.60±0.61 (Poor)	None
West River (2008)	1.86±0.30 (Very Poor)	2.89±0.28 (Poor)	Upward*
Little Patuxent (2007)	2.09±0.79 (Poor)	2.34±0.27 (Poor)	None
Rock Branch (2008)	2.43±0.97 (Poor)	3.03±0.74 (Fair)	Upward

* significant difference (p=0.05)

Habitat Conditions

The RBP habitat assessment showed no differences between Round 1 and Round 2 PSU averages. All PSUs were rated as “Partially Supporting” during both assessments. PSU averages basically ranged between 100 and 110 points.

For MPHI, habitat conditions were also basically unchanged, as illustrated in **Table 19**. Conditions in the Lower North River and Little Patuxent PSUs showed slight increases in average scores sufficient to move them from “Degraded” to “Partially Degraded,” but the differences were not statistically significant.

For both assessment methods, those habitat metrics judged consistently impaired remained the same from Round 1 to Round 2. For RPB, these include excessive sediment deposition, poor

diversity in stream physical features such as pool depth, and marginal instream habitat quality. For MPHI, degraded instream habitat, low amounts of woody debris, and marginal overall bank stability stand out as primary impairments.

Table 19. Comparison Between MPHI Habitat Scores for Sampling Units in Round 1 versus Round 2.

Primary Sampling Unit (Round 1 Sampling Year)	Round 1 MPHI±1SD (Narrative Condition)	Round 2 MPHI±1SD (Narrative Condition)	Condition Trend
Marley Creek (2006)	63.9±7.5 (Degraded)	60.5±12.0 (Degraded)	None
Lower North River (2005)	65.0±8.5 (Degraded)	66.3±10.8 (Partially Degraded)	Upward
West River (2008)	70.1±5.9 (Partially Degraded)	67.3±12.8 (Partially Degraded)	None
Little Patuxent (2007)	62.9±7.8 (Degraded)	67.0±12.4 (Partially Degraded)	Upward
Rock Branch (2008)	67.8±8.9 (Partially Degraded)	69.5±10.3 (Partially Degraded)	None

Geomorphic Conditions

It should be emphasized that the Rosgen classification data—like the biological samples—collected during the rounds occurred at different sites and these results do not represent what happened at individual sites in the time from Round 1 sampling to Round 2 sampling. However, within some PSUs, stream type distributions appeared to change in comparison to work done during Round 1, although no strong trends emerge. Rosgen types observed in each

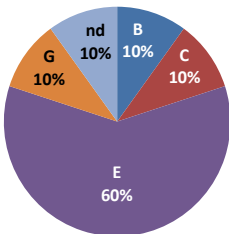
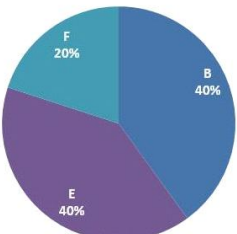
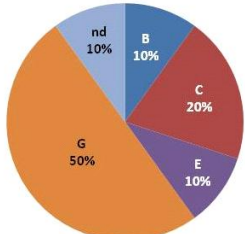
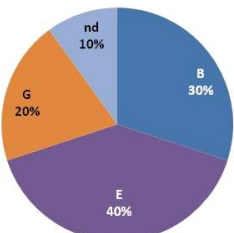
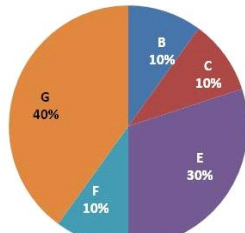
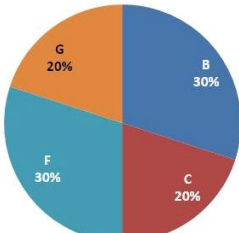
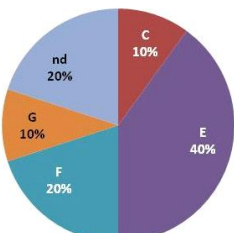
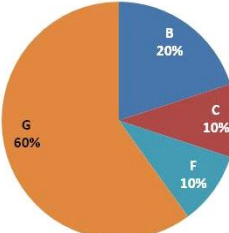
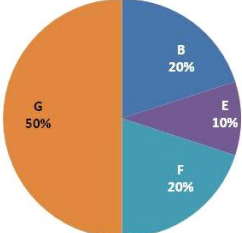
PSU during Round 1 and Round 2 sampling is summarized in **Table 20**.

For example, in the Lower North River PSU, a wholesale replacement of a stable stream type with an unstable one occurred. In 2005, the E and B type each made up 40% of reaches observed. In 2009, 50% of reaches sampled were classified as G systems. An examination of the classification variables used in 2005 shows that some of the B types observed at that time had W/D ratios and ER values near the breakpoint with the G type. It is unclear if this shift represents an artifact of sampling or represents a PSU-wide shift toward reach instability. Another example of apparent increased instability also occurred in the West River PSU, with the G type doubling in frequency and the F type appearing in 2009.

In some cases, the stable stream types predominated but the individual type shifted between Rounds. For example, in the Marley Creek PSU the E type was the predominate single type from Round 1 to Round 2, but the DA channel was observed in 2009 and not in 2006. Also in Marley Creek PSU, the C type was observed more frequently in 2009 versus 2006. In the Little Patuxent PSU, 30% (3 of 10) of the sites evaluated were classified as B type in Round 1 (2007) and no E types were observed. However, no B types were observed in 2009 while 40% (4 of 10) of sites were classified as E types. While the C, G, and F types were observed in 2009, they were less prevalent than in 2007.

Regarding slope and bed material sizes, there were no changes of note between Round 1 and Round 2. All PSUs here had very similar slopes (mostly less than 1% on average) and had median particle sizes in the sand class (< 2 mm). One exception was Rock Branch, where the average D50 increased to 1.13 mm in 2009 versus 0.26 mm in 2008. However, this change appears due to the presence of one large median value (9.6 mm) collected during 2009.

Table 20. Distribution of Rosgen stream types observed during Round 1 and Round 2 sampling

PSU	Round 1	Round 2
Marley Creek	 <p>Pie chart showing the distribution of Rosgen stream types for Marley Creek in Round 1. The chart is divided into five segments: E (60%, purple), B (10%, blue), C (10%, red), G (10%, orange), and nd (10%, light blue).</p>	 <p>Pie chart showing the distribution of Rosgen stream types for Marley Creek in Round 2. The chart is divided into five segments: E (40%, purple), DA (20%, green), C (20%, red), G (10%, orange), and nd (10%, light blue).</p>
Lower North River	 <p>Pie chart showing the distribution of Rosgen stream types for Lower North River in Round 1. The chart is divided into three segments: B (40%, blue), E (40%, purple), and F (20%, teal).</p>	 <p>Pie chart showing the distribution of Rosgen stream types for Lower North River in Round 2. The chart is divided into five segments: G (50%, orange), B (10%, blue), C (20%, red), E (10%, purple), and nd (10%, light blue).</p>
West River	 <p>Pie chart showing the distribution of Rosgen stream types for West River in Round 1. The chart is divided into four segments: B (30%, blue), E (40%, purple), G (20%, orange), and nd (10%, light blue).</p>	 <p>Pie chart showing the distribution of Rosgen stream types for West River in Round 2. The chart is divided into five segments: G (40%, orange), E (30%, purple), F (10%, teal), B (10%, blue), and C (10%, red).</p>
Little Patuxent	 <p>Pie chart showing the distribution of Rosgen stream types for Little Patuxent in Round 1. The chart is divided into four segments: B (30%, blue), F (30%, teal), C (20%, red), and G (20%, orange).</p>	 <p>Pie chart showing the distribution of Rosgen stream types for Little Patuxent in Round 2. The chart is divided into five segments: E (40%, purple), nd (20%, light blue), F (20%, teal), C (10%, red), and G (10%, orange).</p>
Rock Branch	 <p>Pie chart showing the distribution of Rosgen stream types for Rock Branch in Round 1. The chart is divided into four segments: G (60%, orange), B (20%, blue), C (10%, red), and F (10%, teal).</p>	 <p>Pie chart showing the distribution of Rosgen stream types for Rock Branch in Round 2. The chart is divided into four segments: G (50%, orange), B (20%, blue), F (20%, teal), and E (10%, purple).</p>

Recommendations

Based on these 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 sources of stressors that are causing biological degradation in its watersheds.

Investigate potential for retrofitting with stormwater best management practices. As illustrated in **Table 15**, 15 of 50 sites (26%) had biological conditions that were unexpected given the existing quality of physical habitat, suggesting degradation of chemical water quality, including potential nutrient over enrichment. 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.

Target Marley Creek PSU for BMP implementation. The only statistically significant loss of biological quality was observed in this PSU. The degraded health conditions measured during this year's work was confirmed by concurrent work done at targeted sites throughout this PSU (Roth et al. 2009). Given the trend toward continued impairment of biological conditions in the Marley Creek PSU, it should be targeted for focused water quality improvements as that seems to be a primary stressor in this PSU.

Target Rock Branch, Lower North River, and the West River PSUs for more intensive geomorphic assessment. Unstable stream types dominated the West River and Rock Branch PSUs during both Round 1 and Round 2 sampling and were found in significant numbers in the Lower North River PSU during Round 2. Additional assessments are necessary to determine the extent and intensity of instability in these PSUs and to develop corrective plans for improving channel stability conditions should widespread instability be verified.

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APPENDIX A

SAMPLE FIELD SHEETS



Stream Channel Classification and Assessment Form

Rosgen Classification System

Level II



Watershed Name: _____ Stream/ReachID: _____

Drainage Area: _____ mi²/acres/ha

Observers: _____ Date/Time: _____/_____/_____

Lat: _____

GPS [] Y [] N Differential Correction? [] Y [] N Positional Error: _____ ft.

Lon: _____

Location Description: _____

Camera/Film No. _____

Weather: _____ Rain in last 24 hrs? [] Y [] N

Photo Nos: US _____ DS _____ LB _____ RB _____

Bankfull Width (W): _____ ft.

Bankfull Mean Depth (D) : _____ ft.

W/D Ratio: _____

W and D checked on Regional Curve?

[] Y [] N

Describe feature(s) used:

Thalweg elv.(TE): _____ ft.

Bankfull elv.(BFE): _____ ft.

Max Bankfull Depth (TE-BFE): _____ ft.

2X Max Bankfull Depth (2XMBD): _____ ft.

Floodprone Area Elevation (TE-

2XMBD): _____ ft.

Floodprone Area Width (FPW): _____ ft.

Entrenchment Ratio(FPW/W): _____

	us elv	ds elv	elv. diff.
WS Elv.(WSE)	_____ ft.	_____ ft.	_____ ft.
Thalweg Elv.(TE)	_____ ft.	_____ ft.	_____ ft.
Valley Elv.(VE)	_____ ft.	_____ ft.	_____ ft.
Assessment Reach Length (ARL):	_____ ft.		
Valley Distance (VD):	_____ ft.		

WS Slope (WSE/ARL): _____ ft./ft.

Valley Slope (VE/VD): _____ ft./ft.

Sinuosity (ARD/VD): _____

Meander Length: _____ ft.

Belt Width: _____ ft.

CLASSIFICATION (USE ROSGEN KEY OF NATURAL RIVERS):

Channel Type:

Single Thread []

Multiple Channels []

Entrenchment Ratio:

<1.4 []

1.4-2.2 []

>2.2 []

Width/Depth Ratio:

<12 []

12-40 []

>40 []

Sinuosity:

<1.2 []

1.2-1.5 []

>1.5 []

D50: _____

Adjustments? _____

**Rosgen
Stream
Type: _____**

Habitat Parameter	Optimal 16-20	Sub-Optimal 11-15	Marginal 6-10	Poor 0-5
Instream Habitat	Greater than 50% of a variety of cobble, boulder, submerged logs, undercut banks, snags rootwads, aquatic plants or other stable habitat.	30-50% of stable habitat. Adequate habitat.	10-30% mix of stable habitat. Habitat availability less than desirable.	Less than 10% of stable habitat. Lack of habitat is obvious.
Epifaunal Substrate	Preferred substrate abundant, stable, and at full colonization potential (riffles well developed and dominated by cobble; and/or woody debris prevalent, no new, and not transient)	Abundance of cobble with gravel &/or boulders common; or woody debris, aquatic veg., undercut banks, or other productive common but not prevalent/suited for full colonization.	Large boulders and/or bedrock prevalent; cobble, woody debris, or other preferred surfaces uncommon.	Stable substrates lacking; or particles are over 75% surrounded by fine sediment or flocculent material.
Velocity/Depth Diversity	Slow (<0.3 m/s), deep (>0.5m); slow, shallow (<0.5m); fast (>0.3m/s), deep; fast, shallow habitats all 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; both deep (>0.5m)/shallows (<0.2m) 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 pool/glide/eddy habitat; or absent completely.
Riffle/Run Quality	Riffle/run depth generally >10 cm, with maximum depth greater than 50 cm (maximum score); substrate stable (e.g. cobble, boulder) & variety of current velocities.	Riffle/run depth generally 5-10 cm, variety of current velocities.	Riffle/run depth generally 1-5 cm; primarily a single current velocity.	Riffle/run depth <1 cm; or riffle/run substrates concreted.
Embeddedness	Percentage that gravel, cobble, and boulder particles are surrounded by line sediment or flocculent material.			
Shading	Percentage of segment that is shaded (duration is considered in scoring). 0%= fully exposed to sunlight all day in summer; 100% fully and densely shaded in summer.			
Trash Rating	Little or no human refuse visible from stream channel or riparian zone.	Refuse present in minor amounts.	Refuse present in moderate amounts.	Refuse abundant and unsightly.
Bank Stability	Upper banks stable, 0-10% of banks with erosional scars and little potential for future problems.	Moderately stable. 10-30% of banks with erosional scars, mostly healed over. Slight potential in extreme floods.	Moderately unstable. 30-60% of banks with erosional scars and high erosion potential during extreme high flow.	Unstable. Many eroded areas. "Raw" areas frequent along straight sections and bends. Side slopes >60 common.
Remoteness	Stream segment more than ¼ mile from nearest road; access difficult and little or no evidence of human activity.	Stream segment within ¼ mile of but not immediately accessible to roadside access by trail; site with moderately wild character.	Stream within ¼ mile of roadside and accessible by trail; anthropogenic activities readily evident.	Segment immediately adjacent to roadside access; visual, olfactory, and/or auditory 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 Gauge

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

Other Notes:

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

STREAM NAME _____	LOCATION _____	
STATION # _____	STREAM CLASS _____	
LAT _____	RIVER BASIN _____	
STORET # _____	AGENCY _____	
INVESTIGATORS _____		
FORM COMPLETED BY _____	DATE _____ TIME _____	REASON FOR SURVEY _____

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

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

Total Score _____

Benthic Spring Sampling Data Sheet

SITE	Watershed Code [][][][]	Segment [][][]	Type [][]	Year 2 0 0 5	Reviewed By: _____
BASIN	[][]	Sample Label Verified By: _____			2nd Reviewer: _____
DATE	Year [][]	Month [][]	Day [][]	Crew: _____	
TIME	[][][][] (Military)	Project: _____			

Distance from Nearest Road to Site (m) [][][][]

Remoteness [][][][]

Bank Erosion

	Left Bank	Right Bank
Extent	[][]	[][]
Severity		
1=min		
2=mod	[][]	[][]
3=severe		
Eroded Area (m ² X 10)	[][][][]	[][][][]
Bank Stability	[][][][]	[][][][]

Benthic Habitat Sampled
(Square feet; Total = 20 square feet)

Riffle	[][][][]
Rootwad/Woody Debris	[][][][]
Leaf Pack	[][][][]
Macrophytes	[][][][]
Undercut Banks	[][][][]
Other (Specify) _____	[][][][]

Stream Width (m)

0 m	[][][][]
75 m	[][][][]

LANDUSE (Y/N)

Old Field	[][]
Deciduous Forest	[][]
Coniferous Forest	[][]
Wetland	[][]
Surface Mine	[][]
Landfill	[][]
Residential	[][]
Commercial/Industrial	[][]
Cropland	[][]
Pasture	[][]
Orchard/Vineyard/Nursery	[][]
Golf Course	[][]

RIPARIAN VEGETATION (facing upstream)

	Left Bank	Right Bank
Width (50m max)	[][][][]	[][][][]
Adjacent Land Cover	[][][][]	[][][][]
Vegetation Type (see back)	[][][][]	[][][][]
Buffer Breaks (Y/N)	[][][][]	[][][][]
Buffer Break Types (M=minor; S=severe)		
Storm Drain	[][]	[][]
Tile Drain	[][]	[][]
Impervious Drainage	[][]	[][]
Gully	[][]	[][]
Orchard	[][]	[][]
Crop	[][]	[][]
Pasture	[][]	[][]
New Construction	[][]	[][]
Dirt Road	[][]	[][]
Gravel Road	[][]	[][]
Raw Sewage	[][]	[][]
Railroad	[][]	[][]

CHANNELIZATION

Evidence of Channel Straightening or Dredging (Y/N) [][]

TYPE	Left Bank	Bottom	Right Bank
Concrete	[][][][]	[][][][]	[][][][]
Gabion	[][][][]	[][][][]	[][][][]
Rip-rap	[][][][]	[][][][]	[][][][]
Earthen Berm	[][][][]	[][][][]	[][][][]
Drege Spoil off Channel	[][][][]	[][][][]	[][][][]
Pipe Culvert	[][][][]	[][][][]	[][][][]

HABITAT ASSESSMENT

Instream Habitat (0-20)	[][][][]
Epifaunal Substrate (0-20)	[][][][]
Velocity/Depth Diversity (0-20)	[][][][]
Pool/Glide/Eddy Quality (0-20)	[][][][]
Extent (0-20)	[][][][]
Riffle/Run Quality (0-20)	[][][][]
Extent (0-20)	[][][][]
Embeddedness (%)	[][][][]
Shading (%)	[][][][]
Trash Rating	[][][][]

WATER QUALITY PARAMETERS

Temperature © [][] . [][]

DO (mg/L) [][] . [][]

pH [][] . [][]

Cond (ms/cm) [][] . [][][][]

Turbidity (NTU) [][][] . [][]

Meter Calibrations by: _____

Sampleability

[][] Benthos

[][] Habitat Assessment

[][] Water Quality

Road Culvert

[][] Culvert in Segment? (y/n)

[][] Sampleable? (y/n)

[][] Length of Culvert (m)

[][] Width of Culvert (m)

Maximum Depth (cm)

[][][]

No. Instream Woody Debris [][]

No. of Dewatered [][]

Woody Debris [][][][]

No. of Instream Rootwads [][]

No. of Dewatered Rootwads [][]

PHOTODOCUMENTATION

Picture Number [][][]

Subject _____

Picture Number [][][]

Subject _____

Picture Number [][][]

Subject _____

Picture Number [][][]

Subject _____

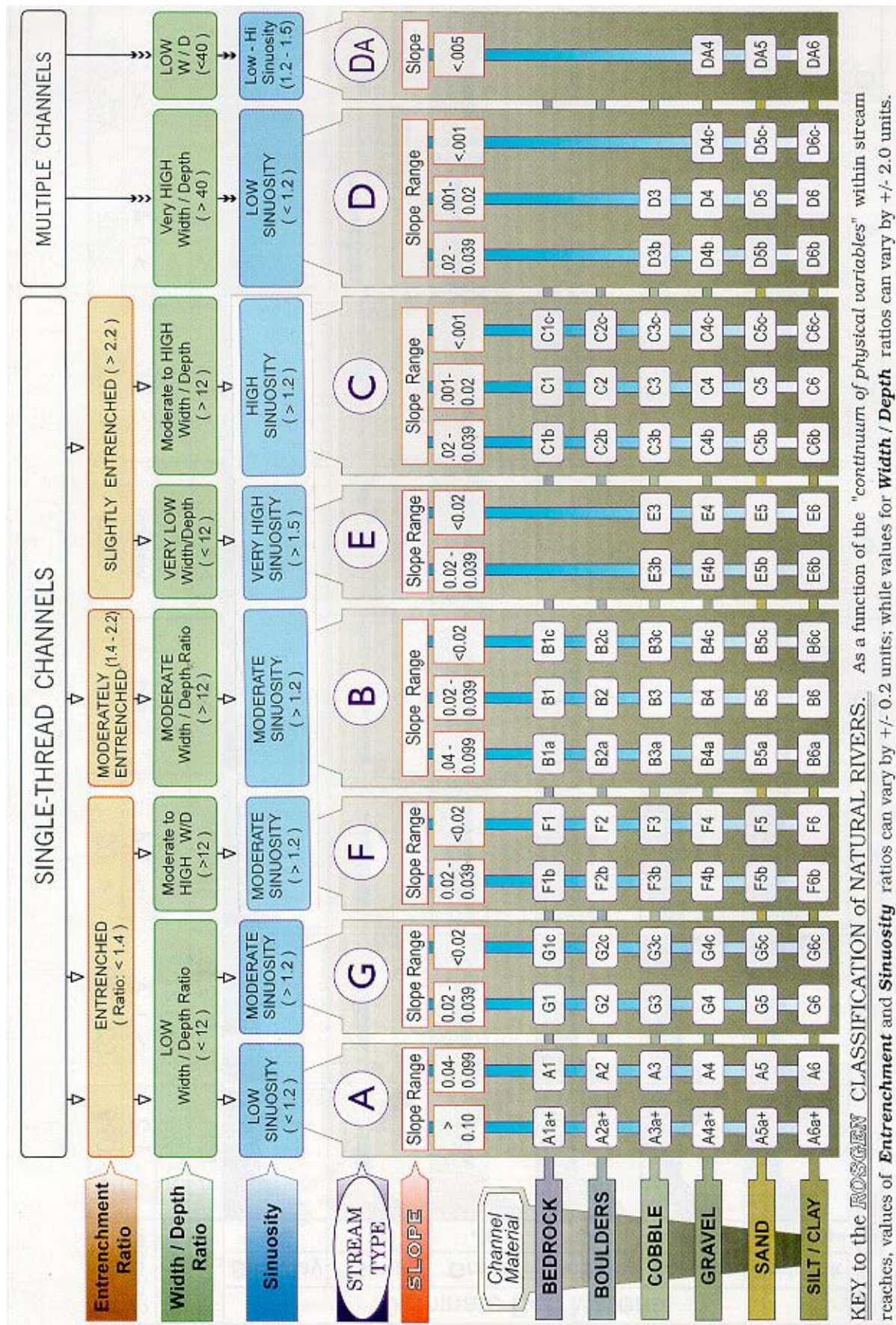
Site Access Route _____

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

GEOMORPHOLOGY RESULTS

Station ID	DA (mi ²)	ER (f/f)	Wbf (ft)	Dbf (ft)	W/D (ft/ft)	Abf (ft ²)	Slope (%)	Sinuosity (ft/ft)	Wfp (ft)	D50 (mm)	Adj?	Level II Stream Type
R2-05-01	0.65	2.8	11	1	10.5	11.5	0.26	1.5	32	0.32	↑WD	C5
R2-05-02	0.33	1.3	8.5	0.7	12.1	6	0.3	1.3	11	0.062	↓WD	G6c
R2-05-03	0.75	9.4	17	2.5	6.7	43.2	0.45	1.2	160	0.21	↑Sin	E5
R2-05-04	0.33	–	–	–	–	–	–	–	–	–	–	ND
R2-05-05	0.81	8.8	9.3	1.3	7.2	12.1	0.31	1	82	0.31	↑Sin	E5
R2-05-07	0.42	9.1	11.9	0.9	13.3	10.6	0.39	1.1	108	0.35	↑Sin	E5
R2-05-08	0.67	7.4	9.7	1.2	8.2	11.6	0.75	1.5	72	0.067	None	E5
R2-05-09	4.25	2.9	50.1	1.3	37.4	67	0.38	1	143	0.12	None	DA5
R2-05-10	7.01	1.9	102.6	1.7	61.5	171.1	0.05	1.2	198	0.2	None	DA5
R2-05-12A	1.2	7.8	25.2	2.2	11.5	55.1	0.02	1.2	197	0.22	↑WD	C5
R2-12-01	0.25	–	–	–	–	–	–	–	–	–	–	ND
R2-12-02	0.66	1.6	13.5	1.5	9.1	20	0.38	1.1	22	0.3	↓ER	G5c
R2-12-03	1.14	15.9	11.2	0.9	12.7	9.8	0.55	1.7	177	0.2	None	C5
R2-12-04	0.34	1.5	6.2	0.8	7.3	5.2	1.1	1.1	9	0.19	↓ER	G5c
R2-12-06	0.22	1.6	9.6	0.5	18.9	4.9	0.22	1	15	0.14	↑Sin	B5c
R2-12-07	0.4	10.7	11.3	0.4	25.6	5	0.54	1.1	121	0.26	↑Sin	C5
R2-12-08	0.44	1.4	6.3	0.9	6.8	5.7	0.44	1.2	9	0.062	None	G6c
R2-12-11A	0.47	1.5	6.3	0.8	8	5	0.52	1.2	9	0.062	↓ER	G6c
R2-12-12A	1.57	1.6	10.5	1.1	9.6	11.4	0.38	1.5	17	0.27	↓ER	G6c
R2-12-13A	0.58	2.1	8.2	1.2	6.6	10	0.73	1	17	0.081	↑ER, Sin	E5
R2-14-04	0.26	1.2	8.4	1.4	6	11.8	0.55	1.1	10	0.062	↑Sin	G6c
R2-14-05	0.26	1.5	6.5	0.8	7.9	5.4	0.61	1.2	10	0.22	↓ER	G5c
R2-14-06	0.24	1.3	6.2	0.7	9.1	4.2	0.98	1.1	8	0.24	↑Sin	G5c
R2-14-07	0.21	1.2	7.9	0.7	10.7	5.8	0.98	1.1	9	0.25	↑Sin	G5c
R2-14-08	0.6	22.2	6.2	0.8	7.4	5.2	0.42	1	138	0.1	↑Sin	E5
R2-14-10	2.2	2.7	14.1	2	11	18.2	0.38	1	38	0.076	↑Sin	E5
R2-14-13A	0.18	2.1	5.2	0.8	6.4	4.3	0.74	1.4	11	0.39	↑ER	E5
R2-14-14A	0.81	1.3	10.4	0.6	18	5.9	0.15	1.1	13	0.17	↑Sin	F5
R2-14-15A	2.2	2.6	19.2	1	19.3	19	0.27	1	50	0.13	↑Sin	C5
R2-14-16A	0.09	2	5.4	0.7	8	3.6	1.03	1.2	11	0.23	↑WD	B5c
R2-17-01	2.9	22.9	20	1.5	13.1	30.6	0.62	1.1	459	0.4	↑Sin	C5
R2-17-02	1.04	1.2	16.7	1.3	12.4	22.5	0.65	1	20	11	↑Sin	F4
R2-17-03	0.54	4.1	6.3	1.2	5.2	7.7	0.66	1	26	0.6	↑Sin	E5
R2-17-04	0.66	11.5	9.7	1.7	5.9	16.1	0.37	1.3	112	2.6	↑Sin	E4
R2-17-05	0.13	2.1	3.8	1	3.6	3.9	1.4	1.4	8	0.19	↑Sin, ER	E5
R2-17-06	0.96	1.4	11.6	1.2	9.7	14	0.4	1	16	4.7	↑Sin	G4
R2-17-09	0.48	1.9	7.7	1.2	6.5	9.1	0.46	1.4	15	0.47	↑ER, Sin	E5

Station ID	DA (mi ²)	ER (f/f)	Wbf (ft)	Dbf (ft)	W/D (ft/ft)	Abf (ft ²)	Slope (%)	Sinuosity (ft/ft)	Wfp (ft)	D50 (mm)	Adj?	Level II Stream Type
R2-17-10	1.03	–	–	–	–	–	–	–	–	–	–	ND
R2-17-11A	0.63	1.2	10	0.6	16	6.3	0.79	1.2	12	11	None	F4
R2-17-12A	1.1	–	–	–	–	–	–	–	–	–	–	ND
R2-20-01	0.28	35.2	7.4	1.1	6.4	8.4	0.52	1.2	259	0.16	↑Sin	E5
R2-20-03	0.18	1.8	5.3	0.9	6.2	4.5	1.5	1.1	10	0.062	↓ER	G6c
R2-20-04	5.7	1.2	19.7	1.4	13.8	28.1	0.13	1.1	23	9.6	↑Sin	F4
R2-20-07	0.26	1.4	7.2	1.5	4.7	10.9	0.87	1	10	0.21	↑Sin	G5
R2-20-08	3.9	1.9	18.6	1.1	16.4	21.2	0.25	1	35	0.17	↑Sin	B5c
R2-20-11A	5.2	1.3	22.7	1.5	15.3	33.8	0.57	1	29	0.48	↑Sin	F5
R2-20-12A	0.12	1.2	5.3	0.8	6.5	4.2	0.51	1	6	0.13	↑Sin	G5c
R2-20-13A	0.03	1.6	4.2	0.4	9.5	1.9	2.4	1.1	7	0.21	↓ER, ↑Sin	G5
R2-20-14A	0.25	1.2	7.8	1.4	5.7	10.6	1.2	1.3	9	0.23	None	G5c
R2-20-17A	0.31	1.7	9	1.4	6.4	12.7	0.96	1.2	15	0.062	↑WD	B6c

NOTES:

ND = no data; data collection/stream classification not done for sites 05-04, 12-01, 7-10, and 17-12A

DA = Drainage Area

ER = Entrenchment Ratio

Wbf = Width of the bankfull channel

Dbf = Mean depth of the bankfull channel

Abf = Area of the bankfull channel

Wfp= Width of the floodprone area

D50 = Size of median particle within the reach

Adj? = Any adjustments made to parameters as allowed in the Rosgen Classification System

APPENDIX D

QUALITY CONTROL SUMMARY

QUALITY CONTROL SUMMARY

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).

Field sampling precision 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 ± 0.5 for median relative percent difference (RPD), coefficient of variability (CV), and 90 percent confidence interval, respectively. Results for the 2009 data in this dataset were 0.1, 4.8, and ± 0.2 . 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. The same is true for scrapers.

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

Index and metrics	mean	avgRPD	medRPD	MSE	RMSE	CV	CI90
B-IBI	2.4	7.2	0.1	0.0	0.1	4.8	0.2
Total Taxa	25.0	13.6	13.3	2.9	1.7	6.9	2.8
EPT Taxa	2.7	76.4	66.7	0.4	0.7	24.4	1.1
Ephemeroptera taxa	na	na	na	na	na	na	na
% Intolerant-Urban	20.0	71.0	30.8	208.6	14.4	72.1	23.7
% Ephemeroptera	na	na	na	na	na	na	na
Scraper Taxa	na	na	na	na	na	na	na
% climbers	22.5	19.5	17.2	12.4	3.5	15.7	5.8

Abbreviations: medRPD is median 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, indicating zero (0) values for Ephemeroptera and scrapers in the samples.

Laboratory sorting and subsampling bias was tested by an external laboratory for 12 sort residue samples over a 2-year period (2007-08) (Table D-2). All samples passed the measurement quality objective of PSE > 90%. For these samples, PSE ranged from 92.9 to 100%. Although these sort QC results do not represent the 2009 Anne Arundel County sample lot, they do demonstrate the efficiency of the lab sorting personnel from the same contract laboratory (Aon previous Anne Arundel County samples).

Table D-2. Results from external re-checks of laboratory sort residue, benthic macroinvertebrates.

Station ID	No. orgs (primary)	No. recoveries	Total No.	PSE
01-12a	103	0	103	100
07-02	102	0	102	100
07-08	110	2	112	98.2
24-11A	115	0	115	100
24-11A	103	1	104	99.0
24-11A	110	0	110	100
04-06	100	4	104	96.2
04-10	100	1	101	99.0
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
mean				97.9

Taxonomic precision was tested by using an independent taxonomist (from a separate laboratory) to re-identify a randomly-selected subset of five samples, and then quantifying differences. The most important result is that of PTD, for which the measurement quality objective (MQO) is 15%. All five sample comparisons fell well below the MQO, with an overall mean of 4.4 (sd. 2.0), with values ranging from 2.6-7.0 (Table D-3). There were very few disagreements. No corrective actions were necessary. Table D-4 provides a summary comparison of QC results with programmatic MQO.

Table D-3. QC results from taxonomic re-identification of randomly selected samples. Abbreviations: T1, primary taxonomist; T2, quality control taxonomist; PDE, percent difference in enumeration; PTD, percent taxonomic disagreement; PTC (absdiff), percent taxonomic completeness (absolute difference).

