

QUALITY ASSURANCE/QUALITY CONTROL PLAN

*For the Macroinvertebrate Biomonitoring of Black Brook and Occooch Watersheds
In the Town of Aquinnah, Massachusetts*

Submitted to: U.S. Environmental Protection Agency

Prepared by: Wampanoag Tribe of Gay Head (Aquinnah)

Created by: Leah Tofte-Dorr

Date: November 1999

Quality Assurance / Quality Control Plan

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the Town of Aquinnah, Massachusetts***

Submitted to: U.S. Environmental Protection Agency

Prepared by: Wampanoag Tribe of Gay Head, Aquinnah

Date: November 1999

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1.0 Purpose and Scope

The Wampanoag Tribe of Gay Head (Aquinnah) [the Tribe], a federally recognized Native American Tribe, is proposing a study to characterize the relative health of the wetlands within the Menemsha and Squibnocket Watersheds in the town of Aquinnah. The assessment of the wetlands will help determine the health of the watersheds that drain into the ponds.

The Quality Assurance/Quality Control Plan is designed to meet the following objectives:

- Outline the procedures the assessment project will use to ensure that sample collection, analysis, data recording, storage, and management are of high quality
- Provide a means by which the quality of information produced can be maintained throughout the project
- Provide a sound basis for documenting, evaluating and verifying the accuracy of results of project activities
- Provide guidelines for the preparation and review of project plans and reports

2.0 Project Description

Overall goal is to assess the health of wetlands and streams on and adjacent to Tribal lands. The data collected in this study will provide information about the macroinvertebrate communities found in the freshwater wetlands and streams that drain through Tribal land and into the coastal ponds. This aquatic macroinvertebrate community will be used as biomonitors to determine the relative health of the watersheds sampled. This study will be qualitative rather than quantitative by assessing the relative health of the wetland by the number of sensitive versus tolerant species present.

At each wetland or stream sampling location basic water parameters will be collected as well as samples of the existing macroinvertebrates. In addition, the surrounding watershed and drainage area will be assessed for land use factors that directly affect the wetland. The combination of the wetland's physical features as well as the aquatic invertebrate's sensitivity will be used to determine the relative health of each site. In addition, collection of land use and physical details of the wetlands and/or streams allow for comparability to similar hydrologic and impacted sites. This study will allow for baseline data of the health of these watersheds. It will also help design a monitoring program that can be implemented in future years to measure changes in the watershed's health.

Figure 1 is a copy of the USGS Squibnocket Quadrangle overlaid with tribal land boundaries. This map shows the proximity of tribal land to both Menemsha and Squibnocket ponds. Figure 2 shows the delineated watersheds within Aquinnah. As seen on the map, most of wetlands and streams on tribal land drain into these ponds.

Figure 3 shows an aerial photograph of the sampling sites that have been selected for this study. All of these sites are either on or directly adjacent to tribal land. Table 1 lists the sites by

watershed and includes the type of sampling site, either wetland or stream, and the date that the site is to be sampled during this study. This initial study will be completed in the fall of 2000. At that time a final report will be completed that will provide a complete review of the results as well as recommendations for future monitoring and sampling.

Wetlands have been selected within the Black Brook watershed, which drains into Squibnocket Pond and eventually Menemsha Pond. Water quality data has been collected by the Wampanoag Tribe since 1995 to monitor these coastal ponds health. This study is designed to complement the current pond studies by looking at the conditions of the wetlands and streams that drain into these fragile ponds. This study will also provide the basis for a monitoring program, which will determine the health of the watershed in future years.

This study will create baseline data that will be combined into a final report to show the relative health of the two watersheds involved. In addition, this study will be used to create priority wetlands and stream sites to be monitored for in future years. The sites to be sampled initially are listed in Table 1. Additional sites that could aid in watershed assessment will be studied in future years.

