



**Sample Collection, Sorting, and Taxonomic Identification
of
Benthic Macroinvertebrates**

Water Quality Planning Bureau
Standard Operation Procedure
WQPBWQM-009

Approvals:

[Signature on File]	[09/08/06]
Dave Feldman, Water Quality Specialist, WQ Standards	Date
[Signature on File]	[09/08/06]
Mark Bostrom, QA Officer, Water Quality Planning Bureau	Date
[Signature on File]	[09/06/06]
Bob Bukantis, Environmental Program Manager, Water Quality Standards	Date

This page left intentionally Blank

Table of Contents

Macroinvertebrates.....	5
1. Scope and Applicability.....	6
1.1. General Considerations	6
1.1.1. Index Period.....	6
1.1.2. Site Selection.....	6
1.1.3. Sample Collection Methods.....	7
1.1.4. Checklist of Recommended Field Supplies	7
2. Sample Collection Procedures	8
2.1. Quantitative Sampling Protocol (Hess Sampler).....	8
2.1.1. Protocol Summary	8
2.1.2. Equipment.....	8
2.1.3. Sample Collection.....	8
2.1.4. Precautions	9
2.1.5. Sample Labeling	9
2.1.6. Sample Containers and Preservation	9
2.1.7. Sampling Quality Control	10
2.2. Semi-Quantitative Sampling Protocols (Traveling Kick Net and Jab Techniques).....	10
2.2.1. Sampling Protocol Summaries.....	10
2.2.2. Equipment.....	10
2.2.3. Sample Collection.....	10
2.2.4. Other sampling methods and protocols	12
2.2.5. Precautions	12
2.2.6. Sample Labeling	12
2.2.7. Sample Containers and Preservation	12
2.2.8. Sampling Quality Control	12
2.3. Supporting Field Data.....	13
3. Subsampling & Sorting	14
3.1. Pre-subsampling methods.....	14
3.1.1. Picking detritus.....	14
3.1.2. Elutriation.....	14
3.2. Sub-sampling and Sorting	15
3.2.1. Sorting QC.....	15
4. Taxonomy	16
4.1. Taxonomic Identification.....	16
4.2. Quality Control for Taxonomy	16
4.2.1. Accuracy	16
4.2.2. Precision	17
4.2.3. Corrections to database.....	18
5. Data Analysis and Interpretation.....	19
5.1. Transfer sample data	19
5.2. Reduce sample data.....	19
5.2.1. OTUs.....	19
5.2.2. Excluded Taxa.....	19
5.2.3. Rarefaction.....	20
5.2.4. Re-Sampling.....	20

5.3.	Identify site classes	20
5.3.1.	<i>Predictor Variables.....</i>	<i>20</i>
5.3.2.	<i>Determine Site Class.....</i>	<i>21</i>
5.4.	Calculate the MMI	22
5.5.	Calculate RIVPACS.....	22
5.6.	Validating Model Outputs.....	23
5.7.	Interpret the Indices	23
5.7.1.	<i>Reconciling Differences in MMI and RIVPACS Results.....</i>	<i>24</i>
5.8.	Determine degrees of Impairment	26
6.	Reporting Results.....	27
7.	Glossary of Metrics	28

List of Appendices

Appendix A	Master Taxa List
Appendix B	Taxa List Template
Appendix C	Rarefaction
Appendix D	Example Output for the MMI and RIVPACS

List of Attachments

Attachment 1	- Montana DEQ Site Visit Form
Attachment 2	- Photo Points Form
Attachment 3	- Site Sketch Form

Macroinvertebrates

This Standard Operating Procedure (SOP) describes methods that have been developed for determining the health of macroinvertebrate communities for use in water quality assessments. This SOP will be reviewed annually. Before using this SOPs, please confirm the revision number that is presently in use by contacting the following individuals (or their replacements):

David Feldman
Water Quality Standards Section
Montana Department of Environmental Quality
PO Box 200901
Helena, MT 59620-0901
(406)-444-6764

Mark Bostrom
Data Management Section
Montana Department of Environmental Quality
PO Box 200901
Helena, MT 59620-0901
(406)-444-2680

1. Scope and Applicability

The methods described herein are used in wadeable streams (2nd order or higher). These methods may be used in a first-order stream but special care needs to be taken in data analysis and interpretation. Benthic macroinvertebrate data collected on large rivers is beyond the scope of this method.

1.1. General Considerations

Before conducting a benthic survey, determine specific data quality objectives (DQOs) and clearly define the information sought. DQOs are qualitative and quantitative statements developed to specify the quality of data needed to support specific decisions and conclusions about the information sought.

1.1.1. Index Period

The index period is the period of time that samples should be collected to minimize seasonal variation.

- The index period for Montana is generally the summer (June 21 to September 21), following runoff (Richards 1996). Eastern Montana streams may be sampled May 1 to September 15.
- Sampling may occur outside of the index period, however this may reduce certainty that the data are comparable to historical data, reference conditions or indices (see discussion below).

The index period noted above was the temporal basis for reference conditions used in the development of the MMI and RIVPACS models. However, even within this index period, extreme runoff or summer drought conditions could affect these periods; professional judgment must be used when considering sampling schedules. Sampling macroinvertebrates during high flows, besides being potentially unsafe, is likely to increase sampling variance due to the difficulties associated with sampling these waters using the methods described herein.

When monitoring for trends at a particular site, minimize seasonal variation by sampling as close as possible to the same date each year.

1.1.2. Site Selection

The total number of sites, their location in the study area, and the number of replicate samples used to represent each site should be determined as part of the sample process design during the DQO process. Once established, the design should be adhered to in order to achieve the objectives of the project. In developing a sampling design, always consider potential constraints to collecting representative samples such as site access. If design changes become necessary due to site access restrictions, those changes must be well documented.

The study design should specify requisite site specifications for the study. For example, many study designs use the riffle environment as the specific point of comparison between streams. A *rationale* described in the Sampling and Analysis Plan (SAP) for determining representative riffles for the anticipated stream types would be a *site selection specification*.