No. individuals						
Sample ID	T1	T2	No. matches	PDE	PTD	PTC (absdiff)
R2-05-01	116	116	113	0	2.6	0.9
R2-05-08	113	113	109	0	3.5	0

No. individuals						
Sample ID	T1	T2	No. matches	PDE	PTD	PTC (absdiff)
R2-12-01	109	109	106	0	2.8	1.9
R2-14-16A	114	113	106	0.4	7.0	6.2
R2-20-12A	117	116	110	0.4	6.0	0
mean				0.2	4.4	1.8
sd				0.2	2.0	2.6

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

Activity	Performance indicator	Term	MQO	Result
A. Field sampling	Precision	Median relative pct. difference (mRPD)	<15	0.1
		Root mean square error (RMSE)	na	0.1
		Coefficient of variability (CV)	<10	4.8
		90% confidence interval (CI90)	≤(±0.5)	0.2
B. Sorting/ subsampling	Bias	Pct. sorting efficiency (PSE)	>90	97.9
C. Taxonomic identification	Precision (consistency)	Pct. difference in enumeration (PDE)	<5	0.2
		Pct. taxonomic disagreement (PTD)	<15	4.4

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*. Prepared for: Anne Arundel County (MD), Department of Public Works; Watersheds, Ecosystems, and Restoration Services, Annapolis, MD. Prepared by: 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*).



Martin O'Malley, Governor
Anthony G. Brown, Lt. Governor
John R. Griffin, Secretary
Eric Schwaab, Deputy Secretary

To: Chris Victoria
From: Dan Boward
CC: Ron Klauda, Scott Stranko
Date: May 5, 2009
Subject: Tetra Tech Crew Field Audit – March 18, 2009

The following details my field audit of the Tetra Tech crew (Chad Barbour and Chris Wharton; hereafter referred to as the Anne Arundel [AA] Crew) on March 18, 2009. I'll focus on protocols used by both MBSS and AA crews. Both Chad and Chris had attended Maryland Biological Stream Survey (MBSS) spring 2009 training.

One site (R2-05-03; unnamed tributary to Marley Creek near Glen Burnie) was visited to evaluate the comparability between the AA Crew's protocols and those of the Maryland Biological Stream Survey.

Permission, Site Location and Site Marking: As is done with the MBSS, permission to sample the site was obtained in advance of our arrival. Unlike MBSS, however, Anne Arundel County protocols call for directly contacting only landowners that clearly own the property adjacent to the sample site. This was a randomly-selected site on public property.

Site location was determined using a hand-held GPS unit with coordinates previously uploaded, thereby reducing errors due to manual input of data. All site markings were determined in accordance with MBSS protocols. Note that, because Anne Arundel County sites will not be revisited during summer for electrofishing surveys and habitat assessments (as is done using MBSS protocols), only the 0m, midpoint and 75m locations are marked with flagging. Good care was taken to minimally disturb stream habitat while measuring and marking the site.

I evaluated most of the MBSS parameters relating to site location and description similarly to the AA Crew.

Water Physicochemical Parameters: A YSI 650 MDS unit was used to measure dissolved oxygen, pH, water temperature, and specific conductance. The unit had been calibrated the previous evening. All probes and membranes were clean and in good working condition. AA crew members followed MBSS protocols for the deployment of the unit and allowed ample time for the unit to stabilize.

Benthic Sampling: Benthic sampling equipment, including the D-net and sieve bucket, were in good condition and no holes or tears were observed. The AA crew effectively sampled 20 ft² of the best available habitat. However, sharing data on benthic habitat sampled may be difficult. The AA Crew field sheet lists such benthic habitats as cobble, snags and sand whereas the MBSS field sheet lists riffles and rootwads/woody debris. The volume of sample material was appropriate for the mix of habitat types in the stream. My estimates of the proportions of habitat to sample differed somewhat as follows:

DB riffle: 2 square feet; AA cobble: 0 square feet

DB leaf pack: 10 square feet; AA snags (primary leaves): 7 square feet

DB rootwad/woody debris: 8 square feet; AA Other (woody debris): 4 square feet

The AA Crew also sampled 3 square feet of vegetated banks and 2 square feet of sand.

Habitat Evaluation: AA protocols combine aspects of both spring and summer MBSS habitat protocols. Some summer MBSS habitat parameters are evaluated in the spring (by AA crews) and some are not. Those MBSS summer protocols not evaluated by AA Crews in the spring include: Bar Formation and Substrate, and Flow (velocity is estimated by AA crews using a floating object). However, Bank Erosion, Woody Debris and Rootwad Counts, and the Visual Habitat Assessment – all from the MBSS Summer Data Sheet – are conducted by AA Crews in the spring.

Despite seasonal differences in habitat quality and quantity, the AA crew followed protocols and scored features mostly in line with MBSS protocols.

Summary

The Tetra Tech crew adequately followed the field protocols specified by MBSS. The differences that were noted were relatively minor, and in all likelihood would not dramatically affect the overall evaluation of the site.

Other Comments:

1. On the driver's side window of the sampling vehicle (an unmarked SUV), the crew posted a clearly-worded sign that described what they were doing, why they were doing it and that permission had been granted to access the site. The sign also contained information on how to contact Chris Victoria. I thought this was an excellent idea.
2. I recommend that at least the AA Crew leader attend summer MBSS training to learn, first hand, protocols for summer MBSS habitat assessments.
3. The AA Crew members are disinfecting waders, sampling equipment, etc. with bleach. They were not doing this last year when I conducted an audit. This is good news.



*Department of Public Works
Bureau of Engineering
Watershed, Ecosystem, and Restoration
Services*

**QA/QC
Audit**

**Quality Control Field Audit of Tetra Tech, Inc., Performance in the
Geomorphological Assessment Work as part of the Countywide Biological
Monitoring Program**

Prepared by: Christopher Victoria, DPW, WERS

Date: 18 March 2009

On 9 and 16 March 2009, I evaluated the field activities of Tetra Tech (Tt) personnel as they collected the required geomorphological data as part of Year One of Round Two of the Countywide Biological Monitoring Program. Work at two sites (R2-12-03 and R2-05-02) was evaluated. This short report describes my findings.

OFFICE WORK. For each site, the drainage area was determined before going to the field and the crew had the information with them in the field. At site R2-12-03, the information had been left in the truck, but was obtained later. At site R2-05-02, the crew brought the information with them. However, the crew was unclear on exactly when to use the information in helping them to select the correct bankfull indicator. The survey instrument was an optical instrument owned by Tt, but no calibration or other QC checks were performed on the unit before fieldwork began. The crew chief stated that the unit was new and believed it to be in good working order. However, he did not know what procedures the manufacturer of the instrument might require to ensure that assumption was true.

Conversely, some of the other equipment used by the crews was in very poor condition. The survey rod showed excessive wear in the 2 to 3 meter range, such that the marks were very difficult to see, even close up. The tape measure used for the cross section tag line was broken so the crew needed to begin the section at the 1-meter mark and not at zero, a potential source of error. In addition, no rod levels were used at either site to ensure the survey rod was held plumb and square to the instrument during measurements, an important consideration with optical instruments.

None of the crewmembers have 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 and had performed survey work on streams in the performance of other projects.

REACH RECONNAISSANCE. Site R2-05-02 had the geomorphic reach co-located with the bioassessment reach, with the cross section located near the reach midpoint after a discussion of the possible impact of the culvert outside the bioassessment reach might have had on channel form. At site R2-12-03, a discussion was necessary before cross section placement to ensure proper location, which resulted in its establishment just downstream of the bioassessment reach. A discussion of the need for a thorough

examination of the stream both within and outside of the assessment reach occurred. Suggestions were made to the crew on how to accomplish this efficiently with no additional work. For both sites, the crew was reminded that the bankfull indicator should be found throughout the reach. Discussions of how to accomplish this, in the context of the challenges found at each site, occurred with the crews. The regional relationships were used to confirm calls, but only after reminders and discussions on how to use these numbers correctly.

CROSS SECTION MEASUREMENT. At both reaches, the zero point was set on the left bank / down stream. The survey instrument was properly set up. Monuments were properly installed and marked. A GPS was taken and the location was properly described. Adequate photos were taken, but not precisely at the cross section. All necessary measurements were made on the cross section. At site R2-05-02, the crew was cautioned about not trampling channel features during tag line set up. At R2-12-03, a mistake was made during the measurement, but was caught by the instrument operator and corrected. Additionally, a suggestion was made about standing behind the rod during measurements to better steady it during the work. Data were properly recorded on the appropriate data sheets, but the crew was cautioned not to have any blank fields on the form. Floodprone width calculations were made in the field and the final FPW was measured using a handheld range finder. The accuracy of the rangefinder was confirmed at site R2-12-03 by measuring the distance using the 100 m tape.

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 at R2-12-03 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. At R2-05-02, 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. However, this was not possible at R2-12-03 due to difficult site conditions, but a water surface elevation spanning most of the reach was collected.

OVERALL COMMENTS. In most cases, the geomorphic data collection activities are being properly executed, but there are some deficiencies that require correction or were corrected in the field:

1. The missing (rod levels) and worn out equipment described above compromises data quality and requires immediate correction. The crew leader assured me that a new survey rod would be obtained immediately and that rod levels would be used starting 17 March. An undamaged tape should also be used for the tag line as soon as possible.
2. The level is as much a scientific instrument as your water quality meter and, as such, requires the same attention to calibration and QA/QC procedures. Please ensure that you have a thorough knowledge of these requirements for the survey instruments you are using on this project and implement them as soon as possible.
3. The team was reminded to bring the drainage area vs. channel geometry information to the field. A discussion of the application and utility of this information took place.

4. A variety of technique suggestions were made to increase the speed of the work without compromising data quality.
5. 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 (BENTHIC MACROINVERTEBRATES)

Order	Family	Genus	TolVal	FFG	Habit
Amphipoda	Gammaridae	Synurella	4	Collector	Sprawler
Amphipoda	Crangonyctidae	Crangonyx	4	Collector	Sprawler
Amphipoda	Crangonyctidae	Stygobromus	4	Predator	
Amphipoda	Gammaridae	Gammarus	6	Omnivore	Sprawler
Amphipoda	Gammaridae	Stygonectes	6		
Amphipoda	Hyalellidae	Hyalella	8	Collector	Sprawler
Basommatophora	Ancylidae	Ferrissia	7	Scraper	Climber
Basommatophora	Lymnaeidae	Fossaria	8	Scraper	Climber
Basommatophora	Lymnaeidae	Pseudosuccinea	6	Scraper	Climber
Basommatophora	Physidae	Physa	8	Scraper	
Basommatophora	Physidae	Physella	8	Scraper	Climber
Basommatophora	Planorbidae	Gyraulus	8	Scraper	Climber
Basommatophora	Planorbidae	Helisoma	6	Scraper	Climber
Basommatophora	Planorbidae	Menetus	8	Scraper	Climber
Basommatophora	Planorbidae	Micromenetus		Scraper	
Coleoptera	Chrysomelidae		8	Shredder	Clinger
Coleoptera	Curculionidae		6	Shredder	Clinger
Coleoptera	Dytiscidae		5	Predator	
Coleoptera	Dytiscidae	Agabus	5	Predator	Swimmer
Coleoptera	Dytiscidae	Copelatus	5	Predator	Swimmer
Coleoptera	Dytiscidae	Graphoderus		Predator	
Coleoptera	Dytiscidae	Helichus	5	Scraper	Clinger
Coleoptera	Dytiscidae	Hydaticus	5	Predator	Swimmer
Coleoptera	Dytiscidae	Laccophilus	5	Predator	Swimmer
Coleoptera	Dytiscidae	Lioporeus	5	Predator	Swimmer
Coleoptera	Dytiscidae	Matus		Predator	Swimmer
Coleoptera	Dytiscidae	Neoporus	5	Predator	Swimmer
Coleoptera	Dytiscidae	Oreodytes		Predator	Swimmer
Coleoptera	Dytiscidae	Uvarus	5	Predator	Swimmer
Coleoptera	Elmidae	Ancyronyx	2	Omnivore	Clinger
Coleoptera	Elmidae	Dubiraphia	6	Collector	Clinger
Coleoptera	Elmidae	Macronychus	4	Omnivore	Clinger
Coleoptera	Elmidae	Microcylloepus	2	Collector	Clinger
Coleoptera	Elmidae	Optioservus	4	Scraper	Clinger
Coleoptera	Elmidae	Oulimnius	2	Scraper	Clinger
Coleoptera	Elmidae	Promoresia	2	Scraper	Clinger
Coleoptera	Elmidae	Stenelmis	6	Scraper	Clinger
Coleoptera	Gyrinidae	Dineutus	4	Predator	Swimmer
Coleoptera	Haliplidae	Peltodytes	5	Shredder	Climber
Coleoptera	Hydrophilidae	Helochaers	5	Omnivore	

Order	Family	Genus	TolVal	FFG	Habit
Coleoptera	Hydrophilidae	Helocombus			
Coleoptera	Hydrophilidae	Hydrobius	5	Predator	Climber
Coleoptera	Hydrophilidae	Hydrochara		Collector	
Coleoptera	Hydrophilidae	Sperchopsis	5	Predator	Clinger
Coleoptera	Ptilodactylidae	Anchytarsus	4	Shredder	Clinger
Coleoptera	Scirtidae	Cyphon	7	Scraper	Climber
Coleoptera	Scirtidae	Prionocyphon		Scraper	Climber
Decapoda	Cambaridae		6	Collector	Sprawler
Diptera	Ceratopogonidae	Alluaudomyia	6	Predator	Burrower
Diptera	Ceratopogonidae	Atrichopogon	2	Predator	Clinger
Diptera	Ceratopogonidae	Bezzia	6	Collector	Burrower
Diptera	Ceratopogonidae	Bezzia/Palpomyia	6	Predator	Burrower
Diptera	Ceratopogonidae	Ceratopogon	6	Predator	Burrower
Diptera	Ceratopogonidae	Culicoides	10	Predator	Burrower
Diptera	Ceratopogonidae	Dasyhelea	6	Collector	Sprawler
Diptera	Ceratopogonidae	Mallochohelea		Predator	Burrower
Diptera	Ceratopogonidae	Monohelea	6		
Diptera	Ceratopogonidae	Serromyia	6	Predator	Burrower
Diptera	Ceratopogonidae	Sphaeromyias	6	Predator	Burrower
Diptera	Chironomidae	Ablabesmyia	8	Collector	Sprawler
Diptera	Chironomidae	Alotanypus			Burrower
Diptera	Chironomidae	Apsectrotanypus	5	Predator	Burrower
Diptera	Chironomidae	Brillia	5	Shredder	Burrower
Diptera	Chironomidae	Chaetocladius	6	Collector	Sprawler
Diptera	Chironomidae	Chironomus	10	Collector	Burrower
Diptera	Chironomidae	Cladopelma	7	Collector	Burrower
Diptera	Chironomidae	Clinotanypus	8	Predator	Burrower
Diptera	Chironomidae	Conchapelopia	6	Predator	Sprawler
Diptera	Chironomidae	Constempellina	4	Collector	Climber
Diptera	Chironomidae	Corethrella			Swimmer
Diptera	Chironomidae	Corynoneura	7	Collector	Sprawler
Diptera	Chironomidae	Cricotopus	7	Shredder	Clinger
Diptera	Chironomidae	Cryptochironomus	8	Predator	Sprawler
Diptera	Chironomidae	Cryptotendipes	8	Collector	Sprawler
Diptera	Chironomidae	Diamesa	5	Collector	Sprawler
Diptera	Chironomidae	Dicrotendipes	10	Collector	Burrower
Diptera	Chironomidae	Diplocladius	7	Collector	Sprawler
Diptera	Chironomidae	Endochironomus	10	Shredder	Clinger
Diptera	Chironomidae	Eukiefferiella	8	Collector	Sprawler
Diptera	Chironomidae	Georthocladius	8		Sprawler

Order	Family	Genus	TolVal	FFG	Habit
Diptera	Chironomidae	Glyptotendipes	10	Filterer	Burrower
Diptera	Chironomidae	Guttipelopia		Predator	
Diptera	Chironomidae	Gymnometriocnemus	7	Collector	Sprawler
Diptera	Chironomidae	Heterotanytarsus			
Diptera	Chironomidae	Heterotrissocladius	0	Collector	Sprawler
Diptera	Chironomidae	Hydrobaenus	8	Scraper	Sprawler
Diptera	Chironomidae	Kiefferulus	10	Collector	Burrower
Diptera	Chironomidae	Krenopelopia	6	Predator	Sprawler
Diptera	Chironomidae	Labrundinia	7	Predator	Sprawler
Diptera	Chironomidae	Larsia	6	Predator	Sprawler
Diptera	Chironomidae	Limnophyes	8	Collector	Sprawler
Diptera	Chironomidae	Meropelopia	7		
Diptera	Chironomidae	Mesocricotopus		Collector	
Diptera	Chironomidae	Mesosmittia	4		Sprawler
Diptera	Chironomidae	Nanocladius	3	Collector	Sprawler
Diptera	Chironomidae	Natarsia	8	Predator	Sprawler
Diptera	Chironomidae	Odontomesa	4	Collector	Sprawler
Diptera	Chironomidae	Omisus	4		
Diptera	Chironomidae	Orthocladius	6	Collector	Sprawler
Diptera	Chironomidae	Parachaetocladius	2	Collector	Sprawler
Diptera	Chironomidae	Paracladopelma	7	Collector	Sprawler
Diptera	Chironomidae	Parakiefferiella	4	Collector	Sprawler
Diptera	Chironomidae	Paralauterborniella	8	Collector	Clinger
Diptera	Chironomidae	Paramerina	4	Predator	Sprawler
Diptera	Chironomidae	Parametriocnemus	5	Collector	Sprawler
Diptera	Chironomidae	Paraphaenocladius	4	Collector	Sprawler
Diptera	Chironomidae	Paratendipes	8	Collector	Burrower
Diptera	Chironomidae	Pentaneura	6	Predator	Sprawler
Diptera	Chironomidae	Phaenopsectra	7	Scraper	Clinger
Diptera	Chironomidae	Polypedilum	6	Shredder	Climber
Diptera	Chironomidae	Potthastia	2	Omnivore	Sprawler
Diptera	Chironomidae	Procladius	9	Predator	Sprawler
Diptera	Chironomidae	Prodiamesa	3	Collector	Burrower
Diptera	Chironomidae	Psectrocladius	8	Collector	Sprawler
Diptera	Chironomidae	Psectrotanypus	10	Predator	Sprawler
Diptera	Chironomidae	Pseudorthocladius	0	Collector	Sprawler
Diptera	Chironomidae	Pseudosmittia	6	Collector	Sprawler
Diptera	Chironomidae	Psilometriocnemus		Collector	Sprawler
Diptera	Chironomidae	Radotanytus			
Diptera	Chironomidae	Rheocricotopus	6	Collector	Sprawler

Order	Family	Genus	TolVal	FFG	Habit
Diptera	Chironomidae	Rheosmittia	7	Collector	Burrower
Diptera	Chironomidae	Robackia		Collector	Burrower
Diptera	Chironomidae	Saetheria	4	Collector	Burrower
Diptera	Chironomidae	Smittia	6	Collector	Burrower
Diptera	Chironomidae	Stenochironomus	5	Shredder	Burrower
Diptera	Chironomidae	Stictochironomus	9	Omnivore	Burrower
Diptera	Chironomidae	Stilocladius	1	Collector	Sprawler
Diptera	Chironomidae	Sympotthastia	2	Collector	Sprawler
Diptera	Chironomidae	Tanypodinae	6	Predator	Burrower
Diptera	Chironomidae	Tanypus	10	Predator	Sprawler
Diptera	Chironomidae	Thienemanniella	6	Collector	Sprawler
Diptera	Chironomidae	Thienemannimyia	6	Predator	Sprawler
Diptera	Chironomidae	Thienemannimyia genus gr.			
Diptera	Chironomidae	Tribelos	5	Collector	Burrower
Diptera	Chironomidae	Tvetenia	5	Collector	Sprawler
Diptera	Chironomidae	Xenochironomus	6	Predator	
Diptera	Chironomidae	Xestochironomus	2	Omnivore	Burrower
Diptera	Chironomidae	Xylotopus	2	Shredder	Burrower
Diptera	Chironomidae	Zalutschia	7	Shredder	
Diptera	Chironomidae	Zavreliella		Collector	Burrower
Diptera	Chironomidae	Zavrelimyia	8	Predator	Sprawler
Diptera	Chironomidae	Bethbilbeckia			
Diptera	Chironomidae	Doithrix			
Diptera	Chironomidae	Krenosmittia	1	Collector	Sprawler
Diptera	Chironomidae	Parasmittia			
Diptera	Chironomidae	Telopelopia	8	Predator	
Diptera	Chironomidae	Cladotanytarsus	7	Collector	Climber
Diptera	Chironomidae	Micropsectra	7	Collector	Climber
Diptera	Chironomidae	Microtendipes	6	Filterer	Clinger
Diptera	Chironomidae	Paratanytarsus	6	Collector	Sprawler
Diptera	Chironomidae	Rheotanytarsus	6	Filterer	Clinger
Diptera	Chironomidae	Stempellinella	4	Collector	Climber
Diptera	Chironomidae	Sublettea	4	Filterer	
Diptera	Chironomidae	Tanytarsini	6	Filterer	Burrower
Diptera	Chironomidae	Tanytarsus	6	Filterer	Climber
Diptera	Chironomidae	Zavrelia	4	Collector	Swimmer
Diptera	Culicidae	Aedes	8	Filterer	Swimmer
Diptera	Culicidae	Anopheles	6	Filterer	Swimmer
Diptera	Culicidae	Culiseta		Collector	
Diptera	Culicidae	Wyeomyia			

Order	Family	Genus	TolVal	FFG	Habit
Diptera	Dixidae	Dixa	4	Collector	Swimmer
Diptera	Dixidae	Dixella	1	Collector	Swimmer
Diptera	Dolichopodidae		5	Predator	Burrower
Diptera	Empididae	Chelifera	3	Collector	sp, bu
Diptera	Empididae	Hemerodromia	6	Predator	Sprawler
Diptera	Empididae	Neoplasta		Predator	Sprawler
Diptera	Empididae	Wiedemannia/Clinocera			
Diptera	Ephydriidae		8	Collector	Burrower
Diptera	Psychodidae	Pericoma	4	Collector	Burrower
Diptera	Psychodidae	Psychoda	10	Collector	Burrower
Diptera	Ptychopteridae	Bittacomorpha	8	Collector	Burrower
Diptera	Sciomyzidae		10	Predator	Burrower
Diptera	Simuliidae	Prosimulium	7	Filterer	Clinger
Diptera	Simuliidae	Simulium	7	Filterer	Clinger
Diptera	Simuliidae	Stegopterna	7	Filterer	Clinger
Diptera	Stratiomyidae	Odontomyia	7	Collector	Sprawler
Diptera	Tabanidae	Chrysops	7	Collector	Sprawler
Diptera	Tabanidae	Tabanus	5	Predator	Sprawler
Diptera	Tipulidae	Antocha	5	Collector	Clinger
Diptera	Tipulidae	Cryptolabis	3	Shredder	Burrower
Diptera	Tipulidae	Dicranota	4	Predator	sp, bu
Diptera	Tipulidae	Erioptera	7	Collector	Burrower
Diptera	Tipulidae	Gonomyia	3	Collector	Burrower
Diptera	Tipulidae	Helius	4	Collector	Sprawler
Diptera	Tipulidae	Hexatoma	4	Predator	Burrower
Diptera	Tipulidae	Limnophila	4	Predator	Burrower
Diptera	Tipulidae	Limonia	6	Shredder	Burrower
Diptera	Tipulidae	Ormosia	3	Collector	Burrower
Diptera	Tipulidae	Pilaria	7	Predator	Burrower
Diptera	Tipulidae	Pseudolimnophila	2	Predator	Burrower
Diptera	Tipulidae	Rhabdomastix	2	Predator	Burrower
Diptera	Tipulidae	Tipula	4	Shredder	Burrower
Diptera	Tipulidae	Epiphragma			
Ephemeroptera	Baetidae	Acerpenna	4	Shredder	Swimmer
Ephemeroptera	Baetidae	Baetis	6	Collector	Swimmer
Ephemeroptera	Baetidae	Centroptilum	2	Collector	Swimmer
Ephemeroptera	Caenidae	Caenis	7	Collector	Sprawler
Ephemeroptera	Ephemerellidae	Ephemerella	2	Collector	Clinger
Ephemeroptera	Ephemerellidae	Eurylophella	4	Scraper	Clinger
Ephemeroptera	Heptageniidae	Stenonema		Scraper	Clinger

Order	Family	Genus	TolVal	FFG	Habit
Ephemeroptera	Heptageniidae	Stenonema	4	Scraper	Clinger
Ephemeroptera	Leptophlebiidae	Leptophlebia	4	Collector	Swimmer
Haplotaaxida	Enchytraeidae	Henlea			
Haplotaaxida	Haplotaaxidae	Haplotaaxis			
Haplotaaxida	Naididae	Nais	8	Coll./Gath.	
Haplotaaxida	Tubificidae	Limnodrilus	10	Coll./Gath.	
Haplotaaxida	Naididae	Nais	8	Filterer	Burrower
Haplotaaxida	Naididae	Specaria		Collector	
Haplotaaxida	Naididae	Uncinais			
Haplotaaxida	Tubificidae	Ilyodrilus	10		
Haplotaaxida	Lumbricidae		10	Collector	Burrower
Haplotaaxida	Naididae	Chaetogaster	6	Predator	
Haplotaaxida	Naididae	Dero	10	Collector	Burrower
Haplotaaxida	Naididae	Nais	8	Collector	
Haplotaaxida	Naididae	Pristina	8	Collector	
Haplotaaxida	Naididae	Slavina		Collector	
Haplotaaxida	Naididae	Stylaria			
Haplotaaxida	Tubificidae		10	Collector	Clinger
Haplotaaxida	Tubificidae	Aulodrilus	8	Collector	Sprawler
Haplotaaxida	Tubificidae	Bothrioneurum	5	Scraper	Burrower
Haplotaaxida	Tubificidae	Branchiura		Collector	Climber
Haplotaaxida	Tubificidae	Isochaetides	8	Collector	
Haplotaaxida	Tubificidae	Limnodrilus	10	Collector	Burrower
Haplotaaxida	Tubificidae	Potamothrix	10		
Haplotaaxida	Tubificidae	Quistradrilus	10	Collector	
Haplotaaxida	Tubificidae	Spirosperma	10	Collector	Clinger
Haplotaaxida	Tubificidae	Tubifex	10	Collector	Burrower
Heteroptera	Belostomatidae	Belostoma	10	Predator	Climber
Heteroptera	Corixidae		5	Predator	Swimmer
Heteroptera	Gerridae	Aquarius		Shredder	Skater
Heteroptera	Nepidae	Nepa		Predator	Climber
Heteroptera	Nepidae	Ranatra	7	Predator	Climber
Heteroptera	Veliidae	Microvelia	6	Predator	Skater
Hoplonemertea	Tetrastemmatidae	Prostoma	6	Predator	
Isopoda	Asellidae	Asellus	8	Collector	Sprawler
Isopoda	Asellidae	Caecidotea	8	Collector	Sprawler
Isopoda	Asellidae	Lirceus	8	Collector	Sprawler
Lepidoptera	Noctuidae		6	Shredder	Burrower
Lepidoptera	Pyralidae		5	Shredder	Climber
Lepidoptera	Pyralidae	Crambus	5	Shredder	

Order	Family	Genus	TolVal	FFG	Habit
Lumbriculida	Lumbriculidae	Eclipidrilus	8		
Lumbriculida	Lumbriculidae	Rhynchelmis			
Megaloptera	Corydalidae	Chauliodes	4	Predator	Clinger
Megaloptera	Corydalidae	Chauloides	6	Predator	Clinger
Megaloptera	Corydalidae	Corydalus	5	Predator	Clinger
Megaloptera	Corydalidae	Nigronia	0	Predator	Clinger
Megaloptera	Sialidae	Sialis	4	Predator	Burrower
Mesogastropoda	Hydrobiidae		8	Scraper	Climber
Mesogastropoda	Hydrobiidae	Amnicola	8	Scraper	Climber
Mesogastropoda	Viviparidae	Campeloma	6	Scraper	Climber
Odonata	Aeshnidae	Aeshna			
Odonata	Aeshnidae	Anax	5	Predator	Climber
Odonata	Aeshnidae	Boyeria	2	Predator	Climber
Odonata	Calopterygidae	Calopteryx	6	Predator	Climber
Odonata	Coenagrionidae	Amphiagrion	5	Predator	Climber
Odonata	Coenagrionidae	Argia	8	Predator	Clinger
Odonata	Coenagrionidae	Enallagma	8	Predator	Climber
Odonata	Coenagrionidae	Ischnura	9	Predator	Climber
Odonata	Cordulegastridae	Cordulegaster	3	Predator	Burrower
Odonata	Corduliidae	Somatochlora	1	Predator	Sprawler
Odonata	Gomphidae	Gomphus	5	Predator	Burrower
Odonata	Gomphidae	Progomphus	5	Predator	Burrower
Odonata	Libellulidae	Erythemis	5	Predator	Sprawler
Odonata	Libellulidae	Libellula	8	Predator	Sprawler
Odonata	Libellulidae	Perithemis	4	Predator	Sprawler
Pharyngobdellida	Erpobdellidae	Mooreobdella	8	Predator	Sprawler
Plecoptera	Capniidae	Allocapnia	3	Shredder	Clinger
Plecoptera	Capniidae	Paracapnia	1	Shredder	Sprawler
Plecoptera	Chloroperlidae	Haploperla	1	Scraper	Clinger
Plecoptera	Leuctridae	Leuctra	0	Shredder	Clinger
Plecoptera	Leuctridae	Paraleuctra		Shredder	Sprawler
Plecoptera	Nemouridae	Amphinemura	3	Shredder	Sprawler
Plecoptera	Nemouridae	Nemoura	1	Shredder	Sprawler
Plecoptera	Nemouridae	Paranemoura			
Plecoptera	Nemouridae	Prostoia		Shredder	Sprawler
Plecoptera	Perlidae	Eccopectura	3	Predator	Clinger
Plecoptera	Perlodidae	Cultus	1	Predator	Clinger
Plecoptera	Perlodidae	Isoperla	2	Predator	Clinger
Plecoptera	Taeniopterygidae	Oemopteryx	1	Shredder	Sprawler
Plecoptera	Taeniopterygidae	Strophopteryx	3		Sprawler

Order	Family	Genus	TolVal	FFG	Habit
Plecoptera	Taeniopterygidae	Taenionema		Scraper	Sprawler
Plecoptera	Taeniopterygidae	Taeniopteryx	2	Shredder	Sprawler
Rhynchobdellida	Glossiphoniidae	Helobdella		Parasite	Sprawler
Trichoptera	Calamoceratidae	Heteroplectron	3	Shredder	Sprawler
Trichoptera	Dipseudopsidae	Phylocentropus	5	Filterer	Burrower
Trichoptera	Hydropsychidae	Cheumatopsyche	5	Filterer	Clinger
Trichoptera	Hydropsychidae	Diplectrona	2	Filterer	Clinger
Trichoptera	Hydropsychidae	Hydropsyche	6	Filterer	Clinger
Trichoptera	Hydroptilidae	Ochrotrichia	4	Collector	Clinger
Trichoptera	Lepidostomatidae	Lepidostoma	3	Shredder	Climber
Trichoptera	Leptoceridae	Mystacides	4	Collector	Sprawler
Trichoptera	Leptoceridae	Oecetis	8	Predator	Clinger
Trichoptera	Leptoceridae	Triaenodes	6	MH	Swimmer
Trichoptera	Limnephilidae	Hesperophylax	6	Shredder	Sprawler
Trichoptera	Limnephilidae	Hydatophylax	2	Shredder	Sprawler
Trichoptera	Limnephilidae	Ironoquia	3	SH,SH	Sprawler
Trichoptera	Limnephilidae	Pycnopsyche	4	Shredder	Sprawler
Trichoptera	Molannidae	Molanna	6	Scraper	Sprawler
Trichoptera	Odontoceridae	Psilotreta	0	Scraper	Sprawler
Trichoptera	Philopotamidae	Chimarra	4	Filterer	Clinger
Trichoptera	Philopotamidae	Dolophilodes	0	Collector	Clinger
Trichoptera	Philopotamidae	Wormaldia	0	Filterer	Clinger
Trichoptera	Phryganeidae	Agrypnia	3	Shredder	Climber
Trichoptera	Phryganeidae	Hagenella			
Trichoptera	Phryganeidae	Ptilostomis	5	Shredder	Climber
Trichoptera	Phryganeidae	Oligostomis	2	Predator	Climber
Trichoptera	Polycentropodidae	Nyctiophylax	5	Filterer	Clinger
Trichoptera	Polycentropodidae	Polycentropus	5	Predator	Clinger
Trichoptera	Psychomyiidae	Cernotina	2	Predator	Clinger
Trichoptera	Psychomyiidae	Lype	2	Scraper	Clinger
Trichoptera	Psychomyiidae	Psychomyia	2	Scraper	Clinger
Trichoptera	Rhyacophilidae	Rhyacophila	1	Predator	Clinger
Trichoptera	Sericostomatidae	Agarodes	3	Shredder	Sprawler
Trichoptera	Uenoidae	Neophylax	3	Scraper	Clinger
Tricladida	Planariidae	Dugesia	4	Predator	Sprawler
Trombidiformes	Hygrobatidae	Hygrobates		Predator	
Trombidiformes	Lebertiidae	Lebertia	8	Predator	
Trombidiformes	Mideopsidae	Mideopsis		Predator	
Trombidiformes	Torrenticolidae	Torrenticola		Predator	
Trombidiformes	Unionicolidae	Unionicola		Predator	

Order	Family	Genus	TolVal	FFG	Habit
Veneroida	Corbiculidae	Corbicula	6	Filterer	Burrower
Veneroida	Pisidiidae	Musculium	5	Filterer	
Veneroida	Pisidiidae	Pisidium	8	Filterer	Burrower
Veneroida	Pisidiidae	Sphaerium	8	Collector	Burrower

APPENDIX F

SITE SUMMARIES



Upstream



Downstream

Location/Site Access: Located at end of Denton Ct., 260 ft West
Latitude/Longitude: 39.12602/-76.62431

Land Use Analysis:

Land Use	Acres	% Area
Commercial	22.9	5.5
Open Space	20.9	5.0
Residential 1/2-acre	14.4	3.5
Residential 1/4-acre	68.7	16.5
Residential 1/8-acre	221.1	53.2
Residential 1-acre	2.5	0.6
Residential 2-acre	0.7	0.2
Transportation	19.6	4.7
Utility	0.2	0.0
Woods	44.6	10.7
Grand Total	415.5	100.0

Impervious (acres)	Total Area Above site	% Impervious
142.1	415.5	34.2

Results:

- Biological condition – "Very Poor"
- Habitat scores "Not Supporting" and "Severely Degraded"
- Habitat assessment results indicate degraded conditions at this site and the biological community shows impairment.
- Bank, cover, and sediment conditions are poor or marginal.
- Sample dominated by midges.
- Stream type was identified as a C5, slope was 0.26 percent, and the median channel substrate was medium sand.
- Typically, C channels are stable, though the habitat conditions suggest that this channel may be degrading.