FIGURE 1 – Locus Map



Figure 2 – Aquinnah Watershed Delineations

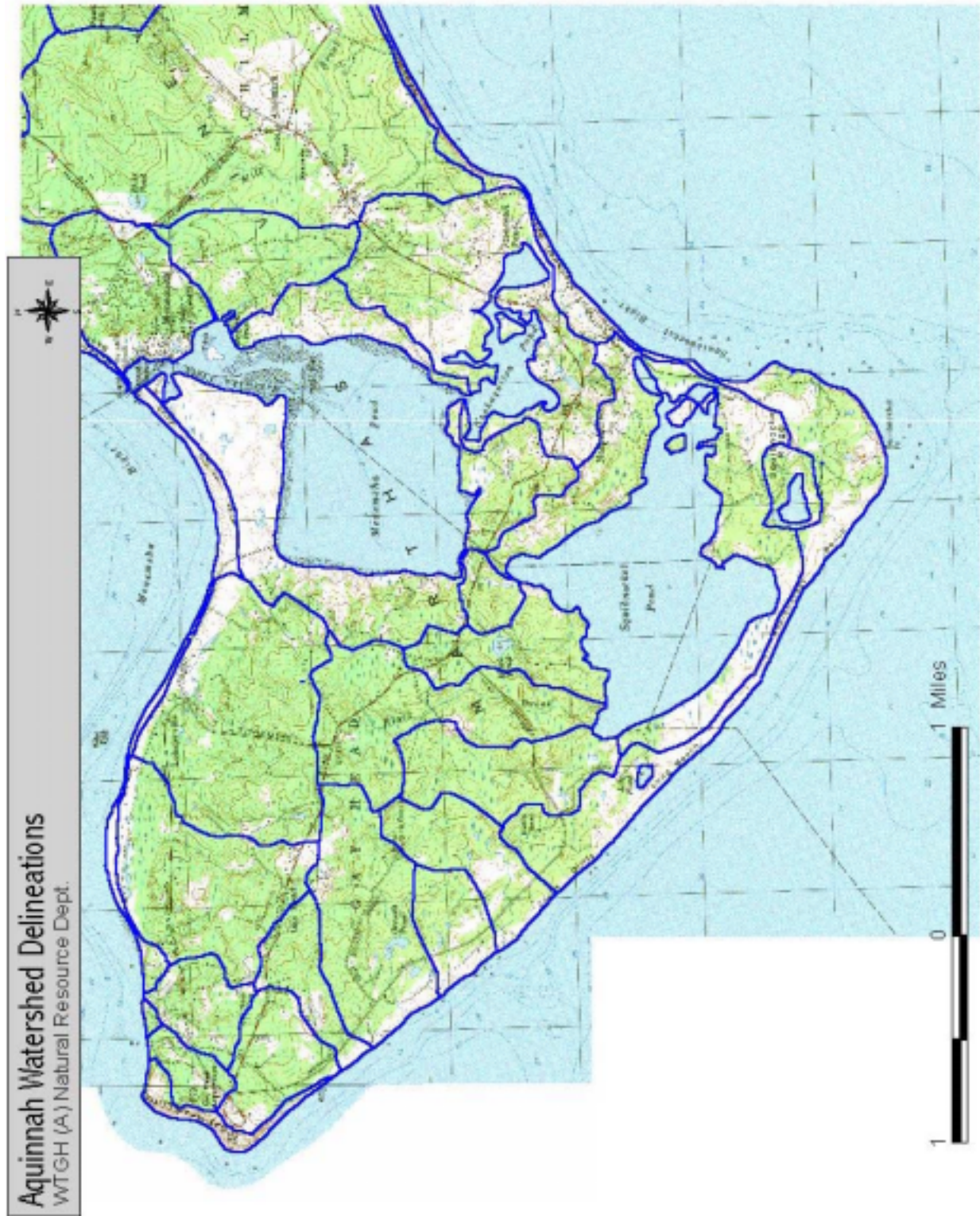


Figure 3 – Biomonitoring Sampling Sites

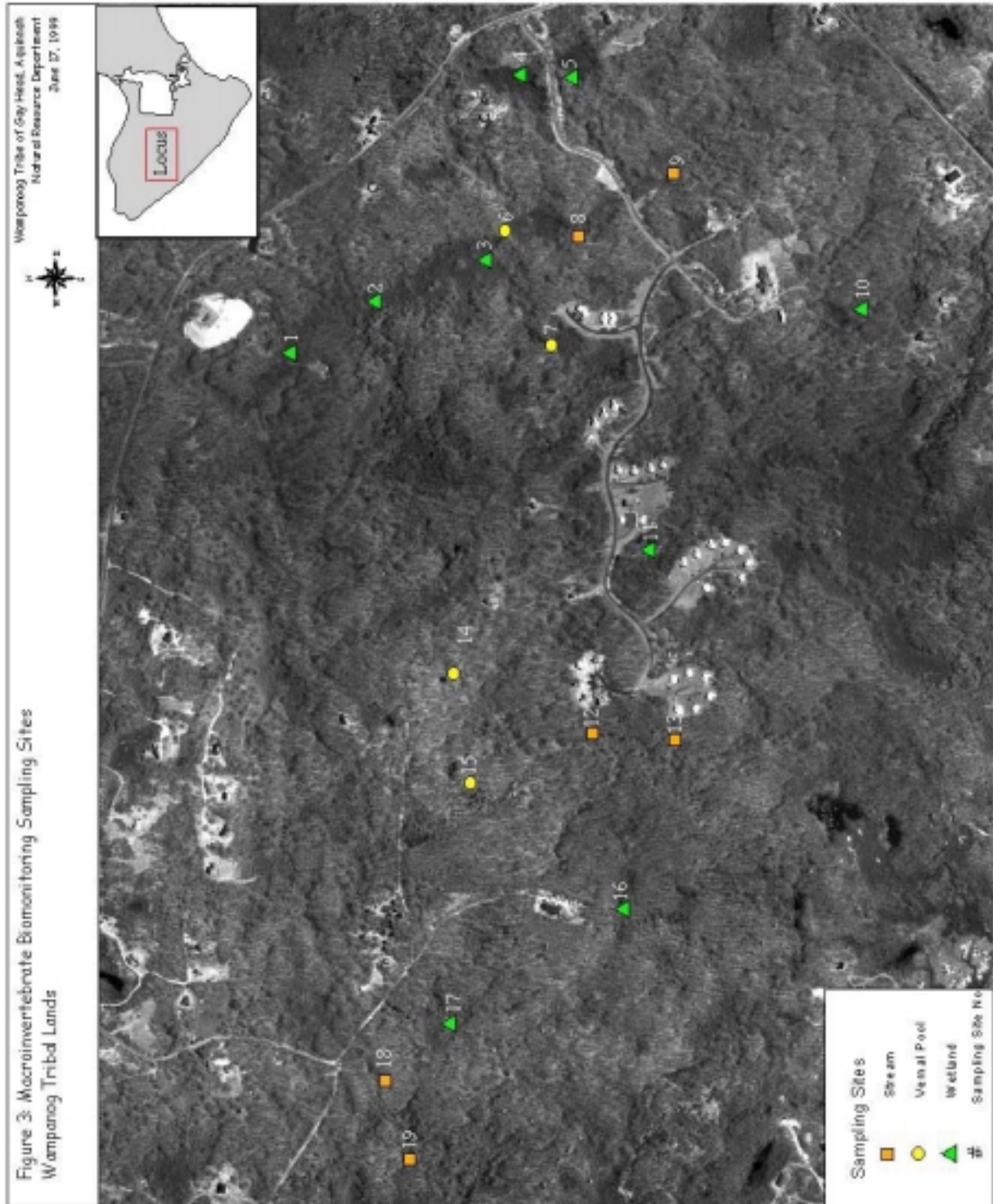


TABLE 1 – Sample Site Location List

Watershed	#	Site	Type	Sample Date
Black Brook				
	1	North of Landfill	Wetland	Spring 2000*
	2	South of Landfill	Wetland	Spring 2000*
	3	Large Marsh	Wetland	Spring 2000*
	4	Black Brook Mitigation	Wetland	Spring 2000*
	5	East of Black Brook	Wetland	Spring 2000*
	6	Black Brook N. Vernal Pool	Wetland	Spring 2000
	7	Elderly Housing Vernal Pool	Wetland	Spring 2000*
	8	Old South Rd Crossing	Stream	Spring 2000
	9	South of Black Brook Road	Stream	Spring 2000
	10	South of Tribal Building	Wetland	Spring 2000
	11	Housing Mitigation Site	Wetland	Spring 2000*
	12	Middle Stream Site 1	Stream	Spring 2000
	13	Middle Stream Site 2	Stream	Spring 2000
	14	Vernal Pool #1	Wetland	Spring 2000
	15	Vernal Pool #2	Wetland	Spring 2000
Occooch				
	16	South of Loran Station	Wetland	Spring 2000
	17	South of South Road	Wetland	Spring 2000
	18	Occooch Steam 1	Stream	Spring 2000
	19	Occooch Stream 2	Stream	Spring 2000