Although riffle areas with cobble substrates are generally the most diverse and productive habitat type, these may not be representative of the predominant type of habitat in the stream. If so, the study design should describe the variety of habitats, the rationale for representative sampling, and the various appropriate sampling techniques for the study.

There is ample evidence that the presence of lakes, impoundments, bridges, road crossings, and bedrock or large-boulder dominated substrates affecting benthic invertebrate community composition; therefore,

sampling sites should be located as far from these as is practical, *unless the objective of the study is to measure their localized influence.*

Always sample sufficiently upstream from the confluence of major tributaries or receiving waterbodies to minimize their influence on study sites. Otherwise, to capture the combined (mixed) biology, consider the mixing zone of the two waterbodies and select sites that are downstream of the confluence, are well mixed, and represent both.

1.1.3. Sample Collection Methods

There are several macroinvertebrate sampling procedures used by DEQ:

Quantitative sampling techniques collect samples in a known area allowing the enumeration of organisms to determine population density, in addition to diversity and abundance. The Hess collection procedure is the one quantitative method addressed in this document.

Semi-quantitative sample collection methods are designed to collect the widest variety of aquatic macroinvertebrates available at the study site. For these methods, it is not necessary to know the exact area (in m²) sampled. Metrics are calculated from a standardized number (300) of the field sample. The macroinvertebrate tools used are based on diversity and abundance within the subsample. The semi-quantitative collection procedures addressed in this document are

- Traveling Kick
- Jab
- Environmental Monitoring and Assessment Protocol (EMAP)

1.1.4. Checklist of Recommended Field Supplies

- ☐ Field Meter (pH, Spec. Conductance, DO)
- ☐ Macroinvertebrate sample bottles (1 liter wide mouth poly)
- ☐ Lab markers, external labels, clear tape, Parafilm-M
- ☐ Internal labels (paper)
- ☐ Sampler (Hess or D-frame net)
- ☐ Field notebook
- ☐ Field data sheets (Site Visit Form, Photo Documentation Form, Site Map Form)
- ☐ Camera
- ☐ GPS unit
- ☐ 95% Ethanol preservative
- ☐ 500 um sieve for washing and sorting out large objects
- ☐ Pencils
- ☐ Clipboard
- ☐ DI Water
- ☐ Hip boots or waders
- ☐ Maps
- ☐ Screwdriver or metal rod (Hess)
- ☐ Dishwashing brush
- ☐ Hard or soft-sided Coolers to store samples
- ☐ Small soft-sided coolers to transport samples

2. Sample Collection Procedures

The following section discusses sample collection procedures used to sample macroinvertebrate populations in streams and wadeable rivers.

2.1. Quantitative Sampling Protocol (Hess Sampler)

2.1.1. Protocol Summary

The Hess sampling technique is considered a quantitative technique because it samples a defined area of substrate.

2.1.2. Equipment

Hess Sampler - The Hess Sampler was designed for effective sampling of shallow streams with gravel and cobble bottoms. It consists of a stainless steel 13" (330 mm) by 16" high cylinder with two upstream and two downstream Nitex windows and two strong handles for pushing the cylinder into the stream bottom. Penetration depths of 3" or 6" are typical of this sampler. Water flows through the upstream opening of the sampler and out through the downstream windows and into the collection net and bucket. The downstream net is constructed of Nitex nylon. Mesh size is 1000 μm .

Specifications:

Maximum working depth: 0.5 m

Dimensions: Cylinder 0.5 m in diameter

Sampling area: 0.61 m^2



2.1.3. Sample Collection

Hess samplers require flowing conditions and a riffle feature. The water must be deep enough to permit flow through the front screen and into the catch net at the back. The depth cannot be so great that water overflows the sampler and washes organisms out the top (see specifications for maximum working depth).

It is usually necessary to collect multiple samples at each site due to the typically patchy distribution of macroinvertebrates. The sampling design must specify the number of replicates collected at each site and whether these will be composited or submitted as discrete samples.

Once a site is selected, prepare to insert the Hess sampler into the substrate. While standing just downstream of the chosen site (facing upstream) grasp the sampler by the handles and hold it just above the water's surface. The collection net must be on the downstream side.

Insert the sampler just upstream of the desired location in order to compensate for stream flow. Tip the sampler slightly to elevate the front (upstream) end, and aim slightly upstream of the desired site, drive the sampler into the water.

When the bottom makes contact with the substrate, immediately drive the bottom of the sampler into the substrate using a series of quick, short, alternating clockwise and counterclockwise rotations. Drive the sampler in as far as necessary to close any gaps between the substrate and the sampler bottom. If large cobbles or other objects prevent closure of the gap, attempt to remove these obstacles by hand.

If the gap cannot be sufficiently closed to prevent loss of organisms, select a new undisturbed sample location within the site.

Once the sampler is in place, thoroughly churn and clean the enclosed substrate by hand. Rocks and other debris should be cleaned so that any attached organisms are removed, making sure all collectible organisms and debris are kept inside the sampler. Continue brushing until all organisms have been removed from the substrate. Next, thoroughly churn the remaining bottom material with the metal rod or screwdriver, using a series of clockwise and counter clockwise rotations. The remaining bottom gravels and sands can also be scooped up with the hands and dropped, allowing any remaining organisms to be flushed into the net.

Wash the contents of the collection net into the attached collection bottle. Lift the sampler from the substrate and allow water flow over the outside of the collection net while brushing organisms down the net with a hand or brush.

Pour the contents of the collection bottle into a one-liter sample bottle. Remove as many organisms as possible from inside the collection net and Hess collection vessel as possible to preserve the integrity of the sample. Inspect collection net and remove any attached organisms.

Completely rinse and clean the inside of the collection net and sampler to prevent contamination of the next sample.

2.1.4. Precautions

Care must be taken when looking for suitable sampling sites not to disturb the substrate or habitat in areas where samples might be collected. A sample collected where the substrate has been disturbed by walking may not be representative of the community.

