

Biological Monitoring Report – Year 1 (Post-Construction)

The Glade - Reaches 2, 3, 4A, and 4B

Fairfax County, Virginia
WSSI #20030, Task I2

Prepared for:

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Biological Monitoring Report – Year 1 (Post-construction)

The Glade – Reaches 2, 3, 4A and 4B WSSI #20003, Task I2

Executive Summary

As set forth in the “Northern Virginia Stream Restoration Bank Banking Instrument” (Banking Instrument), streams and drainage features within The Glade Watershed have been stabilized and restored. This stream restoration should result in a direct improvement of in-stream habitat.

In the first year following restoration, Wetland Studies and Solutions, Inc. (WSSI) conducted biological stream assessments along Design Reaches 2, 3, 4A and 4B of The Glade, which consist of a total of 13,031.8 linear feet of stream restoration, completed in 2010. This monitoring was conducted pursuant to the maintenance and monitoring requirements defined in the Northern Virginia Stream Restoration Bank (NVSRB) Banking Instrument, Section VI.B.2.(i). The assessed reaches were selected to be representative of the condition of The Glade and unnamed tributaries of The Glade following the restoration. This report summarizes the Year 1 monitoring (post-construction) in 2010, as compared to the baseline (pre-construction) conditions assessed from 2007-2009.

Biological stream monitoring was conducted along six¹ permanent biological monitoring reaches using benthic macroinvertebrate and habitat data. Fieldwork was conducted between May 13, and 14, 2010. Benthic macroinvertebrate data was used to calculate a Stream Condition Index for Virginia Non-coastal Streams (VA-SCI) and habitat data was used to calculate the Total Habitat Score for each reach.

Our Year 1 post-restoration results indicate that on average the habitat quality of the restored streams has increased following restoration. However, overall benthic macroinvertebrate condition has not yet shown improvement, which is likely due to factors such as water quality and the short time since the initial disturbance from the restoration. It will take time for benthic macroinvertebrates to re-colonize these streams and in order to expedite colonization, water quality enhancements will need to be undertaken within the watershed (by others).

Introduction

As set forth in the “Northern Virginia Stream Restoration Bank Banking Instrument” (Banking Instrument), dated February 17, 2006 and prepared by Wetland Studies and Solutions, Inc. (WSSI), Northern Virginia Stream Restoration, L.C. will restore approximately 14 miles of streams and upland buffers, within portions of the Snakeden Branch, Colvin Run, and The Glade watersheds in Reston, Virginia. As required in Section VI.B.2. (i) of the Banking Instrument, biological monitoring will be conducted within restored streams within these watersheds. These stream restoration activities should result in a direct improvement of in-stream habitat. Using benthic macroinvertebrate and habitat data, this first post-construction monitoring report

¹ Note that biological monitoring reaches 1-A through 1-C were not restored in 2010. These reaches will be assessed in 2011 as part of the Year 1 monitoring report for The Glade – Reaches 5 and 6.

characterizes the restored streams within Design Reaches 2, 3, 4A, and 4B of The Glade Watershed portion of the NVSRB in 2010, as compared to baseline conditions described in Biological Monitoring Reports #1 (dated December 8, 2008), #2 (dated December 17, 2008), and #3 (dated October 14, 2009). With these data, we propose to determine the effect of stream restoration on the condition of streams within The Glade Watershed portion of the NVSRB.²

Project Area

The study area includes approximately 13,031.8 linear feet of stream along Design Reaches 2, 3, 4A, and 4B of The Glade, as well as the adjacent riparian corridor. The study area is located north of Lawyers Road (Route 673) between Colts Neck Road and Soapstone Drive in Fairfax County, Virginia. Exhibit 1 is a vicinity map that depicts the approximate location of the study area.

The study area is covered mostly by mixed-deciduous forest. The Glade and unnamed tributaries to The Glade flow in an easterly direction through the study area. An asphalt recreational trail, which crosses The Glade multiple times, is located parallel to the stream and to several of its unnamed tributaries. The study area is gently to moderately sloping. The topography can be seen in the excerpt from the Vienna, Virginia-Maryland 1994 USGS topographical quadrangle map included as Exhibit 2.

The boundaries of jurisdictional wetlands and other waters of the U.S. located within the study area were delineated and survey-located by WSSI as described in The Glade delineation report, dated October 9, 2008, revised June 25, 2009. A jurisdictional determination was issued by the U.S. Army Corps of Engineers (COE) on December 29, 2008 (JD #2008-2858), and revised July 27, 2009.

Overall Methodology

Per maintenance and monitoring requirements defined in the Banking Instrument, Section VI.B.2. (i), biological stream assessment reaches are to be established for every 2,000 linear feet of stream restoration along samplable streams at the NVSRB³. Once established, these reaches are to be monitored prior to stream restoration, then in years 1, 5, and 10. The following methods are to be employed:

- Biological Reconnaissance (BioRecon), following guidance established in the U.S. Environmental Protection Agency's "Rapid Bioassessment Protocols for Use in Streams and Wadable Rivers" (EPA's RBP; Barbour et al. 1999.)⁴
- Biological stream assessment for Calculating the Stream Condition Index for Virginia Non-coastal Streams (VA-SCI), following guidance established in "A Stream Condition Index for Virginia Non-Coastal Streams" (Tetra Tech 2003) and "Using Probabilistic

² Note that monitoring reports for the Snakeden Branch and Colvin Run watershed portions of the NVSRB are provided under separate cover.

³ Assessment reaches were established for every 2,000 linear feet of samplable streams, which includes perennial and intermittent streams containing enough flowing water to sample in the spring.

⁴ Note that the BioRecon was used to aid in the selection of permanent monitoring reaches during the first year of pre-construction monitoring and is not required in subsequent monitoring years. The results of the BioRecon are described in "Biological Monitoring Report #1, Pre-construction Monitoring, Northern Virginia Stream Restoration Bank, The Glade Watershed", dated December 8, 2008.

Monitoring Data to Validate the Non-Coastal Virginia Stream Condition Index” (DEQ 2006).⁵

Biological Stream Monitoring

Biological Stream Monitoring Methodology. The biological stream monitoring consisted of two components: 1) Stream habitat assessment and 2) benthic macroinvertebrate assessment. The stream habitat assessment was conducted using guidance established in the DEQ SOPs for stream habitat assessment (DEQ 2008)⁶ and the U.S. Environmental Protection Agency’s Rapid Bioasssessment Protocol for habitat (Barbour et al. 1999). The benthic macroinvertebrate assessment field work was conducted using guidance established in the SOPs for multi-habitat benthic macroinvertebrate sampling (DEQ 2008).⁷

WSSI assessed six 300-linear foot reaches that were selected in Biological Monitoring Report #1 (Reach 1-D through 1-G, 2-A, and 3-A).⁸ The locations of these six sampling reaches relative to the six restoration design reaches are depicted in the Biological Stream Monitoring Map (Exhibit 3). Photographs are included in Exhibit 5 for each reach. Benthic macroinvertebrate sampling and habitat assessment field work was conducted by WSSI environmental scientists Beth Clements, C.T.⁹ and Lynn Straughan, C.T., P.W.S., A.W.B., PWD.¹⁰

In accordance with the SOPs, habitat conditions were assessed by qualitatively rating ten habitat parameters, including Epifaunal Substrate/Available Cover, Embeddedness, Velocity/Depth Regime, Sediment Deposition, Channel Flow Status, Channel Alteration, Frequency of Riffles, Bank Stability, Vegetative Protection, and Riparian Vegetative Zone Width. The overall habitat quality of each reach was determined by adding together the individual metric scores to provide a Total Habitat Score at each reach, with a maximum of 200 points possible. Each reach was then assigned a narrative rating according to the total habitat score, where “Optimal” is 200-160, “Sub-optimal” is 159-107, “Marginal” is 106-54, and “Poor” is 53-0. Stream habitat data were recorded on the WSSI Benthic Macroinvertebrate and Habitat Field Data Sheets (Exhibit 5 for each reach).

To assess benthic macroinvertebrate condition, 60 linear feet of best-available habitat in each reach was sampled using a D-Framed Net. Habitat types sampled include cobble/gravel, snags/leafpacks, under-cut banks, root-wads, and submerged vegetation. Benthic field data was recorded on WSSI Benthic Macroinvertebrate and Field Data Sheets (Exhibit 5 for each reach).

⁵ This method is to be used in all monitoring years and is accompanied by a habitat assessment, following guidance established Virginia Department of Environmental Quality’s (DEQ) standard operating procedures for stream habitat assessment.

⁶ Note that the DEQ has revised their SOP for habitat. Thus, starting in 2010, WSSI is using the latest SOP for habitat (DEQ 2008).

⁷ Note that the DEQ has revised their SOP for benthic macroinvertebrates. Thus, starting in 2010, WSSI is using the latest SOP for benthic macroinvertebrates (DEQ 2008).

⁸ Note that biological monitoring reaches 1-A through 1-C were not restored in 2010. These reaches will be assessed in 2011 as part of the Year 1 monitoring report for The Glade – Reaches 5 and 6.

⁹ North American Benthological Society (NABS) Certified Level 1 Taxonomist: All Phyla

¹⁰ North American Benthological Society (NABS) Certified Level 1 Taxonomist: All Phyla Professional Wetland Scientist #1491, Society of Wetland Scientists Certification Program, Inc.; Associate Wildlife Biologist, The Wildlife Society Virginia; Certified Professional Wetland Delineator #3402 000029; Maryland State Forest Conservation Program Qualified Professional, Maryland Department of Natural Resources.

The benthic macroinvertebrate samples were processed and subsampled by WSSI staff using guidance from the SOPs. Specifically, a fixed-count method was used, where organisms were randomly picked from a gridded (numbered) tray and the organisms were identified to the family level (if possible) using a dissecting microscope. Each individual (containing a head) found in a sample was recorded and enumerated on a WSSI Benthic Macroinvertebrate Bench Sheet ([Exhibit 5](#) for each reach).

Benthic macroinvertebrate data were analyzed by calculating the Stream Condition Index for Virginia Non-coastal Streams (VA-SCI), following guidance established in “A Stream Condition Index for Virginia Non-Coastal Streams” (Tetra Tech 2003) and “Using Probabilistic Monitoring Data to Validate the Non-Coastal Virginia Stream Condition Index” (DEQ 2006). The VA-SCI is a multi-metric Index of Biotic Integrity developed for the DEQ to assess Streams of the Commonwealth. The VA-SCI uses seven biotic metrics and one biotic index including Total Taxa, EPT Taxa, Percent Ephemeroptera, Percent Plecoptera + Trichoptera (Excluding Hydropsychidae), Percent Scrapers, Percent Chironomidae, Percent Top Two Dominant Taxa, and Hilsenhoff Biotic Index. The individual metrics and index used are defined and described as follows:

- Total Taxa Richness. Total Taxa Richness represents the total number of taxa in a sample. Total Taxa Richness is expected to be relatively high in undisturbed streams and is expected to decrease in response to environmental disturbance. Total Taxa Richness can range from 0-22 for the VA-SCI.
- EPT Taxa Richness. EPT Taxa Richness represents the number of taxa from the aquatic insect orders Ephemeroptera, Plecoptera, and Trichoptera. EPT taxa are generally very sensitive to pollution. Total EPT Taxa Richness is expected to be relatively high in undisturbed streams, and it is expected to decrease in response to environmental disturbance. EPT Taxa Richness can range from 0-11 for the VA-SCI.
- Percent Ephemeroptera. The Percent Ephemeroptera represents the ratio of members of the aquatic insect order Ephemeroptera (mayflies) to the total number of individuals in a sample. Mayflies are generally very sensitive to pollution, thus Percent Ephemeroptera is expected to decrease in response to environmental disturbance. Percent Ephemeroptera can range from 0-61.3 for the VA-SCI.
- Percent Plecoptera + Trichoptera (Excluding Hydropsychidae). The Percent Plecoptera + Trichoptera (Excluding Hydropsychidae) represents the ratio of members of the aquatic insect orders Plecoptera (stoneflies) and Trichoptera (caddisflies) (excluding the those in the pollution tolerant family Hydropsychidae) to the total number of individuals in a sample. Percent Plecoptera + Trichoptera (Excluding Hydropsychidae) is expected to decrease in response to environmental disturbance. Percent Plecoptera + Trichoptera (Excluding Hydropsychidae) can range from 0-35.6 for the VA-SCI.
- Percent Scrapers. The Percent Scrapers represents the ratio of taxa adapted primarily for scraping food from a substrate to the total number of individuals in a sample. Percent Scrapers is expected to decrease in response to environmental disturbance. Percent Scrapers can range from 0-51.6 for the VA-SCI.
- Percent Chironomidae. The Percent Chironomidae represents the ratio of members of the aquatic insect family Chironomidae (non-biting midges) to the total number of individuals in a sample. Because chironomids are generally tolerant to pollution, Percent

Chironomidae is expected to increase in response to environmental disturbance. Percent Chironomidae can range from 0-100 for the VA-SCI.