Recommendations:

- Protect the riparian area. Investigate possible hydrologic stresses due to high catchment imperviousness.

IBI and Metric Scores

Narrative Rating	Very Poor
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Overall Index	1.86
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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	23
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	0.86
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	7.76

Taxa List

Anisoptera	2
Cheumatopsyche	2
Corynoneura	3
Dicrotendipes	10
Fossaria	1
Hydrobaenus	1
Naïs	10
Nanocladius	1
Nemata	1
Orthocladinae	1
Orthocladus/Cricotopus	27
Paracladopelma	8
Paratanytarsus	6
Physa	6
Planariidae	1
Polypedilum	3
Prosimulium	1
Stenochironomus	3
Tanypodinae	1
Tanytarsus	5
Thienemanniella	18
Tubificinae	4
Tvetenia	1

Total Individuals

116

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	2	Pool Variability	9
Bank Stability- Right Bank	4	Riparian Vegetative	
Channel Alteration	18	Zone Width- Left Bank	9
Channel Flow Status	8	Riparian Vegetative	
Channel Sinuosity	6	Zone Width- Right Bank	9
Epifaunal Substrate/Available Cover	3	Sediment Deposition	4
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	2
		Vegetative Protection (Right Bank)	5

EPA Habitat Score	87
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EPA Narrative Ranking	NS
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Maryland Biological Stream Survey PHI

Drainage area (acres)	415	Instream Wood Debris	10
Remoteness	1	Bank Stability	6
Shading	90		
Epifaunal Substrate	3		
Instream Habitat	3		

PHI Score	50.76
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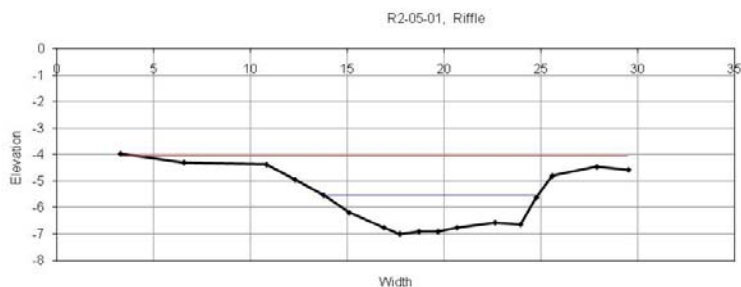
PHI Narrative Ranking	severely degraded
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Water Chemistry

Dissolved Oxygen (mg/L)	12.15	Specific Conductance (µS/cm)	1306
pH	7.31	Temperature (°C)	9.73

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.65	Cross Sectional Area (ft ²)	11.5
Bankfull Width (ft)	11.0	Slope (%)	0.26
Mean Bankfull Depth (ft)	1.0	Sinuosity	1.5
Floodprone Width (ft)	31	D50 (mm)	0.32
Entrenchment Ratio	2.8	Adjustments?	↑WD
Width to Depth Ratio	10.5	Rosgen Stream Type	C5





Upstream



Downstream

Location/Site Access: Located at Marley Neck Rd. Crossing, ~350ft U.S.
Latitude/Longitude: 39.15438/-76.58071

Land Use Analysis:

Land Use	Acres	% Area
Commercial	7.6	3.6
Industrial	11.2	5.3
Residential 1/2-acre	39.7	18.7
Residential 1/8-acre	10.8	5.1
Residential 1-acre	4.3	2.0
Transportation	1.7	0.8
Utility	11.8	5.5
Woods	125.3	59.0
Grand Total	212.3	100.0

Impervious (acres)	Total Area Above site	% Impervious
28.9	212.3	13.6

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Bank stability and vegetative protection conditions are marginal.
- Sample dominated by snails (Physa) and midges (Orthocladius/Cricotopus, Hydrobaenus)
- Stream type was identified as an G6c, slope was 0.3 percent, and the median channel substrate was very fine sand
- Typically, G channels are not stable and this one does not have great bank habitat. The channel may be evolving towards a more stable form.

Recommendations:

- Protect the riparian area. Allow the channel to reach equilibrium by avoiding artificial constraints along the banks.

IBI and Metric Scores

Narrative Rating	Poor
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Overall Index	2.14
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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

Total Taxa	18
EPT Taxa	3
Ephemeroptera Taxa	0
Intolerant Urban %	10.89
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	3.96

Taxa List

Anisoptera	3
Aulodrilus	2
Diplocadius	4
Enchytraeidae	1
Hydrobaenus	11
Ironoquia	1
Limnephilidae	3
Limnodrilus	1
Lymnaeidae	1
Neoporus	1
Orthocladus/Cricotopus	17
Paranemoura	10
Physa	27
Pisidium	3
Prostoma	10
Somatochlora	1
Tipula	1
Tubificinae	4

Total Individuals

101

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	3	Pool Variability	7
Bank Stability- Right Bank	4	Riparian Vegetative	
Channel Alteration	13	Zone Width- Left Bank	9
Channel Flow Status	13	Riparian Vegetative	
Channel Sinuosity	12	Zone Width- Right Bank	9
Epifaunal Substrate/Available Cover	8	Sediment Deposition	11
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	3
		Vegetative Protection (Right Bank)	4

EPA Habitat Score	104
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EPA Narrative Ranking	PS
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Maryland Biological Stream Survey PHI

Drainage area (acres)	212	Instream Wood Debris	8
Remoteness	13	Bank Stability	7
Shading	100		
Epifaunal Substrate	10		
Instream Habitat	8		

PHI Score	77.26
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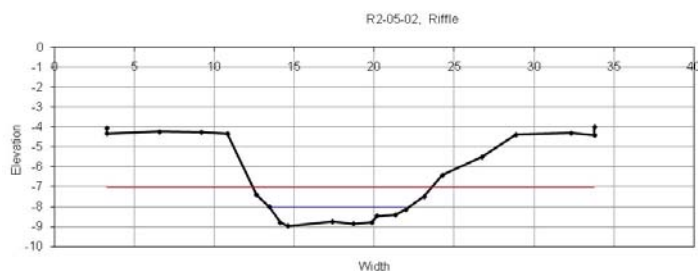
PHI Narrative Ranking	partially degraded
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Water Chemistry

Dissolved Oxygen (mg/L)	11.53	Specific Conductance (µS/cm)	412
pH	7.05	Temperature (°C)	7.02

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.33	Cross Sectional Area (ft ²)	6.0
Bankfull Width (ft)	8.5	Water Surface Slope (%)	0.3
Mean Bankfull Depth (ft)	0.7	Sinuosity	1.3
Floodprone Width (ft)	11.2	D50 (mm)	0.062
Entrenchment Ratio	1.3	Adjustments?	↓WD
Width to Depth Ratio	12.1	Rosgen Stream Type	G6c





Upstream



Downstream

Location/Site Access: Located at Silver Leaf Ct., 0.10 miles Northwest, follow trail
Latitude/Longitude: 39.12989/-76.62572

Land Use Analysis:

Land Use	Acres	% Area
Commercial	29.5	6.1
Open Space	36.1	7.5
Residential 1/2-acre	14.5	3.0
Residential 1/4-acre	69.3	14.5
Residential 1/8-acre	231.4	48.2
Residential 1-acre	2.5	0.5
Residential 2-acre	0.6	0.1
Transportation	21.4	4.5
Utility	2.7	0.6
Woods	71.8	15.0
Grand Total	479.8	100.0

Impervious (acres)	Total Area Above site	% Impervious
152.0	479.8	31.7

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Habitat assessment results indicate fair to poor conditions at this site, which is in agreement with the biological indications.
- Sediment conditions are marginal. Otherwise, habitat features are in fair condition.
- Sample dominated by midges (Orthocladius/Cricotopus, Polypedilum, and Paracladopelma)
- Stream type was identified as an E5, slope was 0.45 percent, and the median channel substrate was fine sand
- Typically, E channels are stable and this one has fair habitat ratings related to banks and substrates.

Recommendations:

- Protect the riparian area. Investigate possibilities for restoring habitat features, including management of runoff that may be associated with high imperviousness

R2-05-03

Marley Creek Sampling Unit

IBI and Metric Scores

Narrative Rating	Poor
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Overall Index	2.14
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Total Taxa Score	5
EPT Taxa Score	1
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	25
EPT Taxa	0
Ephemeroptera Taxa	0
Intolerant Urban %	0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	22.12

Taxa List

Calopteryx	2
Chironomus	1
Corynoneura	2
Culicoides	1
Dicortendipes	4
Enchytraeidae	3
Erioptera	1
Fossaria	1
Naia	3
Nanocladius	2
Orthocladus/Cricotopus	27
Paracladopelma	12
Parametriocnemus	1
Paratanytarsus	6
Phaenopsectra	3
Physa	4
Pisidium	1
Polypedilum	20
Prostoma	1
Slavina	1
Stenochironomus	1
Tanytarsus	2
Thienemanniella	6
Tribelos	1
Tubificinae	7

Total Individuals	113
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Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	6	Pool Variability	7
Bank Stability- Right Bank	6	Riparian Vegetative	
Channel Alteration	20	Zone Width- Left Bank	10
Channel Flow Status	8	Riparian Vegetative	
Channel Sinuosity	8	Zone Width- Right Bank	10
Epifaunal Substrate/Available Cover	7	Sediment Deposition	4
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	6
		Vegetative Protection (Right Bank)	6

EPA Habitat Score	106
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EPA Narrative Ranking	PS
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Maryland Biological Stream Survey PHI

Drainage area (acres)	480	Instream Wood Debris	12
Remoteness	8	Bank Stability	12
Shading	90		
Epifaunal Substrate	3		
Instream Habitat	7		

PHI Score	64.83
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PHI Narrative Ranking	degraded
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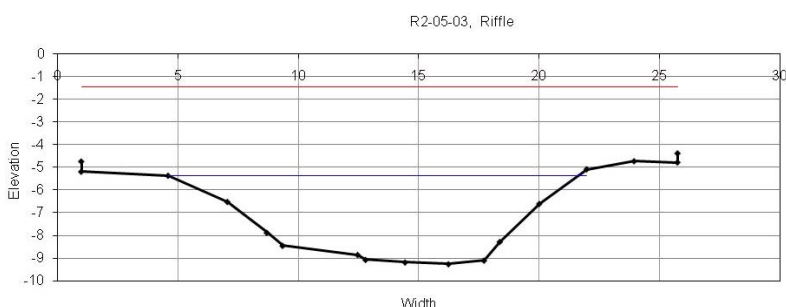
Water Chemistry

Dissolved Oxygen (mg/L)	10.53	Specific Conductance (µS/cm)	562
pH	7.21	Temperature (°C)	6.16

Geomorphic Assessments

Rosen Level II Classification Data

Drainage Area (mi ²)	0.75	Cross Sectional Area (ft ²)	43.2
Bankfull Width (ft)	17.0	Water Surface Slope (%)	0.45
Mean Bankfull Depth (ft)	2.5	Sinuosity	1.2
Floodprone Width (ft)	160	D50 (mm)	0.21
Entrenchment Ratio	9.4	Adjustments?	↑Sin
Width to Depth Ratio	6.7	Rosen Stream Type	E5





Upstream



Downstream

Location/Site Access: Located at New Jersey Ave N.E., 0.10 miles Northeast
Latitude/Longitude: 39.1667/-76.616

Land Use Analysis:

Land Use	Acres	% Area
Commercial	115.8	24.9
Open Space	14.0	3.0
Residential 1/4-acre	113.1	24.3
Residential 1/8-acre	190.4	41.0
Transportation	31.1	6.7
Woods	0.4	0.1
Grand Total	464.8	100.0

Impervious (acres)	Total Area Above site	% Impervious
262.6	464.8	56.5

Results:

- Biological condition – "Very Poor"
- Habitat scores "Not Supporting" and "Severely Degraded"
- Habitat and biological assessment results indicate highly impacted conditions at this site.
- Water quality values are not alarming.
- This concrete swale has a very stable channel form and few other positive habitat qualities.
- Sample dominated by midges (Orthocladius/Cricotopus)
- Stream type was not identified, as it is artificial.
- The extreme armoring in this urban channel may be necessary given the highly impervious upland areas.

Recommendations:

- Naturalize by removing artificial channel and planting. If removal of channel armoring is not feasible, consider artificially increasing channel roughness to enhance habitat complexity.

IBI and Metric Scores

Narrative Rating	Very Poor
Overall Index	1.29
Total Taxa Score	1
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	5
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	1.89

Taxa List

Coenagrionidae	1
Limnephilidae	1
Nemata	1
Orthocladus/Cricotopus	99
Tubificinae	4

Total Individuals

106

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	10	Pool Variability	5
Bank Stability- Right Bank	10	Riparian Vegetative	
Channel Alteration	0	Zone Width- Left Bank	1
Channel Flow Status	4	Riparian Vegetative	
Channel Sinuosity	0	Zone Width- Right Bank	1
Epifaunal Substrate/Available Cover	1	Sediment Deposition	18
Pool Substrate Characterization	3	Vegetative Protection (Left Bank)	1
		Vegetative Protection (Right Bank)	1

EPA Habitat Score 55**EPA Narrative Ranking** NS**Maryland Biological Stream Survey PHI**

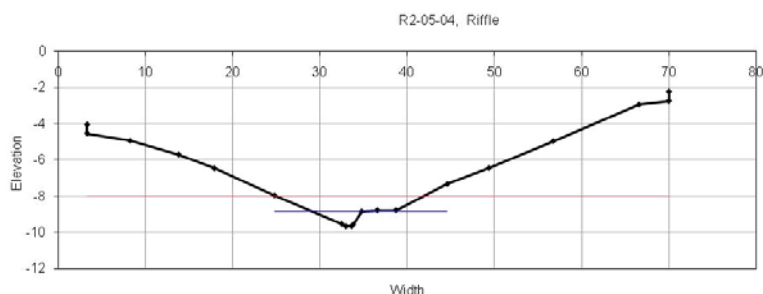
Drainage area (acres)	465	Instream Wood Debris	4
Remoteness	1	Bank Stability	20
Shading	0		
Epifaunal Substrate	1		
Instream Habitat	1		

PHI Score 35.80**PHI Narrative Ranking** severely degraded**Water Chemistry**

Dissolved Oxygen (mg/L)	13.17	Specific Conductance (μS/cm)	1036
pH	7.35	Temperature (°C)	7.78

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.33	Cross Sectional Area (ft ²)	—
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	—



NOTE: Classification not performed because this site contains a concrete channel acting as a bedrock control.



Upstream



Downstream

Location/Site Access: Located at Starwood Drive Crossing U.S.

Latitude/Longitude: 39.13127/-76.62318

Land Use Analysis:

Land Use	Acres	% Area
Commercial	30.5	5.9
Open Space	36.1	7.0
Residential 1/2-acre	14.3	2.8
Residential 1/4-acre	73.1	14.1
Residential 1/8-acre	248.8	48.1
Residential 1-acre	2.5	0.5
Residential 2-acre	2.6	0.5
Transportation	23.9	4.6
Utility	3.7	0.7
Woods	81.5	15.8
Grand Total	517.0	100.0

Impervious (acres)	Total Area Above site	% Impervious
163.8	517.0	31.7

Results:

- Biological condition – "Poor"
- Habitat scores "Not Supporting" and "Degraded"
- Habitat assessment results indicate degraded conditions at this site, and the macroinvertebrate sample is dominated by disturbance tolerant organisms
- Bank, riparian, and sediment conditions are marginal. The channel is highly accessible to residential areas.
- Sample dominated by worms (Nais) and midges
- Stream type was identified as an E5, slope was 0.31 percent, and the median channel substrate was medium sand
- Typically, E channels are stable. The high exposure of the riparian area and sedimentation may contribute to poor biological conditions

Recommendations:

- Protect the riparian area. Naturalize if feasible.

R2-05-05

Marley Creek Sampling Unit

IBI and Metric Scores

Narrative Rating	Poor
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Overall Index	2.14
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Total Taxa Score	5
EPT Taxa Score	1
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	25
EPT Taxa	0
Ephemeroptera Taxa	0
Intolerant Urban %	0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	14.41

Taxa List

Argia	2
Corynoneura	3
Dicortendipes	3
Ischnura	1
Limnodrilus	1
Lumbricidae	1
Mallochohelea	1
Nais	54
Nanocladius	3
Nemata	1
Orthocladius/Cricotopus	5
Paracladopelma	2
Paratanytarsus	3
Paratendipes	1
Phaenopsectra	2
Physa	1
Polypedilum	8
Prostoma	4
Saetheria	1
Tanytarsus	7
Thienemanniella	2
Thienemannimyia genus group	1
Tribelos	2
Tubificinae	1
Zavrelimyia	1

Total Individuals

111

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	6	Pool Variability	3
Bank Stability- Right Bank	5	Riparian Vegetative	
Channel Alteration	12	Zone Width- Left Bank	8
Channel Flow Status	9	Riparian Vegetative	
Channel Sinuosity	2	Zone Width- Right Bank	1
Epifaunal Substrate/Available Cover	4	Sediment Deposition	3
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	6
		Vegetative Protection (Right Bank)	5

EPA Habitat Score	72
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EPA Narrative Ranking	NS
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Maryland Biological Stream Survey PHI

Drainage area (acres)	517	Instream Wood Debris	7
Remoteness	1	Bank Stability	11
Shading	90		
Epifaunal Substrate	4		
Instream Habitat	4		

PHI Score	53.38
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PHI Narrative Ranking	degraded
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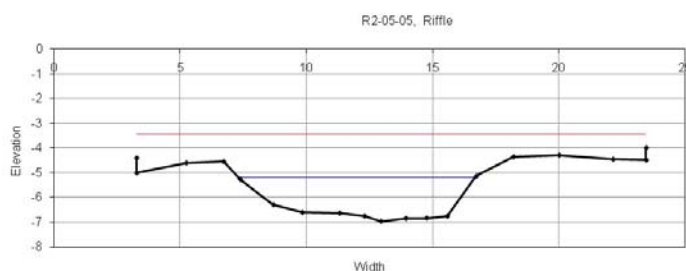
Water Chemistry

Dissolved Oxygen (mg/L)	12.08	Specific Conductance (µS/cm)	1284
pH	7.11	Temperature (°C)	10.46

Geomorphic Assessments

Rosen Level II Classification Data

Drainage Area (mi ²)	0.81	Cross Sectional Area (ft ²)	12.1
Bankfull Width (ft)	9.3	Water Surface Slope (%)	0.31
Mean Bankfull Depth (ft)	1.3	Sinuosity	1.0
Floodprone Width (ft)	82	D50 (mm)	0.31
Entrenchment Ratio	8.8	Adjustments?	↑Sin
Width to Depth Ratio	7.2	Rosen Stream Type	E5





Upstream



Downstream

Location/Site Access: Located at Sunny Brook Dr. road crossing
Latitude/Longitude: 39.17197/-76.60071

Land Use Analysis:

Land Use	Acres	% Area
Commercial	36.9	13.7
Open Space	13.0	4.9
Residential 1/2-acre	2.3	0.8
Residential 1/4-acre	143.6	53.5
Residential 1/8-acre	16.0	5.9
Residential 1-acre	3.2	1.2
Transportation	19.8	7.4
Woods	33.8	12.6
Grand Total	268.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
97.7	268.6	36.4

Results:

- Biological condition – "Very Poor"
- Habitat cores "Not Supporting" and "Degraded"
- Habitat assessment results indicate degraded conditions at this site, which are likely contributing to very poor biological conditions
- Riparian and sediment conditions are mostly marginal. The channel is not remote and the watershed is highly impervious.
- Sample dominated by worms (Tubificinae and Lumbriculidae) and clams (Pisidiidae)
- Stream type was identified as an E5, slope was 0.39 percent, and the median channel substrate was medium sand
- Typically, E channels are stable. However, the poor habitat and biological conditions suggest instability

Recommendations:

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

IBI and Metric Scores

Narrative Rating	Very Poor
Overall Index	1
Total Taxa Score	1
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	13
EPT Taxa	0
Ephemeroptera Taxa	0
Intolerant Urban %	0.92
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	0

Taxa List

Bittacomorpha	2
Cambaridae	1
Culicoides	1
Dero	1
Ilyodrilus	3
Limnodrilus	1
Lumbriculidae	13
Nemata	2
Physa	1
Pisidiidae	39
Pisidium	1
Sphaerium	2
Tubificinae	42

Total Individuals

109

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Variability	8
Bank Stability- Right Bank	6	Riparian Vegetative	
Channel Alteration	7	Zone Width- Left Bank	3
Channel Flow Status	2	Riparian Vegetative	
Channel Sinuosity	6	Zone Width- Right Bank	3
Epifaunal Substrate/Available Cover	6	Sediment Deposition	7
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	6
		Vegetative Protection (Right Bank)	6

EPA Habitat Score	74
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

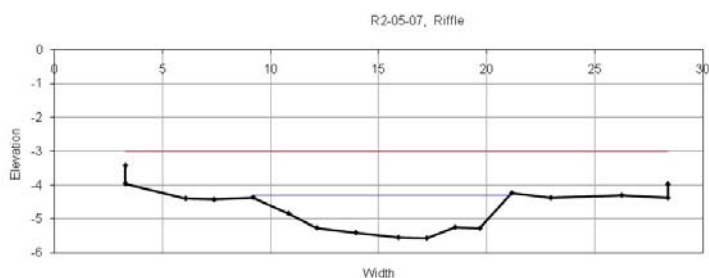
Drainage area (acres)	269	Instream Wood Debris	5
Remoteness	1	Bank Stability	12
Shading	70		
Epifaunal Substrate	6	PHI Score	55.95
Instream Habitat	6	PHI Narrative Ranking	degraded

Water Chemistry

Dissolved Oxygen (mg/L)	6.79	Specific Conductance (µS/cm)	465
pH	6.77	Temperature (°C)	7.82

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.42	Cross Sectional Area (ft ²)	10.6
Bankfull Width (ft)	11.9	Water Surface Slope (%)	0.39
Mean Bankfull Depth (ft)	0.9	Sinuosity	1.1
Floodprone Width (ft)	108	D50 (mm)	0.35
Entrenchment Ratio	9.1	Adjustments?	↑Sin
Width to Depth Ratio	13.3	Rosgen Stream Type	E5





Upstream



Downstream

Location/Site Access: Located at Pine Ridge Rd., 4th left, end of cul-de-sac
Latitude/Longitude: 39.13877/-76.57038

Land Use Analysis:

Land Use	Acres	% Area
Commercial	6.4	1.5
Residential 1/2-acre	6.9	1.6
Residential 1/8-acre	97.2	22.8
Residential 1-acre	40.2	9.4
Residential 2-acre	62.4	14.7
Transportation	14.1	3.3
Woods	199.0	46.7
Grand Total	426.2	100.0

Impervious (acres)	Total Area Above site	% Impervious
67.9	426.2	15.9

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Habitat assessment results indicate fair conditions at this site, but biological conditions are poor.
- Bank and pool substrate conditions are marginal. Otherwise, habitat conditions are fair or good.
- Sample dominated by midges
- Stream type was identified as an E6, slope was 0.75 percent, and the median channel substrate was very fine sand.
- Typically, E channels are stable and this one has moderate bank and sediment conditions.

Recommendations:

- Protect the riparian area. Improve habitat features if feasible.

R2-05-08

Marley Creek 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	27
EPT Taxa	2
Ephemeroptera Taxa	0
Intolerant Urban %	6.19
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	6.19

Taxa List

Ancylidae	1
Brillia	1
Cheumatopsyche	1
Crangonyx	10
Diplectrona	4
Enchytraeidae	1
Hemerodromia	1
Heterotrissocladius	1
Lumbriculidae	1
Micropsectra	2
Nais	2
Nemata	1
Orthocladus/Cricotopus	27
Parametrioctenus	16
Paraphaenocladus	2
Paratendipes	1
Phaenopsectra	1
Pisidiidae	5
Polypedilum	3
Pristina	1
Rheocricotopus	2
Stenelmis	5
Tanytarsus	1
Thienemanniella	5
Tribelos	1
Tubificinae	7
Tvetenia	10

Total Individuals 113

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	5	Pool Variability	9
Bank Stability- Right Bank	5	Riparian Vegetative	10
Channel Alteration	19	Zone Width- Left Bank	7
Channel Flow Status	13	Riparian Vegetative	10
Channel Sinuosity	12	Zone Width- Right Bank	5
Epifaunal Substrate/Available Cover	14	Sediment Deposition	5
Pool Substrate Characterization	9	Vegetative Protection (Left Bank)	5
		Vegetative Protection (Right Bank)	5

EPA Habitat Score	123
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	426	Instream Wood Debris	11
Remoteness	3	Bank Stability	10
Shading	100		
Epifaunal Substrate	6		
Instream Habitat	14		

PHI Score	70.10
PHI Narrative Ranking	partially degraded

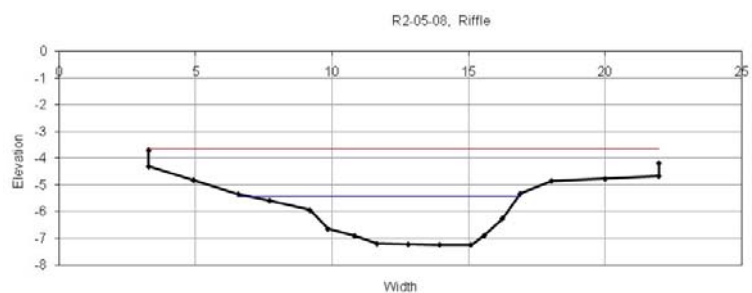
Water Chemistry

Dissolved Oxygen (mg/L)	10.43	Specific Conductance (µS/cm)	322
pH	6.92	Temperature (°C)	8.35

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi ²)	0.67	Cross Sectional Area (ft ²)	11.6
Bankfull Width (ft)	9.7	Water Surface Slope (%)	0.75
Mean Bankfull Depth (ft)	1.2	Sinuosity	1.5
Floodprone Width (ft)	72	D50 (mm)	0.067
Entrenchment Ratio	7.4	Adjustments?	None
Width to Depth Ratio	8.2	Rosgen Stream Type	E6





Upstream



Downstream

Location/Site Access: Located at Twin Ridge Cul-de-sac, 500 ft. East
Latitude/Longitude: 39.13893/-76.60995

Land Use Analysis:

Land Use	Acres	% Area
Commercial	245.3	9.0
Industrial	14.2	0.5
Open Space	135.6	5.0
Pasture/Hay	3.0	0.1
Residential 1/2-acre	54.6	2.0
Residential 1/4-acre	468.9	17.3
Residential 1/8-acre	950.6	35.0
Residential 1-acre	30.3	1.1
Residential 2-acre	55.6	2.0
Row Crops	59.2	2.2
Transportation	177.6	6.5
Utility	18.9	0.7
Water	3.6	0.1
Woods	499.9	18.4
Grand Total	2717.3	100.0

Impervious (acres)	Total Area Above site	% Impervious
947.5	2717.3	34.9

Results:

- Biological condition – "Poor"
- Habitat scores "Supporting" and "Partially Degraded"
- Habitat assessment results indicate fair conditions at this site, but the biological community is poor.
- Substrate conditions are marginal. Otherwise habitat conditions are fair or good.
- Sample dominated by midges and caddisflies
- Stream type was identified as a DA5, slope was 0.38 percent, and the median channel substrate was fine sand
- DA channels are braided, with multiple channels flowing during normal and higher flows. They can be very stable if the floodplain is available during high flows

Recommendations:

- Protect the riparian area. Avoid artificial constraints and allow lateral access to the floodplain. Investigate effects of runoff from high imperviousness and mitigate if feasible.

IBI and Metric Scores

Narrative Rating	Poor
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Overall Index	2.43
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Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	29
EPT Taxa	2
Ephemeroptera Taxa	0
Intolerant Urban %	0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	16.67

Taxa List

Ablabesmyia	1
Ancyronyx	4
Anisoptera	1
Calopteryx	2
Cheumatopsyche	19
Coenagrionidae	1
Corynoneura	1
Crangonyx	1
Dubiraphia	1
Hydropsyche	3
Limnodrilus	2
Macronychus	3
Mallochohelea	1
Nais	2
Nanocladius	2
Orthocladius/Cricotopus	14
Phaenopsectra	1
Pisidium	1
Planariidae	1
Polypedilum	5
Rheocricotopus	10
Rheotanytarsus	20
Slavina	1
Stenochironomus	1
Tanytarsus	11
Thienemannimyia genus group	2
Tribelos	1
Tubificinae	1
Tvetenia	1

Total Individuals	114
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Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	8	Pool Variability	14
Bank Stability- Right Bank	6	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	19	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	15	Sediment Deposition	7
Channel Sinuosity	9	Vegetative Protection (Left Bank)	8
Epifaunal Substrate/Available Cover	15	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	9		

EPA Habitat Score	136
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EPA Narrative Ranking	S
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Maryland Biological Stream Survey PHI

Drainage area (acres)	2718	Instream Wood Debris	26
Remoteness	8	Bank Stability	14
Shading	40		
Epifaunal Substrate	6		
Instream Habitat	15		

PHI Score	65.04
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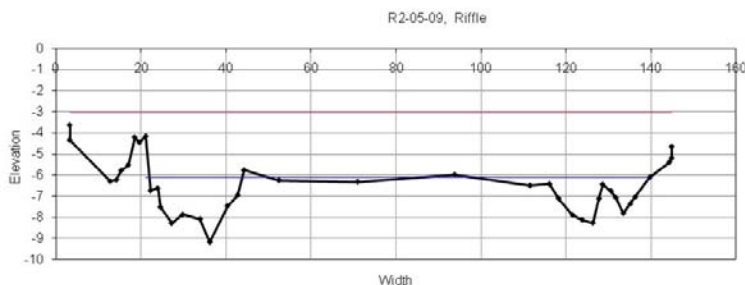
PHI Narrative Ranking	degraded
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Water Chemistry

Dissolved Oxygen (mg/L)	11.9	Specific Conductance (µS/cm)	408
pH	6.85	Temperature (°C)	9.67

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	4.25	Cross Sectional Area (ft ²)	67.0
Bankfull Width (ft)	50.1	Water Surface Slope (%)	0.38
Mean Bankfull Depth (ft)	1.3	Sinuosity	1.0
Floodprone Width (ft)	143	D50 (mm)	0.12
Entrenchment Ratio	2.9	Adjustments?	None
Width to Depth Ratio	37.4	Rosgen Stream Type	DA5





Upstream



Downstream

Location/Site Access: Located at Gate between 1272 and 1274 Guilford Rd.
Latitude/Longitude: 39.14869/-76.60409

Land Use Analysis:

Land Use	Acres	% Area
Commercial	557.3	12.4
Industrial	14.4	0.3
Open Space	244.2	5.4
Pasture/Hay	5.3	0.1
Residential 1/2-acre	88.4	2.0
Residential 1/4-acre	735.1	16.4
Residential 1/8-acre	1516.4	33.8
Residential 1-acre	58.6	1.3
Residential 2-acre	74.8	1.7
Row Crops	78.8	1.8
Transportation	336.1	7.5
Utility	23.7	0.5
Water	3.8	0.1
Woods	752.7	16.8
Grand Total	4489.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
1695.1	4489.6	37.8

Results:

- Biological condition – "Very Poor"
- Habitat scores "Supporting" and "Partially Degraded"
- Habitat assessment results indicate fair conditions at this site, but the biological community is very poor.
- Pool substrate conditions are marginal. Otherwise, habitat conditions are fair or good.
- Sample dominated by worms
- Stream type was identified as an DA5, slope was 0.053 percent, and the median channel substrate was fine sand
- DA channels are braided, with multiple channels flowing during normal and higher flows. They can be very stable if the floodplain is available during high flows

Recommendations:

- Avoid artificial constraints and allow lateral access to the riparian floodplain. Investigate effects of runoff from high imperviousness and mitigate if feasible. Because of poor biology and fair habitat, investigate whether water quality may be a stressor.

