

1. Title Page

# STREAMWATCH VOLUNTEER WATER QUALITY MONITORING PROGRAM BIOLOGICAL ACTION TEAM (BAT)


## QUALITY ASSURANCE PROJECT PLAN (QAPP) Fall 2023 – Spring 2026

Effective Date: August 9, 2023

The Watershed Institute  
31 Titus Mill Road, Pennington, NJ 08534  
609-737-3735  
thewatershed.org

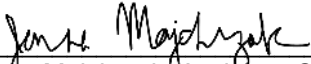
PREPARED BY:  Date: 8/9/2023  
Erin Stretz, NJ Watershed Watch Network Coordinator  
The Watershed Institute

REVIEWED BY:  Date: \_\_\_\_\_  
Jan Smith, StreamWatch Program Coordinator  
The Watershed Institute

REVIEWED BY:  Date: 9/19/2023  
Chris Kunz, Bureau Chief  
NJDEP Bureau of Freshwater and Biological Monitoring

REVIEWED BY:  Date: 9/19/2023  
Frank Klapinski, Environmental Scientist  
NJDEP Bureau of Environmental Analysis, Restoration and Standards

APPROVED BY:  Date: 8/10/2023  
Deborah Kratzer, Environmental Specialist  
NJDEP Bureau of Environmental Analysis, Restoration, and Standards

REVIEWED BY:  Date: 9/19/2023  
Jenna Majchrzak, Assistant Quality Assurance Officer  
NJDEP Office of Quality Assurance

## Table of Contents

|  |    |
|--|----|
| 1. Title Page.....                                       | 1  |
| 2. Project Management.....                               | 4  |
| 2.1. Project Organization .....                          | 4  |
| 2.2. Project Distribution List.....                      | 4  |
| 2.3. Project Organization Chart .....                    | 5  |
| 3. Problem Definition and Background.....                | 5  |
| 4. Project Description.....                              | 5  |
| 4.1. Project Summary and Objectives .....                | 5  |
| 4.2. Study Area .....                                    | 6  |
| 4.3. Project Schedule.....                               | 6  |
| 4.4. Intended Use of Data.....                           | 7  |
| 5. Data Quality Objectives .....                         | 7  |
| 5.1. Measurement Quality Objectives.....                 | 7  |
| 5.2. Data Representativeness .....                       | 7  |
| 5.3. Data Comparability .....                            | 7  |
| 5.4. Data Completeness .....                             | 7  |
| 6. Training and Experience.....                          | 7  |
| 7. Existing Data and Data from Other Sources .....       | 8  |
| 8. Sampling Design and Data Collection Methods .....     | 8  |
| 8.1. Sampling Design.....                                | 8  |
| 8.2. Data Collection Methods.....                        | 8  |
| 8.2.1. Air and Water Temperature .....                   | 8  |
| 8.2.2. Wetted Width .....                                | 8  |
| 8.2.3. Depth .....                                       | 8  |
| 8.2.4. Velocity .....                                    | 9  |
| 8.2.5. Macroinvertebrate Sampling and Preservation ..... | 9  |
| 8.2.6. RBP Habitat Assessment .....                      | 9  |
| 9. Equipment List and Calibration Requirements .....     | 10 |
| 9.1. Equipment List.....                                 | 10 |
| 9.2. Instrument Calibration and Maintenance.....         | 10 |
| 9.3. Instrument Decontamination.....                     | 10 |
| 10. Sample Handling and Chain of Custody.....            | 10 |
| 11. Analytical Methods.....                              | 11 |
| 12. Quality Control Summary .....                        | 11 |
| 13. Data Management .....                                | 11 |
| 14. Data Analysis.....                                   | 11 |
| 15. Oversight and Assessments.....                       | 12 |
| 16. Data Review and Usability.....                       | 12 |

|   |    |
|---|----|
| 17. Reporting .....   | 12 |
| 18. References .....  | 12 |
| 19. Appendices .....  | 14 |
| A. Sample Locations .....   | 14 |
| B. Data Sheets .....  | 17 |
| B-1 Habitat and Macroinvertebrate Field Data Sheet with EPA RBP, High Gradient.....     | 17 |
| B-2 Habitat and Macroinvertebrate Field Data Sheet with EPA RBP, Low Gradient.....      | 17 |
| B-3 Chain of Custody Form.....  | 17 |
| B-4 Preservation Jar Labels .....   | 17 |
| C. Tier 3.3 Field Accreditation and Audit Checklist.....                                | 27 |
| D. Normandeau Associates, Inc. Quality Assurance Documentation.....                     | 29 |
| Table 1: Project Organization .....   | 4  |
| Table 2: QAPP Distribution List.....  | 4  |
| Table 3: StreamWatch BAT Schedule 2022-2025 .....                                       | 6  |
| Table 4: Measurement Quality Objectives .....   | 7  |
| Table 5: Analytical method for macroinvertebrate and habitat methods index scoring..... | 11 |
| Figure 1: StreamWatch Organization Chart .....  | 5  |
| Figure 2: StreamWatch BAT Study Area in WMAs 10, 11, and 20 .....                       | 6  |

## 2. Project Management

### 2.1. Project Organization

Table 1: Project Organization

| Role  | Name                   | Organization  | Responsibilities   |
|---|------------------------|---|--|
| Project and Field Manager                           | Jian Smith             | The Watershed Institute   | <ul style="list-style-type: none"> <li>• Overall project implementation</li> <li>• Scheduling training and QA audits</li> <li>• Maintaining records of training and QA audits for volunteers</li> <li>• Implementing QAPP, initiating corrective actions as needed</li> <li>• Revising QAPP as needed or a minimum of every 3 years</li> <li>• Distributing QAPP, and any revisions, to distribution list</li> <li>• Data QA/QC, management, and analysis</li> </ul> |
| QA Manager / NJ Watershed Watch Network Coordinator | Erin Stretz            | The Watershed Institute   | <ul style="list-style-type: none"> <li>• Overall project design</li> <li>• Assists project manager with QAPP implementation and QA/QC measures</li> <li>• Trains, tests, and audits project manager and field personnel</li> </ul>   |
| Field Personnel                                     | StreamWatch volunteers | The Watershed Institute   | <ul style="list-style-type: none"> <li>• Attends training, testing, and audit sessions</li> <li>• Conducts field assessments</li> <li>• Reports any problems or deviations from QAPP to project manager</li> </ul>   |
| NJDEP Community Water Monitoring Program Liaison    | Deborah Kratzer        | NJDEP Bureau of Environmental Analysis, Restoration and Standards | <ul style="list-style-type: none"> <li>• CWM program coordination</li> <li>• Technical assistance and audits</li> <li>• QAPP approval</li> </ul>   |

### 2.2. Project Distribution List

Table 2: QAPP Distribution List

| Name                                  | Organization  | Contact Information                                     |
|---------------------------------------|---|---|
| Jian Smith                            | The Watershed Institute   | jsmith@thewatershed.org<br>streamwatch@thewatershed.org |
| Erin Stretz                           | The Watershed Institute, NJ Watershed Watch Network                       | estretz@thewatershed.org                                |
| Volunteers (or other field personnel) | The Watershed Institute   | bats@thewatershed.org                                   |
| Deborah Kratzer                       | NJDEP Bureau of Environmental Analysis, Restoration and Standards (BEARS) | Deborah.Kratzer@dep.nj.gov                              |
| Frank Klapinski                       | NJDEP BEARS   | Frank.Klapinski@dep.nj.gov                              |
| Chris Kunz                            | NJDEP Bureau of Freshwater and Biological Monitoring (BFBM)               | Chris.Kunz@dep.nj.gov                                   |
| Jenna Majchrzak                       | NJDEP Office of Quality Assurance (OQA)                                   | Jenna.Majchrzak@dep.nj.gov                              |

### 2.3. Project Organization Chart

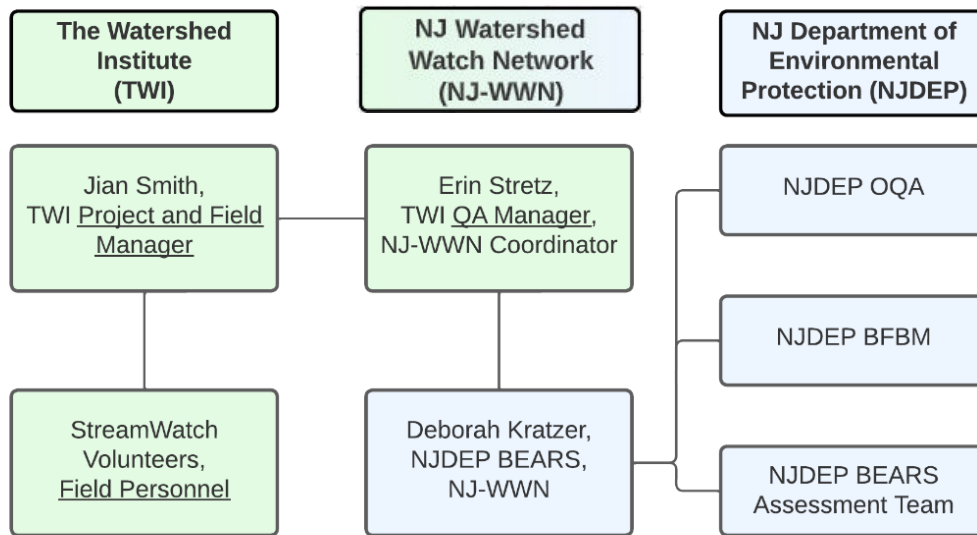


Figure 1: StreamWatch Organization Chart

## 3. Problem Definition and Background

Increasing land development, point and non-point source pollution, and climate change all pose serious risks to the health of Central New Jersey’s rivers and streams. Background water quality data is needed to track these impacts and provide information for where restoration and protection are needed. The StreamWatch program was launched in 1992 by The Watershed Institute, then called the Stony Brook-Millstone Watershed Association, as an outgrowth of the Water Watch education program. The goal of the StreamWatch program is to characterize the health of streams in the Millstone River watershed, and it was led largely by Princeton Garden Club volunteers. For the first three years of StreamWatch, only chemical parameters were measured.

In spring 1995, the StreamWatch Biological Action Team (BAT) was created to enhance monitoring at some of the existing chemical monitoring sites and to fill data gaps in the 5-year NJDEP AMNET sampling schedule. In 2018, the geographic scope of the BAT program was expanded to include portions of the Central Delaware River. In 2016, sampling and sample preservation protocols were updated and volunteers were retrained to increase the rigor of the volunteer-collected data to what is now considered Tier 3.3 monitoring. The StreamWatch BAT program will continue indefinitely into the future, provided that there are sufficient staff, funding, and volunteers.

## 4. Project Description

### 4.1. Project Summary and Objectives

The StreamWatch BAT program seeks to characterize the baseline biological and habitat condition of freshwater non-tidal streams in Central New Jersey. Volunteers collect macroinvertebrate samples through 10-20 kicks, sweeps, or jabs, hereafter collectively referred to as “nets”, using 500-600 micron D-frame nets from the most productive habitats in a 100-meter stream reach. Volunteers preserve the net contents in the field using 95% ethanol in a 1-liter plastic jar. Concurrent to macroinvertebrate sampling, volunteers will conduct a physical and habitat assessment within the 100-meter reach which includes the 10-question EPA Rapid Bioassessment Protocol (RBP). Volunteers will return completed field data sheets and sample jars to the StreamWatch project manager for review and data entry into an internally-maintained data management system. Preserved sample jars will be sent to Normandeau Associates, Inc for identification to the lowest practicable taxonomic level.

- To characterize the water quality in the Millstone River and Central Delaware River Watersheds;

- To involve community members in observing, monitoring, recording, and reporting stream conditions;
- To motivate the public to initiate change in their use of the land and drainage systems that will enhance water quality; and
- To provide quality data to decision-makers to identify restoration and protection needs.

#### 4.2. Study Area

Monitoring will be conducted in the Millstone River watershed (Watershed Management Area [WMA] 10), as well as the adjacent stretch of the Delaware River watershed from Alexauken Creek in Lambertville (WMA 11) to the north down to Crosswicks Creek south of Trenton (WMA 20).

Sites are primarily positioned at the pour point of HUC-14s to characterize the upstream subwatershed or are located near areas of local concern. Sites are located at least 500 feet downstream of impoundments. A site list is provided in Appendix A. The study area is divided into two habitat types: high gradient and low gradient/coastal plain.