Be sure to transfer the entire sample to the bottles. Only fill each bottle one-half full with sample to leave room for preservative. Capture all bugs by thoroughly cleaning off all large rocks and sticks. Excluding large rocks prevents grinding damage to bugs during transport. Discard cleaned rocks and sticks.

Pack and store collection bottles carefully and securely in order to protect the sample jars and prevent the loss of contents during transport or shipment.

2.1.5. Sample Labeling

Accurate labeling of sample bottles is important to preserve critical information. Bottles are best labeled both inside and out. Attach a preprinted label to the jar clearly identifying the sample (location, date, number of bottles, method of collection and sample number). The internal label with station identification number or name, written in pencil, may also be put into the jar to conclusively identify the sample. Use pre-printed, fill-in-the-blank labels to help ensure that the sample information is complete.

2.1.6. Sample Containers and Preservation

Collection jars: 1-liter wide-mouth polyethylene bottle. (Note: It may be necessary to use more than one 1-liter polyethylene bottle.)

Use 95% ethanol (ETOH) to preserve macroinvertebrate samples. Please remember that ETOH is flammable! The drawback of using ethanol is that the fluid composition of the sample needs to be dominated by ethanol to properly preserve the sample. Because of this, fill half of the sample bottle with sample and the remainder with ETOH to fill the bottle completely.

2.1.7. Sampling Quality Control

Examples of quality control for biological measures are as follows:

2.1.7.1. Field Replicates

Field replicates are collected to measure total method error and should always be included in the sampling design at a predetermined frequency (usually 10%).

Field replicates are two or more samples, collected side-by-side or consecutively, at the sampling site. Replicate samples should be taken at places that are very similar in terms of depth, substrate, composition, and slope. Do not to contaminate one site with the other by *always collecting from downstream to upstream*. Replicates are processed in the laboratory as discrete samples and their difference evaluated. This difference represents total method error (e.g., heterogeneity of site, reproducibility of sampling technique, sorting error, and identification error).

Relative Percent Difference (RPD) is used to evaluate results differences between two replicate samples.

$$RPD = \frac{(result1 - result2)}{(result1 + result2)/2} \times 100$$

The results of replicated (MMI value or O/E ratio) samples should be < 20% RPD, however, each project must state its required replicate precision criteria based on project DQO's.

2.2. Semi-Quantitative Sampling Protocols (Traveling Kick Net and Jab Techniques)

2.2.1. Sampling Protocol Summaries

The kick-net method is a semi-quantitative sampling technique designed to collect a representative macroinvertebrate sample in riffle environments (Barbour et al. 1999). The method was developed for use in shallow riffles in second to fifth order streams as defined by Strahler (1957). When necessary, runs or other habitats may be sampled.



The jab technique is a qualitative sampling technique designed to collect a representative macroinvertebrate sample from the various habitats along a single meander length of a low-gradient stream (Barbour et al. 1999).

2.2.2. Equipment

The traveling kick net and jab techniques both use a D-frame dip net. The dimensions of the frame are 0.3 m width and 0.3 m height, shaped like a "D" which is connected to a pole roughly a meter in length. The net is conical or bag-shaped with a 1.2 mm mesh size.

2.2.3. Sample Collection

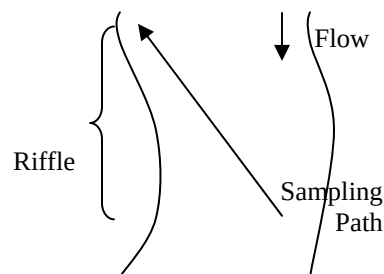
2.2.3.1. Traveling Kick Net Method

The goal of this protocol is to maximize the number of available micro-habitats in a macroinvertebrate riffle sample. This maximizes the abundance and diversity of macroinvertebrates captured in the sample. The traveling kick technique is a vigorous shuffling of one's feet in the substrate while moving diagonally and upstream to dislodge macroinvertebrates

from their habitat. As they are dislodged, macroinvertebrates are swept up by the current and collected in a D-frame net with a 1.2 mm mesh net, held vertically in contact with the bottom, and immediately downstream of the area being disturbed. The effort expended in acquiring the sample should be sufficient to capture as many macroinvertebrates as reasonable.

The habitat sampled should not be too deep (greater than 2 feet, ideally one foot or less), or too fast (greater than about 3 feet per second).

A sample is collected by starting at the downstream corner of a riffle and vigorously shuffling and kicking your feet through the substrate. In very small streams a single sampling path may be sufficient to sample the entire riffle. In larger streams, multiple passes may be needed to assure that all features of the riffle are sampled (i.e., lower, middle, upper, and right/left margins).



Also, shorter runs may be necessary if the D-net rapidly fills with rocks and other debris. Excess debris and larger rocks should be discarded after rinsing them into the net and visually inspecting it to verify that no macroinvertebrates are hanging on to the debris.

Attempt to move through the riffle at about one-third foot per second, so that the total time spent sampling is one minute. The samples are meant to be qualitative, however, the duration of the kick should be timed and the length of stream bottom disturbed estimated, to allow for a later determination of “catch-per-unit-effort”.

Pour the contents of the D frame net into a 500-um sieve. Thoroughly wash large rocks and sticks to remove organisms. Inspect and discard these large objects once cleaned. Dump the contents of the 500-um sieve into the 1-liter sample jar.

Inspect and remove as many organisms from the collection net as possible placing them directly in the sample jar.

Clean net prior to next sampling use to prevent contamination.

2.2.3.2. Jab Method

The sampling site should include at least 1 meander length, approximately 20 bank full channel widths. Examine and record approximate proportions of the various productive macroinvertebrate habitats. Productive lentic habitat types include snags, aquatic vegetation and bank margins.

Proportionally allocate 20 jabs to the various habitats within the site, moving in an upstream direction through the reach.