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	27
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	0.95
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	5.71

Taxa List

Ancyronyx	3
Aulodrilus	1
Cambaridae	1
Chelifera	1
Cheumatopsyche	2
Chironomus	1
Cryptochironomus	1
Dasyhelea	1
Enchytraeidae	7
Eukiefferiella	1
Gammarus	9
Limnodrilus	11
Nais	10
Nemata	2
Orthocladius/Cricotopus	9
Phaenopsectra	3
Physa	1
Pisidium	1
Polypedilum	4
Pseudosmittia	2
Rheocricotopus	2
Rheotanytarsus	1
Slavina	3
Stenochironomus	1
Tanytarsus	2
Thienemanniella	1
Tubificinae	24

Total Individuals 105

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	8	Pool Variability	13
Bank Stability- Right Bank	7	Riparian Vegetative	
Channel Alteration	20	Zone Width- Left Bank	10
Channel Flow Status	18	Riparian Vegetative	
Channel Sinuosity	12	Zone Width- Right Bank	9
Epifaunal Substrate/Available Cover	15	Sediment Deposition	7
Pool Substrate Characterization	9	Vegetative Protection (Left Bank)	8
		Vegetative Protection (Right Bank)	7

EPA Habitat Score 143

EPA Narrative Ranking S

Maryland Biological Stream Survey PHI

Drainage area (acres)	4490	Instream Wood Debris	35
Remoteness	8	Bank Stability	15
Shading	80		
Epifaunal Substrate	6		
Instream Habitat	15		

PHI Score 70.41

PHI Narrative Ranking partially degraded

Water Chemistry

Dissolved Oxygen (mg/L)	10.22	Specific Conductance (µS/cm)	853
pH	6.87	Temperature (°C)	8.93

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	7.01	Cross Sectional Area (ft ²)	171.1
Bankfull Width (ft)	102.6	Water Surface Slope (%)	0.053
Mean Bankfull Depth (ft)	1.7	Sinuosity	1.2
Floodprone Width (ft)	198	D50 (mm)	0.2
Entrenchment Ratio	1.9	Adjustments?	None
Width to Depth Ratio	61.5	Rosgen Stream Type	DA5





Upstream



Downstream

Location/Site Access: Located at Intersections of Hamerlee and Pumping Station Rd.
Latitude/Longitude: 39.1777/-76.60402

Land Use Analysis:

Land Use	Acres	% Area
Commercial	127.6	16.6
Open Space	66.2	8.6
Residential 1/4-acre	229.8	29.8
Residential 1/8-acre	235.2	30.5
Residential 2-acre	1.1	0.1
Transportation	56.5	7.3
Woods	54.2	7.0
Grand Total	770.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
358.1	770.6	46.5

Results:

- Biological condition – "Very Poor"
- Habitat scores "Supporting" and "Degraded"
- Habitat assessments indicate both supporting and degraded conditions at this site, but the biological community shows impairment.
- Substrate conditions are marginal. Otherwise conditions are fair or good.
- Specific conductance is high, which may be related to the high imperviousness in the watershed
- Sample dominated by worms (Enchytreidae and Tubificidae)
- Stream type was identified as an C5, slope was 0.021 percent, and the median channel substrate was fine sand
- Conductivity is higher at this site than at any other site sampled during this year.

Recommendations:

- Protect the riparian area. Investigate possible effects of high imperviousness on water quality. Because of poor biological conditions and high conductivity, water quality may be an issue.

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	14
EPT Taxa	0
Ephemeroptera Taxa	0
Intolerant Urban %	0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	0

Taxa List

Dasyhelea	10
Dubiraphia	1
Enchytraeidae	28
Limnodrilus	7
Lumbriculidae	2
Nais	9
Nemata	2
Orthocladius/Cricotopus	2
Pseudorthocladius	1
Pseudosmittia	6
Rheocricotopus	1
Smittia	6
Tubificinae	25
Uncinaiis	5

Total Individuals

105

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	8	Pool Variability	10
Bank Stability- Right Bank	8	Riparian Vegetative	
Channel Alteration	19	Zone Width- Left Bank	10
Channel Flow Status	18	Riparian Vegetative	
Channel Sinuosity	7	Zone Width- Right Bank	6
Epifaunal Substrate/Available Cover	11	Sediment Deposition	7
Pool Substrate Characterization	10	Vegetative Protection (Left Bank)	8
		Vegetative Protection (Right Bank)	8

EPA Habitat Score 130**EPA Narrative Ranking** S**Maryland Biological Stream Survey PHI**

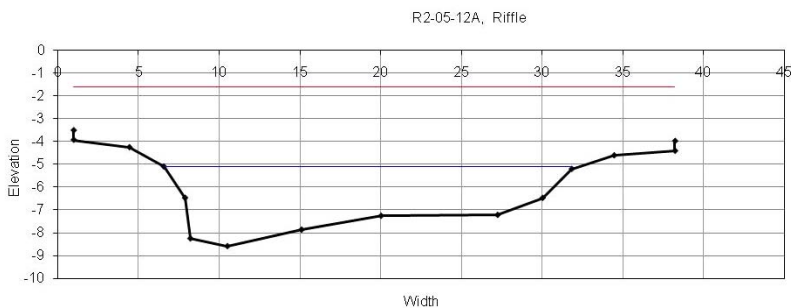
Drainage area (acres)	771	Instream Wood Debris	10
Remoteness	2	Bank Stability	16
Shading	90		
Epifaunal Substrate	3		
Instream Habitat	11		

PHI Score 61.94**PHI Narrative Ranking** degraded**Water Chemistry**

Dissolved Oxygen (mg/L)	11.54	Specific Conductance (µS/cm)	8313
pH	6.94	Temperature (°C)	11.13

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	1.20	Cross Sectional Area (ft ²)	55.1
Bankfull Width (ft)	25.2	Water Surface Slope (%)	0.021
Mean Bankfull Depth (ft)	2.2	Sinuosity	1.2
Floodprone Width (ft)	197	D50 (mm)	0.22
Entrenchment Ratio	7.8	Adjustments?	↑WD
Width to Depth Ratio	11.5	Rosgen Stream Type	C5





Upstream



Downstream

Location/Site Access: Located at Southern district roads operations services garage 350
Latitude/Longitude: 38.93048/-76.59129

Land Use Analysis:

Land Use	Acres	% Area
Commercial	50.3	1.9
Industrial	5.5	0.2
Open Space	202.3	7.8
Open Wetland	0.0	0.0
Pasture/Hay	83.2	3.2
Residential 1/2-acre	17.2	0.7
Residential 1-acre	143.5	5.5
Residential 2-acre	425.2	16.4
Row Crops	108.0	4.2
Transportation	71.2	2.7
Utility	63.4	2.4
Water	1.7	0.1
Woods	1422.6	54.8
Grand Total	2594.1	100.0

Impervious (acres)	Total Area Above site	% Impervious
173.0	2594.1	6.7

Results:

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Severly Degraded"
- Habitat assessments are variable. The PHI score is low due to three variables: shading, epifaunal substrate, and instream habitat.
- Sample dominated by gastropods (Menetus), worms (Tubificinae), and amphipods (Gammarus)
- Stream type and geomorphological measures were not completed at this site due to prevalence of wetlands, which obfuscate standard measures.

Recommendations:

- Investigate possible sources of excess sediments and mitigate, if feasible.

IBI and Metric Scores

Narrative Rating	Fair
Overall Index	3
Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	3
Ephemeroptera % Score	1
Scraper Taxa Score	3
% Climbers	5
Total Taxa	27
EPT Taxa	2
Ephemeroptera Taxa	0
Intolerant Urban %	11.93
Ephemeroptera %	0
Scraper Taxa	1
% Climbers	33.94
Total Taxa	27

Taxa List

Ancyronyx	1
Aulodrilus	1
Brillia	1
Caecidotea	8
Cheumatopsyche	2
Cladotanytarsus	1
Corynoneura	2
Crangonyx	1
Dero	5
Dicrotendipes	1
Diplocladius	1
Gammarus	12
Hydrobiidae	4
Menetus	28
Micropsectra	2
Nemata	4
Nemouridae	1
Orthocladinae	1
Parametriocnemus	1
Paratanytarsus	9
Physa	5
Polypedilum	1
Procladius	1
Quistradilus	1
Stegopterna	1
Tanytarsus	1
Tubificinae	13

Total Individuals 109

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	7	Pool Variability	8
Bank Stability- Right Bank	7	Riparian Vegetative	
Channel Alteration	20	Zone Width- Left Bank	9
Channel Flow Status	16	Riparian Vegetative	
Channel Sinuosity	7	Zone Width- Right Bank	10
Epifaunal Substrate/Available Cover	7	Sediment Deposition	2
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	7
		Vegetative Protection (Right Bank)	7

EPA Habitat Score	115
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	2594	Instream Wood Debris	5
Remoteness	12	Bank Stability	14
Shading	35		
Epifaunal Substrate	2		
Instream Habitat	7		

PHI Score	47.97
PHI Narrative Ranking	Severely degraded

Water Chemistry

Dissolved Oxygen (mg/L)	11.43	Specific Conductance (µS/cm)	305
pH	6.66	Temperature (°C)	11.6

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.25	Cross Sectional Area (ft ²)	—
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	—

Classification not performed due to extensive wetland conditions present at the site.



Location/Site Access: Located at end of Gettysburg Ct., 150 meters northeast
Latitude/Longitude: 38.93703/-76.6172

Land Use Analysis:

Land Use	Acres	% Area
Commercial	12.8	2.5
Industrial	0.6	0.1
Open Space	22.6	4.4
Pasture/Hay	64.7	12.6
Residential 1/2-acre	5.1	1.0
Residential 1-acre	24.9	4.9
Residential 2-acre	134.9	26.4
Row Crops	75.2	14.7
Transportation	6.5	1.3
Water	1.0	0.2
Woods	163.5	32.0
Grand Total	511.8	100.0

Impervious (acres)	Total Area Above site	% Impervious
40.8	511.8	8.0

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Habitat assessment results indicate partially degraded conditions at this site, which could be the cause of poor biological conditions
- The riparian zone is intact, though bank vegetation and stability are only fair.
- Sample dominated by worms (Polypedilum and Parametrioctenemus)
- Stream type was identified as an G5c, slope was 0.38 percent, and the median channel substrate was medium sand
- Typically, G channels are unstable. Habitat ratings related to bank stability indicate moderate stability.

Recommendations:

- Preserve the natural riparian areas.

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
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5
Calculated Metric Values	
Total Taxa	25
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	4.67
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	31.78

Taxa List

Caecidotea	4
Crangonyx	5
Diplocladius	1
Enchytraeidae	2
Ephydriidae	1
Limnephilidae	4
Limnodrilus	5
Limnophyes	2
Lumbriculidae	1
Natarsia	1
Nemata	1
Orthocladius/Cricotopus	4
Paralauterborniella	1
Parametrioecnemus	14
Pisidiidae	1
Polypedilum	30
Prosimulium	1
Sciaridae	1
Stilocladius	5
Thienemanniella	5
Thienemannimyia genus group	3
Tipula	3
Tubificinae	8
Xylotopus	3
Zavreliomyia	1

Total Individuals 107

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Variability	7
Bank Stability- Right Bank	5	Riparian Vegetative	
Channel Alteration	19	Zone Width- Left Bank	10
Channel Flow Status	8	Riparian Vegetative	
Channel Sinuosity	11	Zone Width- Right Bank	10
Epifaunal Substrate/Available Cover	8	Sediment Deposition	5
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	6
		Vegetative Protection (Right Bank)	5

EPA Habitat Score 108

EPA Narrative Ranking PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	512	Instream Wood Debris	10
Remoteness	7	Bank Stability	11
Shading	100		
Epifaunal Substrate	5		
Instream Habitat	8		

PHI Score 66.4

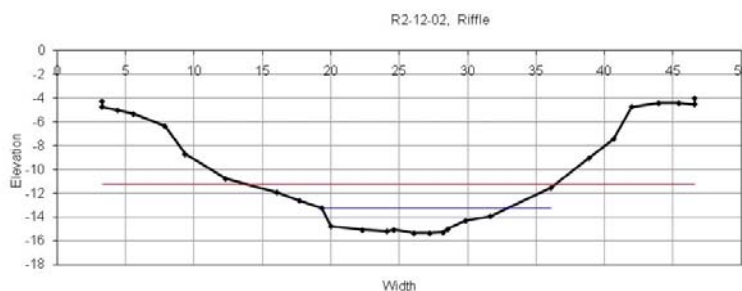
PHI Narrative Ranking partially degraded

Water Chemistry

Dissolved Oxygen (mg/L)	10.35	Specific Conductance (µS/cm)	318
pH	6.07	Temperature (°C)	8.9

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.66	Cross Sectional Area (ft ²)	20.0
Bankfull Width (ft)	13.5	Water Surface Slope (%)	0.38
Mean Bankfull Depth (ft)	1.5	Sinuosity	1.1
Floodprone Width (ft)	22	D50 (mm)	0.3
Entrenchment Ratio	1.6	Adjustments?	↓ER
Width to Depth Ratio	9.1	Rosgen Stream Type	G5c





Upstream



Downstream

Location/Site Access: Located at Central Middle School 0.10m East
Latitude/Longitude: 38.91853/-76.55659

Land Use Analysis:

Land Use	Acres	% Area
Commercial	14.2	1.9
Industrial	0.4	0.0
Open Space	69.3	9.5
Pasture/Hay	0.0	0.0
Residential 1/2-acre	72.8	10.0
Residential 1-acre	70.7	9.7
Residential 2-acre	68.1	9.4
Row Crops	71.8	9.9
Transportation	24.7	3.4
Water	1.6	0.2
Woods	334.1	45.9
Grand Total	727.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
73.2	727.6	10.1

Results:

- Biological condition – "Poor"
- Habitat scores "Supporting" and "Partially Degraded"
- Habitat assessment results indicate good to fair conditions at this site. The biological community shows high diversity but poor overall condition.
- Sediment conditions were marginal, while other habitat features were better.
- Sample dominated by midges (*Hydrobaenus*) and stoneflies (*Paranemoura*)
- Stream type was identified as an C5, slope was 0.55 percent, and the median channel substrate was fine sand
- Typically, C channels are stable. This one seems fairly stable, though substrates are relatively fine.

Recommendations:

- Protect the riparian area. Mitigate any increases in urbanization.

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.71
Total Taxa Score	5
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	29
EPT Taxa	4
Ephemeroptera Taxa	0
Intolerant Urban %	33.98
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	3.88

Taxa List

Allocaupnia	1
Anisoptera	1
Aulodrilus	1
Caecidotea	5
Crangonyx	3
Diplocladius	3
Erioptera	1
Hydrobaenus	15
Limnephilidae	1
Lumbriculidae	1
Nais	2
Nemouridae	8
Neoporus	1
Orthocladius/Cricotopus	4
Parakiefferiella	1
Paranemoura	13
Physa	3
Pisidiidae	6
Pisidium	3
Rheocricotopus	4
Sciomyzidae	1
Serromyia	1
Simuliidae	1
Spirosperma	2
Stegopterna	8
Stenochironomus	1
Tanytarsus	3
Tubificinae	4
Zavreliomyia	5

Total Individuals 103

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Variability	10
Bank Stability- Right Bank	6	Riparian Vegetative	
Channel Alteration	18	Zone Width- Left Bank	10
Channel Flow Status	18	Riparian Vegetative	
Channel Sinuosity	8	Zone Width- Right Bank	10
Epifaunal Substrate/Available Cover	15	Sediment Deposition	7
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	6
		Vegetative Protection (Right Bank)	6

EPA Habitat Score 128

EPA Narrative Ranking S

Maryland Biological Stream Survey PHI

Drainage area (acres)	728	Instream Wood Debris	13
Remoteness	4	Bank Stability	12
Shading	100		
Epifaunal Substrate	5		
Instream Habitat	15		

PHI Score 70.56

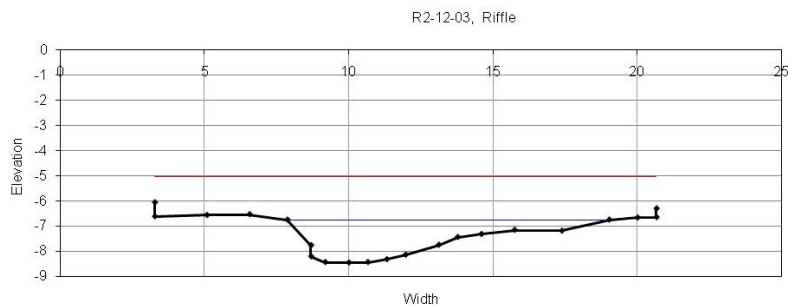
PHI Narrative Ranking partially degraded

Water Chemistry

Dissolved Oxygen (mg/L)	11.32	Specific Conductance (µS/cm)	274
pH	6.07	Temperature (°C)	8.35

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	1.14	Cross Sectional Area (ft ²)	9.8
Bankfull Width (ft)	11.2	Water Surface Slope (%)	0.55
Mean Bankfull Depth (ft)	0.9	Sinuosity	1.7
Floodprone Width (ft)	177	D50 (mm)	0.2
Entrenchment Ratio	15.9	Adjustments?	None
Width to Depth Ratio	12.7	Rosgen Stream Type	C5





Upstream



Downstream

Location/Site Access: Located at Hobbins Lane 0.15 miles west
Latitude/Longitude: 38.91426/-76.61778

Land Use Analysis:

Land Use	Acres	% Area
Open Space	10.1	4.7
Pasture/Hay	17.8	8.2
Residential 1/2-acre	6.4	3.0
Residential 1-acre	25.8	11.9
Residential 2-acre	29.7	13.7
Row Crops	19.7	9.1
Transportation	4.0	1.8
Woods	103.0	47.5
Grand Total	216.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
12.0	216.6	5.5

Results:

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Habitat assessment results indicate fair conditions at this site, matching the indications from the biological community.
- Pool variability is poor and bank stability is fair, but other features are suboptimal
- Sample dominated by midges (Parametriocnemus), amphipods, (Gammarus) and stoneflies (Paranemoura)
- Stream type was identified as an G5c, slope was 1.1 percent, and the median channel substrate was fine sand
- Typically, G channels are not stable. This channel is marginally unstable

Recommendations:

- Protect the riparian area. Mitigate any increases in imperviousness.

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	23
EPT Taxa	6
Ephemeroptera Taxa	0
Intolerant Urban %	27.83
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	17.39

Taxa List

Amphinemura	3
Bezzia/Palpomyia	1
Corynoneura	7
Diplocladius	1
Gammarus	16
Limnephilidae	5
Micropsectra	8
Nais	3
Nemouridae	2
Neophylax	1
Orthocladiinae	3
Orthocladius/Cricotopus	2
Parametriocnemus	19
Paranemoura	11
Pisidiidae	2
Polypedilum	7
Rheocricotopus	3
Simuliidae	1
Stegopterna	4
Thienemanniella	1
Thienemannimyia genus group	5
Wormaldia	3
Zavrelimyia	7

Total Individuals

115

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	3	Pool Variability	3
Bank Stability- Right Bank	5	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	20	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	8	Sediment Deposition	13
Channel Sinuosity	6	Vegetative Protection (Left Bank)	4
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	8		

EPA Habitat Score	107
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	217	Instream Wood Debris	14
Remoteness	9	Bank Stability	8
Shading	100		
Epifaunal Substrate	6		
Instream Habitat	11		

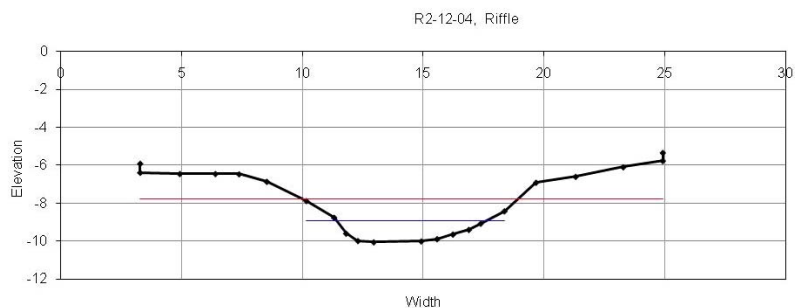
PHI Score	75.73
PHI Narrative Ranking	partially degraded

Water Chemistry

Dissolved Oxygen (mg/L)	11.68	Specific Conductance (μS/cm)	294
pH	6.54	Temperature (°C)	6.35

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.34	Cross Sectional Area (ft ²)	5.2
Bankfull Width (ft)	6.2	Water Surface Slope (%)	1.1
Mean Bankfull Depth (ft)	0.8	Sinuosity	1.1
Floodprone Width (ft)	9.3	D50 (mm)	0.19
Entrenchment Ratio	1.5	Adjustments?	↓ER
Width to Depth Ratio	7.3	Rosgen Stream Type	G5c





Upstream



Downstream

Location/Site Access: Located at 2897 Spring Lakes Dr. Lou Lauer Residence
Latitude/Longitude: 38.96043/-76.61828

Land Use Analysis:

Land Use	Acres	% Area
Open Space	2.8	2.1
Residential 1-acre	40.4	31.1
Residential 2-acre	36.4	28.0
Transportation	6.4	4.9
Woods	44.1	33.9
Grand Total	130.0	100.0

Impervious (acres)	Total Area Above site	% Impervious
15.3	130.0	11.8

Results:

- Biological condition – "Very Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Habitat assessment results indicate fair conditions at this site, but the biological community shows more impairment than expected based on the observed habitat quality.
- Substrate and pool features are mostly marginal. Channel is not sinuous.
- Sample dominated by worms (Tubificinae) and midges (Paratendipes)
- Stream type was identified as an B5c, slope was 0.22 percent, and the median channel substrate was fine sand
- Typically, B channels are stable as this one appears to be.

Recommendations:

- Protect the riparian area. Mitigate any increases in imperviousness. Investigate potential stressors other than habitat.

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	0
Ephemeroptera Taxa	0
Intolerant Urban %	9.52
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	0

Taxa List

Caecidotea	10
Crangonyx	6
Enchytraeidae	1
Ilyodrilus	7
Limnodrilus	2
Mallochohelea	1
Odontomesa	1
Parametriocnemus	1
Paratendipes	18
Pisidiidae	13
Pisidium	11
Planariidae	1
Prostoma	2
Rheocricotopus	1
Seromyia	2
Sphaerium	1
Stilocladius	4
Tubificinae	23

Total Individuals 105

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	8	Pool Variability	6
Bank Stability- Right Bank	8	Riparian Vegetative	10
Channel Alteration	19	Zone Width- Left Bank	10
Channel Flow Status	10	Riparian Vegetative	10
Channel Sinuosity	3	Zone Width- Right Bank	7
Epifaunal Substrate/Available Cover	7	Sediment Deposition	8
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	8
		Vegetative Protection (Right Bank)	8

EPA Habitat Score 112

EPA Narrative Ranking PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	130	Instream Wood Debris	11
Remoteness	3	Bank Stability	16
Shading	100		
Epifaunal Substrate	2		
Instream Habitat	7		

PHI Score 68.43

PHI Narrative Ranking partially degraded

Water Chemistry

Dissolved Oxygen (mg/L)	8.31	Specific Conductance (µS/cm)	417
pH	6.27	Temperature (°C)	7.74

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.20	Cross Sectional Area (ft ²)	4.9
Bankfull Width (ft)	9.6	Water Surface Slope (%)	0.22
Mean Bankfull Depth (ft)	0.5	Sinuosity	1.0
Floodprone Width (ft)	15	D50 (mm)	0.14
Entrenchment Ratio	1.6	Adjustments?	↑Sin
Width to Depth Ratio	18.9	Rosgen Stream Type	B5c





Upstream



Downstream

Location/Site Access: Located at end of Mansion Woods Rd., walk 0.30 miles southwest
Latitude/Longitude: 39.00543/-76.57362

Land Use Analysis:

Land Use	Acres	% Area
Commercial	14.5	5.7
Residential 1-acre	2.4	0.9
Residential 2-acre	13.4	5.2
Row Crops	57.2	22.3
Transportation	1.2	0.5
Woods	167.9	65.5
Grand Total	256.5	100.0

Impervious (acres)	Total Area Above site	% Impervious
9.1	256.5	3.5

Results:

- Biological condition – "Poor"
- Habitat scores "Supporting" and "Minimally Degraded"
- Habitat assessment results indicate good conditions at this site, but the biological community shows more impairment than expected based on the observed habitat quality.
- Conductivity is relatively high.
- Sample dominated by amphipods (*Gammarus*) and midges (*Parametrioctenus* and *Thienemannimyia*)
- Stream type was identified as an C5, slope was 0.54 percent, and the median channel substrate was medium sand
- Typically, C channels are stable as this one appears to be.

Recommendations:

- Protect the riparian area. Investigate possible stressors to biota other than habitat.

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	34
EPT Taxa	4
Ephemeroptera Taxa	0
Intolerant Urban %	7.27
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	6.36

Taxa List

Anchytarsus	1
Ancyronyx	1
Aspsectrotanypus	2
Aulodrilus	7
Bezzia/Palpomyia	1
Gammarus	16
Gomphus	1
Hemerodromia	1
Heteroplectron	1
Heterotrissocladius	1
Hygrobates	1
Leuctra	1
Mallochohelea	1
Micropsectra	1
Microtendipes	1
Nigronia	1
Orthocladius/Cricotopus	6
Paralauterborniella	4
Parametriocnemus	15
Paratendipes	3
Phaenopsectra	1
Pisidiidae	6
Pisidium	5
Polycentropus	1
Polypedilum	1
Prostoma	1
Pseudorthocladius	2
Psilotreta	1
Rheocricotopus	1
Rheotanytarsus	5
Serromyia	1
Tanytarsus	5
Thienemannimyia genus group	11
Zavrelimyia	3
Total Individuals	110

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	9	Pool Variability	7
Bank Stability- Right Bank	9	Riparian Vegetative	
Channel Alteration	20	Zone Width- Left Bank	10
Channel Flow Status	18	Riparian Vegetative	
Channel Sinuosity	7	Zone Width- Right Bank	10
Epifaunal Substrate/Available Cover	17	Sediment Deposition	11
Pool Substrate Characterization	9	Vegetative Protection (Left Bank)	9
		Vegetative Protection (Right Bank)	9

EPA Habitat Score	145
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EPA Narrative Ranking	S
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Maryland Biological Stream Survey PHI

Drainage area (acres)	256.5	Instream Wood Debris	15
Remoteness	13	Bank Stability	18
Shading	35		
Epifaunal Substrate	14		
Instream Habitat	17		

PHI Score	83.54
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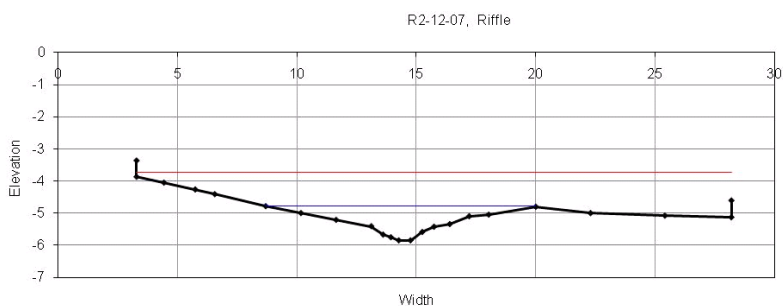
PHI Narrative Ranking	Minimally degraded
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Water Chemistry

Dissolved Oxygen (mg/L)	9.99	Specific Conductance (µS/cm)	1447
pH	6.62	Temperature (°C)	7.39

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.4	Cross Sectional Area (ft ²)	5.0
Bankfull Width (ft)	11.3	Water Surface Slope (%)	0.54
Mean Bankfull Depth (ft)	0.4	Sinuosity	1.1
Floodprone Width (ft)	121	D50 (mm)	0.26
Entrenchment Ratio	10.7	Adjustments?	↑Sin
Width to Depth Ratio	25.6	Rosgen Stream Type	C5





Location/Site Access: Located at Clear Pond Ct. Culdesac : walk 350 ft Southeast
Latitude/Longitude: 38.96366/-76.61172

Land Use Analysis:

Land Use	Acres	% Area
Open Space	2.8	1.0
Residential 1-acre	48.1	17.0
Residential 2-acre	114.5	40.5
Transportation	11.2	4.0
Utility	24.3	8.6
Woods	81.8	28.9
Grand Total	282.8	100.0

Impervious (acres)	Total Area Above site	% Impervious
29.1	282.8	10.3

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Habitat assessment results indicate fair and degraded conditions at this site. The biological community shows poor conditions, agreeing with the PHI assessment.
- Bank and sediment conditions are mostly marginal.
- Sample dominated by midges (Paratendipes and Parametrioctenemus)
- Stream type was identified as an G6c, slope was 0.44 percent, and the median channel substrate was very fine sand
- Typically, G channels are not stable, as this one appears to be.

Recommendations:

- Protect the riparian area. Mitigate any increases in imperviousness.

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.71
Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5
Calculated Metric Values	
Total Taxa	29
EPT Taxa	6
Ephemeroptera Taxa	0
Intolerant Urban %	7.62
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	12.38

Taxa List

Anchytarsus	8
Apsectrotanypus	1
Brillia	1
Caecidotea	1
Capniidae	1
Diplectrona	1
Diplocladius	2
Heterotrissocladius	2
Limnephilidae	1
Lype	1
Micropsectra	1
Odontomesa	3
Orthocladius/Cricotopus	2
Paralauterborniella	1
Parametriocnemus	18
Paratendipes	23
Pisidium	4
Polypedilum	4
Ptilostomis	3
Pycnopsyche	2
Rheocricotopus	2
Rheotanytarsus	1
Stegopterna	3
Stempellinella	4
Stilocladius	7
Thienemanniella	1
Thienemannimyia genus group	2
Zalutschia	1
Zavrelimyia	4

Total Individuals 105

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	2	Pool Variability	10
Bank Stability- Right Bank	4	Riparian Vegetative	
Channel Alteration	13	Zone Width- Left Bank	10
Channel Flow Status	14	Riparian Vegetative	
Channel Sinuosity	8	Zone Width- Right Bank	10
Epifaunal Substrate/Available Cover	9	Sediment Deposition	7
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	2
		Vegetative Protection (Right Bank)	4

EPA Habitat Score 101

EPA Narrative Ranking PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	283	Instream Wood Debris	10
Remoteness	4	Bank Stability	6
Shading	95		
Epifaunal Substrate	5		
Instream Habitat	9		

PHI Score 64.16

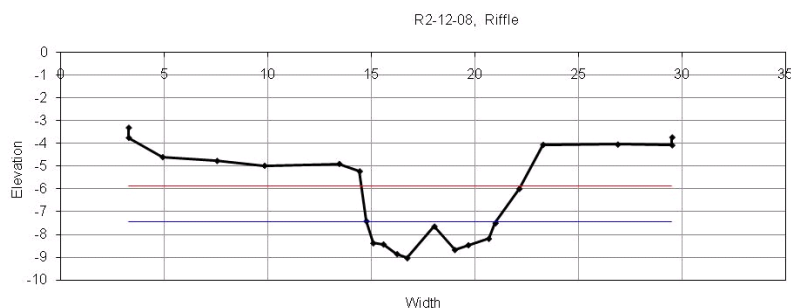
PHI Narrative Ranking degraded

Water Chemistry

Dissolved Oxygen (mg/L)	10.39	Specific Conductance (µS/cm)	261
pH	6.22	Temperature (°C)	10.36

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.44	Cross Sectional Area (ft ²)	5.7
Bankfull Width (ft)	6.3	Water Surface Slope (%)	0.44
Mean Bankfull Depth (ft)	0.9	Sinuosity	1.2
Floodprone Width (ft)	9.0	D50 (mm)	0.062
Entrenchment Ratio	1.4	Adjustments?	None
Width to Depth Ratio	6.8	Rosgen Stream Type	G6c





Upstream



Downstream

Location/Site Access: Located at Monarch Dr. Crossing 165 ft D.S

Latitude/Longitude: 38.91575/-76.56106

Land Use Analysis:

Land Use	Acres	% Area
Open Space	34.7	11.6
Residential 1/2-acre	53.7	18.0
Residential 1-acre	51.2	17.1
Residential 2-acre	42.9	14.4
Transportation	17.4	5.8
Water	0.7	0.2
Woods	98.0	32.8
Grand Total	298.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
46.4	298.6	15.5

Results:

- Biological condition – "Poor"
- Habitat scores "Not Supporting" and "Degraded"
- Habitat assessment results indicate degraded conditions at this site, which basically agrees with the biological condition.
- Bank and sediment conditions are mostly marginal.
- Sample dominated by diptera (Stegopterna), midges (Hydrobaenus), and caddisflies (Limnephilidae)
- Stream type was identified as an G6c, slope was 0.52 percent, and the median channel substrate was very fine sand
- Typically, G channels are not stable as this one seems to be

Recommendations:

- Protect the riparian area. Mitigate against any increasing imperviousness.