- Percent Top Two Dominant. The Percent Top Two Dominant is the ratio of the top two most abundant taxa in a sample to the total number of individuals in a sample. Percent Top Two Dominant is expected to increase in response to environmental disturbance. Percent Top Two Dominant can range from 30.8-100 for the VA-SCI.
- Hilsenhoff Biotic Index (HBI). The Hilsenhoff Biotic Index is the abundance-weighted average tolerance of assemblage of organisms (Family taxonomic level). The HBI is expected to increase in response to environmental disturbance. The HBI can range from 3.2-10 for the VA-SCI.
- The VA-SCI was calculated by taking the weighted average of the individual metric (and index) scores, with a VA-SCI range of 0-100. The weighting is as follows:
 - Total Taxa: Score = $100 \times (X/22)$, where X = Metric Value
 - EPT Taxa: Score = $100 \times (X/11)$, where X = Metric Value
 - Percent Ephemeroptera: Score = $100 \times (X/61.3)$, where X = Metric Value
 - Percent Plecoptera + Trichoptera less Hydropsychidae: Score = $100 \times (X/35.6)$, where X = Metric Value
 - Percent Scrapers: Score = $100 \times (X/51.6)$, where X = Metric Value
 - Percent Chironomidae: Score = $100 \times [(100-X)(100-0)]$, where X = Metric Value
 - Percent Top 2 Dominant: Score = $100 \times [(100-X)(100-30.8)]$, where X = Metric Value
 - Hilsenhoff Biotic Index: Score = $100 \times [(100-X)(100-3.2)]$, where X = Metric Value

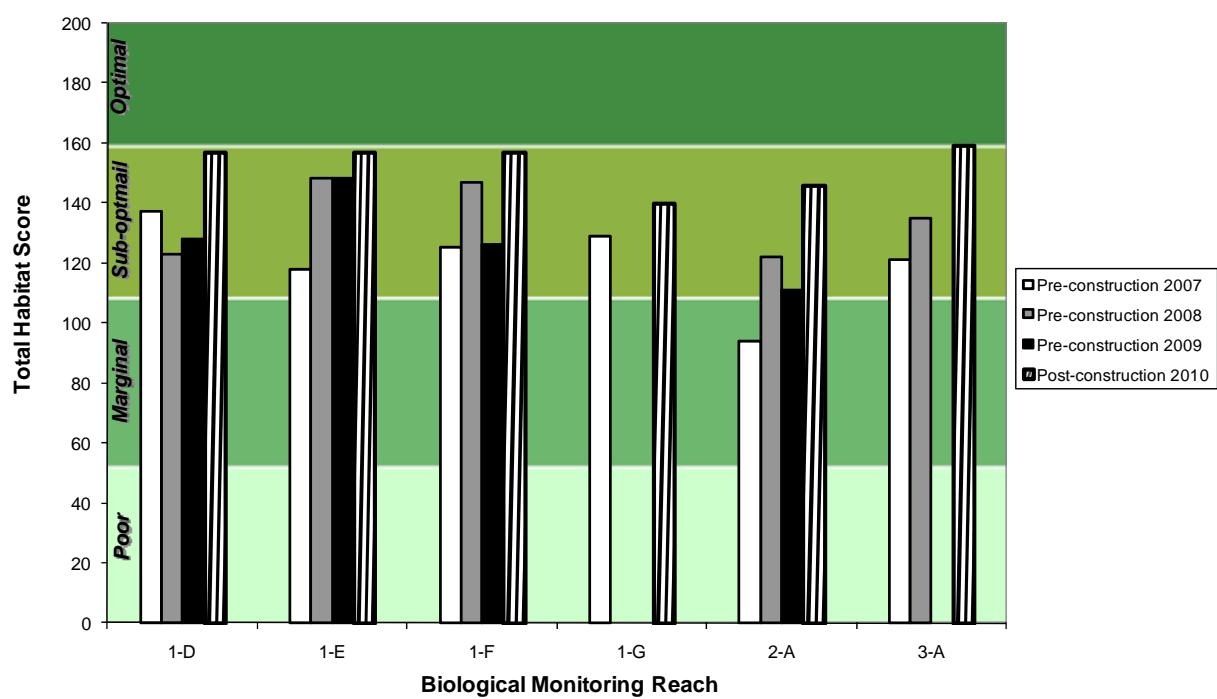
Each reach was then assigned a narrative rating according to the calculated VA-SCI, where “Excellent” is >73, “Good” is 60-72, “Stress” is 43-59, and “Severe Stress” is <42.

Biological Stream Monitoring Results and Discussion. Habitat results for Year 1 show that all stream reaches have “Sub-optimal” habitat conditions, though the reaches are generally at the high end of “Sub-optimal” (Table 1, Figure 1, and Exhibit 5 for each reach). The average habitat assessment score for all restored stream reaches assessed in 2010 is 153 out of 200 following restoration. These results show improved habitat conditions following restoration, with scores exceeding the pre-restoration scores. Improved habitat assessment scores relate to the success of the well vegetated and stabilized banks, with little erosion or depositional zones present throughout the restored reaches. It is expected that this trend will continue over time as the density of the reforested riparian zone increases.

Table 1. 2010 Total Habitat Assessment Scores

BIOMONITORING REACH	Total Habitat Score	Narrative Rating
1-D	157	Sub-optimal
1-E	157	Sub-optimal
1-F	157	Sub-optimal
1-G	140	Sub-optimal
2-A	146	Sub-optimal
3-A	159	Sub-optimal
Average	153	Sub-optimal

Figure 1. Comparison of Habitat Assessment Scores from 2007-2010 for The Glade Watershed



*Note that biological monitoring reach 1-G was not assessed in 2008 and 2009 and biological monitoring reach 3-A was not assessed in 2009 due to the lack of flowing water during the time of the sampling fieldwork.

Benthic macroinvertebrate results show that individuals from 9 taxa¹¹ were collected from all six reaches collectively (Table 2, Exhibit 5) during the 2010 post-construction benthic macroinvertebrate monitoring. Of all taxa collected, non-biting midge larvae (Chironomidae) and aquatic worms (Naididae) comprised the majority of individuals in the majority of the reaches.

Table 2. 2010 Raw Benthic Macroinvertebrate Data at The Glade

TAXA	BIOMONITORING REACH						Total
	1-D	1-E	1-F	1-G	2-A	3-A	
PHYSIDAE	-	12	-	1	1	51	65
OLIGOCHAETA	33	35	35	2	2	12	119
NAIDIDAE	46	31	45	-	6	12	140
TUBIFICIDAE	-	14	10	-	1	14	39
STRATIOMYIDAE	-	-	-	-	14	-	14
HYDROPSYCHIDAE	-	-	-	-	1	-	1
TABANIDAE	-	-	-	1	-	-	1
CHOABORIDAE	-	2	-	-	-	-	2
HYALELLIDAE	-	1	-	-	-	-	1
CHIRONOMIDAE	28	22	13	98	72	32	265
TOTAL	107	117	103	102	97	121	647

The above data collected for each reach were used to calculate the biotic metrics as shown in Table 3. The VA-SCI requires that these metrics be weighted to determine the VA-SCI, as shown in Table 4. The results of our data analysis indicate that the benthic macroinvertebrate community at all six stream reaches (Reaches 1-D through 1-G, 2-A, and 3-A) were in “Severe Stress” in 2010 following stream restoration activities, based on their VA-SCI scores. The average VA-SCI numerical score for all reaches assessed in 2010 is 24.56 (“Severe Stress”). These scores are the result of the low number of total taxa, low number of total EPT taxa, low percentage of Plecoptera and Trichoptera (excluding Hydropsychidae), low percentage of Scraper taxa, high percentage of Chironomidae, high percentage of top two dominant taxa, and high HBI found within the reaches assessed.

¹¹

Although 10 taxa are listed in Table 3, Oligochaeta were not included as part of the total taxa collected within the study area, because individuals were too damaged to identify to the family-level.

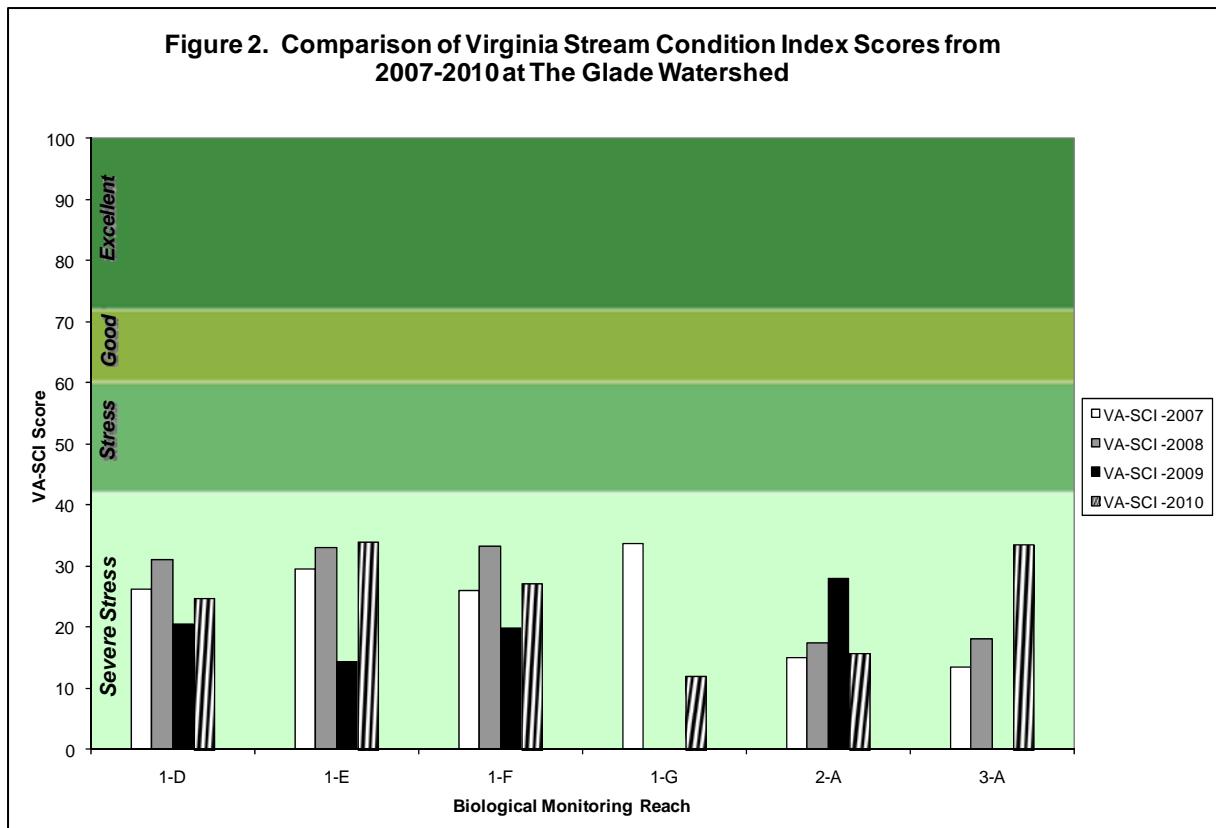
Table 3. 2010 Biotic Metric Scores at The Glade.