Specific descriptions of what constitutes one jab in typical environments is as follows:

Snags: Highly dependent on the nature of the snag. The idea is to try to sample roughly an equivalent of a meter sweep. Jab the net into the snag then sweep it through the disturbed area and around the snag in such a way as to capture dislodged inhabitants. Inhabitants should be scrubbed off by hand into the net on coarser snags.

Aquatic Vegetation: Jab and sweep the net through the vegetation for about 1 meter loosening and capturing inhabitants.

Bank Margins: Typically a combination of the above.

Pour the contents of the D frame net into a 500-um sieve. Thoroughly wash large rocks and sticks to remove organisms. Inspect and discard these large objects once cleaned. Dump the contents of the 500-um sieve into the 1-liter sample jar.

Inspect and remove as many organisms from the collection net as possible placing them directly in the sample jar.

Clean net prior to next sampling use to prevent contamination.

2.2.4. Other sampling methods and protocols

A variety of other sampling methods are available from EPA, USGS, and other organizations. It is beyond the scope of this SOP to discuss all available sampling methods, or the applicability of their sampling design for determining the health of benthic macroinvertebrate communities using the Data Analysis and Interpretation tools presented in Section 5 of this SOP.

When sampling methods other than those listed in this SOP are used for water quality assessments or development of narrative water quality standards (reference condition) for use by or for DEQ, the SOP(s) for the alternate methods must be attached or cited in the project's Quality Assurance Project Plan (QAPP) or Sampling and Analysis Plan (SAP). Any known (documented) or assumed comparability to the methods in this SOP should be cited or documented in these QA documents.

2.2.4.1. Environmental Monitoring and Assessment Protocol (EMAP)

Currently, the DEQ Reference Project uses EMAP sampling protocols to identify and assess reference sites (Lazorchak et al. 2000). These data were included in the compiled reference data collection used for the MMI and RIVPACS models. Therefore, EMAP methods are considered valid sampling techniques for use with the tools presented in Section 5 of this SOP.

2.2.5. Precautions

Precautions for semi-quantitative sampling techniques are the same as are discussed for quantitative techniques. Refer to section 2.1.4.

2.2.6. Sample Labeling

Sampling labeling requirements for semi-quantitative sampling techniques are the same as are discussed for quantitative techniques. Refer to section 2.1.5.

2.2.7. Sample Containers and Preservation

Sample container and preservation requirements for semi-quantitative sampling techniques are the same as are discussed for quantitative techniques. Refer to section 2.1.6.

2.2.8. Sampling Quality Control

Sampling quality control requirements for semi-quantitative sampling techniques are the same as are discussed for quantitative techniques. Refer to section 2.1.7.

2.3. Supporting Field Data

Macroinvertebrate sample sites are described by metadata recorded at the time of sampling as well as any field observations taken at the time of sampling. Use the Site Visit Form (**Attachment 1**) to record metadata (GPS lat/long in decimal degrees, NAD 83) for the sampling site and record sample identifiers. Record the sampling protocol used (e.g., kick, jab.).

Digital photographs should be taken of the sampling site (upstream, down stream, and the site itself) and of the substrate sampled. Record metadata for photos on the Photo Point Form (**Attachment 2**). As a back up to digital photos, a sketch of the sampling site is recommended, along with an indication where the sample was taken at the site. A Site Sketch Form is included in this SOP (**Attachment 3**).

3. Subsampling & Sorting

Subsampling is using a representative portion of the field-collected sample for analysis. Sorting is the physical separation, counting, and grouping of organisms from the debris collected in the sample.

It is important to understand the objectives of the project when selecting subsampling techniques. If the intention of the study is to measure population density (from a quantitative sampling), the entire sample is for sorting. Full sample sorts can be used for samples collected by semi-quantitative collection methods if the study requires that all organisms are identified. However, full sample sorts are more time consuming for the taxonomist, adding additional expense to each sample.

DEQ uses a target subsample count of $300 \pm 10\%$ organisms. This means that the last Caton cell processed should result in a subsample between 270 and 330 organisms. DEQ requires that the final Caton cell counted is completed, *even if this results in a subsample that exceeds 330 organisms*. Projects that vary from this target and cite this method must describe the method modification in the QA project plan.

3.1. Pre-subsampling methods

To get a relatively even distribution of organisms prior to subsampling or sorting, large debris should be removed from the sample. There are two approaches to this sample clean-up. The debris can be removed from the sample (picking) or the sample can be removed from the debris (elutriation).

3.1.1. Picking detritus

Picking the debris from the sample involves rinsing out fine material, removing large rocks, woody debris and setting them aside. Picking and rinsing should be performed in a 500 um sieve with a gentle stream of water to prevent splattering. Large rocks and sticks must be thoroughly scraped, rinsed and examined prior to setting them aside. The remaining sample is placed in an appropriately sized Caton tray for subsampling and sorting.

3.1.2. Elutriation

Elutriation is basically an extraction of the organisms from the substrate remaining in the sample. This technique works best when the substrate is inorganic material such as sand, pebbles, and rocks. Samples with a large amount of organic material are not amenable to this extraction.

Dump the sample into a tray and fill the tray with water. Swish the sample around in the tray to liberate organic material and bugs from the substrate. The organic material and organisms should float in the water. Pour the water and all floating material and organisms into a 500um sieve. Add more water and repeat the process until no more organic material remains in the tray.

Once the sample is separated, use a magnifying lamp to check the inorganic portion of the sample for snails, clams, stone cased organisms, or any other organism too heavy to have floated. Have a fellow technician take a second look to verify. Any organisms found in the inorganic fraction must be added to the organisms in the sieve so they may be included in the sort. Once the inorganic fraction is verified to be free of organisms, place the sample fraction in the sieve in an appropriately sized Caton for sorting. If a large number of organisms are found in the inorganic fraction, the elutriation technique is not appropriate and the sample fraction in the sieve must be recombined with the inorganic fraction and sorted as a whole.

