Fairfax County 2023 MS4 Program Plan and Annual Report

Appendix P13

Standard Operating Procedures for the MS4 Biological Stream Monitoring Program

VSMP Permit Number
VA0088587 9-29-2023

Department of Public Works and Environmental Services
POLICIES AND PROCEDURES Memorandum No.: SWPD16-07

SUBJECT: Standard Operating Procedures for the MS4 Biological Stream Monitoring Program

Effective: 09/01/2016 Revised: Approval:

I. Purpose

Fairfax County's (renewed) 2015 Virginia Stormwater Management Program (VSMP) Municipal Separate Storm Sewer System (MS4) permit includes provisions to evaluate the condition of select streams within the county by conducting biological stream monitoring. The applicable requirement of the permit (Part I, Section C.1) states:

The permittee shall continue to implement a biological stream monitoring program to evaluate the condition of select stream sites within Fairfax County as follows:

- *Five (5) stream sites within Fairfax County shall be selected for monitoring during the term of this permit.*
- *Monitoring shall be conducted twice per year with one sample collected between July 1st and December 31st and one sample collected between January 1st and June 30th each year at each "selected stream site."*
- *The permittee shall use a biological stream monitoring approach based on "USEPA's Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers" or other method approved by the Department, and shall include an assessment of the benthic macroinvertebrate community and habitat assessment.*

SPECIFIC REPORTING REQUIREMENTS:

- *The annual report due October 1, 2016 shall include the list of sites to be monitored during the term of the state permit and monitoring protocols.*

- *Beginning with the annual report due October 1, 2017, each annual report shall include a summary of the monitoring results and analyses and an interpretation of that data with respect to long-term patterns/trends.*

This Biological Stream Monitoring Program Standard Operating Procedure (SOP) describes Fairfax County's site selection and sampling protocols for executing this program and provides a framework for full compliance with the above MS4 permit requirements.

This document contains the following:

- Site Selection Protocol
- Field and Lab Protocols for Biological Stream Monitoring
- Data Management/Quality Control
- Products of the Program
- References
- Appendices

II. MS4 Biological Stream Monitoring Program

A. Program Goals

Since 2007, Fairfax County has been conducting an extensive monitoring program in partnership with the United States Geological Survey (USGS). This program was designed by USGS and Fairfax County Stormwater Planning staff to accomplish the following objectives:

- Generate long-term monitoring data to describe:
  - Current water-quality (sediment and nutrients) and quantity conditions
  - Trends in water-quality and quantity
  - Nutrient and sediment loads and yields
  - Current biological (benthic macroinvertebrate) conditions
  - Trends in biological (benthic macroinvertebrate) conditions
- Evaluate relationships between observed conditions/trends and stormwater best management practice (BMP) implementation throughout Fairfax County.
- Transfer the understanding gained from intensively monitored watersheds to less-intensively monitored ones.

To utilize the existing monitoring program network to support the MS4 Permit, Fairfax County will continue ongoing benthic macroinvertebrate sampling at selected sites while adhering to the monitoring frequency specified in the MS4 Permit. The robust dataset already collected can provide significant value to assist with data interpretation with respect to long-term patterns and trends.

B. Site Selection Protocol

For the MS4 Permit, Fairfax County has chosen the five most intensely monitored sites within the existing partnership study with USGS. The site selection was based on available watershed characterization data, the presence of a Board of Supervisors-adopted watershed management plan, the timetable for BMP implementation, and local knowledge of the watersheds. In general, an effort was made to limit the size of basins to 6 mi^2 or smaller to ensure that changes in the basins were detectable. Watershed characterization data from the Fairfax County watershed management plans along with other available datasets were used to classify and evaluate all potential monitoring basins. Ultimately, the primary factors used in the analysis and site selection process were:

- Land Use (10 land use classes)
- Presence of water quality and/or quantity controls (and % area served by controls within each basin)
- Existing Index of Biotic Integrity (IBI) scores
- Percent impervious cover in each basin
- Average basin slope
- Planned stormwater BMP implementation

The goal is to ensure that the monitoring network effectively characterizes the range of watershed conditions within Fairfax County. To accomplish this goal, a cluster analysis was performed (using the statistical package SPLUS) to group the basins into similar types and to select representative sampling sites from the resultant clusters. Hierarchical clustering was performed, and the complete linkage approach was used for joining clusters because little was known about the variance and sample size for each cluster. Land use was shown to be the most influential factor in the cluster analysis.

Table 1: Site Name and Characterization for Fairfax County MS4 Biological Stream Monitoring Program.

Site Name	Watershed	Drainage Area (mi^2)	% Impervious Area
Dead Run	Dead Run	2.09	30.97
Difficult Run	Difficult Run	5.47	27.61
Flatlick Branch	Cub Run	4.26	28.60
Long Branch	Accotink Creek	3.79	25.66
South Fork Little Difficult Run	Difficult Run	2.71	14.02

A map of the five biological stream monitoring locations is in Appendix A.

III. Field Protocol for MS4 Biological Stream Monitoring Program

This section provides details of the protocols to be followed during biological stream monitoring and includes descriptions of safety procedures, sampling frequency, proper sampling equipment, and sampling protocols.

A. Health and Safety

Ensuring the health and safety of field personnel is the responsibility of every member of the staff for the project. The collective effort of all staff members in providing a healthy and safe work environment helps to minimize or eliminate the potential for accidents. In general, the following safety protocol is followed to protect the field staff:

- Perform field work in teams of at least two.
- Bring mobile phone and first aid kit on all field site visits.
- Exercise caution when encountering any wildlife and hazardous plants.
- Use common sense during electrical storms and/or when severe conditions (e.g., high wind, hail) develop. The safety of field staff overrides all other considerations.

Additional information on Health and Safety may be found in Appendix B, including information on field staff conduct, personal protective equipment, confined space entry, dangerous flora and fauna, unknown hazardous substances and wastes, blood-borne pathogens, remote areas, weather-related hazards, and heat and cold stress.

