Quality Assurance Project Plan

FOR BIOMONITORING OF RHODE ISLAND NON-WADEABLE STREAMS

PREPARED FOR

Rhode Island Department of Environmental Management
Office of Water Resources
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PREPARED BY

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Project No. R298-007

October 1, 2008

ESS Group, Inc.

QUALITY ASSURANCE PROJECT PLAN
for Biomonitoring of Rhode Island Non-wadeable Streams

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EPA-NE Worksheet 1
Title and Approval Page

QUALITY ASSURANCE PROJECT PLAN FOR
BIOMONITORING OF RHODE ISLAND NON-WADEABLE STREAMS

October 1, 2008

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n.b.: Table 1 provides a summary of EPA-NE Quality Assurance Project Plan (QAPP) Worksheets (USEPA, 1999) not submitted in this QAPP and details the rationale for their omission. The decision to omit several worksheets from this QAPP was made in an attempt to limit redundancy within the document and to remove worksheets which are not relevant to the current project. Table 1 also summarizes information requested from Appendix A, Worksheet 2, Item 9.

1.0 DISTRIBUTION LIST AND PROJECT PERSONNEL SIGN-OFF SHEET

The information requested on the distribution list and project personnel sign-off sheets is encompassed on Worksheet 1, Title and Approval Page, located at the front of this document and therefore, Worksheet 3 Distribution List and Worksheet 4; Project Personnel Sign-Off Sheets have been omitted from this QAPP.

2.0 PROJECT ORGANIZATION

ESS Group, Inc. (ESS) has been contracted by the Rhode Island Department of Environmental Management (RIDEM) to assist with the implementation of a biomonitoring program that will provide the RIDEM with benthic macroinvertebrate data from selected non-wadeable streams in the state of Rhode Island. The primary tasks may include any or all of the following, as determined by the RIDEM: (1) deployment and retrieval of artificial substrate (AS) samplers used in the collection of benthic macroinvertebrates; (2) collection of water quality data; (3) sorting of benthic macroinvertebrate samples; (4) taxonomic identification of benthic macroinvertebrates; and (5) analysis of results. The RIDEM will provide oversight on the project.

Figure 1 (Worksheet 5A), Organizational Chart describes the principal officials and investigators from academic and private institutions associated with the project. In addition, this figure illustrates the pathways of communication that will be utilized during the project and therefore, serves to replace Worksheet 5B, Communication Pathways.

2.1 Communication Pathways

For all work requested by RIDEM, Carl Nielsen of ESS will serve as Lead Project Manager and will coordinate all lab and office work to ensure that it meets the standards established for the project and that work is performed in a timely manner. He will be responsible for overseeing ESS laboratory efforts (for benthic macroinvertebrate processing and identification) and will ensure that all involved personnel are properly trained in all appropriate protocols relating to the collection, sorting and identification of samples. Mr. Nielsen will review field and laboratory data and oversee the completion of all draft and final reports. In addition, Mr. Nielsen will provide regular written or verbal progress updates to RIDEM staff and will be responsible for meeting all project requirements. Mr. Nielsen will serve as the primary point of contact for the entire project.

Carl Nielsen of ESS will act as Quality Assurance Officer. He will verify the accuracy and correctness of procedures and protocols described in the QAPP and will confirm that reporting requirements are met with respect to time of delivery and the product quality.

The Field Data Collection and Analysis Team will be led by Katie DeGoosh of RIDEM, who will be responsible for deployment and recovery of the AS samplers, as well as field processing and preservation. ESS will perform taxonomic identification of the AS samples. Matt Ladewig will perform these services in the laboratory, ensuring that data collection protocols listed in the QAPP are followed (refer to Appendix B, ESS Standard Operating Guidelines for methodology).

Matt Ladewig of ESS will be responsible for the systematic taxonomic identification of oligochaete and chironomid larvae. Responsibilities include the proper mounting of larvae, if necessary, and the successful identification to subfamily or tribe for chironomids and subfamily for oligochaetes (refer to Appendix B for methodology).

Likewise, Mr. Douglas G. Smith (retired) of The University of Massachusetts - Amherst (hereafter Mr. Smith) will be responsible for the taxonomic identification of crustaceans and mollusks upon the request of the RIDEM. Responsibilities include the successful identification to the lowest taxonomic level possible (usually species).

For a full description of the project plan in terms of organizations involved and their respective duties, please refer to Appendix A, Worksheet 6, Personnel Responsibilities and Qualifications Table.

2.1.1 Modifications to the QAPP

In the event that the QAPP requires substantial modification, Carl Nielsen will contact involved parties at the RIDEM before proceeding with any further project activities. The organizational chart (Figure 1, Worksheet 5A Organizational Chart) describes the principal officials and investigators associated with the project and illustrates the chain of communication and authorization. This QAPP covers the third year of a three-year project.

2.2 Personnel Responsibilities and Qualifications

For a full description of the project plan in terms of the organizations involved and their duties, refer to Figure 1, Worksheet 5A, Organizational Chart and Appendix A, Worksheet 6, Personnel Responsibilities and Qualifications.

2.3 Special Training Requirements/Certification

The Project Team has extensive experience in the collection, processing and analysis of benthic samples. ESS staff assigned to this project have been conducting benthic community assessments for over twenty years, while members of the ESS Project Team and Mr. Douglas G. Smith formerly of UMASS have dedicated the majority of their professional careers toward macroinvertebrate biology and taxonomy.

No special training or certification courses were attended specifically in preparation for this project. However, ESS staff, specializing in benthic community assessments, received training in macroinvertebrate identification from previous academic study as well as during informal ESS in-house training associated with a variety of similar projects. Furthermore, ESS has annually conducted biomonitoring of wadeable streams for the RIDEM since 2002. As a result, Worksheet 7, Special Personnel Training Requirements Table, is not included as part of the QAPP.

3.0 PLANNING/PROJECT DEFINITION

Aquatic ecosystem health of freshwater bodies, as inferred from the benthic macroinvertebrate community, has gained increasing popularity among the academic community, environmental scientists from the private sector and state and federal regulatory agencies. Biological monitoring can provide information about past and/or episodic pollution and readily gives an accurate representation of relative health of aquatic ecosystems.

Bioassessments of freshwater streams and lakes aid in assessing the effectiveness of mitigation actions, evaluating point and non-point sources of pollution and prioritizing water bodies for future mitigation activities. Information about benthic macroinvertebrate community structure may also be used to help determine water quality characteristics for Total Maximum Daily Load determinations and to provide additional data for National Pollutant Discharge Elimination System permit modifications (Plotnikoff, 1998). Benthic macroinvertebrates act as indicators of habitat quality and are useful in the biological monitoring of their freshwater surroundings because:

- Some species of benthic macroinvertebrates are sensitive to pollution and some are tolerant, therefore, even short-term environmental fluctuations may be readily inferred from benthic community composition.
- Often, invertebrates are relatively sedentary and long-lived and therefore, information inferred from community composition may accurately characterize local conditions.
- Generally, invertebrates are easy to collect and identify and therefore, are often regarded as a time- and cost-effective technique to assess aquatic ecosystem health.
- Benthic macroinvertebrates are ubiquitous and are often present even where fish are absent (Johnson et al., 2006).

3.1 Project Planning Meetings

Initial scoping of this project was defined by the RIDEM in their Request for Proposals (RFP) for this project. Since the work to be carried out was well defined in this RFP, an initial scoping meeting was not held in order to ascertain the work to be carried out or the project role of the organizations involved. However, a project "kick-off" meeting was held on 8 April 2008 in order to clarify project and contract details. Consequently, Appendix A, Worksheet 8A, Project Scoping Meeting Attendance Sheet has been prepared.

3.2 Problem Definition/Site History and Background

The importance of biological assessments in the evaluation of water quality has long been recognized by Rhode Island state regulatory agencies. The RIDEM Office of Water Resources has monitored benthic macroinvertebrates in wadeable streams according to the U.S. Environmental Protection Agency's (EPA) rapid bioassessment protocols (Barbour et al., 1999) since the early 1990s and has successfully characterized the health of several freshwater habitats across the state in this manner. Likewise, non-wadeable streams (typically fourth-order streams and larger) were sampled until 2002 using an artificial substrate protocol consistent with EPA guidelines as outlined by Klemm et al. (1990). RIDEM previously sampled seven non-wadeable sites in the Blackstone, Pawcatuck and Pawtuxet Rivers on an annual basis. These sites corresponded with locations sampled for water chemistry and other parameters on a quarterly basis by the US Geological Survey (USGS).

4.0 PROJECT DESCRIPTION AND SCHEDULE

The goal of the biomonitoring study is to execute an AS sampling and taxonomic identification program that will provide RIDEM with benthic macroinvertebrate data on selected non-wadeable rivers in the state of Rhode Island. This is a companion program to the state's long-term state-wide monitoring program targeting wadeable rivers. The primary tasks include (1) collection of benthic macroinvertebrates and water quality data; (2) sorting of benthic macroinvertebrate samples; (3) taxonomic identification of benthic macroinvertebrates; and (4) analysis of results. In order to successfully achieve study objectives, ESS will complete the following tasks:

- Develop a QAPP
- Conduct taxonomic identification of benthic macroinvertebrates in the laboratory
- Manage and analyze data and interpret results
- Prepare a final report

Additionally, RIDEM will complete the following tasks:

- Deploy and retrieve artificial substrate devices and assess water quality and physical parameters at selected sampling sites
- Lab process all recovered artificial substrate sampling devices

Crustaceans and mollusks will be identified by ESS scientists and/or sent to Doug Smith for further taxonomic identification or confirmation of ESS identification. Matt Ladewig of ESS will identify all remaining organisms.

Based on the results generated from the taxonomic identification effort, it will be possible to compare and assess each site with respect to the reference site (Wood River at Skunk Hill Road – see Appendix C for details on this location).

ESS will develop a draft final report which presents data and information obtained from the present study including: field sampling data, sample collection and processing information, taxonomic lists of organisms observed at each station, selected metrics and indices, and the overall assessment of aquatic environmental health at each sampling location for review by RIDEM. The draft report will summarize findings following the year's sampling effort.

For an overview of the activities to be performed, field and quality control details, and the overall project schedule time line, refer to Appendix A, Worksheets 9A, Project Description, Worksheet 9C, Field and Quality Control Sample Summary Table, and Worksheet 10, Project Schedule and Timeline Table. Since no contaminants or other target analytes will be assessed in the present study, Worksheet 9B, Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table), has been omitted from this QAPP submittal.

5.0 PROJECT QUALITY OBJECTIVES AND MEASUREMENT PERFORMANCE CRITERA

Data quality objectives (DQOs) are qualitative and quantitative statements that clarify the intended use of the data, define the type of data needed to support the decision, identify the conditions under which the data should be collected, and specify tolerable limits on the probability of making a decision error because of uncertainty in the data (if applicable). DQOs are developed by data users to specify the data quality needed to support specific decisions.

5.1 Project Quality Objectives

The quality of an environmental monitoring program can be evaluated in three steps: (1) Establishing scientific assessment quality objectives; (2) Evaluating program design for whether the objectives can be met; and (3) Establishing assessment and measurement quality objectives that can be used to evaluate the appropriateness of the methods being used in the program. The process of establishing DQOs involves identifying the allowable uncertainty of a data set that may lead to two types of error: *false positives* (Type I error: a problem is found to exist when in fact it does not) and *false negatives* (Type II error: a problem is not found when in fact it does exist). The acceptance probabilities of those errors as established by the data users are the DQOs. The DQO process entails establishing action-triggering values and selecting rates of false positives and false negatives that are acceptable to the data user (decision maker). The quality of a particular data set is some measure of the types and amount of error associated with the data. Additional information pertaining to this section can be found in Appendix A, Worksheets 9A, Project Description, and Worksheet 9C, Field and Quality Control Sample Summary Table.

Sources of error or uncertainty associated with variables and indicators include the following:

1. Sampling error: The difference between actual representative values and sampling values that are related to error in sampling design. Sampling error consists of station specific natural variability due to unknown stream characteristics (may produce adequate living conditions in an isolated area of water) and anthropogenic variability associated with the impact of unknown recent disturbance events (may result in temporary loss of adequate living conditions).

2. Identification error: The difference between sample values and in situ "true" values associated with the sorting and identification process. Identification error includes bias and imprecision associated with sample labeling, handling, storage, sorting and taxonomic classification.

The data requirements for this project encompass aspects of field analysis, laboratory identification and database management to reduce sources of errors and uncertainty in the use of the data. Methods and procedures described in this document are intended to reduce the magnitude of measurement error sources and frequency of occurrence. The relevant quality objectives for this project are related to sample handling, sample area selection and sample identification. General project quality objectives include the following:

- Use of standardized, repeatable sample collection procedures
- Use of trained scientists to perform the sample collection and analyses
- Use of Chains-of-Custody when sending samples to taxonomic experts involved with the identification procedures
- A random quality check on a minimum of 10% of the samples analyzed during sorting and identification
- Maintenance of a taxonomic reference collection

The purpose of these quality checks is to minimize human error throughout these processes. Also, the checks will validate the identifications made by personnel. In addition, ESS will confirm the identifications made with other regional experts as necessary.

5.2 Measurement Performance Criteria

Measurement performance criteria are quantitative statistics used to interpret the degree of acceptability or utility of the data to the user. These criteria, also known as data quality indicators, include the following:

- Precision
- Accuracy
- Representativeness
- Completeness
- Comparability

Data quality indicators that cannot be expressed in terms of accuracy, precision, or completeness will be reported by fully describing the specified method. Because no contaminants or other target analytes will be assessed in the present study, Worksheet 11B, the Measurement Performance Criteria Table has been omitted from this QAPP submittal. Refer to Appendix B, ESS Standard Operating Guidelines (hereafter, SOGs) for additional information.

6.0 SAMPLING PROCESS DESIGN, PROCEDURES AND REQUIREMENTS

Sampling and data collection conducted as part of this project will include an AS benthic macroinvertebrate sample from each specified sampling location following the protocols as detailed in Klemm et al. (1990). In addition, water quality physical parameters to be measured include: dissolved oxygen (mg/L and % saturation), temperature, and conductivity. These data will be attained according to the protocols as outlined in Appendix B SOGs. Information presented in this section will supplant the need for Worksheet 12A, Sampling Design and Rationale.

Refer to Appendix A, Worksheet 14 Field Sampling Equipment Calibration Table and Worksheet 15 Field Equipment Maintenance, Testing and Inspection Table for further information regarding the acquisition of physical water quality parameters. Refer to Appendix B, SOGs for additional information and field protocols for all equipment proposed for the present study. Because no contaminants or other target analytes will be assessed in the present study Worksheet 9B, Contaminants of Concern and Other Target Analytes Table, Worksheet 11B, Measurement Performance Criteria Table, Worksheet 21, Fixed Laboratory Instrument Maintenance and Calibration Table, Worksheet 24A, Fixed Laboratory Analytical QA Sample Table, and Worksheet 24B, Fixed Laboratory Analytical QC Sample have been omitted from this QAPP submittal.

6.1 Sampling Design Rational

As requested in the Scope of Work, an artificial substrate approach for inferring aquatic ecosystem health has been adopted for the present study. This approach entails installation of one artificial substrate sampler at each sampling location and retrieval after a period of at least six weeks. This technique has the advantage of creating a known area of uniform substrate at a distance from the natural river substrate that is consistent across all sampling locations, which allows quantitative comparison of data between sites. It also yields samples that are relatively free of debris, allowing the sorting process to be more efficient. When this sampling regime is conducted over a long time period (years), as in the present study, variations in macroinvertebrate composition are readily observed at a single sampling location. Moreover, when this sampling regime is employed simultaneously at several sampling locations, as in the present study, comparisons of macroinvertebrate composition and inferences of relative aquatic ecosystem health may be ascertained between sampling locations.

The AS approach is not intended to represent a sampling of all macroinvertebrate taxa that may be present in any given stream segment since other habitats are likely to be present in addition to the sampled habitat.

7.0 SAMPLING PROCEDURES AND TRACKING AND CUSTODY REQUIREMENTS

All artificial substrates will be collected and subsequently stored in clean, labeled containers prior to transport from the field. The artificial substrate samplers will be dismantled by RIDEM at the Office of Water Resources (OWR) Sampling Center, cleaned, and sample contents placed in clean, labeled containers. A chain-of-custody form will be completed for each set of samples and will be provided to the laboratory personnel along with the samples. A copy of the chain-of-custody forms will be maintained in the project file at ESS' East Providence office.

After the sorting of the samples has commenced, a quality check will be randomly performed on a minimum of 10% of the samples analyzed. During the sorting phase, if more than a 10% discrepancy is detected between the numbers of organisms identified by the sorter and those identified by the quality assurance check, the sample will be re-processed. The re-sorted sample will receive a second quality assurance check. If the second check again reveals that too many organisms are being missed (>10%), then two (2) additional samples, previously handled by the same sorter, will be randomly selected to undergo a similar quality assurance check. If the percent error in these two (2) additional samples is again more than 10%, then all samples handled by the sorter will be reprocessed.

In order to conduct a Quality Control (hereafter, QC) review for the identification process, an ESS staff member trained in macroinvertebrate identification will randomly check a minimum of 10% of the samples. The purpose of this check will be to validate that identifications are being made accurately. This check will also serve to confirm that crustaceans and mollusks are placed in the appropriate labeled and preserved containers for shipping to Mr. Smith. If necessary, identifications may be confirmed with other regional experts or with Mr. Smith.

Any new taxa found will be added to a reference collection. It is anticipated that this collection will continue to be a valuable resource for confirming identifications with regional experts as well as for proficiently identifying organisms in subsequent years of the study. All new specimens will be labeled and preserved in 70% ethanol and stored for future reference and/or for study by ESS, RIDEM or other regional experts as necessary. A record of the results of each of the various quality assurance checks described above will be kept in an EPA approved Laboratory Analysis Log (Barbour et al., 1999).

7.1 Sampling Procedures

Macroinvertebrates will be sampled using artificial substrate samplers. One Hester-Dendy (1962) style multi-plate sampler will be deployed at each station (for complete list of selected sampling stations please refer to Appendix C, Sampling Locations for Biomonitoring of Rhode Island Non-wadeable Streams). These samplers consist of fourteen 7.6-centimeter diameter, 0.3-centimeter thick tempered hardboard square plates with 24 2.5-centimeter spacers between the plates for a total surface area of 0.12 square meters (not including the central eyebolt).

Field staff will carefully attach AS samplers to anchored buoys so that each sampler may be oriented directly upward and will be exposed to similar depths across all sampling sites. Care will be taken to locate AS samplers away from any structures in order to avoid sampling the effects of direct human alteration to river hydraulics and morphology. AS samplers will be located away from stream access points or areas where they may be directly visible to heavy foot, vehicle or boat traffic to minimize the potential for vandalism or theft.