3.2. Sub-sampling and Sorting

Sorting equipment needed:

- ☐ Caton trays (various sizes)
- ☐ Glass or plastic petri dish
- ☐ Two pairs of forceps
- ☐ Tally counter
- ☐ Spatula, pipette, pencil, indelible ink pen, sharpie, scissors
- ☐ Squirrt bottle with 70% ETOH solution
- ☐ Vials for general taxa, large/rare, worm, and midges
- ☐ Block for holding vials upright
- ☐ Magnifying lamp
- ☐ Microscope
- ☐ Random number generator

The techniques for subsampling and sorting vary slightly between the contractors used by DEQ. Rather than describing (in detail) each contractor's specific method, DEQ requires that each contractor documents their procedure in a SOP, which includes the following components:

- Magnifying glass or microscope used for subsample and sort. (Specify power)
- Standardized sorting bench sheets
- Random selection of cells
- Last cell chosen
- Quality Controls to determine sorting efficiency or precision

SOPs must be submitted to DEQ as part of the contractor qualification process.

3.2.1. Sorting QC

3.2.1.1. Relative Percent Difference in Enumeration (RPDE)

Precision of sample counts is determined by calculating relative percent difference of enumeration (RPDE) by comparing results from two independent laboratories or taxonomists using the formula:

$$RPDE = \frac{| \text{Sample Result}_1 - \text{Sample Result}_2 |}{(\text{Sample Result}_1 + \text{Sample Result}_2)/2}$$

where *sample result*₁ is the number of organisms in a sample counted by the first laboratory, and *duplicate result*₂ is the recount by the second taxonomist or laboratory (adapted from Standard Methods 20th Ed. - 1020 B). The purpose of this calculation is to highlight those samples where counts might differ substantially and to focus attention on the reason or reasons for the miscounts.

For the 2006 field season and beyond, the measurement quality objective (MQO) for RPDE is 10%. Values for individual sample comparisons exceeding the MQO (> 10%) will prompt a more detailed examination of the individual samples to determine causes of the difference. Upon completion of this investigation, DEQ will prepare corrective actions and forwarded them, in writing, to the primarily responsible laboratory, and if necessary, both laboratories. The corrective actions will include requirements to be implemented and whether these apply to the entire sample lot, or only the 10% subset that were associated with the QC samples.

4. Taxonomy

4.1. Taxonomic Identification

Consistency in benthic macroinvertebrate taxonomy within and among samples is critical for helping manage the potential influence of that error on final site assessments and interpretation. It is the responsibility of the taxonomist to communicate the composition of samples to those personnel performing data entry, and to be able to defend taxonomic results to the ultimate data analysts. DEQ encourages taxonomists to identify specimens to the *lowest practical taxonomic level* (lptl). However, DEQ also understands that specimen condition (damage, early instar, poor slide mounts) may force the taxonomist into an unavoidable situation of having to leave identification at more coarse levels (e. g., family instead of genus). With the limitation of organism condition in mind, DEQ will judge consistency of data based on historical hierarchical levels that have been achieved, resulting in the Montana Master Taxa list (Appendix A).

Count vs. non-count specimens. In general, all specimens in the subsample, should be identified and counted by the taxonomist, including pupae. However, there are several exceptions known as non-counts, which include:

- Empty mollusk shells (lacking soft tissue)
- Worm fragments lacking the anterior (head) end
- Body parts NOT INCLUDING at least the head and thorax
- Surface dwellers such as Collembola, Gerridae, and Veliidae
- Incidentally-collected terrestrial specimens

Some hierarchical inconsistency in taxonomic data is dealt with during coding and analysis (see section 5.2). For multimetric indices (such as Montana's MMI, section 5.4) as calculated by the Ecological Data Application System (EDAS, Tetra Tech 2006a), taxa are coded within samples as distinct or indistinct, that is, whether they should be counted as unique taxa in taxa richness-type metrics. If they are specified as "excluded" in a sample, the number of individuals is still used for calculation of composition metrics. During development of the River Invertebrate Prediction and Classification System (RIVPACS, section 5.5), operational taxonomic units (OTUs) are specified to help reduce the influence of ambiguous taxonomy. Both approaches lead to a similar result, that is, to control the magnitude of ambiguity in the taxonomic data, and thus reduce the potential for bias in final assessments.

The complete Montana taxa list with OTUs and other attributes is available from DEQ as a table within EDAS and as Appendix A. This appendix will be updated annually from STORET during future SOP reviews. A template for tracking identification and enumerations is provided as Appendix B.

4.2. Quality Control for Taxonomy

All QC activities, including specification and response to corrective actions, should be completed *prior* to initiation of data reduction (metric calculation and indicator analysis). The relevant aspects to taxonomic data quality: accuracy, and precision (Stribling et al. 2003).

4.2.1. Accuracy

Accuracy is defined as the nearness of a measurement to a specified analytical truth. For taxonomy, there are several options that can be used as the analytical truth, including:

- 1) Museum-based type material (holotype, paratype, or other; the original specimen or series of specimens on which the original description of a species is based),
- 2) The most current and accepted taxonomic literature (dichotomous keys with illustrated, diagnostic morphological characters), or
- 3) A reference collection, verified by an independent taxonomic specialist.

Type material is usually found in museums, and direct interaction with museum curators is required to use it for comparisons. Thus, it is often not feasible, or even necessary, for routine monitoring and assessment programs or projects (Stribling et al. 2003). Contractors must provide at least one reference collection per year that can be verified by a qualified, independent macroinvertebrate taxonomist. Depending on the magnitude of an individual project, a project-specific reference collection may be requested by DEQ; what the reference collection is intended to represent will be determined by DEQ. Whether the reference collection is annual or project-based, specimens included in it are intended to represent the original taxonomist's concept of the morphological basis of each taxon. Verification of the reference collection, by DEQ staff or independent laboratories or taxonomists, documents the morphological and nomenclatural understanding of the original taxonomist. This will provide DEQ with some assurance of the contract taxonomist's use of up-to-date nomenclature (with the Integrated Taxonomic Information System [ITIS] as the standard), as well as verifying their understanding of the morphological bases of taxonomic groupings.