B. Sampling Frequency

As specified by the permit, monitoring shall be conducted twice per year with sampling windows between July 1st to December 31st and January 1st to June 30th at each of the 5 established monitoring locations. Fall sampling will be conducted in the October/November timeframe and the spring sampling will be conducted in the March/April timeframe to coincide with Fairfax County's current biological monitoring window.

C. Field Work Preparation

A. Equipment Checklist

Before heading out into the field, staff should assemble the following equipment:

- Standard D-frame dip net, 500-micrometer (µm) opening mesh, 0.3-meter (m) width (~ 1.0 ft. frame width)
- Sieve bucket, with 500 µm opening mesh
- Large polyethylene wash tray
- Sieve with 500 µm opening mesh
- 2-liter (L) HDPE Nalgene® sample jars, lids
- Forceps
- Packing tape
- Pencils, clipboard & calculator
- Benthic Macroinvertebrate Field Sheet (Appendix C)
- Habitat assessment form (Appendix D)
- Site maps
- Waders and insulated neoprene gloves
- Weatherproof labels for bottles
- Chemical proof labels for inside bottles
- Permanent/indelible markers

D. Benthic Macroinvertebrate Sample Collection

Benthic macroinvertebrate communities are a major component of any healthy stream system. They are an important link in the aquatic food web, forming the core diet of many stream fishes and other aquatic life forms. These organisms are also useful indicators of water quality, due to their short life spans and their varying tolerances to disturbance, including chemical, organic, and sediment pollution.

A. Benthic Field Sampling

Selected sites will sampled in the early spring between March and April (prior to the spring/summer emergence of many adult aquatic insects). The 100-m sampling reaches will be sampled using the "20-Jab" or "multi-habitat" Mid-Atlantic Coastal Streams Workgroup (MACS) method (USEPA, 1997). This method was developed specifically for streams with variable habitat structure and adopted for use in USEPA's Rapid Bioassessment Protocol II (RBP II) for benthic macroinvertebrate sampling in streams and wadeable rivers (Barbour et al., 1999). Observed habitats within the sample reach are proportionally sampled using twenty 0.5-m- "jabs" with the D-frame net. Habitats are designated as vegetated (undercut) banks, submerged macrophytes (aquatic vegetation), sand, cobble, and snags. Samples collected in the field have the larger organic debris removed and then are placed in 2L HDPE Nalgene® jars. Sample jars are labelled both internally and externally with the site code, collection date and time, sample number and the collection team's initials. The collecting team members should ensure that the information on the internal and external labels match each other, as well as the information on the site map and field data sheet. Labeled jars are then transported to a laboratory where they are logged in on the Benthic Macroinvertebrate Sample Log-In Sheet (Appendix E), preserved with 95% denatured ethanol and stored in flameproof cabinets for later subsampling and taxonomic identification. Samples selected for processing (subsampling, sorting and enumeration) by an outside contractor are also logged in on the Fairfax County Benthic Macroinvertebrate Sample Chain-of-Custody Sheet (Appendix F).

B. Benthic Macroinvertebrate Subsampling and Identification

The following laboratory equipment will be used to subsample, sort, enumerate and identify benthic macroinvertebrate samples:

- Previously collected benthic sample in 2L HDPE Nalgene® jars(s)
- 8-inch diameter sieve with 500-µm mesh
- Benthic sample sorting grid (30 squares) with 500-µm mesh
- Polyethylene wash tray
- Dissecting microscopes (stereoscopes)
- Fiber-optic light source
- 95% ethanol (denatured)
- 20 milliliter (ml) screw top glass specimen vials (with Teflon™ lids) and label tape
- 9-unit laboratory counter with grand total counter
- Petri dishes & extra-fine/jewelers forceps
- Benthic Macroinvertebrate Sorting Log-In Sheet (Appendix G)
- Benthic Macroinvertebrate Identification Form (Appendix H)

Field samples selected for in-house subsampling, sorting and enumeration are logged in on the Benthic Macroinvertebrate Sorting Log-in Sheet. Each sample is rinsed and spread over the surface of a 30 x 36-centimeter (cm), 500-µm mesh sample sorting grid (Caton, 1991) [very large volume samples may be divided into two sorting grids]. The sorting grid is placed in enough water to cover the sample and allowed to hydrate for at least 10 minutes. A subsample of individuals is picked or "sorted" from a randomly selected square subdivision marked on the grid's surface (30 total squares). The sorting is accomplished by removing debris and organisms from the randomly selected square, placing this mixture into a water-filled white plastic tray which is illuminated via fiber optic lights, and carefully removing all organisms (a microscope is not used for subsampling but may be used to verify an organism). It is quite helpful to inspect and remove larger debris from the tray. Once that square is fully picked, another randomly selected square is then picked until a minimum of 200 (not to exceed 240) organisms are obtained. If picking through an entire grid is likely to result in a subsample of greater than 240 organisms, then that grid is subsampled in the same manner as before to decrease the likelihood of exceeding 240 organisms. Subsampling is accomplished by spreading the contents of a grid into another gridded pan and further sorting by picking grids one at a time until the target number is reached. If a specimen lies across 2 squares, it belongs to the square containing its head.

Specimens fall into one of three groups; 1) Chironomidae, 2) Oligochaeta, and 3) all others. Organisms that are not counted in the sample include vertebrates (e.g. salamanders, newts, fish), zooplankton (i.e. copepods), non-aquatic macroinvertebrates (e.g. adult dipterans), or aquatic macroinvertebrate individuals too damaged to identify (e.g. lacking a head). Organisms from each site's subsample are tallied by group and transferred to one of three sample vials (one vial for each respective group), preserved with 95 percent ethanol, and labeled with the following information:

- Site code
- Date collected (found on sample jar label)
- Date sorted

- Sorted by (sorter's initials)
- Particular sample group (C = Chironomidae, O = Oligochaeta, • = others).
- Number of organisms in the particular group vial
- Total number of organisms in the sub-sample (200 < n < 240)

The total number of "squares" from the sorting grid that were picked to reach the 200 organism target number is recorded on the Benthic Macroinvertebrate Lab Bench Sheet. In compliance with protocols, after laboratory processing is completed for a given sample, all sieves, pans, trays, etc., that have come in contact with the current sample will be rinsed thoroughly, examined carefully, and picked free of organisms or debris. Any organisms found are added to the sample residue, which is then re-preserved in 95% ethanol.