Field data obtained during this effort will include: a generalized site description and sketch of the river segment depicting the placement of the AS samples, weather conditions during the time of sampling, and predominant land usages along the river corridor. The map depicting the entire sampling reach, areas where sampling is conducted, and in-stream physical features such as riffles, falls, fallen trees, pools, bends and other important structures will be sketched in the field.

As specified within the EPA methodology (Klemm et al., 1990), the sample collection team will perform in-field measurement of the following water quality parameters: dissolved oxygen (mg/L and % saturation), conductivity (µmhos/cm), and temperature (^{o}C). Discharge (cfs or mgd) will be estimated using nearby stream gages. Water quality parameters will be field-monitored during both the installation and retrieval of the artificial substrate samplers. Responsible personnel will follow the SOGs outlined in Appendix B to obtain these field measurements.

During retrieval, field sampling personnel will be careful to approach the AS samplers from downstream to minimize loss of organisms during retrieval. Once a sampler has been touched, it will be pulled immediately and placed intact and entire into a net. Subsequently, the sampler will be carefully and entirely transferred into a clean, labeled bottle with screened water. At the OWR Sampling Center upon dismantling, each individual piece of substrate will be rinsed, gently but thoroughly cleaned underwater with a soft brush, examined visually and placed in a labeled storage bag. The water in the bucket or sampling container will then be poured through a 500 micron sieve to remove fine particles. Organisms and debris will be retained on the surface of the screen and will subsequently be picked or washed from the screen and placed in a sample container for preservation with >70% ethanol. A label will be placed inside the container indicating the sample identification code, date, stream name, sampling location and collector's name. The outside of each container will be labeled similarly, but will also have the words "preservative: >70% ethanol" printed on the label. Sample container information will be recorded on the EPA Sample Log-In Sheet (Barbour et al., 1999).

After sampling has been completed at a given site, all sieves, pans, and other equipment that have come in contact with the sample will be thoroughly rinsed, examined and picked free of any remaining organisms or debris. Any additional organisms found will be placed into the appropriate sample containers. The equipment will be examined again prior to use at the next site.

Preserved and labeled macroinvertebrate samples will be sorted, if already at the laboratory, or transported to the laboratory for sorting. Prior to analysis, ESS will review the EPA Sample Log-In Sheet (Barbour et al., 1999) to verify that all samples have arrived and are in proper condition for processing. Samples will be carefully washed with tap water in a 500 µm-mesh sieve to remove preservative and fine sediment. Care will be taken to ensure that macroinvertebrates are not damaged by coming between the direct flow of tap water and the mesh screen. Large organic material (whole leaves, twigs, algal or plant materials, etc.) will be rinsed, inspected and discarded if no associated macroinvertebrates are identified on these substrates. Because the samples have been preserved in ethanol it may be necessary to soak the sample contents in water for about 15 minutes in order to hydrate the macroinvertebrates, thereby preventing organisms from floating on the water surface.

After each sample has been adequately washed, sorting of the sample will begin. Depending on the size of the samples collected, sub-sampling prior to sorting may be desirable. If necessary, ESS will sub-sample by passing the sample through a plankton splitter or other device (e.g. gridded sieve) that accommodates random sub-sampling, until a 100-organism target sub-sample size has been reached. A 100-organism sub-sample is sufficient to meet the needs of the non-wadeable river monitoring program and is comparable to the level of effort performed throughout other biomonitoring sites state-wide. This "sub-sample" will be passed through a 500 micron sieve and temporarily transferred to a glass or plastic container of adequate size.

Each sample or sub-sample will be sorted under a dissecting microscope on a clean Petri dish. Sub-samples will be scoured for benthic macroinvertebrates and all organisms will be removed and placed in appropriately labeled glass vials (see below). The sorter will complete the EPA Laboratory Bench

Sheet (Barbour et al., 1999), noting sub-sampling/sorting information, time expenditure, and number of organisms found. If a QC check is performed on a particular sample, the QC findings will be noted on the back of the Laboratory Bench Sheet (Barbour et al., 1999). In addition, the sorter will record the date of sorting on the Log-In Sheet (Barbour et al., 1999) as documentation of progress and status of the completion of the sample group.

All sorted macroinvertebrates will be placed into glass vials and preserved in 70% ethanol solution. All macroinvertebrates removed from each sample will be appropriately placed in one of the following three pre-labeled glass vials: (1) Oligochaetes (worms) and Chironomids (midges); (2) Crustaceans and Mollusks; and (3) other organisms. These three vials will be labeled inside and out with the sample identifier code, date, stream name, and taxonomic grouping. If more than one vial is needed, each will be appropriately labeled and will be numbered sequentially (e.g. 1 of n, 2 of n, etc.).

Sorted debris residue for each sample or sub-sample will be saved in a separate container or sealed in a biological sample bag (e.g. Whirl-Pak®), then, labeled with the following information: the sample identification code, date sorted, stream name, sampling location, sorter's name and have the words "sorted residue" and "preserved in 70% ethanol" printed on the label. The remaining unsorted sample debris residue (if any) will be saved in a separate container labeled with all above information as specified for the sorted residue container, but will have the words "sample residue" and "preserved in 70% ethanol" printed on the label.

ESS staff trained in macroinvertebrate taxonomy will identify macroinvertebrates from each sample using standard dissecting tools and the aid of a dissecting microscope. The glass vials containing Crustaceans and Mollusks will be identified by ESS or sent to Doug Smith for further taxonomic identification. A Chain of Custody will be prepared for each sample sent to outside laboratories. ESS will analyze the glass vials labeled "Oligochaetes and Chironomids" or "Other." Before the samples are sent to respective laboratories, a numeration and identification reference list (to Family level) will be compiled. This list will be maintained for sample verification and data recovery in the event that the samples are destroyed or lost during transport. For further details regarding sample handling refer to Appendix A, Worksheet 16, Sample Handling System.

Matt Ladewig of ESS will be responsible for chironomid (midges) and oligochaete (worms) identification, which may require mounting specimens on slides. Slides will be labeled with the site identification code, date collected, and the first initial and last name of the collector. As with chironomids, oligochaetes will also be mounted on slides and will be a similarly labeled. Mounted specimens may be returned to RIDEM at the end of the project upon request.

At the laboratory, further taxonomic identification (to the genus/species level or the lowest practical taxonomic level) and counts of all organisms within each sample will be determined through the use of either a compound microscope or a dissecting microscope (up to 45X magnification), a fiber optic lamp, standard dissecting tools, and appropriate taxonomic keys. Each taxon found in a sample will be recorded and enumerated in a laboratory bench notebook and will then be transcribed to the Laboratory Bench Sheet (Barbour et al., 1999). Any difficulties encountered during identification will be noted on these sheets.

Upon completion of the taxonomic identification effort, samples will be returned to ESS' East Providence office and a master list of all taxa will be compiled along with the accompanying reference collection of macroinvertebrates. The master list of macroinvertebrates observed during year-3 of the contract will be delivered to RIDEM at the end of the identification effort as part of ESS' annual reporting.

ESS will manage, compile, and analyze all collected data. The data will be recorded in electronic format and summarized in table form for inclusion in the final report. All data will be entered into a RIDEM specified electronic data format for analysis and interpretation. Macroinvertebrates (mostly aquatic insect larvae) collected on the artificial substrates will be classified according to their tolerance of pollutants. The organisms will be counted and categorized as described below:

- Tolerant – organisms frequently associated with gross organic contamination and generally capable of thriving under periods of anaerobic conditions, some even in the presence of toxic wastes.
- Facultative or Intermediate – organisms having a wide range of tolerance and frequently associated with moderate levels of organic contamination.
- Intolerant or Sensitive – organisms that are not found associated with even moderate levels of organic contamination and generally intolerant of even moderate reductions in dissolved oxygen.

Data will further be assessed using the Beck's Biotic Index. This Biotic Index affords the clean water taxa twice the weight as the tolerant organisms in the formula:

$$2\,(n \text{ Class I}) + (n \text{ Class II}) = BI$$

where n is the number of taxa in the class

Comparisons of these scores may be made to the Wood River reference station (Wood River at Skunk Hill Road).

7.2 Sampling SOG Modifications

Major modifications will not be made to the EPA's Macroinvertebrate Field and Laboratory Methods for Evaluating the Biological Integrity of Surface Waters, Nov 1990, EPA 600/4-90-030 (Klemm et al., 1990) or Rapid Bioassessment Protocols For Use In Streams and Rivers, May 1989, EPA/444/4-89/00 (Plafkin et al., 1989) unless explicitly communicated to RIDEM and the EPA in advance. Therefore, Appendix A, Worksheet 13, Project Sampling SOP Reference Table is not necessary as part of the QAPP.

7.3 Cleaning and Decontamination of Equipment/Sample Containers

After sampling is completed at each site, all sampling equipment (including nets and pans) will be rinsed with ethanol or fresh water and closely examined to remove any remaining organisms and/or debris. Any organisms and/or debris found on the equipment will be put into appropriate sampling containers. New sampling containers will be utilized at each sampling location and sampling containers will be rinsed with fresh water prior to use.

7.4 Field Equipment Calibration

This project includes the use of equipment that provides water quality data including dissolved oxygen (mg/L and % saturation), conductivity, and temperature. Please refer to Appendix A, Worksheet 14, Field Sampling Equipment Calibration Table and Appendix B, SOGs, for a summary of the calibration procedures required for all water quality equipment.

7.5 Field Equipment Maintenance, Testing and Inspection Requirements

Appendix A, Worksheet 15, Field Equipment Maintenance, Inspection and Testing Table and Appendix B, SOGs both detail the practices that will be used during the project to ensure that equipment is properly functioning during sampling events.

7.6 Inspection and Acceptance Requirements for Supplies/Sample Containers

An itemized list of all supplies and sampling containers is included in Appendix B, SOGs. No specific vendors or suppliers are included in this project and all supplies will be commercially purchased.

8.0 FIELD ANALYTICAL METHOD REQUIREMENTS

All field parameters will be measured in accordance with the SOGs included in Appendix B. All field meters will be calibrated prior to fieldwork on the selected date of sampling. Calibration will be conducted in the lab prior to each field day or in the field prior to sampling as dictated by the SOGs. For further details regarding instrument calibration refer to Appendix A, Worksheet 14, Field Sampling Equipment Calibration Table and Worksheet 15, Field Equipment Maintenance, Testing and Inspection Table.

9.0 FIXED LABORATORY ANALYTICAL METHOD REQUIREMENTS

ESS staff and Mr. Douglas G. Smith, formerly of UMASS, will perform crustacean and mollusk identification. ESS staff will perform the taxonomic identification of all remaining benthic organisms, including oligochaetes and chironomid larvae. For information about laboratory taxonomic identification methods, please refer to Appendix B SOGs.

10.0 QUALITY CONTROL REQUIREMENTS

QC requirements are the system of technical activities that measure the performance of a process. For the purpose of this study, QC requirements will be utilized within the various aspects of field and laboratory analysis. Information on QC protocols followed in this project is provided in Section 5.0 Project Quality Objectives and Measurement Performance Criteria and 6.0 Sampling Process Design, Procedures and Requirements. Because no contaminants or other target analytes will be assessed in the present study Worksheets 11B, Measurement Performance Criteria Table, and Worksheet 24A, Fixed Laboratory Analytical QC Table have been omitted from this QAPP submittal.

A summary of quality controls to be utilized in the present study is provided below:

1. **Water Quality Monitoring:** All equipment used in the field efforts will be calibrated, and data will be recorded in a consistent fashion. Duplicate field measurements of a single sample will be performed at a rate of approximately 10% and should agree within 10% (please see Section 7.0 Sampling Procedures and Tracking and Custody Requirements). In general, if a discrepancy of greater than 10% is observed between the sample and its duplicate, the piece of equipment will be recalibrated and the sample will be reassessed. SOGs pertinent to specific water quality parameters are included as Appendix B.

2. **Artificial Substrate Samples:** Duplicate artificial substrate samplers will be deployed at a 10% rate (or at least one sampler, whichever is greater) for quality control purposes.

3. **Macroinvertebrate Identification:** A random quality check will be performed on approximately 10% of the samples analyzed during sorting and identification. In addition, a taxonomic reference collection will be maintained throughout the duration of the project. Please see Section 7.0 Sampling Procedures and Tracking and Custody Requirements for other related quality control measures.

4. **Laboratory Identification:** For information pertaining to laboratory taxonomic identification methods and quality control checks, please refer to Appendix B SOGs.

11.0 DATA ACQUISITION REQUIREMENTS

This section describes protocols associated with data obtained from external sources (i.e., not collected during sampling). As no data will be obtained from external sources throughout the entirety of this project this section is not applicable to this project and as a consequence, Appendix A, Worksheet 25, Non-Direct Measurements Criteria and Limitations Table is not included as part of the QAPP.

12.0 DOCUMENTATION, RECORDS AND DATA MANAGEMENT

Carl Nielsen, the Lead Scientist and Project Manager, will be in charge of ensuring the proper collection of data and preparation of tables and figures for the entirety of the project. Data collected from the project will be provided to RIDEM in the form of a bound report, with data tables, figures, and a narrative description of findings. The report will be prepared by the report writing team and reviewed by the Project Manager prior to submittal. All data and a narrative report will be submitted to RIDEM in electronic format. The data will be compiled in Microsoft Excel and the narrative will be written in Microsoft Word format. The data will also be made available in an alternate format (specified by RIDEM) should RIDEM require future data uploads to the State of Rhode Island database (RI SWIMS: Rhode Island State Water Information Management System).

A field notebook with waterproof pages will be maintained for field notes during data collection and water quality sampling. All entries into the notebook and on the form will be made with ink or pencil; however, corrections will be made using a single line through the mistake with the initials of the individual who made them. A photocopy of field forms will be maintained in the project files. Entries will include location, time of sampling, date, weather conditions, parameters to be measured, and associated data, as well as any problems encountered during sampling. Copies of the field notebook and field forms will be checked by the Quality Assurance Officer after each sampling event and will be made available for review upon request. Refer to Appendix A, Worksheet 26, Project Documentation and Records Table for additional information regarding the organization of project files.

Data presented in the final report will be made available for distribution by RIDEM. RIDEM will maintain and distribute copies of the report on a necessary basis. Tables and figures will be attached as appendices to draft and final reports.

13.0 ASSESSMENT AND RESPONSE ACTIONS

Laboratory data and figures generated as part of this project will be periodically assessed by the Project Manager to ensure that data collected is usable for the purposes of the study.

- The Project Officer will provide oversight for each field data collection effort to ensure that protocols described on the QAPP are being followed. This duty includes: ensuring that field equipment is properly calibrated, data are recorded in a consistent manner, sampling methodology is being conducted in accordance with Barbour et al. (1999), except as noted in the QAPP, and samples are being properly distributed to laboratories.

- The Project Manager will review laboratory data, including macroinvertebrate sorting and identification, to ensure that appropriate methodology is adhered to and reported data is within the accepted range for each parameter. Any "outlier" data discovered will be reported in the final report, and potential sources of error will be described.

- The Project Manager will review Mr. Smith's laboratory results to ensure that identifications are acceptable. Refer to the ESS SOP, included as Appendix B for additional information pertaining to acceptable ranges. Any discrepancies will be discussed with the respective Laboratory Project Manager and Katie DeGoosh of RIDEM to assess the need to re-sample a particular site. Laboratory "outlier" data will be reported in the final report, and potential sources of error will be described.

14.0 QUALITY MANAGEMENT REPORTS

Quality management reports serve to ensure that the management organization (ESS) and the review agency RIDEM are regularly informed on the project status. To accomplish this goal, the following will be conducted.

- Upon receipt and review by ESS, laboratory results for the first round of macroinvertebrate taxonomic identification will be sent to RIDEM for review. Any problems detected in the data will be verbally discussed between ESS and RIDEM.

- Any "non-conformance" of Laboratory data will be verbally discussed with RIDEM and the appropriate Laboratory.

- A draft report summarizing findings at the conclusion of the sampling effort will be provided to RIDEM for review and comment.

15.0 VERIFICATION AND VALIDATION REQUIREMENTS

Data review, validation, and verification provide methods for determining the usability and limitations of data, as well as a standardized data quality assessment. RIDEM will be responsible for reviewing field sheets while ESS will review laboratory data sheets, data entries, and transmittals for completeness, correctness, and adherence to QC requirements. The Project Manager from ESS will review data received from the laboratories, to assess the data against applicable precision, accuracy and acceptance criteria. The laboratories conducting the analyses will be required to conduct internal data verifications before submitting the data to ESS.

16.0 VERIFICATION AND VALIDATION PROCEDURES

Information on the verification and validation of data is presented in this section; additional information on personnel responsibilities is included as Figure 1, aka Worksheet 5A, Organizational Chart and in Appendix A, Worksheet 6, Personnel Responsibilities and Qualifications Table. All field logbook entries, Chain-of-Custody forms, and other records will be reviewed by the ESS Project Manager for completeness and correctness. Analytical data provided by the laboratories will be reviewed and validated internally to provide information on whether data are acceptable, qualified, or should be rejected. The ESS Project Manager will be responsible for reviewing the laboratory reports and data packages, as well as data entries and transmittals, for completeness and adherence to QA requirements. Data packages will include, to the extent possible, sample receipt and tracking information, chain-of-custody forms, tabulated data summary forms, and raw analytical data for all field samples, standards, QC checks, and other project-specific documents. Data quality will be assessed by comparing entered data to original data or by comparing results with the measurement performance criteria summarized in Section 5.2 Measurement Performance Criteria to determine whether to accept, reject, or qualify the data.

Results of the verification and validation processes will be reported to the RIDEM Project Officer (Katie DeGoosh). The RIDEM Project Officer will make the final determination to reject data and remove any unusable data. If fewer than 90% of the data are judged valid (completeness requirement), statistical procedures and best professional judgment will be applied to verify whether the remaining data will make it possible to draw the correct conclusions for the project. Limitations in the data set will be communicated to the end user, RIDEM, in the draft and final reports prepared for the project.

17.0 DATA USABILITY/RECONCILIATION WITH PROJECT QUALITY OBJECTIVES

Following completion of each year's sample collection, the precision, accuracy, and completeness measures will be assessed by ESS and compared with the criteria discussed in Section 5.2 Measurement Performance Criteria. This will represent the final determination of whether the data collected are of the correct type, quantity, and quality to support their intended use for this project. All analytical data will undergo an assessment to determine their suitability for meeting project objectives outlined in Section 4.0 Project Description and Schedule. This assessment will be conducted by ESS. If data collected meet the DQOs for the study, then the data are considered to meet the objectives of the study. Uncertainties and limitations in the use of these data and interpretation of results will be provided to the RIDEM and will be reconciled, if necessary and possible.

Reconciliation might involve reanalyzing a sample or reviewing the performance criteria to determine whether different criteria (for example, less than 90 percent complete) are capable of meeting project objectives. Noncompliant data that cannot be reconciled will be rejected.

18.0 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.

Hester, F.E., and J. S. Dendy. 1962. A multiple sampler for aquatic macroinvertebrates. Transactions of the American Fisheries Society 91:420-421.

