Fairfax County 2016 MS4 Program Plan and Annual Report

Appendix R15

Standard Operating Procedures for the MS4 In-Stream Monitoring Program

VSMP Permit Number VA0088587
9-30-2016

Department of Public Works and Environmental Services
POLICIES AND PROCEDURES

Memorandum No.: SWPD16-06

SUBJECT: Standard Operating Procedures for the MS4 In-Stream Monitoring Program

Effective: 07/01/2016 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 in-stream monitoring. The applicable requirement of the permit (Part I, Section C.2) states:

The permittee shall continue to implement an in-stream monitoring program to evaluate the condition of select streams 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 once per two months between January 1st and December 31st at each monitoring location.*
- *Monitoring shall be performed for the following parameters:*
  - *pH*
  - *Dissolved Oxygen*
  - *Temperature*
  - *Total Suspended Solids*
  - *Ammonia as Nitrogen*
  - *Nitrate plus Nitrite Nitrogen*
  - *Total Kjeldahl Nitrogen*
  - *Total Nitrogen (calculated)*
  - *Dissolved Phosphorus*
  - *Total Phosphorus*
  - *Escherichia coli*
- *Monitoring for the parameters listed in Part I.C.2.c) shall be in accordance with Part II.A of this state permit.*
- *The permittee may replace a sampling location with a new proposed location after 15 samples are collected and analyzed. Written notification of the monitoring plan revisions shall be given to the Department in writing and shall include a statistical analysis of the monitoring results, conclusions regarding the data, the proposed new monitoring location, and the reasoning for site location choice.*

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 In-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 compliance with the above MS4 permit requirements.

This document contains the following: -

- Site Selection Protocol -
- Field Protocol for In-Stream Monitoring -
- Documentation/Reporting Procedures -
- Appendices -

II. Site Selection for MS4 In-Stream Monitoring Program

Since 2007, Fairfax County has been conducting an in-stream 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.
- Evaluate relationships between observed conditions/trends and best management practice (BMP) implementation throughout Fairfax County.
- Transfer the understanding gained from intensively monitored watersheds to less-intensively monitored ones.

In order to utilize an existing network to support the MS4 Permit requirements, Fairfax County will supplement this study with all required parameters and adhere to the monitoring frequency as stated in the MS4 Permit. The dataset already collected will provide significant value in satisfying the permit in regard to data interpretation with respect to long-term patterns and trends. If this long-term study with USGS would cease due to some unforeseen reason, the sites chosen for MS4 monitoring would continue to be monitored by Fairfax County to ensure consistency.

A. 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 types)
- 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. In order to accomplish this, a cluster analysis was performed (using 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 displays the name and watershed characterization for each selected site.

Table 1: Site Name and Characterization for Fairfax County In-Stream Monitoring Program.

Site Name	Watershed	Drainage Area (mi^2)	% Impervious
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	3.79	25.66
South Fork Little Difficult Run	Difficult Run	2.71	14.02

A map of the five in-stream monitoring sites, along with site-specific maps of each location, can be found in Appendix A.

III. Field Protocol for MS4 In-Stream Monitoring Program

This section provides details of the protocols to be followed during in-stream monitoring events 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.
- 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.

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, bloodborne pathogens, remote areas, hand tool safety, weather-related hazards, and heat and cold stress.

B. Sampling Frequency

As specified by the permit, monitoring shall be conducted once per two months between January 1st and December 31st at each monitoring location. In order to characterize the full range of possible water quality conditions, this sampling shall be a scheduled event to be conducted in dry or wet conditions, unless otherwise noted due to severe weather. It is imperative that County staff head out into the field as early as possible in order to deliver samples to lab in within the established holding times (See Table 2).

C. Field Work Preparation

1. Equipment Checklist

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

- Field Form
- Chain of Custody
- Weatherproof Labels for Bottles
- Coolers and ice for samples
- Sharpies/Pens
- Thermometer
- Multi-Parameter Water Quality Sonde
- Nitrile Gloves
- Paper Towels
- Clipboard

2. Water Quality Sonde Calibration

Calibration of the water quality sonde must be completed prior to sample collection. Calibration procedures can be found in Appendix C and provide a step-by-step guide to ensure accuracy of the sonde. A few steps to follow prior to calibration:

- All buffers and standards should be at a similar temperature as the stream in order to ensure accurate calibrations. For winter months, this requires staff to either keep them on ice or place them in the refrigerator the night before.
- Check to make sure that the sonde has a charged battery - for backup, bring 4 ‘C’ batteries in the field.

The sonde can be calibrated either in the office or from the back of the vehicle prior to leaving for the sampling run. Calibration readings should be entered on the back of the field form (Figure 1) for the first site – the site name should then be referenced on each subsequent field form instead of re-entering the calibration values. Values for all field form sections within this SOP are included for illustrative purposes as not all fields are used for this monitoring program. Blank field forms are generated for each new sampling run as the routes are randomized in consultation with USGS.