4.2.2. Precision

Precision is defined as nearness of different measures of the same property. Simply stated, it is a measure of consistency and repeatability; for production taxonomy (Stribling et al. 2003), quantification of taxonomic precision provides the ability to document and communicate the quality of taxonomic data within a project, or within a laboratory over time. Taxonomic precision is evaluated by direct comparison of the results (list of taxa and number of individual of each) of a randomly-selected sample that is processed by 2 taxonomists or laboratories. Once a sample is identified by the primary taxonomist (T1), it is sent to an outside, independent taxonomist (T2), who re-identifies the entire (sub)sample. The sample should be sent to T2 blind, that is, without any identification labels associated with vials or slides. Each taxonomist will be provided with a hierarchical target list (standard level of effort for each taxon) and "counting rules" (need to be included as attachments). The total set of randomly-selected subsamples is a subset of the total number of samples collected for:

- o A single project,
- o Multiple projects within a sampling year, or
- o ≥ 1 projects over several sampling years.

If multiple taxonomists within a project or laboratory have each identified enough samples, the subset can be stratified among the taxonomists so that specific checks can be made on individual taxonomists. Generally, and as a rule-of-thumb, the subset of samples can be approximately 10% of the total sample lot. For example, if a project has a total of 30 samples, there should be 3 samples randomly selected that will be re-identified by an outside/independent taxonomist. It is recommended that there be at least 3 samples selected and re-identified for sample lots of ≤ 30 . For large programs or projects, say > 500 samples, it may be unnecessary to have 50 samples re-identified, but that decision will be made by DEQ.

Using the final results by the taxonomists, precision is quantified for both specimen enumeration and taxonomic identifications for each of the QC or re-id samples.

4.2.2.1. Percent Taxonomic Disagreement (PTD)

Use the formula below for determining Percent Taxonomic Disagreement (PTD):

$$PTD = \left[1 - \left(\frac{comp_{pos}}{N} \right) \right] \times 100$$

where $comp_{pos}$ is the number of agreements, and N is the total number of organisms in the larger of the two counts (Stribling et al. 2003).

Three types of taxonomic errors are illuminated by this comparison process: 1) straight disagreements, 2) hierarchical differences, and 3) missing specimens. Effort will be made during the side by side comparison of individual samples to specify the types of differences that are observed, and which types predominate in each sample. The lower the PTD value, the greater is the overall taxonomic precision, indicating relative consistency in sample treatment. For the 2006 field season and beyond, an MQO for PTD $\leq 15\%$ is established. Values for individual sample comparisons exceeding the MQO ($> 15\%$) will prompt more detailed examination of those individual samples to determine the cause or causes of the difference in counts. PTD results as well as parsing of the difference types will be used by DEQ to develop corrective actions. Corrective actions related to taxonomic disagreement will be forwarded in writing to the taxonomy laboratory responsible for the primary identifications. The corrective actions will include requirements to be implemented and whether these apply to the entire sample lot, or only the 10% subset that were the QC samples.

4.2.2.2. Bias

Bias is defined as statistical or method error caused by systematically favoring some outcomes over others and can be characterized as the degree of departure from a true value. Taxonomic bias exists if there are consistent misinterpretations of dichotomous keys or morphological features, poor processing of samples (e.g., poor slide-mounting techniques), or inadequate optical equipment. There is no specific MQO established for bias but it may be a factor in the review of accuracy, which is described as low bias (directional error) and high precision.

4.2.3. Corrections to database

Any corrections to DEQ databases will be handled by the DEQ QA Officer, who will work directly with the DEQ STORET Coordinator and the DEQ macroinvertebrate specialist, who are responsible for the STORET and EDAS databases, respectively.

5. Data Analysis and Interpretation

Data analysis and assessment of biological integrity should be performed following the six steps listed here and described in sections 5.1 – 5.6.

1. Transfer sample data from laboratory output to a reliable database
2. Reduce sample data
 - a. Condense to proper OTUs
 - b. exclude taxa marked
 - c. artificially reduce large samples
3. Compile site information (predictor variables) and identify site classes
4. Calculate a Multi-Metric Index (MMI)
5. Calculate a River Invertebrate Prediction and Classification System (RIVPACS) Model
6. Assess site biological integrity through interpretation of index results

Most of these steps are considerably simplified by using EDAS (Tetra Tech 2006a), which can be obtained from DEQ along with its User's Manual (Tetra Tech 2006b). Compiling site information (step 3), calculating the RIVPACS model (step 5), and the final site assessment (step 6) are accomplished using other technologies and procedures.

5.1. Transfer sample data

Benthic macroinvertebrate taxa lists with individual counts should be transferred into EDAS (Tetra Tech 2006a) or another database in which taxa can be associated with the taxonomic attributes used in calculating metrics and predictive models. EDAS includes a function that automates import of taxonomic data after the data are properly formatted in a spreadsheet. With any data transfer procedure, the accuracy of the transfer should be checked to assure 100% accuracy.

5.2. Reduce sample data

5.2.1. OTUs

For each taxon in a sample taxa list, the OTU must be determined. OTUs are identified in the Benthic Master Taxa table of EDAS. This is the level of identification at which taxonomic counts are condensed for calculations, for both MMI (multimetric) and RIVPACS (predictive model) calculations¹. For instance, midges (Diptera: Chironomidae) have OTUs at the subfamily level because this is the level at which all agencies in Montana reliably identify them. Numbers of individuals in multiple taxa identified at a more detailed level are summed within a sample if the OTU is at a more coarse level. OTUs for metric calculations include family and order level identifications. OTUs for predictive models exclude family and more coarse identifications for some taxa groups.