Johnson, B.R., J.B. Stribling, J.E. Flotemersch and M.J. Paul. 2006. Chapter 6.0 Benthic Macroinvertebrates *in* Concepts and Approaches for the Bioassessment of Non-wadeable Streams and Rivers. EPA/600/R-06/127. U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.

Klemm, D.J., P.A. Lewis, F. Fulk and J.M. Lazorchack. 1990. Macroinvertebrate field and laboratory methods for evaluating the biological integrity of surface waters. EPA 600/4-90-030. U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Washington, D.C.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: Benthic macroinvertebrates and fish. EPA 440-4-89-001. U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, D.C.

Plotnikoff, R. 1998. Stream Biological Assessments for Watershed Analysis. Washington State Department of Ecology.

USEPA (US Environmental Protection Agency). 1999. Region I EPA-New England Compendium of Quality Assurance Project Plan Requirements and Guidance. U.S. Environmental Protection Agency, Office of Environmental Measurement and Evaluation.

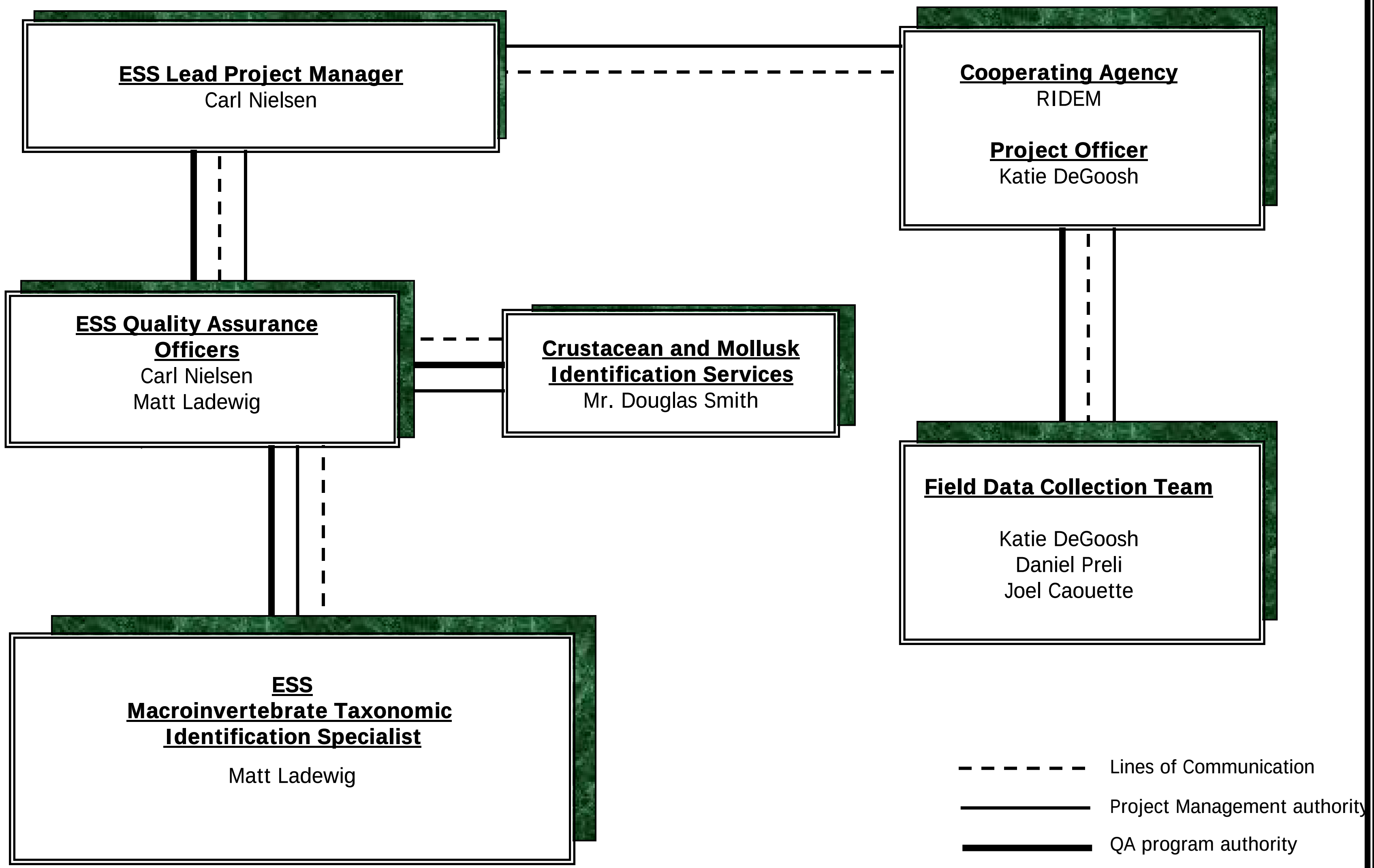
Tables

Table 1. Summary of Omitted EPA-NE QAPP Worksheets and Rationale.

This Table summarizes information requested from Appendix A, Worksheet 2, Item 9.

Worksheets not included in QAPP	Rationale
3	Information located on Worksheet 1
4	Information located on Worksheet 1
5B	Refer to Organizational Chart (Figure 1)
7	No special training courses attended, training received from previous academic study and during in-house, informal training sessions
8B	Problem definition and background provided in text, Section 3.2
9B	No contaminants or other target analytes will be assessed
11A	Project quality objectives discussed in Section 5.0
11B	No contaminants or other target analytes will be assessed
12A	Refer to Section 6.0
13	Refer to Appendix B and C (ESS and ARC methodology)
17	Refer to Appendix B and C (ESS and ARC methodology)
18	Refer to Worksheet 14
19	Refer to Worksheet 15
21	No contaminants or other target analytes will be assessed
22A, 22B	Refer to Sections 5.0-6.0
23A, 23B	Not applicable to this study
24A, 24B	No contaminants or other target analytes will be assessed
25	No data will be obtained from non-direct measurements
27A-30	Refer to Sections 13.0-17.0

Figures



Organizational Chart for the Biomonitoring of Rhode Island Non-wadeable Streams, ESS 2008
EPA-NE Worksheet 5A

FIGURE 1

Appendix A

EPA-NE QAPP Worksheets

EPA-NE QAPP Worksheet #2 - Rev. 10/99

Site Name/Project Name: Macroinvertebrate Identification
Site Location: Rhode Island
Site Number/Code: N/A
Operable Unit: N/A
Contractor Name: ESS
Contractor Number:
Contract Title:
Work Assignment Number:
Anticipated date of QAPP Implementation:

1. Identify Guidance used to prepare QAPP: Region 1, EPA-New England Compendium of Quality Assurance Project Plan Requirements And Guidance. October 1999

2. Identify EPA Program:
   (1) 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.
   (2) Klemm, D.J., P.A. Lewis, F. Fulk and J.M. Lazorchack. 1990. Macroinvertebrate field and laboratory methods for evaluating the biological integrity of surface waters. EPA 600/4-90-030. U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Washington, D.C.

3. Identify approval entity: EPA-NE or State: RIDEM
or other entity:

4. Indicate whether the QAPP is a generic program QAPP or a <u>project specific QAPP</u>. (underline one)

5. List dates of scoping meetings that were held: **04/08/2008** (See Worksheet # 8a)

6. List title of QAPP documents and approval dates written for previous site work, if applicable: N/A

Title	Approval Date

7. List organizational partners (stakeholders) and connection with EPA and/or State:
See attached sheets

8. List data users: RIDEM, EPA-NE, ESS Group, Inc.

9. If any required QAPP Elements (1-20), Worksheets and/or Required Information are not applicable the project, then circle the omitted QAPP Elements, Worksheets and Required Information on the attached Table. Provide an explanation for their exclusion below: Refer to Table 1. Summary of Omitted EPA-NE QAPP Worksheets and Rationale.

Bold QAPP Elements, Worksheets and/or Required Information that are not applicable to the project and provide an explanation on EPA-NE QAPP Worksheet #2, Item 9. (Refer to Attached Table 1 for information on worksheets not included).

REQUIRED EPA QA/R-5 QAPP ELEMENTS	REQUIRED EPA-NE QAPP ELEMENTS and CORRESPONDING EPA-NE QAPP SECTIONS	EPA-NE QAPP Worksheet #	REQUIRED INFORMATION
Project Management and Objectives			
A1	1.0 Title and Approval Page	1	- Title and Approval Page
A2	2.0 Table of Contents and Document Format 2.1 Table of Contents 2.2 Document Control Format 2.3 Document Control Numbering System 2.4 EPA-NE QAPP Worksheet #2	2	- Table of Contents - EPA-NE QAPP Worksheet
A3	3.0 Distribution List and Project Personnel Sign-off Sheet	**3** **4**	**- Distribution List** **- Project Personnel Sign-off Sheet**
A4, A8	4.0 Project Organization 4.1 Project Organizational Chart 4.2 Communication Pathways 4.2.1 Modifications to Approved QAPP 4.3 Personnel Responsibilities and Qualifications 4.4 Special Training Requirements/ Certification	5a **5b** 6 **7**	- Organizational Chart **- Communication Pathways** - Personnel Responsibilities and Qualifications Table **- Special Personnel Training Requirements Table**
A5	5.0 Project Planning/Project Definition 5.1 Project Planning Meetings 5.2 Problem Definition/Site History and Background	8a **8b**	- Project Scoping Meeting Attendance Sheet with Agenda and other Project Planning Meeting Documentation **- Problem Definition/Site History and Background** **- EPA-NE DQO Summary Form** **- Site Maps (historical and present)**
A6	6.0 Project Description and Schedule 6.1 Project Overview 6.2 Project Schedule	9a **9b** 9c 9d 10	- Project Description **- Contaminants of Concern and Other Target Analytes Table** - Field and Quality Control Sample Summary Table - Analytical Services Table - System Designs - Project Schedule Timeline Table
A7	7.0 Project Quality Objectives and Measurement Performance Criteria 7.1 Project Quality Objectives 7.2 Measurement Performance Criteria	**11a** **11b**	**- Project Quality Objectives/Decision Statements** **- Measurement Performance Criteria Table**

Measurement/Data Acquisition			
B1	8.0 Sampling Process Design 8.1 Sampling Design Rationale	**12a** 12b	- **Sampling Design and Rationale** - Sampling Locations, Sampling and Analysis Method/SOP Requirements Table - Sample Location Map
B2, B6, B7, B8	9.0 Sampling Procedures and Requirements 9.1 Sampling Procedures 9.2 Sampling SOP Modifications 9.3 Cleaning and Decontamination of Equipment/Sample Containers 9.4 Field Equipment Calibration 9.5 Field Equipment Maintenance, Testing and Inspection Requirements 9.6 Inspection and Acceptance Requirements for Supplies/Sample Containers	**13** 12b 14 15	- **Sampling SOPs** - **Project Sampling SOP Reference Table** - Sampling Container, Volumes and Preservation Table - Field Sampling Equipment Calibration Table - Cleaning and Decontamination SOPs - Field Equipment Maintenance, Testing and Inspection Table
B3	10.0 Sample Handling, Tracking and Custody Requirements 10.1 Sample Collection Documentation 10.1.1 Field Notes 10.1.2 Field Documentation Management System 10.2 Sample Handling and Tracking System 10.3 Sample Custody	16	- Sample Handling, Tracking and Custody SOPs - Sample Handling Flow Diagram - Sample Container Label (Sample Tag) - Chain-of-Custody Form and Seal
B4, B6, B7, B8	11.0 Field Analytical Method Requirements 11.1 Field Analytical Methods and SOPs 11.2 Field Analytical Method/SOP Modifications 11.3 Field Analytical Instrument Calibration 11.4 Field Analytical Instrument/ Equipment Maintenance, Testing and Inspection Requirements 11.5 Field Analytical Inspection and Acceptance Requirements for Supplies	**17** **18** **19**	- **Field Analytical Methods/SOPs** - **Field Analytical Method/SOP Reference Table** - **Field Analytical Instrument Calibration Table** - **Field Analytical Instrument/Equipment Maintenance, Testing and Inspection Table**
B4, B6, B7, B8	12.0 Fixed Laboratory Analytical Method Requirements 12.1 Fixed Laboratory Analytical Methods and SOPs 12.2 Fixed Laboratory Analytical Method/SOP Modifications 12.3 Fixed Laboratory Instrument Calibration 12.4 Fixed Laboratory Instrument/ Equipment Maintenance, Testing and Inspection Requirements 12.5 Fixed Laboratory Inspection and Acceptance Requirements for Supplies	20 **21**	- Fixed Laboratory Analytical Methods/SOPs - Fixed Laboratory Analytical Method/SOP Reference Table - **Fixed Laboratory Instrument Maintenance and Calibration Table**

B5	13.0 Quality Control Requirements 13.1 Sampling Quality Control 13.2 Analytical Quality Control 13.2.1 Field Analytical QC 13.2.2 Fixed Laboratory QC	**22a** **22b** **23a** **23b** **24a** **24b**	**Sampling** - **Field Sampling QC Table** - **Field Sampling QC Table cont.** **Analytical** - **Field Analytical QC Sample Table** - **Field Analytical QC Sample Table cont.** - **Field Screening/Confirmatory Analysis Decision Tree** - **Fixed Laboratory Analytical QC Sample Table** - **Fixed Laboratory Analytical QC Sample**
B9	14.0 Data Acquisition Requirements	**25**	- **Non-Direct Measurements Criteria and Limitations Table**
A9, B10	15.0 Documentation, Records and Data Management 15.1 Project Documentation and Records 15.2 Field Analysis Data Package Deliverables 15.3 Fixed Laboratory Data Package Deliverables 15.4 Data Reporting Formats 15.5 Data Handling and Management 15.6 Data Tracking and Control	26	- Project Documentation and Records Table - Data Management SOPs
Assessment/Oversight			
C1	16.0 Assessments and Response Actions 16.1 Planned Assessments 16.2 Assessment Findings and Corrective Action Responses 16.3 Additional QAPP Non-Conformances	**27a** **27b** **27c**	- **Assessment and Response Actions** - **Project Assessment Table** - **Project Assessment Plan** - **Audit Checklists**
C2	17.0 QA Management Reports	**28**	- **QA Management Reports Table**
Data Validation and Usability			
D1	18.0 Verification and Validation Requirements		- **Validation Criteria Documents** *
D2	19.0 Verification and Validation Procedures	**29a** **29b** **29c**	- **Data Evaluation Process** - **Data Validation Summary Table** - **Data Validation Modifications**
D3	20.0 Data Usability/Reconciliation with Project Quality Objectives	**30**	- **Data Usability Assessment**

* Include Data Validation Criteria Document as an attachment to the QAPP if Region I, EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses will not be used for validating project data.

Note: Required project-specific information should be provided in tabular format, as much as practicable. However, sufficient written discussion in text format should accompany these tables. Certain sections, by their nature, will require more written discussion than others. In particular, Section 6.0 should provide an in-depth explanation of the sampling design rationale and Sections 13-17 should describe the procedures and criteria that will be used to verify, validate and assess data usability.

Identify project personnel associated with each organization, contractor, and subcontractor participating in responsible project functions. Include the name of the organization for whom they work, and their project responsibilities. Indicate project Case Team members with an "*". Attach resumes to this worksheet. (Refer to *QAPP Manual* Section 4.3 for guidance.)

Personnel Responsibilities and Qualifications Table

Name	Organizational Affiliation	Responsibilities	Location of Personnel Resumes, if not included[1]	Education and Experience Qualifications[2]
Carl Nielsen	ESS	ESS Lead Project Manager, Quality Assurance Officer		See attached resume
Matt Ladewig	ESS	ESS Macroinvertebrate Taxonomic Identification Specialist		See attached resume
Douglas G. Smith	University of Massachusetts-Amherst (Retired)	Crustacean and Mollusk identification		See attached resume
Katie DeGoosh	RIDEM	Project Officer, Field Data Collection		See attached resume
Daniel J. Preli	RIDEM	Field Data Collection		See attached resume
Joel Caouette	RIDEM	Field Data Collection		See attached resume

[1]If a resume is on file elsewhere, document location in this column and summarize the individual's education and experience in the next column. If a resume does not exist for an individual, then indicate not available in this column and summarize the individual's education and experience in the next column.
[2]If a resume is attached to this worksheet, then write "See attached" in this column.

Carl D. Nielsen, CLM
Aquatic Biologist and Senior Taxonomist

EXPERIENCE

ESS Group, Inc. – January 1998 to Present
Years of Prior Related Experience – 8

EDUCATION

MS, Fisheries and Wildlife, University of Missouri - Columbia, 1994
BA, Biology, Colgate University, 1990
Tufts University, Water Quality Monitoring Workshop, 2001

SUMMARY OF PROJECT EXPERIENCE

Mr. Nielsen has more than 18 years of experience in the assessment and evaluation of aquatic ecosystems. He has worked extensively in identifying and understanding the ecology of most aquatic organisms including freshwater macroinvertebrates, marine shellfish and benthos, aquatic plants, algae, zooplankton, fish, reptiles and amphibians. Mr. Nielsen has been Senior Project Scientist for more than 100 aquatic resource studies which have been performed for numerous clients including: federal, state and local governments, municipal water districts, local lake and watershed associations, industrial facilities, property developers, major corporations, utilities, golf courses, ski areas, and airports. Representative project experience includes:

- **Wilcox and Barton – Guilford Commons Monitoring Program; Guilford, CT.** Manages project is to establish baseline conditions in Spinning Mill Brook prior to completion of new storm and waste water systems on the Guilford Commons property. Habitat assessment, water quality sampling and biomonitoring are being conducted at three sites along the brook. In addition, the project includes plant and bathymetry mapping of a small pond in line with the stream. The biomonitoring design employs quantitative methods for sampling macroinvertebrates, periphyton and fish within the brook. Completion of baseline monitoring will permit the evaluation of post-construction water quality, sedimentation and biological conditions in Spinning Mill Brook, as needed.

- **Rhode Island Department of Environmental Management – Statewide Biomonitoring of Rhode Island's Wadeable Streams, Rhode Island.** Mr. Nielsen is currently responsible for managing and conducting a multi-year biomonitoring program for wadeable streams of Rhode Island. The purpose of the program is to provide the Rhode Island Department of Environmental Management (RIDEM) with benthic macroinvertebrate and stream habitat data from selected streams within the state's two main eco-regions. The biological data collected is being used to fulfill the state's 305(b) reporting requirements and to provide a greater understanding of the relationship between the macroinvertebrate community and stream habitat. A total of 50 stream segments are being assessed each year. Additionally, participated in a September 2007 review of Rhode Island's stream biomonitoring program. Yearly data reports are being provided to RIDEM during the contract period. Mr. Nielsen provides multi-year data trend analysis along with recommendations for future monitoring and stream restoration as part of the annual reporting.