Reach	Total Taxa	Total EPT Taxa	Percent Ephemeroptera	Percent Plecoptera + Trichoptera (Excluding Hydropsychidae)	Percent Scrapers	Percent Chironomidae	Percent Top Two Dominant	HBI
1-D	3	0	0.00	0.00	0.00	26.17	73.83	5.01
1-E	7	1	0.00	0.00	10.26	18.80	56.41	5.38
1-F	4	1	0.00	0.00	0.00	12.62	77.67	5.22
1-G	4	1	0.00	0.00	0.98	96.08	98.04	5.92
2-A	7	0	0.00	0.00	1.03	74.23	88.66	6.63
3-A	5	0	0.00	0.00	42.15	26.45	68.60	6.91

Table 4. 2010 Biotic Metric and Index Weighting and VA-SCI at The Glade.

METRIC	BIOLOGICAL MONITORING REACH					
	1-D	1-E	1-F	1-G	2-A	3-A
Total Taxa	13.64	31.82	18.18	18.18	31.82	22.73
EPT Taxa	0.00	9.09	9.09	9.09	0.00	0.00
Percent Ephemeroptera	0.00	0.00	0.00	0.00	0.00	0.00
Percent Plecoptera + Trichoptera (Excluding Hydropsychidae)	0.00	0.00	0.00	0.00	0.00	0.00
Percent Scrapers	0.00	19.88	0.00	1.90	2.00	81.68
Percent Chironomidae	73.83	81.20	87.38	3.92	25.77	73.55
Percent Top Two Dominant	37.82	62.99	32.27	2.83	16.39	45.38
HBI	73.39	67.87	70.25	59.98	49.58	45.45
VA-SCI Numerical Score	24.83	34.11	27.15	11.99	15.69	33.60
VA-SCI Narrative Score	Severe Stress	Severe Stress	Severe Stress	Severe Stress	Severe Stress	Severe Stress
Average VA-SCI Numerical Score	24.56					
Average VA-SCI Narrative Score	Severe Stress					

These results are similar to the 2007-2009 monitoring, where the benthic macroinvertebrate community at almost all reaches was also in “Severe Stress” (Figure 2). It is expected that the VA-SCI scores in 2010 would not improve immediately following restoration efforts due to disturbance from construction. Such disturbances can temporarily reduce benthic condition, and recovery of the benthic community can be slow (Muatka 2002).



*Note that biological monitoring reach 1-G was not sampled in 2008 and 2009 and biological monitoring reach 3-A was not sampled in 2009 due to the lack of flowing water during the time of the sampling fieldwork.

An analysis of land use within the watershed of each stream reach indicates that each watershed is highly developed, with all reaches having at least 15 percent impervious land cover (with a weighted watershed average of 15 percent), as depicted in the Land Cover Map (Exhibit 4), and Table 5. It has been documented that increases in watershed imperviousness reduce macroinvertebrate diversity, such that when imperviousness exceeds 10 to 15 percent, macroinvertebrate diversity becomes low (Klein 1979). Runoff from the highly impervious land within these watersheds typically produces a high volume and velocity of flowing water and sediment in the stream channels during storm events. As a result, epifaunal substrate/available cover within these streams becomes highly mobile and benthic macrofauna could not easily colonize the available substrate (Debrey and Lockwood 1990) or they were buried and killed by high sediment deposition (Wood and Armitage 1997). However, because the restored streams within our study area have been engineered to accommodate high volume flows, future habitat degradation should be minimized.

Table 5. Impervious Land Cover for Each Biological Monitoring Reach at The Glade.		
REACH	Watershed Acres	Percent Impervious
1-D	395	16
1-E	221	16
1-F	95	15
1-G	27	17
2-A	40	28
3-A	91	18

Nutrients, pesticides, and other chemical pollutants that enter the streams through runoff can also have a negative effect on the macroinvertebrate community (Wright et al 1995; O'Halloran et al. 1996; Kiffney and Clements 1994). Sources for such pollutants within the streams we assessed likely include residential lawns, roads, wildlife, and faulty sewer lines. High amounts of such pollutants into streams inevitably result in a shift in macroinvertebrate community composition, where pollutant tolerant taxa such as non-biting midge larvae and oligochaete worms out-compete sensitive taxa such as EPT (Shueler 1994).

Thus, given the factors listed above, it is not a surprise that our benthic macroinvertebrate data show low VA-SCI scores and pollution-tolerant taxa such as non-biting midges and aquatic worms as the dominant taxa. However, restoration has improved in-stream habitat, thus providing a stable substrate for colonization of benthic macroinvertebrates. It will take time for benthic macroinvertebrates to re-colonize these reaches and in order to expedite colonization, water quality enhancing measures will need to be undertaken in the watershed (by others).

Conclusions

The above results indicate that the habitat of Design Reaches 2, 3, 4A, and 4B of The Glade on average is "Sub-optimal" (though at the high end of the range) and the benthic macroinvertebrate community of the streams is in "Severe Stress". Improved habitat assessment scores following restoration relate to the success of the well vegetated and stabilized banks, with little erosion or depositional zones present throughout the restored reaches. Habitat scores not exceeding the "Sub-optimal" category are due mostly to the young reforested riparian zone. As the density of the riparian vegetation increases over time, habitat conditions should become "Optimal". The low VA-SCI are likely due to several abiotic factors, including highly impervious land cover, high nutrient, toxicant and sediment input from adjacent land use, and recent disturbance from restoration. It will take time for benthic macroinvertebrates to re-colonize these reaches and in order to expedite colonization, water quality enhancing measures will need to be undertaken in the watershed (by others).

Limitations

This study is based on examination of the conditions on the site at the time of our review and does not address conditions in the future. Such conditions may change over time and will be addressed in subsequent monitoring reports. Our biological monitoring report has been prepared in accordance with generally accepted guidelines for the conduct of such evaluations. We make no other warranties, either expressed or implied, and our report is not a recommendation to buy, sell or develop the property.

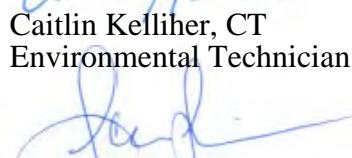
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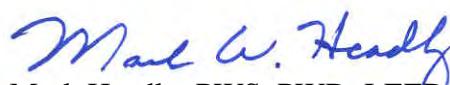
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Executive Vice President

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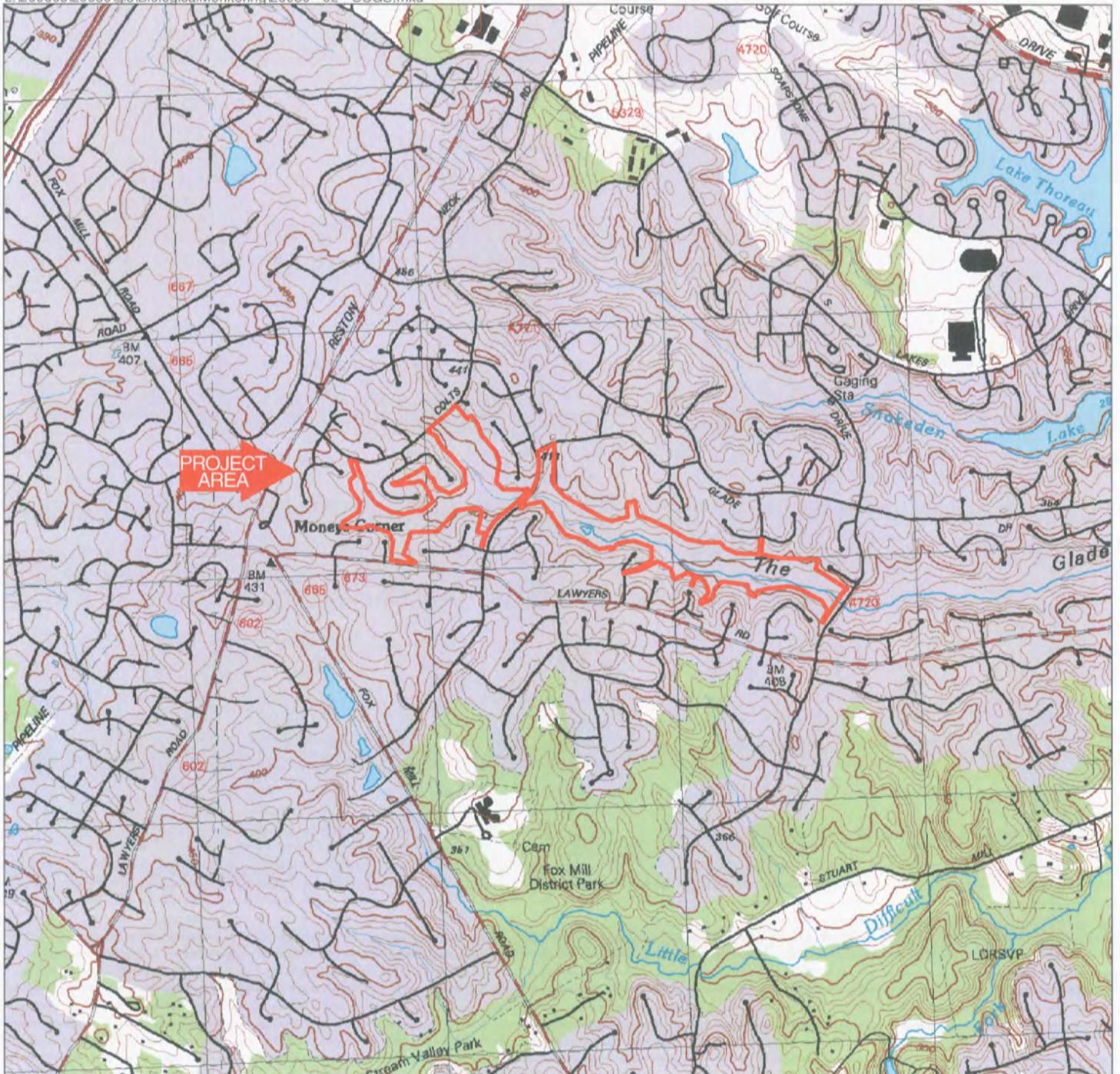
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Vicinity Map
The Glade Reaches 2, 3, 4A, and 4B
WSSI #20030
Scale: 1" = 2000'





**USGS Quad Map
Vienna, VA-MD 1994
The Glade Reaches 2, 3, 4A, and 4B
WSSI #20030
Scale: 1" = 2000'**

Latitude: 38°55'50" N
Longitude: 77°20'51" W
Hydrologic Unit Code (HUC): 020700081004
Stream Class: III
Name of Watershed: The Glade