Once site samples are subsampled, sorted and labeled, taxonomic identifications will then be made to the genus level (whenever possible) using microscopes. Genus level classification of macroinvertebrate samples will be performed using select taxonomic keys (e.g. Pennak, 1989, Peckarsky et al., 1990, Wiggins, 1996, Merritt et al., 2008, Stewart and Stark, 2002). Certain specimens may be physically damaged to such an extent that accurate genus-level identification is not possible. In these situations, the lowest possible taxonomic identification will be noted on the data sheet. Time constraints prevent the more detailed examinations required to identify taxa such as aquatic worms (Oligochaeta) and midge larvae (Chironomidae) to this level. Therefore, oligochaetes will be identified at the class level, and chironomids will be identified at the family level. The representatives in each respective taxonomic grouping will be enumerated, recorded and summed on the Benthic Macroinvertebrate Identification Form (Appendix H). The final total number of organisms will be recorded along with the date the identification was completed and the taxonomist's initials. All individuals from the subsample will then be returned to the 95 percent ethanol solution and held for at least one year.

E. Habitat Assessment

Habitat assessments will be conducted at each monitoring location using the USEPA's Habitat Assessment Form (Appendix D). The assessments will be conducted in conjunction with the benthic macroinvertebrate sampling and will be a collaborative effort between the members of the sampling team.

F. Data Analysis

Each annual report shall include a summary of the monitoring results and analyses and an interpretation of that data with respect to long-term patterns/trends. The Virginia Stream Condition Index (VASCI) (Burton, 2003) will be used with the benthic macroinvertebrate data to assess site conditions and long term trends of biological health.

IV. Data Management/Quality Control

A. Documentation of Field Monitoring

A dedicated sample label (Figure 1) will be created in the field and applied to sample containers for each collected sample. The label will include the following information:

- Site Name
- Sample Date

- Sample Time
- Investigators
- Number of sample containers
- Any comments relevant to the stream conditions

Fairfax County WPAB Benthic Sample		
Site ID:	Sample # of	
Collected by:	Date:	
QC site: Yes No	Time:	AM / PM
Comments:		
Warning: Sample contains 95% Ethanol as a preservative. Please see the SDS for safety instructions.		

Figure 1: Benthic sample jar label

B. Chain of Custody

Chain of custody (COC) forms (Appendix F), are a permanent record of transfer of sample custody. Custom COC forms for this project are located at the Springfield Lab and are filled out when samples are delivered and when they are processed.

C. Quality Control

Training for benthic macroinvertebrate sampling, lab protocols and habitat assessment will occur on a yearly basis to refresh current field personnel and teach new field staff the protocols used.

V. Anticipated Products of the Program

A. Biological Stream Monitoring Yearly Report

- A report on biological stream monitoring will be prepared for use in the development of the County's annual MS4 report to VA DEQ at the end of each MS4 reporting year (July 1 – June 30). The annual report due October 1, 2016 will include the list of sites to be monitored during the term of the state permit and monitoring protocols. Beginning with the annual report due October 1, 2017, each annual report shall include a summary of the monitoring results and analyses and an interpretation of that data with respect to long-term patterns/trends.

VI. Administrator of the SOP

This SOP document is administered by the Stream Monitoring Section within the Stormwater Planning Division. For more information about this document, please call the Stormwater Planning Division at (703) 324-5500.

VII. References

Barbour, M. T., J. Gerritsen, B. D. Snyder, and J. B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

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Pennak, R. W. 1989. Fresh-water invertebrates of the United States. 3rd Edition. John Wiley and Sons, Inc. New York.

Stewart, K. W. and B. P. Stark. 2002. Nymphs of North American Stonefly Genera. Second Edition. The Caddis Press. Columbus, Ohio.

US Environmental Protection Agency; 1997; "Field and laboratory methods for macroinvertebrate and habitat assessment of low gradient nontidal streams"; Mid-Atlantic Coastal Streams Workgroup, Environmental Services Division, Region 3, Wheeling, WV; 23 pages with appendices.