- **Town of Norton, Massachusetts. Diagnostic and Feasibility Assessment for Management of Lake Winnecunnet, Norton, Massachusetts.** Mr. Nielsen was responsible for conducting an assessment of Lake Winnecunnet and its watershed which are located within a Massachusetts ACEC (Area of Critical Environmental Concern). The deep-water habitat associated with the lake is threatened by the invasive and exotic plant *Cabomba caroliniana* (fanwort) which has spread throughout the lake to the detriment of native plants and potentially native fauna. The need to manage this situation while protecting the potentially rare or threatened species that exist within the lake required extensive survey of the lake shoreline, the major tributaries to the lake (Canoe River and Mulberry Meadow Brook), and the lake outlet (Snake River). Mr. Nielsen conducted a survey of freshwater mussels, aquatic macroinvertebrates, minnows and young-of-the-year fish, aquatic and semi-aquatic plants, reptiles, and amphibians. Based on these detailed surveys, Mr. Nielsen developed a comprehensive lake and watershed management plan for the Town.

- **Town of Westford, Massachusetts. Baseline Characterization, Drawdown Feasibility Assessment, and Long-term Monitoring Program for Nabnasset Lake, Westford, Massachusetts.** Mr. Nielsen served as Project Manager and lead scientist in an investigation of the baseline characteristics of Nabnasset Lake and a hydrologically-linked wetland system known as Shipley Swamp. The purpose of the investigations was to determine the nature of impacts that could be anticipated as a result of a proposed winter lake drawdown for the purpose of controlling nuisance aquatic plants. As part of the baseline assessments, Mr. Nielsen established numerous plant monitoring plots within the wetland, biological monitoring stations (including both macroinvertebrate and freshwater mussels) within the wetland and lake, and established aquatic plant transects within the lake. These stations are currently being monitored annually to determine the response to drawdown (if any) to allow for immediate management actions to be taken as necessary to prevent significant damage from occurring to the ecosystem. Mr. Nielsen also prepared a Notice of Intent for the control of nuisance aquatic plants at Nabnasset Lake by lake drawdown.

- **Massachusetts Department of Environmental Protection – Aquatic Habitat Evaluation, French and Quinebaug Watersheds, Massachusetts.** Developed and implemented a watershed-wide aquatic habitat assessment program to identify potential problems within the watersheds and to serve as baseline data for future monitoring efforts. Aquatic habitat monitoring was conducted in a manner consistent with DEP's Method 004 Aquatic Habitat Assessment Protocol at 50 sites within the two watersheds. Aquatic invertebrates and water quality data were collected and assessed at 10 key sites. All sampling was conducted in accordance with a project specific Quality Assurance Project Plan (QAPP). All information was incorporated into a GIS database and provided to DEP as an interactive CD-ROM for use by the French and Quinebaug Watershed Team.

- **Club Motorsports, Inc. – 401 Water Quality Certificate and Baseline Monitoring, Tamworth, New Hampshire.** Mr. Nielsen was the lead investigator tasked with designing and implementing a complete baseline monitoring program for the Club Motorsports, Inc.'s proposed racetrack development in New Hampshire. Mr. Nielsen worked closely with NHDES to design and implement a program that would be protective of the aquatic resources of the State on-site and down stream of the property. This program was accepted and the client received their 401 Water Quality Certificate. A long-term monitoring program including water quality, macroinvertebrates, and stream habitat quality is ongoing.

- **Burke Mountain/Northern Star Ski Area - Biomonitoring, Burke, Vermont**. Performed an aquatic invertebrate assessment at two sites on the Passumpsic River in Burke, Vermont as part of a multi-year monitoring program associated with the Burke Mountain/Northern Star Ski Area discharge permit. Invertebrate analysis was performed to the Species level and verified by the Vermont Department of Environmental Conservation (VTDEC). No significant impact to the river has been detected as a result of the water treatment discharge area.

- **Massachusetts Department of Conservation and Recreation – Diagnostic/Feasibility Assessment of Big Pond, Otis, Massachusetts**. Mr. Nielsen designed and conducted an investigation of Big Pond and its watershed to gather baseline information on water quality, stormwater quality, macroinvertebrate community composition, aquatic and wetland plants, fish, and wildlife. Mr. Nielsen made recommendations for monitoring and preserving the ecological integrity of this relatively healthy aquatic system.

- **Murtha Cullina, LLP – Macroinvertebrate and Stream Habitat Evaluation, Danbury, Connecticut.** Mr. Nielsen was responsible for designing and implementing a biomonitoring program that was prompted in response to claims by the State of Connecticut that activities at an industrial site may have resulted in an impact to the Still River as it flowed through the site. In order to respond to these concerns Mr. Nielsen conducted an investigation of benthic macroinvertebrates, water quality and surrounding stream habitat in several reaches of the Still River bracketing the discharges associated with the site.

- **AES Enterprise – Biomonitoring and Habitat Assessment, New Britain and Southington, Connecticut.** Downstream resources associated with the New Britain Water Supply System were evaluated by Mr. Nielsen as part of a water diversion permit application for a proposed power generating plant in the Town of Southington, Connecticut. Mr. Nielsen designed studies to determine impacts associated with the withdrawal of an additional four million gallons per day. Fish, aquatic invertebrates, water chemistry and habitat were assessed to determine means by which the water supply system could be operated to deliver the required volume of water while minimizing environmental impacts associated with the project. ESS was the prime environmental/regulatory permitting consultant on this assignment.

- **Town of Wilton, Connecticut – Biomonitoring**. Project manager for a long-term baseline macroinvertebrate monitoring program for two urban streams in southwestern Connecticut. Macroinvertebrates were collected semi-annually for more than five years in Silvermine River and Comstock Brook, establishing an excellent baseline data set from which to evaluate any future impacts to this area as a result of ongoing development.

- **Property Developer – Biomonitoring, Old Lyme, Connecticut**. Conducted a macroinvertebrate biomonitoring survey and subsequent analysis for several stream systems located in Old Lyme, Connecticut. Baseline data was established prior to the proposed development of a golf course.

- **Neponset River Watershed Association - Neponset River Flow Stressed Stream Habitat Assessment & Fish Passage Evaluations, Boston, Massachusetts.** Mr. Nielsen evaluated streamflow augmentation and instream habitat restoration alternatives and recommended enhancements that would restore habitat for macroinvertebrates and a target list of freshwater fish species in six sub-watersheds draining to the East Branch of the Neponset River, a tributary to Boston Harbor. Mr. Nielsen served as the macroinvertebrate expert on a team designated as the “trio of experts” (a fisheries biologist, macroinvertebrate specialist, and stream hydrologist) charged with assessing 12 selected stream reaches within the study area during a variety of flow regimes.

- **Aquarion Water Company – Biological Survey in Response to Fish Kill, Easton, Connecticut.** ESS responded quickly to design and conduct a biological (fish and macroinvertebrates) assessment of numerous sites upstream and downstream of a reported chlorine spill downstream of a water supply reservoir managed by Aquarion Water Company. Mr. Nielsen initiated work immediately following reports of a fish kill in order to characterize the true nature of impacts to Mill River and to develop an appropriate remedial response. The scope of work was coordinated directly with CTDEP staff. Although work on this project is ongoing, initial results seem to indicate that the effects of the spill on the macroinvertebrate community was minimal and that a natural recovery of the stream would be expected within a very short period of time. ESS recommended that baseline macroinvertebrate data be collected for other key streams within the watershed so that any future problems within the water supplier’s watershed could be easily evaluated. ESS was the prime environmental/regulatory permitting consultant on this assignment and continues to support compliance with DEP requirements.

- **Westvaco, Pennsylvania – 316a Thermal Effluent Study**. Mr. Nielsen conducted the biological assessment of areas upstream and downstream of a thermal discharge produced by the Westvaco paper company as part of a 316a thermal effluent study. Habitat, water quality, macroinvertebrate, and fish data were collected each season for one year to quantify differences between stream reaches. Work was conducted in accordance with Pennsylvania state protocols. No significant impact to the river has been detected as a result of the thermal discharge area.

- **Massachusetts Highway Department – Ecological Monitoring Investigation, Taunton, Massachusetts.** Examined five stream systems along the Route 44 corridor near Taunton, Massachusetts to document existing conditions in order to assess potential environmental impacts associated with a proposed highway expansion. This investigation included an evaluation of water chemistry, physical habitat, fish community composition, algal community composition, and macroinvertebrate community composition.

- **Portland Water District – Periphyton Colonization Study, Portland, Maine**. Assisted in the design and implementation of an experimental investigation to detect changes in periphyton quantity and quality among three distinct shoreline segments in Sebago Lake, the primary water supply for Portland, Maine. The intent of the study was to use periphyton as a reflection of water quality over an extended period of time to evaluate conditions along gradients of shoreline development and water depth. It was demonstrated that it was possible to detect nearshore impacts in a system that exhibited no discernible degradation in offshore water quality. Nearshore periphyton monitoring was recommended as a viable early warning method for detecting future offshore impact.

- **National Science Foundation – Investigation of the Effects of Artificial Shading on the Macroinvertebrate and Periphyton Communities, New Hampshire**. A study of stream shading on several tributaries in the Hubbard Brook Experimental Forest in New Hampshire was designed as part of a National Science Foundation grant. Macroinvertebrate communities were not significantly different between shaded and non-shaded stream segments. This unexpected result was due to low nutrient levels being the limiting factor controlling primary productivity rather than light levels. Information from this study was used as part of a broader study researching the effects of clear-cutting practices by the forest industry.

- **National Parks Service – Baseline Survey, Missouri**. Investigated baseline characteristics of Big Spring, the second largest spring system in the United States, for the Ozark National Scenic Riverways branch of the National Parks Service. Work focused on differences in substrate use by macroinvertebrates, temporal changes in the aquatic plant bed, and storm water discharge monitoring. Over 600 individual macroinvertebrate samples were collected and processed as part of this investigation. Habitat throughout the system was mapped via GPS and the HABSIM protocol. The study was prompted by proposed lead mining within Big Spring's recharge area.

- **Southern New England Telephone – Biomonitoring Program, New London to Groton, Connecticut**. Supervised the marine benthic macroinvertebrate sampling conducted in the Thames River between New London and Groton, Connecticut along directional drill path. A biomonitoring program was established to describe the possible impacts to the benthic community associated with a bentonite clay breakout area along the drill path after one-year and two-year recolonization period. Results from the first year of the study determined successful recolonization had occurred and precluded further monitoring.

PROFESSIONAL REGISTRATIONS AND AFFILIATIONS

- North American Benthological Society
- North American Lake Management Society, Certified Lake Manager
- Northeast Aquatic Plant Management Society
- National Association of Underwater Instructors
- American Heart Association – CPR and First Aid

PUBLICATIONS

Fuller, R.L., B.P. Kennedy and C. Nielsen. 2004. Macroinvertebrate responses to algal and bacterial manipulations in streams. Hydrobiologia 523:113-126.

Nielsen, C. D. and D. L. Galat. 1996. Substrate association by macroinvertebrates in a large, cold-water springbranch. University of Missouri- Columbia.

Schubert, A. L. S., C. D. Nielsen, and D.B. Noltie. 1993. Habitat use and gas bubble disease in southern cavefish (*Typhlichthys subterraneus*). International Journal of Speleology 22(1-4): 131-143.

PRESENTATIONS

Innovative watershed study design – Techniques for locating sources of non-point source pollution. April, 2000. Environmental Protection Agency – Region 1.

An investigation of the sources of non-point source pollution affecting water quality within the lower Westfield River watershed. March, 2000. 6th Annual Westfield River Symposium.

Impaired Waters. April, 1999. 5th Annual Westfield River Symposium.

Differences in substrate use by macroinvertebrates of a large, cold-water springbranch. May, 1993. 42^{nd} Annual Meeting of the North American Benthological Society.

Seasonal variation in macroinvertebrate and fish assemblages in a thermally constant aquatic system. 1993. George Wright Society (National Park Service).

The aquatic plant, invertebrate, and fish communities of Big Spring. 1992. Ozark National Scenic Riverways (National Park Service).

Matthew D. Ladewig
Environmental Scientist

EXPERIENCE

ESS Group, Inc. – September 2006 to Present
Years of Prior Related Experience – 3

EDUCATION

MS, Aquatic Resource Ecology and Management, University of Michigan, 2006
BA, Geography, University of Illinois at Urbana-Champaign, 2000

SUMMARY OF EXPERIENCE

Mr. Ladewig possesses a broad range of field and lab skills useful in bioassessment, monitoring, and modeling of aquatic ecosystems. He is a North American Benthological Society Certified Taxonomist and is proficient in freshwater macroinvertebrate identification to genus level. Mr. Ladewig is also familiar with the standard methods used to collect and process hydrologic, geomorphologic, and water chemistry data for surface and storm water analysis. In addition, he is experienced in the use of Global Positioning System (GPS) units for field data collection and Geographic Information System (GIS) software for data analysis and mapping. Mr. Ladewig is also skilled in statistical analysis and data management.

Mr. Ladewig's representative work experience includes the following:

- **Wilcox and Barton – Guilford Commons Monitoring Program; Guilford, CT.** Conducts field work including habitat assessment, water quality sampling and biomonitoring at three sites along Spinning Mill Brook, as well as plant and bathymetry mapping of a small pond in line with the stream. The biomonitoring design employs quantitative methods for sampling macroinvertebrates, periphyton and fish within the brook. The primary purpose of this project is to establish baseline conditions in the stream prior to completion of new storm and waste water systems on the Guilford Commons property. This will permit the evaluation of post-construction water quality, sedimentation and biological conditions in Spinning Mill Brook, as needed.

- **KeySpan and Northeast Utilities - Long Island Submarine Cable Replacement Project, Norwalk, CT to Northport, NY.** Assisted in the design of a post-construction benthic macroinvertebrate monitoring program. ESS was responsible for project permitting under the Connecticut Siting Council, Connecticut Department of Environmental Protection (CTDEP) Office of Long Island Sounds Programs (OLISP), New York State Department of Public Service (NYSDPS) Article VII, and U.S. Army Corps of Engineers (USACE) permitting processes. The major environmental resource evaluations presented in the permit application filings included: marine resources (fisheries, benthos, shellfish, and essential fish habitat), avian resources, endangered and threatened species, water and marine sediment quality, and coastal wetlands. The Project has been granted the Certificate of Environmental Compatibility and Public Need from the Connecticut Siting Council and the New York State Coastal Consistency Concurrence. Currently, the Project Team is in the construction and installation phase of the project.

- **Massachusetts Department of Conservation and Recreation, Lakes and Ponds Program – Sampling, Design and Permitting Services to Support Dredging at Robinson Pond and Farm Pond; Agawam and Carlisle, MA.** Assists with the design and implementation of a sediment sampling plan for two small ponds on state-managed land. The principal objectives of this project are to assist the client in obtaining the necessary environmental permits for dredging and onsite disposal as well as prepare the final engineering drawings for each pond.

- **Massachusetts Department of Conservation and Recreation, Lakes and Ponds Program – Quagga and Zebra Mussel Education, Monitoring and Outreach; Western MA.** Managed project designed to help prevent the spread of invasive quagga and zebra mussels into the waters of western Massachusetts. The approach of this project was multifaceted and incorporates education, monitoring and outreach activities. The project team developed educational materials, including brochures for outreach to boaters and anglers as well as metal signs for posting at strategically targeted water bodies. On the monitoring front, volunteers from the Lakes and Ponds Association of Western Massachusetts (LAPA-West) were trained to collect and process samples using kits developed by ESS that focus on early life stage detection. In this way invasions of quagga and zebra mussels can be detected and assessed before they become firmly established in a water body.

- **Housatonic River Natural Resource Damage (NRD) Fund – Enhancement of Housatonic River Public Access; Western MA.** Assists with the review of existing data and development of field protocols for the assessment of 41 potential public access improvement sites along the Housatonic River. Up to six sites will be chosen for design, permitting and construction of canoe launches based on the assessment results. The assessment is based mainly on feasibility of access, ecological constraints and distance to the nearest existing river access point.

- **Walpole Country Club – Sampling, Design and Permitting Services to Support Dredging at Allen Pond; Walpole, MA.** Collected sediment cores for analysis of grain size distribution, physical properties and chemical constituents to support permitting of dredging in Allen Pond. The principal objectives of this project are to assist the client in obtaining the necessary environmental permits for dredging and onsite disposal as well as prepare the final engineering drawings for the pond.

- **Rhode Island Department of Environmental Management (RIDEM) – Statistical Analysis of Biomonitoring Data.** Managed project examining the statistical relationships between biological condition, stream habitat and relative abundance of taxa for sites sampled statewide during the 2002 to 2006 period. Results from this analysis will be used to guide classification of surface water bodies into designated use categories for reporting to the U.S. Environmental Protection Agency.

- **Confidential Client – Environmental Impact Assessment for Cat Island Beach Resort; Cat Island, Bahamas.** Conducted biological and water quality surveys of the aquatic and marine habitats adjacent to the proposed Cat Island Beach Resort. Also assisted with avian surveys of the terrestrial, wetland and shoreline habitats on the property. Researched and developed language in relevant sections of the environmental impact assessment to reflect the conditions observed during field surveys.

- **Rose Island Hotel Company – Environmental Monitoring for Rose Island Resort; Rose Island, Bahamas.** Collects water quality, sediment, phytoplankton and benthic samples in accordance with the environmental monitoring plan (EMP) for the pre-construction, construction and operation phases of a mixed-use development project. Also identifies and enumerates marine invertebrate species from benthic samples collected in the shallow coastal waters surrounding the property.

- **C. Webb and Associates, LLC. - Darrow Pond Baseline Assessment; East Lyme, CT.** As part of a baseline assessment, provided quality control and taxonomic identification for macroinvertebrate samples collected from tributaries and the outlet of Darrow Pond. Also conducted baseline water quality data collection in parallel sampling effort with the Connecticut Department of Environmental Protection (CTDEP). A goal of this study was to identify the baseline water quality condition in the pond prior to completion of a clustered development near the pond that incorporates Low Impact Design (LID) principles.

- **Aquarion Water Company – Stream Biomonitoring; Redding and Seymour, CT.** Responsible for quantitative macroinvertebrate sample collection and stream habitat assessment at six sites on two wadeable streams. In response to water quality issues, baseline data were collected at strategic locations within the source watershed.

- **Central Beach Fire District – West Pond Restoration Program; Charlestown, RI.** Developed content of an educational brochure concerning the removal of several acres of exotic common reed (*Phragmites australis*). Aquatic vegetation control is planned in order to remove exotic weeds, enhance wildlife habitat and maintain the recreational assets of West Pond.

- **Jacobs Pond Estate Condominium Trust – Water Quality Impact Assessment; Jacobs Pond, Norwell, MA.** Deployed seepage meters to estimate groundwater flow at four shoreline segments. Also extracted groundwater water quality samples with a Littoral Interstitial Porewater sampler. Pollutant concentrations for each shoreline segment were evaluated to identify areas contributing excessive levels of nutrients or bacteria.