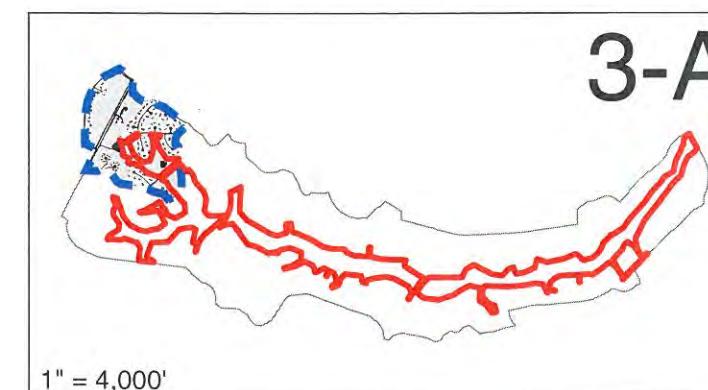
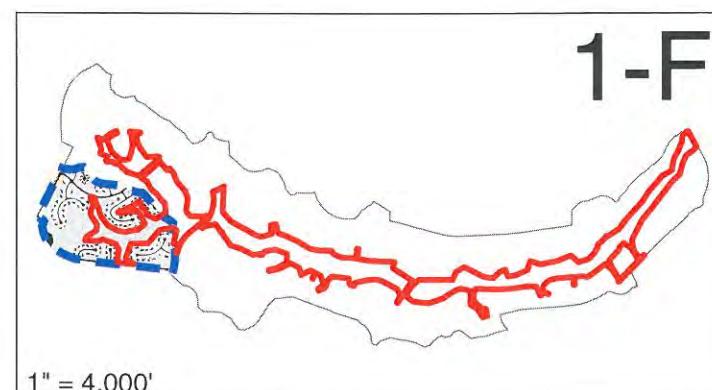
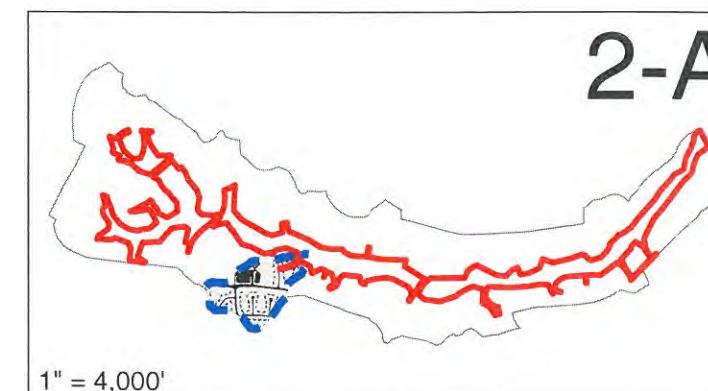
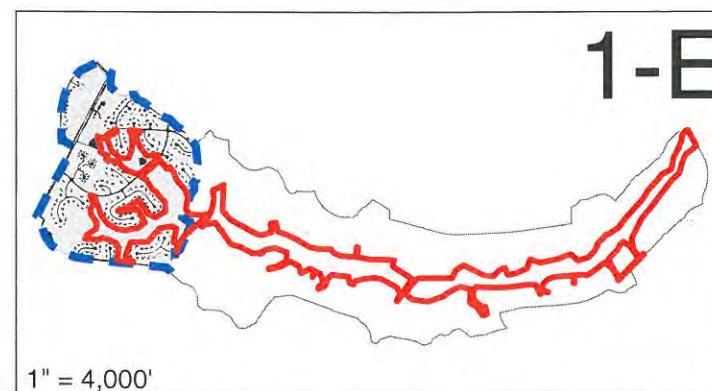
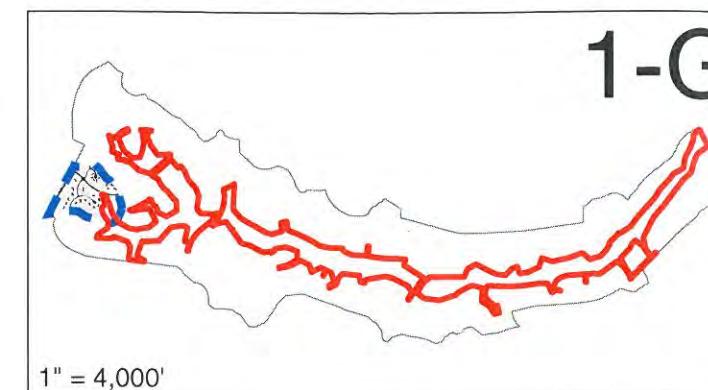
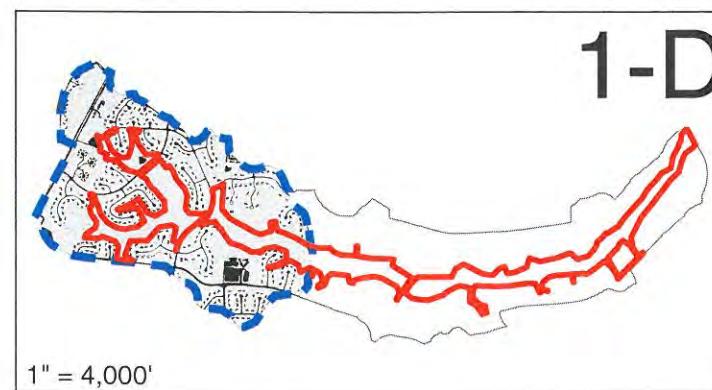
Biological Monitoring Map 2010

Northern Virginia Stream Restoration Bank

Glade Reaches 2, 3, 4A, and 4B

Reston, Virginia





Land Cover Map
The Glade Reaches 2, 3, 4A, and 4B
WSSI #20030
Scale as Noted

Stream	Impervious	Total
	ID	Percent
1-D	16%	395
1-E	16%	221
1-F	15%	95
1-G	17%	27
2-A	28%	40
3-A	18%	91

□ PROJECT AREA
□ DRAINAGE BOUNDARIES
■ IMPERVIOUS AREAS
■ PERVIOUS AREAS

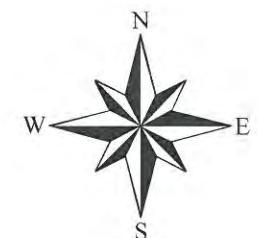


EXHIBIT 5 – INDIVIDUAL BIOLOGICAL MONITORING REACH DATA

- BIOLOGICAL STREAM ASSESSMENT PHOTOGRAPHS
- BENTHIC MACROINVERTEBRATE AND HABITAT ASSESSMENT DATA SHEET
- BENTHIC MACROINVERTEBRATE I.D. AND ENUMERATION BENCH SHEET

**REACH 1-D
BIOLOGICAL STREAM ASSESSMENT PHOTOGRAPHS
THE GLADE WATERSHED
WSSI #20030**



1. Looking northwest (upstream) at Reach 1-D of The Glade in the eastern portion of the study area. Photo taken March 2007, prior to construction.



2. Looking northwest (upstream) at Reach 1-D of The Glade in the eastern portion of the study area. Photo taken May 2008, prior to construction.

**REACH 1-D
BIOLOGICAL STREAM ASSESSMENT PHOTOGRAPHS
THE GLADE WATERSHED
WSSI #20030**



3. Looking northwest (upstream) at Reach 1-D of The Glade in the eastern portion of the study area. Photo taken March 2009, prior to construction.



4. Looking northwest (upstream) at Reach 1-D of The Glade in the eastern portion of the study area. Photo taken May 2010, during Year 1.

Benthic Macroinvertebrate and Habitat Field Data Sheet

Job # Task	The Glade - 20030				
Station ID:	Reach 1-D	Ecoregion:	Piedmont	Land Use:	Urban
Field Team:	Team Green	Survey Reason:	Year 1 monitoring	Start time:	10:15 AM
Stream Name:	Glade	Location:	Reston, Virginia	Finish time:	11:00 AM
Date:	5/13/2010	Latitude:	-77.353	Longitude:	38.924

Stream Physiochemical Measurements

Instrument ID number:	N/A	pH:	N/A	
Temperature:	N/A °C	Conductivity:	N/A uS/cm	
Dissolved Oxygen:	N/A mg/L	Did instrument pass all post-calibration checks?	N/A	

If NO- which parameter(s) failed and action taken:

N/A

Benthic Macroinvertebrate Collection

Method Used:	Single Habitat (Riffle)			Multi Habitat (Logs, Plants, etc.)		X
Riffle Quality	Good x	Marginal		Poor		None
Habitats Sampled and # Jabs	Riffle 15	Snags 5		Banks		Vegetation
Total area sampled (sq. m)	20					

Weather Observations

Current Weather	Cloudy x	Clear	Rain/Snow	Foggy
Recent Precipitation	Clear	Showers	Rain x	Storms
Stream Flow	Low	Normal x	Above Normal	Flood

Biological Observations

Periphyton	2	Salamanders	0	Other....
Filamentous Algae	0	Warmwater Fish	1	0= Not observed
Submerged Macrophytes	0	Coldwater Fish	0	1= Sparse
Emergent Macrophytes	0	Beavers	0	2= Common to Abundant
Crayfish	0	Muskrats	0	3= Dominant-
Corbicula	0	Ducks/Geese	0	abnormally high density where other taxa are
unionidae	0	Snakes	0	insignificant in relation to the dominant taxa.
Operculate Snails	0	Turtles	0	There can be situations where multiple taxa
Non-operculate Snails	0	Frogs/Tadpoles	1	are dominant such as algae and snails

Notes

High Gradient Habitat Data

Habitat Parameter	Condition Category				
	Optimal	Suboptimal	Marginal	Poor	Score
1. Epifaunal Substrate/ Available Cover	Greater than 70% 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. snags/logs that are not new fall and not transient).	40-70% 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.	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.	13
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.	8
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast shallow)(slow is <0.3m/s, deep is >0.5 m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).	19
	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 <5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand, or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand, or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.	19
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	

Benthic Macroinvertebrate and Habitat Field Data Sheet

Habitat Parameter	Condition Category					Score
	Optimal	Suboptimal	Marginal	Poor		
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.	19	19
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		
6. Channel Alteration	Channelization or dredging absent or minimal; stream width normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40-80% 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.	15	15
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		
7. Frequency of Riffles	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distances between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.	19	19
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 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.	9	9
Score Left Bank	10 9	8 7 6	5 4 3	2 1 0		
Score Right Bank	10 9	8 7 6	5 4 3	2 1 0	9	9
9. Vegetation 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 non-woody macrophytes; vegetation 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.	4	4
Score Left Bank	10 9	8 7 6	5 4 3	2 1 0		
Score Right Bank	10 9	8 7 6	5 4 3	2 1 0	4	4
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.	10	10
Score Left Bank	10 9	8 7 6	5 4 3	2 1 0		
Score Right Bank	10 9	8 7 6	5 4 3	2 1 0	9	9
Total Score					157	

WSSI BENTHIC MACROINVERTEBRATE BENCH SHEET

Job Name/#	The Glade - 20030	Sample subsorted by:	SDS/CP	
Station ID:	Reach 1-D	Date Subsorbed:	5/17/10	
Stream Name:	The Glade	# of Grids subsorted	4	
Date Sampled:	5/13/10	Total # of subsorted:	111	Total # identified: 107
Sampling Method:	Multi-habitat	Sample Identified by:	CEK	Date Identified: 6/14/10

Taxa Collected:

Porifera			Metretopodidae	
Flatworms	Spongillidae		Neophemeridae	
Gastropoda	Tricladida		Oligoneuriidae	
Limpets	Planariidae		Psuedironidae	
Snails	Unknown		Polymitarcyidae	
	Ancylidae		Potamanthidae	
	Immature		Siphlonuridae	
	Lymnaeidae		Tricorythidae	
	Physidae		Early Instar and/or damaged	Zygoptera
	Planorbidae		Calopterygidae	
	Hydrobiidae		Coenagrionidae	
	Pleuroceridae		Lestidae	
Unionida	Viviparidae		Protoneuridae	Anisoptera
	Immature		Early Instar and/or damaged	
	Corbiculidae		Aeshnidae	
	Sphaeridae		Cordulegastridae	
Oligochaeta	Unionidae		Corduliidae	
Lumbriculida	Unknown	33	Gomphidae	
Tubificida	Lumbriculidae		Libellulidae	
Haplotauxida	Enchytraeidae		Macromiidae	
	Naididae	46	Petaluridae	
	Tubificidae		Corduliidae/Libellulidae	Plecoptera
	Haplotauxidae		Early Instar and/or damaged	
Leeches	Hirudinea		Capniidae	
	Erpobdellidae		Chloroperlidae	
	Glossiphoniidae		Leuctridae	
	Hirudinidae		Nemouridae	
Branchiobdellida	Pisciolidae		Peltoperlidae	
Decapoda	Branchiobdellidae		Perlidae	
Shrimp	Cambaridae		Perlodidae	
Isopoda	Portunidae		Pteronarcyidae	
Amphipoda	Palaemonidae		Taeniopterygidae	
	Asellidae		Early Instar and/or damaged	Hemiptera
	Crangonyctidae		Belostomatidae	
Water Mites	Gammaeridae		Corixidae	
Ephemeroptera	Talitridae		Gelastocoridae	
	Hydracarina		Gerridae	
	Early Instar and/or damaged		Hebridae	
	Acanthometropodidae		Hydrometridae	
	Ameletidae		Mesoveliidae	
	Baetidae		Naucoridae	
	Baetiscidae		Nepidae	
	Behningiidae		Notonectidae	
	Caenidae		Veliidae	
	Ephemerellidae		Pleidae	
	Ephemeridae		Sisyridae	
	Heptageniidae		Corydalidae	
	Isonychiidae		Sialidae	
	Leptophlebiidae		Early Instar and/or damaged	Neuroptera
	TOTAL:	79	Branchycentridae	
			Calamoceratidae	
			Glossosomatidae	
			Goeridae	
			Heliocpsychidae	
			Hydropsychidae	
			Hydroptilida	