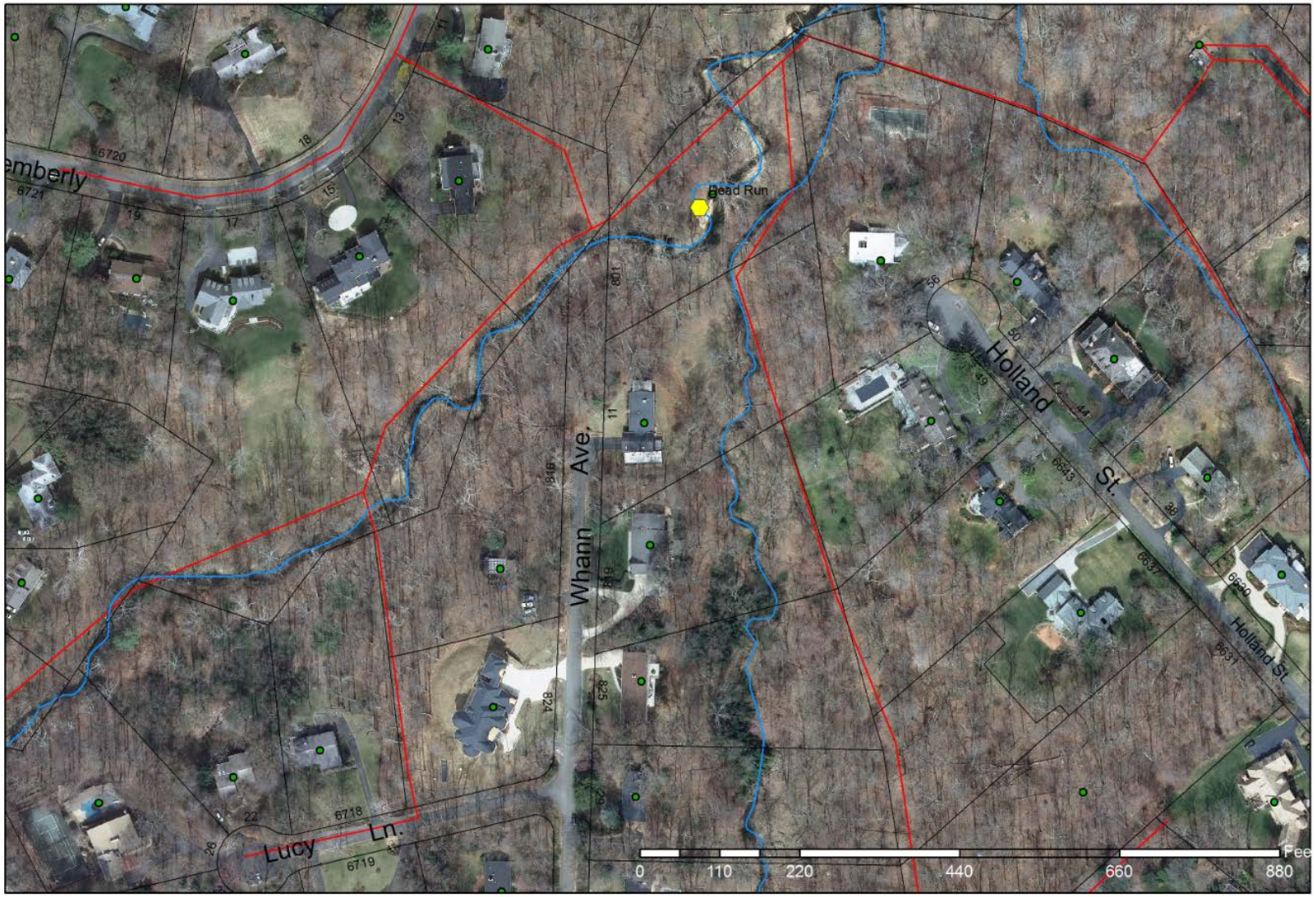
Wiggins, G. B. 1996. Larvae of the North American Caddisfly Genera (Trichoptera). Second Edition. University of Toronto Press Incorporated. Toronto, Ontario.

VIII. Appendices

A. Fairfax County MS4 Biological Monitoring Locations
B. Health and Safety Guidance for Biological Stream Monitoring Field Work
C. Benthic Macroinvertebrate Field Sheet
D. Habitat Assessment Form
E. Benthic Sample Log-In Sheet
F. Benthic MS4 Chain of Custody Form
G. Benthic Macroinvertebrate Sorting Log-In Form
H. Benthic Macroinvertebrate Identification Form