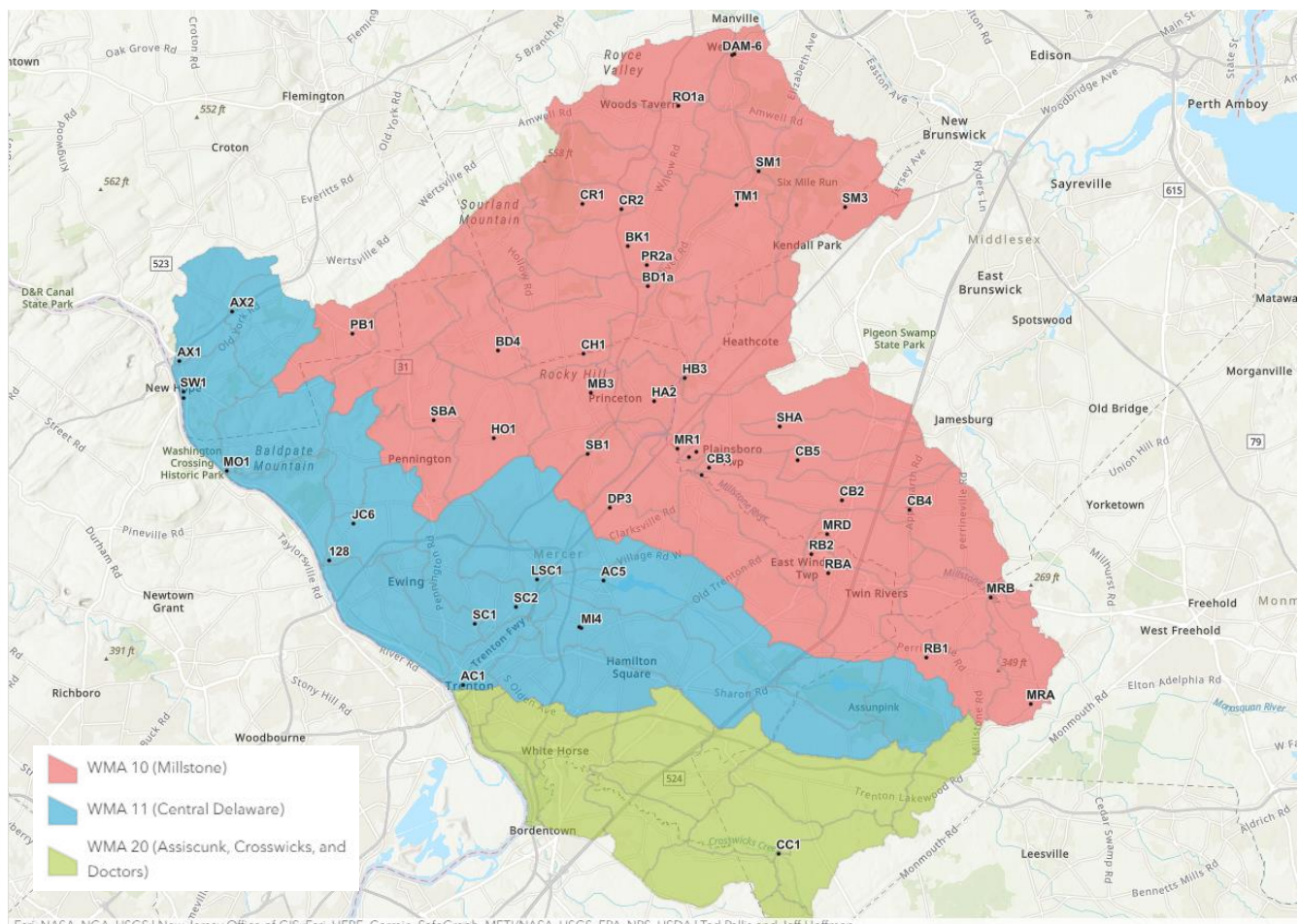


Figure 2: StreamWatch BAT Study Area in WMAs 10, 11, and 20

#### 4.3. Project Schedule

Sampling periods will last for 6 weeks in the spring and fall of each year.

Table 3: StreamWatch BAT Schedule 2022-2025

|      | Spring           | Fall                      |
|------|------------------|---------------------------|
| 2023 | April 1 – May 14 | September 16 – October 29 |
| 2024 | April 6 – May 19 | September 14 – October 27 |

|             |                  |                           |
|-------------|------------------|---------------------------|
| <b>2025</b> | April 5 – May 18 | September 20 – November 2 |
|-------------|------------------|---------------------------|

#### 4.4. Intended Use of Data

The StreamWatch BAT program operates at the NJ Tier 3.3 regulatory level of data quality as defined by the NJDEP and NJ-WWN (NJ-WWN, 2022). The data will be submitted to the Water Quality Exchange (WQX) for NJDEP use in regulatory assessment.

### 5. Data Quality Objectives

#### 5.1. Measurement Quality Objectives

Table 4: Measurement Quality Objectives

| Parameter                        | Measurement Range   | Accuracy   | Precision   |
|----------------------------------|---|--|---|
| Macroinvertebrate collection     | 100-meter reach; 10-20 nets                                   | Multi-habitat approach; Volunteers must not deviate significantly from appropriate techniques during field accreditation |   |
| Habitat assessment               | 100-meter reach; EPA RBP habitat assessment ranges from 0-200 | Volunteers must not deviate significantly from appropriate techniques during field accreditation                         | ±1 unit for EPA RBP score                                     |
| Macroinvertebrate identification | 100 organisms   | 90% accuracy compared to known sample  | See Normandeau Associates, Inc. QA documentation (Appendix D) |
| Temperature                      | -5°C to 40°C  | Calibration to NIST thermometer within 1°C   | 0.5°C   |

#### 5.2. Data Representativeness

StreamWatch BAT volunteers collect baseline data to reflect ambient conditions. Sites are generally positioned at the pour point of HUC-14s to characterize the subwatershed as a whole.

Monitoring sites will be located at least 500 ft downstream of dams and lakes to avoid the influence of impoundments on water quality.

#### 5.3. Data Comparability

BAT data is collected in accordance with established NJDEP community water monitoring procedures (NJ-WWN, 2022). While there are aspects of the visual habitat assessment that are subjective, volunteers are trained and accredited together to “calibrate their eyes”. They are asked to include descriptive assessments on the habitat assessment data sheet to add clarification where needed.

#### 5.4. Data Completeness

Data sheets will be checked for completeness by field personnel prior to leaving the stream monitoring site. Data will be assessed for gaps or abnormalities by the project manager upon review and data entry, which will be addressed prior to submitting the data to WQX.

### 6. Training and Experience

Field personnel attend a multi-day training workshop held by NJDEP-accredited staff from The Watershed Institute to learn and gain hands-on experience with macroinvertebrate collection and preservation, habitat

assessment, decontamination, and field safety protocols. Before field personnel are eligible to collect data at the Tier 3 level, they are evaluated on their ability to conduct a macroinvertebrate and habitat assessment through a field accreditation administered by the NJ Watershed Watch Network (checklist provided in Appendix C). Individuals must undergo field accreditation every three years.

## 7. Existing Data and Data from Other Sources

In the absence of first-hand accounts of weather and precipitation amounts, historical records may be drawn from Weather Underground (<https://www.wunderground.com/history>).

## 8. Sampling Design and Data Collection Methods

### 8.1. Sampling Design

24 sites are currently listed as 'Active' on the site list in Appendix A. These sites are monitored annually in the spring and/or fall as volunteers are available. The number of active sites will fluctuate as accredited volunteers shift in and out of the program, but each site will be monitored at least once during the QAPP coverage period (three years). Sites listed as 'Priority' and 'Secondary' will be filled if there are sufficient accredited volunteers.

Habitat and macroinvertebrate assessments will be conducted concurrently. The assessment area will span a stream reach of approximately 100 meters. In the event that there are access limitations due to private property boundaries or safety concerns, the actual stream length will be adjusted accordingly and indicated on the data sheet. Field personnel will confirm their sampling location geographic coordinates through a map application on a smartphone or GPS device.

Field personnel will work in pairs or groups for safety. Peak flows will be avoided and samples should not be collected during or immediately after a rain event that appears to significantly affect water quality or safety. In the event that the site is not safe, field personnel will be asked to visit the site again on another date when it is safe to enter the stream. It is the responsibility of field personnel to check weather conditions before visiting the stream to conduct an assessment. If the site is not safe for any reason, field personnel will report back to the project manager.

### 8.2. Data Collection Methods

The field parameters that will be measured on-site are the weather conditions, air and water temperature, stream wetted width, stream depth, stream velocity, and aquatic macroinvertebrate counts. A visual assessment is performed on the aquatic and riparian habitat conditions using the NJ Habitat and Macroinvertebrate Data Sheet and USEPA RBP form for the appropriate habitat type (Appendix B). Measurement protocols are in line with the NJDEP Community Monitoring Habitat and Biological Assessment Manual (NJDEP, 2022).

#### 8.2.1. Air and Water Temperature

Air and water temperatures are measured with the assigned thermometer, which is calibrated annually by the NJ-WWN at the NJDEP BFBM lab. The thermometer will be allowed to acclimate for at least one minute before reading the measurement. Air is measured first, followed by the water.

#### 8.2.2. Wetted Width

In a section of stream that is representative of the 100 m reach, measure the wetted width of the stream, from water's edge to water's edge using a measuring tape.

#### 8.2.3. Depth

Take 5 depth measurements across the width of the stream at the section where wetted width is recorded. The first and fifth depth measurements are collected about 1 ft from the streambank. The third depth measurement is collected in the center of the stream, with two depth measurements equally spaced on both sides.

#### 8.2.4. Velocity

Stream velocity will be measured by calculating the amount of time it takes a neutrally buoyant object, like a tennis ball, orange, or weighted rubber duck, to travel over a length of stream. Two field personnel will stand 10 feet or 3 meters apart from one another longitudinally. The neutrally buoyant object will be dropped behind the first person and allowed to equilibrate in the flow before passing the start point and measuring time. The measurement will be repeated for a total of 4 times to account for variations. The average time will be used to determine the average velocity of the stream. This will be done by dividing the float distance (D) by the average time (T) to calculate velocity in meters per second ( $V = D/T$ ). The result will be recorded in meters per second on the data sheet.

#### 8.2.5. Macroinvertebrate Sampling and Preservation

Ten to twenty kicks, jabs, and/or scoops will be performed with a 500-600 micron mesh D-net throughout the 100 meter reach with the goal of collecting at least 100 macroinvertebrate specimens. Sampling effort is allocated to the most productive habitats present proportionate to the habitat types present. For example, if riffle is the dominant productive habitat type present, sampling is concentrated in this habitat type. If a habitat type is found in less than 10% of the sampling reach, it is not targeted. Freshly fallen woody debris or leaves and silt/sand are not targeted unless more established habitats are not present.

In riffle and cobble habitat, the D-net is placed facing upstream and square with the bottom. The sampling area is one square foot upstream of the net. All rocks that can be picked up in the sampling area are scrubbed into the net to remove clinging organisms. Once the area is cleared of cobble, personnel will vigorously shuffle their feet until the benthos is fully disturbed, or for about 45 seconds to one minute. The stream flow will carry organisms into the net. Upon completion of the "kick," the net should be picked up carefully to avoid losing any of the sample. Coarse gravel and sandy bottom substrates can be sampled in the same manner, taking care not to kick too much sediment into the net.

Aquatic vegetation and vegetated bank margins are sampled by jabbing the net into the aquatic habitat to dislodge clinging organisms, then sweeping the net through the water to capture dislodged organisms. Submerged logs and woody debris are scraped vigorously, after which the net is swept through the water column to capture dislodged organisms. Leaf packs are picked up and rubbed into the net. After these habitats are fully disturbed, or after about 30 seconds, personnel swish the net back and forth to collect any remaining organisms in the water column. Each sample will cover approximately 3 feet in length.

Net contents are deposited into the bucket after each kick or jab. After the final net is collected, it is carefully examined for clinging organisms. Larger pieces of debris are removed from the sample, after being rinsed and picked clean of organisms. The bucket is poured through the sieve to remove water and its contents are scooped into the preservation jar. The bucket and sieve are rinsed gently with 95% ethanol and poured into the preservation jar, then inspected for any remaining organisms. The sample contents will be covered with at least one inch of ethanol and an adhesive label will be attached and completed in pencil (Appendix B).

#### 8.2.6. RBP Habitat Assessment

A visual-based habitat assessment will be performed at each site using USEPA's Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition (RBP) form for high or low gradient streams (Barbour et al., 1999) depending on the monitoring site location. The RBP habitat assessment method, which evaluates 10 different in-stream and riparian zone parameters, is tabulated for the entire assessed stream reach (usually 100 m). Based on the score, the habitat is rated as optimal, suboptimal, marginal, or poor. The habitat assessment is performed concurrent with the collection of the benthic macroinvertebrate sampling.

The NJ Habitat and Macroinvertebrate data sheet (Appendix B) will also be completed in the field, including parameters for both physical and habitat assessment. Additional observations and photographs may be recorded to document potential stressors.

## 9. Equipment List and Calibration Requirements

### 9.1. Equipment List

#### MACROINVERTEBRATE AND HABITAT ASSESSMENT

- Clipboard, pen, and pencil
- Data sheets (see Appendix B)
- Waders
- D-Net, 500-600 micron mesh
- 5-gallon bucket
- Sieve or sieve bucket, 500-600 micron mesh
- Utensils (plastic spoons, field forceps)
- Ethanol, 95%
- Preservation jars
- Jar labels
- Meter stick
- 100-meter measuring tape
- Neutrally buoyant object (ex. tennis ball, weighted rubber duck, orange)
- Stopwatch or phone timer

#### DECONTAMINATION

- Alconox, or other phosphate-free detergent
- 5-gallon bucket or large plastic bin
- Scrub brush

### 9.2. Instrument Calibration and Maintenance

The project manager will inspect all equipment before it is handed over to field personnel. It is the responsibility of field personnel to report any equipment damage to the project manager.