*** These wetland were included in the 1999 Spring and Summer training mentioned in the Past Studies portion of this document.**

3.0 Data Quality Objectives

The quality assurance objectives for collection and measurement of data for the aquatic invertebrate monitoring are:

3.1 Precision: The degree of agreement among repeated measurements of the same characteristic on the same sample or on separate samples collected as close as possible in time and place (Hunt et al., 1996)

Because this study is a qualitative assessment of the wetlands and streams sampled, precision is not expected to be assessed. This study will take three samples from each wetland or stream site. During the assessment the number of each organism will be averaged. This number will be weighted by the unique sensitivity of the species to human impacts. The exact species and numbers collected do not have to be the same for a sample to show that a site is impacted. Rather an impacted site will have a lack of sensitive species and an assemblage of tolerant species that are able to survive at the site. Inversely, an unimpacted site will have sensitive species present and a wide variety of species with different tolerances.

Precision in collection techniques will be required. Only the aquatic biologist will be collecting, sorting and identifying the samples. This will prevent any difference between sampling techniques as well as sorting and identification abilities. This biologist has been trained to conduct these surveys by Anna Hicks scientist for the Umass Extension Office in Amherst, MA and Bruce Bruce Carlisle, Wetland Scientist from Massachusetts Coastal Zone Management, who developed the wetlands sampling methodology and landscape characterization protocols. In addition the Aquatic Biologist has experience in quantitative scientific methods as well as macroinvertebrate taxonomy.

3.2 Accuracy: The measure of confidence in a measurement. The smaller the difference between the measurement of a parameter and its “true” or expected value (Hunt et al., 1996)

There is no “true” or expected value associated with aquatic macroinvertebrate counts. This methodology is not trying to assess the “true” aquatic species diversity or populations. Rather it is trying to assess the health of the system based on the tolerance to impact of the species that are present. The systematics involved with identification enumeration and recording of sample raw data is outlined in “Analytic Procedures” and is designed to standardize the processing of invertebrate data.

Similarly no “true” values exist for many of the observations relating to the characterization of landscape and wetland habitat as they alter over the season and from year to year. The aquatic invertebrate biomonitor has had 3 years of experience and practice in estimating/measuring descriptors such as % composition of wetland soil texture, aquatic plant groups, abundance of different food sources, etc. The descriptor information obtained will be compared for accuracy to similar data collected for the Land Use Index.

3.3 *Completeness: A measure of the number of samples you must take to be able to use the information, as compared to the number of samples you originally planned to take.* (Hunt et al., 1996)

The monitoring protocol that will be used requires three randomly selected composite samples at each wetland or stream site. Given this constraint, standardization of sampling and analysis techniques for the invertebrates, water measurement and the rapid habitat assessment will reduce variability due to: sampling error, sample preparation error, analytical or measurement error, and will strengthen comparability due to a gradient of impairment. All of the data sheets on which the field measurements will be recorded will be checked for completeness both by the QAQC Field Officer after the measurements are made at each site and by the QAQC Data Officer when the sheets are reviewed in the office.

3.4 *Representativeness: The extent to which measurements actually depict the true environmental condition or population you are evaluating.* (Hunt et al., 1996)

Representativeness of the characteristics of each site will be assessed through the methodology outlined in "Sampling Procedures". The design ensures collected samples are representative of the environmental conditions and populations of each site by reducing sampling error, sample preparation error, analytical or measurement error. Replicate sampling of the invertebrates will allow for statistical analysis of variance as well as the provision of a means, which will be used to characterize the populations from each site.

3.5 *Comparability To Other Data in the Scientific Field: The extent to which data from one study can be compared directly to either past data from the current project or data from another study.* (Hunt et al., 1996)

Two studies that used these methodologies have been conducted in on Cape Cod and the North Shore. The first is a published study which gathered data in 1996 through 1998 by the Massachusetts Coastal Zone Management(MCZM). This study is entitled *Wetland Ecological Integrity: An Assessment Approach* (Charlisle et al., 1998) This study used the same sampling methodologies and forms as well as the same assessment procedures. The other study, also being conducted by MCZM, is presently ongoing and is concentrated on studying the North Shore area's wetlands.

4.0 Summary of Past Studies

To date no quantitative data has been collected about Aquinnah's wetland and stream macroinvertebrate composition. Qualitative data about families of invertebrates observed during a four month period during the early spring and summer of 1997 was recorded in the *Wampanoag Tribe of Gay Head or Aquinnah, Massachusetts: Natural Resource Inventory* (Tofte-Dorr, 1997) This inventory was conducted to document the diversity of the invertebrates found in wetlands. It was not intended to collect quantitative data or to relate relative health of

the wetland systems to the presence or absence of intolerant macroinvertebrate species. The families of invertebrates were included in the inventory to list the observed families found during the vegetative inventory, and to document the need for further investigation of the macroinvertebrates that utilize wetlands of the Tribe.

One published study, *Wetlands Ecological Integrity: An Assessment Approach* (Carlsisle et al., 1998) used the same invertebrate sampling methodologies and recording forms as well as the same assessment procedures.