Appendix A: Fairfax County MS4 Biological Monitoring Locations

Dead Run USGS Sites
Tax Map 21-2

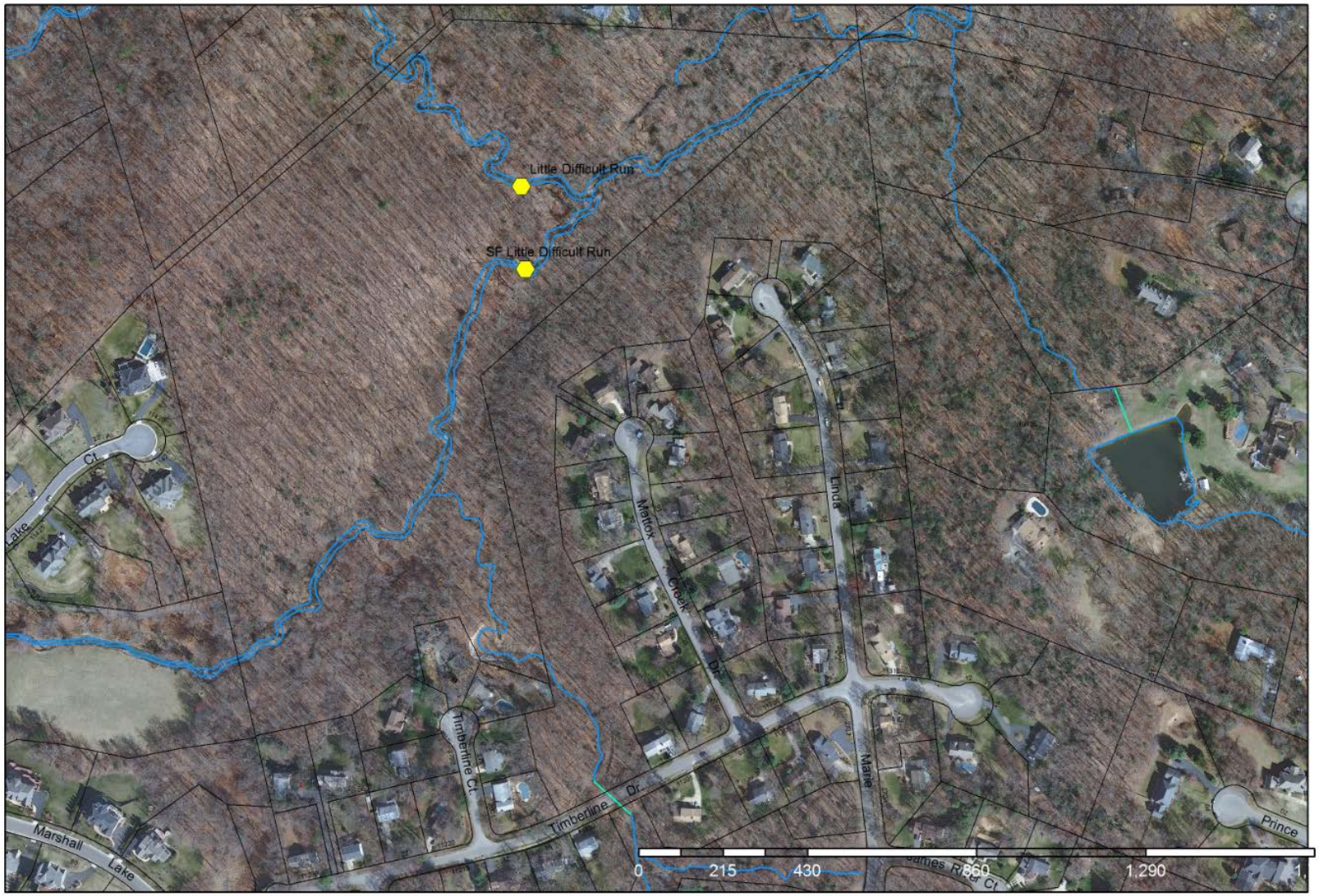


Difficult Run USGS Sites
Tax Map 47-1

Flatlick and Frog Branches (Cub Run) USGS Sites
Tax Map 44-2

Long Branch (Accotink Creek) USGS Site
Tax Map 70-3

N. & S. Fork Little Difficult Run USGS Sites
Tax Map 36-2



Appendix B: Health and Safety Guidance for Biological Stream Monitoring Field Work

General

Health and safety responsibility and accountability involves every employee. The collective effort of all employees in providing a healthy and safe work environment will minimize or eliminate the potential for accidents. In general, field sampling will require the following safety protocols to protect the field staff:

1. Perform field work in teams of at least two.
2. Bring cell phone and first aid kit on all field site visits.
3. Exercise caution when encountering any wildlife and hazardous plants. In addition, many outfalls are located in remote areas that may be near gathering places for homeless or transient individuals. Do not enter a potentially hostile area.
4. Take proper precautions (e.g. seek shelter) during electrical storms and/or when severe conditions (e.g., high wind, hail) develop. The safety of field staff overrides all other considerations.
5. Streams may contain a variety of water-borne bacteria and other harmful chemicals. Wash hands or use anti-bacterial wipes or hand gels liberally, especially prior to lunch breaks, etc.

Conduct

All field staff are expected to:

- Understand and comply with health and safety policies. Each employee is not only responsible and accountable for his/her own actions, but for those others around him/her.
- All employees shall show professional courtesy to fellow employees, clients, subcontractors, regulators, the general public and visitors.
- Understand and follow good health and safety practices.
- Horseplay, practical joking, inattention to work or other inappropriate accident-causing behavior will not be tolerated.
- Use of alcohol or controlled substances is prohibited.
- While traveling to and from the job site, employees shall: obey all federal, state and local regulations regarding seat belt use, all traffic laws, and any other laws regarding proper conduct in public areas.

Personal protective equipment (PPE)

Engineering and administrative controls will be used as the primary means of exposure control, as required by OSHA standards. However, PPE may also be necessary to further minimize potential employee exposure. All employees shall dress appropriately for the tasks to be performed. Specialized health and safety equipment, including PPE, monitoring equipment, and other devices designed to protect the employee shall be issued to the employee on an as-needed basis.

Employees performing field activities and certain laboratory functions have the potential of coming in contact with hazardous materials. Many of these hazardous materials can cause significant injury or illness through acute or chronic exposures. For field work (including industrial operations), all field employees are required to wear the following basic PPE:

- Appropriate work clothing
- ANSI-approved steel-toed, steel-shank boots
- ANSI-approved safety glasses
- ANSI-approved hard hat (when overhead hazards exist)
- Hearing Protection (when appropriate)
- Rain Gear (when appropriate)

Confined space entry program

A confined space is any location not intended for human occupation, has limited or no ventilation, has the potential for containing dangerous or lethal atmospheres, and has limited ingress/egress. OSHA has addressed confined space entry requirements and procedures in 29 CFR 1910.146 (Permit Required Confined Spaces) and 1926.651 (Excavations). Confined space entry will not be performed under any circumstances during this monitoring.

Dangerous flora and fauna

During the course of field activities, employees may come in contact with a wide range of dangerous or toxic animals and plants. Dangerous animals may include: black widow and brown recluse spiders; fire ants; mosquitoes and biting flies; bees, wasps and hornets; ticks and chiggers; microbial organisms (e.g., found in water, soil, and air and on carrier/host organisms); dogs; rabid mammals; and poisonous snakes. Dangerous plants may include: thorny plants; poison ivy, oak, and sumac; and molds, mildews, and fungi (which may cause allergic reactions). Contact with these organisms can cause effects from simple discomfort (such as from thorny bush scratches) to severe allergic reactions and possibly death. If interactions do occur, take appropriate actions related to specific interaction and individual response to interaction. Appropriate, suitable PPE is provided to all field staff (e.g. insect repellant, first aid kits, etc.)

Blood borne pathogens (BBP)

Exposure to BBP is possible in the case of certain emergency situations. Personnel may be exposed to body fluids such as blood, saliva, vomit, mucus or others. These fluids could contain pathogens that have the potential for causing disease in humans. Should personnel be required to administer life-saving procedures, such as CPR, the following procedures will be followed to minimize the potential for exposure:

1. Wear disposable gloves when hand contact with blood, mucus membranes, non-intact skin or other potentially infectious materials could be involved;
2. Use disposable mouthpieces, pocket masks or other ventilation devices for administering artificial ventilation;
3. Wash hands with soap and water after administering first aid;
4. In the case of eye contact, flush eyes using an eye wash for at least 15 minutes;
5. Remove garments contacted by blood or other body fluids as soon as possible;
6. Do not eat, drink, smoke or handle contact lenses in areas with possible BBP exposure; and
7. Persons cleaning up an accident scene should not pick up broken glass or other sharp objects by hand. All clothes and other items at the first aid scene should be safely secured prior to leaving.

Employees who may have been exposed to BBPs should report the incident at once.

Remote areas

The sampling team may be located in areas not readily accessible by vehicle. Radio or phone communication will be maintained from the sampling team to a base station in the event of an emergency.

Heavy lifting

It may be necessary to carry sampling equipment (e.g., coolers, sampling containers, and equipment) during the course of the field activities. Care must be taken to avoid injury while carrying equipment to the sampling locations.

Hand tools

Some of the field activities and sampling procedures may require the use of hand tools with sharp edges including machetes, scissors, clippers, knives, and razor blades. Care must be taken during their use to prevent injuries from cuts.