Alcohol thermometers will be calibrated annually against a NIST certified thermometer at the NJDEP Bureau of Freshwater and Biological Monitoring lab.

### 9.3. Instrument Decontamination

Field personnel are required to decontaminate their equipment after each stream habitat and biological assessment. It is imperative that all equipment and personal items (such as boots) that have been in the water are thoroughly decontaminated to prevent the spread of invasive species to unaffected streams.

- a. Remove all organic material from the equipment.
- b. Fill the bucket with stream water, add phosphate-free soap to the water, and mix to create bubbles.
- c. Place all equipment into the bucket and use a scrub brush to vigorously scrub all equipment.
- d. Let air dry.

The soap solution can be disposed of outdoors, as far from the stream as possible, to biodegrade.

Alternatively, equipment may be allowed to air dry and remain dry for at least 72 hours to eradicate all clinging invasive organisms. Field personnel are also permitted to visit multiple sites on the same stream system as long as they begin at the furthest upstream site and work their way downstream.

## 10. Sample Handling and Chain of Custody

Field personnel will label and deliver preserved jars with a chain of custody form (Appendix B) to the project manager who will log each delivery in a sample log (Appendix B). Jars and forms will be stored at The Watershed

Institute and transported en masse to the Normandeau Associates, Inc. lab for processing and identification. The lab will return chain of custody forms to The Watershed Institute upon completion of sample processing.

## 11. Analytical Methods

Normandeau Associates, Inc., an independent laboratory located in Spring City, Pennsylvania, will identify preserved macroinvertebrate samples to the lowest taxonomic level. Normandeau’s biologists are certified by the Society of Freshwater Science to conduct taxonomic analysis on Eastern EPT genera. See Appendix D for Normandeau lab analytical methods and quality assurance documentation.

## 12. Quality Control Summary

Field personnel will be evaluated on both their habitat and macroinvertebrate assessment technique to ensure they understand the proper procedure and can demonstrate their abilities to correctly collect data. This field accreditation will occur prior to their first field season and every three years thereafter. The NJ-WWN will perform field accreditations (Appendix C). Field personnel who demonstrate proficiency in performing assessments and macroinvertebrate identification according to the Tier 3.3 guidelines are considered by NJDEP to be accredited. The project manager will maintain records of personnel accreditation status and provide annual refresher training, or will request assistance from the NJ-WWN or NJDEP as individuals require accreditation. If field personnel fail to demonstrate proper techniques or follow appropriate Tier 3.3 procedure, their data will not be considered valid and will not be submitted to WQX for NJDEP assessment purposes.

A duplicate macroinvertebrate sample will be collected at approximately 10% of the samples. If the original reach is thoroughly sampled, the adjacent reach immediately upstream or downstream will be used if they are similar in terms of habitat, riparian zone condition, and land use.

NJDEP reserves the right to audit field activities at any time as a condition of QAPP approval.

## 13. Data Management

The data will be collected by field personnel using the NJ Habitat and Macroinvertebrate Assessment hardcopy data sheet (Appendix B). The data sheet will be submitted to the project manager via email, mail, fax, or online submission. Digital scans of the data sheet will be taken by the project manager if the sheet is received in hardcopy. If a volunteer chooses to submit their data through an online form, they must include a photo of the hardcopy data sheet. The Watershed Institute owns the field data and manages the data internally.

Macroinvertebrate counts will be performed by Normandeau Associates, Inc. and emailed to the project manager who will check the results and incorporate them into local data storage.

## 14. Data Analysis

The geologically-relevant NJDEP macroinvertebrate index and EPA RBP habitat assessment criteria will be used. The study area includes both high gradient and low gradient sites.

*Table 5: Analytical method for macroinvertebrate and habitat methods index scoring*

| Index  | Metric Score | Rating Category | Assessment   |
|--|--------------|-----------------|--------------|
| High Gradient Macroinvertebrate Index Genus-Level (HGMI-gen) | ≥ 63         | Excellent       | Non-impaired |
|  | < 63 – 42    | Good            |              |
|  | < 42 – 21    | Fair            | Impaired     |
|  | < 21         | Poor            |              |
| Coastal Plain Macroinvertebrate Index (CPMI)                 | 30 – 22      | Excellent       | Non-impaired |
|  | 20 – 12      | Good            |              |
|  | 10 – 6       | Fair            | Impaired     |
|  | < 6          | Poor            |              |

| Index  | Metric Score | Rating Category | Assessment   |
|--|--------------|-----------------|--------------|
| RBP2, High Gradient, habitat assessment total rating | 160 - 200    | Optimal         | Non-impaired |
|  | 110 – 159    | Sub-Optimal     |              |
|  | 60 – 109     | Marginal        | Impaired     |
|  | < 60         | Poor            |              |
| RBP2, Low Gradient, habitat assessment total rating  | 160 - 200    | Optimal         | Non-impaired |
|  | 110 – 159    | Sub-Optimal     |              |
|  | 60 – 109     | Marginal        | Impaired     |
|  | < 60         | Poor            |              |

## 15. Oversight and Assessments

Field personnel performance will be reviewed by the NJ-WWN, NJDEP, and The Watershed Institute project manager. Follow-up with field personnel regarding issues with data or performance will be done by the project manager. Non-accredited volunteers may assist only as a data recorder or observer. All data will be checked by the project manager. Data that is not collected according to this QAPP will be flagged as “invalid” and will not be uploaded to WQX.

If a method or procedure needs to be updated or changed, this information must be brought to the attention of the signatories of this QAPP through writing and needs approval prior to being implemented.

## 16. Data Review and Usability

Review of all data sheets will be performed by the project manager. If the data is incomplete or appears to be inaccurate, the project manager will contact the field personnel to review the datasheet and request that they correct the data. When the project manager determines that the data is correct, the data will be uploaded to The Watershed Institute’s local data storage. The project manager will check the data again and verify site names, locations, and results to ensure that the data uploaded correctly. The project manager will scan the hard copies of the field data sheets to retain on file.

All data collected by accredited volunteers and that passes the QA checks will be submitted to WQX. The data that does not pass the QA Check will be flagged as “invalid” and will not be submitted to WQX.

## 17. Reporting

Data will be uploaded to the EPA’s WQX-Web and shared with the public via the Water Quality Portal, along with supporting quality assurance documentation.

The results from only the primary sample will be reported in WQX. Duplicate results will be stored internally and used by the QA manager to provide precision estimates of the individual metrics and overall index scores and ratings (Stribling, 2008), which will be reported on request to the NJDEP Community Water Monitoring Coordinator.

## 18. 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.  
<https://www3.epa.gov/region1/npdes/merrimackstation/pdfs/ar/AR-1164.pdf>

NJDEP BEARS. 2020. FINAL 2018/2020 New Jersey Integrated Water Quality Assessment Report.  
<https://www.state.nj.us/dep/wms/bears/assessment-report20182020.html>

NJDEP BEARS. 2022. NJDEP Community Monitoring Habitat Assessment Manual and Biological Assessment Manual [https://www.state.nj.us/dep/wms/bears/cwm\\_protocols.htm](https://www.state.nj.us/dep/wms/bears/cwm_protocols.htm)

NJDEP BFBM. 2007. Standard Operating Procedures: Ambient Biological Monitoring Using Benthic Macroinvertebrates. Document No. BMNJ2. [https://www.nj.gov/dep/wms/bfbm/download/AMNET\\_SOP.pdf](https://www.nj.gov/dep/wms/bfbm/download/AMNET_SOP.pdf)

NJWWN & NJDEP. 2022. New Jersey Community Water Monitoring Guide to Tier 3 Macroinvertebrate and Habitat Assessments. Version 2. <https://njwatershedwatch.org/wp-content/uploads/2023/01/NJ-Tier-3-CWM-Guidance-Doc-FINAL-2022-7-22.pdf>

Stribling, J.B., B.K. Jessup, and D.L. Feldman, 2008. Precision of benthic macroinvertebrate indicators of stream condition in Montana. *J.N. Am. Benthol. Soc.* 27(1):58-67.  
[https://acwi.gov/monitoring/pubs/misc/Stribling%20et%20al.%202008\\_JNABS%20\(Montana%20field%20sampling%20precision\).pdf](https://acwi.gov/monitoring/pubs/misc/Stribling%20et%20al.%202008_JNABS%20(Montana%20field%20sampling%20precision).pdf)

## 19. Appendices

### A. Sample Locations

| Site Name | Waterbody Name   | Location Description  | Municipality      | HUC-14         | Monitoring Status | Gradient Type | Drainage Area (km <sup>2</sup> ) | Latitude <sup>1</sup> | Longitude <sup>1</sup> |
|-----------|------------------|---|-------------------|----------------|-------------------|---------------|----------------------------------|-----------------------|------------------------|
| 128       | Jacobs Creek     | From property of 1200 River Road, just above Delaware River   | Hopewell Township | 02040105210070 | Priority          | High          | 33.867                           | 40.28020              | -74.85087              |
| AC1       | Assunpink Creek  | Mill Hill Park  | Trenton           | 02040105240060 | Active            | Low           | 236.146                          | 40.21823              | -74.76312              |
| AC5       | Assunpink Creek  | At Quakerbridge Road  | Lawrence Township | 02040105230050 | Active            | Low           | 87.604                           | 40.27003              | -74.67176              |
| AX1       | Alexauken Creek  | 640 feet downstream of River Road   | West Amwell       | 02040105210020 | Active            | High          | 39.164                           | 40.37884              | -74.94835              |
| AX2       | Alexauken Creek  | At Route 202 and Queen Road   | West Amwell       | 02040105210020 | Active            | High          | 16.609                           | 40.40331              | -74.91359              |
| BB1       | Bear Brook       | Downstream Cranbury Road  | West Windsor      | 2030105100060  | Secondary         | Low           | 31.239                           | 40.31835              | -74.61253              |
| BD1a      | Beden Brook      | Behind Stonebridge apt complex  | Montgomery        | 02030105110050 | Active            | High          | 71.042                           | 40.41603              | -74.64303              |
| BD4       | Beden Brook      | Upstream of Aunt Molly Road   | Montgomery        | 02030105110040 | Active            | High          | 17.623                           | 40.38441              | -74.74061              |
| BK1       | Back Brook       | Downstream of Bridgepoint Road  | Montgomery        | 02030105110100 | Secondary         | High          | 12.33                            | 40.43601              | -74.65634              |
| CB2       | Cranbury Brook   | Cranbury Brook at Main Street   | Cranbury          | 02030105100090 | Secondary         | Low           | 28.574                           | 40.30979              | -74.51690              |
| CB3       | Cranbury Brook   | Downstream Maple Avenue; We have permission from the property owners at 43 Maple Avenue to walk along the side of the yard to access the stream | Plainsboro        | 02030105100090 | Priority          | Low           | 57.172                           | 40.32612              | -74.60347              |
| CB4       | Cranbury Brook   | Applegarth Road   | Monroe            | 02030105100070 | Priority          | Low           | 19.737                           | 40.30514              | -74.47319              |
| CB5       | Cedar Brook      | Downstream Petty Ave  | Cranbury          | 02030105100080 | Secondary         | Low           | 14.437                           | 40.32995              | -74.54559              |
| CC1       | Crosswicks Creek | At Walnford   | Upper Freehold    | 02040201050040 | Secondary         | Low           | 202.537                          | 40.13452              | -74.55837              |
| CR1       | Cruser Brook     | Upstream of Belle Mead-Blawenberg Road  | Montgomery        | 02030105110090 | Active            | High          | 8.45                             | 40.45709              | -74.68555              |
| CR2       | Cruser Brook     | Upstream of Rt. 206   | Montgomery        | 02030105110090 | Secondary         | High          | 12.593                           | 40.45426              | -74.66044              |
| DAM-6     | Millstone River  | Upstream of Weston Causeway Dam, above mill race  | Manville          | 02030105110170 | Secondary         | High          | 689.93                           | 40.53025              | -74.58829              |