R2-12-11A

Lower North River Sampling Unit

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.71
Total Taxa Score	3
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	15
EPT Taxa	2
Ephemeroptera Taxa	0
Intolerant Urban %	52.78
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	12.04

Taxa List

Chaetocladius	1
Crangonyx	2
Diplocladius	1
Hydrobaenus	19
Ilyodrilus	2
Limnephilidae	13
Neoporus	1
Orthocladius/Cricotopus	6
Parametriocnemus	1
Paranemoura	6
Physa	1
Stegopterna	51
Stenochironomus	1
Tubificinae	1
Zavreliomyia	2

Total Individuals 108

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	4	Pool Variability	3
Bank Stability- Right Bank	3	Riparian Vegetative	9
Channel Alteration	11	Zone Width- Left Bank	9
Channel Flow Status	15	Riparian Vegetative	8
Channel Sinuosity	9	Zone Width- Right Bank	15
Epifaunal Substrate/Available Cover	3	Sediment Deposition	5
Pool Substrate Characterization	6	Vegetative Protection (Left Bank)	3
		Vegetative Protection (Right Bank)	

EPA Habitat Score	94
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	299	Instream Wood Debris	7
Remoteness	4	Bank Stability	7
Shading	85		
Epifaunal Substrate	5		
Instream Habitat	3		

PHI Score	55.04
PHI Narrative Ranking	degraded

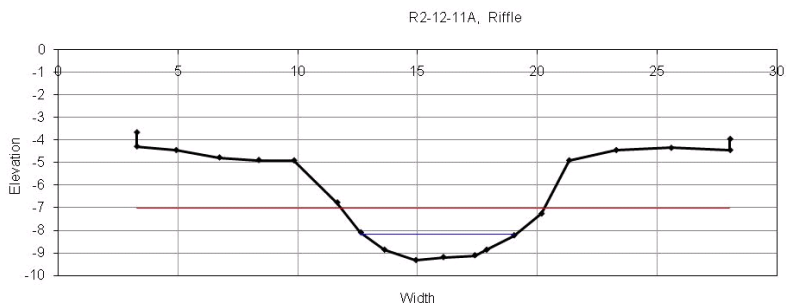
Water Chemistry

Dissolved Oxygen (mg/L)	10.93	Specific Conductance (µS/cm)	276
pH	6.57	Temperature (°C)	13.1

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi ²)	0.47	Cross Sectional Area (ft ²)	5.0
Bankfull Width (ft)	6.3	Water Surface Slope (%)	0.52
Mean Bankfull Depth (ft)	0.8	Sinuosity	1.2
Floodprone Width (ft)	9.3	D50 (mm)	0.062
Entrenchment Ratio	1.5	Adjustments?	↓ER
Width to Depth Ratio	8.0	Rosgen Stream Type	G6c





Upstream



Downstream

Location/Site Access: Located at Brick Church Rd. Crossing, 300 ft. West
Latitude/Longitude: 38.91989/-76.59519

Land Use Analysis:

Land Use	Acres	% Area
Open Space	57.4	5.7
Pasture/Hay	20.5	2.0
Residential 1/2-acre	2.0	0.2
Residential 1-acre	56.3	5.6
Residential 2-acre	124.1	12.4
Row Crops	72.1	7.2
Transportation	18.0	1.8
Utility	39.4	3.9
Water	1.7	0.2
Woods	611.7	61.0
Grand Total	1003.3	100.0

Impervious (acres)	Total Area Above site	% Impervious
38.2	1003.3	3.8

Results:

- Biological condition – "Fair"
- Habitat scores "Not 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 and sediment conditions are mostly marginal.
- Sample dominated by blackflies (Stegopterna) and stoneflies (Paranemoura)
- Stream type was identified as an G5c, slope was 0.38 percent, and the median channel substrate was medium sand
- Typically, G channels are not stable as this one appears to be. The habitat is in poor condition for the watershed imperviousness.

Recommendations:

- Protect the riparian area. Investigate possible stressors to the habitat.

R2-12-12A

Lower North River Sampling Unit

IBI and Metric Scores

Narrative Rating	Fair
Overall Index	3.29
Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	28
EPT Taxa	6
Ephemeroptera Taxa	0
Intolerant Urban %	48
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	10

Taxa List

Amphinemura	1
Aulodrilus	7
Caecidotea	5
Chrysops	1
Corynoneura	1
Crangonyx	3
Diplocladius	2
Ferrissia	1
Gammarus	3
Hydrobaenus	1
Limnephilidae	2
Lumbriculidae	1
Mesocricotopus	1
Nais	6
Nemouridae	5
Parametriocnemus	3
Paranemoura	12
Paratendipes	1
Philopotamidae	1
Pisidiidae	6
Planariidae	1
Polypedilum	6
Prosimulium	4
Ptilostomis	1
Stegopterna	19
Tipula	3
Tubificinae	2
Zavrelinmyia	1

Total Individuals 100

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	5	Pool Variability	3
Bank Stability- Right Bank	4	Riparian Vegetative	10
Channel Alteration	19	Zone Width- Left Bank	10
Channel Flow Status	8	Riparian Vegetative	10
Channel Sinuosity	10	Zone Width- Right Bank	7
Epifaunal Substrate/Available Cover	8	Sediment Deposition	4
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	4
		Vegetative Protection (Right Bank)	4

EPA Habitat Score	100
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	1003	Instream Wood Debris	6
Remoteness	5	Bank Stability	9
Shading	100		
Epifaunal Substrate	3		
Instream Habitat	8		

PHI Score	56.37
PHI Narrative Ranking	degraded

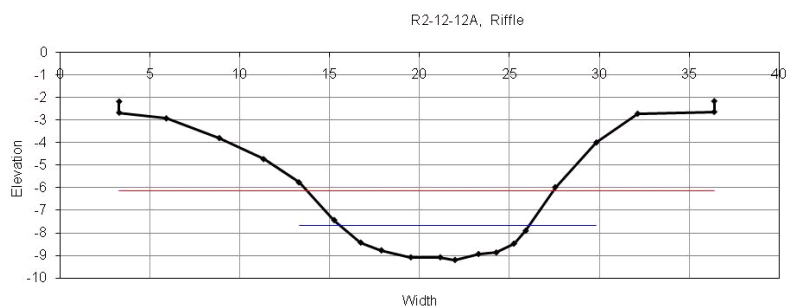
Water Chemistry

Dissolved Oxygen (mg/L)	10.46	Specific Conductance (µS/cm)	253
pH	6.23	Temperature (°C)	13.25

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi ²)	1.57	Cross Sectional Area (ft ²)	11.4
Bankfull Width (ft)	10.5	Water Surface Slope (%)	0.38
Mean Bankfull Depth (ft)	1.1	Sinuosity	1.5
Floodprone Width (ft)	16.7	D50 (mm)	0.27
Entrenchment Ratio	1.6	Adjustments?	↓ER
Width to Depth Ratio	9.6	Rosgen Stream Type	G5c





Upstream



Downstream

Location/Site Access: Located at Gresham Lane. 0.23 miles East
Latitude/Longitude: 38.91145/-76.59582

Land Use Analysis:

Land Use	Acres	% Area
Open Space	24.9	6.7
Pasture/Hay	1.5	0.4
Residential 1/2-acre	2.0	0.5
Residential 1-acre	16.3	4.4
Residential 2-acre	51.6	13.8
Row Crops	24.9	6.7
Transportation	4.4	1.2
Utility	4.8	1.3
Woods	242.3	65.0
Grand Total	372.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
12.5	372.6	3.4

Results:

- Biological condition – "Fair"
- Habitat scores "Not Supporting" and "Partially Degraded"
- Habitat assessment results indicate degraded conditions at this site, but the biological community is fair.
- Bank, riparian, and sediment conditions are mostly marginal.
- Sample dominated by blackflies (Stegopterna and Prosimulium) and midges (Parametrioctenemus and Polypedilum)
- Stream type was identified as an E5, slope was 0.73 percent, and the median channel substrate was very fine sand
- Typically, E channels are stable. This channel has some instability despite low imperviousness in the watershed.

Recommendations:

- Protect the riparian area. Because watershed imperviousness is so low and habitat conditions are poor, check for disturbances to the channel that are not due to hydrologic instability.

R2-12-13A

Lower North River Sampling Unit

IBI and Metric Scores

Narrative Rating	Fair
Overall Index	3
Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	22
EPT Taxa	3
Ephemeroptera Taxa	0
Intolerant Urban %	39.64
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	14.41

Taxa List

Amphinemura	1
Caecidotea	4
Corynoneura	4
Crangonyx	1
Diplocladius	4
Gammarus	1
Limnephilidae	3
Limnodrilus	6
Nais	4
Parametriocnemus	22
Paranemoura	4
Pisidium	3
Polypedilum	11
Potamothenix	1
Prosimulium	9
Pseudolimnophila	1
Seromyia	1
Stegopterna	25
Tanytarsus	2
Tipula	1
Tubificinae	2
Zavrelimyia	1

Total Individuals 111

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	5	Pool Variability	7
Bank Stability- Right Bank	5	Riparian Vegetative	
Channel Alteration	14	Zone Width- Left Bank	5
Channel Flow Status	10	Riparian Vegetative	
Channel Sinuosity	6	Zone Width- Right Bank	2
Epifaunal Substrate/Available Cover	9	Sediment Deposition	8
Pool Substrate Characterization	9	Vegetative Protection (Left Bank)	5
		Vegetative Protection (Right Bank)	5

EPA Habitat Score	90
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	373	Instream Wood Debris	12
Remoteness	13	Bank Stability	10
Shading	95		
Epifaunal Substrate	5		
Instream Habitat	9		

PHI Score	74.59
PHI Narrative Ranking	partially degraded

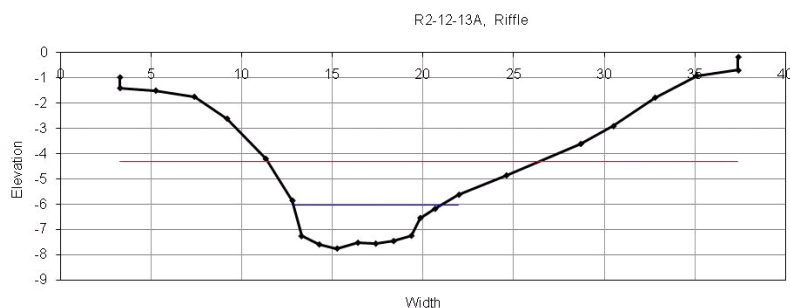
Water Chemistry

Dissolved Oxygen (mg/L)	11.01	Specific Conductance (µS/cm)	274
pH	6.06	Temperature (°C)	5.86

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi ²)	0.58	Cross Sectional Area (ft ²)	10.0
Bankfull Width (ft)	8.2	Water Surface Slope (%)	0.73
Mean Bankfull Depth (ft)	1.2	Sinuosity	1.0
Floodprone Width (ft)	17.3	D50 (mm)	0.081
Entrenchment Ratio	2.1	Adjustments?	↑ER, Sin
Width to Depth Ratio	6.6	Rosgen Stream Type	E5





Upstream



Downstream

Location/Site Access: Located at 0.5 miles behind 5095 Sudley Road
Latitude/Longitude: 38.83374/-76.57797

Land Use Analysis:

Land Use	Acres	% Area
Open Space	1.2	0.7
Residential 1-acre	2.6	1.6
Residential 2-acre	13.2	8.0
Transportation	2.5	1.5
Woods	145.0	88.2
Grand Total	164.4	100.0

Impervious (acres)	Total Area Above site	% Impervious
2.4	164.4	1.5

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Habitat assessment results indicate partially degraded conditions at this site, which could contribute to the poor biological condition.
- Bank and sediment conditions are marginal, though the riparian zone is relatively undisturbed.
- Sample dominated by blackflies (Stegopterna), caddisflies (Limnephilidae and Ironoquia), and stoneflies (Paranemoura and Amphinemura)
- Stream type was identified as an G6c, slope was 0.55 percent, and the median channel substrate was very fine sand
- Typically, G channels are not stable, and this one shows bank instability and dominance of fine sediments

Recommendations:

- Protect the riparian area. Mitigate any increases in imperviousness.

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.71
Total Taxa Score	3
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	19
EPT Taxa	4
Ephemeroptera Taxa	0
Intolerant Urban %	54.62
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	13.45

Taxa List

Amphinemura	10
Chrysops	1
Corduliidae/Libellulidae	1
Crangonyx	1
Diplocladius	9
Enchytraeidae	2
Ephydriidae	1
Erioptera	2
Hydrobaenus	2
Isonychia	11
Limnephilidae	15
Nais	1
Orthocladus/Cricotopus	2
Paranemoura	11
Pisidiidae	1
Rheocricotopus	2
Simuliidae	1
Stegopterna	43
Tubificinae	3

Total Individuals

119

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	3	Pool Variability	5
Bank Stability- Right Bank	3	Riparian Vegetative	
Channel Alteration	20	Zone Width- Left Bank	10
Channel Flow Status	15	Riparian Vegetative	
Channel Sinuosity	11	Zone Width- Right Bank	10
Epifaunal Substrate/Available Cover	7	Sediment Deposition	5
Pool Substrate Characterization	6	Vegetative Protection (Left Bank)	4
		Vegetative Protection (Right Bank)	3

EPA Habitat Score	102
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	164	Instream Wood Debris	3
Remoteness	20	Bank Stability	3
Shading	85		
Epifaunal Substrate	4		
Instream Habitat	5		

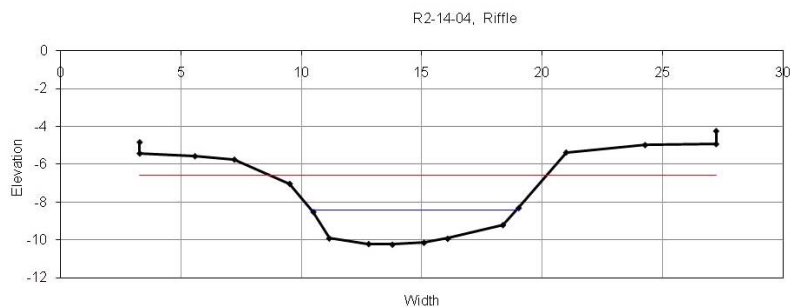
PHI Score	66.43
PHI Narrative Ranking	partially degraded

Water Chemistry

Dissolved Oxygen (mg/L)	11.2	Specific Conductance (µS/cm)	134
pH	6.35	Temperature (°C)	7.45

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.26	Cross Sectional Area (ft ²)	11.8
Bankfull Width (ft)	8.4	Water Surface Slope (%)	0.55
Mean Bankfull Depth (ft)	1.4	Sinuosity	1.1
Floodprone Width (ft)	9.8	D50 (mm)	0.062
Entrenchment Ratio	1.2	Adjustments?	↑Sin
Width to Depth Ratio	6.0	Rosgen Stream Type	G6c





Location/Site Access: Located at 0.65 miles behind 5095 Sudley Road
 Latitude/Longitude: 38.83439/-76.57639

Land Use Analysis:

Land Use	Acres	% Area
Open Space	1.1	0.7
Residential 1-acre	2.5	1.5
Residential 2-acre	13.0	7.7
Transportation	2.5	1.8
Woods	149.5	88.7
Grand Total	168.5	100

Impervious (acres)	Total Area Above site	% Impervious
2.4	168.5	1.4

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Minimally 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, riparian, and sediment conditions are fair, while pool variability is poor and riparian conditions are excellent.
- Sample dominated by stoneflies (Paranemoura) and blackflies (Stegopterna)
- Stream type was identified as an G5c, slope was 0.61 percent, and the median channel substrate was fine sand
- Typically, G channels are not stable and this one has only fair stability

Recommendations:

- Protect the riparian area. Mitigate any increases to imperviousness.

IBI and Metric Scores

Narrative Rating	Poor
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Overall Index	2.71
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Total Taxa Score	3
EPT Taxa Score	5
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	7
Ephemeroptera Taxa	0
Intolerant Urban %	70.09
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	5.61

Taxa List

Amphinemura	10
Diplocladius	8
Enchytraeidae	2
Hydrobaenus	1
Ironoquia	4
Limnephilidae	6
Nais	1
Nemouridae	5
Orthocladius/Cricotopus	2
Paranemoura	32
Perlidae	3
Philopotamidae	1
Rheocricotopus	2
Smittia	2
Stegopterna	24
Thienemannimyia genus group	1
Tubificinae	3

Total Individuals

107

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Variability	2
Bank Stability- Right Bank	5	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	20	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	17	Sediment Deposition	11
Channel Sinuosity	12	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	5
Pool Substrate Characterization	10		

EPA Habitat Score	124
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EPA Narrative Ranking	PS
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Maryland Biological Stream Survey PHI

Drainage area (acres)	169	Instream Wood Debris	4
Remoteness	20	Bank Stability	10
Shading	80		
Epifaunal Substrate	11		
Instream Habitat	10		

PHI Score	82.54
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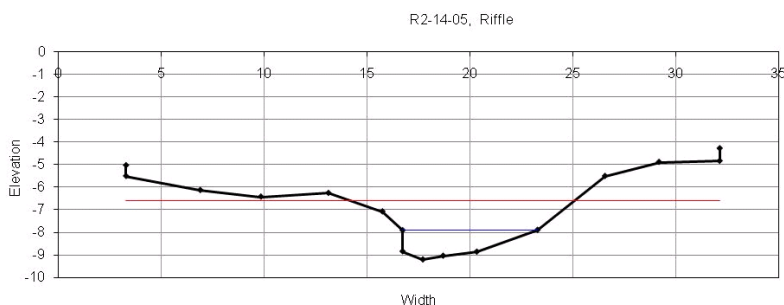
PHI Narrative Ranking	minimally degraded
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Water Chemistry

Dissolved Oxygen (mg/L)	9.71	Specific Conductance (µS/cm)	147
pH	6.19	Temperature (°C)	6.85

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.26	Cross Sectional Area (ft ²)	5.4
Bankfull Width (ft)	6.5	Water Surface Slope (%)	0.61
Mean Bankfull Depth (ft)	0.8	Sinuosity	1.2
Floodprone Width (ft)	9.8	D50 (mm)	0.22
Entrenchment Ratio	1.5	Adjustments?	↓ER
Width to Depth Ratio	7.9	Rosgen Stream Type	G5c





Upstream



Downstream

Location/Site Access: Located at 0.1 miles behind 5238 old Sudley Road
Latitude/Longitude: 38.82255/-76.57285

Land Use Analysis:

Land Use	Acres	% Area
Open Space	12.0	7.9
Residential 1-acre	4.1	2.7
Residential 2-acre	27.0	17.8
Row Crops	18.8	12.4
Transportation	2.9	1.9
Woods	87.0	57.3
Grand Total	151.9	100.0

Impervious (acres)	Total Area Above site	% Impervious
3.8	151.9	2.5

Results:

- Biological condition – "Fair"
- Habitat scores "Not 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, pool, and sediment conditions are marginal.
- Sample dominated by midges (Diplocladius) and worms (Tubificinae)
- Stream type was identified as an G5c, slope was 0.98 percent, and the median channel substrate was fine sand
- Typically, G channels are not stable. This stream may need to continue evolving to a stable form.

Recommendations:

- Protect the riparian area. Mitigate any increases in imperviousness.

IBI and Metric Scores

Narrative Rating	Fair
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Overall Index	3
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Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	3

Calculated Metric Values

Total Taxa	25
EPT Taxa	5
Ephemeroptera Taxa	0
Intolerant Urban %	32.43
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	2.7

Taxa List

Amphinemura	3
Caecidotea	11
Crangonyx	5
Diplocladius	18
Empididae	2
Enchytraeidae	1
Erioptera	1
Hydrobaenus	4
Ironoquia	2
Limnephilidae	3
Limnodrilus	4
Lumbriculidae	1
Nais	1
Nemouridae	3
Orthocladius/Cricotopus	2
Parachaetocladius	1
Parametrioctenus	1
Paranemoura	11
Pisidium	5
Planariidae	1
Rheocricotopus	8
Simuliidae	2
Smittia	1
Stegopterna	8
Tubificinae	12

Total Individuals	111
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Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	4	Pool Variability	2
Bank Stability- Right Bank	3	Riparian Vegetative Zone Width- Left Bank	8
Channel Alteration	20	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	15	Sediment Deposition	5
Channel Sinuosity	9	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	8	Vegetative Protection (Right Bank)	4
Pool Substrate Characterization	7		

EPA Habitat Score	100
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EPA Narrative Ranking	NS
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Maryland Biological Stream Survey PHI

Drainage area (acres)	152	Instream Wood Debris	3
Remoteness	6	Bank Stability	9
Shading	80		
Epifaunal Substrate	7		
Instream Habitat	8		

PHI Score	64.93
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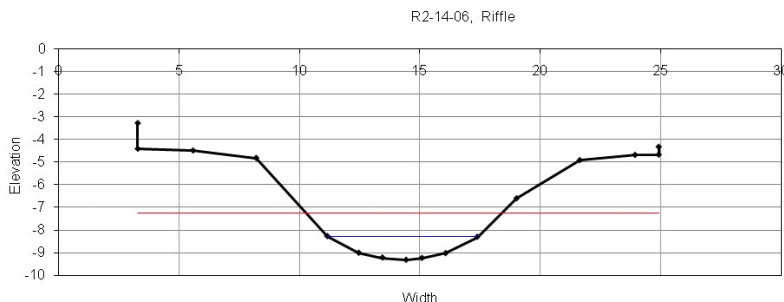
PHI Narrative Ranking	degraded
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Water Chemistry

Dissolved Oxygen (mg/L)	10.62	Specific Conductance (µS/cm)	131
pH	6.21	Temperature (°C)	8.15

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.24	Cross Sectional Area (ft ²)	4.2
Bankfull Width (ft)	6.2	Water Surface Slope (%)	0.98
Mean Bankfull Depth (ft)	0.7	Sinuosity	1.1
Floodprone Width (ft)	8.2	D50 (mm)	0.24
Entrenchment Ratio	1.3	Adjustments?	↑Sin
Width to Depth Ratio	9.1	Rosgen Stream Type	G5c





Upstream



Downstream

Location/Site Access: Located at 0.4 miles behind 5095 Sudley Road

Latitude/Longitude: 38.83279/-76.57975

Land Use Analysis:

Land Use	Acres	% Area
Open Space	1.2	0.9
Residential 1-acre	2.6	2.0
Residential 2-acre	13.2	9.9
Transportation	2.5	1.9
Woods	113.1	85.3
Grand Total	132.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
2.4	132.6	1.8

Results:

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Habitat and biological assessments are in agreement
- Bank and pool conditions are marginal, while riparian conditions are excellent.
- Sample dominated by blackflies (Stegopterna) and stoneflies (Amphinemura)
- Stream type was identified as an G5c, slope was 0.98 percent, and the median channel substrate was medium sand
- Typically, G channels are not stable. This one may be evolving towards a more stable form

Recommendations:

- Protect the riparian area. Mitigate any increases in imperviousness.

IBI and Metric Scores

Narrative Rating	Fair
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Overall Index	3
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Total Taxa Score	3
EPT Taxa Score	5
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	20
EPT Taxa	6
Ephemeroptera Taxa	0
Intolerant Urban %	49.55
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	8.11

Taxa List

Amphinemura	22
Crangonyx	1
Diplocladius	11
Dolichopodidae	1
Enchytraeidae	4
Hydrobaenus	2
Ironoquia	7
Limnephilidae	9
Limnodrilus	1
Nais	1
Nemouridae	2
Orthocladiinae	1
Paranemoura	4
Perlodidae	2
Pisidium	2
Rheocricotopus	5
Simuliidae	2
Smittia	1
Stegopterna	25
Tubificinae	8

Total Individuals

111

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	4	Pool Variability	4
Bank Stability- Right Bank	4	Riparian Vegetative	
Channel Alteration	20	Zone Width- Left Bank	10
Channel Flow Status	16	Riparian Vegetative	
Channel Sinuosity	6	Zone Width- Right Bank	10
Epifaunal Substrate/Available Cover	8	Sediment Deposition	8
Pool Substrate Characterization	7	Vegetative Protection (Left Bank)	4
		Vegetative Protection (Right Bank)	3

EPA Habitat Score	104
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EPA Narrative Ranking	PS
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Maryland Biological Stream Survey PHI

Drainage area (acres)	133	Instream Wood Debris	2
Remoteness	20	Bank Stability	4
Shading	80		
Epifaunal Substrate	4		
Instream Habitat	8		

PHI Score	69.71
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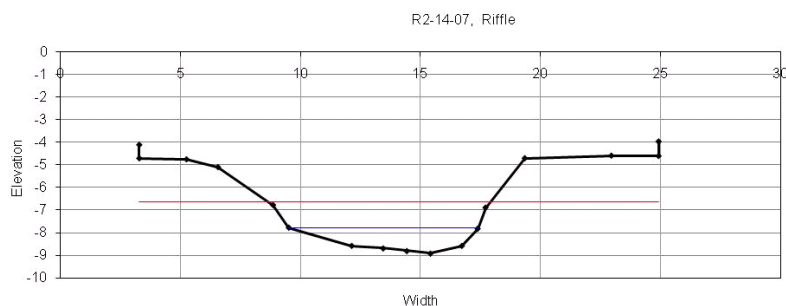
PHI Narrative Ranking	partially degraded
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Water Chemistry

Dissolved Oxygen (mg/L)	12.35	Specific Conductance (µS/cm)	128
pH	6.3	Temperature (°C)	5.83

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.21	Cross Sectional Area (ft ²)	5.8
Bankfull Width (ft)	7.9	Water Surface Slope (%)	0.98
Mean Bankfull Depth (ft)	0.7	Sinuosity	1.1
Floodprone Width (ft)	9.3	D50 (mm)	0.25
Entrenchment Ratio	1.2	Adjustments?	↑Sin
Width to Depth Ratio	10.7	Rosgen Stream Type	G5c





Upstream



Downstream

Location/Site Access: Located 0.1 mile behind 5160 old Sudley Road

Latitude/Longitude: 38.82602/-76.56609

Land Use Analysis:

Land Use	Acres	% Area
Open Space	32.0	8.3
Pasture/Hay	35.9	9.4
Residential 1-acre	9.7	2.5
Residential 2-acre	46.2	12.0
Row Crops	56.9	14.8
Transportation	10.7	2.8
Woods	192.1	50.1
Grand Total	383.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
29.1	383.6	7.6

Results:

- Biological condition – "Poor"
- Habitat scores "Not Supporting" and "Severely Degraded"
- Habitat assessment results indicate major degradation at this site, which may contribute to the poor biological condition.
- Bank, riparian, and sediment conditions are mostly marginal. The channel is highly accessible to public trails.
- Sample dominated by stoneflies (Paranemoura), blackflies (Stegopterna), isopods (Caecidotea), and worms (Tubificinae)
- Stream type was identified as an E5, slope was 0.42 percent, and the median channel substrate was very fine sand
- Typically, E channels are stable. The high exposure and landscape management of the riparian area may contribute to poor biological conditions

Recommendations:

- Protect the riparian area. Restrict access if feasible.

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.71
Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	1

Calculated Metric Values

Total Taxa	23
EPT Taxa	5
Ephemeroptera Taxa	0
Intolerant Urban %	63.33
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	0

Taxa List

Amphinemura	3
Caecidotea	15
Crangonyx	2
Diplocladius	1
Dolichopodidae	1
Enchytraeidae	3
Ironoquia	4
Limnodrilus	1
Lumbricidae	2
Lumbriculidae	1
Nais	1
Nemouridae	3
Orthocladus/Cricotopus	1
Paranemoura	39
Perlodidae	1
Pisidium	2
Rheocricotopus	3
Rhynchelmis	1
Simuliidae	3
Stegopterna	15
Stenochironomus	2
Tubificinae	13
Zavreliomyia	3

Total Individuals 120

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	4	Pool Variability	3
Bank Stability- Right Bank	4	Riparian Vegetative	10
Channel Alteration	20	Zone Width- Left Bank	2
Channel Flow Status	18	Riparian Vegetative	5
Channel Sinuosity	5	Zone Width- Right Bank	4
Epifaunal Substrate/Available Cover	10	Sediment Deposition	4
Pool Substrate Characterization	6	Vegetative Protection (Left Bank)	4
		Vegetative Protection (Right Bank)	4

EPA Habitat Score 95

EPA Narrative Ranking NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	384	Instream Wood Debris	3
Remoteness	3	Bank Stability	8
Shading	50		
Epifaunal Substrate	5		
Instream Habitat	8		

PHI Score 50.54

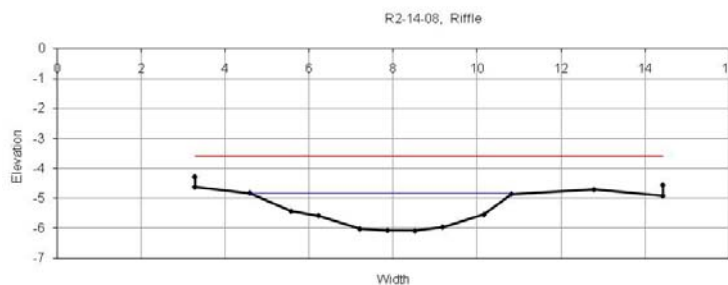
PHI Narrative Ranking severely degraded

Water Chemistry

Dissolved Oxygen (mg/L)	9.93	Specific Conductance (µS/cm)	159
pH	6.38	Temperature (°C)	12.76

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.6	Cross Sectional Area (ft ²)	5.2
Bankfull Width (ft)	6.2	Water Surface Slope (%)	0.42
Mean Bankfull Depth (ft)	0.8	Sinuosity	1.0
Floodprone Width (ft)	138	D50 (mm)	0.1
Entrenchment Ratio	22.2	Adjustments?	↑Sin
Width to Depth Ratio	7.4	Rosgen Stream Type	E5





Upstream



Downstream

Location/Site Access: Located at Owensville Road West, turn on Small Farm Road on left - 0.25 miles

Latitude/Longitude: 38.84998/-76.56361

Land Use Analysis:

Land Use	Acres	% Area
Commercial	3.8	0.3
Open Space	58.0	4.2
Pasture/Hay	147.1	10.7
Residential 1/2-acre	5.1	0.4
Residential 1-acre	35.6	2.6
Residential 2-acre	152.5	11.1
Row Crops	210.4	15.3
Transportation	21.8	1.6
Utility	40.9	3.0
Water	0.5	0.0
Woods	703.1	51.0
Grand Total	1378.8	100.0

Impervious (acres)	Total Area Above site	% Impervious
38.2	1378.8	2.8

Results:

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Degraded"
- Habitat assessment results indicate degraded conditions at this site, but the biological conditions are fair, somewhat better than expected.
- Riparian conditions are as bad as can be – heavy agricultural use.
- Sample dominated by isopods (Caecidotea), amphipods (Crangonyx), and caddisflies (Ironoquia)
- Stream type was identified as an E5, slope was 0.38 percent, and the median channel substrate was very fine sand
- Typically, E channels are stable. This one is as stable as can be expected given the riparian pressures

Recommendations:

- Protect the riparian area. Increase the buffer zone width, if feasible.

IBI and Metric Scores

Narrative Rating	Fair
Overall Index	3.29
Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	3
% Climbers	3

Calculated Metric Values

Total Taxa	26
EPT Taxa	6
Ephemeroptera Taxa	0
Intolerant Urban %	32.48
Ephemeroptera %	0
Scraper Taxa	1
% Climbers	3.42

Taxa List

Aulodrilus	2
Caecidotea	19
Crangonyx	17
Dero	1
Diplocladius	1
Gastropoda	1
Hydrobaenus	3
Ironoquia	17
Limnephilidae	2
Limnodrilus	1
Menetus	1
Nais	4
Nemouridae	1
Orthoclaudiinae	1
Orthoclaadius/Cricotopus	12
Parametriocnemus	1
Paranemoura	13
Perlidae	1
Perlodidae	1
Physa	2
Polypedilum	1
Rheocricotopus	6
Seromyia	1
Spirosperma	1
Stegopterna	3
Tubificinae	4

Total Individuals

117

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Variability	12
Bank Stability- Right Bank	6	Riparian Vegetative	1
Channel Alteration	20	Zone Width- Left Bank	1
Channel Flow Status	18	Riparian Vegetative	1
Channel Sinuosity	7	Zone Width- Right Bank	1
Epifaunal Substrate/Available Cover	14	Sediment Deposition	8
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	6
		Vegetative Protection (Right Bank)	6

EPA Habitat Score	113
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

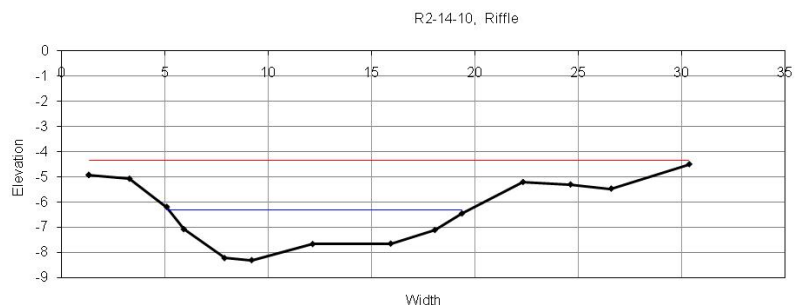
Drainage area (acres)	1379	Instream Wood Debris	5
Remoteness	5	Bank Stability	12
Shading	40		
Epifaunal Substrate	5	PHI Score	53.76
Instream Habitat	14	PHI Narrative Ranking	degraded

Water Chemistry

Dissolved Oxygen (mg/L)	10.63	Specific Conductance (µS/cm)	169
pH	6.47	Temperature (°C)	12.08

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	2.2	Cross Sectional Area (ft ²)	18.2
Bankfull Width (ft)	14.1	Water Surface Slope (%)	0.38
Mean Bankfull Depth (ft)	2.0	Sinuosity	1.0
Floodprone Width (ft)	38	D50 (mm)	0.076
Entrenchment Ratio	2.7	Adjustments?	↑Sin
Width to Depth Ratio	11.0	Rosgen Stream Type	E5





Upstream



Downstream

Location/Site Access: Located 0.4 miles off of Sudley Road

Latitude/Longitude: 38.83154/-76.5816

Land Use Analysis:

Land Use	Acres	% Area
Open Space	1.1	0.9
Residential 1-acre	2.6	2.2
Residential 2-acre	13.1	11.2
Transportation	2.5	2.1
Woods	97.5	83.5
Grand Total	116.8	100.0

Impervious (acres)	Total Area Above site	% Impervious
2.4	116.8	2.1

Results:

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Minimally Degraded"
- Habitat assessment results indicate fair and good conditions at this site, which is generally in agreement with the biological assessment.
- Bank and sediment conditions are marginal. Pool variability is poor and riparian conditions are excellent.
- Sample dominated by midges (Diplocladius), worms (Nais), and blackflies (Stegopterna)
- Stream type was identified as an E5, slope was 0.74 percent, and the median channel substrate was fine sand
- Typically, E channels are stable. This one has somewhat unstable banks.