In addition, some sampling of wetlands on Tribal land took place in the spring of 1999 using this sampling technique. The samples were collected during the field training portion of a Biomonitoring Workshop facilitated by Anna Hicks who co-authored the *Freshwater Wetlands Invertebrate Biomonitoring Protocol*. During the training, the sampling methodology was demonstrated as well as the assessment techniques described in this text. All of the sites sampled are included in Table 1 – Site Sample Location List. All sample sites listed as collected in Spring 1999 were sampled during this training.

5.0 Project Organization and Responsibility

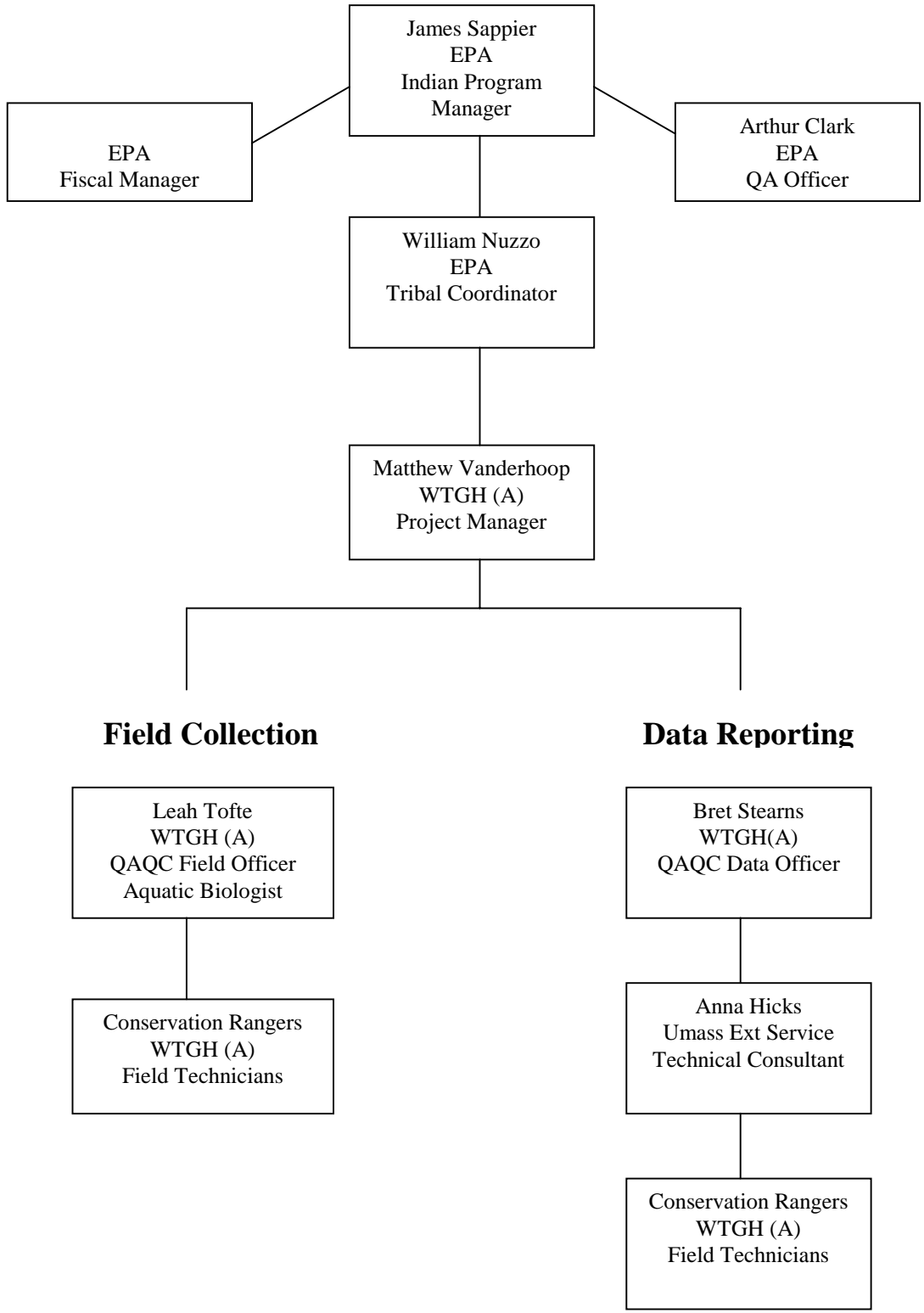
The U.S. Environmental Protection Agency (EPA) shall provide program oversight. Mr. James Sappier, Indian Program Manager, from the Region I office of EPA, will administer the program.

The project shall be staffed by personnel from the Tribe's Natural Resources Department, volunteers, and hired consultants (see Figure 2). The Tribe's staff is lead by Mr. Matthew Vanderhoop, Program Director, who will be responsible for program oversight, management, and report preparation. The aquatic biologist and QAQC Field Officer, Leah Tofte-Dorr, will conduct field data collection, sorting and identification, as well as report preparation. Bret Stearns will serve as the QAQC Data Officer for the project and will be responsible for checking data input and accuracy.

Outside professional representation shall be sought through cooperative agreements and contracts. Anna Hicks of the UMass Extension, University of Massachusetts at Amherst, Ma will be consulted for species identification issues as well as to review the data and samples for audits.

Figure 4 shows a diagram of this project's responsibilities and organization.

Figure 4 - Organizational Chart



6.0 Sampling Procedures

The following methodology has been modified from the *New England Freshwater Wetlands Invertebrate Biomonitoring Protocol*, Appendix H, developed by Anna Hicks from UMASS Extension Service in Amherst, MA and Bruce Carlisle, Wetland Scientist from Massachusetts Coastal Zone Management, from Massachusetts CZM. The methodology and associated worksheets that will be used can be found in Appendices A-F. This methodology was taught to the Natural Resource Staff of the Wampanoag Tribe during a week long training session in the spring of 1999. In addition to wetland sampling that this methodology focuses on, streams will also be sampled to determine their relative health. The methods described in this section for stream sampling were modified from *Volunteer Stream Monitoring: A Methods Manual* created and distributed by the US Environmental Protection Agency, Office of Water.