- **Confidential Client – Submarine Cable Installation; Lower Hudson River, NY and NJ.** Identified and enumerated macroinvertebrates from 10 benthic samples collected in the lower Hudson River estuary. Summarized data in a report on baseline benthic resources in the Project area for Article VII submission.

- **Narragansett Bay Commission — Midge Larvae Monitoring and Management Recommendations; Bucklin Point, East Providence, RI.** Conducted an invertebrate monitoring effort in order to identify non-biting midge larvae “hot spots” in the mud flats of the area of concern. Monitoring involved sampling set locations within the mud flats several times throughout the season for midge larvae. The focus of this study was to develop site-specific management recommendations and assist the Narragansett Bay Commission with community outreach activities.

- **Massachusetts Department of Conservation and Recreation – Ponkapoag Golf Course, Water Supply Development and Ecological Monitoring; Canton, MA.** Conducts biological surveys for several state-listed butterflies, damselflies and dragonflies. Monitors water levels in Ponkapoag Pond and Bog in compliance with an Order of Conditions and Water Level Monitoring Plan issued by the Canton Conservation Commission. These efforts are conducted to preserve the fragile ecosystem of an Atlantic white cedar/emergent/scrub-shrub wetland.

- **United States Navy – Storm Water Drainage Map Updates; Naval Station Newport, RI.** Performed field verification of storm water structures using a GPS unit with sub-meter accuracy. Coordinated the incorporation of these field-verified updates into Computer-aided Design (CAD) files of the overall storm water drainage plan for Naval Station Newport. Also contributed to drafting of the final report.

- **City of New Haven – Monitoring Report Review for Water Diversion from the Mill River; New Haven, CT.** Provides third party review of annual environmental evaluation reports concerning the Lake Whitney Water Treatment Plant. These reports focus largely on the aquatic macroinvertebrate community and are prepared by an environmental study team contracted to the South Central Connecticut Regional Water Authority to monitor the impacts associated with the withdrawal of up to 15 million gallons per day of water from Lake Whitney. The area of evaluation includes the Mill River system below Eli Whitney Dam, much of which flows through East Rock Park, a significant resource located in an urbanized area of New Haven. The third party evaluation was prompted in response to concern by the City of New Haven and members of the community over decreased flows and reduced water quality in Mill River below the Eli Whitney Dam.

- **United States Navy – Illicit Discharge Tracking; Naval Station Newport, RI.** As part of the illicit discharge tracking and elimination program, conducted GPS-aided field tracking of dry-weather flow from storm water outfalls within the Station boundaries. Supported the project with GIS storm water feature mapping, outfall sampling and report writing. Additionally, helped coordinate updates to the overall storm drainage system map for the Station. Illicit discharge detection was completed as part of Naval Station Newport's Phase II Storm Water Management Plan (SWMP) in order to comply with the Rhode Island Pollution Discharge Elimination System (RIPDES) regulations as required by the Environmental Protection Agency (EPA) under the Clean Water Act.

- **Rhode Island Department of Environmental Management (RIDEM) - Statewide Biomonitoring and Habitat Assessment of Rhode Island's Wadeable Streams.** Responsible for the annual collection and identification of macroinvertebrates from 50 sites across the state of Rhode Island. Analyzes the habitat, water quality and macroinvertebrate community data and summarizes the results in report form for submission to the U.S. Environmental Protection Agency as part of Rhode Island's 305(b) reporting requirements. Additionally, participated in an August 2007 review of Rhode Island's stream biomonitoring program. The purpose of this multi-year program is to provide RIDEM with benthic macroinvertebrate and stream habitat data from selected streams within the state's two main eco-regions. The biological data collected are being used to provide a greater understanding of the relationship between the macroinvertebrate community and stream habitat.

- **Massachusetts Executive Office of Environmental Affairs - Statewide Water Budgets & Report Development Project; MA.** Prepared GIS figures for towns within various watersheds and assisted with report discussions of wastewater recharge and water transfers. The purpose of the project is to evaluate potential human impacts on stream flow. The water budget model accounts for regulated human derived water inputs and outputs as well as irrigation loses and total recharge loss from impervious area. Data are analyzed at the sub-basin level (HUC-14) on a monthly basis. Results are calculated on a seasonal basis (Summer/Winter).

- **Town of Brookfield - Watershed Nonpoint Source Assessment; Brookfield, MA.** Assisted with collection of discharge and water quality data at targeted sites throughout the Quabog Pond watershed. The results of the monitoring and watershed assessment will be used to design and implement Best Management Practices (BMPs) to address non-point source pollution in Quaboag Pond.

- **Winchester Country Club (WCC) - Stream Biomonitoring; Winchester, MA.** Completed all macroinvertebrate identification, statistical analysis and report writing for the monitoring of Herbert Meyer Brook following completion of an irrigation improvement project in 2003. Compared a stream reach within the zone of potential impact to a control reach upstream. Also compared these data to baseline data collected prior to construction and operation of the small well supplying water for irrigation. No significant impacts of well operation to the stream biota were identified.

- **Gomez and Sullivan - Housatonic River Freshwater Mussel Survey; Glendale Power Station, Stockbridge, MA.** Assisted with a field survey for mussels in the bypass channel of a hydro power station on the Housatonic River. In addition, was responsible for filing a Rare Animal Observation Form with the Massachusetts Natural Heritage and Endangered Species Program when evidence of a state-listed mussel species was found in the channel. Summarized the findings of the survey in a report to the client for compliance with Federal Energy Regulatory Commission (FERC) relicensing procedures.

- **Gomez and Sullivan - Housatonic River Freshwater Mussel Survey; South Lee, MA.** Assisted with a field survey for mussels in the bypass channel of a hydro-powered paper mill on the Housatonic River. No rare or endangered mussels were found in the initial survey. Summarized the findings of the survey in a report to the client.

- **ARCADIS, Inc. - Wetland Biomonitoring; Staten Island, NY.** Responsible for project management, macroinvertebrate taxonomy and reporting of samples collected annually from a landfill wetland.

- **Vespera, Inc. - Darrow Pond Baseline Assessment, Nutrient Modeling and Long-Term Management Plan; East Lyme, CT.** Collected baseline water quality data on Darrow Pond and assisted with technical writing for the diagnostic and feasibility study and data reports

- **University of Michigan, School of Natural Resources and Environment – Study of Disturbance and its Effects on *Glossosoma* and the Structure of Macroinvertebrate Communities in Coldwater Streams; ME and MI.** Assisted with the sorting, identification and enumeration of quantitative macroinvertebrate samples taken over several years from multiple coldwater streams in Maine and Michigan. These efforts are part of an ongoing study to investigate community dynamics related to pathogen-induced disturbance in streams dominated by the caddisfly genus *Glossosoma*.

- **University of Michigan, School of Natural Resources and Environment - Muskegon River Habitat Mapping and Hydraulic Modeling; MI**. Instrumental in the execution of all stages of a major river habitat mapping and modeling project, including the collection of field data, development of GIS maps, and hydraulic modeling (using HEC-RAS and HEC-GeoRAS modeling software). These accomplishments allowed other researchers to couple fish and invertebrate models with six years of modeled hydraulic output.

- **University of Michigan, School of Natural Resources and Environment - Estimation of Sediment Transport Rates on the Lower Muskegon River; MI.** Collaborated with state agencies and citizen groups to complete a sediment transport study on the lower Muskegon River and three major tributaries. Spearheaded organization and execution of field sampling campaigns, lab processing and data analysis. Developed a model of annual suspended sediment and bedload transport rates across the sub-watershed.

- **University of Michigan, School of Natural Resources and Environment - Quantitative Assessments of Fish and Invertebrate Communities in the Muskegon River Watershed; MI.** As an integral member of a multidisciplinary team, collected and processed hydrologic, geomorphic, chemical and biological data on wadeable tributaries and navigable segments of the Muskegon River in Michigan. In addition to operating portable and boat-mounted electrofishing equipment, helped deploy minnow traps, fyke nets and a smolt trap to estimate fish abundance and migration. Deployed standard quantitative sampling equipment (including zooplankton tow nets, Hess samplers and Ponar grab samplers) to estimate abundance and biomass of macroinvertebrates and flux of larval fish and zooplankton. Provided taxonomic identification of fish and macroinvertebrates in the field as a regular part of this work.

- **US Geological Survey - Coastal Freshwater Wetland Management Study; Ottawa National Wildlife Refuge, OH.** Conducted fieldwork on the Crane Creek/Lake Erie wetlands of the Ottawa National Wildlife Refuge. As part of this project, operated towed barge and small watercraft electrofishing units to help characterize the seasonal movements of fish in the freshwater estuary system. Surveyed diked pools and unmanaged wetlands using a laserplane and survey-grade GPS unit.

PROFESSIONAL REGISTRATIONS AND AFFILIATIONS

- North American Benthological Society: Level II Ephemeroptera, Plecoptera and Trichoptera (EPT) Certified Taxonomist for Eastern North America
- American Fisheries Society
- Coastal and Estuarine Research Federation
- Northeast Aquatic Plant Management Society
- New Hampshire Lakes Association
- American Red Cross First Aid and CPR certification

PRESENTATIONS

- Nielsen, C.D. and M.D. Ladewig. Got Swarms? Successful Management of the Non-biting Midge Population in Seekonk River, Rhode Island. Estuarine Research Federation 2007 Conference, November 2007. Providence, RI.

- Nielsen, C.D. and M.D. Ladewig. The Benefits of Biomonitoring for Watershed Assessment. Charles River Watershed Association. June 2007. Weston, MA.

- Riseng, C.M., M.J. Wiley, B. Sparks-Jackson, M. Ladewig and S.R. David. Assessment of the Interacting Effects of Channel Unit Substrate and Hydraulics on Benthic Standing Stock in the Lower Muskegon River, Michigan. North American Benthological Society 53rd Annual Meeting, June 2006. Anchorage, Alaska.

- Ladewig, M.D. and M.J. Wiley. Estimation of Sediment Transport Rates in the Lower Muskegon River, Michigan. 48th Annual Conference of the International Association for Great Lakes Research, May 2005. Ann Arbor, Michigan.

DOUGLAS G. SMITH

EDUCATION

University of Miami, Coral Gables, Florida, 1964-1967 (12 hours Zoology).

B.S. University of Massachusetts, Amherst, Massachusetts, 1977, (Fisheries Biology, cum laude).

M.S. University of Massachusetts, Amherst, Massachusetts, 1982, (Zoology).

MILITARY SERVICE

United States Navy, Submarine Service, 1967-1971. Last rank: Quartermaster Second Class (QM2SS). Received Honorable Discharge, 1971.

Life member, U.S.S. Nautilus (SSN 571) Alumni Association.

WORK EXPERIENCE

Technical Assistant (full time), Museum of Zoology, University of Massachusetts, Amherst, 1971 to 1984.

Technical Assistant II (full time), Museum of Zoology, University of Massachusetts, Amherst, 1984 to 1993.

Acting Curator of Invertebrates, Museum of Zoology, University of Massachusetts, Amherst, 1977 to 1993.

Laboratory Instructor, "Biology of Lower Invertebrates" University of Massachusetts, Amherst, 1980; "Biology of Higher Invertebrates" University of Massachusetts, Amherst,
1982 to 1987.

Lecturer/Curator of Invertebrates, Department of Biology, University of Massachusetts, Amherst, 1993 to present.

Courses taught:
Biology 497H - Tropical Field Studies (team instructed, includes field trip to Caribbean)
Biology 530 - Biology of Invertebrates
Biology 576 - Aquatic Invertebrates (team instructed)
Biology 396, 496, 696 - Independent study
Biology 597B - Metazoan parasites of fishes

APPOINTMENTS

Consultant in Malacology, American Museum of Natural History, New York, 1979 to 1983.

Associate in Invertebrate Zoology, Museum of Comparative Zoology, Harvard University. 1981 to present.

Citizens Advisory Committee on Massachusetts Water Supply Project (WSCAC), 1982 to 1987.
Chair, Scientific Task Force, WSCAC, 1982 to 1987.

Member, Special Subcommittees on Fish and Invertebrates, Vermont Endangered Species Program, 1983 to 1992.

Associate Member, Massachusetts Non-game and Endangered Species Program Advisory Committee. 1985 to 1990.

Associate, Wetlands/Wildlife Technical Advisory Committee (MDEQE). 1987.

Member, Exotic Plant and Animal Species Subcommittee, Massachusetts Department Environmental Protection. 1989 to present.

Member, Massachusetts Non-game and Endangered Species Program Advisory Committee. 1990 to 1993.

Member, Invertebrate Advisory Group, Connecticut Department Environmental Protection. 1990 to present.

Member, Nature Preserves Council, Massachusetts Division Fisheries and Wildlife. 1990 to 1993.

Member, Massachusetts Endangered Species Act Technical Advisory Committee. 1991.

AWARDS, HONORS

Chancellor's Citation, University of Massachusetts. 1986.

Audubon "A" award, Massachusetts Audubon Society, awarded to Water Supply Citizens Advisory Committee (WSCAC). 1986.

Certificate of Appreciation, 25 years of service, University of Massachusetts. 1997.

RESEARCH AND TRAVEL GRANTS RECEIVED

Received almost 30 research and travel grants from private, state, and federal sources to conduct research.

PUBLICATIONS

BOOKS:

1. Smith, D.G. 1991. Keys to the Freshwater Macroinvertebrates of Massachusetts. Including the Porifera, Cnidaria, Entoprocta, Ectoprocta, Platyhelminthes, Nematomorpha, Nemertea, Mollusca (Prosobranchia and Pelecypoda), and Crustacea (Branchiopoda and Malacostraca). ¸ Douglas G. Smith. 236 pp.
Second Edition completed in 1995

2. Smith, D.G. 2001. Pennak’s Freshwater Invertebrates of the United States. 4th Edition. John Wiley and Sons, New York. 638 pp.

CHAPTER in BOOK:

1. Smith, D.G. 2001. Systematics and Distribution of the Recent Margaritiferidae. In: G. Bauer and K. Wachtler (eds.) Ecology and Evolution of the Freshwater Mussels Unionoida. Ecological Studies 145:33-49. Springer-Verlag, Berlin.

Over 70 original research papers in peer reviewed journals.

CONSULTING

Operated private consulting business since 1993. Projects include wetlands surveys for rare and endangered invertebrates, habitat evaluation, and general aquatic surveys. Performed identification services for private, state, and federal institutions.

Katie E. DeGoosh

Curriculum Vitae

RI Department of Environmental Management
Office of Water Resources
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Providence, RI 02908

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Fax: 401-222-3564
Katie.degoosh@dem.ri.gov

EDUCATION

M.S. in Ecology and Environmental Science **2007**

University of Maine, Orono, ME
Thesis Title: *Development and Application of a Paleolimnological Inference Model to Identify Historically Fishless Lakes in Maine*
Advisors: Dr. Cynthia Loftin and Dr. Katherine Webster. GPA: 3.47

B.A. in Biology with a concentration in Environmental Science **2002**

Russell Sage College, Troy, NY
Senior Project Honors: Poesten Kill Creek Assessment (with NYS DEC).
Advisor: Dr. Kathleen Skinner. GPA: 3.26

RELATED EXPERIENCE

Stream Monitoring Program Coordinator **2006-present**

RI Department of Environmental Management, Office of Water Resources, Providence RI. Supervisors: Sue Kiernan & Connie Carey RIDEM; Beth Card, NEIWPCC.

- Coordinate, execute and evaluate Stream Monitoring Program (water chemistry, macroinvertebrate and stream flow data)
- Evaluate data and develop BCG model-based Biocriteria
- Redesign and implement sampling strategy, methods and analysis
- Review stream biological and chemical data for EPA Assessments and Integrated Reports, and various related state documents
- Oversee design and maintenance of OWR Sampling Center
- Produce educational materials on Aquatic Invasive Species (AIS)
- Edit and revise RI State AIS Management Plan with RICRMC
- Consult with EPA Region 1 on various regional projects
- Act as office resource for questions regarding freshwater biology

Graduate Research Assistant **2002-2006**

University of Maine Department of Wildlife Ecology; Ecology and Environmental Science Program, Orono, ME. Advisors: Dr. Cynthia Loftin and Dr. Katherine Webster

- Designed and executed research project using paleolimnology to ground-truth predictive GIS landscape model
- Produced a tool for lake managers to identify historically fishless lakes
- Managed and maintained a scientific laboratory
- Hired and supervised undergraduate student workers
- Statistically analyzed results, prepared thesis and presented research at meetings and conferences

Ashuelot Pond Project Coordinator **Summer 2002, 2003**

NH Department of Environmental Services Limnology Center, Concord, NH.
Supervisors: Jody Connor and Amy Smagula, NHDES

- Planned and executed aquatic plant, invertebrate, amphibian and fish surveys at Ashuelot Pond, Washington, NH
- Analyzed water samples in NH State DES Chemistry Laboratory
- Involved with the Volunteer Lake Assessment Program, interacting with lake monitors, receiving and processing water samples
- Assisted Exotic Species Coordinator when giving public workshops on aquatic plants and when enforcing regulations

Senior Research Project **2001-2002**

NYS Department of Environmental Conservation, Stream Biomonitoring Unit, Greenbush, NY. Supervisor: Robert Bode, NYSDEC

- Sampled Poesten Kill Creek at 10 sites for macroinvertebrates using EPA RBP Protocol (Barbour et. al. 1999)
- Picked invertebrate samples and identified insects to genus
- Wrote official NY state report (*Biological Assessment of Poesten Kill Creek;* available online*)* and orally presented findings

Laboratory Technician **Summer 2001**

NYS Department of Environmental Conservation, Wildlife Pathology Unit, Delmar, NY.
Supervisor: Ward Stone, NYDEC

- Assisted with animal necropsies as primary note-taker for pathologist
- Labeled and packaged organ samples for WNV / toxicity screening
- Organized and maintained NY State rabies database
- Shipped, received, and logged-in pathology specimens

TEACHING ASSISTANTSHIPS

2004. ***University of Maine, Department of Wildlife Ecology***
Teaching assistant for General Ecology Laboratory

2002-2003. ***University of Maine, Biology Department***
Teaching assistant for General Biology Laboratory I & II

2000-2002. ***Russell Sage College, Biology Department***
Teaching assistant for General Biology Laboratory I & II

CERTIFICATIONS

2005. American Canoe Association – Canoe Safety Training

2004. UMaine Hands-on Fire Extinguisher Training

2003. SCUBA Certification (pending 2 open water dives)

2002. National Association of State Boating Law Administrators – NH Boat Safety

GRANTS AND SCHOLARSHIPS

2005. ASLO Aquatic Sciences Meeting Travel Stipend $1000

2004. AFS, Atlantic International Chapter Student Travel Grant $100

2004. Penobscot Conservation Association Scholarship $2000

2003. Dysart Student Travel Grant $300

2003. UMaine Association of Graduate Students Travel Grant $750

HONORS AND AWARDS

2005. Outstanding Student Poster Award. American Society of Limnology and Oceanography, Aquatic Sciences Meeting, Salt Lake City, UT

2004. Best Graduate Student Poster. Maine Water Conference, Augusta, ME

2004. Second Place, Biological Sciences Poster. UMaine Graduate Student Expo, Orono, ME

2002. Departmental Honors in Biology. Russell Sage College, NY

2002. Cogswell Award for Outstanding Community Service. Russell Sage College, NY

PUBLICATIONS

Schilling, E.G., C.S. Loftin, K.E. DeGoosh, A.D. Huryn and K.E. Webster. 2008. Predicting the locations of naturally fishless lakes. Freshwater Biology 53:1021-1035.