Lepidostomatidae	
Leptoceridae	
Limnephilidae	
Molannidae	
Odontoceridae	
Philopotamidae	
Phryganeidae	
Polycentropodidae	
Psychomyiidae	
Ryacophilidae	
Sericostomatidae	
Uenoidae	
Early Instar and/or damaged	Lepidoptera
Pyralidae	
Early Instar and/or damaged	Coleoptera
Chrysomelidae	
Curculionidae	
Dryopidae	
Dytiscidae	
Elmidae	
Gyrinidae	
Halipidae	
Helodidae	
Helophoridae	
Hydraenidae	
Hydrochidae	
Hydrophilidae	
Limnichidae	
Noteridae	
Psephenidae	
Ptilodactylidae	
Scirtidae	
Early Instar and/or damaged	Diptera
Athericidae	
Blephariceridae	
Canaceidae	
Ceratopogonidae	
Choaboridae	
Chironomidae (A)	28
Chironomidae (B)	
Culicidae	
Dixidae	
Dolichopodidae	
Epididae	
Ephydriidae	
Muscidae	
Nymphomyiidae	
Pelecorhynchidae	
Psychodidae	
Ptychopteridae	
Sciomyzidae	
Simuliidae	
Stratiomyidae	
Syrphidae	
Tabanidae	
Tanyderidae	
Thaumaleidae	
Tipulidae	
TOTAL:	28

**REACH 1-E
BIOLOGICAL STREAM ASSESSMENT PHOTOGRAPHS
THE GLADE WATERSHED
WSSI #20030**



1. Looking west (upstream) at Reach 1-E of The Glade in the eastern portion of the study area.
Photo taken March 2007, prior to construction.



2. Looking west (upstream) at Reach 1-E of The Glade in the eastern portion of the study area.
Photo taken May 2008, prior to construction.

**REACH 1-E
BIOLOGICAL STREAM ASSESSMENT PHOTOGRAPHS
THE GLADE WATERSHED
WSSI #20030**



3. Looking west (upstream) at Reach 1-E of The Glade in the eastern portion of the study area. Photo taken March 2009, prior to construction.



4. Looking west (upstream) at Reach 1-E of The Glade in the eastern portion of the study area. Photo taken May 2010, during Year 1.

Benthic Macroinvertebrate and Habitat Field Data Sheet

Job # Task	The Glade -- 20030				
Station ID:	1-E	Ecoregion:	Piedmont	Land Use:	Urban
Field Team:	BC/CP	Survey Reason:	Year 1 monitoring	Start time:	9:30 AM
Stream Name:	Glade	Location:	Reston, Virginia	Finish time:	10:15 AM
Date:	5/14/2010	Latitude:	-77.362	Longitude:	38.926

Stream Physiochemical Measurements

Instrument ID number:	N/A	pH:	N/A	
Temperature:	N/A	°C	Conductivity:	N/A uS/cm
Dissolved Oxygen:	N/A	mg/L	Did instrument pass all post-calibration checks?	N/A
			If NO- which parameter(s) failed and action taken:	
			N/A	

Benthic Macroinvertebrate Collection

Method Used:	Single Habitat (Riffle)			Multi Habitat (Logs, Plants, etc.)		X
Riffle Quality	Good	x	Marginal	Poor	None	
Habitats Sampled and # Jabs	Riffle	17	Snags	Banks	Vegetation	
Total area sampled (sq. m)	20					

Weather Observations

Current Weather	Cloudy	Clear	Rain/Snow	Foggy
Recent Precipitation	Clear X	Showers	Rain	Storms
Stream Flow	Low	Normal x	Above Normal	Flood

Biological Observations

Periphyton	2	Salamanders	0	Other....
Filamentous Algae	0	Warmwater Fish	0	0= Not observed
Submerged Macrophytes	0	Coldwater Fish	0	1= Sparse
Emergent Macrophytes	0	Beavers	0	2= Common to Abundant
Crayfish	0	Muskrats	0	3= Dominant-
Corbicula	0	Ducks/Geese	0	abnormally high density where other taxa are
unionidae	0	Snakes	0	insignificant in relation to the dominant taxa.
Operculate Snails	0	Turtles	0	There can be situations where multiple taxa
Non-operculate Snails	0	Frogs/Tadpoles	2	are dominant such as algae and snails

Notes

High Gradient Habitat Data

Habitat Parameter	Condition Category				
	Optimal	Suboptimal	Marginal	Poor	Score
1. Epifaunal Substrate/ Available Cover	Greater than 70% 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. snags/logs that are not new fall and not transient).	40-70% 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.	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% 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	12
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.	
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	8
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast shallow)(slow is <0.3m/s, deep is >0.5 m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).	
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	18
4. Sediment Deposition	Little or no enlargement of islands or point bars and <5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand, or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand, or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools	Heavy deposits of fine material, increased bar development; more than 50% 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	19

Benthic Macroinvertebrate and Habitat Field Data Sheet

Habitat Parameter	Condition Category					Score
	Optimal	Suboptimal	Marginal	Poor		
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.	14	14
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		
6. Channel Alteration	Channelization or dredging absent or minimal; stream width normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40-80% 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.	15	15
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		
7. Frequency of Riffles	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distances between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.	19	19
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 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.	9	9
Score Left Bank	10 9	8 7 6	5 4 3	2 1 0		
Score Right Bank	10 9	8 7 6	5 4 3	2 1 0	9	9
9. Vegetation 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 non-woody macrophytes; vegetation 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.	8	8
Score Left Bank	10 9	8 7 6	5 4 3	2 1 0		
Score Right Bank	10 9	8 7 6	5 4 3	2 1 0	8	8
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.	9	9
Score Left Bank	10 9	8 7 6	5 4 3	2 1 0		
Score Right Bank	10 9	8 7 6	5 4 3	2 1 0	9	9
Total Score					157	

WSSI BENTHIC MACROINVERTEBRATE BENCH SHEET

Job Name/#	Glade - 20030	Sample subsorted by:	CEK	 Wetland Studies and Solutions, Inc. [®]
Station ID:	Reach 1-E	Date Subsorbed:	6/17/10	
Stream Name:	The Glade	# of Grids subsorted	4	
Date Sampled:	5/14/10	Total # of subsorted insects:	117	
Sampling Method:	Multihabitat	Sample Identified by:	CEK	Total # identified: 117

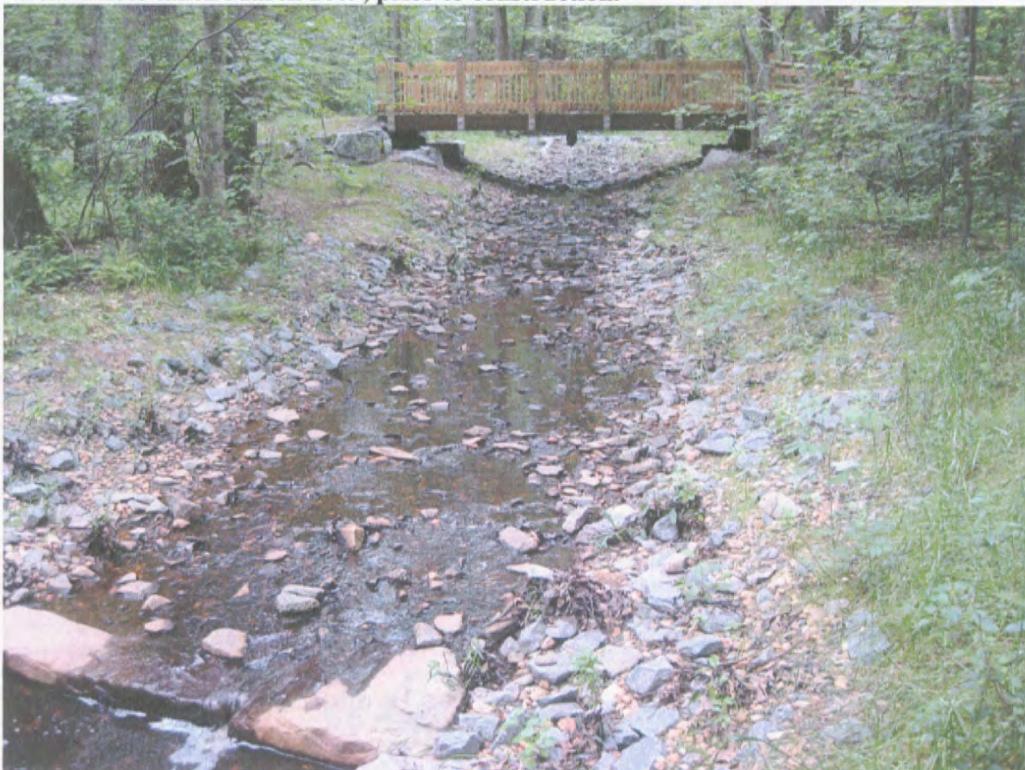
Taxa Collected:

Porifera		Metretopodidae		Lepidostomatidae
Flatworms	Spongillidae	Neophehmeridae		Leptoceridae
Gastropoda	Tricladida	Oligoneuriidae		Limnephilidae
Limpets	Planariidae	Psuedironidae		Molanidae
Snails	Unknown	Polymitarcyidae		Odontoceridae
	Ancylidae	Potamanthidae		Philopotamidae
	Immature	Siphlonuridae		Phryganeidae
	Lymnaeidae	Tricorythidae		Polycentropodidae
	Physidae	Early Instar and/or damaged		Psychomyiidae
Unionida	Planorbidae	Calopterygidae		Ryacophilidae
	Hydrobiidae	Coenagrionidae		Sericostomatidae
	Pleuroceridae	Lestidae		Uenoidae
	Viviparidae	Protoneuridae		Early Instar and/or damaged
Oligochaeta	Immature	Early Instar and/or damaged		Pyralidae
Lumbriculida	Corbiculidae	Aeshnidae		Coleoptera
Tubificida	Sphaeriidae	Cordulegastridae		Early Instar and/or damaged
Haplotauxida	Unionidae	Corduliidae		Chrysomelidae
	Unknown	Gomphidae		Curculionidae
	35	Libellulidae		Dryopidae
	Lumbriculidae	Macromiidae		Dytiscidae
	Enchytraeidae	Petaluridae		Elmidae
	Naididae	Corduliidae/Libellulidae		Gyrinidae
	31	Early Instar and/or damaged		Haliciidae
	Tubificidae	Capniidae		Helodidae
		Chloroperlidae		Helophoridae
		Leuctridae		Hydraenidae
Leeches	Haplotaxidae	Nemouridae		Hydrochidae
	Hirudinea	Peltoperlidae		Hydrophilidae
	Erpobdellidae	Perlidae		Limnichidae
	Glossiphoniidae	Perlodidae		Noteridae
	Hirudinidae	Pteronarcidae		Psephenidae
Branchiobdellida	Pisciolidae	Taeniopterygidae		Ptilodactylidae
	Branchiobdellidae	Early Instar and/or damaged		Scirtidae
Decapoda	Cambaridae	Belostomatidae		Early Instar and/or damaged
Shrimp	Portunidae	Corixidae		Athericidae
Isopoda	Palaemonidae	Gelastocoridae		Blephariceridae
Amphipoda	Asellidae	Gerridae		Canaceidae
	Hyalellidae	Hebridae		Ceratopogonidae
	1	Hydrometridae		Choaboridae
	Crangonyctidae	Mesoveliidae		22
	Gammaeridae	Naucoridae		Chironomidae (A)
Water Mites	Talitridae	Nepidae		Chironomidae (B)
Ephemeroptera	Hydracarina	Notonectidae		Culicidae
	Early Instar and/or damaged	Veliidae		Dixidae
	Acanthometropodidae	Pleidae		Dolichopodidae
	Ameletidae	Sisyridae		Epididae
	Baetidae	Corydalidae		Ephydriidae
	Baetiscidae	Sialidae		Muscidae
	Behningiidae	Early Instar and/or damaged		Nymphomyiidae
	Caenidae	Branchycentridae		Pelecorhynchidae
	Ephemerellidae	Calamoceratidae		Psychodidae
	Ephemeridae	Glossosomatidae		Ptychopteridae
	Heptageniidae	Goeridae		Sciomyzidae
	Isonychiidae	Heliocpsychidae		Simuliidae
	Leptophlebiidae	Hydropsychidae		Stratiomyidae
		Hydroptilida		Syrphidae
				Tabanidae
				Tanyderidae
				Thaumaleidae
				Tipulidae
	TOTAL: 93	TOTAL: 0		TOTAL: 24

**REACH 1-F
BIOLOGICAL STREAM ASSESSMENT PHOTOGRAPHS
THE GLADE WATERSHED
WSSI #20030**



3. Looking southwest (upstream) at Reach 1-F of The Glade in the eastern portion of the study area. Photo taken March 2009, prior to construction.