In addition to the actual macroinvertebrate sampling, a Land Use Index, LUI, methodology developed by the Massachusetts Coastal Zone Management will be used. This method is used to, “estimate the potential nonpoint source (NPS) pollutant contributions, or loadings, to Wetland Evaluation Areas (WEA) from surrounding land uses and landscape conditions.” (Carlisle, 1997) This methodology description as well as the *Land Use Index Worksheet* are included in Appendix G: *Massachusetts Coastal Zone Management Land Use Index: Description and Methodology*.

6.1 Required Equipment

Meter tape, meter stick, chest waders or hip boots, plastic gloves, sweep net, D-net, sand auger, sampling frame approximately 30 x 30 cm, standard 30 sieve, I bowl spatula, 2 buckets, forceps scissors, zip lock bags, 70% isopropanol alcohol, labeling pens, cooler and ice, sealing tape, field recording sheets.

6.2 Selecting the Sampling Sites

Monitoring is being undertaken for two of circumstances:

- a) to inventory the invertebrate community within freshwater wetlands to determine a gradient of impairment from human disturbance
- b) to inventory the invertebrate community within freshwater streams to determine a gradient of impairment from human disturbance

For a) Reference Sites

Two wetland sampling stations will be selected to serve as reference sites to compare the condition of the impacted wetlands. The reference wetlands will be selected for their relatively pristine wetland and surrounding upland conditions. Each reference site will have minimal human impact and will be selected from other adjacent watersheds for comparison. The Land Use Index methodology will be used to measure the impact from surrounding human impact. A wetland will need have a minimum LUI value of 95 in order to be considered a reference site.

These reference wetland sites will be used to compare the Black Brook Sites.

For b) Wetland Sites

For each wetland to be sampled three randomly selected wetland sampling stations will be sampled within the wetland. In addition, vernal pool sites will be selected on Tribal Land and sampled using the wetland methodology.

For c) Stream Sites

Three randomly selected sampling stations along the streambed of each stream will be selected. These three samples will be collected within a 100 yard stream reach. The stream reach will be marked off. The sampling will start downstream and work upstream to the end of the reach. The downstream site will have the lowest sampling bag record number and the upstream site will have the highest.

6.3 Sample Site Location

Sampling stations will be located in the Mass State Plane NAD 83 Island Zone coordinate system with a Trimble ProXRS GPS unit with real-time beacon corrections. These coordinates will be exported to a GIS coverage to be used in the Natural Resource Mapping Software, ArcView. The GPS unit will allow navigation back to each specific sampling site within sub-meter accuracy.

6.4 Describing the Immediate Habitat Conditions

The MCZM *Land Use Index* will be used prior to the field sampling to determine the relative health of the wetland system surrounding the site. This work will be done with the aid of the Department's GIS and Aerial photos.

Completion of "NEFWIBP Aquatic Invertebrate Field Sheet – Part B. Invertebrate Sampling Observation and Record Sheet" (*Appendix B: Form 2*) is the first field requirement prior to the sampling process. The information included on this field sheet covers the immediate habitat conditions for the marine invertebrates at the sampling station. Part of this information will be included in the Habitat Assessment, and the rest will be valuable for the final interpretation of the results.

Included also on this form are the records of water quality parameters which will be collected by the Tribe's YSI 6000. The following parameters will be collected with the YSI for each sampling site: depth, temperature, pH, dissolved oxygen, conductivity, and total dissolved solids. No water samples will be collected for laboratory analysis.

In addition, for stream sites a Global Flow Probe FP201 will be used to determine the velocity of the stream. This measurement is necessary to determine the volume of water passing the collection site during the sampling. Stream flow can have impact on the water quality as well as the organisms that inhabit the streams. The following is the methods that will be used to determine flow.

1. A transect of the stream will be created at the sampling site.
2. The average depth will be calculated along the transect area by measuring the depth at the one-fourth, half, and three-fourths distance across the stream. These values will then be averaged by dividing by 4 (to compensate for the 0 depths that occur at the shores).
3. The width of the transect will be measured from shoreline to shoreline.
4. The cross-sectional area will be determined by multiplying the width by the average depth.
5. Three transects will be measured this way for each sampling site.
6. These three transects will be averaged to obtain an average cross-sectional area.
7. The flow probe will then be used to determine the flow of the stream in feet per second.
8. Stream flow will be calculated by

6.5 Conducting the Sampling Procedure

A - Wetland Sites:

At each sampling site 3 randomly selected composite samples are to be collected following the collection method instructions given below:

SWEEP NET SAMPLE COLLECTION METHOD

- 1 Hold the sweep net fully extended to the right hand side of the body and starting at the surface of the water.
- 2 Slowly prescribe a 180° sweeping arc that incrementally descends through the water column floating surface and attached algae downwards to complete the sweep on the left hand side and the substrate interface.
- 3 Bring the net containing the sample directly upwards to the surface for retrieval
- 4 Invert the retrieved contents of the net over a bucket and using the second bucket wash all debris and invertebrates free of the net into the first bucket.
- 5 Carefully examine the net and vegetation for any clinging organisms, and remove with forceps as necessary.
- 6 Strain bucket contents through the standard US No 30 brass sieve to remove the water. Place the contents of the sieve into a zip-lock bag with the aid of the spatula and/or bare hands and forceps ensuring that no invertebrates are left on the sieve. Be careful not to crush any invertebrates with the spatula during this procedure.
- 7 Flood the contents with 70% isopropanol alcohol.
- 8 Carefully seal the zip lock bag, label it with water-proof marker and record the sample on the field sheet.
- 9 After completion of sampling, wash out the sweep net sampler to remove all remaining debris.
- 10 When repeating the procedure the timing of each sweep should be consistent.

B - Stream Sites Sampling: Muddy-Bottom Sampling Method

At each sampling station 3 randomly selected composite samples are to be collected following

the collection method instructions given below. Each composite sample will be comprised of 20 Jabs of the aquatic communities.