DeGoosh, K.E. 2007. Development and Application of a Paleolimnological Inference Model to Identify Historically Fishless Lakes in Maine; Master's thesis. University of Maine. 94pp.

MEETING PRESENTATIONS & PUBLISHED ABSTRACTS

DeGoosh, K.E. 2008. Rhode Island Monitoring Program Update on Critical Elements Evaluation *in Workshop 3: Critical Technical and Programatic Elements in Bioassessment Programs*; oral presentation. 32nd Annual Meeting of the New England Association of Environmental Biologists, Bartlett, NH.

DeGoosh, K.E. & C.A. Dudley. 2008. Identifying and Managing Aquatic Invasives; oral presentation. 5th Annual RI Land & Water Conservation Summit, Kingstown, RI.

Schilling, E.G., C.S. Loftin, A.D. Huryn, K.E. DeGoosh. 2007. A habitat on the brink? An assessment of the status of fishless lakes in Maine; oral presentation. 13th Annual Maine Water Conference, Augusta, ME.

DeGoosh, K.E., Schilling, E.G., C. S. Loftin, K.E. Webster. 2006. There's something fishy about fly larvae: *Chaoborus* assemblages as an indicator of fishless ponds; oral presentation. 30th Annual Meeting of the New England Association of Environmental Biologists, Bethel, ME.

Schilling, E.G., C.S. Loftin, A.D. Huryn, K.E. DeGoosh. 2006. A habitat on the brink? An assessment of the status of fishless lakes in Maine; oral presentation. North American Benthological Society Annual Meeting, Anchorage, AK.

DeGoosh, K.E., Schilling, E.G., C. S. Loftin, K.E. Webster. 2006. Identifying historically fishless lakes as a target for conservation**;** oral presentation. 12th Annual Maine Water Conference, Augusta, ME.

Schilling, E.G., K.E. DeGoosh, C.S. Loftin, A.D. Huryn, R.G. Butler, P.G. DeMaynadier. 2005. Assessing the geographic distribution and invertebrate biodiversity of naturally fishless lakes in Maine, USA; poster presentation. 90th annual meeting of the Ecological Society of America: Ecology at multiple scales. Montreal, Canada.

Webster, K.E., D. Anderson, E.G. Schilling, C.S. Loftin and K.E. DeGoosh. 2005. Landscape setting influences control of cladoceran body size and abundance by fish in small lakes in Maine; poster presentation. 90th annual meeting of the Ecological Society of America: Ecology at multiple scales. Montreal, Canada.

DeGoosh, K.E., E.G. Schilling, C.S. Loftin, K.E. Webster. 2005. Message in the mud: Does *Chaoborus americanus* indicate fish absence in Maine ponds? oral presentation. Annual Meeting of the New England Chapter of the North American Lake Management Society: On Golden Pond, 21st Century Lake Management. Plymouth, New Hampshire.

DeGoosh, K.E., E.G. Schilling, C. S. Loftin, K.E. Webster. 2005. Message in the mud: Does *Chaoborus americanus* indicate fish absence in Maine ponds? oral presentation. University of Maine Graduate Student Expo, Orono, ME.

DeGoosh, K.E., E.G. Schilling, C. S. Loftin, K.E. Webster. 2005. Message in the mud: Does *Chaoborus americanus* indicate fish absence in Maine ponds? poster presentation. 11th Annual Maine Water Conference, Augusta, ME.

Schilling, E.G., K.E. DeGoosh, C.S. Loftin, A.D. Huryn, R.G. Butler, P.G. DeMaynadier. 2005. Assessing the geographic distribution and invertebrate biodiversity of naturally fishless lakes in Maine, USA; poster presentation. Tenth annual Spring symposium of the Center for Biodiversity and Conservation: New Currents in Conserving Freshwater Systems. American Museum of Natural History, New York, NY.

DeGoosh, K.E., E.G. Schilling, C. S. Loftin, K.E. Webster. 2005. Message in the mud: What the presence of *Chaoborus americanus* can tell us about fish distributions throughout the Maine landscape; poster presentation. American Society of Limnology and Oceanography, Aquatic Sciences Meeting, Salt Lake City, UT.

Schilling, E.G., C.S. Loftin, A.D. Huryn, K. DeGoosh. 2004. Landscape attributes of fishless lakes in Maine, USA; poster presentation. 18th annual meeting of the Society for Conservation Biology: Conservation in an urbanizing world. New York, NY. 2004.

DeGoosh, K.E., C. S. Loftin, K.E. Webster. 2004. Does *Chaoborus americanus* indicate the presence of fishless ponds in Maine? oral presentation. 30th Annual Meeting of the Atlantic International Chapter of the American Fisheries Society. Fairlee, VT.

DeGoosh, K.E., C. S. Loftin, K.E. Webster. 2004. Is *Chaoborus americanus* an indicator of fishless ponds in Maine? poster presentation. University of Maine Graduate Student Expo, Orono, ME.

DeGoosh, K.E., C. S. Loftin, K.E. Webster. 2004. Using sub-fossil mandibles of *Chaoborus americanus* as a paleolimnological indicator of fishless ponds in Maine; poster presentation. 10th Annual Maine Water Conference, Augusta, ME.

DeGoosh, K.E., C. S. Loftin, K.E. Webster. 2004. Using sub-fossil mandibles of *Chaoborus americanus* as a paleolimnological indicator of fishless ponds in Maine; poster presentation. North East Biological Graduate Student Conference, Orono, ME.

ATTENDED PROFESSIONAL MEETINGS

2008. Northeast Aquatic Nuisance Species Panel Meeting. Lake George, NY

2008. US EPA Workshop on Climate Change Effects on Biological Indicators: Rivers, Streams and Lakes. Crystal City, VA

2007. Northeast Aquatic Nuisance Species Panel Meeting. Providence, RI

2007. 31st Annual Meeting of the New England Association of Environmental Biologists, Mt. Snow, VT.

2007. US EPA Workshop: Climate Change Effects on Biological Indicators. Baltimore, MD

2006. US EPA Water Quality Standards Academy. Washington, D.C.

2004. "The Gathering: Leopold's Legacy for Fisheries." 134th Annual Meeting of the American Fisheries Society, Madison, WI.

2003. "Protecting our Lake's Legacy." 23rd Annual International Symposium of the North American Lake Management Society, CT.

PROFESSIONAL, ACADEMIC & COMMUNITY SERVICE

***Seminar Committee member*, Fall 2004, University of Maine, Orono, ME**
- Invited and introduced speakers for weekly departmental seminars

***Vice President*, UMaine Student Subunit of the American Fisheries Society 2004-2005, University of Maine, Orono, ME**
- Promoted presence of AFS on campus, volunteered for stream assessments

***Class President*, 2000-2002, Russell Sage College, Troy, NY**
- Organized senior class events and traditional ceremonies
- Represented class in student government and administrative meetings
- Interacted with class officers to coordinate fundraising and prepare budget

***"Rally 2002" Overall Co-Chair*, Russell Sage College, Troy, NY**
- Planned traditional two-week community event to fundraise for non-profit groups (American Cancer Society and James Wheelock Clark Library)
- Lead and created themed student assemblies to foster unity and spirit
- Orchestrated cheerful campus decoration and dining hall festivities

***Erwin Lecture Coordinator* , SMaRT (Science, Math and Research Technology) Women's Club, 2000-2002, Russell Sage College, Troy, NY**
- Invited students to present research and internship experiences
- Scheduled lecture times, reserved meeting space and prepared refreshments

***Sage Circle member*, 2002. Russell Sage College, Troy, NY**
- Inducted to exclusive non-academic honor society
- Assisted community fundraising (benefited American Caner Society)

***Resident Assistant*, 2000-2001. Russell Sage College, Troy, NY**
- Assisted freshman living in dormitory (peer mediation, mentoring etc.)
- Enforced campus rules and fostered safe community atmosphere

***Biology Club President*, 2000-2001. Russell Sage College, Troy, NY**
- Ran monthly meetings of club
- Planned fund-raising events
- Instituted Adopt-A-Highway clean-up group on campus

PROFESSIONAL SOCIETIES

Northeast Aquatic Nuisance Species Panel

American Society of Limnology and Oceanography

American Fisheries Society, Atlantic International Chapter

North American Lake Management Society, New England Chapter

Beta Beta Beta, Biological Honor Society

JOEL P. CAOUETTE

34 Stella Drive
Cumberland, RI 02864
(401) 374-2719
jpcaouette@gmail.com

EDUCATION

B.S. in Wildlife Conservation Biology **August, 2008**
University of Rhode Island, Kingston, RI
Eligible for T.W.S. Associate Wildlife Biologist certification

PROFESSIONAL EXPERIENCE

Surface Water Monitoring Intern **May 2008-Present**
Rhode Island Department of Environmental Management, Providence, RI

- Participate in water chemistry sample collection, assist with stream flow study, and conduct stream biomonitoring recon
- Enter fieldwork data
- Write and revise documents for current chemistry monitoring (QAPP)

Seasonal Fisheries Intern **Summer 2007**
New York State Department of Environmental Conservation, East Setauket, NY

- Assisted fishery biologists in marine fisheries data collection and trawl surveys of tautog, winter flounder, and weakfish in Long Island waters
- Responsible for setting and maintaining fisheries gear, fish identification and enumeration, and field data collection
- Performed data entry for the studies
- Performed general maintenance on the boats and equipment

FIELD & VOLUNTEER EXPERIENCE

Atlantic Brant Bioenergetics Research Volunteer **February-May 2008**

- Conducted focal observations and scan samples of Atlantic brant in East Narragansett Bay
- Assisted in aquatic and terrestrial vegetation sampling

Ruffed Grouse and Turkey Research Volunteer **April 2008**

- Conducted point counts for RIDEM on ruffed grouse and wild turkeys

Wildlife Techniques Class **January-May 2008**

- Completed radiotelemetry and GPS exercises
- Capture and marking techniques for birds and mammals

Endangered Species Management Class **January-May 2008**

- Currently participating in writing a recovery plan for the Northeast Beach Tiger Beetle

Blackstone River Watershed Coalition Water Monitoring Program **March 2005-Present**

- Tested the levels of nitrates and phosphates in the waters of the Blackstone River and its tributaries

Watershed Hydrology Laboratory **October-November 2006**

- Gauged stream using the slug test method
- Studied macro-invertebrates found in the stream bed to assess the health of the stream

SKILLS

- Working knowledge of Microsoft Excel and Microsoft Word
- Ability to identify native fauna of Northeast

AWARDS

- Life Scout, Boy Scouts of America
- Citation for volunteer work with the Blackstone River Watershed Coalition

Daniel J. Preli
1 Riverside Drive
Cromwell, CT 06416
Daniel.Preli@Salve.edu
(860)-803-8897

Education

Salve Regina University, Newport RI May 2008
Bachelor of Science in Biology Minor in Chemistry

Relevant Courses:

Biochemistry	Organic Chemistry	Genetics
Microbiology	Ecology	Cancer Biology
Physics	Cell Biology	General Biology

Key Competencies

Laboratory Ready	Highly Organized	Goal Oriented
Leadership Skills	Field Ready	Reliable

Work Experience

May 2008 – present

Seasonal Technician, RIDEM Office of Water Resources Surface Water Monitoring Program, Providence, RI

- Prepare field materials
- Perform field reconnaissance
- Conduct water chemistry sampling
- Measure stream flows
- Identify invasive species
- Maintain sampling center laboratory
- Enter data and maintain lake file system

December 2007 – May 2008

Independent Research Project: Owl Habitat Selection, Newport RI

- Design pilot program to establish local owl habitat and monitoring
- Collect data using GPS
- Organize volunteer program
- Employ field research skills

Jan 2007 – Present

Musician in rock band "The Shake UP"

- Play at local Newport clubs on weekends

May 2007 – Sept. 2007

Computer Technician, A&C Computer Inc. East Hartford, CT

- Diagnose and repair computer problems
- Manage parts and services
- Solve problems with clients over the phone

Dec. 2006 – May 2007 *Independent Research Project: Bailey's Brook Watershed Newport, RI*

- Create student monitoring guidelines for Baileys Brook
- Develop data collection and analysis skills
- Employ Field/Lab research skills
- Attend state water zoning and planning conferences

Summers '03 – '06

Tax Assistant: Cromwell Tax Collectors Office, CT

- Responsible for tax collections and data management
- Significant responsibility and high risk position
- Develop work ethics and client relationship skills
- Attend town meetings and planning law conferences

Activities & Volunteer Experience

Jan. – May 2007 – 2008 Sampler: Clean Ocean Access

- Sampled beaches for coliforms and nutrients
- Collected ocean temperature data and water samples
- Surveyed beach front and collected data

SRU – 2004 – 2006 Percussionist: Salve Regina University Jazz Ensemble

- Drummer in big band style jazz orchestra
- Played for school fund raising events
- Played for Hurricane Katrina fundraising event

Spring 2005 – 2006 Volunteer at Martin Luther King/Salvation Army Center

- After-school buddy program

Xavier High School Career Volunteer at Cromwell Middle School

- Assisted in Fine Arts Program with 6th, 7th, graders

Volunteer at Connecticut Special Olympics

- Involved in managing the Long Jump Event

Interests

Skiing	Environment	Music	Computers
Soccer	Traveling	Snorkeling	

Project Scoping Meeting Attendance Sheet

EPA Regulation Program: RCRA FIFRA TSCA CERCLA DW <u>CWA</u> CAA (underline one)	**Site Name**:
Program (Brownfields, NPDES, etc.):	**Site Location**: 7 locations throughout RI
Project Date(s) of Sampling: To be determined	**CERCLA Site/Spill Identifier No.**:
Project Manager: Carl Nielsen, ESS Inc	**Operable Unit**:
	Other Site Number/Code:
	Phase: ERA SA/SI Pre-RI RI (phase I, etc.) FS RD RA post-RA (underline one)
	Other phase:

Date of Meeting: 04/08/08
Meeting Location: RIDEM offices, Providence, RI

Name	Project Role	Affiliation	Phone #	e-Mail Address
Sue Kiernan	Contract Officer	RIDEM	401-222-4700 Ext. 7600	sue.kiernan@dem.state.ri.us
Connie Carey	Contract Officer	RIDEM	401-222-4700 Ext. 7239	connie.carey@dem.state.ri.us
Katie DeGoosh	Project Officer	RIDEM	401-222-4700 Ext. 7211	katie.degoosh@dem.state.ri.us
Matt Ladewig	Macroinvertebrate Taxonomist	ESS	401-330-1204	mladewig@essgroup.com

Meeting Purpose: Establish project responsibilities

Comments and Action Items:

Project Description

Sampling Tasks: Artificial substrate macroinvertebrate sampling, habitat characterization and water quality sampling (dissolved oxygen, conductivity, and temperature).

Analysis Tasks: Taxonomic Identification of all organisms collected from each sampling location to the lowest practical taxonomic level.

Biological Metrics selected and employed to develop a single value representative of each site's macroinvertebrate community.

Quality Control Tasks: Laboratory sorting and identification check (10% of all samples).
Reference collection will be compiled for Taxonomic Identification Verification.

Secondary Data: N/A

Data Management Tasks: Management and organization of data. Data will be presented in tables.

Documentation and Records: Field notebooks/sheets, EPA Sample Log-In Sheet, Habitat Assessment Field Data Sheets, Laboratory Bench Sheet, Chains of Custody.

Data Packages: Data report including a taxonomic list of all taxa and tables of metrics.

Assessment/Audit Tasks: RIDEM did not include funding for audits to be conducted during this project.

Data Verification and Validation Tasks: Project Manager will review data prior to submission. Laboratories will provide internal review of data generated.

Data Usability Assessment Tasks: Final report will be written for technical and non-technical review. Project Manager will review all deliverables for data usability assessment before data are used in benthic studies to determine whether data have met project objectives.

Field and Quality Control Sample Summary Table

Medium/ Matrix	Analytical Parameter	Conc. Level	Analytical Method/ SOP Reference[1]	No. of Sampling Locations[2]	No. of Field Duplicate Pairs	Organic		Inorganic		No. of Trip Blanks	No. of Bottle Blanks	No. of Equip. Blanks	No. of PE Samples	Total No. of Samples to Lab
						No. of MS	No. of MSD	No. of Duplicates	No. of MS					
Benthos	Sampling		Refer to Appendix B	7 sites	1						N/A			8
Surface Water	Dissolved oxygen		Refer to Appendix B	7 sites	N/A						0			0
Surface Water	Temperature		Refer to Appendix B	7 sites	N/A						0			0
Surface Water	Conductivity		Refer to Appendix B	7 sites	N/A						0			0

[1]Complete the Field Analytical Method/SOP Reference Table (EPA-NE QAPP Worksheet #17), and the Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20) and specify the appropriate letter/number reference in the above table.
[2]If samples will be collected at different depths at the same location, count each discrete sampling depth as a separate sampling location/station.

Analytical Services Table

Medium/ Matrix	Analytical Parameter	Analytical Method/SOP[1]	Data Package Turnaround Time	Laboratory/Organization (Name and Address: Contact Person and Telephone Number)
Macroinvertebrates	Chironomid and oligochaete identification	Appendix B	30 Days	ESS, Inc. Matt Ladewig
Macroinvertebrates	Crustacean and mollusk identification	Not available but similar to Appendix B	30 Days	ESS, Inc. Matt Ladewig and Mr. Douglas G. Smith
Macroinvertebrates	Ephemeroptera, Plecoptera, Trichoptera and all remaining organisms	Appendix B	30 Days	ESS, Inc. Matt Ladewig

[1]**Specify appropriate reference number/letter from the Field Analytical Method/SOP Reference Table (EPA-NE QAPP Worksheet #17) and from the Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20).**

List project activities, anticipated start and completion dates. Identify all products and/or deliverables as outcomes of project activities and the anticipated dates of delivery. (Refer to *QAPP Manual* Section 6.2 for guidance.)

Project Schedule Timeline Table

Activities	**Dates (04/08)**		**Deliverable**	**Deliverable Due Date**
	Anticipated Date(s) of Initiation	**Anticipated Date of Completion**		
QAPP and Monitoring Plan Development	04/08	07/08	QAPP	-
Collection of Benthic Macroinvertebrates and Habitat Assessment	09/08	09/08	Samples, field notes, habitat assessment sheets	-
Laboratory Processing and Identification	09/08	10/08	Identification list, reference collection	-
Data Management, Analyses, Interpretation	10/08	11/08	Data tables	-
Final Report	01/09	03/09	Data Report (3 hard copies and electronic format)	-

List all site locations that will be sampled and include sample location ID number, if applicable. Specify medium/matrix and, if applicable depth at which samples will be taken. Complete all required information, using additional worksheets if necessary. (Refer to *QAPP Manual* Section 8.1 for guidance.)