5.2.2. Excluded Taxa

In calculations of metrics that are counts of taxa (richness metrics), only those taxa that are unique within each sample should be counted. Ambiguous taxa are excluded from taxa counts. Such taxa include family level identifications within a sample that also includes genus level identifications from the same family. Likewise, order or coarser identifications may be ambiguously unique and should be excluded. Such exclusions should be made after converting taxa and individual counts at the

¹ Note: OTUs are not considered taxonomic target levels. Future DEQ macroinvertebrate tools may require different taxonomic requirements. Therefore, macroinvertebrate taxonomy should include identifications at the lowest practical taxonomic level, as stated in Section 4.1.

appropriate OTU level. In EDAS, 'Excluded Taxa' are automatically marked as they are imported. Excluded taxa can also be marked manually. Within each sample, every OTU taxon that defines a group that is also represented by another OTU taxon identified at a more detailed taxonomic level should be marked for exclusion from metrics that count unique taxa.

5.2.3. Rarefaction

Rarefaction is the process by which taxa counts are reduced to account for sample sizes that are larger than the subsample target. This applies only to richness metric calculations after the taxa list is condensed to the appropriate OTU level. The computations described by Hurlbert (1971) are reproduced in all EDAS richness metrics to estimate the expected number of taxa in a random sample of the target subsample size (300 individuals). The rarefaction formula calculates the sum of the probabilities that each taxon will be included in the sample. Richness metrics therefore result in fractional taxa counts. Metric scoring in EDAS is based on the rarefacted counts, though bioassessment reports show taxa counts rounded to the nearest whole number. Samples with 300 or fewer individuals do not require rarefaction. Rarefaction can be calculated outside of EDAS by replicating the function as detailed in Appendix C.

5.2.4. Re-Sampling

Random re-sampling is the process by which samples larger than the target subsample size are reduced to the exact target subsample size. Random re-sampling generates a list of taxa and their abundances that would occur if the original sample had identified only the target number of individuals. Such a list is necessary for the predictive model, in which presence and absence of taxa for a standard sample size is required. It contrasts from rarefaction, which gives a probability for every taxon, but does not reduce the list of individuals or taxa.

In EDAS, random re-sampling is accomplished by assigning a random number to each individual in an oversized sample, ordering the list by the random numbers, and selecting the top 300 individuals to represent the new sample. By this method, some individuals and perhaps some uncommon taxa are eliminated from the list. Because it uses random number generators in determining the final list of taxa, random re-sampling can result in different taxa lists every time it is executed.

5.3. Identify site classes

5.3.1. Predictor Variables

Site classes are explicit and distinct in the MMI. Site classes for the predictive model (RIVPACS) are not distinct, but are calculated as probabilities within the model. Both indices require predictor variables for site classification (Table 5-1). These variables can be derived by associating geographically referenced data with the coordinates and delineated watersheds of each site. While it is possible to derive predictor values through map analysis, watershed delineation and spatial analyses are best performed with a Geographic Information System (GIS), such as ArcGIS 9.x. The GIS analysis is outlined in Chinnayakanahalli et al. (2006). The basic analytical procedures include tabulation of Station IDs with waterbody names and decimal coordinates, loading the spatially referenced stations into the GIS program, verifying station locations and delineating catchments, loading the data layers into the GIS program, and intersecting station points and catchments with the predictor data layers.

Table 5-1. Predictive variables associated with each sampling station.

Variable (EDAS name)	Description	Model^a	Data Source
Latitude (GIS_LAT)	Latitude (decimal), confirmed during delineation	RIVPACS	GIS or map
Longitude (GIS_LONG)	Longitude (decimal), confirmed during delineation	RIVPACS	GIS or map
Area (SQ_KM)	Catchment area (km ²)	RIVPACS	GIS or map
Basin (CRB)	Within the Columbia River Basin (1 = yes, 0 = no)	RIVPACS	GIS or map
Air Temperature (TMAX_PT)	Annual mean of daily maximum temperatures at the site (C x 10, e.g., 14.4C = 144)	MMI, RIVPACS	PRISM database ^b
Ecoregion (L3_1_ECO)	Dominant Level 3 ecoregion within catchment (ecoregion number)	MMI	GIS ^c or map
Elevation (ELEV)	Elevation at the site (meters)	MMI	GIS ^d or map
Precipitation (PRCP_PT)	Annual precipitation at the site (mm)	MMI	PRISM database ^b

^aModel in which the predictive variable is required to determine site class

^bPRISM: Parameter-elevation Regressions on Independent Slopes Model (Daly et al. 2004), URL: <http://www.ocs.orst.edu/prism/>

^cEcoregion: (U.S. EPA 2002), URL: http://nris.mt.gov/nsdi/nris/ecoreg_2002.html

^dElevation: URL: <http://nris.mt.gov/nsdi/nris/ned.html>

5.3.2. Determine Site Class

For the MMI, three site classes have been identified in Montana (Jessup et al. 2006). Each site class represents a distinct type of site in which biological expectations are somewhat different than expectations in other site classes. The site class for the MMI is determined using the following predictive variables: dominant ecoregion in the catchment, elevation, precipitation, and mean annual daily maximum temperature, according to criteria listed in Table 5-2. When predictor variables are automatically uploaded to EDAS, the site class is appended to the EDAS Stations table (see details in the EDAS User's Manual, Tetra Tech 2006b).

Table 5-2. Site class criteria in Montana for application in the MMI.

Site Class	Description
Mountains	In the catchment of the site, the dominant level III ecoregions are the Northern Rockies, the Idaho Batholith, the Middle Rockies, or the Canadian Rockies, excluding those sites in the Middle Rockies that meet all the criteria for Low Valleys. The ecoregions (15, 16, 17, and 41) are generally mountainous.
Low Valleys	In the catchment of the site, the dominant level III ecoregion is the Middle Rockies (ecoregion 17), the site elevation is lower than 1700 m, the site receives less than 700 mm precipitation per year, and the site has an annual mean of daily maximum air temperatures greater than 11.0 C
Plains	In the catchment of the site, the dominant level III ecoregion is the Northwestern Glaciated Plains or the Northwestern Great Plains (ecoregions 42 and 43).