Figure 1: Calibration Entry

Multiparameter Meter

Make/Model YSI 6920 Serial Number 12E100825

Calibrated at _____ (site name) today

SC Calibration			
Std. Value	1000	250	50
Temp	12.83	12.91	13.05
Initial	998	250	50
Adjusted	1000	—	—
Lot #	1206469	1203394	1206479
Exp Date	12/13	9/13	6/13

In standard ≥ 167 µS/cm, calibrate if probe reads ± 3% from expected value.
In standard < 167 µS/cm, calibrate if probe reads ± 5 µS/cm from expected value.

Turbidity Calibration			
Std. Value	0	100	—
Temp	11.37	10.95	
Initial	0.4	98.3	
Adjusted	0.0	100.0	
Lot #	DIW	82180	
Exp Date	—	6/14	

In standard ≥ 40 NTU, calibrate if probe reads ± 5% from expected value.
In standard < 40 NTU, calibrate if probe reads ± 2 NTU from expected value.

pH Calibration			
	pH 7	pH 10	pH4
Theo. pH	7.05	10.14	4.00
Temp	12.24	12.18	12.27
Initial	7.04	10.12	3.97
Adjusted	7.05	10.14	3.99
Lot #	2206313	2207301	2207139
Exp Date	6/14	1/14	6/14

Calibrate if probe reads ± 0.1 units from expected value.

DO Calibration		
Temp. 11.38	BP 754	
	Initial	Adjusted
DO %	97.7	99.1
DO mg/L	10.68	10.85
DO charge		
Chart DO	10.7	

Changed Membrane? YES NO Value in zero D.O. sol'n: 0.20

Calibrate if probe reads ± 0.3 mg/L from expected value.

D. Sample Collection

This section will describe the steps to be completed and the areas of the form to be filled out. Please see Appendix D for a copy of the field form.

1. Field Measurements

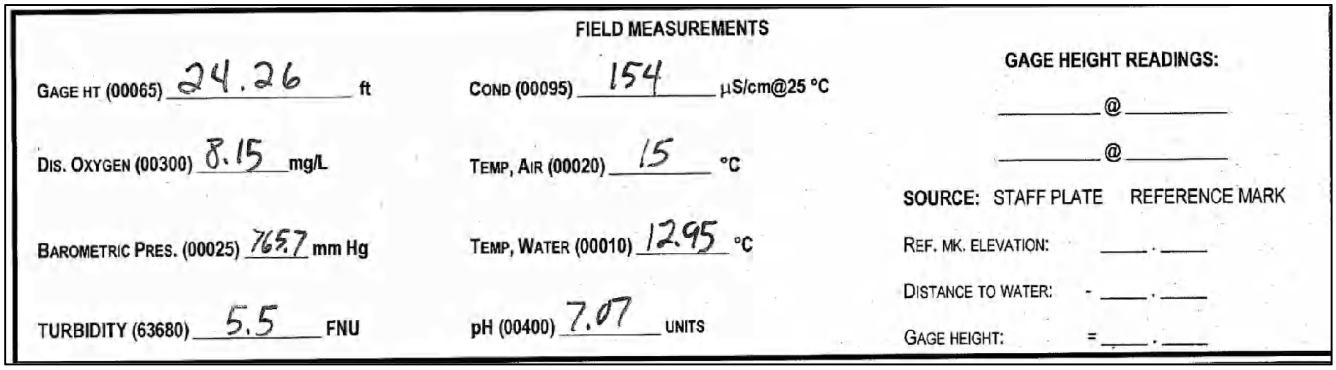
Some basic tips for using the water quality sonde in field monitoring:

- The unit should be on for about 10 minutes before readings are taken.
- Place the sonde guard on the unit to protect the probes during readings.
- Ensure the probes are fully immersed in flowing water upstream of any other collection activity.

- Allow the readings to stabilize before taking a reading, especially in winter months.
- Always write out measurements to the full precision of the instrument.

Figure 2 shows how to fill out the field measurements on the form. Gage height readings (as seen on form) are not necessary for the collection of these measurements.

Figure 2: Field Measurements



FIELD MEASUREMENTS

GAGE HT (00065) 24.26 ft

COND (00095) 154 µS/cm@25 °C

DIS. OXYGEN (00300) 8.15 mg/L

TEMP, AIR (00020) 15 °C

BAROMETRIC PRES. (00025) 765.7 mm Hg

TEMP, WATER (00010) 12.95 °C

TURBIDITY (63680) 5.5 FNU

pH (00400) 7.07 UNITS

GAGE HEIGHT READINGS:

_____ @ _____

_____ @ _____

SOURCE: STAFF PLATE REFERENCE MARK

REF. MK. ELEVATION: ____.____

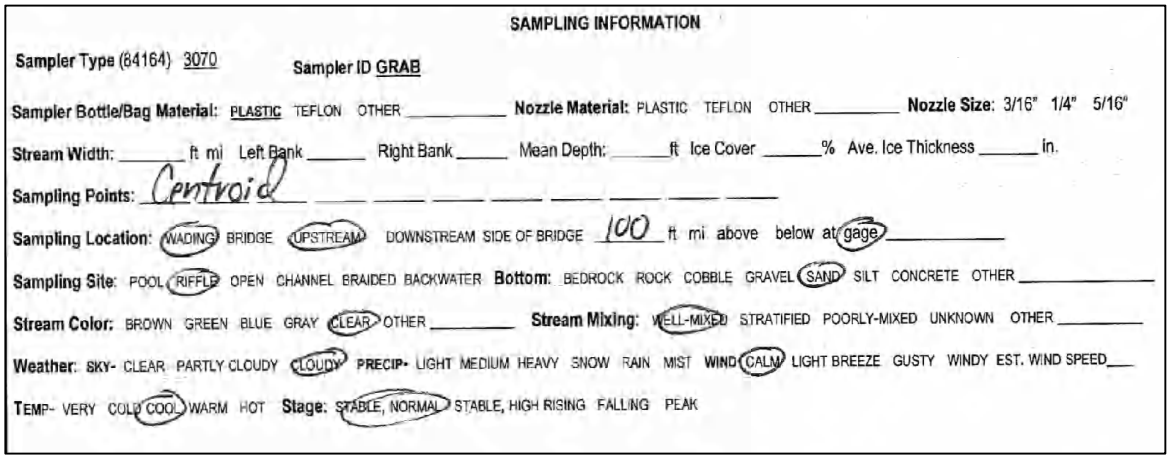
DISTANCE TO WATER: - ____.____

GAGE HEIGHT: = ____.____

2. Sampling Information

Located just below the field measurements is a section to describe the environment being sampled. Ideally, all samples should be taken in the center of the stream along a riffle or other flowing water. This information, along with water and weather conditions should be transcribed in the sampling information section. Figure 3 is an example of how to fill out this section.

Figure 3: Sampling Information



SAMPLING INFORMATION

Sampler Type (84164) 3070 Sampler ID GRAB

Sampler Bottle/Bag Material: PLASTIC TEFLON OTHER _____ Nozzle Material: PLASTIC TEFLON OTHER _____ Nozzle Size: 3/16" 1/4" 5/16"

Stream Width: ____ ft mi Left Bank ____ Right Bank ____ Mean Depth: ____ ft Ice Cover ____ % Ave. Ice Thickness ____ in.

Sampling Points: Centroid

Sampling Location: WADING BRIDGE UPSTREAM DOWNSTREAM SIDE OF BRIDGE 100 ft mi above below at gage _____

Sampling Site: POOL RIFFLE OPEN CHANNEL BRAIDED BACKWATER Bottom: BEDROCK ROCK COBBLE GRAVEL SAND SILT CONCRETE OTHER _____

Stream Color: BROWN GREEN BLUE GRAY CLEAR OTHER _____ Stream Mixing: WELL-MIXED STRATIFIED POORLY-MIXED UNKNOWN OTHER _____

Weather: SKY- CLEAR PARTLY CLOUDY CLOUDY PRECIP- LIGHT MEDIUM HEAVY SNOW RAIN MIST WIND CALM LIGHT BREEZE GUSTY WINDY EST. WIND SPEED ___

TEMP- VERY COLD COOL WARM HOT Stage: STABLE, NORMAL STABLE, HIGH RISING FALLING PEAK

3. Grab Samples

Three grab samples are to be collected at each site. All grab sample labels should include the following information:

- Sample Date
- Sample Time
- Sample Location
- Sample Collector

All samples should be taken in a reach with well mixed, flowing water. Be sure that grab samples are taken downstream of water quality measurements to ensure accuracy. Be aware of any disturbed sediments from sonde placement and avoid collection of this water. For nutrient samples, rinse bottle with sample water three times before filling. Sediment and E. coli bottles should not be rinsed prior to collection.

The nutrient, bacteria and sediment samples should be given the same time. ***Always round the sample time to the nearest 15 minute increment - XX:00, XX:15, XX:30, XX:45.*** For a regular field sample, staff must fill out both the time and the sample type on the field form. For a regular sample, the sample type is **'9'.** As noted on the field form, if a replicate sample is collected, staff must label both the regular and replicate '**7**'. The sample times should be noted 15 minutes apart, even if they are taken concurrently. Figures 4 and illustrates both examples below.

Figure 4: Regular Sample Time and Type

Time: Label Fairfax replicates 15 minutes past regular samples and blanks 5 minutes before regular samples.
Sample Type: A regular sample is Sample Type 9. If a replicate is collected, label both regular and replicate 7. If a blank is collected, label the blank Sample Type 2 and the regular sample Sample Type 9.

Sample Type	Time	Medium	Sample Type	Dupl. Type 99105	
Regular	1000	WS	9		
Replicate		WSQ	7	30 (split)	

Figure 5: Replicate Sample Time and Type

Time: Label Fairfax replicates 15 minutes past regular samples and blanks 5 minutes before regular samples.
Sample Type: A regular sample is Sample Type 9. If a replicate is collected, label both regular and replicate 7. If a blank is collected, label the blank Sample Type 2 and the regular sample Sample Type 9.