Recommendations:

- Protect the riparian area. Mitigate any increased imperviousness.

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	5
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	3

Calculated Metric Values

Total Taxa	22
EPT Taxa	6
Ephemeroptera Taxa	0
Intolerant Urban %	32.71
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	4.67

Taxa List

Amphinemura	7
Caecidotea	9
Chrysops	3
Crangonyx	4
Diplocladius	13
Enchytraeidae	5
Ephydriidae	1
Gomphidae	1
Ironoquia	9
Isoperla	1
Limnephilidae	5
Lumbriculidae	2
Nais	10
Natarsia	2
Paranemoura	3
Philopotamidae	1
Pisidium	2
Rheocricotopus	9
Stegopterna	10
Stygobromus	1
Thienemannimyia genus group	1
Tubificinae	8

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	5	Pool Variability	2
Bank Stability- Right Bank	4	Riparian Vegetative	10
Channel Alteration	20	Zone Width- Left Bank	10
Channel Flow Status	17	Riparian Vegetative	10
Channel Sinuosity	15	Zone Width- Right Bank	10
Epifaunal Substrate/Available Cover	12	Sediment Deposition	5
Pool Substrate Characterization	7	Vegetative Protection (Left Bank)	4
		Vegetative Protection (Right Bank)	4

EPA Habitat Score	115
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EPA Narrative Ranking	PS
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Maryland Biological Stream Survey PHI

Drainage area (acres)	117	Instream Wood Debris	7
Remoteness	20	Bank Stability	12
Shading	85		
Epifaunal Substrate	11		
Instream Habitat	13		

PHI Score	89.94
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PHI Narrative Ranking	minimally degraded
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Water Chemistry

Dissolved Oxygen (mg/L)	10.16	Specific Conductance (µS/cm)	153
pH	6.34	Temperature (°C)	7.59

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.18	Cross Sectional Area (ft ²)	4.3
Bankfull Width (ft)	5.2	Water Surface Slope (%)	0.74
Mean Bankfull Depth (ft)	0.8	Sinuosity	1.4
Floodprone Width (ft)	10.9	D50 (mm)	0.39
Entrenchment Ratio	2.1	Adjustments?	↑ER
Width to Depth Ratio	6.4	Rosgen Stream Type	E5

**Total Individuals**

307



Upstream



Downstream

Location/Site Access: Located at 0.4 miles behind Muddy Creek Road

Latitude/Longitude: 38.83845/-76.5713

Land Use Analysis:

Land Use	Acres	% Area
Commercial	1.1	0.2
Open Space	7.1	1.4
Pasture/Hay	2.8	0.5
Residential 1-acre	2.6	0.5
Residential 2-acre	34.8	6.7
Row Crops	52.7	10.2
Transportation	3.8	0.7
Woods	413.8	79.8
Grand Total	518.7	100.0

Impervious (acres)	Total Area Above site	% Impervious
5.6	518.7	1.1

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Habitat assessment results indicate partially degraded conditions at this site, which might contribute to the poor biological conditions.
- Bank and sediment conditions are mostly marginal. Riparian conditions are excellent.
- Sample dominated by blackflies (Stegopterna) and stoneflies (Paranemoura)
- Stream type was identified as an F5, slope was 0.15 percent, and the median channel substrate was fine sand
- Typically, F channels are unstable. The banks in this channel are not very stable.

Recommendations:

- Protect the riparian area. Mitigate any increases in imperviousness..

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.71
Total Taxa Score	3
EPT Taxa Score	5
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	3

Calculated Metric Values

Total Taxa	18
EPT Taxa	5
Ephemeroptera Taxa	0
Intolerant Urban %	67.52
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	2.56

Taxa List

Amphinemura	4
Caecidotea	2
Crangonyx	1
Diplocladius	2
Hydrobaenus	8
Ironoquia	9
Limnephilidae	3
Nais	2
Nemouridae	2
Neoporus	1
Orthocladius/Cricotopus	2
Paranemoura	16
Pisidium	1
Pseudorthocladius	1
Rheocricotopus	1
Simuliidae	1
Stegopterna	55
Tubificinae	6

Total Individuals

117

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	5	Pool Variability	3
Bank Stability- Right Bank	6	Riparian Vegetative	
Channel Alteration	20	Zone Width- Left Bank	10
Channel Flow Status	18	Riparian Vegetative	
Channel Sinuosity	5	Zone Width- Right Bank	10
Epifaunal Substrate/Available Cover	7	Sediment Deposition	5
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	5
		Vegetative Protection (Right Bank)	6

EPA Habitat Score 108**EPA Narrative Ranking** PS**Maryland Biological Stream Survey PHI**

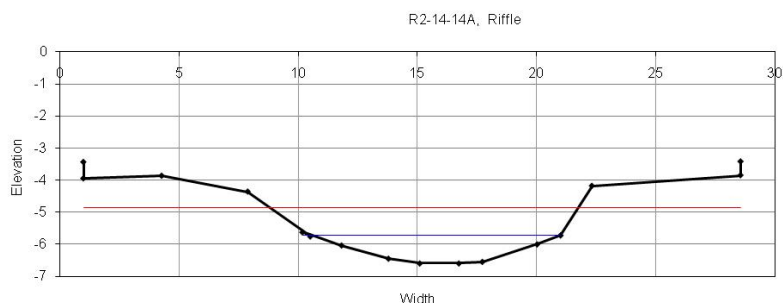
Drainage area (acres)	519	Instream Wood Debris	4
Remoteness	20	Bank Stability	12
Shading	70		
Epifaunal Substrate	4		
Instream Habitat	7		

PHI Score 67.14**PHI Narrative Ranking** partially degraded**Water Chemistry**

Dissolved Oxygen (mg/L)	10.26	Specific Conductance (µS/cm)	122
pH	6.61	Temperature (°C)	13.02

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.81	Cross Sectional Area (ft ²)	5.9
Bankfull Width (ft)	10.4	Water Surface Slope (%)	0.15
Mean Bankfull Depth (ft)	0.6	Sinuosity	1.1
Floodprone Width (ft)	13	D50 (mm)	0.17
Entrenchment Ratio	1.3	Adjustments?	↑Sin
Width to Depth Ratio	18	Rosgen Stream Type	F5





Location/Site Access: Located at Owensville Road West, Turn on Small Farm Road on left - 0.25 miles

Latitude/Longitude: 38.8498/-76.56258

Land Use Analysis:

Land Use	Acres	% Area
Commercial	3.8	0.3
Open Space	59.0	4.2
Pasture/Hay	149.5	10.8
Residential 1/2-acre	5.1	0.4
Residential 1-acre	35.6	2.6
Residential 2-acre	153.1	11.0
Row Crops	210.7	15.2
Transportation	21.9	1.6
Utility	40.9	2.9
Water	0.5	0.0
Woods	708.4	51.0
Grand Total	1388.5	100.0

Impervious (acres)	Total Area Above site	% Impervious
38.2	1388.5	2.8

Results:

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Degraded"
- Habitat assessment results indicate fair conditions at this site, which agrees with the biological conditions.
- Bank and sediment conditions are marginal. Riparian vegetation has been removed for agricultural uses.
- Sample dominated by blackflies (Stegopterns), stoneflies (Paranemoura), amphipods (Cragonyx), and isopods (Caecidotea)
- Stream type was identified as an C5, slope was 0.27 percent, and the median channel substrate was fine sand
- Typically, C channels are stable. This channel does not have very stable banks, possibly due to intensive riparian uses.

Recommendations:

- Naturalize riparian area.

IBI and Metric Scores

Narrative Rating	Fair
Overall Index	3.29
Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	3
% Climbers	3

Calculated Metric Values

Total Taxa	23
EPT Taxa	5
Ephemeroptera Taxa	0
Intolerant Urban %	50.47
Ephemeroptera %	0
Scraper Taxa	1
% Climbers	0.93

Taxa List

Amphinemura	3
Bezzia/Palpomysia	1
Caecidotea	11
Crangonyx	14
Culicoides	1
Dero	1
Erioptera	1
Hydrobaenus	3
Ironoquia	8
Limnodrilus	3
Menetus	1
Natarsia	2
Nemouridae	4
Orthocladius/Cricotopus	3
Parametriocnemus	2
Paranemoura	19
Perlodidae	2
Pisidium	4
Rheocricotopus	5
Spirosperma	1
Stegopterna	15
Tipula	1
Tubificinae	2

Total Individuals

107

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	4	Pool Variability	11
Bank Stability- Right Bank	4	Riparian Vegetative	1
Channel Alteration	20	Zone Width- Left Bank	1
Channel Flow Status	17	Riparian Vegetative	1
Channel Sinuosity	6	Zone Width- Right Bank	1
Epifaunal Substrate/Available Cover	14	Sediment Deposition	8
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	4
		Vegetative Protection (Right Bank)	4

EPA Habitat Score	102
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

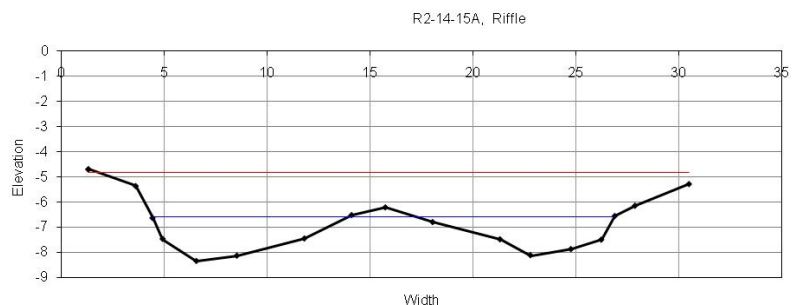
Drainage area (acres)	1388	Instream Wood Debris	10
Remoteness	5	Bank Stability	8
Shading	35		
Epifaunal Substrate	5	PHI Score	53.06
Instream Habitat	14	PHI Narrative Ranking	degraded

Water Chemistry

Dissolved Oxygen (mg/L)	10.94	Specific Conductance (µS/cm)	170
pH	6.65	Temperature (°C)	11.36

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	2.2	Cross Sectional Area (ft ²)	19.0
Bankfull Width (ft)	19.2	Water Surface Slope (%)	0.27
Mean Bankfull Depth (ft)	1.0	Sinuosity	1.0
Floodprone Width (ft)	50	D50 (mm)	0.13
Entrenchment Ratio	2.6	Adjustments?	↑Sin
Width to Depth Ratio	19.3	Rosgen Stream Type	C5





Upstream



Downstream

Location/Site Access: Located at Muddy Creek Road, Powerline Row 0.25 miles North
Latitude/Longitude: 38.85986/-76.5830

Land Use Analysis:

Land Use	Acres	% Area
Open Space	11.0	19.1
Pasture/Hay	1.4	2.4
Residential 1-acre	5.5	9.5
Residential 2-acre	4.7	8.1
Row Crops	3.9	6.8
Transportation	1.9	3.3
Utility	5.7	10.0
Woods	23.4	40.7
Grand Total	57.4	100.0

Impervious (acres)	Total Area Above site	% Impervious
2.0	57.4	3.5

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Habitat assessment results indicate fair conditions at this site, but the biological community shows only poor conditions.
- Sediment conditions are marginal and riparian conditions are excellent.
- Sample strongly dominated by amphipods (Gammarus)
- Stream type was identified as an B5c, slope was 1.03 percent, and the median channel substrate was fine sand
- Typically, B channels are stable. This channel has fair bank conditions, but marginal sediment conditions.

Recommendations:

- Protect the riparian area. Mitigate any increases in imperviousness.

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	15
EPT Taxa	2
Ephemeroptera Taxa	0
Intolerant Urban %	11.02
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	12.71

Taxa List

Bezzia/Palpomyia	2
Chrysops	3
Corynoneura	1
Diplectrona	1
Enchytraeidae	1
Gammarus	60
Ironoquia	6
Micropsectra	9
Nais	2
Parametriocnemus	3
Pisidium	21
Polypedilum	6
Thienemanniella	1
Thienemannimyia genus group	1
Tubificinae	1

Total Individuals

118

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	7	Pool Variability	7
Bank Stability- Right Bank	5	Riparian Vegetative	
Channel Alteration	20	Zone Width- Left Bank	10
Channel Flow Status	12	Riparian Vegetative	
Channel Sinuosity	10	Zone Width- Right Bank	10
Epifaunal Substrate/Available Cover	9	Sediment Deposition	9
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	7
		Vegetative Protection (Right Bank)	5

EPA Habitat Score 119**EPA Narrative Ranking** PS**Maryland Biological Stream Survey PHI**

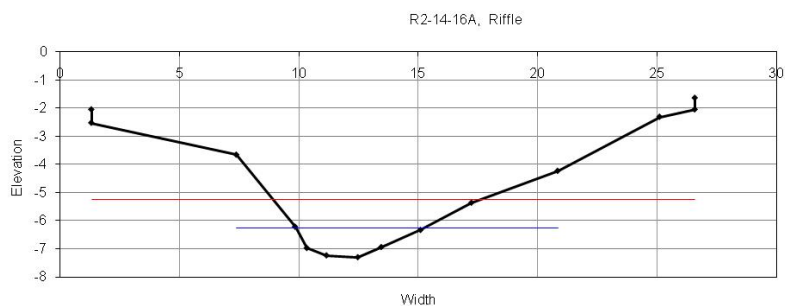
Drainage area (acres)	57	Instream Wood Debris	5
Remoteness	10	Bank Stability	12
Shading	100		
Epifaunal Substrate	4		
Instream Habitat	9		

PHI Score 77.40**PHI Narrative Ranking** partially degraded**Water Chemistry**

Dissolved Oxygen (mg/L)	10.65	Specific Conductance (µS/cm)	150
pH	6.31	Temperature (°C)	11.96

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.09	Cross Sectional Area (ft ²)	3.6
Bankfull Width (ft)	5.4	Water Surface Slope (%)	1.03
Mean Bankfull Depth (ft)	0.7	Sinuosity	1.23
Floodprone Width (ft)	10.8	D50 (mm)	0.23
Entrenchment Ratio	2.0	Adjustments?	↑WD
Width to Depth Ratio	8.0	Rosgen Stream Type	B5c





Location/Site Access: Located at Gaffney Fitness Center. Broadfoot Rd., 0.15 miles east
Latitude/Longitude: 39.09306/-76.74284

Land Use Analysis:

Land Use	Acres	% Area
Commercial	219.3	11.6
Open Space	471.6	25.0
Pasture/Hay	40.1	2.1
Residential 1/4-acre	86.9	4.6
Residential 1/8-acre	333.8	17.7
Residential 1-acre	19.5	1.0
Residential 2-acre	10.1	0.5
Transportation	86.3	4.6
Water	2.4	0.1
Woods	616.0	32.7
Grand Total	1886.0	100.0

Impervious (acres)	Total Area Above site	% Impervious
378.8	1886.0	20.1

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Habitat assessment results indicate fair to degraded conditions at this site, in agreement with the poor biological condition.
- Bank, riparian, and sediment conditions are suboptimal. Riparian conditions are excellent.
- Sample dominated by midges (*Rheotanytarsus*, *Polypedilum*, and *Orthocladius/Cricotopus*)
- Stream type was identified as an C5, slope was 0.62 percent, and the median channel substrate was medium sand
- Typically, C channels are stable. This one has sub-optimal stability.

Recommendations:

- Protect the riparian area. Habitat degradation may be due to upstream conditions and relatively high imperviousness. Mitigate any effects of hydrological imbalances.

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
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	24
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	2.7
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	20.72

Taxa List

Ablabesmyia	1
Calopteryx	1
Cheumatopsyche	2
Chironomini	1
Eukiefferiella	2
Hydrobaenus	1
Nais	5
Nanocladius	1
Orthocladius/Cricotopus	11
Parakiefferiella	1
Parametrioctenus	3
Paratanytarsus	8
Polypedilum	15
Potthastia	2
Rheotanytarsus	30
Simulium	1
Slavina	3
Stenelmis	1
Tanytarsini	4
Tanytarsus	7
Thienemanniella	2
Thienemannimyia genus group	3
Tubificinae	4
Tvetenia	2

Total Individuals 111

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Variability	11
Bank Stability- Right Bank	6	Riparian Vegetative	
Channel Alteration	18	Zone Width- Left Bank	9
Channel Flow Status	14	Riparian Vegetative	
Channel Sinuosity	6	Zone Width- Right Bank	10
Epifaunal Substrate/Available Cover	13	Sediment Deposition	8
Pool Substrate Characterization	9	Vegetative Protection (Left Bank)	6
		Vegetative Protection (Right Bank)	6

EPA Habitat Score	122
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	1886	Instream Wood Debris	9
Remoteness	8	Bank Stability	12
Shading	35		
Epifaunal Substrate	6		
Instream Habitat	13		

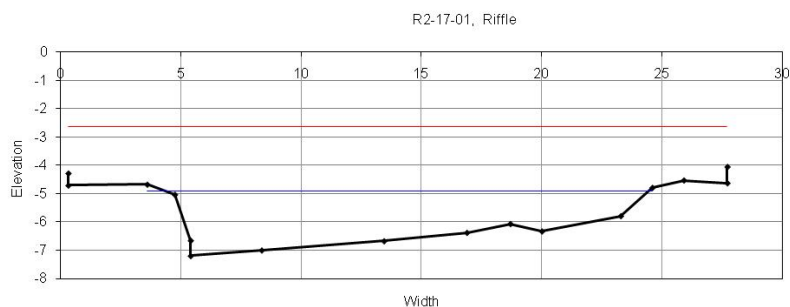
PHI Score	56.23
PHI Narrative Ranking	degraded

Water Chemistry

Dissolved Oxygen (mg/L)	11.84	Specific Conductance (µS/cm)	314
pH	7.17	Temperature (°C)	11.27

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	2.9	Cross Sectional Area (ft ²)	30.6
Bankfull Width (ft)	20	Water Surface Slope (%)	0.62
Mean Bankfull Depth (ft)	1.5	Sinuosity	1.1
Floodprone Width (ft)	459	D50 (mm)	0.4
Entrenchment Ratio	22.9	Adjustments?	↑Sin
Width to Depth Ratio	13.1	Rosgen Stream Type	C5





Upstream



Downstream

Location/Site Access: Located at end of Highland Rd., turn right. Follow to dead end - 270 ft. SW

Latitude/Longitude: 39.1183/-76.74592

Land Use Analysis:

Land Use	Acres	% Area
Commercial	66.4	9.9
Open Space	84.1	12.6
Pasture/Hay	40.0	6.0
Residential 1/4-acre	0.4	0.1
Residential 1/8-acre	63.8	9.5
Residential 1-acre	19.4	2.9
Residential 2-acre	10.1	1.5
Transportation	22.9	3.4
Woods	360.9	54.0
Grand Total	668.0	100.0

Impervious (acres)	Total Area Above site	% Impervious
98.0	668.0	14.7

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Habitat assessment results indicate fair to degraded conditions at this site, in agreement with the poor biological conditions.
- Pool and sediment conditions are marginal.
- Sample dominated by caddisflies (Cheumatopsyche), midges (Paratendipes), and worms (Tubificinae)
- Stream type was identified as an F4, slope was 0.65 percent, and the median channel substrate was pebbles.
- Typically, F channels are not stable and can meander laterally. This one appears constrained by high and somewhat stable banks

Recommendations:

- Protect the riparian area. Allow the channel to meander if feasible. Mitigate hydrologic instability, if necessary.

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	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	30
EPT Taxa	3
Ephemeroptera Taxa	0
Intolerant Urban %	1.92
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	11.54

Taxa List

Ablabesmyia	2
Aulodrilus	3
Chaetocladius	4
Cheumatopsyche	11
Chrysops	1
Dasyhelea	1
Dero	3
Eukiefferiella	1
Hydrobaenus	9
Hydropsyche	1
Ironoquia	1
Limnodrilus	1
Nemata	1
Noctuidae	1
Orthocladius/Cricotopus	2
Parametriocnemus	6
Paratendipes	11
Pisidium	3
Polypedilum	8
Potthastia	1
Prostoma	1
Rheocricotopus	1
Rheotanytarsus	8
Seromyia	1
Slavina	1
Spirosperma	1
Stenochironomus	1
Tanytarsus	4
Thienemannimyia genus group	4
Tubificinae	11

Total Individuals 104

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Variability	8
Bank Stability- Right Bank	7	Riparian Vegetative	8
Channel Alteration	12	Zone Width- Left Bank	8
Channel Flow Status	10	Riparian Vegetative	8
Channel Sinuosity	6	Zone Width- Right Bank	8
Epifaunal Substrate/Available Cover	9	Sediment Deposition	8
Pool Substrate Characterization	9	Vegetative Protection (Left Bank)	6
		Vegetative Protection (Right Bank)	7

EPA Habitat Score 104

EPA Narrative Ranking PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	668	Instream Wood Debris	5
Remoteness	4	Bank Stability	13
Shading	95		
Epifaunal Substrate	6		
Instream Habitat	9		

PHI Score 62.95

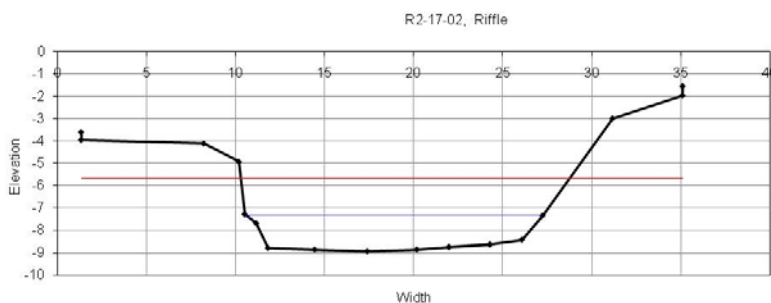
PHI Narrative Ranking degraded

Water Chemistry

Dissolved Oxygen (mg/L)	11.7	Specific Conductance (µS/cm)	585
pH	6.73	Temperature (°C)	12.59

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	1.04	Cross Sectional Area (ft ²)	22.5
Bankfull Width (ft)	16.7	Water Surface Slope (%)	0.65
Mean Bankfull Depth (ft)	1.3	Sinuosity	1.0
Floodprone Width (ft)	20.2	D50 (mm)	11
Entrenchment Ratio	1.2	Adjustments?	↑Sin
Width to Depth Ratio	12.4	Rosgen Stream Type	F4





Upstream



Downstream

Location/Site Access: Located at end of Hawkins Drive 250Ft North
Latitude/Longitude: 39.10572/-76.73248

Land Use Analysis:

Land Use	Acres	% Area
Commercial	54.4	15.7
Open Space	73.8	21.3
Residential 1/8-acre	65.4	18.9
Transportation	19.6	5.6
Water	0.6	0.2
Woods	133.1	38.4
Grand Total	346.8	100.0

Impervious (acres)	Total Area Above site	% Impervious
98.0	346.8	28.3

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Habitat assessment results indicate partial degradation at this site, but the biological community shows poor conditions, which might be due to more than habitat effects alone.
- All habitat conditions are mediocre, except that the riparian areas and channel alteration scores are excellent.
- Sample dominated by midges (Polypedilum)
- Stream type was identified as an E5, slope was 0.66 percent, and the median channel substrate was coarse sand
- Typically, E channels are stable and this one appears to be so.

Recommendations:

- Protect the riparian area. Investigate possible effects of hydrologic instability (due to high imperviousness) and toxicants within the runoff.

IBI and Metric Scores

Narrative Rating	Poor
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Overall Index	2.14
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Total Taxa Score	5
EPT Taxa Score	1
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values*

Total Taxa	26
EPT Taxa	0
Ephemeroptera Taxa	0
Intolerant Urban %	5.77
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	43.27

Taxa List

Corynoneura	6
Crangonyx	2
Diplocladius	6
Hydrobius	1
Lumbriculidae	5
Micropsectra	8
Naïs	10
Nemata	2
Neoporus	2
Odontomesa	1
Orthocladius/Cricotopus	2
Parametriocnemus	5
Paraphaenocladius	1
Phaenopsectra	1
Pisidium	4
Polypedilum	45
Prostoma	1
Rheotanytarsus	7
Simulium	3
Stempellinella	1
Stygobromus	1
Tanytarsus	2
Thienemanniella	3
Thienemannimyia genus group	1
Tipula	1
Tubificinae	1
Tvetenia	1
Zavrelimyia	1

*Original taxa counts are shown in the taxa list. However, metrics were calculated after randomly reducing to a subsample with 104 individuals (to stay within the target subsample size)

Total Individuals	124
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Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	7	Pool Variability	5
Bank Stability- Right Bank	7	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	19	Riparian Vegetative Zone Width- Right Bank	9
Channel Flow Status	12	Sediment Deposition	9
Channel Sinuosity	6	Vegetative Protection (Left Bank)	8
Epifaunal Substrate/Available Cover	12	Vegetative Protection (Right Bank)	8
Pool Substrate Characterization	8		

EPA Habitat Score	120
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EPA Narrative Ranking	PS
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Maryland Biological Stream Survey PHI

Drainage area (acres)	347	Instream Wood Debris	10
Remoteness	9	Bank Stability	14
Shading	45		
Epifaunal Substrate	7		
Instream Habitat	12		

PHI Score	68.14
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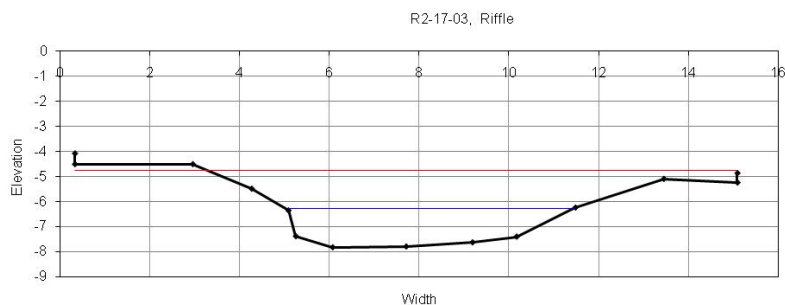
PHI Narrative Ranking	partially degraded
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Water Chemistry

Dissolved Oxygen (mg/L)	13.46	Specific Conductance (µS/cm)	198
pH	6.9	Temperature (°C)	11.56

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.54	Cross Sectional Area (ft ²)	7.7
Bankfull Width (ft)	6.3	Water Surface Slope (%)	0.66
Mean Bankfull Depth (ft)	1.2	Sinuosity	1.0
Floodprone Width (ft)	26	D50 (mm)	0.6
Entrenchment Ratio	4.1	Adjustments?	↑Sin
Width to Depth Ratio	5.2	Rosgen Stream Type	E5





Upstream



Downstream

Location/Site Access: Located at end of Higgins Dr., 0.10 miles south
Latitude/Longitude: 39.06908/-76.69124

Land Use Analysis:

Land Use	Acres	% Area
Commercial	2.6	0.6
Open Space	1.6	0.4
Residential 1/4-acre	193.6	46.2
Residential 1/8-acre	118.1	28.2
Residential 1-acre	4.7	1.1
Residential 2-acre	0.4	0.1
Transportation	3.6	0.9
Utility	12.9	3.1
Woods	81.4	19.4
Grand Total	419.0	100.0

Impervious (acres)	Total Area Above site	% Impervious
130.5	419.0	31.2

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Habitat assessment results indicate fair to degraded conditions at this site and the biological community shows poor conditions, which generally agree with the habitat scores.
- Bank and sediment conditions are marginal or poor. Riparian conditions are excellent.
- Sample dominated by midges (*Hydrobaenus*) and worms (*Tubificinae*)
- Stream type was identified as an E4, slope was 0.37 percent, and the median channel substrate was granule gravel
- Typically, E channels are stable and this one is relatively stable

Recommendations:

- Protect the riparian area. Investigate and mitigate effects of imperviousness.

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	1
Ephemeroptera % Score	1
Scraper Taxa Score	3
% Climbers	5

Calculated Metric Values

Total Taxa	23
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	0
Ephemeroptera %	0
Scraper Taxa	1
% Climbers	9.52

Taxa List

Ancyronyx	2
Cheumatopsyche	5
Corynoneura	3
Crangonyx	1
Hydrobaenus	43
Limnodrilus	3
Menetus	1
Nais	5
Orthocladus/Cricotopus	2
Paracladopelma	2
Paratendipes	1
Phaenopsectra	1
Physa	3
Pisidium	2
Polypedilum	8
Stenelmis	1
Tanytarsus	1
Thienemanniella	1
Tipula	1
Torrenticola	1
Tubificinae	12
Tvetenia	4
Zavreliomyia	2

Total Individuals 105

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	5	Pool Variability	7
Bank Stability- Right Bank	6	Riparian Vegetative	
Channel Alteration	20	Zone Width- Left Bank	10
Channel Flow Status	7	Riparian Vegetative	
Channel Sinuosity	12	Zone Width- Right Bank	10
Epifaunal Substrate/Available Cover	9	Sediment Deposition	4
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	5
		Vegetative Protection (Right Bank)	6

EPA Habitat Score	109
EPA Narrative Ranking	PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	419	Instream Wood Debris	9
Remoteness	7	Bank Stability	11
Shading	100		
Epifaunal Substrate	3		
Instream Habitat	9		

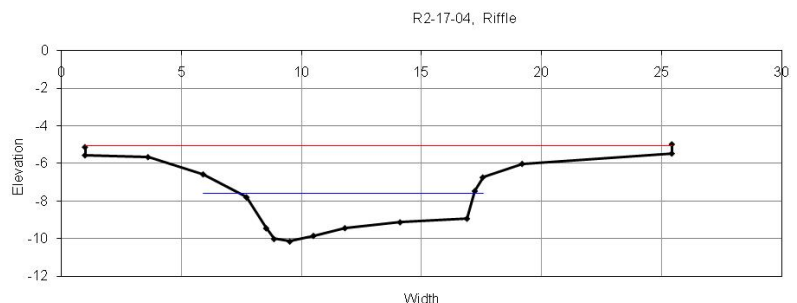
PHI Score	65.83
PHI Narrative Ranking	degraded

Water Chemistry

Dissolved Oxygen (mg/L)	12.79	Specific Conductance (µS/cm)	535
pH	7.3	Temperature (°C)	11.83

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.66	Cross Sectional Area (ft ²)	16.1
Bankfull Width (ft)	9.7	Water Surface Slope (%)	0.37
Mean Bankfull Depth (ft)	1.7	Sinuosity	1.3
Floodprone Width (ft)	112	D50 (mm)	2.6
Entrenchment Ratio	11.5	Adjustments?	↑Sin
Width to Depth Ratio	5.9	Rosgen Stream Type	E4





Upstream



Downstream

Location/Site Access: Located at Sweetfern Way Crossing, 0.10 miles west
Latitude/Longitude: 39.0049/-76.667

Land Use Analysis:

Land Use	Acres	% Area
Open Space	16.5	20.2
Residential 1/8-acre	18.5	22.7
Residential 1-acre	0.1	0.2
Residential 2-acre	5.6	6.9
Row Crops	7.1	8.7
Transportation	2.2	2.6
Woods	31.5	38.7
Grand Total	81.5	100.0

Impervious (acres)	Total Area Above site	% Impervious
2.7	81.5	3.3

Results:

- Biological condition – "Poor"
- Habitat scores "Supporting" and "Minimally Degraded"
- Habitat assessment results indicate good conditions at this site, but the biological community shows poor conditions and is more impaired than expected based on the observed habitat quality.
- Pool conditions are the worst of the habitat features
- Sample dominated by clams (*Pisidium*), amphipods (*Crangonyx*), and midges (*Rheocricotopus*)
- Stream type was identified as an E5, slope was 1.4 percent, and the median channel substrate was fine sand
- Typically, E channels are stable, as is this one

Recommendations:

- Protect the riparian area. Mitigate any increases in imperviousness. Investigate existence of stressors other than habitat.