Weather related hazards

Weather-related hazards include the potential for heat or cold stress, electrical storms, treacherous weather-related working conditions, high winds, and limited visibility. These hazards correlate with the season in which site activities occur. Field sampling will not take place in the event of adverse weather conditions.

Heat stress

Heat stress is a significant potential hazard during the warmer months. Heat stress manifests itself as one of three conditions: heat cramps, heat exhaustion, or heat stroke. Heat cramps are brought about by a prolonged exposure to heat. As an individual sweats, water and salts are lost by the body, triggering painful muscle cramps. The signs and symptoms of heat cramps include:

- Severe muscle cramps, usually in the legs and abdomen;
- Exhaustion, often to the point of collapse; and
- Dizziness or periods of faintness.

First aid treatment includes shade, rest, and fluid replacement. If the individual has not recovered within ½ hour, then he/she will be transported to the hospital for medical attention.

Heat exhaustion usually occurs in a healthy individual who has been exposed to excessive heat while working or exercising. Blood collects near the skin in an effort to rid the body of excess heat. The signs and symptoms of heat exhaustion include:

- Rapid and shallow breathing;
- Weak pulse;
- Cold and clammy skin, with heavy perspiration;
- Skin appears pale;
- Fatigue, weakness, and/or dizziness; and

- Elevated body temperature.

First aid treatment includes cooling the victim, elevating the feet, and replacing fluids. If the individual has not recovered within ½ hour, he/she will be transported to the hospital for medical attention.

Heat stroke occurs when an individual is exposed to excessive heat, and their body systems become overwhelmed by heat and begin to stop functioning. This condition is a medical emergency, requiring the immediate cooling of the victim and transport to the hospital immediately. The signs and symptoms of heat stroke include:

- Victim has stopped sweating;
- Dry, hot, red skin;
- Body temperature approaching or above 105° F;
- Dilated (large) pupils; and
- Loss of consciousness; victim may lapse into a coma.

Local weather conditions may produce an environment which will require restricted work schedules in order to protect employees. The Field Team Leader will observe workers for any potential symptoms of heat stress. Adaptation of work schedules and training in recognition of heat stress conditions will help prevent heat-related illnesses from occurring.

Cold stress

Cold stress is a danger at low temperatures and when the wind chill factor is low. Cold stress is generally described as a local cooling (frost nip, frost bite, and freezing) or a general cooling (hypothermia). Personnel working outdoors in temperatures at or below freezing may be subject to local cooling. Areas of the body that have a high surface area-to-volume ratio, such as fingers, toes, and ears, are the most susceptible. The three categories of local cooling include:

- Frost nip - characterized by a blanching or whitening of the skin;
- Frost bite - skin has a waxy or white appearance and is firm to the touch, but the tissue beneath is resilient; and
- Freezing - skin tissue is cold, pale, and solid.

Frost nip and frost bite first aid includes covering the affected area with warmth and retreating to a warm area. Frozen tissue is a medical emergency, and the victim will be transported to the hospital immediately.

General cooling (hypothermia) occurs when exposure to cold reduces body temperature. With prolonged exposure, the body becomes unable to maintain its proper internal temperature. Without treatment, hypothermia will lead to stupor, collapse, and death. The signs and symptoms of mild hypothermia include:

- Shivering;
- Numbness; and
- Drowsiness.

First aid for mild hypothermia includes using heat to raise the individual's body temperature. Heat may be applied to the victim in the form of heat packs, hot water bottles, and blankets.

The signs and symptoms of severe hypothermia include:

- Unconsciousness;
- Slowed respiration or respiratory arrest;
- Slowed pulse or cardiac arrest;
- Irrational or stuporous state; and
- Muscular rigidity.

First aid for severe hypothermia includes handling the victim very gently; rough handling may set off an irregular heartbeat. Do not attempt to re-warm the severely hypothermic victim; re-warming may cause the development of an irregular heartbeat. Severe hypothermia is a medical emergency, and the victim will be transported to the hospital immediately.

Prevention of cold stress is a function of whole body protection. Adequate insulated clothing will be worn when the air temperature drops below 50 °F. Reduced work periods may be necessary in extreme conditions to allow adequate periods in a warm area.

Appendix C: Benthic Macroinvertebrate Field Sheet (Page 1)

Site Code: _____

Benthic Macroinvertebrate Sampling
Data Sheets

Watershed:	Date:	Start Time:
Stream Order:	Recorder:	Finish Time:
Investigators:	QC Site: Yes No	

Habitat Types: Field Duplicate Collected Yes / No (circle)

	Tally	# of Jabs:
Sand	_____	_____
Snags	_____	_____
Cobble	_____	_____
Vegetated Banks	_____	_____
Submerged Macrophytes	_____	_____

# of jabs = tally/total number of tallies x 20

***If habitat type is less than 5% of area, do not count it toward jabs**

Water Quality		
Temperature	___.___	°C
% Saturation	___.___	%
Dissolved Oxygen	___.___	mg/l
Conductivity	____	µS/cm
Specific Conductance	____	(µS/cm)/c°
pH	___.___	

Weather		
Today:	storm/heavy rain	showers (intermittent)
	rain (steady)	sunny
	partly cloudy	cloudy
Past 24 hrs	storm/heavy rain	showers (intermittent)
	rain (steady)	sunny
	partly cloudy	cloudy

Riparian Zone/ Instream Features

Predominant Surrounding Landuse

Forest	Commercial
Field/Pasture	Industrial
Agricultural	Golf Course
Residential	Other _____

Canopy Cover

Open Moderate Heavy

Channelized?

Yes No

Local Streambank and Channel Bottom Erosion

None Low Moderate Heavy

Riparian Zone Width (ft)

LB	RB
0-25	0-25
25-50	25-50
50-75	50-75
75-100	75-100
100+	100+

Possible impairments to benthics (i.e. golf course, industrial area)

Other Comments:

Appendix C: Benthic Macroinvertebrate Field Sheet (page 2)

Cobble (hard substrate) - Cobble will be prevalent in the riffles (and runs), which are a common feature throughout most mountain and piedmont streams. In many high-gradient streams, this habitat type will be dominant. However, riffles are not a common feature of most coastal or other low-gradient streams. Sample shallow areas with coarse (mixed gravel, cobble or larger) substrates by holding the bottom of the dip net against the substrate and dislodging organisms by kicking the substrate for 0.5 m upstream of the net.