Sample Type	Time	Medium	Sample Type	Dupl. Type 99105	
Regular	1215	WS	7		
Replicate	1230	WSQ	7	30 (split)	

All nutrient and bacteria samples should be stored in a cooler with wet ice. Sediment bottles can be stored without ice. As an additional precaution, be sure that

the bottles remain upright in the cooler, as it is possible that the lids are not completely sealed.

4. Sample Drop-off

Once all sites in the sampling route have been completed, staff will immediately transport samples to the Fairfax County Environmental Monitoring Laboratory at the Noman M. Cole, Jr., Pollution Control Plant. This lab is certified under the Virginia Environmental Laboratory Accreditation Program (VELAP). The samples will then be processed according to the analyte suite listed in Table 2 within the applicable holding times.

5. Analytes

Per the permit requirements, parameters to be tested are sediment, bacteria and a suite of nutrients. These parameters will provide information about suspended material transport, the presence of pathogenic material, and deposition and mobilization of nutrients commonly used in detergents and fertilizers. The analyte suite is shown below in Table 2.

Table 2: Field and Laboratory Analytes with Method Detection and Reporting Limits for Fairfax County In-Stream Monitoring Program.

Parameter	Method Detection Limit	Reporting Limits	Method	Holding Time
pH	NA	NA	Field Measurement	Analyze at collection
Dissolved Oxygen	NA	NA	Field Measurement	Analyze at collection
Temperature	NA	NA	Field Measurement	Analyze at collection
Total Suspended Solids	0.1 mg/L	1.0 mg/L	SM 22nd Ed 2540 D	7 Days
Ammonia as Nitrogen	0.047 mg/L	0.1 mg/L	EPA 350.1	28 Days
Nitrate plus Nitrite Nitrogen	0.026 mg/L	0.1 mg/L	EPA 353.2	28 Days
Total Kjeldahl Nitrogen	0.056 mg/L	0.2 mg/L	EPA 351.2	28 Days
Total Nitrogen	NA	NA	Calculated	NA
Dissolved Phosphorus	0.0080 mg/L	0.03 mg/L	SM 22nd Ed. 4500 P-E	28 Days
Total Phosphorus	0.0080 mg/L	0.03 mg/L	SM 22nd Ed. 4500 P-E	28 Days
Escherichia coli	<1 MPN/100 mL	1 MPN/100 mL	Colilert MPN	8 Hours

IV. Documentation/Reporting Procedures

A. Documentation of Field Monitoring

For sample events, a dedicated field form (Appendix D) is used to document the following information:

- Site Name

- Sample Date -
- Sample Time -
- Field crew -
- Stream Condition -
- Field Measurements -

B. Chain of Custody

Chain of custody (COC) forms, used for all samples, are a permanent record of transfer of sample custody. Custom COC forms for this project are preprinted with the site names and sample date. Field staff need only to complete the sample time during collection and indicate laboratory delivery date and time during drop-off of samples. Chain of custody should also be signed by receiving laboratory once samples are delivered. Field staff should make a copy of signed chain of custody and retain for their records.

V. In-Stream Monitoring Reports

For the In-Stream Monitoring Program, Fairfax County will produce an annual report that shall include a summary of the monitoring results and analyses for the five selected sites. Along with this information, an interpretation of the data with respect to long-term patterns and trends will be initiated and built upon with each additional year of data.

A. Monitoring Yearly Report

At the end of each MS4 reporting year (July 1 – June 30), a report on in-stream monitoring is prepared for use in the development of the County's annual MS4 report to VA DEQ. The yearly report includes the following:

- The list of locations where in-stream monitoring was conducted
- Sample date for each collection
- A compilation of analytical results for each site

Year 2 through Year 5 reports will include comparisons to prior years monitoring efforts and results. The Year 5 report will also include an overall summary of the five years of monitoring with respect to any developing patterns or trends discerned in the data.