R2-17-05

Little Patuxent 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	29
EPT Taxa	2
Ephemeroptera Taxa	0
Intolerant Urban %	8.65
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	7.69

Taxa List

Aulodrilus	1
Bezzia/Palpomyia	3
Caecidotea	1
Ceratopogon	6
Cordulegaster	1
Crangonyx	12
Culicoides	1
Diplocladius	1
Enchytraeidae	3
Hydrobaenus	1
Limnephilidae	4
Limnodrilus	7
Lumbricidae	1
Mallochohelea	1
Microtendipes	1
Nemouridae	1
Parachaetocladius	1
Parametriochnemus	7
Paratendipes	4
Pisidiidae	4
Pisidium	18
Polypedium	4
Prostoma	1
Pseudorthocladius	2
Rheocricotopus	10
Thienemannimyia genus group	2
Tipula	2
Tubificinae	3
Zavreliomyia	1

Total Individuals 104

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	7	Pool Variability	5
Bank Stability- Right Bank	8	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	20	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	9	Sediment Deposition	13
Channel Sinuosity	10	Vegetative Protection (Left Bank)	7
Epifaunal Substrate/Available Cover	14	Vegetative Protection (Right Bank)	8
Pool Substrate Characterization	9		

EPA Habitat Score	130
EPA Narrative Ranking	S

Maryland Biological Stream Survey PHI

Drainage area (acres)	82	Instream Wood Debris	13
Remoteness	7	Bank Stability	15
Shading	100		
Epifaunal Substrate	8	PHI Score	83.05
Instream Habitat	14	PHI Narrative Ranking	minimally degraded

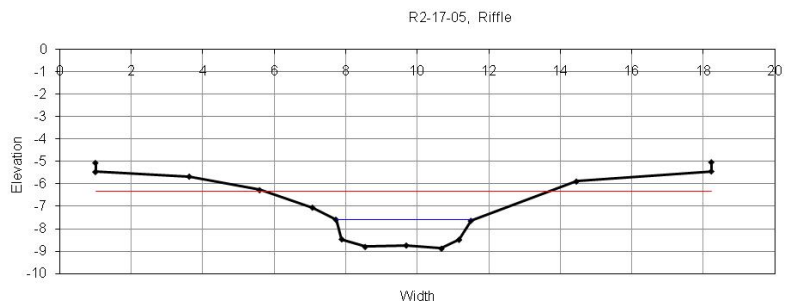
Water Chemistry

Dissolved Oxygen (mg/L)	9.44	Specific Conductance (µS/cm)	191
pH	6.3	Temperature (°C)	8.58

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi ²)	0.13	Cross Sectional Area (ft ²)	3.9
Bankfull Width (ft)	3.8	Water Surface Slope (%)	1.4
Mean Bankfull Depth (ft)	1.0	Sinuosity	1.4
Floodprone Width (ft)	8	D50 (mm)	0.19
Entrenchment Ratio	2.1	Adjustments?	↑Sin, ER
Width to Depth Ratio	3.6	Rosgen Stream Type	E5





Upstream



Downstream

Location/Site Access: Located at Fort Meade, Park on Rockenbach Road, walk 250 ft. North

Latitude/Longitude: 39.12122/-76.74732

Land Use Analysis:

Land Use	Acres	% Area
Commercial	61.7	10.0
Open Space	78.2	12.7
Pasture/Hay	40.0	6.5
Residential 1/4-acre	0.4	0.1
Residential 1/8-acre	38.0	6.2
Residential 1-acre	19.7	3.2
Residential 2-acre	9.9	1.6
Transportation	20.7	3.3
Woods	348.7	56.5
Grand Total	617.2	100.0

Impervious (acres)	Total Area Above site	% Impervious
84.7	617.2	13.7

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Degraded"
- Habitat assessment results indicate fair and degraded conditions at this site, which may contribute to the poor conditions in the biological community.
- Bank, pool, and sediment conditions are mostly marginal.
- Sample dominated by worms (Tubificinae) and clams (Pisidium)
- Stream type was identified as an G4, slope was 0.4 percent, and the median channel substrate was gravel
- Typically, G channels are unstable with grade control problems and high bank erosion. This channel is more stable than might be expected for its type.

Recommendations:

- Protect the riparian area and allow this channel to evolve into a more stable form. Mitigate any increases in imperviousness.

R2-17-06

Little Patuxent 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	27
EPT Taxa	2
Ephemeroptera Taxa	0
Intolerant Urban %	1.02
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	7.14

Taxa List

Aulodrilus	2
Cheumatopsyche	6
Dicerotendipes	1
Diplocladius	2
Enchytraeidae	1
Gomphus	1
Helichus	1
Hydrobaenus	2
Laccophilus	1
Limnephilidae	1
Limnodrilus	5
Lumbriculidae	1
Natarsia	1
Parametriocnemus	5
Physa	1
Pisidiidae	9
Pisidium	11
Polypedilum	5
Pseudorthocladius	1
Rheocricotopus	3
Rheotanytarsus	1
Spirosperma	4
Stenelmis	1
Tanytarsus	1
Thienemannimyia genus group	6
Tipula	2
Tubificinae	23

Total Individuals 98

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	4	Pool Variability	7
Bank Stability- Right Bank	6	Riparian Vegetative	
Channel Alteration	20	Zone Width- Left Bank	7
Channel Flow Status	9	Riparian Vegetative	
Channel Sinuosity	6	Zone Width- Right Bank	10
Epifaunal Substrate/Available Cover	8	Sediment Deposition	8
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	4
		Vegetative Protection (Right Bank)	6

EPA Habitat Score 103

EPA Narrative Ranking PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	617	Instream Wood Debris	3
Remoteness	3	Bank Stability	10
Shading	100		
Epifaunal Substrate	4		
Instream Habitat	8		

PHI Score 56.94

PHI Narrative Ranking degraded

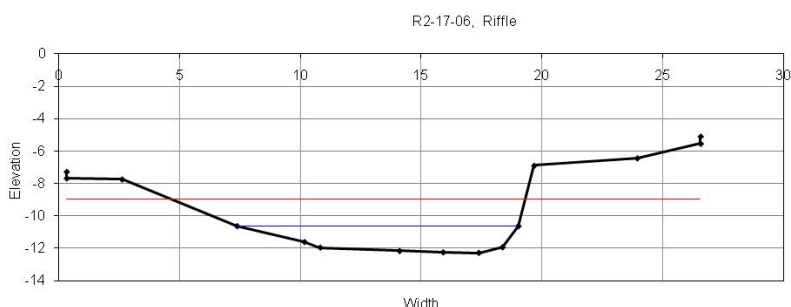
Water Chemistry

Dissolved Oxygen (mg/L)	9.65	Specific Conductance (µS/cm)	409
pH	6.31	Temperature (°C)	9.19

Geomorphic Assessments

Rosen Level II Classification Data

Drainage Area (mi ²)	0.92	Cross Sectional Area (ft ²)	14
Bankfull Width (ft)	11.6	Water Surface Slope (%)	0.4
Mean Bankfull Depth (ft)	1.2	Sinuosity	1.0
Floodprone Width (ft)	16.1	D50 (mm)	4.7
Entrenchment Ratio	1.4	Adjustments?	↑Sin
Width to Depth Ratio	9.7	Rosen Stream Type	G4





Upstream



Downstream

Location/Site Access: Located at end of Arundel Gateway Blvd. 0.15 miles SW
Latitude/Longitude: 39.09077/-76.79712

Land Use Analysis:

Land Use	Acres	% Area
Commercial	27.5	8.9
Industrial	0.6	0.2
Open Space	8.5	2.7
Residential 1/4-acre	0.9	0.3
Residential 1/8-acre	24.2	7.8
Transportation	18.5	6.0
Utility	25.0	8.1
Water	1.8	0.6
Woods	202.7	65.4
Grand Total	309.8	100.0

Impervious (acres)	Total Area Above site	% Impervious
46.4	309.8	15.0

Results:

- Biological condition – "Poor"
- Habitat scores "Supporting" and "Partially Degraded"
- Habitat assessment results indicate good and fair conditions at this site, but the biological community shows poor conditions and is more impaired than expected based on the observed habitat quality.
- Conductivity was relatively high.
- Pool and sediment conditions are marginal. Riparian conditions are excellent.
- Sample dominated by midges (Tvetnia, Parametrioctenemus, and Polypedilum)
- Stream type was identified as an E5, slope was 0.46 percent, and the median channel substrate was medium sand
- Typically, E channels are stable and this one is fairly stable

Recommendations:

- Protect the riparian area. Investigate possible effects of high conductivity from upstream runoff.

IBI and Metric Scores

Narrative Rating	Poor
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Overall Index	2.43
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Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	29
EPT Taxa	3
Ephemeroptera Taxa	0
Intolerant Urban %	4.67
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	13.08

Taxa List

Ablabesmyia	3
Ancyronyx	1
Aulodrilus	4
Corynoneura	4
Eukiefferiella	2
Ferrissia	2
Gomphidae	1
Hydrobaenus	1
Limnephilidae	1
Mideopsis	1
Mystacides	1
Nais	3
Nemata	1
Neoplasta	1
Neoporus	1
Paracladopelma	1
Parametrioctenemus	19
Paratanytarsus	5
Physa	1
Polycentropus	4
Polypedilum	11
Prostoma	1
Rheotanytarsus	1
Stenochironomus	3
Tanypodinae	2
Thienemannimyia genus group	5
Tubificinae	1
Tvetenia	24
Xylotopus	2

Total Individuals	107
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Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	8	Pool Variability	9
Bank Stability- Right Bank	7	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	20	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	10	Sediment Deposition	7
Channel Sinuosity	14	Vegetative Protection (Left Bank)	8
Epifaunal Substrate/Available Cover	15	Vegetative Protection (Right Bank)	7
Pool Substrate Characterization	8		

EPA Habitat Score	133
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EPA Narrative Ranking	S
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Maryland Biological Stream Survey PHI

Drainage area (acres)	310	Instream Wood Debris	16
Remoteness	13	Bank Stability	15
Shading	55		
Epifaunal Substrate	7		
Instream Habitat	15		

PHI Score	78.42
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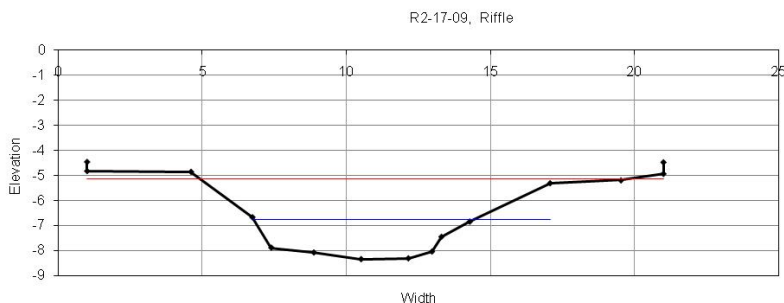
PHI Narrative Ranking	partially degraded
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Water Chemistry

Dissolved Oxygen (mg/L)	10.47	Specific Conductance (µS/cm)	847
pH	7.15	Temperature (°C)	8.86

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.48	Cross Sectional Area (ft ²)	9.1
Bankfull Width (ft)	7.7	Water Surface Slope (%)	0.46
Mean Bankfull Depth (ft)	1.2	Sinuosity	1.4*
Floodprone Width (ft)	14.8	D50 (mm)	0.47
Entrenchment Ratio	1.9	Adjustments?	↑ER, Sin
Width to Depth Ratio	6.5	Rosgen Stream Type	E5





Upstream



Downstream

Location/Site Access: Located at Tipton Airport private access Rd.

Latitude/Longitude: 39.09013/-76.76623

Land Use Analysis:

Land Use	Acres	% Area
Airport	29.1	4.4
Commercial	208.9	31.8
Forested Wetland	1.1	0.2
Industrial	8.0	1.2
Open Space	135.0	20.6
Transportation	53.9	8.2
Utility	13.2	2.0
Woods	207.4	31.6
Grand Total	656.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
220.9	656.6	33.6

Results:

- Biological condition – "Fair"
- Habitat scores "Not Supporting" and "Partially Degraded"
- Habitat assessment results indicate poor and fair conditions at this site, which is in agreement with the diverse biological assemblage.
- Bank, channel, pool, and sediment conditions are mostly marginal.
- Conductivity is high.
- Sample dominated by midges (Parametrioctenus, Orthocladus/Cricotopus) and caddisflies (Chimarra)
- Stream type was not identified because it has been highly modified.

Recommendations:

- Protect the riparian area. Naturalize the riparian areas and channel, if feasible. Investigate sources of high conductivity and existence any other pollutants associated with high imperviousness.

IBI and Metric Scores

Narrative Rating	Fair
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Overall Index	3
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Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	1
Ephemeroptera % Score	3
Scraper Taxa Score	1
% Climbers	3

Calculated Metric Values

Total Taxa	37
EPT Taxa	5
Ephemeroptera Taxa	1
Intolerant Urban %	3.77
Ephemeroptera %	0.94
Scraper Taxa	0
% Climbers	5.66

Taxa List

Ablabesmyia	3
Ancyronyx	2
Argia	1
Caecidotea	1
Caenis	1
Calopteryx	1
Cheumatopsyche	4
Chimarra	10
Corynoneura	2
Crangonyx	1
Dicrotendipes	1
Dubiraphia	1
Hemerodromia	4
Hydrobaenus	1
Hydropsyche	2
Macronychus	1
Microtendipes	1
Neoplasta	1
Orthocladus/Cricotopus	9
Parametrioctenus	16
Paratanytarsus	2
Paratendipes	6
Phaenopsectra	1
Pisidium	1
Polycentropus	1
Polypedilum	2
Prostoma	1
Rheotanytarsus	4
Stegopterna	1
Stenelmis	7
Stenochironomus	1
Sublettea	1
Tanytarsus	3
Thienemanniella	4
Thienemannimyia genus group	5
Tipula	1
Tvetenia	2
Total Individuals	106

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	4	Pool Variability	8
Bank Stability- Right Bank	6	Riparian Vegetative	
		Zone Width- Left Bank	3
Channel Alteration	7	Riparian Vegetative	
Channel Flow Status	9	Zone Width- Right Bank	10
Channel Sinuosity	7	Sediment Deposition	11
Epifaunal Substrate/Available Cover	13	Vegetative Protection (Left Bank)	3
Pool Substrate Characterization	11	Vegetative Protection (Right Bank)	6

EPA Habitat Score	98
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EPA Narrative Ranking	NS
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Maryland Biological Stream Survey PHI

Drainage area (acres)	657	Instream Wood Debris	5
Remoteness	13	Bank Stability	10
Shading	90		
Epifaunal Substrate	11		
Instream Habitat	13		

PHI Score	76.57
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PHI Narrative Ranking	partially degraded
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Water Chemistry

Dissolved Oxygen (mg/L)	10.9	Specific Conductance (µS/cm)	1612
pH	7.28	Temperature (°C)	9.7

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	1.0	Cross Sectional Area (ft ²)	
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	

Classification not performed due to highly altered nature of stream channel.



Upstream



Downstream

Location/Site Access: Located at 0.15 miles from the end of Edwards Drive
Latitude/Longitude: 39.06953/-76.69262

Land Use Analysis:

Land Use	Acres	% Area
Commercial	2.6	0.7
Open Space	1.6	0.4
Residential 1/4-acre	189.8	47.0
Residential 1/8-acre	118.1	29.3
Residential 1-acre	4.7	1.2
Residential 2-acre	0.4	0.1
Transportation	3.6	0.9
Utility	12.9	3.2
Woods	69.8	17.3
Grand Total	403.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
129.5	403.6	32.1

Results:

- Biological condition – "Poor"
- Habitat scores "Supporting" and "Partially Degraded"
- Habitat assessment results indicate good and fair conditions at this site, but the biological community shows more impaired than expected based on the observed habitat quality.
- Bank and sediment conditions are mostly sub-optimal.
- Sample dominated by midges (*Hydrobaenus* and *Polypedilum*) and worms (*Nais*)
- Stream type was identified as an F4, slope was 0.79 percent, and the median channel substrate was pebble
- Typically, F channels are not stable. This channel is relatively stable and in good shape.

Recommendations:

- Protect the riparian area. Investigate possible water quality pollution such as may be associated with the highly impervious catchment.

R2-17-11A

Little Patuxent 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	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	25
EPT Taxa	2
Ephemeroptera Taxa	0
Intolerant Urban %	0
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	15.6

Taxa List

Ablabesmyia	3
Ancyronyx	1
Brillia	1
Chaetocladius	2
Cheumatopsyche	5
Corynoneura	1
Dasyhelea	1
Dicrotendipes	1
Diplocladius	1
Enchytraeidae	1
Hydrobaenus	30
Hydropsyche	1
Nais	19
Orthocladius/Cricotopus	7
Polypedilum	17
Rheocricotopus	1
Saetheria	1
Stenochironomus	1
Tanytopodinae	1
Thienemannimyia genus group	1
Tipula	1
Tubificinae	4
Tvetenia	6
Xylotopus	1
Zavrelimyia	1

Total Individuals 109

Physical Habitat

EPA Rapid Bioassessment

Bank Stability- Left Bank	6	Pool Variability	13
Bank Stability- Right Bank	7	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	20	Riparian Vegetative Zone Width- Right Bank	8
Channel Flow Status	13	Sediment Deposition	10
Channel Sinuosity	11	Vegetative Protection (Left Bank)	6
Epifaunal Substrate/Available Cover	12	Vegetative Protection (Right Bank)	7
Pool Substrate Characterization	16		

EPA Habitat Score	139
EPA Narrative Ranking	S

Maryland Biological Stream Survey PHI

Drainage area (acres)	404	Instream Wood Debris	2
Remoteness (Note: Estimated from photos)	10	Bank Stability	17
Shading	70		
Epifaunal Substrate	16		
Instream Habitat	14		

PHI Score	78.50
PHI Narrative Ranking	partially degraded

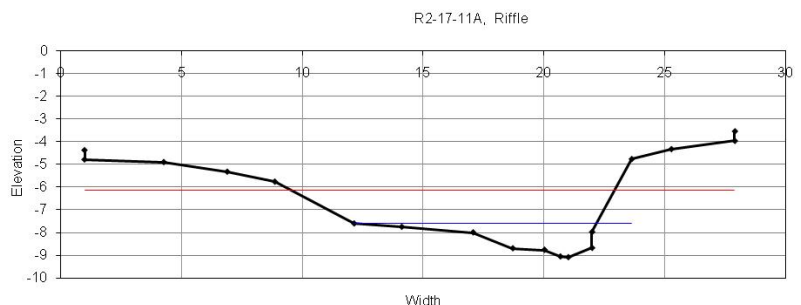
Water Chemistry

Dissolved Oxygen (mg/L)	10.6	Specific Conductance (µS/cm)	291
pH	7.63	Temperature (°C)	5.99

Geomorphic Assessments

Rosgen Level II Classification Data

Drainage Area (mi ²)	0.63	Cross Sectional Area (ft ²)	6.3
Bankfull Width (ft)	10.0	Water Surface Slope (%)	0.79
Mean Bankfull Depth (ft)	0.6	Sinuosity	1.2
Floodprone Width (ft)	12.4	D50 (mm)	11
Entrenchment Ratio	1.2	Adjustments?	None
Width to Depth Ratio	16	Rosgen Stream Type	F4





Upstream



Downstream

Location/Site Access: Located at Along LSX tracks under bridge
Latitude/Longitude: 39.15118/-76.7766

Land Use Analysis:

Land Use	Acres	% Area
Commercial	18.1	2.7
Industrial	82.2	12.2
Open Space	38.8	5.8
Pasture/Hay	11.5	1.7
Residential 1/2-acre	100.8	14.9
Residential 1-acre	49.1	7.3
Residential 2-acre	44.5	6.6
Transportation	27.0	4.0
Water	0.2	0.0
Woods	303.3	44.9
Grand Total	675.3	100.0

Impervious (acres)	Total Area Above site	% Impervious
107.5	675.3	15.9

Results:

- Biological condition – "Poor"
- Habitat scores "Not Supporting" and "Severely Degraded"
- Habitat assessment results indicate degraded conditions at this site, which are reflected in the poor biological assessment results.
- This highly altered channel in the midst of intensive land uses has multiple habitat problems, including substrate, riparian, bank, and pool conditions.
- Sample dominated by midges (*Hydrobaenus* and *Orthocladius/Cricotopus*) and worms (*Nais*)
- Stream type was not identified because the channel has been highly modified.

Recommendations:

- Add natural or artificial habitat enhancements to replace those disturbed for channel management. The biological community may not improve without habitat improvements.

IBI and Metric Scores

Narrative Rating	Poor
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Overall Index	2.14
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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	25
EPT Taxa	2
Ephemeroptera Taxa	0
Intolerant Urban %	1.89
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	3.77

Taxa List

Ablabesmyia	1
Argia	1
Aulodrilus	1
Cheumatopsyche	1
Enchytraeidae	2
Endochironomus	1
Hydrobaenus	31
Laccophilus	1
Limnodrilus	1
Lymnaeidae	1
Nais	11
Orthocladius/Cricotopus	20
Parametrioctenus	2
Paranemoura	1
Peltodytes	1
Phaenopsectra	1
Polypedilum	2
Procladius	1
Rheocricotopus	1
Seromyia	2
Stenelmis	3
Stenochironomus	1
Thienemannimyia genus group	8
Tubificinae	9
Zavrelimyia	2

Total Individuals	106
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Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	7	Pool Variability	5
Bank Stability- Right Bank	10	Riparian Vegetative Zone Width- Left Bank	2
Channel Alteration	3	Riparian Vegetative Zone Width- Right Bank	0
Channel Flow Status	17	Sediment Deposition	10
Channel Sinuosity	2	Vegetative Protection (Left Bank)	8
Epifaunal Substrate/Available Cover	7	Vegetative Protection (Right Bank)	0
Pool Substrate Characterization	6		

EPA Habitat Score	77
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EPA Narrative Ranking	NS
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Maryland Biological Stream Survey PHI

Drainage area (acres)	675	Instream Wood Debris	1
Remoteness	0	Bank Stability	16
Shading	15		
Epifaunal Substrate	7		
Instream Habitat	7		

PHI Score	43.83
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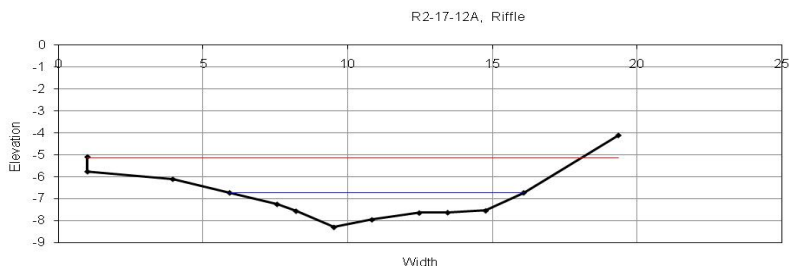
PHI Narrative Ranking	severely degraded
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Water Chemistry

Dissolved Oxygen (mg/L)	9.92	Specific Conductance (μS/cm)	421
pH	6.92	Temperature (°C)	7.86

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	1.1	Cross Sectional Area (ft ²)	—
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	—



Not classified due to concrete lining of right bank over entire assessment reach.



Location/Site Access: Located at end of Cobalt Lane, 0.12 miles North
Latitude/Longitude: 38.86745/-76.63219

Land Use Analysis:

Land Use	Acres	% Area
Commercial	1.8	1.0
Open Space	14.6	8.3
Pasture/Hay	17.7	10.0
Residential 1-acre	9.3	5.3
Residential 2-acre	44.7	25.4
Row Crops	17.4	9.9
Transportation	0.9	0.5
Woods	69.9	39.7
Grand Total	176.3	100.0

Impervious (acres)	Total Area Above site	% Impervious
10.0	176.3	5.7

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Habitat assessment results indicate fair conditions at this site, but the biological community is poor, somewhat worse than would be expected based on habitat conditions alone.
- Pool conditions are marginal, though riparian conditions are excellent.
- Sample dominated by midges (Micropsectra, Polypedilum, and Parametriocnemus)
- Stream type was identified as an E5, slope was 0.52 percent, and the median channel substrate was fine sand
- Typically, E channels are stable and this one is reasonably so

Recommendations:

- Protect the riparian area. Mitigate any increases in imperviousness. Investigate potential water quality pollutants.

IBI and Metric Scores

Narrative Rating	Poor
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Overall Index	2.43
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Total Taxa Score	5
EPT Taxa Score	1
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	3
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values*

Total Taxa	24
EPT Taxa	1
Ephemeroptera Taxa	0
Intolerant Urban %	17.02
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	41.94

Taxa List

Bezzia/Palpomyia	3
Diplocladius	7
Gammarus	13
Ironoquia	1
Limnephilidae	3
Micropsectra	24
Nemata	1
Nigronia	1
Odontomesa	1
Orthoclaudiinae	1
Orthocladus/Cricotopus	3
Parakiefferiella	1
Parametriocnemus	12
Paratanytarsus	2
Paratendipes	1
Phaenopsectra	1
Physa	1
Pisidiidae	3
Pisidium	13
Polypedilum	24
Prosimulium	2
Rheocricotopus	3
Rheotanytarsus	2
Simulium	4
Stempellinella	2
Stenelmis	1
Tanytarsus	9
Thienemannimyia genus group	4
Tvetenia	1
Zavrelinmyia	3

*Original taxa counts are shown in the taxa list. However, metrics were calculated after randomly reducing to a subsample with 93 individuals (to stay within the target subsample size)

Total Individuals	147
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Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	7	Pool Variability	5
Bank Stability- Right Bank	6	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	20	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	10	Sediment Deposition	11
Channel Sinuosity	8	Vegetative Protection (Left Bank)	7
Epifaunal Substrate/Available Cover	11	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	9		

EPA Habitat Score	120
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EPA Narrative Ranking	PS
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Maryland Biological Stream Survey PHI

Drainage area (acres)	176	Instream Wood Debris	9
Remoteness	8	Bank Stability	13
Shading	100		
Epifaunal Substrate	6		
Instream Habitat	11		

PHI Score	76.62
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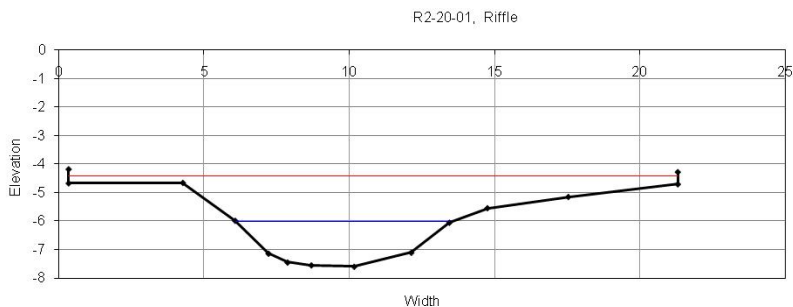
PHI Narrative Ranking	partially degraded
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Water Chemistry

Dissolved Oxygen (mg/L)	13.46	Specific Conductance (µS/cm)	254
pH	7.24	Temperature (°C)	8.25

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.28	Cross Sectional Area (ft ²)	8.4
Bankfull Width (ft)	7.4	Water Surface Slope (%)	0.52
Mean Bankfull Depth (ft)	1.1	Sinuosity	1.2
Floodprone Width (ft)	259	D50 (mm)	0.16
Entrenchment Ratio	35.2	Adjustments?	↑Sin
Width to Depth Ratio	6.4	Rosgen Stream Type	E5





Upstream



Downstream

Location/Site Access: Located at 4252 South Poling House Rd
 Latitude/Longitude: 38.84822/-76.63236

Land Use Analysis:

Land Use	Acres	% Area
Open Space	7.8	6.7
Residential 1/2-acre	2.2	1.9
Residential 1-acre	3.4	2.9
Residential 2-acre	22.7	19.3
Row Crops	30.8	26.3
Transportation	2.9	2.5
Woods	47.5	40.5
Grand Total	117.3	100.0

Impervious (acres)	Total Area Above site	% Impervious
6.4	117.3	5.5

Results:

- Biological condition – "Poor"
- Habitat scores "Not Supporting" and "Degraded"
- Habitat assessment results indicate degraded conditions at this site, which is likely impacting the biological conditions.
- Bank conditions are extremely poor and sediment and pool conditions are marginal
- Sample dominated by blackflies (Stegopterna) and stoneflies (Amphinemura and Paranemoura)
- Stream type was identified as a G6c, slope was 1.5 percent, and the median channel substrate was silt
- Typically, G channels are not stable and this one has unstable banks and sedimentation.

Recommendations:

- Protect the riparian area. Allow the channel to evolve to a stable form. Investigate potential inputs of sediment from upstream.

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.71
Total Taxa Score	3
EPT Taxa Score	5
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	5
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	3

Calculated Metric Values

Total Taxa	20
EPT Taxa	7
Ephemeroptera Taxa	0
Intolerant Urban %	71.84
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	3.88

Taxa List

Amphinemura	15
Diplocladius	3
Gammarus	6
Hydrobaenus	2
Ironoquia	1
Limnephilidae	3
Nais	3
Nemouridae	3
Neophylax	1
Orthocladius/Cricotopus	3
Paranemoura	12
Perlidae	1
Pisidium	1
Polypedilum	1
Prosimulium	4
Rheocricotopus	2
Stegopterna	55
Thienemannimyia genus group	1
Tubificinae	1
Zavrelimyia	5

*Original taxa counts are shown in the taxa list. However, metrics were calculated after randomly reducing to a subsample with 103 individuals (to stay within the target subsample size)

Total Individuals 123

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	1	Pool Variability	7
Bank Stability- Right Bank	1	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	20	Riparian Vegetative Zone Width- Right Bank	9
Channel Flow Status	8	Sediment Deposition	8
Channel Sinuosity	7	Vegetative Protection (Left Bank)	1
Epifaunal Substrate/Available Cover	8	Vegetative Protection (Right Bank)	1
Pool Substrate Characterization	8		

EPA Habitat Score	89
EPA Narrative Ranking	NS

Maryland Biological Stream Survey PHI

Drainage area (acres)	117	Instream Wood Debris	6
Remoteness	5	Bank Stability	2
Shading	100		
Epifaunal Substrate	3		
Instream Habitat	8		

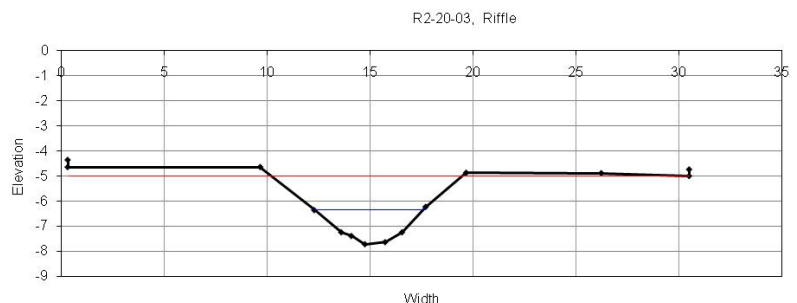
PHI Score	60.5
PHI Narrative Ranking	degraded

Water Chemistry

Dissolved Oxygen (mg/L)	11.38	Specific Conductance (µS/cm)	197
pH	7	Temperature (°C)	10.15

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.18	Cross Sectional Area (ft ²)	4.5
Bankfull Width (ft)	5.3	Water Surface Slope (%)	1.5
Mean Bankfull Depth (ft)	0.9	Sinuosity	1.1
Floodprone Width (ft)	9.5	D50 (mm)	0.062
Entrenchment Ratio	1.8	Adjustments?	↓ER
Width to Depth Ratio	6.2	Rosgen Stream Type	G6c





Upstream



Downstream

Location/Site Access: Located at 0.3 Miles off of Sands Roads
 Latitude/Longitude 38.85292/-76.68119

Land Use Analysis:

Land Use	Acres	% Area
Commercial	24.2	0.7
Industrial	65.9	1.8
Open Space	167.4	4.6
Pasture/Hay	203.1	5.5
Residential 1/2-acre	19.8	0.5
Residential 1-acre	142.2	3.9
Residential 2-acre	410.1	11.2
Row Crops	780.7	21.3
Transportation	53.8	1.5
Water	15.4	0.4
Woods	1778.1	48.6
Grand Total	3660.8	100.0

Impervious (acres)	Total Area Above site	% Impervious
118.5	3660.8	3.2

Results:

- Biological condition – "Fair"
- Habitat scores "Supporting" and "Partially Degraded"
- Habitat assessment results indicate supporting and fair conditions at this site, in agreement with the biological assessment.
- Bank, riparian, and sediment conditions are sub-optimal.
- Sample dominated by midges (Orthocladius/Cricotopus and Hydrobaenus)
- Stream type was identified as an F4, slope was 0.13 percent, and the median channel substrate was medium gravel
- Typically, F channels are not stable, but this one is in relatively good shape.