Snags - Snags and other woody debris that have been submerged for a relatively long period (not recent deadfall) provide excellent colonization habitat. Sample submerged woody debris by jabbing in medium-sized snag material (sticks and branches). The snag habitat may be kicked first to help dislodge organisms, but only after placing the net downstream of the snag. Accumulated woody material in pool areas are considered snag habitat. Large logs should be avoided because they are generally difficult to sample adequately.

Vegetated banks - When lower banks are submerged and have roots and emergent plants associated with them, they are sampled in a fashion similar to snags. Submerged areas of undercut banks are good habitats to sample. Sample banks with protruding roots and plants by jabbing into the habitat. Bank habitat can be kicked first to help dislodge organisms, but only after placing the net downstream.

Submerged macrophytes - Submerged macrophytes are seasonal in their occurrence and may not be a common feature of many streams, particularly those that are high-gradient. Sample aquatic plants that are rooted on the bottom of the stream in deep water by drawing the net through the vegetation from the bottom to the surface of the water (maximum of 0.5 m each jab). In shallow water, sample by bumping or jabbing the net along the bottom in the rooted area, avoiding sediments where possible.

Sand (and other fine sediment) - Usually the least productive macroinvertebrate habitat in streams, this habitat may be the most prevalent in some streams. Sample banks of unvegetated or soft soil by bumping the net along the surface of the substrate rather than dragging the net through soft substrates; this reduces the amount of debris in the sample.

Appendix D: Habitat Assessment Form (Page 1)

US EPA RBP Habitat Assessment Reference Sheet for Piedmont/Triassic Areas (modified)

(front)

Habitat Parameter	Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1) Epifaunal Substrate/ Availible Cover	>70% of substrate favorable for epifaunal colonization & fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (I.e. logs/snags that are 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 (may rate at high end of scale).	20-40% mix of stable habitat; habitat availablity less than desirable; substrate frequently disturbed or removed.	<20% stable habitat; lack of habitat is obvious; substrate unstable/lacking
Score_____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2) Embedded-ness	Gravel, cobble & boulder particles in riffles and runs are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble & boulder in riffles and runs particles are 25-50% surrounded by fine sediment.	Gravel, cobble & boulder particles in riffles and runs are 50-75% surrounded by fine sediment.	Gravel, cobble & boulder particles in riffles and runs are >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
3) Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep & fast-shallow, relative to stream size).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes.	Only 2 of the 4 regimes present (if fast-shallow or slow-shallow are missing, score lower).	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
4) Sediment Deposition	<5% of the bottom affected by sediment deposition, little or no enlargement of islands or point bars.	5-30% of the bottom affected; slight deposition in pools; may be some new increase in bar formation, mostly from gravel, sand or fine sediment;	30-50% of the bottom affected; sediment deposits at obstructions, constrictions & bends; moderate deposition of pools prevalent; may be moderate deposition of new gravel, sand or fine sediment on old & new bars.	>50% of the bottom affected; heavy deposits of fine material, increased bar development; score lower if pools absent due to substantial sedimentation.
Score_____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5) Channel Flow Status	Water reaches base of both lower banks and fills >75% of channel, minimal amount of channel substrate is exposed.	Water fills 75-50% of the available channel; or <50% of channel substrate is exposed	Water fills 50-25% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools, water fills <25% of channel.
Score_____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Appendix D: Habitat Assessment Form (Page 2)

US EPA RBP Habitat Assessment Reference Sheet for Piedmont/Triassic Areas (modified)

(back)

6) Channel Alteration	Channelization or dredging absent or minimal, <10% of reach disrupted; no obvious shoring structures; may have recovered from past channelization; stream with normal pattern.	Some channelization present, 10-40% of reach channelized or disrupted; may be recovering from past channelization, stream is developing a normal pattern.	Channelization extensive; shoring sturctures present on both banks; 40-80% of stream reach channelized & disrupted; stream does not have a normal pattern.	Banks shored with gabion or cement; >80% of the stream reach channelized & disrupted, stream is a straight channel. Instream habitat greatly altered or removed entirely.
Score_____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7) Frequency of riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by stream width is <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; distances between riffles divided by stream width is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by stream width is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided stream width is a ratio of >25.
Score_____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8) Bank Stablity	Banks stable; evidence of erosion or bank failure absent/minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank slouging; 60-100% of bank has erosional scars.
Score (RB)_____	Right bank 10 9	8 7 6	5 4 3	2 1 0
Score (LB)_____	Left bank 10 9	8 7 6	5 4 3	2 1 0
9) Bank Vegetative Protection	>90% of the streambank surfaces covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	<50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation Is very high; vegetation has been removed to 5 centimeters or less in average stubble height
Score (RB)_____	Right bank 10 9	8 7 6	5 4 3	2 1 0
Score (LB)_____	Left bank 10 9	8 7 6	5 4 3	2 1 0
10) Riparian Vegetative Zone Width	Width of riparian zone >40 meters; human activities (parking lots, roadbeds, clear-cuts, lawns or crops) have not impacted zone.	Width of riparian zone 40-20 meters; human activities have impacted zone only minimally.	Width of riparian zone 20-10 meters; human activities have impacted zone a great deal.	Width of riparian zone <10 meters; little or no riparian vegetation due to human activities
Score (RB)_____	Right bank 10 9	8 7 6	5 4 3	2 1 0
Score (LB)_____	Left bank 10 9	8 7 6	5 4 3	2 1 0

Appendix E: Benthic Sample Log-In Sheet

Benthic Macroinvertebrate Sample Log-in Sheet						
	Site ID	**Watershed**	**Date collected**	**Date delivered to lab**	**Initials**	**# of containers**
1						
2						
3						
4						
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9						
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Appendix F: Benthic Chain of Custody Form