Sampling Locations, Sampling and Analysis Method/SOP Requirements Table

Sampling Location[1,2]	Medium/ Matrix	Depth (Units)	No. of Samples (Identify field duplicates and replicates)	Sampling SOP[3]	Analytical Method/SOP[3]	Sample Volume	Containers (Number, size and type)	Preservation Requirements (chemical, temperature, light protected)
Euphotic zone	Benthic Macroinvertebrates	Artificial substrate	8 samples (includes one sample at each of seven sites plus one duplicate)	See Appendix B	Appendix B	32 oz	32 oz Nalgene bottles	70 % ethanol

[1]Indicate critical field sampling locations with "1".
[2]Indicate background sampling locations with "2".
[3]Complete the Project Sampling SOP Reference Table (EPA-NE QAPP Worksheet #13), Field Analytical Method/SOP Reference Table (EPA-NE QAPP Worksheet #17), and Fixed Laboratory Method/SOP Reference Table (EPA-NE QAPP Worksheet #20) and specify the appropriate letter/number reference in the above table.

Identify all field equipment and procedures that require calibration and provide the SOP reference and person responsible for corrective action for each type of equipment. If frequency of calibration, acceptance criteria and corrective action information is not included in an SOP, then document this information on the worksheet. (Refer to *QAPP Manual* Section 9.4 for guidance.)

Field Sampling Equipment Calibration Table

Equipment	Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
YSI Model 85 Dissolved Oxygen/ Conductivity/ Salinity/ Temperature Meter	Refer to Appendix B	Daily	Refer to Appendix B	Refer to Appendix B	Field Personnel	Refer to Appendix B

Identify all field equipment and instruments (include analytical instruments on Worksheet #19) that require maintenance and provide the SOP reference and person responsible for corrective action for each type of equipment. If frequency of calibration, acceptance criteria and corrective action information is not included in an SOP, then document this information on the worksheet. (Refer to *QAPP Manual* Section 9.5 for guidance.)

Field Equipment Maintenance, Testing and Inspection Table

Sampling Equipment/ Instrument	Maintenance Activity	Testing Activity	Inspection Activity	Responsible Person	Frequency	Acceptance Criteria	Corrective Action	SOP Reference
YSI Model 85 Dissolved Oxygen/ Conductivity/ Salinity/ Temperature Meter	Replacing probe membrane and liquid. Keeping sponge in storage chamber wet.	Operation	Visual Inspection for defective parts Extreme readings	RIDEM staff	Prior to use	Probe is operable with accurate readings	Replace faulty parts and liquid and calibrate	See Appendix B

EPA-NE QAPP Worksheet #16 - Rev. 10/99
Use this worksheet to identify components of the project-specific sample handling system. Record personnel and their organizational affiliations, who are primarily responsible for ensuring proper handling, custody, and storage of field samples from the time of collection to laboratory delivery, to final sample disposal. Indicate the number of days original field samples and their extracts/digestates will be archived prior to disposal. (Refer to *QAPP Manual* Section 10.2 for guidance.)

Sample Handling System

SAMPLE COLLECTION, PACKAGING AND SHIPMENT
Sample Collection: RIDEM data collection field team
Sample Packing: RIDEM data collection field team
Coordination of Shipment: RIDEM data collection field team
Type of Shipment (Courier): Hand delivery to lab
SAMPLE RECEIPT AND ANALYSIS
Responsible Organization: ESS Group, Inc., Mr. Doug Smith
Sample Receipt: Laboratory sample custodian
Sample Custody and Storage: Laboratory sample custodian
Sample Preparation: Laboratory personnel
Sample Determinative Analysis: Laboratory personnel
SAMPLE ARCHIVAL
Field Sample Storage (No. of days from sample collection): 2 months, Samples preserved in 75% ethanol solution
SAMPLE DISPOSAL
Responsible Organization: ESS
Responsible Personnel: Carl Nielsen

List all methods/SOPs that will be used to perform analyses in fixed laboratories. Indicate whether method procedure produces definitive or screening data. Sequentially number fixed laboratory SOP references in the Reference Number column. Use additional pages if necessary. Include copies of all methods/SOPs as attachments to the QAPP or attach Laboratory QA Plans/Manuals for each laboratory that will provide analytical services and reference the appropriate sections in the project QAPP. The Reference Number can be used throughout the QAPP to refer to a specific method/SOP. (Refer to *QAPP Manual* Sections 12.1 and 12.2 for guidance.)

Fixed Laboratory Analytical Method/SOP Reference Table

Reference Number	Fixed Laboratory Performing Analysis	Title, Revision Date and/or Number	Definitive or Screening Data	Region I NESTS Method Code*	Analytical Parameter	Instrument	Modified for Project Work Y or N
1	ESS Group, Inc	Appendix B	Definitive		Identification	N/A	No

Project Documentation and Records Table

Sample Collection Records	Field Analysis Records	Fixed Laboratory Records	Data Assessment Records	Other ________
Field Notes	Habitat Assessment Sheets	Laboratory chain of custody, Sample Log-In forms, Laboratory Bench Sheets	Draft report, organism mountings on slides, reference collection	Final report

Appendix B

Standard Operating Guidelines

Rhode Island Department of Environmental Management

Standard Operating Guidelines for the Measurement of Dissolved Oxygen, Temperature, Specific Conductance, and Salinity using a Handheld YSI Model 85 Instrument

1.0 INTRODUCTION

1.1 Purpose and Applicability

These Standard Operating Guidelines (SOG) provide basic instructions for routine calibration and operation of a Handheld YSI Model 85 Instrument that will be used during this study. This SOG for this meter addresses measurements taken for dissolved oxygen, temperature, conductivity, specific conductance and salinity in drinking, surface, and saline waters, domestic and industrial wastes, and acid rain.

1.2 Quality Assurance Planning Considerations

The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. These quality assurance requirements will be defined in the site-specific workplan or Quality Assurance Project Plan (QAPP) (hereafter referred to as the project plan) or laboratory Quality Assurance Manual (OAM) and may include duplicate or replicate measurements or confirmatory analyses.

2.0 RESPONSIBILITIES

2.1

The analyst is responsible for verifying that the YSI Model 85 meter is in proper operating condition prior to use and for implementing the calibration and measurement procedures in accordance with this SOG and the project plan.

2.2

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this SOG and the project plan.

3.0 REQUIRED MATERIALS

The following materials are necessary for this procedure:

- YSI Model 85 meter
- YSI Model 85 manufacturer's instruction manual
- Lint-free tissues
- YSI data sheets or logbooks

4.0 METHOD

4.1 Sample Handling, Preservation, and General Measurement Procedures

4.1.1

Use of the YSI Model 85 for this project is specifically for measurements taken in the field, in lotic or lentic surface waters.

4.1.2

The following units should be used for measurements taken with the YSI 85:

Dissolved Oxygen %................................ % saturation

Dissolved Oxygen .... mg/L

Conductivity .... μS/cm

(Measurement of conductive material without regard to temperature)

Specific Conductance.............................. μS/cm

(Temperature compensated conductivity)

Temperature.. °C

Salinity .... mg/L

4.2 Calibration Procedures

4.2.1

The YSI Model 85 Meter must be calibrated for dissolved oxygen measurements each time it is turned on. Each time it is turned off, it is necessary to re-calibrate before taking measurements. All calibrations should be completed at a temperature that is as close as possible to the sample temperature. If sampling sites are relatively close together, it is acceptable to leave the meter on until all measurements are recorded to avoid recalibration. (System calibration (for conductivity/specific conductance) is rarely required because of the factory calibration of the YIS Model 85. However, from time to time it is wise to check the system calibration and make adjustments as necessary. See YSI meter Operations manual.)

4.2.2

Ensure that the sponge inside the instrument's calibration chamber is damp. Insert the probe into the calibration chamber.

4.2.3

Turn the meter on using the ON/OFF button, and the instrument will activate all segments of the display for a few seconds, which will be followed by a self-test procedure that will last for several more seconds. During this power on self-test sequence, the instrument's microprocessor is verifying that the instrument is working properly.

4.2.4

Press the MODE button until dissolved oxygen is displayed in mg/L or %. Wait for the dissolved oxygen and temperature readings to stabilize (usually fifteen minutes required.)

4.2.5

Use two fingers to press and release both the UP ARROW and DOWN ARROW buttons at the same time.

4.2.6

The LCD screen will prompt you to enter the local altitude in hundreds of feet. Use the arrow to increase or decrease the altitude as necessary. When proper altitude appears on the LCD, press the ENTER button once.

4.2.7

The LDC should now display CAL in the lower left of the display, the calibration value should be displayed in the lower right of the display and the current % reading (before calibration) should be on the main display. Make sure that the current % reading (large display) is stable, then press the ENTER button. The display should read SAVE then should return to the normal operation mode.

4.2.6

Record the stabilized, calibrated dissolved oxygen (mg/L) measurement and the temperature on attached YSI data sheet.

4.2.7

Ensure that the calibrated dissolved oxygen measurement falls within 5% of the ideal value for dissolved oxygen (mg/L; according to the oxygen solubility table below) at the temperature recorded. If the calibrated dissolved oxygen measurement exceeds 5% of the value, recalibrate the YSI 85 Model. If problem persists, contact the manufacturers.

100% Oxygen Solubility

Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)
0.0	**14.62**	**5.0**	**12.77**	**10.0**	**11.29**	**15.0**	**10.08**	**20.0**	**9.09**	**25.0**	**8.26**	**30.0**	**7.56**	**35.0**	**6.95**
0.1	14.58	5.1	12.74	10.1	11.26	15.1	10.06	20.1	9.07	25.1	8.24	30.1	7.55	35.1	6.94
0.2	14.54	5.2	12.71	10.2	11.24	15.2	10.04	20.2	9.06	25.2	8.23	30.2	7.53	35.2	6.93
0.3	14.50	5.3	12.67	10.3	11.21	15.3	10.02	20.3	9.04	25.3	8.21	30.3	7.52	35.3	6.92
0.4	14.46	5.4	12.64	10.4	11.19	15.4	10.00	20.4	9.02	25.4	8.20	30.4	7.51	35.4	6.91
0.5	14.42	5.5	12.61	10.5	11.16	15.5	9.97	20.5	9.00	25.5	8.18	30.5	7.49	35.5	6.89
0.6	14.38	5.6	12.58	10.6	11.13	15.6	9.95	20.6	8.99	25.6	8.17	30.6	7.48	35.6	6.88
0.7	14.34	5.7	12.55	10.7	11.11	15.7	9.93	20.7	8.97	25.7	8.15	30.7	7.47	35.7	6.87
0.8	14.30	5.8	12.51	10.8	11.08	15.8	9.91	20.8	8.95	25.8	8.14	30.8	7.46	35.8	6.86
0.9	14.26	5.9	12.48	10.9	11.06	15.9	9.89	20.9	8.94	25.9	8.12	30.9	7.44	35.9	6.85
1.0	**14.22**	**6.0**	**12.45**	**11.0**	**11.03**	**16.0**	**9.87**	**21.0**	**8.92**	**26.0**	**8.11**	**31.0**	**7.43**	**36.0**	**6.84**
1.1	14.18	6.1	12.42	11.1	11.01	16.1	9.85	21.1	8.90	26.1	8.10	31.1	7.42	36.1	6.83
1.2	14.14	6.2	12.39	11.2	10.98	16.2	9.83	21.2	8.88	26.2	8.08	31.2	7.41	36.2	6.82
1.3	14.10	6.3	12.36	11.3	10.96	16.3	9.81	21.3	8.87	26.3	8.07	31.3	7.39	36.3	6.81
1.4	14.06	6.4	12.33	11.4	10.93	16.4	9.79	21.4	8.85	26.4	8.05	31.4	7.38	36.4	6.80
1.5	14.03	6.5	12.30	11.5	10.91	16.5	9.77	21.5	8.83	26.5	8.04	31.5	7.37	36.5	6.78
1.6	13.99	6.6	12.26	11.6	10.88	16.6	9.75	21.6	8.81	26.6	8.03	31.6	7.36	36.6	6.77
1.7	13.95	6.7	12.23	11.7	10.86	16.7	9.73	21.7	8.79	26.7	8.01	31.7	7.35	36.7	6.76
1.8	13.91	6.8	12.20	11.8	10.83	16.8	9.71	21.8	8.78	26.8	8.00	31.8	7.33	36.8	6.75
1.9	13.87	6.9	12.17	11.9	10.81	16.9	9.69	21.9	8.76	26.9	7.98	31.9	7.32	36.9	6.74
2.0	**13.83**	**7.0**	**12.14**	**12.0**	**10.78**	**17.0**	**9.67**	**22.0**	**8.74**	**27.0**	**7.97**	**32.0**	**7.31**	**37.0**	**6.73**
2.1	13.79	7.1	12.11	12.1	10.76	17.1	9.65	22.1	8.72	27.1	7.96	32.1	7.30	37.1	6.72
2.2	13.76	7.2	12.08	12.2	10.73	17.2	9.63	22.2	8.71	27.2	7.94	32.2	7.28	37.2	6.71
2.3	13.72	7.3	12.05	12.3	10.71	17.3	9.61	22.3	8.69	27.3	7.93	32.3	7.27	37.3	6.70
2.4	13.68	7.4	12.02	12.4	10.68	17.4	9.59	22.4	8.68	27.4	7.91	32.4	7.26	37.4	6.69
2.5	13.65	7.5	11.99	12.5	10.66	17.5	9.57	22.5	8.66	27.5	7.90	32.5	7.24	37.5	6.67
2.6	13.61	7.6	11.96	12.6	10.64	17.6	9.55	22.6	8.64	27.6	7.89	32.6	7.23	37.6	6.66
2.7	13.57	7.7	11.93	12.7	10.61	17.7	9.53	22.7	8.63	27.7	7.87	32.7	7.22	37.7	6.65
2.8	13.53	7.8	11.90	12.8	10.59	17.8	9.51	22.8	8.61	27.8	7.86	32.8	7.21	37.8	6.64
2.9	13.50	7.9	11.87	12.9	10.56	17.9	9.49	22.9	8.60	27.9	7.84	32.9	7.19	37.9	6.63
3.0	**13.46**	**8.0**	**11.84**	**13.0**	**10.54**	**18.0**	**9.47**	**23.0**	**8.58**	**28.0**	**7.83**	**33.0**	**7.18**	**38.0**	**6.62**
3.1	13.43	8.1	11.81	13.1	10.52	18.1	9.45	23.1	8.56	28.1	7.82	33.1	7.17	38.1	6.61
3.2	13.39	8.2	11.78	13.2	10.49	18.2	9.43	23.2	8.55	28.2	7.80	33.2	7.16	38.2	6.60
3.3	13.36	8.3	11.76	13.3	10.47	18.3	9.41	23.3	8.53	28.3	7.79	33.3	7.15	38.3	6.59
3.4	13.32	8.4	11.73	13.4	10.45	18.4	9.39	23.4	8.52	28.4	7.77	33.4	7.14	38.4	6.58
3.5	13.29	8.5	11.70	13.5	10.43	18.5	9.37	23.5	8.50	28.5	7.76	33.5	7.12	38.5	6.57
3.6	13.25	8.6	11.67	13.6	10.40	18.6	9.36	23.6	8.48	28.6	7.75	33.6	7.11	38.6	6.56
3.7	13.22	8.7	11.64	13.7	10.38	18.7	9.34	23.7	8.47	28.7	7.73	33.7	7.10	38.7	6.55
3.8	13.18	8.8	11.62	13.8	10.36	18.8	9.32	23.8	8.45	28.8	7.72	33.8	7.09	38.8	6.54
3.9	13.15	8.9	11.59	13.9	10.33	18.9	9.30	23.9	8.44	28.9	7.70	33.9	7.08	38.9	6.53
4.0	**13.11**	**9.0**	**11.56**	**14.0**	**10.31**	**19.0**	**9.28**	**24.0**	**8.42**	**29.0**	**7.69**	**34.0**	**7.07**	**39.0**	**6.52**
4.1	13.08	9.1	11.53	14.1	10.29	19.1	9.26	24.1	8.40	29.1	7.68	34.1	7.06	39.1	6.51
4.2	13.04	9.2	11.51	14.2	10.26	19.2	9.24	24.2	8.39	29.2	7.66	34.2	7.05	39.2	6.50
4.3	13.01	9.3	11.48	14.3	10.24	19.3	9.22	24.3	8.37	29.3	7.65	34.3	7.03	39.3	6.49
4.4	12.97	9.4	11.45	14.4	10.22	19.4	9.20	24.4	8.36	29.4	7.64	34.4	7.02	39.4	6.48
4.5	12.94	9.5	11.43	14.5	10.20	19.5	9.18	24.5	8.34	29.5	7.62	34.5	7.01	39.5	6.46
4.6	12.91	9.6	11.40	14.6	10.17	19.6	9.17	24.6	8.32	29.6	7.61	34.6	7.00	39.6	6.45
4.7	12.87	9.7	11.37	14.7	10.15	19.7	9.15	24.7	8.31	29.7	7.60	34.7	6.99	39.7	6.44
4.8	12.84	9.8	11.34	14.8	10.13	19.8	9.13	24.8	8.29	29.8	7.59	34.8	6.97	39.8	6.43
4.9	12.80	9.9	11.32	14.9	10.10	19.9	9.11	24.9	8.28	29.9	7.57	34.9	6.96	39.9	6.42
5.0	**12.77**	**10.0**	**11.29**	**15.0**	**10.08**	**20.0**	**9.09**	**25.0**	**8.26**	**30.0**	**7.56**	**35.0**	**6.95**	**40.0**	**6.41**

***Chlorinity: 0** ***Salinity: 0**

4.3 Measurement Procedures

4.3.1

Lower electrode to the desired depth (surface, middle, or bottom of the water column). When recording the bottom measurement, be sure to keep the electrode at least 0.5 ft above the bottom. Be sure not to disturb bottom substrates prior to or during measurement.

4.3.2

Select the dissolved oxygen % measurement mode on the main display. Temperature is always displayed *below* the main display. Allow measurements to stabilize. Record dissolved oxygen % and temperature measurement on YSI data sheet.

4.3.3

Cycle to the next measurement mode and record the next parameter on the YSI data sheet. This step should be continued until measurements for all parameters are recorded.

Selecting another measurement mode is accomplished by simply pressing and releasing the MODE button.

> NOTE: If the instrument is reading specific conductance (temperature compensated), the large numbers on the display will be followed by µS. Additionally, the small portion of the display will show the °C *flashing on and off*. If the instrument is reading conductivity (NOT temperature compensated), the large numbers on the display will be followed by either a µS or an mS; however, the small portion of the display will show the °C NOT flashing.