D-Frame NET SAMPLE COLLECTION (taken from the *Volunteer Stream Monitoring: A Methods Manual* created and distributed by EPA Office of Water)

- 1 The sampling stretch will be approached from downstream to prevent disturbance of the sampling area.
- 2 Fill a bucket 1/3 full with water.
- 3 Sieve the water into another bucket to remove any macroinvertebrates or debris.
- 4 A series of 20 jabs with a D-frame Net will be used to sample the stream. The following four habitats will be sampled: vegetated bank margins, snags & logs, aquatic vegetative beds, silt/sand/gravel substrate.
- 5 To sample Vegetated banks jab quickly with “an upward motion, brushing the net against vegetation and roots along the bank. The entire jab motion should occur underwater.” (USEPA, 1997)
- 6 To sample snags and logs, “hold the net with one hand under the section of submerged wood you are sampling. With the other hand (which should be gloved), rub about 1 square foot area on the snag or log. Scoop organisms, bark, twigs, or other organic matter you dislodge into your net. Each combination of log rubbing and net scooping is one jab.” (USEPA, 1997)
- 7 To sample aquatic vegetation beds “jab vigorously, with an upward motion, against or through the plant bed. The entire jab motion should occur underwater.” (USEPA 1997)
- 8 To sample a silt/sand/gravel substrate “place the net with one edge against the stream bottom and push it forward about a foot (in an upstream direction) to dislodge the first few inches of silt, sand, gravel or rocks. To avoid gathering a netful of mud, periodically sweep the mesh bottom of the net back and forth in the water, making sure that water does not run over the top of the net. This will allow fine silt to rinse out of the net.” (USEPA, 1997)
- 9 Each jab will be approximately 1 foot in length. Since the D-frame net is one foot wide, the total area sampled with 20 jabs will be 20 square feet of combined habitat.
- 10 The jabs will be distributed within all four of the habitats present. However, the distribution will not be even. The most productive habitat, which is the vegetated bank, will be sampled with 10 jabs. The remaining 10 jabs will be divided among the remaining habitats that are present
- 11 After every few jabs the net should be rinsed into the bucket to remove invertebrates
- 12 After all 20 jabs rinse the net in the bucket filled 1/3 with water.
- 13 Check the net for any clinging organisms.
- 14 Pour the contents of the bucket into a US No 30 sieve
- 15 Place the contents of the sieve into a zip-lock bag with the aid of the spatula ensuring that no invertebrates are left on the sieve
- 16 Flood the contents with 70% isopropanol alcohol
- 17 Carefully seal the zip lock bag, label it with water-proof marker and record the sample on the field sheet.
- 18 After completion of sampling, wash out the sweep net sampler to remove all remaining debris.

- 19 Repeat this procedure for the 2 other composite samples to be taken at this site. Each consecutive sample should be upstream of the prior sample to avoid contamination.

6.6 *Sample Preservation & Handling*

SAMPLE CONTAINERS (both wetland and stream sites)

Unused Glad-Lock Zipper Storage bags with “Yellow and Blue Make Green” seal, *or* similar product, 10.5” x 12” size bags, should be used to collect and temporarily store the samples. These “zip lock” bags should be doubled to minimize the chance of accidental spills and lost samples. Three containers for each wetland or stream site will be marked the day of field sampling with a permanent marker with the wetland or stream site number, the wetland or stream name, the sample number, the collector’s name and the date. In addition, the sample numbers and the wetland or stream site in which they will be used will be marked on the NEFWIBP Aquatic Invertebrate Sampling Record Sheet before field collection (Hicks, 1999). This step will ensure that the appropriate sample container will be used in the assigned wetland or stream and will avoid any confusion over the location of the samples taken.

SAMPLE BAGGING AND LABELING

Flood all samples with 70% alcohol or similar preservative, seal carefully, and label using a water proof marker with the following information: Sample number; Field site; Location; Date; Collected by; Sampling method; Preservative used. Then record the sample numbers on the field data sheet. Mark the location of the sampling site on the “NEFWIBP Aquatic Invertebrate Field Sheet – Part B. Invertebrate Sampling Observation and Record Sheet” (*Appendix B: Form 2*)

All sample and wetland numbers will be unique and consecutive. The wetland or stream numbers will have a first digit of “w” for wetland sites and “s” for stream sites and then be followed by a unique two-digit number. The sample numbers will be consecutive numbers and will have no letters associated with them.

HANDLING

Place samples in cooler containers with the addition of ice to prevent heating.

7.0 Sample Custody

On return from the field the samples are to be stored in an air conditioned laboratory for no longer than 2 weeks before the invertebrates have been sorted from the debris and placed in glass vials, preserved in 70% isopropanol alcohol, and sealed with screw tops. Each vial must be

labeled with its sample number, and a record of all samples kept on “NEFWIBP Aquatic Invertebrate Sampling Record Sheet” (*Appendix C Forms*). Once the invertebrates have been identified and counted they are once again to be placed in glass vials, preserved in 70% isopropanol alcohol, and sealed with screw tops labeled with the sample number. The samples are to be kept in an archival location for a period of two years to provide an opportunity to take contents to genus and species level, if required or to perform a QAQC audit.

8.0 Laboratory Procedures

The laboratory procedures for both the wetland and stream sites are the same. All laboratory work will be conducted at the WTGH(A) Natural Resource Department Laboratory.

8.1 Equipment

White enamel or plastic trays; U.S. 30 mesh sieve; spatula, hand lens; overhead lamp / magnifying lens; identification references, dissecting scope, preferably 10x to 40X zoom; microscope; vials and vial racks of assorted sizes, 70% isopropanol alcohol; dissecting kit with forceps, probe and scalpel; petri dishes; small beakers; registration sheet; laboratory bench sheet;

8.2 Sorting

Individually empty the contents of each bag into a sieve held over a bucket in a laboratory sink. Gently rinse the contents under tap water to remove all fine organic detritus, leaving the remainder free of silt and clay. Place the remaining contents into a white sorting tray. (If the amount of material is excessive, take one handful at a time). Take care to remove any clinging organisms from the sieve. Take the tray to a desk or work bench, place under a strong desk lamp with magnifying lens and using forceps, remove invertebrates from the vegetation and detritus and place into a vial two thirds filled with 70% isopropanol alcohol. Fully label each vial, register it on the “NEFWIBP Aquatic Invertebrate Sampling Record Sheet” (*Appendix C: Form 3*), and store it until time is available for identification.