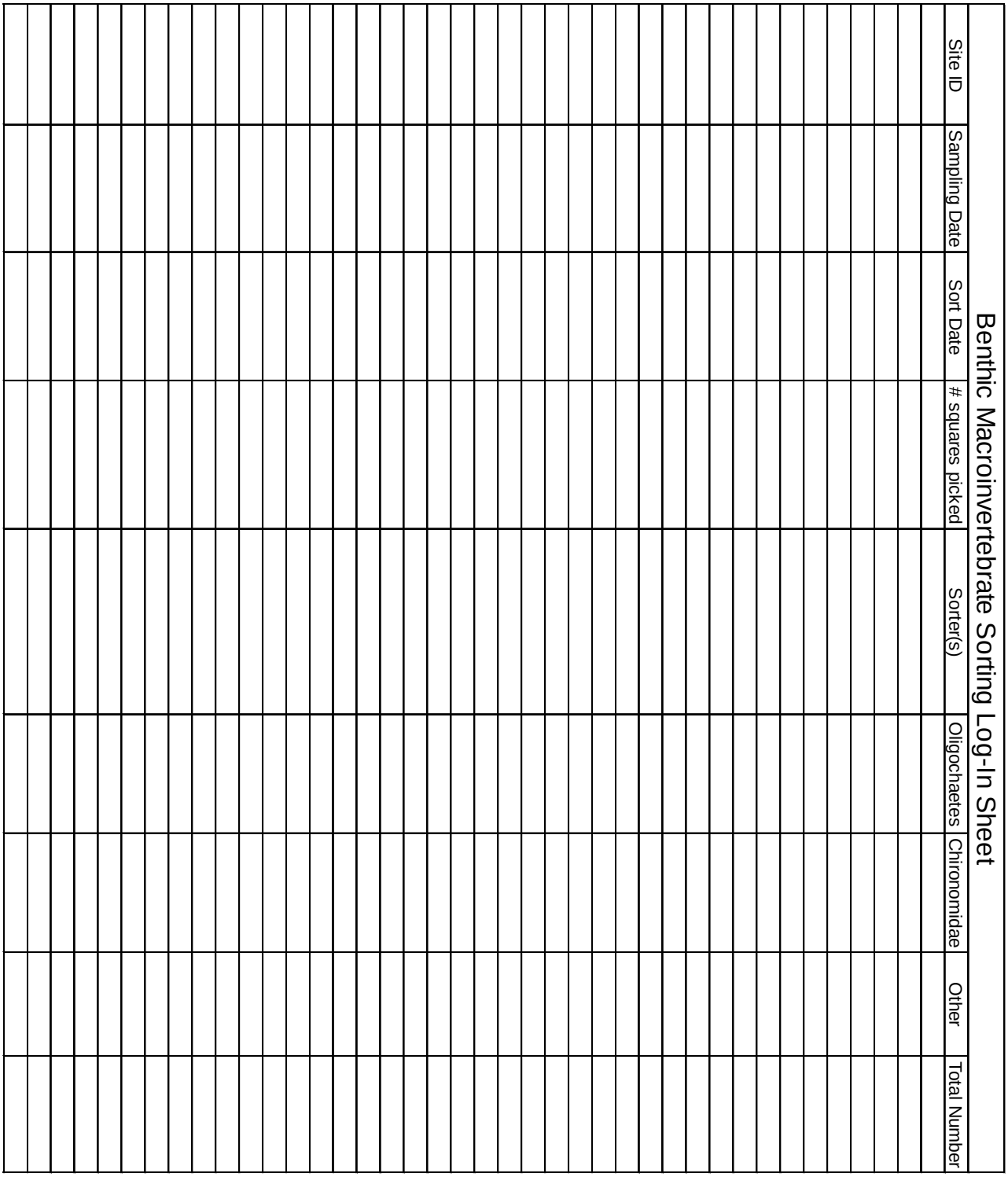
BENTHIC MS4 SAMPLE CHAIN OF CUSTODY FORM

Name: Fairfax County DPWES/SWPD **Address: 12000 Government Center Parkway Suite 449** **Fairfax, VA 22035** **Phone Number: 703-324-5500**	**Delivered to: DPWES Water Quality Lab** **6800 Industrial Rd, Springfield, VA 22151**
	Lab Phone #: **Lab Contact:** **Lab Email:**

Date Sampled	Time Sampled AM/PM	Site ID	Sample Location Stream Name	Sample Type
_ _/_ _/_ _ _ _	_ _ _ _			Benthic

Collected/Relinquished by:			
Print Name	**Signature**	**Date/Time Collected**	**Date/Time Relinquished**
Relinquished to:			
Print Name	**Signature**	**Date Relinquished**	**Time Relinquished**
Delivered to Laboratory by:			
Print Name	**Signature**	**Date Delivered**	**Time Delivered**

Appendix G: Benthic Sorting Log-In Sheet



Appendix H: Benthic Macroinvertebrate Identification Form (Page 1)

SITE ID: _____

Benthic Macroinvertebrate Identification Sheet

Taxonomist:		**Identification Start Date:**			
		Identification Finish Date:			
Watershed:					
		Collection Date:			
QC Sample? Y N	**QC Site? Y N**	**Sorting Date(s):**			
Organisms			**#**	**Tally**	**Exc?**
Order	**Family**	**Genus**			
Oligochaeta					
Chironomidae					
Hirudinea					
Isopoda					
Amphipoda					
Decapoda					
Ephemeroptera					
Plecoptera					
Trichoptera					
		Subtotal:			

Appendix H: Benthic Macroinvertebrate Identification Form (Page 2)

SITE ID: _____

Benthic Macroinvertebrate Identification Sheet

Organisms			#	Tally	Exc?
Order	Family	Genus			
Odonata					
Hemiptera					
Lepidoptera					
Megaloptera					
Coleoptera					
Diptera					
Gastropoda					
Bivalves					
Acariformes					
Other					
		Subtotal:			
		Total from front:			
		Grand Total:			