Recommendations:

- Protect the riparian area. Allow the channel to meander laterally as naturally occurs. Mitigate any increases in imperviousness.

IBI and Metric Scores

Narrative Rating	Fair
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Overall Index	3.86
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Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	3
Ephemeroptera % Score	3
Scraper Taxa Score	3
% Climbers	5

Calculated Metric Values

Total Taxa	31
EPT Taxa	8
Ephemeroptera Taxa	1
Intolerant Urban %	24.11
Ephemeroptera %	6.25
Scraper Taxa	1
% Climbers	14.29

Taxa List

Ablabesmyia	1
Acerpenna	7
Amphinemura	5
Caecidotea	2
Gammarus	3
Haploperla	1
Hemerodromia	1
Hydrobaenus	11
Hydropsyche	3
Isoperla	4
Labrundinia	1
Limnephilidae	1
Mallochochelea	2
Micropsectra	1
Microtendipes	1
Nanocladius	1
Nemouridae	1
Neophylax	6
Neoplasta	5
Orthocladus/Cricotopus	28
Paracladopelma	4
Parametrioconemus	1
Physa	1
Pisidium	2
Polypedilum	1
Simulium	1
Stempellinella	6
Tanytarsus	7
Thienemanniella	1
Thienemannimyia genus group	2
Zavrelimyia	1

Total Individuals	112
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Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	7	Pool Variability	13
Bank Stability- Right Bank	7	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	20	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	16	Sediment Deposition	9
Channel Sinuosity	7	Vegetative Protection (Left Bank)	6
Epifaunal Substrate/Available Cover	18	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	10		

EPA Habitat Score	139
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EPA Narrative Ranking	S
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Maryland Biological Stream Survey PHI

Drainage area (acres)	3661	Instream Wood Debris	5
Remoteness	20	Bank Stability	13
Shading	85		
Epifaunal Substrate	14		
Instream Habitat	15		

PHI Score	78.80
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PHI Narrative Ranking	partially degraded
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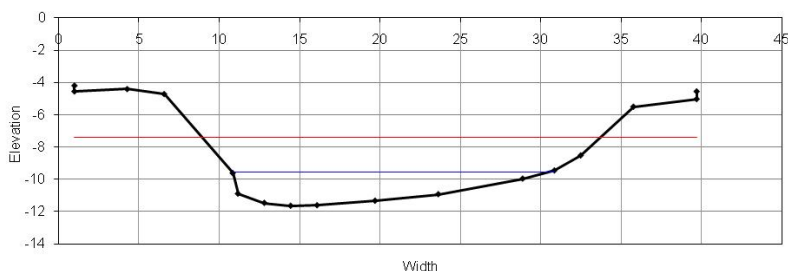
Water Chemistry

Dissolved Oxygen (mg/L)	11.32	Specific Conductance (μS/cm)	217
pH	7.01	Temperature (°C)	9.54

Geomorphic Assessments**Rosen Level II Classification Data**

Drainage Area (mi ²)	5.7	Cross Sectional Area (ft ²)	28.1
Bankfull Width (ft)	19.7	Water Surface Slope (%)	0.13
Mean Bankfull Depth (ft)	1.4	Sinuosity	1.1
Floodprone Width (ft)	23	D50 (mm)	9.6
Entrenchment Ratio	1.2	Adjustments?	↑Sin
Width to Depth Ratio	13.8	Rosen Stream Type	F4

R2-20-04, Riffle





Upstream



Downstream

Location/Site Access: Located at Anne Arundel Manor Golf Course
Latitude/Longitude: 38.86646/-76.66788

Land Use Analysis:

Land Use	Acres	% Area
Industrial	19.4	11.6
Open Space	1.6	0.9
Residential 1-acre	9.4	5.6
Residential 2-acre	10.6	6.3
Row Crops	67.4	40.3
Transportation	1.9	1.2
Woods	57.1	34.1
Grand Total	167.5	100.0

Impervious (acres)	Total Area Above site	% Impervious
3.7	167.5	2.2

Results:

- Biological condition – "Fair"
- Habitat scores "Not Supporting" and "Partially Degraded"
- Habitat assessment results indicate degraded to fair conditions at this site, with biological conditions more in line with the PHI assessment.
- Bank, riparian, and sediment conditions are marginal. The channel is highly accessible to the golf course.
- Sample dominated by midges (Tanytarsus), worms (Aulodrilus), and isopods (Caecidotea)
- Stream type was identified as an G5, slope was 0.87 percent, and the median channel substrate was fine sand
- Typically, G channels are not stable and this one is threatened.

Recommendations:

- Naturalize the riparian area if feasible. Mitigate any increases in imperviousness.

IBI and Metric Scores

Narrative Rating	Fair
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Overall Index	3.57
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Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	3
Intolerant Urban % Score	3
Ephemeroptera % Score	3
Scraper Taxa Score	3
% Climbers	5

Calculated Metric Values

Total Taxa	28
EPT Taxa	2
Ephemeroptera Taxa	1
Intolerant Urban %	17.59
Ephemeroptera %	0.93
Scraper Taxa	1
% Climbers	26.85

Taxa List

Aulodrilus	15
Bezzia/Palpomyia	2
Caecidotea	15
Caenis	1
Diplocladius	3
Ferrissia	1
Hydrobaenus	2
Limnodrilus	1
Limnophyes	1
Lumbriculidae	1
Menetus	6
Microtendipes	2
Nais	4
Neoporus	3
Paranemoura	1
Paratendipes	1
Phaenopsectra	2
Physa	11
Pisidiidae	1
Polypedilum	2
Procladius	1
Pseudolimnophila	1
Rheotanytarsus	2
Tanypodinae	1
Tanytarsus	20
Thienemannimyia genus group	3
Tribelos	4
Zavreliella	1

Total Individuals	108
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Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	4	Pool Variability	7
Bank Stability- Right Bank	5	Riparian Vegetative	1
Channel Alteration	14	Zone Width- Left Bank	9
Channel Flow Status	9	Riparian Vegetative	8
Channel Sinuosity	7	Zone Width- Right Bank	4
Epifaunal Substrate/Available Cover	10	Sediment Deposition	5
Pool Substrate Characterization	13	Vegetative Protection (Left Bank)	
		Vegetative Protection (Right Bank)	

EPA Habitat Score	96
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EPA Narrative Ranking	NS
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Maryland Biological Stream Survey PHI

Drainage area (acres)	168	Instream Wood Debris	6
Remoteness	7	Bank Stability	9
Shading	80		
Epifaunal Substrate	6		
Instream Habitat	10		

PHI Score	67.74
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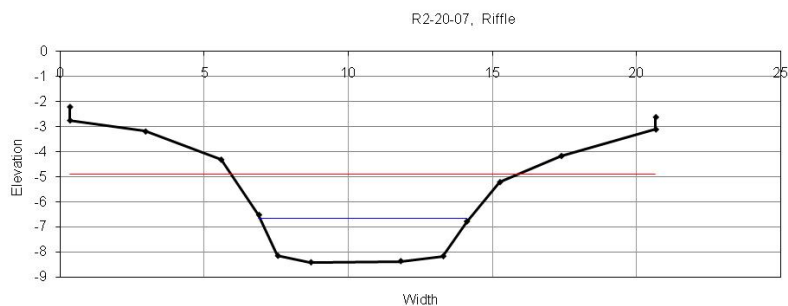
PHI Narrative Ranking	partially degraded
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Water Chemistry

Dissolved Oxygen (mg/L)	9.88	Specific Conductance (µS/cm)	145
pH	6.77	Temperature (°C)	4.83

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.26	Cross Sectional Area (ft ²)	10.9
Bankfull Width (ft)	7.2	Water Surface Slope (%)	0.87
Mean Bankfull Depth (ft)	1.5	Sinuosity	1.0
Floodprone Width (ft)	10	D50 (mm)	0.21
Entrenchment Ratio	1.4	Adjustments?	↑Sin
Width to Depth Ratio	4.7	Rosgen Stream Type	G5





Upstream



Downstream

Location/Site Access: Located at Polling House Road Golf Course Trailer 0.25 miles Southeast

Latitude/Longitude: 38.85358/-76.66353

Land Use Analysis:

Land Use	Acres	% Area
Commercial	17.1	0.7
Open Space	112.8	4.5
Pasture/Hay	189.1	7.6
Residential 1/2-acre	19.8	0.8
Residential 1-acre	98.8	4.0
Residential 2-acre	299.0	12.0
Row Crops	510.2	20.4
Transportation	33.0	1.3
Water	1.5	0.1
Woods	1219.2	48.8
Grand Total	2500.5	100.0

Impervious (acres)	Total Area Above site	% Impervious
87.9	2500.5	3.5

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Severely Degraded"
- Habitat assessment results indicate mixed conditions at this site, with the poor biological conditions in line with the PHI index.
- Sediment, pool, and riparian conditions are poor or marginal.
- Sample dominated by midges (Hydrobaenus, Microtendipes, Orthocladius/Cricotopus)
- Stream type was identified as an B5c, slope was 0.25 percent, and the median channel substrate was fine sand
- Typically, B channels are stable. The high exposure and landscape management of the riparian area may contribute to poor biological conditions

Recommendations:

- Naturalize the riparian area if feasible.

IBI and Metric Scores

Narrative Rating	Poor
Overall Index	2.71
Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	24
EPT Taxa	6
Ephemeroptera Taxa	0
Intolerant Urban %	7.76
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	12.07

Taxa List

Amphinemura	3
Cheumatopsyche	1
Cladotanytarsus	3
Cryptochironomus	2
Eukiefferiella	2
Hemerodromia	1
Hexatoma	1
Hydrobaenus	35
Limnephilidae	1
Macronychus	1
Microtendipes	20
Mideopsis	1
Neophylax	2
Ochrotrichia	1
Orthocladius/Cricotopus	20
Parametriocnemus	3
Paratanytarsus	1
Pisidiidae	1
Prosimulium	3
Stempellinella	1
Stilocladius	1
Strophopteryx	1
Tanytarsus	9
Zavrelimyia	2

Total Individuals

116

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	7	Pool Variability	10
Bank Stability- Right Bank	7	Riparian Vegetative	
Channel Alteration	19	Zone Width- Left Bank	3
Channel Flow Status	9	Riparian Vegetative	
Channel Sinuosity	6	Zone Width- Right Bank	1
Epifaunal Substrate/Available Cover	11	Sediment Deposition	7
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	7
		Vegetative Protection (Right Bank)	7

EPA Habitat Score 102**EPA Narrative Ranking** PS**Maryland Biological Stream Survey PHI**

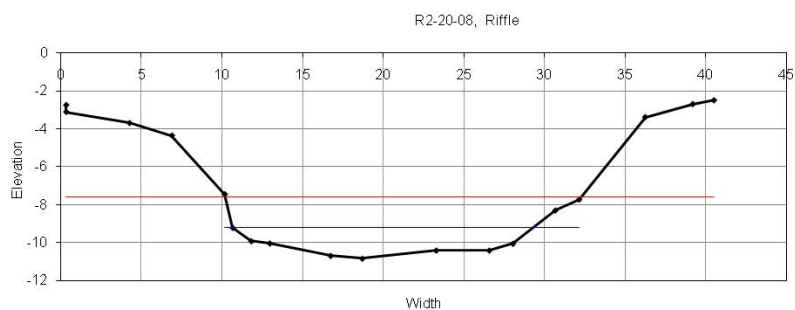
Drainage area (acres)	2500	Instream Wood Debris	9
Remoteness	3	Bank Stability	14
Shading	15		
Epifaunal Substrate	6		
Instream Habitat	11		

PHI Score 46.11**PHI Narrative Ranking** severely degraded**Water Chemistry**

Dissolved Oxygen (mg/L)	13.89	Specific Conductance (µS/cm)	203
pH	7.57	Temperature (°C)	5.43

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	3.9	Cross Sectional Area (ft ²)	21.2
Bankfull Width (ft)	18.6	Water Surface Slope (%)	0.25
Mean Bankfull Depth (ft)	1.1	Sinuosity	1.0
Floodprone Width (ft)	35	D50 (mm)	0.17
Entrenchment Ratio	1.9	Adjustments?	↑Sin
Width to Depth Ratio	16.4	Rosgen Stream Type	B5c





Upstream



Downstream

Location/Site Access: Located at Anne Arundel Manor Golf Course
Latitude/Longitude: 38.85213/-76.67445

Land Use Analysis:

Land Use	Acres	% Area
Commercial	18.0	0.5
Industrial	47.6	1.4
Open Space	136.4	4.1
Pasture/Hay	203.1	6.0
Residential 1/2-acre	19.8	0.6
Residential 1-acre	135.2	4.0
Residential 2-acre	379.1	11.3
Row Crops	727.7	21.7
Transportation	46.9	1.4
Water	10.7	0.3
Woods	1633.3	48.6
Grand Total	3357.8	100.0

Impervious (acres)	Total Area Above site	% Impervious
107.2	3357.8	3.2

Results:

- Biological condition – "Fair"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Habitat assessment results indicate fair conditions at this site, which are in agreement with the fair biological conditions.
- Most habitat features are of mediocre quality, though the riparian integrity is excellent.
- Sample dominated by midges (Orthocladius/Cricotopus and Tanytarsus)
- Stream type was identified as an F5, slope was 0.57 percent, and the median channel substrate was medium sand
- Typically, F channels are not stable. This one has mediocre bank and sediment conditions.

Recommendations:

- Protect the riparian area. Mitigate any increases in imperviousness. Allow the channel to migrate laterally.

IBI and Metric Scores

Narrative Rating	Fair
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Overall Index	3.86
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Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	5
Intolerant Urban % Score	3
Ephemeroptera % Score	3
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	37
EPT Taxa	12
Ephemeroptera Taxa	3
Intolerant Urban %	22.12
Ephemeroptera %	9.62
Scraper Taxa	0
% Climbers	15.38

Taxa List

Ablabesmyia	1
Acerpenna	7
Amphinemura	3
Cheumatopsyche	1
Chloroperlidae	1
Crangonyx	1
Diplocladius	1
Dubiraphia	1
Enchytraeidae	1
Ephemerella	1
Eukiefferiella	1
Gammarus	1
Hexatoma	2
Hydrobaenus	7
Hydropsyche	1
Isoperla	1
Limnephilidae	1
Maccaffertium	2
Neophylax	3
Neoplasta	4
Orthocladus/Cricotopus	20
Parametrioctenus	2
Paratanytarsus	4
Physa	1
Pisidium	4
Polycentropus	1
Prosimulium	4
Rheotanytarsus	3
Stempellinella	5
Stenelmis	1
Strophopteryx	2
Tanytarsus	10
Thienemannimyia genus group	2
Tipula	1
Tubificinae	1
Tvetenia	1
Zavrelimyia	1
Total Individuals	104

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	6	Pool Variability	10
Bank Stability- Right Bank	5	Riparian Vegetative	
Channel Alteration	19	Zone Width- Left Bank	10
Channel Flow Status	8	Riparian Vegetative	
Channel Sinuosity	7	Zone Width- Right Bank	10
Epifaunal Substrate/Available Cover	14	Sediment Deposition	7
Pool Substrate Characterization	9	Vegetative Protection (Left Bank)	6
		Vegetative Protection (Right Bank)	5

EPA Habitat Score	116
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EPA Narrative Ranking	PS
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Maryland Biological Stream Survey PHI

Drainage area (acres)	3358	Instream Wood Debris	9
Remoteness	13	Bank Stability	11
Shading	100		
Epifaunal Substrate	10		
Instream Habitat	14		

PHI Score	72.88
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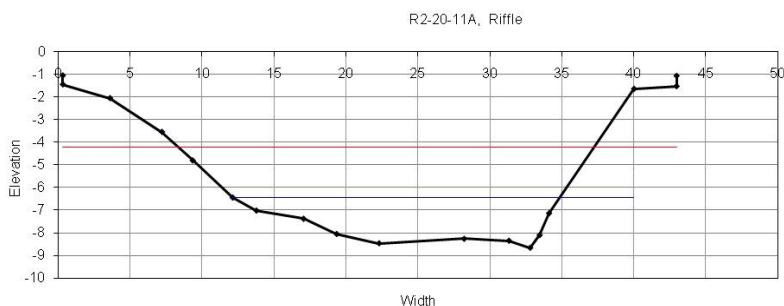
PHI Narrative Ranking	partially degraded
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Water Chemistry

Dissolved Oxygen (mg/L)	11.82	Specific Conductance (µS/cm)	254
pH	6.97	Temperature (°C)	6.89

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	5.2	Cross Sectional Area (ft ²)	33.8
Bankfull Width (ft)	22.7	Water Surface Slope (%)	0.57
Mean Bankfull Depth (ft)	1.5	Sinuosity	1.0
Floodprone Width (ft)	29	D50 (mm)	0.48
Entrenchment Ratio	1.3	Adjustments?	↑Sin
Width to Depth Ratio	15.3	Rosgen Stream Type	F5





Upstream



Downstream

Location/Site Access: Location not described.

Latitude/Longitude: 38.85279/-76.61275

Land Use Analysis:

Land Use	Acres	% Area
Open Space	0.0	0.0
Residential 2-acre	3.2	4.2
Row Crops	31.3	41.1
Transportation	1.6	2.1
Woods	40.0	52.6
Grand Total	76.2	100.0

Impervious (acres)	Total Area Above site	% Impervious
2.0	76.2	2.6

Results:

- Biological condition – "Poor"
- Habitat scores "Not Supporting" and "Degraded"
- Habitat assessment results indicate degraded conditions at this site, which is in agreement with biological assessment results.
- Banks and substrates are in very poor conditions, though the riparian conditions are excellent.
- Sample dominated by midges (Polypedilum)
- Stream type was identified as an G5c, slope was 0.51 percent, and the median channel substrate was fine sand
- Typically, G channels are not stable, as is this one

Recommendations:

- Protect the riparian area. Investigate threats to hydrologic and bank stability.

IBI and Metric Scores

Narrative Rating	Poor
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Overall Index	2.43
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Total Taxa Score	5
EPT Taxa Score	3
Ephemeroptera Taxa Score	1
Intolerant Urban % Score	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	22
EPT Taxa	2
Ephemeroptera Taxa	0
Intolerant Urban %	5.93
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	33.9

Taxa List

Amphinemura	1
Caecidotea	1
Corynoneura	10
Diplocladius	4
Gammarus	15
Ironoquia	5
Limnodrilus	3
Micropsectra	5
Nais	2
Orthocladus/Cricotopus	2
Paralauterborniella	1
Parametriocnemus	8
Paraphaenocladus	1
Pisidium	4
Polypedilum	35
Rheocricotopus	1
Serromyia	3
Thienemanniella	5
Thienemannimyia genus group	2
Tubificinae	2
Tvetenia	2
Zavreliomyia	6

Total Individuals

118

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	1	Pool Variability	3
Bank Stability- Right Bank	1	Riparian Vegetative Zone Width- Left Bank	10
Channel Alteration	20	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	8	Sediment Deposition	8
Channel Sinuosity	2	Vegetative Protection (Left Bank)	1
Epifaunal Substrate/Available Cover	4	Vegetative Protection (Right Bank)	1
Pool Substrate Characterization	8		

EPA Habitat Score	77
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EPA Narrative Ranking	NS
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Maryland Biological Stream Survey PHI

Drainage area (acres)	76	Instream Wood Debris	5
Remoteness	13	Bank Stability	2
Shading	100		
Epifaunal Substrate	3		
Instream Habitat	4		

PHI Score	65.52
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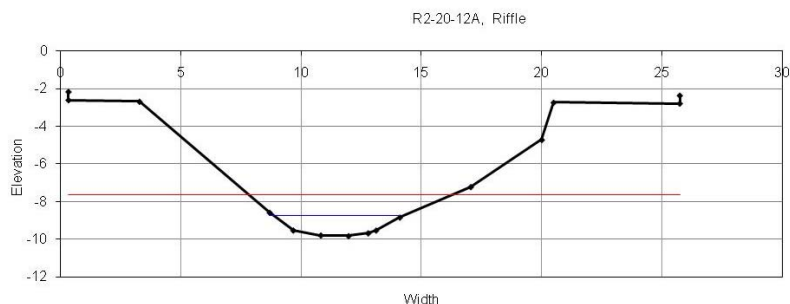
PHI Narrative Ranking	degraded
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Water Chemistry

Dissolved Oxygen (mg/L)	9.44	Specific Conductance (µS/cm)	153
pH	6.83	Temperature (°C)	12.24

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.12	Cross Sectional Area (ft ²)	4.2
Bankfull Width (ft)	5.3	Water Surface Slope (%)	0.51
Mean Bankfull Depth (ft)	0.8	Sinuosity	1.0
Floodprone Width (ft)	6.2	D50 (mm)	0.13
Entrenchment Ratio	1.2	Adjustments?	↑Sin
Width to Depth Ratio	6.5	Rosgen Stream Type	G5c





Upstream



Downstream

Location/Site Access: Located at Trailer at new golf course, Polling House Road, 0.25 miles Southeast

Latitude/Longitude: 38.85283/-76.66154

Land Use Analysis:

Land Use	Acres	% Area
Commercial	1.5	8.8
Row Crops	7.3	41.9
Woods	8.6	49.3
Grand Total	17.5	100.0

Impervious (acres)	Total Area Above site	% Impervious
0.22	17.5	1.3

Results:

- Biological condition – "Poor"
- Habitat scores "Partially Supporting" and "Minimally Degraded"
- Habitat assessment results indicate fair to degraded conditions at this site. The poor biological conditions are in agreement with the PHI assessment.
- Pool and sediment conditions are poor.
- Sample dominated by midges (Limnophyes and Tanytarsus)
- Stream type was identified as an G5, slope was 2.4 percent, and the median channel substrate was fine sand
- Typically, G channels are not stable and this one appears threatened.

Recommendations:

- Protect the riparian area. Mitigate any increases in imperviousness.

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	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	24
EPT Taxa	4
Ephemeroptera Taxa	0
Intolerant Urban %	6.78
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	23.73

Taxa List

Bezzia/Palpomyia	5
Ceratopogon	5
Crangonyx	1
Enchytraeidae	5
Helochaers	1
Heterotrissocladius	1
Hydrobaenus	5
Ironoquia	6
Limnephilidae	7
Limnophyes	33
Nais	1
Neoporus	1
Orthocladus/Cricotopus	2
Paranemoura	1
Phaenopsectra	3
Polycentropus	1
Polypedilum	1
Stempellinella	1
Tanytarsus	19
Thienemanniella	1
Thienemannimyia genus group	3
Tipula	3
Tubificinae	1
Zavrelimyia	11

Total Individuals 118

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	5	Pool Variability	3
Bank Stability- Right Bank	6	Riparian Vegetative	
Channel Alteration	20	Zone Width- Left Bank	9
Channel Flow Status	4	Riparian Vegetative	
Channel Sinuosity	8	Zone Width- Right Bank	9
Epifaunal Substrate/Available Cover	5	Sediment Deposition	14
Pool Substrate Characterization	8	Vegetative Protection (Left Bank)	5
		Vegetative Protection (Right Bank)	6

EPA Habitat Score 102

EPA Narrative Ranking PS

Maryland Biological Stream Survey PHI

Drainage area (acres)	17.5	Instream Wood Debris	9
Remoteness	13	Bank Stability	11
Shading	100		
Epifaunal Substrate	5		
Instream Habitat	5		

PHI Score 81.65

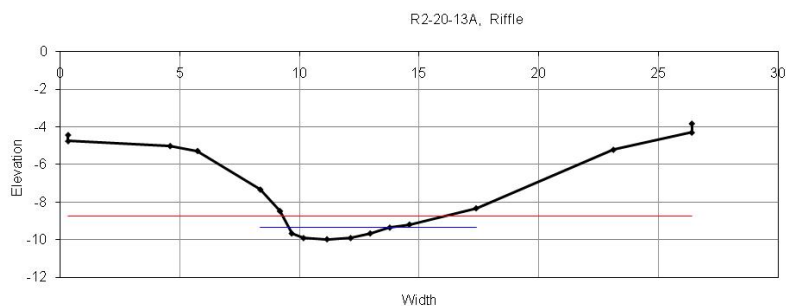
PHI Narrative Ranking Minimally degraded

Water Chemistry

Dissolved Oxygen (mg/L)	11.65	Specific Conductance (µS/cm)	356
pH	3.87	Temperature (°C)	6.36

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.03	Cross Sectional Area (ft ²)	1.9
Bankfull Width (ft)	4.2	Water Surface Slope (%)	2.4
Mean Bankfull Depth (ft)	0.4	Sinuosity	1.1
Floodprone Width (ft)	6.8	D50 (mm)	0.21
Entrenchment Ratio	1.6	Adjustments?	↓ER, ↑Sin
Width to Depth Ratio	9.5	Rosgen Stream Type	G5





Upstream



Downstream

Location/Site Access: Located at Preservation Lane Road crossing, 350 ft. ds
Latitude/Longitude: 38.87358/-76.66405

Land Use Analysis:

Land Use	Acres	% Area
Open Space	0.8	0.5
Pasture/Hay	0.8	0.5
Residential 1-acre	0.7	0.5
Residential 2-acre	25.3	15.8
Row Crops	55.7	34.7
Transportation	1.6	1.0
Woods	75.7	47.1
Grand Total	160.6	100.0

Impervious (acres)	Total Area Above site	% Impervious
5.1	160.6	3.2

Results:

- Biological condition – "Good"
- Habitat scores "Partially Supporting" and "Partially Degraded"
- Habitat assessment results indicate partially degraded conditions at this site, suggesting that the poor biological community is stressed by something more than habitat alone.
- Except for the excellent riparian conditions, many habitat features at this site are mediocre.
- Sample dominated by midges (Microtendipes, Tanytarsus, and Diplocladius)
- Stream type was identified as an G5c, slope was 1.2 percent, and the median channel substrate was fine sand
- Typically, G channels are not stable and this one appears to be threatened.

Recommendations:

- Protect the riparian area. Allow the channel to meander laterally.

IBI and Metric Scores

Narrative Rating	Good
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Overall Index	4.14
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Total Taxa Score	5
EPT Taxa Score	5
Ephemeroptera Taxa Score	5
Intolerant Urban % Score	3
Ephemeroptera % Score	3
Scraper Taxa Score	3
% Climbers	5

Calculated Metric Values

Total Taxa	31
EPT Taxa	10
Ephemeroptera Taxa	3
Intolerant Urban %	15.74
Ephemeroptera %	4.63
Scraper Taxa	1
% Climbers	25

Taxa List

Ablabesmyia	3
Amphinemura	3
Anchytarsus	3
Centroptilum	1
Diplectrona	7
Diplocladius	11
Eurylophella	2
Haploperla	3
Hydrobaenus	1
Hydropsyche	2
Ironoquia	1
Leptophlebiidae	2
Limnephilidae	5
Mallochohelea	1
Microtendipes	18
Natarsia	1
Orthoclaudiinae	1
Paratanytarsus	1
Phaenopsectra	2
Pisidiidae	1
Polypedilum	1
Pseudolimnophila	1
Pycnopsyche	1
Rheotanytarsus	1
Stempellinella	7
Tanypodinae	1
Tanytarsus	14
Thienemannimyia genus group	6
Tribelos	1
Tvetenia	5
Zavrelimyia	1

Total Individuals	108
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Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	5	Pool Variability	9
Bank Stability- Right Bank	6	Riparian Vegetative Zone Width- Left Bank	8
Channel Alteration	18	Riparian Vegetative Zone Width- Right Bank	10
Channel Flow Status	10	Sediment Deposition	10
Channel Sinuosity	10	Vegetative Protection (Left Bank)	5
Epifaunal Substrate/Available Cover	13	Vegetative Protection (Right Bank)	6
Pool Substrate Characterization	9		

EPA Habitat Score	119
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EPA Narrative Ranking	PS
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Maryland Biological Stream Survey PHI

Drainage area (acres)	161	Instream Wood Debris	6
Remoteness	5	Bank Stability	11
Shading	100		
Epifaunal Substrate	6		
Instream Habitat	13		

PHI Score	73.50
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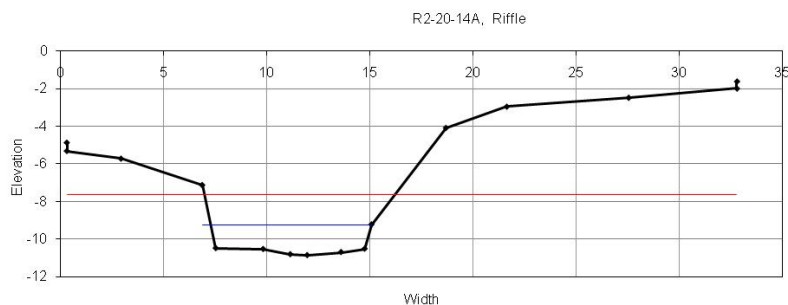
PHI Narrative Ranking	partially degraded
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Water Chemistry

Dissolved Oxygen (mg/L)	11.1	Specific Conductance (µS/cm)	226
pH	6.14	Temperature (°C)	10.58

Geomorphic Assessments**Rosen Level II Classification Data**

Drainage Area (mi ²)	0.25	Cross Sectional Area (ft ²)	10.6
Bankfull Width (ft)	7.8	Water Surface Slope (%)	1.2
Mean Bankfull Depth (ft)	1.4	Sinuosity	1.3
Floodprone Width (ft)	9.3	D50 (mm)	0.23
Entrenchment Ratio	1.2	Adjustments?	None
Width to Depth Ratio	5.7	Rosen Stream Type	G5c





Upstream



Downstream

Location/Site Access: Located at 660 Bayard Road
 Latitude/Longitude: 38.8446/-76.65061

Land Use Analysis:

Land Use	Acres	% Area
Open Space	14.7	7.4
Pasture/Hay	13.9	7.0
Residential 1-acre	17.0	8.6
Residential 2-acre	37.0	18.8
Row Crops	36.9	18.7
Transportation	3.0	1.5
Water	0.6	0.3
Woods	74.0	37.5
Grand Total	197.2	100.0

Impervious (acres)	Total Area Above site	% Impervious
8.1	197.2	4.1

Results:

- Biological condition – "Poor"
- Habitat scores "Not Supporting" and "Partially Degraded"
- Habitat assessment results indicate degraded to fair conditions at this site, with the poor biological community in agreement with the RBP assessment.
- Bank and pool conditions are especially poor, despite excellent riparian conditions.
- Sample dominated by midges (Polypedilum) and amphipods (Gammarus)
- Stream type was identified as an B6c, slope was 0.96 percent, and the median channel substrate was silt
- Typically, B channels are stable, but this one has unstable banks.

Recommendations:

- Protect the riparian area. Investigate possible sources of hydrologic instability. Mitigate any increases in imperviousness.

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	1
Ephemeroptera % Score	1
Scraper Taxa Score	1
% Climbers	5

Calculated Metric Values

Total Taxa	20
EPT Taxa	3
Ephemeroptera Taxa	0
Intolerant Urban %	0.92
Ephemeroptera %	0
Scraper Taxa	0
% Climbers	33.94

Taxa List

Aulodrilus	3
Chaetocladius	1
Cheumatopsyche	1
Crangonyctidae	9
Diplocladius	5
Gammarus	23
Hemerodromia	1
Ironoquia	9
Limnodrilus	1
Lumbriculidae	1
Neophylax	1
Neoplasta	1
Orthocladius/Cricotopus	5
Parametrioctenus	6
Paratendipes	1
Physa	2
Polypedilum	36
Tanytarsus	1
Thienemannimyia genus group	1
Tubificinae	1

Total Individuals

109

Physical Habitat**EPA Rapid Bioassessment**

Bank Stability- Left Bank	3	Pool Variability	5
Bank Stability- Right Bank	2	Riparian Vegetative	10
Channel Alteration	20	Zone Width- Left Bank	10
Channel Flow Status	8	Riparian Vegetative	10
Channel Sinuosity	9	Zone Width- Right Bank	7
Epifaunal Substrate/Available Cover	7	Sediment Deposition	3
Pool Substrate Characterization	7	Vegetative Protection (Left Bank)	3
		Vegetative Protection (Right Bank)	3

EPA Habitat Score 94**EPA Narrative Ranking** NS**Maryland Biological Stream Survey PHI**

Drainage area (acres)	197	Instream Wood Debris	7
Remoteness	16	Bank Stability	6
Shading	100		
Epifaunal Substrate	3		
Instream Habitat	7		

PHI Score 71.37**PHI Narrative Ranking** partially degraded**Water Chemistry**

Dissolved Oxygen (mg/L)	9.15	Specific Conductance (µS/cm)	202
pH	7.4	Temperature (°C)	16.12

Geomorphic Assessments**Rosgen Level II Classification Data**

Drainage Area (mi ²)	0.31	Cross Sectional Area (ft ²)	12.7
Bankfull Width (ft)	9.0	Water Surface Slope (%)	0.96
Mean Bankfull Depth (ft)	1.4	Sinuosity	1.2
Floodprone Width (ft)	15	D50 (mm)	0.062
Entrenchment Ratio	1.7	Adjustments?	↑W/D
Width to Depth Ratio	6.4	Rosgen Stream Type	B6c