<sup>1</sup> Using WGS84 coordinate system

| Site Name | Waterbody Name  | Location Description   | Municipality       | HUC-14         | Monitoring Status | Gradient Type | Drainage Area (km <sup>2</sup> ) | Latitude <sup>1</sup> | Longitude <sup>1</sup> |
|-----------|-----------------|--|--------------------|----------------|-------------------|---------------|----------------------------------|-----------------------|------------------------|
| DAM-7     | Millstone River | Downstream of (former) Weston Causeway Dam, access from boat ramp at Lincoln Avenue Park | Manville           | 02030105110170 | Secondary         | High          | 732.454                          | 40.53106              | -74.58716              |
| DB1       | Devils Brook    | Devils Brook at Plainsboro Road  | Plainsboro         | 02030105100110 | Secondary         | Low           | 39.481                           | 40.33388              | -74.61166              |
| DB2       | Devils Brook    | Access from trail behind Birch Drive neighborhood; Downstream of Gordon Pond             | Plainsboro         | 02030105100110 | Secondary         | Low           | 39.828                           | 40.33121              | -74.61634              |
| DP3       | Duck Pond Run   | Upstream of Route 1  | West Windsor       | 02030105090080 | Active            | Low           | 9.509                            | 40.30645              | -74.66783              |
| HA1       | Harrys Brook    | Upstream of Kingston Road (Rt. 27)   | Princeton          | 02030105110020 | Active            | High          | 7.236                            | 40.36599              | -74.62739              |
| HA2       | Harrys Brook    | Backyard of 50 Wheatsheaf Lane   | Princeton          | 02030105110020 | Secondary         | High          | 1.934                            | 40.35904              | -74.63873              |
| HB3       | Heathcote Brook | Just upstream of D&R Canal and Towpath   | South Brunswick    | 02030105110010 | Active            | High          | 24.748                           | 40.37076              | -74.61924              |
| HO1       | Stony Brook     | Honey Brook at Elm Ridge Road  | Hopewell Township  | 02030105090050 | Secondary         | High          | 10.174                           | 40.34053              | -74.74313              |
| JC6       | Jacobs Creek    | Gravel parking on southbound side of Jacobs Creek Road, just south of Todd Ridge Road    | Titusville         | 02040105210070 | Secondary         | High          | 23.828                           | 40.29863              | -74.83493              |
| LSC1      | Shabakunk Creek | Near 70 Stonicker Drive  | Lawrence Township  | 02040105240050 | Active            | Low           | 9.41                             | 40.27052              | -74.71509              |
| MB3       | Mountain Brook  | Western trib upstream of Palmer Lake   | Princeton          | 02030105090060 | Active            | High          | 1.78                             | 40.36353              | -74.68005              |
| MI4       | Miry Run        | US of Quakerbridge Road  | Hamilton Township  | 02040105240030 | Active            | Low           | 27.563                           | 40.24667              | -74.68620              |
| MI4b      | Miry Run        | DS of Quakerbridge Road  | Hamilton Township  | 02040105240030 | Secondary         | Low           | 27.836                           | 40.24685              | -74.68762              |
| MO1       | Moore Creek     | US of River Road   | Hopewell Township  | 02040105210040 | Active            | High          | 25.254                           | 40.32442              | -74.91685              |
| MR1       | Millstone River | Access from UMCP Park  | Plainsboro         | 02030105100140 | Secondary         | Low           | 252.947                          | 40.33542              | -74.6242               |
| MR2       | Millstone River | Downstream of Millstone Road/Grovers Mill Road   | Plainsboro         | 02030105100060 | Secondary         | Low           | 112.37                           | 40.32221              | -74.60839              |
| MRA       | Millstone River | Stillhouse Road  | Millstone Township | 02030105100010 | Secondary         | Low           | 2.434                            | 40.20887              | -74.39386              |
| MRB       | Millstone River | Upstream of Rt. 33   | Millstone Township | 02030105100010 | Secondary         | Low           | 19.281                           | 40.26158              | -74.42003              |
| MRD       | Millstone River | Park at Pin Oak Loop Trail   | Cranbury           | 02030105100030 | Secondary         | Low           | 54.711                           | 40.29297              | -74.52671              |
| PR2a      | Pike Run        | End of Partridge Court   | Montgomery         | 02030105110100 | Active            | High          | 55.897                           | 40.42650              | -74.64374              |

| Site Name | Waterbody Name  | Location Description   | Municipality       | HUC-14         | Monitoring Status | Gradient Type | Drainage Area (km <sup>2</sup> ) | Latitude <sup>1</sup> | Longitude <sup>1</sup> |
|-----------|-----------------|--|--------------------|----------------|-------------------|---------------|----------------------------------|-----------------------|------------------------|
| RB1       | Rocky Brook     | Park on grassy pull off on side of Fairplay Rd; public property upstream of bridge<br>From Rocky Brook Rd culdesac   | Millstone Township | 02030105100040 | Active            | Low           | 12.807                           | 40.23206              | -74.46166              |
| RB2       | Rocky Brook     | (40.28378253289884, -74.53575622457035), walk straight back into woods, take a right to go around the pond, then follow trail to underpass Rocky Brook at Bank Street, downstream of Peddie Lake | East Windsor       | 02030105100050 | Secondary         | Low           | 38.205                           | 40.28306              | -74.53693              |
| RBA       | Rocky Brook     | Upstream of Hamilton Road  | Hightstown         | 02030105100050 | Active            | Low           | 35.794                           | 40.27351              | -74.52587              |
| RO1a      | Royce Brook     | Upstream of Route 206  | Hillsborough       | 02030105110150 | Active            | High          | 20.56                            | 40.50546              | -74.62359              |
| SB1       | Stony Brook     | Upstream of Titus Mill Road  | Princeton          | 02030105090060 | Active            | High          | 118.125                          | 40.33300              | -74.68198              |
| SBA       | Stony Brook     | West Branch Shabakunk at Spruce Street   | Hopewell Township  | 02030105090030 | Secondary         | High          | 54.245                           | 40.34959              | -74.78258              |
| SC1       | Shabakunk Creek | Lawrence Shopping Center   | Ewing Township     | 02040105240020 | Active            | Low           | 11.96                            | 40.24884              | -74.75598              |
| SC2       | Shabakunk Creek | Downstream Scotts Corner Road  | Lawrence Township  | 02040105240010 | Active            | Low           | 32.606                           | 40.25720              | -74.72905              |
| SHA       | Shallow Brook   | Upstream of Canal Road   | Plainsboro         | 02030105100100 | Priority          | Low           | 16.632                           | 40.34677              | -74.55731              |
| SM1       | Six Mile Run    | Upstream of Lincoln Hwy (Rt. 27)   | Franklin           | 02030105110130 | Active            | High          | 41.5                             | 40.47281              | -74.57086              |
| SM3       | Six Mile Run    | 100 feet downstream of Union Street  | North Brunswick    | 02030105110120 | Secondary         | High          | 7.679                            | 40.45536              | -74.51453              |
| SW1       | Swan Creek      | Downstream of Canal Road   | Lambertville       | 02040105210030 | Active            | High          | 8.999                            | 40.36404              | -74.94504              |
| TM1       | Ten Mile Run    |  | Franklin           | 02030105110110 | Active            | High          | 11.364                           | 40.45650              | -74.58569              |

B. Data Sheets

- B-1 Habitat and Macroinvertebrate Field Data Sheet
- B-2 EPA RBP High Gradient Form
- B-3 EPA RBP Low Gradient Form
- B-4 Chain of Custody Form
- B-5 Preservation Jar Labels
- B-6 Sample Receipt Log

The Watershed Institute | **HABITAT AND MACROINVERTEBRATE DATA SHEET**

|   |                         |   |  |   |  |
|---|-------------------------|---|--|---|--|
| <b>Date:</b>  |                         | <b>Start Time:</b>  |  | <b>Organization:</b>  |  |
| <b>Investigators:</b>   |                         |   |  | <b>Project Name:</b>  |  |
| <b>Site ID:</b>   |                         | <b>Site Location Description:</b>   |  |   |  |
| <b>Approximate Reach Length</b><br><small>(aim for 100m):</small> |                         | <b>Current Weather Conditions:</b>  |  | <b>Time Since Last Rain or Snowmelt:</b>  |  |
| <b>Air Temp (°C):</b>   | <b>Water Temp (°C):</b> | <input type="checkbox"/> Clear<br><input type="checkbox"/> Partly Cloudy<br><input type="checkbox"/> Overcast<br><input type="checkbox"/> Light Rain (no runoff)<br><input type="checkbox"/> Heavy Rain (runoff)<br><input type="checkbox"/> Snow<br><input type="checkbox"/> Heavy Snow Melt |  | <input type="checkbox"/> Within 24 hours<br><input type="checkbox"/> 24-48 hours ago<br><input type="checkbox"/> More than 2 days ago<br><input type="checkbox"/> Unknown |  |

|   |  |  |  |  |  |
|---|--|--|--|--|--|
| <b>Representative Wetted Width</b><br><small>(indicate units):</small>  |  | <b>Representative Depth Profile</b> (measured at five equidistant points across representative width)<br><small>(indicate units): _____ , _____ , _____ , _____ , _____ = Avg. _____</small> |  |  |  |
| <b>Velocity</b>   |  |  |  |  |  |
| <b>Distance</b> (aim for 3-5 meters) _____ (if using feet, convert to meters before calculating velocity)<br><div style="text-align: right;">= <b>Avg. Velocity</b> _____ m/s</div> |  |  |  |  |  |
| <b>Float Time:</b> _____ = <b>Avg.</b> _____ seconds  |  |  |  |  |  |
| <input type="checkbox"/> <b>Check here if this section is not completed due to nonwadable assessment.</b>   |  |  |  |  |  |

|  |  |   |  |   |
|--|--|---|--|---|
| <b>Stream Flow:</b><br><input type="checkbox"/> Slow (barely moving or not at all)<br><input type="checkbox"/> Moderate (clearly moving, surface flat)<br><input type="checkbox"/> Swift (clearly moving, surface disturbed) | <b>Water Odor:</b><br><input type="checkbox"/> Normal<br><input type="checkbox"/> Anaerobic<br><input type="checkbox"/> Sulfuric<br><input type="checkbox"/> Sewage<br><input type="checkbox"/> Petroleum<br><input type="checkbox"/> Other: | <b>Turbidity:</b><br><input type="checkbox"/> Clear<br><input type="checkbox"/> Slightly turbid<br><input type="checkbox"/> Turbid/Muddy<br><input type="checkbox"/> Milky<br><input type="checkbox"/> Green pea soup | <b>Surface Coating:</b><br><input type="checkbox"/> None<br><input type="checkbox"/> Foam<br><input type="checkbox"/> Scum<br><input type="checkbox"/> "Paint" streaks<br><input type="checkbox"/> Duckweed or vegetation<br><input type="checkbox"/> Oil<br><input type="checkbox"/> Other: | <b>Water Color:</b><br><input type="checkbox"/> Clear<br><input type="checkbox"/> Green<br><input type="checkbox"/> Blue-green<br><input type="checkbox"/> Tea-stained<br><input type="checkbox"/> Brown<br><input type="checkbox"/> Yellow<br><input type="checkbox"/> Gray<br><input type="checkbox"/> Other: |
|--|--|---|--|---|

|  |   |  |                           |                          |                            |                   |                 |                     |        |  |
|--|---|--|---------------------------|--------------------------|----------------------------|-------------------|-----------------|---------------------|--------|--|
| <b>Stream Morphology:</b><br><input type="checkbox"/> Riffle: _____%<br><input type="checkbox"/> Run: _____%<br><input type="checkbox"/> Pool: _____%              | <b>Macroinvertebrate Habitat Types:</b><br><input type="checkbox"/> Riffles and cobble<br><input type="checkbox"/> Wood and submerged logs<br><input type="checkbox"/> Leaf packs<br><input type="checkbox"/> Aquatic vegetation<br><input type="checkbox"/> Overhanging vegetation<br><input type="checkbox"/> Undercut banks<br><input type="checkbox"/> Gravel/Sand<br><input type="checkbox"/> Other: | <b>Benthic Substrate Characterization</b><br><small>(check if present or indicate relative percentage):</small> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:50%;">Clay and Silt: (&lt;0.06 mm)</td> <td style="width:50%;">Sand: (0.06-2mm, gritty)</td> </tr> <tr> <td>Gravel: (2-64mm, 0.1-2.5")</td> <td>Cobble: (2.5-10")</td> </tr> <tr> <td>Boulder: (&gt;10")</td> <td>Bedrock: (unbroken)</td> </tr> <tr> <td colspan="2">Other:</td> </tr> </table> | Clay and Silt: (<0.06 mm) | Sand: (0.06-2mm, gritty) | Gravel: (2-64mm, 0.1-2.5") | Cobble: (2.5-10") | Boulder: (>10") | Bedrock: (unbroken) | Other: |  |
| Clay and Silt: (<0.06 mm)  | Sand: (0.06-2mm, gritty)  |  |                           |                          |                            |                   |                 |                     |        |  |
| Gravel: (2-64mm, 0.1-2.5")   | Cobble: (2.5-10")   |  |                           |                          |                            |                   |                 |                     |        |  |
| Boulder: (>10")  | Bedrock: (unbroken)   |  |                           |                          |                            |                   |                 |                     |        |  |
| Other:   |   |  |                           |                          |                            |                   |                 |                     |        |  |
| <b>Woody Debris:</b><br><input type="checkbox"/> None<br><input type="checkbox"/> Scarce<br><input type="checkbox"/> Moderate<br><input type="checkbox"/> Abundant |   |  |                           |                          |                            |                   |                 |                     |        |  |