4.3.4

Place electrode into storage chamber.

4.5 Maintenance

4.5.1

Instrument maintenance should be performed according to the procedures and frequencies required by the manufacturer.

4.5.2

The probe must be stored and maintained according to the manufacturer's instructions.

5.0 QUALITY CONTROL

5.1

The meter must be calibrated each time it is turned on or recalibrated every 12 hours, and will not be used for sample determinations unless the dissolved oxygen value is within 5% of the ideal dissolved oxygen (mg/L) value at the temperature measured according to the oxygen solubility table in section 4.2.7.

5.2

Duplicate measurements of a single sample will be performed at the frequency specified in the project plan. In the absence of project-specific criteria, duplicate measurements should agree within 10%.

5.3

If there are any performance problems with the YSI 85 meter that results in an inability to achieve the acceptance criteria presented in Section 5.0, consult the appropriate section of the meter instruction manual for the checkout and self-test procedures. If the problem persists, consult the manufacturer's customer service department immediately for further instructions.

6.0 DOCUMENTATION

6.1

All calibration and field measurements will be recorded on YSI data collection sheet (attached).

6.2

Calibration documentation must be maintained in a thorough and consistent manner. At a minimum, the following information must be recorded:

- Date and time of calibration
- Instrument identification number/model
- Readings for all continuing calibration checks
- Comments

6.3

Documentation for recorded data must include a minimum of the following:

- Date and time of analysis
- Instrument identification number/model
- Sample identification/station location
- Comments

7.0 TRAINING/QUALIFICATIONS

To properly perform specific conductance measurements, the analyst must be familiar with the calibration and measurement techniques stated in this SOG. The analyst must also be experienced in the operation of the meter.

8.0 REFERENCES

YSI Model 85: Handheld Oxygen, Conductivity, Salinity, and Temperature System Operations Manual. YSI incorporated. Yellow Springs Ohio, USA.

YSI Data Collection Sheet

FIELD CREW:
YSI Instrument (circle one): #1 #2 #3

	1	2	3	4	5	6	7	8	9	10	11
Site ID											
Name											
Date											
Time											
YSI											
% Saturation											
Dis. Oxygen											
Temp (oC)											
Conductivity											
Specific Cond.											
Salinity											

	12	13	14	15	16	17	18	19	20	21	22
Site ID											
Name											
Date											
Time											
YSI											
% Saturation											
Dis. Oxygen											
Temp (oC)											
Conductivity											
Specific Cond.											
Salinity											

ESS Group, Inc.

ESS GROUP, INC.
STANDARD OPERATING GUIDELINES
FOR FRESHWATER MACROINVERTEBRATE SAMPLE PROCESSING & IDENTIFICATION

1.0 INTRODUCTION

The following Standard Operating Guidelines (SOGs) are used by ESS Group, Inc. (ESS) for the processing and identification of freshwater macroinvertebrate samples. The laboratory analysis procedures outlined below are specific with respect to critical techniques and quality assurance and quality control procedures. Procedures for macroinvertebrate sample collection are available under a separate set of SOGs.

2.0 REQUIRED MATERIALS

The following materials are necessary or useful for this procedure:

Equipment

- Chain-of-custody sheets
- Sample log-in sheets
- Laboratory bench sheets
- Laboratory analysis log
- Sorting sieve tray (36cm x 30cm)
- Metal frame (6cm x 6cm)
- Flat scoop (6cm)
- Denatured 70% - 80% ethanol for storage of specimens
- Forceps – very fine or superfine gauge
- Shell vials or specimen vials with screw-caps
- Cotton (if shell vials used)
- Glass jars or Nalgene bottles with caps (if shell vials used)
- Sample labels (internal and external)
- Archival ink pen for labeling
- Standard laboratory bench sheets for identification
- Dissecting microscope for organism identification
- Compound microscope for slide-mounted organism identification

- Fiber optics light source for dissecting microscope
- Petri dishes
- Glass slides
- Glass cover slips (size and grade may vary depending on specimen size and type)
- Slide case
- CMC- 9/10 mounting medium

3.0 PROTOCOL FOR LABORATORY ANALYSIS

Summary of Requirements:

- Samples will be rinsed to remove preservatives and fines.
- Sub-samples will be taken using a grid-marked sorting sieve tray and metal frame.
- Large, unique, or rare species will be removed and identified separately.
- Sub-samples will be sorted under a dissecting microscope until 100 organisms have been removed.
- Organisms will be preserved with 70% ethanol in small, appropriately labeled, vials or jars.
- Unsorted residue and sorted residue will be preserved in 70% ethanol in appropriately labeled jars.
- Midges and worms will be mounted on labeled slides.
- Identification to genus/species level or the lowest practical taxon using a compound microscope for mounted slides and a dissecting microscope for other organisms.

Specific Requirements:

1. The Sample Log-in sheet will be reviewed to verify that all samples have arrived and are in proper condition for processing.

2. The sample will be rinsed in a 500 µm-mesh sieve to remove preservative and fine sediment, never allowing the animals to come between direct flow of water and the screen. Large organic material (whole leaves, twigs. algal or macrophyte mats, etc.) not removed in the field will be rinsed, visually inspected, and discarded. If the samples have been preserved in alcohol, it will be necessary to soak the sample contents in water for about 15 minutes to hydrate the benthic organisms, which will prevent them from floating on the water surface during sorting.

3. After washing, the sub-sample will be evenly spread across the grid-marked sorting sieve tray by immersing in water. Large rare or unique organisms will be picked out and identified and reported as supplemental information for each location but not as part of the rest of the sub-sample. A random grid from the tray will be selected and the sieve lifted to temporarily drain the water. A metal frame

(6 cm x 6 cm) will be used to clearly define the selected grid; debris overhanging the grid may be cut with scissors. A 6cm flat scoop will be used to remove all debris and organisms from the grid. The sub-sample will then be transferred to a small container temporarily.

4. The sub-sample will be sorted under a dissecting microscope on a Petri dish. At least 100 organisms should be removed from the sub-sample, if less than 100 are removed then another random grid from the sorting sieve tray must be selected and steps (3) and (4) repeated. These steps will be repeated until the whole sample has been sorted or 100 organisms have been removed.

5. The organisms will be placed into glass vials and preserved in 70% ethanol. The vials will be labeled inside and out with the sample identifier or lot number, date, stream name, sampling location and taxonomic group. If more than one vial is needed, each will be labeled separately and numbered (e.g., 1 of 2, 2 of 2).

6. The sorted debris residue will be saved in a separate container labeled as "sorted residue" in addition to all prior sample label information and preserved in 70% ethanol. The remaining unsorted sample debris residue will be saved in a separate container labeled "sample residue".

7. The sorter will fill out the EPA "Laboratory Bench Sheet," noting sub-sampling/sorting information, the number of grids picked, time expenditure, and number of organisms. If a QC check was performed on a particular sample, the person conducting QC will note findings on the back of the Laboratory Bench Sheet. The sorter will record the date of sorting and slide mounting, if applicable, on Log-In Sheet as documentation of progress and status of completion of sample lot.

8. Taxonomic determinations (to the genus/species level or the lowest practical taxonomic level based on organism condition or taxonomic key availability) and counts for all organisms within each sample will be determined through the use of a dissecting microscope (up to 45X magnification), a fiber optic lamp, standard dissecting tools, and appropriate taxonomic keys. Depending on the level of identification desired, non-biting midges (Diptera: Chironomidae) and aquatic worms (Oligochaeta) may need to be mounted on slides and identified using a compound microscope with magnification up to 1,000X.

9. Aquatic worms (Oligochaeta) and non-biting midge (Chironomidae) larvae and pupae may be mounted on slides using an appropriate medium (e.g., Euporal, CMC-9, CMC-10) in accordance with the methods outlined by Epler (2001). Slides will be labeled with the site identifier (code and full site name), date collected, taxonomic group (e.g. Oligochaeta or Chironomidae), the first initial and last name of the taxonomist and any other information, as required by project. Slides may be archived in a slide case, which should be labeled on the outside with the project name, date and total number of slides. Oligochaetes that are too large to be mounted (e.g. certain Lumbriculidae) will be preserved in denatured 70% ethanol and stored in appropriately labeled vials.

10. For archiving purposes, samples (grouped by station and date) will be preserved with denatured 70%-80% ethanol and placed in tightly capped and labeled vials. The inside of each vial will be labeled with the site identifier (code and full site name), date collected, the taxonomic determination of the specimens in the vial (if appropriate), the first initial and last name of the taxonomist and any

other information, as may be required by specific project. The outside of each vial (or jar, if shell vials are used) will be labeled with the sample station code, date collected and "70% ethanol" as an indication of preservative.

11. Each taxon found in a sample will be recorded and enumerated on a laboratory bench sheet for subsequent data entry and reporting. Any difficulties encountered during identification (e.g. missing organism parts, degraded condition, etc.) that result in a taxonomic determination coarser than the target level will be noted on these sheets.

4.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

In the lab, ESS will randomly perform a quality check on a minimum of 10% of the samples analyzed. This quality check will cover both the sorting and the identification phases of the analysis.

For the sorting phase, if more than 10 % error (calculated by dividing the number found in the quality check by the total number of individuals) is found between the sorter and the quality assurance check, 4 additional samples will be reprocessed. If the percent error in those samples is more than 10% in those samples, then all samples sorted by that individual will be reprocessed.

Following the initial identification by an aquatic macroinvertebrate taxonomist, a second staff member trained in aquatic macroinvertebrate identification will act as the QC officer, randomly checking a minimum of 5% of the samples (or at least one sample, if there are fewer than twenty samples). The purpose of this check will be to validate the identifications made on the individuals comprising the sample, as well as to examine for errors in sample labeling and transcription of names and enumerations onto laboratory bench sheets. The results of the random QC checks will be recorded on the respective laboratory bench sheets, dated and initialed by the QC officer. If systematic errors in identification, labeling or transcription are noted, the QC officer will bring specific problems to the attention of the original taxonomist for correction throughout the dataset.

A reference collection of all taxa identified during each project may be maintained if required by the project. These specimens will be labeled and preserved in 70% - 80% ethanol (or slide mounted, where appropriate) and stored for future reference.

Taxonomic determinations may be confirmed with other regional experts, if deemed necessary. Specimens submitted during any QA checks must be accompanied by a chain-of-custody form. Following a QA check, labels on externally validated samples will be updated to reflect the name of the taxonomist performing the confirmatory identification as well as the date of validation.

Once the taxonomy is complete, data may be entered into the project database by project personnel. The QC officer will check the data at a minimum of 5% of the project sites and review any calculations in order to ensure a satisfactory level of accuracy in data entry. Any systematic errors in data entry or calculation of metrics will be brought to the attention of the project data entry personnel for correction throughout the dataset.

Records of the results of QA/QC checks described above will be maintained in a laboratory analysis log for each project.

5.0 QUALIFICATIONS

To properly conduct the taxonomic identification of aquatic macroinvertebrates, the taxonomist and QC officer must be familiar with the protocols stated in this SOG, have confidence in the appropriate use of aquatic macroinvertebrate keys and be familiar with the organisms of the area in question.

Staff responsible for slide mounting of Chironomidae and Oligochaeta must be familiar with the protocols stated in this SOG and be proficient in the methods outlined by Epler (2001).

In-house training with an experienced aquatic macroinvertebrate taxonomist is required for all staff responsible for entering taxonomic data into a project database. The staff member responsible for data entry must be familiar with the structure of the database and nature of the calculated metrics in order to ensure accuracy of the data and any associated calculations.

6.0 REFERENCES

Epler, J.H. 2001. Identification Manual for the Larval Chironomidae (Diptera) of North and South Carolina. Special Publication SJ2001-SP13. North Carolina Department of Environment and Natural Resources, Raleigh, NC and St. Johns River Water Management District, Palatka FL. 526 pp.

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

STREAM NAME	LOCATION	
STATION #__________ RIVERMILE__________	STREAM CLASS	
LAT _______________ LONG _______________	RIVER BASIN	
STOREET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE _________ TIME _________ AM PM	REASON FOR SURVEY

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Parameters to be evaluated in sampling reach

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	**Condition Category**			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score __________

Physical Characterization/Water Quality Field Data Sheet

STATION:________________ STREAM NAME:______________ RIVER MILE: __________ DATE:_________

RIVER BASIN:_____________ STREAM CLASSIFICATION:___________INVESTIGATORS:__________________

DESCRIBE LOCATION:____

STREAM CHARACTERIZATION

■ Subsystem Classification
___ Tidal
___ Lower Perennial
___ Upper Perennial
___ Intermittent

■ Stream Type
___ Coldwater
___ Warmwater

RIPARIAN ZONE/INSTREAM FEATURES

■ Predominant Surrounding Land Use
___ Forest
___ Field/Pasture
___ Agricultural
___ Residential
___ Commercial
___ Industrial
___ Other
■ Channelized ___Y ___N
■ Dam Present ___Y ___N

■ Local Water Erosion
___ None
___ Moderate
___ Heavy
■ Local Watershed NPS Pollution
___ No evidence
___ Some potential sources
___ Obvious sources
■ High Water Mark ___m
■ Velocity ___m/sec

■ Estimated Stream Width ___m
■ Estimated Stream Depth
Riffle___ m
Run___ m
Pool___ m
■ Est. Fish Reach Length___ m
■ Canopy Cover
___ Partly open
___ Partly shaded
___ Shaded

SEDIMENT/SUBSTRATE

■ Odors
___ Normal
___ Sewage
___ Petroleum
___ Chemical
___ Anaerobic
___ None
___ Other

■ Oils
___ Absent
___ Slight
___ Moderate
___ Profuse
___ Relict shells
___ Other

■ Deposits
___ Sludge
___ Sawdust
___ Paper fiber
___ Sand

■ Are the underside of stones not deeply embedded black?
___Y ___N

INORGANIC SUBSTRATE COMPONENTS			ORGANIC SUBSTRATE COMPONENTS		
Substrate Type	Diameter	Percent Composition in Sampling Area	Substrate Type	Characteristic	Percent Composition in Sampling Area
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	
Boulder	>256mm (10 in)				
Cobble	64-256mm (2.5-10 in)				
Gravel	2-64mm (0.1-2.5 in)		Muck-mud	black, very fine organic (FPOM)	
Sand	0.06-2mm (gritty)				
Silt	0.004-0.06mm		Marl	grey, shell fragments	
Clay	<0.004mm (slick)				

WATER QUALITY

■ Temperature ______
■ Specific Conductance ___
■ Dissolved Oxygen ___
■ pH ___
■ Turbidity

■ Water Odors
___ Normal/None
___ Sewage
___ Petroleum
___ Chemical
___ Fish

■ Water Surface Oils
___ Slick
___ Sheen
___ Globs
___ Flecks
___ None

■ Turbidity (if not measured)
___ Clear
___ Slightly turbid
___ Turbid
___ Opaque
___ Water color

BENTHIC MACROINVERTEBRATE LABORATORY BENCH SHEET (FRONT)

page _____ of _____

STREAM NAME	LOCATION
STATION #_________ RIVERMILE_________	STREAM CLASS
LAT ______________ LONG ______________	RIVER BASIN
STORET #	AGENCY
COLLECTED BY DATE_________	LOT #
TAXONOMIST DATE_________	SUBSAMPLE TARGET ❑ 100 ❑ 200 ❑ 300 ❑ Other ____

Enter Family and/or Genus and Species name on blank line.

Organisms		No.	LS	TI	TCR	Organisms		No.	LS	TI	TCR
Oligochaeta						Megaloptera					
Hirudinea						Coleoptera					
Isopoda											
Amphipoda						Diptera					
Decapoda											
Ephemeroptera											
						Gastropoda					
						Pelecypoda					
Plecoptera											
						Other					
Trichoptera											
Hemiptera											

Taxonomic certainty rating (TCR) 1-5:1=most certain, 5=least certain. If rating is 3-5, give reason (e.g., missing gills). LS= life stage: I = immature; P = pupa; A = adult TI = Taxonomists initials

Total No. Organisms _______________ **Total No. Taxa** _______________

BENTHIC MACROINVERTEBRATE LABORATORY BENCH SHEET (BACK)

SUBSAMPLING/SORTING INFORMATION Sorter ___________________ Date ___________________	Number of grids picked: __________ Time expenditure __________ No. of organisms __________ Indicate the presence of large or obviously abundant organisms: **QC:** ❑ YES ❑ NO **QC Checker** _________________________ # organisms originally sorted [ ] ÷ (# organisms recovered by checker [ ] + # organisms originally sorted [ ]) = % sorting efficiency [ ] ≥90%, sample passes __________ <90%, sample fails, action taken ____________________________________ ____
TAXONOMY ID ___________________ Date ___________________	Explain TCR ratings of 3-5: Other Comments (e.g. condition of specimens): **QC:** ❑ YES ❑ NO **QC Checker** _________________________ Organism recognition ❑ pass ❑ fail Verification complete ❑ YES ❑ NO

page __ of __

BENTHIC MACROINVERTEBRATE SAMPLE LOG-IN SHEET

Date Collected	Collected By	Number of Containers	Preservation	Station #	Stream Name and Location	Date Received by Lab	Lot Number	Date of Completion		
								sorting	mounting	identification

Serial Code Example: B0754001(1)
B = Benthos (F = Fish; P = Periphyton)**#** 0754 = project number **#** 001 = sample number **#** (1) = lot number (e.g., winter 1996 =1; summer 1996 = 2)

ESS Group, Inc.

401 Wampanoag Trail, Suite 400, East Providence, RI 02915
Phone: 401-330-1204 Fax: 401-434-8158

Chain-of-Custody for:

ESS Job Number:

Sample ID as Labeled on Sample Vial	Sample Description	Date Sample Collected	Number of Containers	Sample Preservative
Total number of containers				

ID Crustaceans down to Genus/Species
ID Mollusks down to Genus/Species

Sent by: Date:

Appendix C

Sampling Locations for the Biomonitoring of Rhode Island Non-wadeable Streams

2008 Artifical Substrate Locations

Waterbody ID	River Name	Latitude	Longitude	Town
RI0001003R-01A	Blackstone River at Millville, MA	42.0227	-71.5727	Millville, MA
RI0001003R-01A	Blackstone River at Manville, RI	41.9711	-71.4706	Lincoln
RI0001002R-01B	Branch River at Forestdale, RI	41.9946	-71.5631	North Smithfield
RI0006017R-03	Pawtuxet River at Cranston, RI	41.7508	-71.4456	Cranston
RI0006017R-03	Pawtuxet River at Pawtuxet, RI	41.7675	-71.4058	Cranston
RI0008039R-18E	Pawcatuck River at Westerly, RI	41.3836	-71.8336	Westerly
RI0008040R-16B	Wood River at Skunk Hill Road, Richmond/Hopkinton, RI	41.52225	-71.69152	near Wyoming