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. Appendices

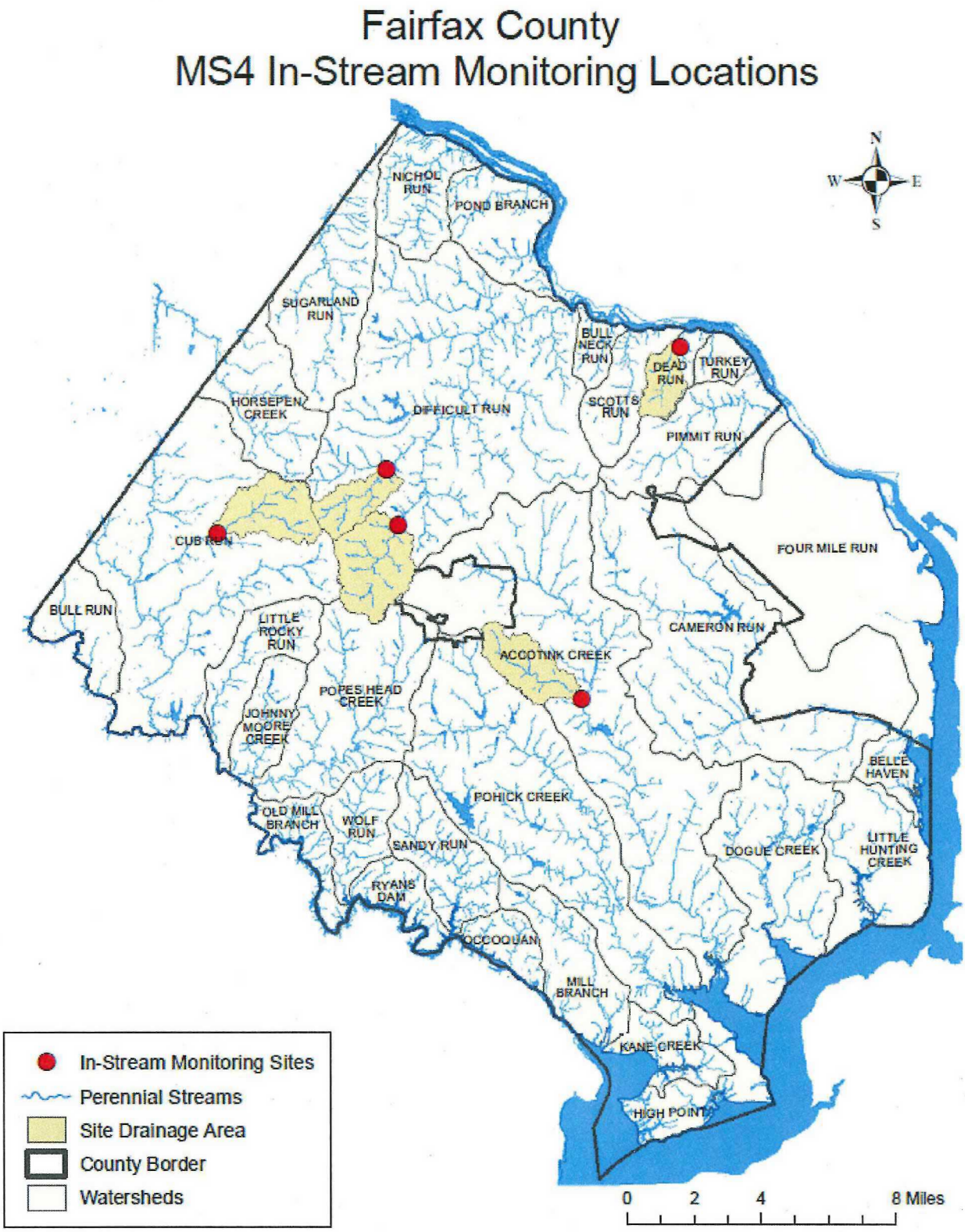
A. Fairfax County MS4 In-Stream Monitoring Locations

B. Health and Safety Guidance for In-Stream Monitoring Field Work

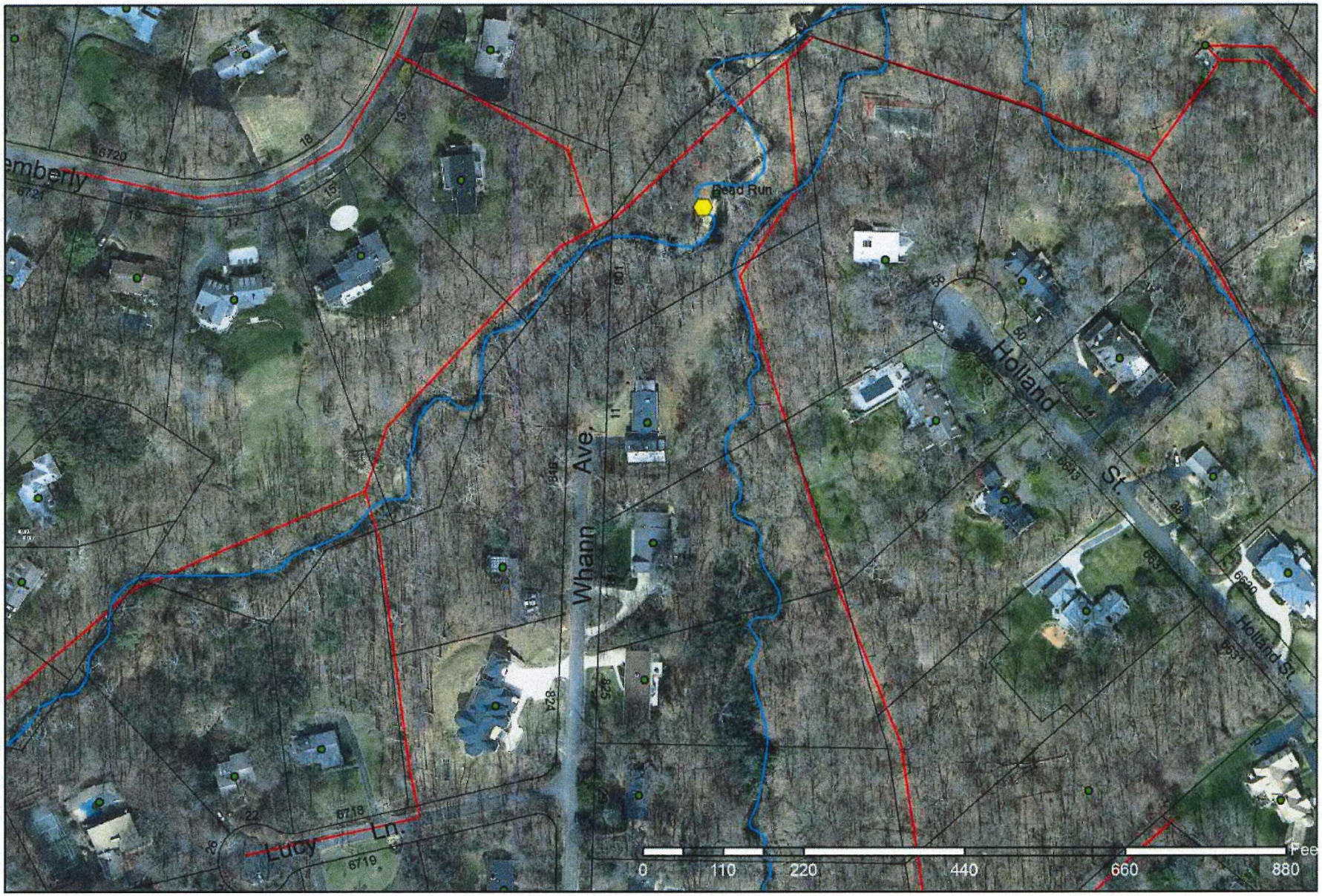
C. Calibration Procedures for Water Quality Field Instruments