4. Looking southwest (upstream) at Reach 1-F of The Glade in the eastern portion of the study area. Photo taken May 2010, during Year 1.

**REACH 1-F
BIOLOGICAL STREAM ASSESSMENT PHOTOGRAPHS
THE GLADE WATERSHED
WSSI #20030**



1. Looking southwest (upstream) at Reach 1-F of The Glade in the eastern portion of the study area. Photo taken March 2007, prior to construction.



2. Looking southwest (upstream) at Reach 1-F of The Glade in the eastern portion of the study area. Photo taken May 2008, prior to construction.

Benthic Macroinvertebrate and Habitat Field Data Sheet

Job # Task	The Glade -- 20030				
Station ID:	1-F	Ecoregion:	Piedmont	Land Use:	Urban
Field Team:	BC/CP	Survey Reason:	Year 1 monitoring	Start time:	10:30 AM
Stream Name:	Glade	Location:	Reston, Virginia	Finish time:	11:15 AM
Date:	5/14/2010	Latitude:	-77.363	Longitude	38.927

Stream Physiochemical Measurements

Instrument ID number:	N/A	pH:	N/A	
Temperature:	N/A	°C	Conductivity:	N/A uS/cm
Dissolved Oxygen:	N/A	mg/L	Did instrument pass all post-calibration checks?	
			If NO- which parameter(s) failed and action taken:	
			N/A	

Benthic Macroinvertebrate Collection

Method Used:	Single Habitat (Riffle)			Multi Habitat (Logs, Plants, etc.)		x
Riffle Quality	Good	x	Marginal	Poor	None	
Habitats Sampled and # Jabs	Riffle	17	Snags	3	Banks	Vegetation
Total area sampled (sq. m)	20					

Weather Observations

Current Weather	Cloudy	Clear x	Rain/Snow	Foggy
Recent Precipitation	Clear X	Showers	Rain	Storms
Stream Flow	Low	Normal x	Above Normal	Flood

Biological Observations

Periphyton	2	Salamanders	0	Other....
Filamentous Algae	0	Warmwater Fish	0	0= Not observed
Submerged Macrophytes	0	Coldwater Fish	0	1= Sparse
Emergent Macrophytes	0	Beavers	0	2= Common to Abundant
Crayfish	0	Muskrats	0	3= Dominant-
Corbicula	0	Ducks/Geese	0	abnormally high density where other taxa are
unionidae	0	Snakes	0	insignificant in relation to the dominant taxa.
Operculate Snails	0	Turtles	0	There can be situations where multiple taxa
Non-operculate Snails	0	Frogs/Tadpoles	2	are dominant such as algae and snails

Notes

High Gradient Habitat Data

Habitat Parameter	Condition Category					Score
	Optimal	Suboptimal	Marginal	Poor		
1. Epifaunal Substrate/ Available Cover	Greater than 70% 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. snags/logs that are not new fall and not transient).	40-70% 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.	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% 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		12
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.		
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		8
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow)(slow is <0.3m/s, deep is >0.5 m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).		
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		18
4. Sediment Deposition	Little or no enlargement of islands or point bars and <5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand, or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand, or fine sediment on old and new bars; 30-50% 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 50% 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		19

Benthic Macroinvertebrate and Habitat Field Data Sheet

Habitat Parameter	Condition Category					Score
	Optimal	Suboptimal	Marginal	Poor		
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.	14	14
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		
6. Channel Alteration	Channelization or dredging absent or minimal; stream width normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40-80% 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.	15	15
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		
7. Frequency of Riffles	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distances between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.	19	19
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 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.	9	9
Score Left Bank	10 9	8 7 6	5 4 3	2 1 0		
Score Right Bank	10 9	8 7 6	5 4 3	2 1 0		
9. Vegetation 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 non-woody macrophytes; vegetation 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.	8	8
Score Left Bank	10 9	8 7 6	5 4 3	2 1 0		
Score Right Bank	10 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.	9	9
Score Left Bank	10 9	8 7 6	5 4 3	2 1 0		
Score Right Bank	10 9	8 7 6	5 4 3	2 1 0		
<i>Total Score</i>						157

WSSI BENTHIC MACROINVERTEBRATE BENCH SHEET

Job Name/#	Glade - 20030	Sample subsorted by:	BC	 Wetland Studies and Solutions, Inc. [®]
Station ID:	Reach 1-F	Date Subsorbed:	5/17/10	
Stream Name:	The Glade	# of Grids subsorted	11	
Date Sampled:	5/14/10	Total # of subsorted insects:	104	
Sampling Method:	Multihabitat	Sample Identified by:	ASO/CAT	Total # identified: 103
				Date Identified: 6/14/10

Taxa Collected:

Porifera

Spongillidae

Flatworms

Tricladida

Gastropoda

Planariidae

Limpets

Unknown

Snails

Aculyidae

Immature

Lymnaeidae

Physidae

Planorbidae

Hydrobiidae

Pleuroceridae

Viviparidae

Unionida

Immature

Corbiculidae

Sphaeridae

Unionidae

Oligochaeta

Unknown

35

Lumbriculida

Lumbriculidae

Tubificida

Enchytraeidae

Naididae

45

Tubificidae

10

Haplotauxida

Haplotauxidae

Hirudinea

Erpobdellidae

Glossiphoniidae

Hirudinidae

Piscicolidae

Branchiobdellida

Branchiobdellidae

Decapoda

Cambaridae

Shrimp

Portunidae

Isopoda

Palaemonidae

Amphipoda

Asellidae

Crangonyctidae

Gammaridae

Talitridae

Water Mites

Hydracarina

Early Instar and/or damaged

Acanthometropodidae

Ameletidae

Baetidae

Baetiscidae

Behningiidae

Caenidae

Ephemerellidae

Ephemeridae

Heptageniidae

Isomychiidae

Leptophlebiidae

TOTAL:

90

TOTAL:

0

Metretopodidae		Lepidostomatidae	
Neophehmeridae		Leptoceridae	
Oligoneuriidae		Limnephilidae	
Psuedironidae		Molannidae	
Polymitarcyidae		Odontoceridae	
Potamanthidae		Philopotamidae	
Siphlonuridae		Phryganeidae	
Tricorythidae		Polycentropodidae	
Early Instar and/or damaged		Psychomyiidae	
Zygoptera		Ryacophilidae	
Calopterygidae		Sericostomatidae	
Anisoptera		Uenoidae	
Coenagrionidae		Early Instar and/or damaged	
Lestidae		Pyralidae	
Protoneuridae		Coleoptera	
Early Instar and/or damaged		Early Instar and/or damaged	
Aeshnidae		Chrysomelidae	
Cordulegastridae		Curculionidae	
Corduliidae		Dryopidae	
Gomphidae		Dytiscidae	
Libellulidae		Elmidae	
Macromiidae		Gyrinidae	
Petaluridae		Halipidae	
Cordullidae/Libellulidae		Helodidae	
Early Instar and/or damaged		Helophoridae	
Plecoptera		Hydraenidae	
Capniidae		Hydrochidae	
Chloroperlidae		Hydrophilidae	
Leuctridae		Limnichidae	
Nemouridae		Noteridae	
Peltoperlidae		Psephenidae	
Perlidae		Ptilodactylidae	
Perlodidae		Scirtidae	
Pteronarcylidae		Early Instar and/or damaged	
Taeniopterygidae		Athericidae	
Hemiptera		Blephariceridae	
Early Instar and/or damaged		Canaceidae	
Belostomatidae		Ceratopogonidae	
Corixidae		Choaboridae	
Gelastocoridae		Chironomidae (A)	13
Gerridae		Chironomidae (B)	
Hebridae		Culicidae	
Hydrometridae		Dixidae	
Mesoveliidae		Dolichopodidae	
Naucoridae		Epididae	
Nepidae		Ephydriidae	
Notonectidae		Muscidae	
Veliidae		Nymphomyiidae	
Pleidae		Pelecorhynchidae	
Sisyridae		Psychodidae	
Corydalidae		Ptychopteridae	
Sialidae		Sciomyzidae	
Early Instar and/or damaged		Simuliidae	
Trichoptera		Stratiomyidae	
Branchycentridae		Syrphidae	
Calamoceratidae		Tabanidae	
Glossosomatidae		Tanyderidae	
Goeridae		Thaumaleidae	
Helicopsychidae		Tipulidae	
Hydropsychidae		TOTAL:	13
Hydroptilida			

**REACH 1-G
BIOLOGICAL STREAM ASSESSMENT PHOTOGRAPHS
THE GLADE WATERSHED
WSSI #20030**



1. Looking northwest (upstream) at Reach 1-G of The Glade in the western portion of the study area. Photo taken April 2007, prior to construction.



2. Looking northwest (upstream), just downstream of Reach 1-G of The Glade in the western portion of the study area. Reach 1-G had no flow during the 2008 sampling fieldwork and this photo depicts the lack of flow downstream of the reach. Due to the lack of flow within and just downstream of Reach 1-G, this area was not samplable in 2008. Photo taken May 2008, prior to construction.

REACH 1-G
BIOLOGICAL STREAM ASSESSMENT PHOTOGRAPHS
THE GLADE WATERSHED
WSSI #20030



3. Photo taken northwest (upstream) at Reach 1-G of The Glade in the western portion of the study area. This reach did not have continuous flow and was therefore not sampleable at the time of field work in 2009. Photo taken March 2009, prior to construction.



4. Looking northwest (upstream), just downstream of original Reach 1-G in the western portion of the study area. Because the area containing concrete was not restored, Reach 1-G has been moved just downstream of the original reach. This area depicts the new location of Reach 1-G during Year 1 following restoration. Photo taken May 2010, during Year 1.