|  |   |   |  |
|--|---|---|--|
| <b>Aquatic Veget. Type:</b><br><input type="checkbox"/> Emergent<br><input type="checkbox"/> Submergent<br><input type="checkbox"/> Rooted floating<br><input type="checkbox"/> Floating<br><br><b>Amount:</b><br><input type="checkbox"/> Absent<br><input type="checkbox"/> Scarce<br><input type="checkbox"/> Moderate<br><input type="checkbox"/> Abundant | <b>Algae Type:</b><br><input type="checkbox"/> Biofilm<br><input type="checkbox"/> Filamentous<br><input type="checkbox"/> Floating<br><input type="checkbox"/> Suspected HAB<br><br><b>Amount:</b><br><input type="checkbox"/> Absent<br><input type="checkbox"/> Scarce<br><input type="checkbox"/> Moderate<br><input type="checkbox"/> Abundant | <b>Bank Vegetation:</b><br><input type="checkbox"/> Trees<br><input type="checkbox"/> Shrubs<br><input type="checkbox"/> Grasses<br><input type="checkbox"/> Lawns<br><input type="checkbox"/> Invasive species<br><input type="checkbox"/> None<br><input type="checkbox"/> Other: | <b>Tree Canopy (at full leaf):</b><br><input type="checkbox"/> Open (0-25%)<br><input type="checkbox"/> Mostly Open (25-50%)<br><input type="checkbox"/> Mostly Closed (50-75%)<br><input type="checkbox"/> Closed (75-100%) |
|--|---|---|--|

|  |  |  |  |  |
|--|--|--|--|--|
| <b>Land Uses in ¼ Mile Radius:</b><br><input type="checkbox"/> Rural/Low Density Residential<br><input type="checkbox"/> Medium Density Residential<br><input type="checkbox"/> High Density Residential<br><input type="checkbox"/> Urban<br><input type="checkbox"/> Commercial<br><input type="checkbox"/> Industrial<br><input type="checkbox"/> Roads<br><input type="checkbox"/> Parking Lot | <input type="checkbox"/> Agriculture (cropland)<br><input type="checkbox"/> Agriculture (livestock)<br><input type="checkbox"/> Meadow/Field<br><input type="checkbox"/> Forested<br><input type="checkbox"/> Preserved Open Space<br><input type="checkbox"/> Athletic Fields<br><input type="checkbox"/> Construction<br><input type="checkbox"/> Other: | <b>Structures:</b><br><input type="checkbox"/> None<br><input type="checkbox"/> Bridge<br><input type="checkbox"/> Culvert<br><input type="checkbox"/> Outfall<br><input type="checkbox"/> Dam<br><input type="checkbox"/> Drainage Ditch<br><input type="checkbox"/> Other: | <b>Litter:</b><br><input type="checkbox"/> None<br><input type="checkbox"/> Scarce<br><input type="checkbox"/> Moderate<br><input type="checkbox"/> Abundant<br><input type="checkbox"/> Dump site<br><b>Comments:</b> | <b>Wildlife Observations:</b><br><input type="checkbox"/> Fish<br><input type="checkbox"/> Frogs<br><input type="checkbox"/> Turtles<br><input type="checkbox"/> Crayfish<br><input type="checkbox"/> Clams/Mussels<br><input type="checkbox"/> Salamanders<br><input type="checkbox"/> Waterfowl<br><input type="checkbox"/> Other: |
|--|--|--|--|--|

**Comments/Observations:**

**Site Sketch** Indicate roads, buildings, landmarks, parking area, access point(s) to stream, stream flow direction, in-stream habitat for macroinvertebrate sampling (i.e. riffles, pools, aquatic vegetation, woody debris), outfalls, etc.:

**Regional Scored Habitat Assessment:**     High Gradient Habitat Assessment     Low Gradient Habitat Assessment

**COMPLETE THIS SECTION ONLY IF MACROINVERTEBRATE SAMPLING WAS PERFORMED.**

|   |  |   |
|---|--|---|
| <b>Sample Equipment:</b><br><input type="checkbox"/> D-net<br><input type="checkbox"/> Other: | <b>Preservation Method:</b><br><input type="checkbox"/> Tier 3.3, 3.2: Detritus preservation<br><input type="checkbox"/> Organism-only preservation<br><input type="checkbox"/> None: Tier 3.1 Field identification<br><input type="checkbox"/> Other: | <b>Form Attached:</b><br><input type="checkbox"/> Tier 3.3, 3.2: Chain of Custody Form<br><input type="checkbox"/> Tier 3.1: Macroinvertebrate Tally Sheet<br><input type="checkbox"/> Other: |
|---|--|---|

## EPA Rapid Bioassessment | HIGH GRADIENT HABITAT ASSESSMENT

| Habitat Parameter                             | Condition Category  |    |    |    |    |  |    |    |    |    |  |   |   |   |   |  |   |   |   |   |   |
|---|---|----|----|----|----|--|----|----|----|----|--|---|---|---|---|--|---|---|---|---|---|
|   | Optimal   |    |    |    |    | Suboptimal   |    |    |    |    | Marginal   |   |   |   |   | Poor   |   |   |   |   |   |
| <b>1. Epifaunal Substrate/Available Cover</b> | 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., logs/snags that are <u>not</u> new fall and <u>not</u> 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 new fall, but not yet prepared for colonization (may rate at high end of scale). |    |    |    |    | 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.   |   |   |   |   |   |
| <b>SCORE</b>                                  | 20  | 19 | 18 | 17 | 16 | 15   | 14 | 13 | 12 | 11 | 10   | 9 | 8 | 7 | 6 | 5  | 4 | 3 | 2 | 1 | 0 |
| <b>2. Embeddedness</b>                        | 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.  |   |   |   |   |   |
| <b>SCORE</b>                                  | 20  | 19 | 18 | 17 | 16 | 15   | 14 | 13 | 12 | 11 | 10   | 9 | 8 | 7 | 6 | 5  | 4 | 3 | 2 | 1 | 0 |
| <b>3. Velocity/Depth Combinations</b>         | All 4 velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is <0.3 m/s, deep is >0.5 m/s)   |    |    |    |    | 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).  |   |   |   |   |   |
| <b>SCORE</b>                                  | 20  | 19 | 18 | 17 | 16 | 15   | 14 | 13 | 12 | 11 | 10   | 9 | 8 | 7 | 6 | 5  | 4 | 3 | 2 | 1 | 0 |
| <b>4. Sediment Deposition</b>                 | Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition.  |    |    |    |    | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.  |    |    |    |    | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions and bends; moderate deposition of pools prevalent. |   |   |   |   | Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. |   |   |   |   |   |
| <b>SCORE</b>                                  | 20  | 19 | 18 | 17 | 16 | 15   | 14 | 13 | 12 | 11 | 10   | 9 | 8 | 7 | 6 | 5  | 4 | 3 | 2 | 1 | 0 |
| <b>5. Channel Flow Status</b>                 | 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.   |   |   |   |   |   |
| <b>SCORE</b>                                  | 20  | 19 | 18 | 17 | 16 | 15   | 14 | 13 | 12 | 11 | 10   | 9 | 8 | 7 | 6 | 5  | 4 | 3 | 2 | 1 | 0 |

| HABITAT CONDITION | SCORE     |
|-------------------|-----------|
| OPTIMAL           | 160 – 200 |
| SUB-OPTIMAL       | 110 – 159 |
| MARGINAL          | 60 – 109  |
| POOR              | < 60      |

| TOTAL HABITAT SCORE | HABITAT CONDITION |
|---------------------|-------------------|
|                     |                   |

| Habitat Parameter  | Condition Category  |    |    |    |    |  |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |
|--|---|----|----|----|----|--|----|----|----|----|---|---|---|---|---|---|---|---|---|---|---|
|  | Optimal   |    |    |    |    | Suboptimal   |    |    |    |    | Marginal  |   |   |   |   | Poor  |   |   |   |   |   |
| <b>6. Channel Alteration</b>                                   | Channelization or dredging absent or minimal; stream with normal pattern.   |    |    |    |    | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.  |    |    |    |    | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.  |   |   |   |   | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. In stream habitat greatly altered or removed entirely.  |   |   |   |   |   |
| <b>SCORE</b>   | 20  | 19 | 18 | 17 | 16 | 15   | 14 | 13 | 12 | 11 | 10  | 9 | 8 | 7 | 6 | 5   | 4 | 3 | 2 | 1 | 0 |
| <b>7. Frequency of Riffles</b>                                 | Occurrence of riffles relatively frequent; distance between riffles is 5-7 times stream width; 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 is 7 to 15 times stream width.  |    |    |    |    | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles is 15 to 25 times stream width.   |   |   |   |   | Generally all flat water or shallow riffles; poor habitat; distance between riffles is >25 times stream width.  |   |   |   |   |   |
| <b>SCORE</b>   | 20  | 19 | 18 | 17 | 16 | 15   | 14 | 13 | 12 | 11 | 10  | 9 | 8 | 7 | 6 | 5   | 4 | 3 | 2 | 1 | 0 |
| <b>8. Bank Stability</b><br>(score each bank)                  | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.  |    |    |    |    | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.   |    |    |    |    | Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.  |   |   |   |   | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.   |   |   |   |   |   |
| Note: determine left or right side by facing DOWNSTREAM.       |   |    |    |    |    |  |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |
| <b>SCORE – LEFT BANK</b>                                       |   |    |    |    |    | 8 7 6  |    |    |    |    | 5 4 3   |   |   |   |   | 2 1 0   |   |   |   |   |   |
| <b>SCORE – RIGHT BANK</b>                                      | 10 9  |    |    |    |    | 8 7 6  |    |    |    |    | 5 4 3   |   |   |   |   | 2 1 0   |   |   |   |   |   |
| <b>9. Bank Vegetative Protection</b><br>(score each bank)      | More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. |    |    |    |    | 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. |    |    |    |    | 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. |   |   |   |   | Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. |   |   |   |   |   |
| Note: determine left or right side by facing DOWNSTREAM.       |   |    |    |    |    |  |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |
| <b>SCORE – LEFT BANK</b>                                       | 10 9  |    |    |    |    | 8 7 6  |    |    |    |    | 5 4 3   |   |   |   |   | 2 1 0   |   |   |   |   |   |
| <b>SCORE – RIGHT BANK</b>                                      | 10 9  |    |    |    |    | 8 7 6  |    |    |    |    | 5 4 3   |   |   |   |   | 2 1 0   |   |   |   |   |   |
| <b>10. Riparian Vegetative Zone Width</b><br>(score each bank) | 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.   |   |   |   |   |   |
| Note: determine left or right side by facing DOWNSTREAM.       |   |    |    |    |    |  |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |
| <b>SCORE – LEFT BANK</b>                                       | 10 9  |    |    |    |    | 8 7 6  |    |    |    |    | 5 4 3   |   |   |   |   | 2 1 0   |   |   |   |   |   |
| <b>SCORE – RIGHT BANK</b>                                      | 10 9  |    |    |    |    | 8 7 6  |    |    |    |    | 5 4 3   |   |   |   |   | 2 1 0   |   |   |   |   |   |

## EPA Rapid Bioassessment | LOW GRADIENT HABITAT ASSESSMENT

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

| SCORE     | HABITAT CONDITION |
|-----------|-------------------|
| 160 – 200 | OPTIMAL           |
| 110 – 159 | SUB-OPTIMAL       |
| 60 – 109  | MARGINAL          |
| < 60      | POOR              |

| TOTAL HABITAT SCORE | HABITAT CONDITION |
|---------------------|-------------------|
|                     |                   |