8.3 Identification and Counting

For this investigative study each sample vial will be examined and recorded individually.

- 1 Pour the contents of each vial into a petri dish. Ensure no organisms are left on the sides of the emptied vial.
- 2 Place the petri dish under the dissecting scope starting at 10X, and if necessary increase the magnification to verify identification. In a deliberate systematic manner, scan back and forth to find organisms in the petri dish.
- 3 Using the identification guide, *Aquatic Entomology: The Fisherman's and Ecologists' Illustrated Guide to Insects and Their Relatives* (McCafferty, I 981), identify the invertebrates to family level only. Record and enumerate each organism on “NEFWIBP Laboratory Bench Sheet” (*Appendix C: Form 4*). As each individual organism is identified and registered remove it with forceps and return to a labeled storage vial two thirds fill of 70% alcohol. If, at some future date, it is thought necessary to identify the

collection for the project to a lower level of taxonomy it will be possible. NEFWIBP Aquatic Invertebrate Sampling Record Sheet” (*Appendix C: Form 3*) traces the processing of the sample to this stage.

- 4 Repeat for the two replicates taken from each site using separate laboratory sheets for each sample.

9.0 Quality Control for Taxonomy

All samples will be preserved and stored in archives for future reference and for review by a taxonomist who was not responsible for the original identifications

Any specimen not able to be positively identified will be sent to a taxonomist specialist for validation. Anna Hicks of the UMASS Extension Service in Amherst, Massachusetts will function as the macroinvertebrate specialist for this project.

Information on samples completed through all processes will be recorded on the sampling record sheet (*Appendix C: Form 3*).

A variety of taxonomic references held by the aquatic invertebrate biomonitor will be consulted for cross-referencing. These references include *Aquatic Entomology: The Fishermen's and Ecologists' Illustrated Guide to Insects and Their Relatives* (McCafferty, W.P. 1981) and *An introduction to the Aquatic Insects of North America, Third Edition* (Merritt, R.W. and K. W. Cummins 1995)

10.0 Analytical Procedures

Once identification and enumeration has been completed for each wetland or stream site, three composite samples per sampling site, all records will be entered into the FileMaker Pro v.4.0 Database created to summarize and calculate the metrics for each site. This database was created to automatically calculate the metrics for each wetland site. The calculations in this database have been checked for accuracy by WTGH Natural Resource Staff. From the completion of data entry into this database for each wetland the indicators/metrics listed in Table 2 can be determined.

Table 2. Freshwater invertebrate community metrics and indicies

Metric/Index	Category	Rationale	Response to Stressor
Total Number of Organisms	Enumeration and community composition	Nutrient enrichment will usually support higher numbers of Organisms. Toxicity and habitat Degredation will reduce numbers.	Variable
Taxa Richness	Richness	Diversity is a measure of community complexity, responds adversely to stress intensity.	Decline
% Composition of Major Feeding Groups	Enumeration and community composition	A healthy community will have a balanced between the various Trophic groups	Variable
% Composition of Dominant Family	Enumeration and community composition	A healthy community will have a balanced composition between taxa, with more than 2 dominant groups.	Rise
EOT Richness (<i>Ephemeroptera</i> <i>Odonata</i> , <i>Trichoptera</i>)	Richness	Healthy system have greater numbers of sensitive taxa and predator-guild organisms	Decline
EOT/ <i>Chironomidae</i> Ratio	Community Health	Healthy systems have higher sensitive/predator to tolerant organisms ratios.	Decline
Other <i>Odonata</i> / <i>Choenagrionidae</i> Ratio	Community Health	Healthy systems have higher sensitive to tolerant Odonate ratios.	Decline
% Tolerant/ % Intolerant ratio	Community Health	Impacted systems have higher tolerant to intolerant organisms	Rise

Metric/Index	Category	Rationale	Response to Stressor
% Predators	Community Health	Healthy systems have a higher predator:prey ratio.	Decrease
Family Biotic Index	Community Health	Community's averaged tolerance value will rise with increasing stressors.	Rise
Community Taxa Similarity Index	Similarity to reference condition	Resemblance of taxa composition to reference will shift with stressors.	Decline
Community Trophic Similarity Index	Similarity to reference condition	Resemblance of trophic pattern to reference will shift with stressors.	Decline
Invertebrate Community Index	Summarized Bioassessment	Overall community condition will decline with increasing degradation.	Decline

This table taken from Table 5.1 in *Wetland Ecological Integrity: An Assessment Approach*. (Charlisle et al., 1998)

11.0 Data Reduction, Validation and Reporting

11.1 Origin of Data

The data for this project will originate from field observations, measurements, sampling, and laboratory analysis. All data will be recorded on field data sheets, laboratory sheets, entered into the database, and presented in report tables and graphs.

11.2 Data Processing

- 1 Raw data will be entered into the FileMaker Pro 4.0 Database followed by data validation check and back-up onto the Jaz Drive
- 2 Raw data reduction to indicators/metrics will be done automatically by the FileMaker Database followed by a data validation check and back-up onto the Jaz Drive.
- 3 Calculation of FW-ICI for Wetlands and SR-ICI for Streams & Rivers will be calculated by the FileMaker Pro 4.0 Database followed by a data validation check and back up onto the Jaz Drive.

11.3 Computer System Description

A FileMaker Database was created by the Natural Resource Department of the Tribe to calculate the Metrics as well as to summarize the information from each site. All information will be kept on the Dell workstation, located in the Aquatic Biologist's office in the Natural Resource Department, and backed up onto the Jaz Drive after any modifications are made.

11.4 Data Validation

Data validation will be done after each stage of the data processing. All data records will be checked for accuracy, completeness, reasonableness, and spelling by the QAQC Data Officer.