Benthic Macroinvertebrate and Habitat Field Data Sheet

Job # Task	The Glade -- 20030				
Station ID:	1-G	Ecoregion:	Piedmont	Land Use:	Urban
Field Team:	BC/CP	Survey Reason:	Year 1 monitoring	Start time:	11:30 AM
Stream Name:	Glade	Location:	Reston, Virginia	Finish time:	12:20 PM
Date:	5/14/2010	Latitude:	-77.368	Longitude	38.927

Stream Physiochemical Measurements

Instrument ID number:	N/A	pH:	N/A	
Temperature:	N/A °C	Conductivity:	N/A uS/cm	
Dissolved Oxygen:	N/A mg/L	Did instrument pass all post-calibration checks?		N/A

If NO- which parameter(s) failed and action taken:

N/A

N/A

Benthic Macroinvertebrate Collection

Method Used:	Single Habitat (Riffle)			Multi Habitat (Logs, Plants, etc.)			X
Riffle Quality	Good X	Marginal		Poor		None	
Habitats Sampled and # Jabs	Riffle 17	Snags 3		Banks		Vegetation	
Total area sampled (sq. m)	20						

Weather Observations

Current Weather	Cloudy	Clear X	Rain/Snow	Foggy
Recent Precipitation	Clear X	Showers	Rain	Storms
Stream Flow	Low X	Normal	Above Normal	Flood

Biological Observations

Periphyton	2	Salamanders	0	Other....
Filamentous Algae	0	Warmwater Fish	0	0= Not observed
Submerged Macrophytes	0	Coldwater Fish	0	1= Sparse
Emergent Macrophytes	0	Beavers	0	2= Common to Abundant
Crayfish	0	Muskrats	0	3= Dominant-
Corbicula	0	Ducks/Geese	0	abnormally high density where other taxa are
unionidae	0	Snakes	0	insignificant in relation to the dominant taxa.
Operculate Snails	0	Turtles	0	There can be situations where multiple taxa
Non-operculate Snails	0	Frogs/Tadpoles	0	are dominant such as algae and snails

Notes

High Gradient Habitat Data

Habitat Parameter	Condition Category					Score
	Optimal	Suboptimal	Marginal	Poor		
1. Epifaunal Substrate/ Available Cover	Greater than 70% 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. snags/logs that are not new fall and not transient).	40-70% 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.	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% 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		12
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.		
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		8
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow)(slow is <0.3m/s, deep is >0.5 m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).		
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		8
4. Sediment Deposition	Little or no enlargement of islands or point bars and <5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand, or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand, or fine sediment on old and new bars; 30-50% 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 50% 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		19

Benthic Macroinvertebrate and Habitat Field Data Sheet

Habitat Parameter	Condition Category					Score
	Optimal	Suboptimal	Marginal	Poor		
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.	8	8
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		
6. Channel Alteration	Channelization or dredging absent or minimal; stream width normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40-80% 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.	15	15
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		
7. Frequency of Riffles	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distances between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.	14	14
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 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.	9	9
Score Left Bank	10 9	8 7 6	5 4 3	2 1 0		
Score Right Bank	10 9	8 7 6	5 4 3	2 1 0		
9. Vegetation 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 non-woody macrophytes; vegetation 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.	10	10
Score Left Bank	10 9	8 7 6	5 4 3	2 1 0		
Score Right Bank	10 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.	9	9
Score Left Bank	10 9	8 7 6	5 4 3	2 1 0		
Score Right Bank	10 9	8 7 6	5 4 3	2 1 0		
Total Score					140	

WSSI BENTHIC MACROINVERTEBRATE BENCH SHEET

Job Name/#	Glade - 20030	Sample subsorted by:	CEK	 Wetland Studies and Solutions, Inc. [®]
Station ID:	Reach 1-G	Date Subsorbed:	6/17/10	
Stream Name:	The Glade	# of Grids subsorted	3	
Date Sampled:	5/14/10	Total # of subsorted insects:	105	
Sampling Method:	Multihabitat	Sample Identified by:	CEK	

Taxa Collected:

Porifera

Spongillidae

Flatworms

Tricladida

Gastropoda

Planariidae

Limpets

Unknown

Snails

Aculyidae

Immature

Lymnaeidae

Physidae

Zygoptera

Planorbidae

Hydrobiidae

Pleuroceridae

Viviparidae

Immature

Corbiculidae

Sphaeriidae

Unionidae

Unknown

Lumbriculida

Lumbriculidae

Unionida

Enchytraeidae

Naididae

Tubificidae

Tubificida

Haplotaxida

Haplotaixidae

Haplotaixida

Hirudinea

Erpobdellidae

Glossiphoniidae

Hirudinidae

Pisciolidae

Leeches

Branchiobdellida

Branchiobdellidae

Branchiobdellida

Decapoda

Cambaridae

Decapoda

Portunidae

Portunidae

Shrimp

Palaemonidae

Palaemonidae

Isopoda

Asellidae

Asellidae

Amphipoda

Crangonyctidae

Gammaridae

Talitridae

Crangonyctidae

Water Mites

Hydracarina

Early Instar and/or damaged

Hydracarina

Acanthometropodidae

Ameletidae

Baetidae

Baetiscidae

Behningiidae

Caenidae

Ephemerellidae

Ephemeridae

Heptageniidae

Isonychiidae

Leptophlebiidae

TOTAL:

3

TOTAL:

0

TOTAL: 99

Metretopodidae	
Neophemeridae	
Oligoneuriidae	
Pseudironidae	
Polymitarcyidae	
Potamanthidae	
Siphlonuridae	
Tricorythidae	
Early Instar and/or damaged	
Zygoptera	
Calopterygidae	
Coenagrionidae	
Lestidae	
Protoneuridae	
Anisoptera	
Early Instar and/or damaged	
Aeshnidae	
Cordulegastridae	
Corduliidae	
Gomphidae	
Libellulidae	
Macromiidae	
Petaluridae	
Cordullidae/Libelluidae	
Plecoptera	
Early Instar and/or damaged	
Capniidae	
Chloroperlidae	
Leuctridae	
Nemouridae	
Peltoperlidae	
Perlidae	
Perlodidae	
Pteronarcyidae	
Hemiptera	
Taeniopterygidae	
Early Instar and/or damaged	
Belostomatidae	
Corixidae	
Gelastocoridae	
Gerridae	
Hebridae	
Hydrometridae	
Mesoveliidae	
Naucoridae	
Nepidae	
Notonectidae	
Veliidae	
Pleidae	
Sisyridae	
Megaloptera	
Corydalidae	
Sialidae	
Trichoptera	
Early Instar and/or damaged	
Brachycentridae	
Calamoceratidae	
Glossosomatidae	
Goeridae	
Helicopsychidae	
Hydropsychidae	
Hydroptilida	

Lepidostomatidae	
Leptoceridae	
Limnephilidae	
Molannidae	
Odontoceridae	
Philopotamidae	
Phryganeidae	
Polycentropodidae	
Psychomyiidae	
Ryacophilidae	
Sericostomatidae	
Uenoidae	
Early Instar and/or damaged	
Lepidoptera	
Pyralidae	
Early Instar and/or damaged	
Coleoptera	
Chrysomelidae	
Curculionidae	
Dryopidae	
Dytiscidae	
Elmidae	
Gyrinidae	
Halipidae	
Helodidae	
Helophoridae	
Hydraenidae	
Hydrochidae	
Hydrophilidae	
Limnichidae	
Noteridae	
Psephenidae	
Ptilodactylidae	
Scirtidae	
Early Instar and/or damaged	
Athericidae	
Blephariceridae	
Canaceidae	
Ceratopogonidae	
Choaboridae	
Chironomidae (A)	98
Chironomidae (B)	
Culicidae	
Dixidae	
Dolichopodidae	
Epididae	
Ephydriidae	
Muscidae	
Nymphomyiidae	
Pelecorhynchidae	
Psychodidae	
Ptychopteridae	
Sciomyzidae	
Simuliidae	
Stratiomyidae	
Syrphidae	
Tabanidae	1
Tanyderidae	
Thaumaleidae	
Tipulidae	

**REACH 2-A
BIOLOGICAL STREAM ASSESSMENT PHOTOGRAPHS
THE GLADE WATERSHED
WSSI #20030**



1. Looking northeast (downstream) at Reach 2-A of The Glade in the eastern portion of the study area. Photo taken March 2007, prior to construction.



2. Looking northeast (downstream) at Reach 2-A of The Glade in the eastern portion of the study area. Photo taken May 2008, prior to construction.

**REACH 2-A
BIOLOGICAL STREAM ASSESSMENT PHOTOGRAPHS
THE GLADE WATERSHED
WSSI #20030**



3. Looking northeast (downstream) at Reach 2-A of The Glade in the eastern portion of the study area. Photo taken March 2009, prior to construction.



4. Looking northeast (downstream) at Reach 2-A of The Glade in the eastern portion of the study area. Photo taken May 2010, during Year 1.

Benthic Macroinvertebrate and Habitat Field Data Sheet

Job # Task	The Glade -- 20030				
Station ID:	2-A	Ecoregion:	Piedmont	Land Use:	Urban
Field Team:	LS/BC	Survey Reason:	Year 1 monitoring	Start time:	11:30 AM
Stream Name:	Glade	Location:	Reston, Virginia	Finish time:	12:15 PM
Date:	5/13/2010	Latitude:	-77.354	Longitude:	38.925

Stream Physiochemical Measurements

Instrument ID number:	N/A	pH:	N/A	
Temperature:	N/A	°C	Conductivity:	N/A uS/cm
Dissolved Oxygen:	N/A mg/L		Did instrument pass all post-calibration checks?	N/A

If NO- which parameter(s) failed and action taken:

N/A

Benthic Macroinvertebrate Collection

Method Used:	Single Habitat (Riffle)			Multi Habitat (Logs, Plants, etc.)		X
	Good	X	Marginal	Poor	None	
Riffle Quality						
Habitats Sampled and # Jabs	Riffle	12	Snags	8	Banks	
Total area sampled (sq. m)	20				Vegetation	

Weather Observations

Current Weather	Cloudy X	Clear	Rain/Snow	Foggy
Recent Precipitation	Clear	Showers	Rain X	Storms
Stream Flow	Low X	Normal	Above Normal	Flood

Biological Observations

Periphyton	2	Salamanders	0	Other....
Filamentous Algae	0	Warmwater Fish	0	0= Not observed
Submerged Macrophytes	0	Coldwater Fish	0	1= Sparse
Emergent Macrophytes	1	Beavers	0	2= Common to Abundant
Crayfish	0	Muskrats	0	3= Dominant-
Corbicula	0	Ducks/Geese	0	abnormally high density where other taxa are
unionidae	0	Snakes	0	insignificant in relation to the dominant taxa.
Operculate Snails	0	Turtles	0	There can be situations where multiple taxa
Non-operculate Snails	0	Frogs/Tadpoles	2	are dominant such as algae and snails

Notes

High Gradient Habitat Data

Habitat Parameter	Condition Category				
	Optimal	Suboptimal	Marginal	Poor	Score
1. Epifaunal Substrate/ Available Cover	Greater than 70% 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. snags/logs that are not new fall and not transient).	40-70% 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.	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% 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	12
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.	
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	8
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast shallow)(slow is <0.3m/s, deep is >0.5 m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).	
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	9
4. Sediment Deposition	Little or no enlargement of islands or point bars and <5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand, or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand, or fine sediment on old and new bars; 30-50% 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 50% 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	19

Benthic Macroinvertebrate and Habitat Field Data Sheet

Habitat Parameter	Condition Category					
	Optimal	Suboptimal	Marginal	Poor	Score	
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.		
<i>Score</i>	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	14	
6. Channel Alteration	Channelization or dredging absent or minimal; stream width normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40-80% 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.		
<i>Score</i>	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	15	
7. Frequency of Riffles	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distances between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.		
<i>Score</i>	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	19	
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 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.		
<i>Score Left Bank</i>	10 9	8 7 6	5 4 3	2 1 0	9	
<i>Score Right Bank</i>	10 9	8 7 6	5 4 3	2 1 0	9	
9. Vegetation 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 non-woody macrophytes; vegetation 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.		
<i>- Score Left Bank</i>	10 9	8 7 6	5 4 3	2 1 0	7	
<i>Score Right Bank</i>	10 9	8 7 6	5 4 3	2 1 0	7	
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.		
<i>Score Left Bank</i>	10 9	8 7 6	5 4 3	2 1 0	9	
<i>Score Right Bank</i>	10 9	8 7 6	5 4 3	2 1 0	9	
<i>Total Score</i>					146	

WSSI BENTHIC MACROINVERTEBRATE BENCH SHEET

Job Name/#	Glade - 20030	Sample subsorted by:	CEK	 Wetland Studies and Solutions, Inc.
Station ID:	Reach 2-A	Date Subsorted:	6/16/10	
Stream Name:	The Glade	# of Grids subsorted	4	
Date Sampled:	5/13/10	Total # of subsorted insects:	103	Total # identified: 97
Sampling Method:	Multihabitat	Sample Identified by:	CEK	Date Identified: 6/16/10

Taxa Collected:

Porifera

Spongillidae

Flatworms

Tricladida

Gastropoda

Planariidae

Limpets

Ancylidae

Snails

Immature

Unionida

Lymnaeidae

Physidae

1

Planorbidae

Hydrobiidae

Pleuroceridae

Viviparidae

Immature

Corbiculidae

Sphaeriidae

Unionidae

Oligochaeta

Unknown

2

Lumbriculida

Lumbriculidae

Tubificida

Enchytraeidae

Naididae

6

Tubificidae

1

Haplodida

Haplodidae

Leeches

Hirudinea

Erpobdellidae

Glossiphoniidae

Hirudinidae

Pisciidae

Branchiobdellida

Branchiobdellidae

Decapoda

Cambaridae

Shrimp

Portunidae

Isopoda

Palaemonidae

Amphipoda

Asellidae

Water Mites

Crangonyctidae

Gammaridae

Talitridae

Hydracarina

Early Instar and/or damaged

Acanthometropodidae

Ameletidae

Baetidae

Baetiscidae

Behningiidae

Caenidae

Ephemerellidae

Ephemeridae

Heptageniidae

Isonychiidae

Leptophlebiidae

TOTAL:

10

Metretopodidae		Lepidostomatidae	
Neoephemeridae		Leptoceridae	
Oligoneuriidae		Limnephilidae	
Psuedironidae		Molannidae	
Polymitarcyidae		Odontoceridae	
Potamanthidae		Philopotamidae	
Siphlonuridae		Phryganeidae	
Tricorythidae		Polycentropodidae	
Early Instar and/or damaged		Psychomyiidae	
Zygoptera		Ryacophilidae	
Calopterygidae		Sericostomatidae	
Anisoptera		Uenoidae	
Coenagrionidae		Early Instar and/or damaged	
Lestidae		Pyralidae	
Protoneuriidae		Coleoptera	
Early Instar and/or damaged		Early Instar and/or damaged	
Aeshnidae		Chrysomelidae	
Cordulegastridae		Curculionidae	
Corduliidae		Dryopidae	
Gomphidae		Dytiscidae	
Libellulidae		Elmidae	
Macromiidae		Gyrinidae	
Petaluridae		Haloplidae	
Cordullidae/Libellulidae		Helodidae	
Plecoptera		Helophoridae	
Early Instar and/or damaged		Hydraenidae	
Capniidae		Hydrochidae	
Chloroperlidae		Hydrophilidae	
Leuctridae		Limnichidae	
Nemouridae		Noteridae	
Peltoperlidae		Psephenidae	
Perlidae		Ptilodactylidae	
Perlodidae		Scirtidae	
Pteronarcylidae		Early Instar and/or damaged	
Taeniopterygidae		Athericidae	
Hemiptera		Blephariceridae	
Early Instar and/or damaged		Canaceidae	
Belostomatidae		Ceratopogonidae	
Corixidae		Choaboridae	
Gelastocoridae		Chironomidae (A)	72
Gerridae		Chironomidae (B)	
Hebridae		Culicidae	
Hydrometridae		Dixidae	
Mesoveliidae		Dolichopodidae	
Naucoridae		Epididae	
Nepidae		Ephydriidae	
Notonectidae		Muscidae	
Veliidae		Nymphomyiidae	
Pleidae		Pelecorhynchidae	
Sisyridae		Psychodidae	
Corydalidae		Ptychopteridae	
Sialidae		Sciomyzidae	
Early Instar and/or damaged		Simuliidae	
Brachyceridae		Stratiomyidae	14
Calamoceratidae		Syrphidae	
Glossosomatidae		Tabanidae	
Goeridae		Tanyderidae	
Helicopsychidae		Thaumaleidae	
Hydropsychidae	1	Tipulidae	
Hydroptilida		TOTAL:	86

**REACH 3-A
BIOLOGICAL STREAM ASSESSMENT PHOTOGRAPHS
THE GLADE WATERSHED
WSSI #20030**



1. Looking northwest (upstream) at Reach 3-A, an unnamed tributary of The Glade in the western portion of the study area. Photo taken March 2007, prior to construction.



2. Looking northwest (upstream) at Reach 3-A, an unnamed tributary of The Glade in the western portion of the study area. Photo taken April 2008, prior to construction.

REACH 3-A
BIOLOGICAL STREAM ASSESSMENT PHOTOGRAPHS
THE GLADE WATERSHED
WSSI #20030



3. Looking northwest (upstream) at Reach 3-A, an unnamed tributary of The Glade in the western portion of the study area. The stream did not have continuous flow and was therefore not sampleable at the time of field work. Photo taken March 2009, prior to construction.



4. Looking northwest (upstream) at Reach 3-A, an unnamed tributary of The Glade in the western portion of the study area. Photo taken May 2010, during Year 1.

Benthic Macroinvertebrate and Habitat Field Data Sheet

Job # Task	The Glade -- 20030				
Station ID:	3-A	Ecoregion:	Piedmont	Land Use:	Urban
Field Team:	BC/CP	Survey Reason:	Year 1 monitoring	Start time:	1:30 PM
Stream Name:	Glade	Location:	Reston, Virginia	Finish time:	2:15 PM
Date:	5/14/2010	Latitude:	-77.364	Longitude	38.928

Stream Physiochemical Measurements

Instrument ID number:	N/A	pH:	N/A		
Temperature:	N/A	°C	Conductivity:	N/A uS/cm	
Dissolved Oxygen:	N/A	mg/L	Did instrument pass all post-calibration checks?		
			If NO- which parameter(s) failed and action taken:		
			N/A		

Benthic Macroinvertebrate Collection

Method Used:	Single Habitat (Riffle)			Multi Habitat (Logs, Plants, etc.)		X
Riffle Quality	Good X	Marginal		Poor		None
Habitats Sampled and # Jabs	Riffle 17	Snags 3		Banks		Vegetation
Total area sampled (sq. m)	20					

Weather Observations

Current Weather	Cloudy	Clear X	Rain/Snow	Foggy
Recent Precipitation	Clear X	Showers	Rain	Storms
Stream Flow	Low X	Normal	Above Normal	Flood

Biological Observations

Periphyton	2	Salamanders	0	Other....
Filamentous Algae	0	Warmwater Fish	0	0= Not observed
Submerged Macrophytes	0	Coldwater Fish	0	1= Sparse
Emergent Macrophytes	0	Beavers	0	2= Common to Abundant
Crayfish	0	Muskrats	0	3= Dominant-
Corbicula	0	Ducks/Geese	0	abnormally high density where other taxa are
unionidae	0	Snakes	0	insignificant in relation to the dominant taxa.
Operculate Snails	0	Turtles	0	There can be situations where multiple taxa
Non-operculate Snails	0	Frogs/Tadpoles	2	are dominant such as algae and snails

Notes

High Gradient Habitat Data

Habitat Parameter	Condition Category					Score
	Optimal	Suboptimal	Marginal	Poor		
1. Epifaunal Substrate/ Available Cover	Greater than 70% 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. snags/logs that are not new fall and not transient).	40-70% 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.	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.	12	
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.	8	
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast shallow)(slow is <0.3m/s, deep is >0.5 m).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).	18	
	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 <5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand, or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand, or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.	19	
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		

Benthic Macroinvertebrate and Habitat Field Data Sheet

Habitat Parameter	Condition Category					Score
	Optimal	Suboptimal	Marginal	Poor		
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.	14	14
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		
6. Channel Alteration	Channelization or dredging absent or minimal; stream width normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40-80% 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.	15	15
Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0		
7. Frequency of Riffles	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distances between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.	19	19
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 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.	9	9
Score Left Bank	10 9	8 7 6	5 4 3	2 1 0		
Score Right Bank	10 9	8 7 6	5 4 3	2 1 0	9	9
9. Vegetation 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 non-woody macrophytes; vegetation 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.	9	9
Score Left Bank	10 9	8 7 6	5 4 3	2 1 0		
Score Right Bank	10 9	8 7 6	5 4 3	2 1 0	9	9
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.	9	9
Score Left Bank	10 9	8 7 6	5 4 3	2 1 0		
Score Right Bank	10 9	8 7 6	5 4 3	2 1 0	9	9
Total Score					159	

WSSI BENTHIC MACROINVERTEBRATE BENCH SHEET

Job Name/#	Glade - 20030	Sample subsorted by:	SDS/CP	 Wetland Studies and Solutions, Inc. [®]
Station ID:	Reach 3-A	Date Subsorted:	6/15/10	
Stream Name:	The Glade	# of Grids subsorted	4	
Date Sampled:	5/14/10	Total # of subsorted insects:	121	
Sampling Method:	Multihabitat	Sample Identified by:	CEK	

Taxa Collected:

Porifera

Spongillidae

Flatworms

Tricladida

Gastropoda

Planariidae

Limpets

Unknown

Snails

Aculyidae

Unionida

Immature

Lymnaeidae

Physidae

51

Planorbidae

Hydrobiidae

Pleuroceridae

Viviparidae

Unionida

Immature

Corbiculidae

Sphaeriidae

Unionidae

Oligochaeta

Unknown

12

Lumbriculida

Lumbriculidae

Tubificida

Enchytraeidae

Naididae

12

Tubificidae

14

Haplotauxida

Haplotauxidae

Leeches

Hirudinea

Erpobdellidae

Glossiphoniidae

Hirudinidae

Pisciolidae

Branchiobdellida

Branchiobdellidae

Decapoda

Cambaridae

Shrimp

Portunidae

Isopoda

Palaemonidae

Amphipoda

Asellidae

Water Mites

Crangonyctidae

Gammaridae

Talitridae

Hydracarina

Early Instar and/or damaged

Ephemeroptera

Acanthometropodidae

Ameletidae

Baetidae

Baetiscidae

Behningiidae

Caenidae

Ephemerellidae

Ephemeridae

Heptageniidae

Ischydiidae

Leptophlebiidae

TOTAL:

89

Metretopodidae		Lepidostomatidae	
Neoephemeridae		Leptoceridae	
Oligoneuriidae		Limnephilidae	
Pseudironidae		Molannidae	
Polymitarcyidae		Odontoceridae	
Potamanthidae		Philopotamidae	
Siphlonuridae		Phryganeidae	
Tricorythidae		Polycentropodidae	
Early Instar and/or damaged		Psychomyiidae	
Calopterygidae		Ryacophilidae	
Coenagrionidae		Sericostomatidae	
Lestidae		Uenoidae	
Protoneuriidae		Early Instar and/or damaged	
Early Instar and/or damaged		Pyralidae	
Aeshnidae		Coleoptera	
Cordulegastridae		Early Instar and/or damaged	
Corduliidae		Chrysomelidae	
Gomphidae		Curculionidae	
Libellulidae		Dryopidae	
Macromiidae		Dytiscidae	
Petaluridae		Elmidae	
Cordullidae/Libellulidae		Gyrinidae	
Early Instar and/or damaged		Halipidae	
Capniidae		Helodidae	
Chloroperlidae		Helophoridae	
Leuctridae		Hydraenidae	
Nemouridae		Hydrochidae	
Peltoperlidae		Hydrophilidae	
Perlidae		Limnichidae	
Perlodidae		Noteridae	
Pteronarcyidae		Psephenidae	
Taeniopterygidae		Ptilodactylidae	
Early Instar and/or damaged		Scirtidae	
Belostomatidae		Early Instar and/or damaged	
Corixidae		Athericidae	
Gelastocoridae		Blephariceridae	
Gerridae		Canaceidae	
Hebridae		Ceratopogonidae	
Hydrometridae		Choaboridae	
Mesoveliidae		Chironomidae (A)	32
Naucoridae		Chironomidae (B)	
Nepidae		Culicidae	
Notonectidae		Dixidae	
Veliidae		Dolichopodidae	
Pleidae		Epididae	
Sisyridae		Ephydriidae	
Corydalidae		Muscidae	
Sialidae		Nymphomyiidae	
Early Instar and/or damaged		Pelecorhynchidae	
Branchycentridae		Psychodidae	
Calamoceratidae		Ptychopteridae	
Glossosomatidae		Sciomyzidae	
Goeridae		Simuliidae	
Helicopsychidae		Stratiomyidae	
Hydropsychidae		Syrphidae	
Hydroptilida		Tabanidae	
		Tanyderidae	
		Thaumaleidae	
		Tipulidae	
TOTAL:	0	TOTAL:	32