D. In-Stream Monitoring Field Form

Appendix A: Fairfax County MS4 In-Stream Monitoring Locations



Dead Run USGS Sites
Tax Map 21-2

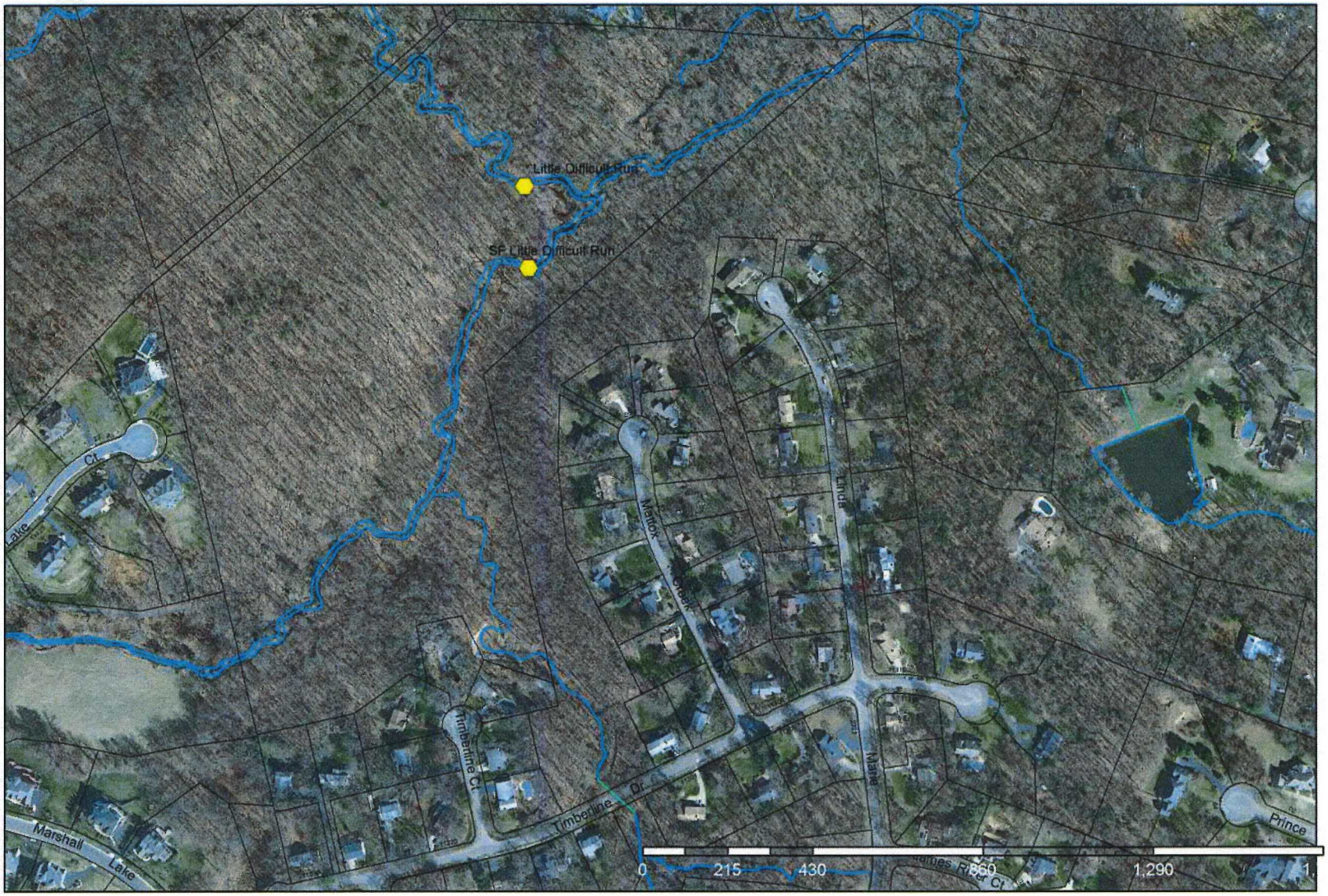


Difficult Run USGS Sites
Tax Map 47-1

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 In-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 protocol 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. - Storm sewers 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, 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.
- Smoking, eating, drinking and chewing shall be conducted only in designated areas.
- 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 personal protective equipment, 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, if necessary, will be performed in accordance with OSHA confined space entry procedures, industry-standard practices, and will be performed by confined space trained personnel.

The Team Leader will provide ongoing, real time ambient air monitoring of the locations to be sampled to determine the need for personal protection. Entry of the sampling personnel will be allowed if the following criteria are met:

- Oxygen level greater than 19.5%. Atmospheres with oxygen concentrations less than 19.5% are considered oxygen deficient and must be treated as Immediately Dangerous to Life and Health (IDLH) atmospheres.
- Lower explosive limit (LEL) reading is less than 3%

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); 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.

Unknown hazardous substances and wastes

The nature of environmental consulting often times requires the investigation of hazardous substances or wastes whose identity is not known. Because of the serious personal and environmental consequences of unintentional release of chemicals, very specific health and safety procedures must be implemented to monitor ambient conditions, mitigate releases to the environment, and protect workers from exposure. Most of these procedures dovetail with site investigation, sampling, and remediation techniques outlined by EPA policy and should be included in the project comprehensive work plan.

Bloodborne pathogens

Exposure to bloodborne pathogens (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 lifesaving 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 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. In the event of adverse weather conditions, the Field Team Leader will determine if work can continue without endangering the health and safety of site personnel.

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. The individual will drink electrolyte-replacement fluids (e.g., Gatorade, Squencher, 10-K), which will be made available to field personnel. 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 symp- toms 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 heartb eat. 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: Calibration Procedures for Water Quality Field Instruments