| Habitat Parameter  | Condition Category  |    |    |    |    |  |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |   |  |  |   |
|--|---|----|----|----|----|--|----|----|----|----|---|---|---|---|---|---|---|---|---|---|---|---|--|--|---|
|  | Optimal   |    |    |    |    | Suboptimal   |    |    |    |    | Marginal  |   |   |   |   | Poor  |   |   |   |   |   |   |  |  |   |
| <b>6. Channel Alteration</b>                                   | Channelization or dredging absent or minimal; stream with normal pattern.   |    |    |    |    | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.  |    |    |    |    | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.  |   |   |   |   | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. In stream habitat greatly altered or removed entirely.  |   |   |   |   |   |   |  |  |   |
| <b>SCORE</b>   | 20  | 19 | 18 | 17 | 16 | 15   | 14 | 13 | 12 | 11 | 10  | 9 | 8 | 7 | 6 | 5   | 4 | 3 | 2 | 1 | 0 |   |  |  |   |
| <b>7. Channel Sinuosity</b>                                    | The bends in the stream increase the stream length by 3 to 4 times compared to if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas).                           |    |    |    |    | The bends in the stream increase the stream length by 2 to 3 times compared to if it was in a straight line.   |    |    |    |    | The bends in the stream increase the stream length by 1 to 2 times compared to if it was in a straight line.  |   |   |   |   | Channel straight; waterway has been channelized for a long distance.  |   |   |   |   |   |   |  |  |   |
| <b>SCORE</b>   | 20  | 19 | 18 | 17 | 16 | 15   | 14 | 13 | 12 | 11 | 10  | 9 | 8 | 7 | 6 | 5   | 4 | 3 | 2 | 1 | 0 |   |  |  |   |
| <b>8. Bank Stability</b><br>(score each bank)                  | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.  |    |    |    |    | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.   |    |    |    |    | Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.  |   |   |   |   | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.   |   |   |   |   |   |   |  |  |   |
| Note: determine left or right side by facing DOWNSTREAM.       |   |    |    |    |    |  |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |   |  |  |   |
| <b>SCORE – LEFT BANK</b>                                       | 10  |    | 9  |    |    | 8  |    | 7  |    |    | 6   |   | 5 |   | 4 |   |   | 3 |   | 2 |   | 1 |  |  | 0 |
| <b>SCORE – RIGHT BANK</b>                                      | 10  |    | 9  |    |    | 8  |    | 7  |    |    | 6   |   | 5 |   | 4 |   |   | 3 |   | 2 |   | 1 |  |  | 0 |
| <b>9. Bank Vegetative Protection</b><br>(score each bank)      | More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. |    |    |    |    | 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. |    |    |    |    | 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. |   |   |   |   | Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. |   |   |   |   |   |   |  |  |   |
| Note: determine left or right side by facing DOWNSTREAM.       |   |    |    |    |    |  |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |   |  |  |   |
| <b>SCORE – LEFT BANK</b>                                       | 10  |    | 9  |    |    | 8  |    | 7  |    |    | 6   |   | 5 |   | 4 |   |   | 3 |   | 2 |   | 1 |  |  | 0 |
| <b>SCORE – RIGHT BANK</b>                                      | 10  |    | 9  |    |    | 8  |    | 7  |    |    | 6   |   | 5 |   | 4 |   |   | 3 |   | 2 |   | 1 |  |  | 0 |
| <b>10. Riparian Vegetative Zone Width</b><br>(score each bank) | 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.   |   |   |   |   |   |   |  |  |   |
| Note: determine left or right side by facing DOWNSTREAM.       |   |    |    |    |    |  |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |   |  |  |   |
| <b>SCORE – LEFT BANK</b>                                       | 10  |    | 9  |    |    | 8  |    | 7  |    |    | 6   |   | 5 |   | 4 |   |   | 3 |   | 2 |   | 1 |  |  | 0 |
| <b>SCORE – RIGHT BANK</b>                                      | 10  |    | 9  |    |    | 8  |    | 7  |    |    | 6   |   | 5 |   | 4 |   |   | 3 |   | 2 |   | 1 |  |  | 0 |



**CHAIN OF CUSTODY FORM**

**THE WATERSHED INSTITUTE STREAMWATCH  
31 TITUS MILL RD, PENNINGTON, NJ 08534  
STREAMWATCH@THEWATERSHED.ORG**

**Sampled by:**

**Name:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

| Station Name | Date Sampled | Time Sampled | Total No. Bottles | Bottle Volume | Preservative |
|--------------|--------------|--------------|-------------------|---------------|--------------|
|              |              |              |                   |               | 95% ethanol  |

**Relinquished by:**

**Received by:**

|    |       |  |    |       |  |
|----|-------|--|----|-------|--|
| 1. | Date: |  | 1. | Date: |  |
|    | Time: |  |    | Time: |  |
| 2. | Date: |  | 2. | Date: |  |
|    | Time: |  |    | Time: |  |
| 3. | Date: |  | 3. | Date: |  |
|    | Time: |  |    | Time: |  |

Site Name: \_\_\_\_\_

Date: \_\_\_\_\_

Stream Name: \_\_\_\_\_

Sample Location: \_\_\_\_\_

Collected By: \_\_\_\_\_

Preservative: 95% ETHANOL

Site Name: \_\_\_\_\_

Date: \_\_\_\_\_

Stream Name: \_\_\_\_\_

Sample Location: \_\_\_\_\_

Collected By: \_\_\_\_\_

Preservative: 95% ETHANOL

Site Name: \_\_\_\_\_

Date: \_\_\_\_\_

Stream Name: \_\_\_\_\_

Sample Location: \_\_\_\_\_

Collected By: \_\_\_\_\_

Preservative: 95% ETHANOL

Site Name: \_\_\_\_\_

Date: \_\_\_\_\_

Stream Name: \_\_\_\_\_

Sample Location: \_\_\_\_\_

Collected By: \_\_\_\_\_

Preservative: 95% ETHANOL

Site Name: \_\_\_\_\_

Date: \_\_\_\_\_

Stream Name: \_\_\_\_\_

Sample Location: \_\_\_\_\_

Collected By: \_\_\_\_\_

Preservative: 95% ETHANOL

Site Name: \_\_\_\_\_

Date: \_\_\_\_\_

Stream Name: \_\_\_\_\_

Sample Location: \_\_\_\_\_

Collected By: \_\_\_\_\_

Preservative: 95% ETHANOL

Site Name: \_\_\_\_\_

Date: \_\_\_\_\_

Stream Name: \_\_\_\_\_

Sample Location: \_\_\_\_\_

Collected By: \_\_\_\_\_

Preservative: 95% ETHANOL

Site Name: \_\_\_\_\_

Date: \_\_\_\_\_

Stream Name: \_\_\_\_\_

Sample Location: \_\_\_\_\_

Collected By: \_\_\_\_\_

Preservative: 95% ETHANOL

**THE WATERSHED INSTITUTE | StreamWatch BAT Samples Received Log**

|    | Date Received | Site | Date Sampled | Sampled By: | Total # of Bottles | Received By |
|----|---------------|------|--------------|-------------|--------------------|-------------|
| 1  |               |      |              |             |                    |             |
| 2  |               |      |              |             |                    |             |
| 3  |               |      |              |             |                    |             |
| 4  |               |      |              |             |                    |             |
| 5  |               |      |              |             |                    |             |
| 6  |               |      |              |             |                    |             |
| 7  |               |      |              |             |                    |             |
| 8  |               |      |              |             |                    |             |
| 9  |               |      |              |             |                    |             |
| 10 |               |      |              |             |                    |             |
| 11 |               |      |              |             |                    |             |
| 12 |               |      |              |             |                    |             |
| 13 |               |      |              |             |                    |             |
| 14 |               |      |              |             |                    |             |
| 15 |               |      |              |             |                    |             |
| 16 |               |      |              |             |                    |             |
| 17 |               |      |              |             |                    |             |
| 18 |               |      |              |             |                    |             |
| 19 |               |      |              |             |                    |             |
| 20 |               |      |              |             |                    |             |
| 21 |               |      |              |             |                    |             |
| 22 |               |      |              |             |                    |             |
| 23 |               |      |              |             |                    |             |
| 24 |               |      |              |             |                    |             |
| 25 |               |      |              |             |                    |             |
| 26 |               |      |              |             |                    |             |
| 27 |               |      |              |             |                    |             |
| 28 |               |      |              |             |                    |             |
| 29 |               |      |              |             |                    |             |
| 30 |               |      |              |             |                    |             |

|                              |                      |             |
|------------------------------|----------------------|-------------|
| <i>Samples Delivered To:</i> | <i>Delivered By:</i> | <i>Date</i> |
|                              |                      |             |

C. Tier 3.3 Field Accreditation and Audit Checklist

NJ Watershed Watch Network | **MACROINVERTEBRATE TIER 3.3**  
**FIELD ACCREDITATION/ AUDIT FORM**

**Instructions:** Observe the volunteer monitor in the field as they run through a full macroinvertebrate and habitat assessment and check off as they perform the following tasks:

- All necessary sampling gear present
- Identify 100 meter stretch
- Identify macroinvertebrate habitat types present
- Begin macroinvertebrate sampling at downstream end
- Used appropriate method for habitat type
  - Disturb 1 foot square area upstream of D-net in riffle area or other sediment
  - Scrape submerged woody debris
  - Jab and sweep vegetation and vegetated banks
  - Rub leaf packs and vegetation
- Take 20 samples from the stream reach, proportional to most productive habitat present at site
- Empty contents of net into sieve bucket after each sample
- At conclusion of sampling, rinse and check net for clinging organisms and add to sample bucket
- Remove larger pieces of debris from sample, checking for clinging macros and adding them to the sample bucket
- Mix sample well to composite if more material is collected than the volume of the preservation jar
- Sieve stream water from sample bucket and rinse sample into preservation jars with 95% ethanol
- At conclusion of preservation, check sieve for clinging organisms and add to preservation jar
- Attach identifying label to sample jars
- Complete biological data sheet
- Collect physical measurements (ex. temperature, width, depth) as needed
- Complete habitat assessment data sheet in full using appropriate sheet
- Decontaminate equipment
- Complete chain-of-custody form

D. Normandeau Associates, Inc. Quality Assurance Documentation

**SORTING OF MACROINVERTEBRATES  
FROM SAMPLE RESIDUE**

REVISION SHEET

| <u>Rev. No.</u> | <u>Page</u>           | <u>Section or Paragraph</u> |
|-----------------|-----------------------|-----------------------------|
| 4               | Title page            | updated                     |
| 4               | 3                     | 2.2, 4.1, 5.0, 6.1          |
| 4               | 4                     | 6.6, 7.0, 8.0               |
| 4               | 5                     | 8.8, 8.11, 9.0, 10.0        |
| 4               | 6                     | 12.0 added                  |
| 4               | Enclosure 1, 2, & 3   | added                       |
| 5               | Title page            | updated                     |
| 5               | 3                     | 2.2; 4.1                    |
| 5               | 5                     | 9.2; 12.0                   |
| 5               | Attachments 1, 2, & 3 |                             |
| 6               | Title page            | updated                     |
| 6               | 5                     | 3.0; 4.3; 5.0; 6.3; 6.14    |
| 6               | 6                     | 6.0; 8.4; 8.12              |
| 6               | 7                     | 9.3; 9.7                    |
| 7               | 5                     | 1.0, 2.0                    |
| 7               | 6                     | 8.12                        |
| 7               | 7                     | 9.2, 9.3, 9.7, 12.0         |

---

\* Revised sections are shown in italics.

## SORTING OF MACROINVERTEBRATES FROM SAMPLE RESIDUE

### 1.0 PURPOSE

This procedure provides instructions for *processing and sorting* macroinvertebrates from sample residue.

### 2.0 SCOPE

- This procedure is applicable to the *processing and sorting* of macroinvertebrates from sample residue.
- This procedure applies to personnel who *process and sort* macroinvertebrates.

### 3.0 DEFINITIONS

**Benthic Macroinvertebrates** - refers to animals that (1) are large enough to be seen by the unaided eye; (2) can be retained by a U.S. Standard No. 30 sieve (0.595 mm mesh); and (3) live at least part of their life cycles within or upon available substrates in a body of water.

### 4.0 REFERENCES

- Normandeau Document "Corporate Health & Safety Plan."
- US EPA. 1973. Biological field and laboratory methods (EPA-670/4-73-001).
- US EPA. 1999. Rapid bioassessment protocols for use in wadeable streams and rivers (EPA 841-B-99-002).
- Normandeau Procedure EA9 "Macroinvertebrate Sample Sub-sampling" (current revision).

### 5.0 SAFETY PRECAUTIONS

- Observe appropriate laboratory safety precautions given per Reference 4.0.
- Handle noxious or toxic preservatives (e.g., ethanol, isopropanol, formalin, stains) in well-ventilated areas (e.g., outside, under a fume hood, or other ventilation system).
- See appropriate SDS(s) prior to working with any preservatives.
- Avoid the use of formalin/formalin products whenever possible.
- Wear appropriate personal protective equipment (PPE) when handling preservatives (e.g., isopropanol, formalin).

#### NOTE

Contact the Project Manager or the Invertebrate Section Supervisor regarding the use of formalin, SDSs, required PPE, and other information regarding safety and site-specific sampling concerns.

### 6.0 APPARATUS

The following equipment (or equivalent) as applicable is needed.

- White enamel sorting pans or white plastic photo developing trays.
- Tensor lamp.
- Preservative (e.g., 70% isopropanol or ethanol) and water.
- *GHS (Globally Harmonized System) container labels.*
- Specimen vials of several sizes.
- Forceps.

- Sieves (mesh size is study specific; those commonly used include 0.350, 0.500, & 0.595 mm).
- Tablespoon.
- Mechanical counters.
- Sample processing sheets.
- Labels
- Pencil or pen (indelible ink)
- Rubber bands.
- Fume hood.
- Dissecting Scope
- Applicable PPE

## **7.0 PRELIMINARY INSTRUCTIONS**

If preliminary observation or initial sorting indicates that a sample contains so many macroinvertebrates that whole sample sorting is impractical, subsample the residue (see Reference 4.0 – Normandeau No. EA9) as instructed by the Project Manager (or as per study specifications).

## **8.0 INSTRUCTIONS**

All sorting shall be done by trained personnel. Samples are prepared and examined per study specifications (e.g., stained, examined with or without magnification, etc.) detailed on the Analytical Request Form (Enclosure 1). Obtain this form from the Project Manager or Invertebrate Section Leader, prior to sorting any sample/sample set.