11.5 Documenting Data Problems

Data deficiencies and problems relating to the data collection and analysis will be recorded in a notebook allocated for Data Analysis. Further entries will include solutions to the encountered problems, and how these solutions were derived.

11.6 Data Storage and Back-Up

A hard copy of the Database analysis will be printed out after all data has been entered for a wetland or stream site. All raw data sheets and computer hard copies will be stored in folders. Each wetland or stream site will have its own folder which will be labeled and stored in a filing cabinet in the Aquatic Biomonitor's office. These folders will be stored together with all other materials from the project.

Computer file back-up procedures will be undertaken regularly. Upon completion of the data entry process, a final copy of the database will be archived on both the Dell workstation and the Jaz Drive. If any subsequent changes are made to the data, the changes will be noted on the

original hard copy, processed on the hard drive and updated onto the Jaz Drive.

11.7 Data Reporting

Data will be recorded on field forms by the Aquatic Biologist. Forms will be checked initially for recording errors and general plausibility and consistency by the aquatic biologist. All data will be reviewed and reported in units specified at the detection level of the analytical methods used.

The QAQC Data Officer will be responsible for receiving the data sheets and field laboratory notebooks, checking for errors in identification numbers, decimal placement, dates, times, units reported, and comments.

Data will be entered into the Biomonitoring Database by the QAQC Field Officer (Aquatic Biologist). Once all data is entered into the database, the values will be checked by the QAQC Data Officer against the originals for errors. All field sheets for each wetland will be kept in the site's folder to allow for checks of the data. A hard-copy, which will be printed out of the data, will also be kept in this folder. This hard copy will be dated and initialed by the QAQC Data Officer.

12.0 Internal Quality Control Checks

12.1 Calibration

The YSI 6000 water quality meter will be used to collect data on the pH, DO, temperature, conductivity, total dissolved solids, and depth. These measurements are required on the NEFWIBP Wetland Invertebrate Field Sheet Part B: Invertebrate Sampling Observation and Record Sheet. The water monitoring equipment will be maintained and checked as per manufacturer's instruction. In addition buffer solutions bracketing the expected range will be used to calibrate for pH, and standards will be used to calibrate for conductivity and turbidity immediately before each sampling round. Equipment calibration procedures are included in Appendix H.

The preparation and expiration dates of standard solutions will be clearly marked on each of the containers to be taken into the field. It will be the responsibility of the Aquatic Biologist to check the calibration status of any meter prior to using the instrument and to check its calibration periodically during use. A log documenting problems experienced with the instruments and corrective measures taken will be maintained by the Aquatic Biologist.

All equipment to be utilized during the field analysis and laboratory analysis will be checked, prior to its use, to see that it is in operating condition. This includes checking the manufacturer's operating manuals and the instructions with each instrument to ensure that all maintenance items are being observed.

All of the field testing instruments will be calibrated according to the manufacturer's

recommendations. Any deviation from these recommendations due to specific peculiarities with certain instruments will be documented in the field logbooks and the monitoring program of the grant work plan. All standards will be traceable to a nationally recognized standard and documented in field logbooks. All instrument calibration information can be found in the calibration procedures Appendix H.

13.0 Preventative Maintenance Procedures

14.0 Corrective Actions

The above two sections have been combined in Table 3 – Quality Control Checks, Procedures and Actions.

15.0 Performance and System Audits

Audits will be conducted by the Technical Consultant, Anna Hicks, who will be responsible for the species identification and enumeration audit. Ten percent of all samples will be sent to her during the duration of the sampling and monitoring period. The samples will be selected randomly from all of the samples collected during the year. These samples will be identified to the family level and enumerated by the Technical Consultant and returned to the Natural Resource Department. This information will then be compared to the species identification and enumeration conducted by the Aquatic Biologist. This comparison will reveal any problems in scientific family identification as well as counting errors. The results of the audit will be included in the Quality Assurance Report to Management.

16.0 Quality Assurance Reports To Management

Project outputs, together with quarterly progress reports, are described in the original Scope of Work. The quarterly progress reports will include a section on quality control addressing (where necessary):

- 1 Problems affecting the quality of the data assembled, project schedules, or project completion, results of the performance system audits
- 2 Corrective actions implemented and the results
- 3 Changes in the project's design, objectives or staffing
- 4 Need for additional resources and equipment to obtain project objectives

Table 3 – Quality Control Checks, Procedures and Actions

TYPE OF QC CHECK	FREQUENCY OF CHECK	PRECISION	ACCURACY	CORRECTIVE ACTION	PREVENTATIVE MAINTENANCE
1. Field Equipment Sweep Net	After sampling each day			Check for tears, holes and mend if necessary or use back up net.	When not in use, net is cleaned, dried, and stored in an upright position in the lab.
Sieve	After Sample each day			Check for damage to mesh, mend if possible, otherwise use back up sieve.	When not in use, sieve is cleaned dried and stored as above.
2. Laboratory Equip. Dissecting Scope	Each Day of use	X40		If necessary, to be serviced by a certified technician.	Instrument is stored with a sealing dust cover when not in use in a temperature controlled area.
Glassware	Each Day of use			Replace broken or damaged glassware. Place discarded glass in correct container.	Wash, rinse, dry and store on equipment shelf in lab.
Dissecting Kits	Each day of use			Replace damaged or blunt parts/instruments.	All used instruments are to be washed rinsed, dried, and packed into carry case and stored on equipment shelf in lab.

17.0 References

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- 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/44/4-89-001. U.S. Environmental Protection Agency, Assessment and Watershed Protection Division, Washington D.C.
- Smith, D. G. 1991. *Keys to Freshwater Macroinvertebrates of Massachusetts*. Department of Zoology, University of Massachusetts, Amherst, MA.
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- U.S. Environmental Protection Agency. 1996. *Volunteer Stream Monitoring: A Methods Manual*. Office of Water, U.S. EPA, Washington, D.C. 20460.

Appendix H

New Engl and Freshwater Invertebrate Biomonitoring Protocol

Appendix I

Massachusetts Coastal Zone Management – Land Use Index
Description & Methodology

Appendix J

YSI Equipment Calibration Procedure