The following is the typical order in which field staff should calibrate a sonde in preparation for a day of water quality sampling. The order in which individual probes are calibrated is not important, but we recommend calibrating the SC probe before the pH probe – pH standards have a very high specific conductance (an order of magnitude higher than SC standard), and any standard accidentally left in the calibration cup could throw off the SC calibration.

Try to keep your standards within 5 °C of expected stream temperatures to ensure accurate calibrations. This may require putting the standards in the vehicle the day before calibrating to cool them overnight or placing the standards in a refrigerator overnight. Do not allow standards to freeze. It is recommended to bring standards into the field in order to recalibrate the field meter should some issue arise while away from the office.

Dissolved Oxygen

Make sure the instrument is turned on and the sonde is running. To calibrate DO% in water saturated air, pour a small amount of water (1/8 inch) in the plastic storage cup. Make sure there are no water droplets on the DO membrane or temperature sensor. Then install the storage sleeve over the sensor. Screw it on to the cable and then disengage one or two threads to ensure atmospheric venting. Wait approximately 5 – 15 minutes to allow the chamber to equilibrate and become completely saturated.

Go through the calibration steps from the main menu screen. **Be sure to calibrate only to one point at 100% saturation.** Return to the sonde run screen.

Specific Conductivity

Remove the black cap from the cal cup and pour a small amount of 1000 µS/cm standard onto the SC probe (the probe with 2 open holes and the metal thermistor protruding from the plastic probe body). Cap the cup and shake vigorously to cover all interior surfaces with standard. Discard this standard and repeat twice more (a "triple rinse"). Then, pour in enough standard to submerge the SC probe and replace the black cap. Record this SC value along with the standard temperature, standard lot number, and standard expiration date. (Also record the lot numbers and expiration dates of the other SC standards used). If the reading is ±3% from the expected value, the probe needs to be calibrated. It is recommended to calibrate if the sonde is reading ±1.5% from the expected value. **The specific conductivity probe is only ever calibrated to 1000 µS/cm**, and any readings in other standards are just to confirm that the calibration was a valid calibration. Record the temperature and SC after the probe is calibrated. Return to the sonde run screen.

Triple rinse in 250 µS/cm standard, then record the reading in the same standard. Repeat for 50 µS/cm standard. The reading in 250 µS/cm standard should be within 3%, and the reading in 50 µS/cm should be within 5 µS/cm.