- 8.1 Wash/rinse sample residue (with tap water), in a sieve of mesh size detailed on the Analytical Request Form, to remove/dilute the remaining preservative.
- 8.2 Place one to several (depending on how difficult it is to discern macroinvertebrates from the residue) tablespoonfuls of residue into a sorting pan filled with about 2 cm of water.
- 8.3 Hand-pick macroinvertebrates with forceps until no more specimens can be found.
- 8.4 Place sorted macroinvertebrates in specimen vials containing preservative. *Attach the GHS Dot to the outside of each vial in a way to avoid covering up internal label visibility or intersecting the vial/cap intersection that might be taped.* Separate by vial the different types (taxa) to the extent possible, and maintain counts for each vial using mechanical counters.
- 8.5 If the sorted residue is to be retained, return it to the storage container; otherwise discard *following quality control acceptance.*
- 8.6 Repeat Instructions 8.2-8.5 until the entire sample is sorted.
- 8.7 If applicable, properly preserve, label, and store the retained residue.
- 8.8 Attach a sample identification label to each vial. The label should at least be cross-referenced to the original sample by date, location, replicate number and client/project number (as necessary).
- 8.9 Rubber-band together all sample specimen vials.
- 8.10 Place the banded sample vials in the appropriate area for identification.
- 8.11 Complete sample processing forms (record all pertinent sub-sampling and other information) and file.
- 8.12 If study objectives call for a fixed-count (ex. 100, 200, or 300 specimen) sub-sample follow the guidelines given in US EPA (1999) *or by applicable federal or state protocols.*

## 9.0 QUALITY CONTROL

- 9.1 Sorting macroinvertebrates from sample residue shall be conducted only by personnel trained in sorting techniques.
- 9.2 Chain-of-Custody forms shall be used for submittal of samples collected *or shipped (e.g., by Fed Ex)* by non-Normandeau personnel to insure sample integrity from the time collected until received at the laboratory.
- 9.3 Sorting efficiency shall be monitored by the Project Manager or Section Leader per client specifications.

### NOTE

In lieu of client specified protocols, sorting efficiency will be determined by re-sorting the residue from one *sample* (randomly selected) of each batch *of ten or one in twenty* (with a minimum of 1 sample) for each *discrete project*. If efficiency (either number of taxa or individuals removed during the first sorting effort) is below 90% for any QC sample, a second sample shall be selected. If efficiency remains below 90%, all samples sorted by that technician for the particular *project* will be re-sorted. Retraining shall be conducted for any technician whose sorting efficiency is below 90% on two consecutive QC samples. *For samples containing 20 or fewer specimens, sorting efficiency is considered acceptable if the difference between the original and QC counts is no more than two for specimen and taxa removal.*

- 9.4 All sample residues retained per client specifications, will be properly preserved and labeled.
- 9.5 All sorted macroinvertebrates will be properly preserved and labeled.
- 9.6 Sample processing forms shall be completed accurately and recorded information legible.
- 9.7 *Use of magnification is required.*

## 10.0 REPORTING

The Project Manager or Invertebrate Section Leader will report the completion of sorting per study specifications, as applicable.

## 11.0 RECORDS

Retain the following records in the laboratory responsible for sorting the samples, per study specifications. In lieu of such, records shall be retained for a period of at least three (3) years following completion of a given study.

- Sample processing forms, including sorting efficiency results.
- Analytical Request and applicable Chain-of-Custody forms.
- Personnel training records.

## 12.0 ATTACHMENTS

See the Project Manager or Invertebrate Section Leader for the latest revision of the following forms:

Attachment 1 - Invertebrate Section Analytical Request Form (Example)

Attachment 2 - Example: Chain-of-Custody Form. (This form is to be provided *upon request* to clients/subcontractors who independently collect and ship (e.g., by Fed Ex) macroinvertebrate samples for analysis. This form is *recommended but* not required for small numbers of samples collected and delivered to the Invertebrate Laboratory by Normandeau personnel

Attachment 3 - Laboratory Processing Form---Example

**PROCEDURE NO. EA9**  
**Rev. 5 (APRIL 2019)**

**MACROINVERTEBRATE SAMPLE SUB-SAMPLING**

**PROCEDURE NO. EA9**

REVISION SHEET

| <u>Rev. No.</u> | <u>Page</u>        | <u>Section or Paragraph</u>                               |
|-----------------|--------------------|---|
| 1               | Title page         | organizational changes                                    |
| 1               | 3                  | 4.3; 5.2; 6.0   |
| 1               | 5                  | 8.1; 8.2.2; 8.2.4   |
| 1               | 6                  | 8.4.7   |
| 1               | 7                  | 8.5   |
| 2               | Title page         | updated   |
| 2               | 3                  | 2.2; 4.3; 5.2; 6.0  |
| 2               | 4                  | 7.2; 7.4; 7.5   |
| 2               | 5                  | 8.1; 8.2  |
| 2               | 6                  | 8.4; 8.5  |
| 2               | 7                  | 9.1; 9.2; 10.1; 10.2                                      |
| 3               | Title page         | updated   |
| 3               | 3                  | 1.0; 2.2; 3.3; 4.0; 5.0                                   |
| 3               | Attachments I & II |   |
| 4               | Title page         | updated   |
| 4               | 4                  | 3.1; 4.2  |
| 4               | 5                  | 7.0   |
| 4               | 6                  | 8.3.3   |
| 4               | 8                  | 9.1; 9.2  |
| 4               | 9                  | 10.1; 10.3  |
| 5               | 4                  | 1.0; 3.0  |
| 5               | 5                  | 7.0 to 7.5  |
| 5               | 6                  | 8.1; 8.2.2; 8.3.1; 9.1                                    |
| 5               | 7                  | 8.4; 8.4.1; 8.4.7; 8.5.1                                  |
| 5               | 8                  | 9.2; 9.3 (deleted text); 10.1; 10.2; 10.3 (deleted); 12.0 |

---

\* Revised sections are shown in italics.

## MACROINVERTEBRATE SAMPLE SUB-SAMPLING

### 1.0 PURPOSE

This procedure is designed to *provide accurate and* cost-effective, numerical estimates of abundant taxa present in macroinvertebrate samples while sorting the entire sample for less abundant taxa.

### 2.0 SCOPE

- This procedure is applicable to sub-sampling of macroinvertebrate samples, which contain a taxon or taxa represented by large numbers of individuals.
- This procedure applies to personnel who sort macroinvertebrate samples.

### 3.0 DEFINITIONS

- **Benthic Macroinvertebrates** - refers to animals that (1) are large enough to be seen by the unaided eye; (2) can be retained by a U.S. Standard No. 30 sieve (0.595 mm mesh); and (3) live at least part of their life cycles within or upon available substrates in a body of water.
- **Sub-sampling** - a technique used to determine the total number of organisms in a sample or the number of organisms in one or more taxa by examining a portion of the sample rather than the entire sample.
- **Abundant taxon** - a taxon that is represented in a sample by large numbers (*e.g.*, >100) of individuals.

### 4.0 REFERENCES

- Normandeau Document "Corporate Health & Safety Plan."
- USEPA. 1973. Biological field and laboratory methods. EPA-670/4-73-001.
- National Marine Fisheries Service. 1983. Manual for biologists aboard foreign groundfish vessels. Northwest and Alaska Fisheries Center, Seattle, WA 2:7A.1.1.
- Normandeau Procedure EA5, "Quantitative sorting of macroinvertebrates from sample residue" (current revision)

### 5.0 SAFETY

- Observe appropriate laboratory safety precautions given per Reference 4.0.
- Handle noxious or toxic preservatives (*e.g.*, ethanol, isopropanol, formalin, stains) in well-ventilated areas (*e.g.*, outside, under a fume hood, or other ventilation system).
- See appropriate SDS(s) prior to working with any preservatives.
- Avoid the use of formalin/formalin products whenever possible.
- Wear appropriate personal protective equipment (PPE) when handling preservatives (*e.g.*, isopropanol, formalin).

#### NOTE

Contact the Project Manager or the Invertebrate Section Supervisor regarding the use of formalin, SDSs, required PPE, and other information regarding safety and site-specific sampling concerns.

## 6.0 APPARATUS

The following equipment (or equivalent) may be needed for sub-sampling:

- Fume hood.
- Standard sorting equipment (see Reference 4.2).
- 2-gallon bucket.
- Appropriate sized sieve (see project specifications).
- Folsom splitter.
- 3-gallon hand sprayer.
- Small sample jars (3 to 5).
- Large spoon or spatula.
- Labels.
- Squeeze bottles.
- *GHS (Globally Harmonized System) container labels.*
- Analytical Request Forms (Attachment I).
- Sample processing log sheets (Attachment II).
- Applicable PPE.

## 7.0 SAMPLE PREPARATION - ELUTRIATION

The time required to *process* samples which contain a large amount of sand or gravel can be greatly reduced by elutriation (US EPA 1973). Elutriating removes the heavier components from the sample *thereby decreasing* the volume of *sample matrix that needs* to be examined. The process is based upon the difference in specific gravity between materials that are capable of absorbing isopropanol (organisms and detritus), thereby becoming lighter than water, and materials which cannot absorb isopropanol (sand and gravel) and remain heavier than water. For the process to work properly, the sample needs to have been preserved by immersion in 70% isopropanol or ethanol (specific gravity = 0.79) for a minimum of 24 hours.

- 7.1 Transfer the sample from its container into a 2-gallon bucket or a wide mouth container, which is at least 5 times the volume of the sample.
- 7.2 Add cold tap water until the container is half-full; detritus and organisms contained in the sample will begin to float. Swirl the contents of the bucket (*by hand or by using a spoon or spatula*) to better facilitate the separation of lighter material.
- 7.3 Gently pour the floating material out of the swirling container *into a sieve*.

**NOTE**

Refer to the Invertebrate Section Analytical Request Form (Attachment 1) for appropriate sieve size.

- 7.4 Repeat steps 7.2 and 7.3 *two more times* or until no more lighter material can be separated. A circular swirling motion will aid in separating organisms which do not float readily (clams, snails, hellgrammites), *but need to be incorporated into the analysis*.
- 7.5 Examine the remaining heavy material (sand and gravel) for any large, heavy organisms missed in the swirling process, remove them and place them *with the light fraction*.

## 8.0 SUB-SAMPLING INSTRUCTIONS

### 8.1 General Information

The purpose of sub-sampling is to reduce the time spent *processing* macroinvertebrate samples by estimating the numbers of particularly abundant *taxa*. The decision to sub-sample or not is to be made by the *technician* after *processing* a small amount of the sample. Care must be taken when deciding which samples to sub-sample, and which taxa within the sample to sub-sample for. Sub-sampling for more than two or three taxa complicates the sorting process for the remaining organisms. The time saved by leaving those taxa to be sub-sampled within the sample needs to be sufficient to cover the time expended splitting and sorting *the* sub-samples.

An appropriate guideline to follow is to sub-sample for taxa which appear to be represented in the sample by large numbers of individuals (e.g., >100). By assuming a sorting rate of 100 organisms per hour, it would take approximately *one hour* to remove all individuals of this taxon from the sample.

### 8.2 To Sub-sample or Not (Evaluating a Sample)

8.2.1 A visual examination of the entire sample is often sufficient to determine if sub-sampling is necessary. Chironomid larvae and certain Trichoptera larvae are commonly found in large numbers.

8.2.2 Place one or two tablespoons of sample *matrix* in an enamel pan and sort the macroinvertebrates as described in Reference 4.2, ***but do not remove taxa identified during performance of Section 8.2.1 that considered to be present in large numbers (abundant taxa)***.

8.2.3 For taxa which appear to be present in the sample in large numbers, make a rough estimate of the total number of individuals in the entire sample using the number observed in the first pan.

8.2.4 Decide whether sub-sampling is practical or if the sample should be sorted in entirety (Section 8.1). If sub-sampling is not necessary, sort the entire sample following Reference 4.2. If sub-sampling is determined necessary, follow the steps outlined in Section 8.3, below.

### 8.3 Pre-sorting Samples to be Sub-sampled

8.3.1 List on the sample processing log sheet (Attachment II) abundant taxa which were determined in Section 8.2.3 to require sub-sampling. To minimize bias in the sub-sample estimates, return any specimens of abundant taxa removed during sample evaluation (Section 8.2) to the sample *matrix*.

8.3.2 Sort the remainder of the sample. Remove all organisms **except** those that were determined to be abundant during performance of Section 8.3.1. During sorting, remove any material (leaves, sticks, clumps or algae) that would interfere with the splitting operation.

8.3.3 Label the vials containing sorted organisms as appropriate and package them for identification. Write the word "**split**" on the sample label, which remains with the organisms. This will alert the identifiers that counts for these taxa will be estimated. *Attach a GHS Dot to the outside of the vial.*

8.3.4 Samples that have been pre-sorted for non-abundant taxa, and which need splitting, should be placed on the appropriate shelf in the sample storage area.

#### 8.4 Splitting Samples

To maintain efficiency in sample handling, splitting *may* be performed when a number of samples (3 or 4) have accumulated on the split shelf in the sample storage area.