If either of these is off, go back and calibrate in 1000 µS/cm standard (if not already done) and repeat the checks in 250 and 50 µS/cm standard. If the values continue to be off, try to troubleshoot the probe – clean the probe ports with an SC probe brush, rinse with DIW before using the SC standard, or open fresh bottles of standard.

In winter months, follow all of this up with a check reading in 10,000 µS/cm standard to make sure the SC probe is operating well in the high SC range.

pH

Triple rinse with pH 7 standard and record the standard temperature as well as a reading from the pH probe. Take this opportunity to write down hypothetical pH values for the 7, 10, and 4 pH standards, all lot numbers, and all expiration dates of the standards. You may need to let the pH probe equilibrate for a few minutes if the standards are cold before recording the first reading. It is recommended that the pH probe is calibrated every time it is used, and the manufacturer recommends that the probe be calibrated if it gives readings ± 0.2 units from the hypothetical pH value.

To calibrate, follow the steps for a three point pH calibration from the main menu. Triple rinse with each standard before actually calibrating, and enter the hypothetical pH values as the values to which the probe should be calibrated. **Always start by calibrating to pH 7**, then calibrate to pH 10 and pH 4 (the order of these two standards is not important). Be sure to record the reading after the probe is actually calibrated. Once fully calibrated, return to the sonde run screen.

Your water quality field instrument is ready for use in the field.

Appendix D: Field Form for In-Stream Monitoring

STATION NO: 01645704 SAMPLE DATE: 9/21/2012 PURPOSE OF SITE VISIT (50280) 1001

STATION NAME : Difficult Run Above Fox Lake Nr Fairfax, VA MEAN SAMPLE TIME (CLOCK) 1045 TIME DATUM: EST EDT

PROJECT NO.: GC13LM009RO3500 PROJECT NAME: FAIRFAX MONITORING HYDRO EVENT 9 HYDRO COND 9

SAMPLING TEAM : JKMcCulla, JDJastram TEAM LEAD SIGNATURE James-Ulla DATE 09/22/2012

Time: Label Fairfax replicates 15 minutes past regular samples and blanks 5 minutes before regular samples.
Sample Type: A regular sample is Sample Type 9. If a replicate is collected, label both regular and replicate 7. If a blank is collected, label the blank Sample Type 2 and the regular sample Sample Type 9.

Analysis Source 5
Collecting Agency USGSVAWC

Sample Type	Time	Medium	Sample Type	Dupl. Type 99105	
Regular	1045	WS	9		
Replicate		WSQ	7	30 (split)	
Lab Split		WSQ	7	200 (lab-split)	
Blank		OAQ	2		
Reference		OAQ	6		
Other					

SAMPLES COLLECTED

SUSP. SED. X
NUTRIENTS X
OTHER: _____

FIELD MEASUREMENTS

GAGE HT (00065) 0.84 ft
COND (00095) 164 µS/cm@25 °C
DIS. OXYGEN (00300) 8.26 mg/L
TEMP, AIR (00020) 19.5 °C
BAROMETRIC PRES. (00025) 756 mm Hg
TEMP, WATER (00010) 16.28 °C
TURBIDITY (63680) 2.0 FNU
pH (00400) 7.09 UNITS

GAGE HEIGHT READINGS:
0.84 @ 1058
_____ @ _____

SOURCE: STAFF PLATE
OTHER: _____ (REASON: _____)

SAMPLING INFORMATION

Sampler Type (84164) 3070 Sampler ID GRAB

Sampler Bottle/Bag Material: PLASTIC TEFLON OTHER _____ Nozzle Material: PLASTIC TEFLON OTHER _____ Nozzle Size: 3/16" 1/4" 5/16"

Stream Width: _____ ft mi Left Bank _____ Right Bank _____ Mean Depth: _____ ft Ice Cover _____ % Ave. Ice Thickness _____ in.

Sampling Points: CENTROID SAMPLE THREE FIVE EQUIDISTANT STATIONS Standard: _____

Sampling Location: WADING BRIDGE UPSTREAM DOWNSTREAM SIDE OF BRIDGE 40 ft mi above below at gage _____

Sampling Site: POOL RIFFLE OPEN CHANNEL BRAIDED BACKWATER Bottom: BEDROCK ROCK COBBLE GRAVEL SAND SILT CONCRETE OTHER _____

Stream Color: BROWN GREEN BLUE GRAY CLEAR OTHER _____ Stream Mixing: WELL MIXED STRATIFIED POORLY-MIXED UNKNOWN OTHER _____

Weather: SKY: CLEAR PARTLY CLOUDY CLOUDY PRECIP: LIGHT MEDIUM HEAVY SNOW RAIN MIST WIND: CALM LIGHT BREEZE GUSTY WINDY EST. WIND SPEED _____

TEMP: VERY COLD COOL WARM HOT Stage: STABLE, NORMAL STABLE, HIGH RISING FALLING PEAK

Sampling Method (82398): EWI [10] GRAB [70] SINGLE VERTICAL [30] MULT VERTICAL [40]

COMPILED BY: _____ CHECKED BY: _____ DATE: _____