- 8.4.1 Level the Folsom Splitter. NOTE: *Rinse* the sample of alcohol residue, which can damage the Folsom Splitter.
- 8.4.2 Place the sample matrix into the cylinder of the splitter, carefully rinsing the sample container clean of all sample residues.
- 8.4.3 Stir the sample with a figure-eight motion until the sample is thoroughly mixed. Then allow the organisms to settle for a few moments.
- 8.4.4 With a smooth motion (taking care not to create unnecessary splashing), pour the sample past the divider into the two rectangular troughs located under the splitter cylinder.
- 8.4.5 Pour the rear-most half-split into *a container*, and pour the remaining half-split back into the cylinder for further splitting into quarter-fractions.
- 8.4.6 Carefully repeat steps 8.4.2 through 8.4.5 until the sample is fractionated to the appropriate level. The fractions should contain no more than 200 organisms.
- 8.4.7 *Randomly* select *one or more* fractions for sorting. Place the selected fraction(s) into separate *containers*. Place the remaining sample residue together in a jar and label it "unsorted residue".

#### 8.5 Sorting Fractions

Fractions may be handled as separate samples, or combined to form one set of vials per sample for identification, as specified below.

- 8.5.1 Remove all organisms from each fraction. Place the abundant taxa listed on the sample processing log sheet (Section 8.3.1) into separate vials. **All other organisms not listed** on the sample processing log sheet for sub-sampling, but removed from the fraction, will be composited into another vial for a sorting *Quality Assurance* estimate (see Section 9.0).

Each fraction will be handled separately, and will produce one vial for each abundant taxon, and an additional vial for all **other** (QC) organisms found.

- 8.5.2 Label all vials as appropriate.
- 8.5.3 Discard the residue from the sorted fraction.
- 8.5.4 Repeat Sections 8.5.1 through 8.5.4 until all fractions are sorted.
- 8.5.5 For identification purposes, package all fractions from the same sample together using rubber bands.

### 9.0 ESTIMATES FROM SPLIT RESULTS

The *taxonomist* is responsible for *identifying the specimens and* reporting the data (*estimated counts*) produced

by the splitting procedure.

- 9.1 The identifier records the number of individuals of each **abundant** taxon observed in the fractions (data from the fractions can be kept separate or combined), and also records the number of **others** (*missed taxa*).
- 9.2 Based upon the information provided by the fractions, estimate the number of individuals of each abundant taxon sub-sampled. (if data from multiple fractions are kept separate they can be used to produce a confidence interval in order to evaluate the precision of the method). A *Quality Assurance (QA)* estimate for the initial sample sorting is also produced.
- 9.3 The identifier transfers the results of the estimate onto the sample processing log sheet.

## 10.0 QUALITY ASSURANCE QUALITY CONTROL (QA/QC)

### 10.1 Sorting QA

Each sample subsampled for abundant taxa (as described above) receives a *QA* estimate for overall sorting efficiency. The total number of individuals and taxa not designated to be sub-sampled in Section 8.3.1, but found in the fractions (*missed specimens*), will provide a *QA* estimate (see Section 9.2). If the accuracy estimate is *above 90%* for total number of individuals *and* taxa, *the effort is considered acceptable*. If the total sample *QA* results *are* below 90%, another sample sorted by that *technician* is examined. On-the-job training will be conducted for any person whose QA results are below the acceptable level for two consecutive samples.

### 10.2 Numerical Estimate QC (Optional)

One sample out of every *ten or twenty* sub-sampled may be examined to *determine the efficiency of the splitting process - the accuracy of the estimates made of the number of individuals of each numerically abundant taxon*. This is accomplished by processing the remaining fractions and comparing the actual sample totals to the numerical estimates made from the fractions.

## 11.0 REPORTING

Personnel completing Sections 8.3, 8.4, 8.5, and 9.0 are responsible for entering the appropriate information on the sample processing log sheet at the completion of each step in the sub-sampling process. Report the completion of sorting per study specifications, as applicable.

## 12.0 RECORDS

Retain the following records in the laboratory as specified in the Invertebrate Section Analytical Request Form. In the event that there are no specifications, records will be retained for a minimum of three (3) years following completion of a given study.

- Invertebrate Section Analytical Request Forms
- Invertebrate Section Sample Processing Log Sheets
- *Sorting Quality Assurance results*
- Personnel training/retraining records

**13.0 ATTACHMENTS**

See the Project Manager or Invertebrate Section Leader for the latest revision of the following forms:

Attachment 1 - Invertebrate Section Analytical Request Form (Example)

Attachment 2 - Invertebrate Section Sample Processing Log Sheet (Example)

**IDENTIFICATION AND ENUMERATION OF MACROINVERTEBRATES**

**PROCEDURE NO. EA6**

REVISION SHEET

| <u>Rev. No.</u> | <u>Page</u>       | <u>Section or Paragraph</u>     |
|-----------------|-------------------|---------------------------------|
| 5               | Title page        | updated                         |
| 5               | 3                 | 2.0; 3.1; 4.1; 5.0              |
| 5               | 4                 | 6.7; 6.11; 6.12; 6.17; 7.1; 7.2 |
| 5               | 5                 | 8.4; 11.0                       |
| 5               | Attachments 1 & 2 | added                           |
| 6               | Title page        | updated                         |
| 6               | 3                 | 2.0; 4.1                        |
| 6               | 4                 | 6.11                            |
| 6               | 5                 | 11.0                            |
| 6               | Attachment II     | removed                         |
| 7               | Title page        | updated                         |
| 7               | 3                 | 2.0                             |
| 7               | 3                 | 4.1                             |
| 7               | 4                 | 6.11                            |
| 7               | 5                 | 8.4 - 8.8                       |
| 7               | 6                 | 10.0                            |
| 8               | no changes        | no changes                      |
| 9               | 3                 | 3.0                             |
| 9               | 4                 | 6.0; 7.2                        |
| 9               | 5                 | 7.2.2; 8.1; 8.2; 8.4; 8.5; 9.0  |

---

\* Revised sections are shown in italics.

## IDENTIFICATION AND ENUMERATION OF MACROINVERTEBRATES

### 1.0 PURPOSE

This procedure is provided to ensure a high level of accuracy and consistency regarding identification and enumeration of macroinvertebrates.

### 2.0 SCOPE

This procedure is applicable to the identification and enumeration of macroinvertebrates and applies to personnel who identify macroinvertebrates.

### 3.0 DEFINITIONS

- **Benthic Macroinvertebrates** - refers to animals that (1) are large enough to be seen by the unaided eye; (2) can be retained by a U.S. Standard No. 30 sieve (0.595 mm mesh); and (3) live at least part of their life cycles within or upon available substrates in a body of water.
- **Trained personnel** - refers to biologists who have acquired experience in macroinvertebrate identification through academic study or training, and have demonstrated the ability to independently make accurate identifications (*to consistently identify 90 percent of the taxa in a sample accurately*).
- **Taxonomist** – *refers to biologists who have passed Certification Tests (received a score of 95%) administered by the Society for Freshwater Science (SFS).*

### 4.0 REFERENCES

- Normandeau Document "Corporate Health & Safety Plan."
- US EPA. 1973. Biological field and laboratory methods (EPA-670/4-73-001).

### 5.0 SAFETY PRECAUTIONS

- Observe appropriate laboratory safety precautions given per Reference 4.0.
- Handle noxious or toxic preservatives (e.g., ethanol, isopropanol, formalin, stains) in well-ventilated areas (e.g., outside, under a fume hood, or other ventilation system).
- See appropriate SDS(s) prior to working with any preservatives.
- Avoid the use of formalin/formalin products whenever possible.
- Wear appropriate personal protective equipment (PPE) when handling preservatives (e.g., isopropanol, formalin).

#### NOTE

Contact the Project Manager or the Invertebrate Section Supervisor regarding the use of formalin, SDSs, required PPE, and other information regarding safety and site-specific sampling concerns.

### 6.0 APPARATUS

The following equipment (or equivalent) as applicable is needed:

- Dissecting microscope with 10-20x oculars and variable magnifications (at least 8-10x), stage micrometer, and ocular micrometer.

- Tensor lamp.
- Compound microscope (1000x and internal light source).
- Forceps.
- Dissecting needles.
- Flat-bottomed Syracuse or petri dishes.
- Preservatives (e.g., isopropanol and ethanol).
- *GHS (Globally Harmonized System) container labels.*
- Clear plastic ruler (mm graduations).
- Glass slides.
- Cover slips.
- Hot plate.
- Clearing agents for chironomids and oligochaetes (e.g., Amman's lactophenol and 10% potassium hydroxide).
- Euparal or *Hoyer's solution* for permanent slide mounts.
- Appropriate taxonomic keys.
- Bench/data sheets (see Attachment I for example).
- Mettler balance.
- Air filtration system (e.g., Ecologizer) or hood, and personal protective gear.
- Applicable PPE

## 7.0 INSTRUCTIONS

- 7.1 Identification requiring dissecting microscope only.
- 7.1.1 Pour vial specimens into a petri or Syracuse dish, and examine with the dissecting microscope.
- 7.1.2 If necessary, segregate morphologically similar specimens into groups.
- 7.1.3 If any taxon or group contains too many individuals as to make identification of all of them impractical, randomly subsample each as allowed per study specifications.
- 7.1.4 Select the proper key and identify the specimen(s) to the lowest practicable taxonomic level (or per client specifications).
- 7.1.5 Record the identification of each taxon and number of specimens by taxon on the bench sheet. Additional information to be recorded on the bench sheet includes project name, sample location, date, identifying biologist, pertinent sub-sampling information, and applicable taxonomic notes.
- 7.1.6 Return specimens to the vial and add preservative.

**NOTE**

If specimens are to be weighed by individual taxon, be sure that each vial contains only one taxon. If necessary, add a label bearing the specimen(s) name.

- 7.2 Identification requiring both dissecting and compound microscopes.

**NOTE**

Chironomid larvae and oligochaetes require special preparation for viewing with a compound microscope. Clear chironomid larvae by placing them in a 10% KOH solution or in *Hoyer's solution* until the head capsule is transparent. Clear oligochaetes in Amman's Lactophenol until the body is translucent. Gentle application of heat will aid the clearing process.

- 7.2.1 Follow instructions 7.1.1 through 7.1.4 until key characters become too small to be observed clearly (e.g., mouthparts of Chironomidae spp.).
- 7.2.2 Using a glass slide, mounting media, and cover slip make a slide mount of the specimen(s) requiring further magnification. *Temporary wet-mounts can be prepared by placing a specimens on a slide with a drop of water and then by securing them using a cover-slip.*
- 7.2.3 Continue with the appropriate taxonomic key using the compound microscope, and identify the specimen to the lowest practicable level.
- 7.2.4 Follow instructions 7.1.5 and 7.1.6.

**8.0 QUALITY CONTROL**

- 8.1 Macroinvertebrate identification and enumeration shall be conducted by *SFS Certified taxonomists or by biologists trained and experienced in appropriate techniques.*
- 8.2 Maintain a reference collection of all taxa (if applicable) identified for a particular study. Taxa *may* be labeled with name, date, location of collection, reference number, taxonomic reference, and identifying biologist. *Reference specimen vials should have a GHS Dot attached to the vial.*
- 8.3 Current taxonomic literature will be used and keys updated as appropriate.
- 8.4 Interchange of taxonomic opinion among in-house taxonomists will ensure consistency and agreement in identification. QC checks of identification accuracy will be made by a second biologist who will re-identify *one* of the samples from consecutive batches of *either ten or twenty*. *A minimum of one sample should be re-examined for each individual project. Samples should be selected at random for QC but should represent a majority of the taxa identified for a particular collection. Each taxon from the selected sample will be either verified or rejected by the second identifier. In cases where identification is rejected, each biologist shall compare their respective criteria and attempt to correct the identity of the taxon. If this effort fails, a third identifier can be utilized to find a resolution. If agreement cannot be reached the identification is moved to the next higher phylogenetic level.*
- 8.5 A data set is considered sufficiently accurate when 90.0 percent of the original *taxa identifications* are confirmed by a second *trained* biologist. Gross counts (the sample total) must *also* be within 90 percent of the QA/QC count. If a sample fails either criterion, another one is selected from the same batch and re-identified. If the second sample passes, corrections can be limited to those taxa that were found to be in error (from both samples). If the second sample fails, all samples from *that* batch analyzed by the first biologist need to be re-examined.
- 8.6 Specimens representing state or federally “endangered”, “threatened”, or “species of special concern (e.g., freshwater mollusks)” taxa will be sent (as applicable) to taxonomic experts for verification.
- 8.7 Quality Control results will be logged on the respective Bench Sheets produced from the sample analysis and any taxonomic changes noted. All data tables and narrative reports produced for each study should be checked for transcription, spelling, and calculation errors by a second biologist.

8.8 Where project specific protocols provided to Normandeau differ from this in-house procedure, the analyses and Quality Assurance/Quality Control shall be conducted according to client specifications.

**9.0 REPORTING**

Report the completion of specimen identification as per study specifications. *Data are best submitted as report-ready data tables in excel format.*

**10.0 RECORDS**

Retain the following records in the laboratory per study specifications. In lieu of such, records shall be retained for a period of at least three (3) years following completion of a given study.

- Laboratory Bench sheets and Sample Processing forms (including QC identification records)
- Reference collection
- Copies of reports generated by Section 9.0
- Personnel training records
- QA/QC log including sample numbers, biologist names, and results (as per study specifications)

**11.0 ATTACHMENTS**

Attachment 1 - Example Laboratory Identification Bench Sheet --- (Example, see Project Manager for current revision)