For the RIVPACS model, site classes are not distinct, but are continuous – meaning that sites have probabilities of belonging to all site classes. Groupings of the cluster analysis are analogous to the MMI site classes. Of the five groups, three are primarily in the Columbia River Basin, have lower temperatures, and have smaller catchment areas (Jessup et al. 2006). The probabilities of site group membership are part of the RIVPACS model and are not explicitly determined. Instead, the predictor variables are uploaded to the website (see section 5.5) and are used in the model to estimate the expected taxa for each site.

5.4. Calculate the MMI

The Multi-Metric Index (MMI) is calculated as an average of metric scores calibrated within each site class (Jessup et al. 2006). Component metrics and scores for each site class are shown in Table 5-3. Metric descriptions provide calculation details and rationale for using these metrics in the MMI (Chapter 7). Metrics must be calculated from taxa lists that are reduced as described in Section 5.2. This reduction includes condensing the taxa lists to the appropriate OTU, rarefying taxa counts, and associating taxa attributes as provided in the EDAS 'Benthics Master Taxa' table and Appendix A. To calculate the MMI for a sample, first calculate scores for metrics using the formulas in Table 5-3 for the appropriate site class. If any scores are outside of the 0 to 100 scoring range, reset them to the nearest extreme of the range. Then average the metric scores to arrive at the MMI, a value between 0 and 100. Metric scores and the MMI can be generated using EDAS. For further details, refer to the EDAS User's Manual (Tetra Tech 2006b).

Table 5-3. Index metrics and scores, by site class

Site Class and Metrics	Scoring Formula
Mountains	
Ephemeroptera taxa (rarefacted to 300)	$100 * \text{MetricValue} / 10$
Plecoptera taxa (rarefacted to 300)	$100 * \text{MetricValue} / 7$
% EPT	$100 * \text{MetricValue} / 90$
% non-insects	$100 * (28 - \text{MetricValue}) / 28$
% predators	$100 * \text{MetricValue} / 39$
Burrower % taxa	$100 * (83 - \text{MetricValue}) / 71$
HBI	$100 * (7.5 - \text{MetricValue}) / 6$
Low Valleys	
% EPT excluding Hydropsychids and Baetids	$100 * \text{MetricValue} / 71$
% Midge	$100 * \text{MetricValue} / 40$
% Crustacea & Mollusca	$100 * (20 - \text{MetricValue}) / 20$
Shredder taxa (rarefacted to 300)	$100 * (7 - \text{MetricValue}) / 7$
% predator	$100 * \text{MetricValue} / 33$
Plains MMI	
EPT Taxa (rarefacted to 300)	$100 * \text{MetricValue} / 14$
% Tanypodinae	$100 * \text{MetricValue} / 10$
% Orthocladiinae of Chironomidae	$100 * (100 - \text{MetricValue}) / 100$
Predator taxa (rarefacted to 300)	$100 * \text{MetricValue} / 9$
% Filterers and Collectors	$100 * (100 - \text{MetricValue}) / 65$

5.5. Calculate RIVPACS

The RIVPACS model is calculated as the ratio of the number of taxa observed (O) in the collected sample to the number expected (E) in that site type (Jessup et al. 2006). The O/E ratio is calculated

from sample taxa lists and predictive variables that are uploaded to a website that runs the model. The website is maintained by the Utah State University's (USU) Western Center for Monitoring and Assessment of Freshwater Ecosystems (<http://www.cnr.usu.edu/wmc/>). Details for generating uploadable files from EDAS and running the model are available in the EDAS User's Manual (Tetra Tech 2006b) and on the website. An explanation of the theory and processes of the model is included in Jessup et al. (2006).

5.6. Validating Model Outputs

Output from EDAS and the USU website provide index values and information to determine the validity of the values (see Appendix D). Validity is dependent on having a minimum sample size after data reduction and, for the RIVPACS, on model recognition of the combination of predictor variables. The minimum sample size below which index results may be distorted is 200 organisms, or two-thirds of the 300 organism target subsample size. Sample sizes for the MMI and the RIVPACS may be different for the same sample because the RIVPACS discounts some coarse taxa identifications (see section 5.2). To determine whether the RIVPACS could recognize the combination of predictor variables, refer to the website results labeled 'Model Test'. A failed model test indicates a site that is outside of the experience of the model and a RIVPACS value that is unreliable. The MMI should also be viewed critically in sites that fail the Model Test because the type of site was not present in the data used to calibrate either model.

5.7. Interpret the Indices

The interpretation of benthic macroinvertebrate data is a component within a broader Water Quality Assessment Method (SOP WQPBWQM-001). Depending on the availability and rigor of other biological data, benthic macroinvertebrate data *may, or may not*, be used exclusively for aquatic life and fisheries beneficial use support determinations. With this in mind, this section of the SOP uses the terms impaired, unimpaired, and full, partial, and non-support in the context of the benthic macroinvertebrate assemblage.

The MMI and RIVPACS models are used in conjunction to determine the integrity of the macroinvertebrate community.

- ❑ For the RIVPACS, O/E values between 0.8 and 1.2 (inclusive) indicate an unimpaired macroinvertebrate sample.

When both indices give results in agreement, the designation is a straightforward statement of impaired or unimpaired biological integrity (Table 5-4).

Table 5-4. Bioassessment impairment thresholds based on RIVPACS and MMI results.

Ecoregion	RIVPACS	MMI	Impairment Determination
Mountain	≥ 0.8	≥ 63	Unimpaired
	< 0.8	< 63	Impaired
Low Valley	≥ 0.8	≥ 48	Unimpaired
	< 0.8	< 48	Impaired
Eastern Plains	≥ 0.8	≥ 37	Unimpaired
	< 0.8	< 37	Impaired

5.7.1. Reconciling Differences in MMI and RIVPACS Results

If the MMI and RIVPACS give contradictory indications, the impairment decision involves considerations of the validity of model results and degrees of impairment suggested by the indices. For these more complex determinations use the following guidelines (Feldman 2006):

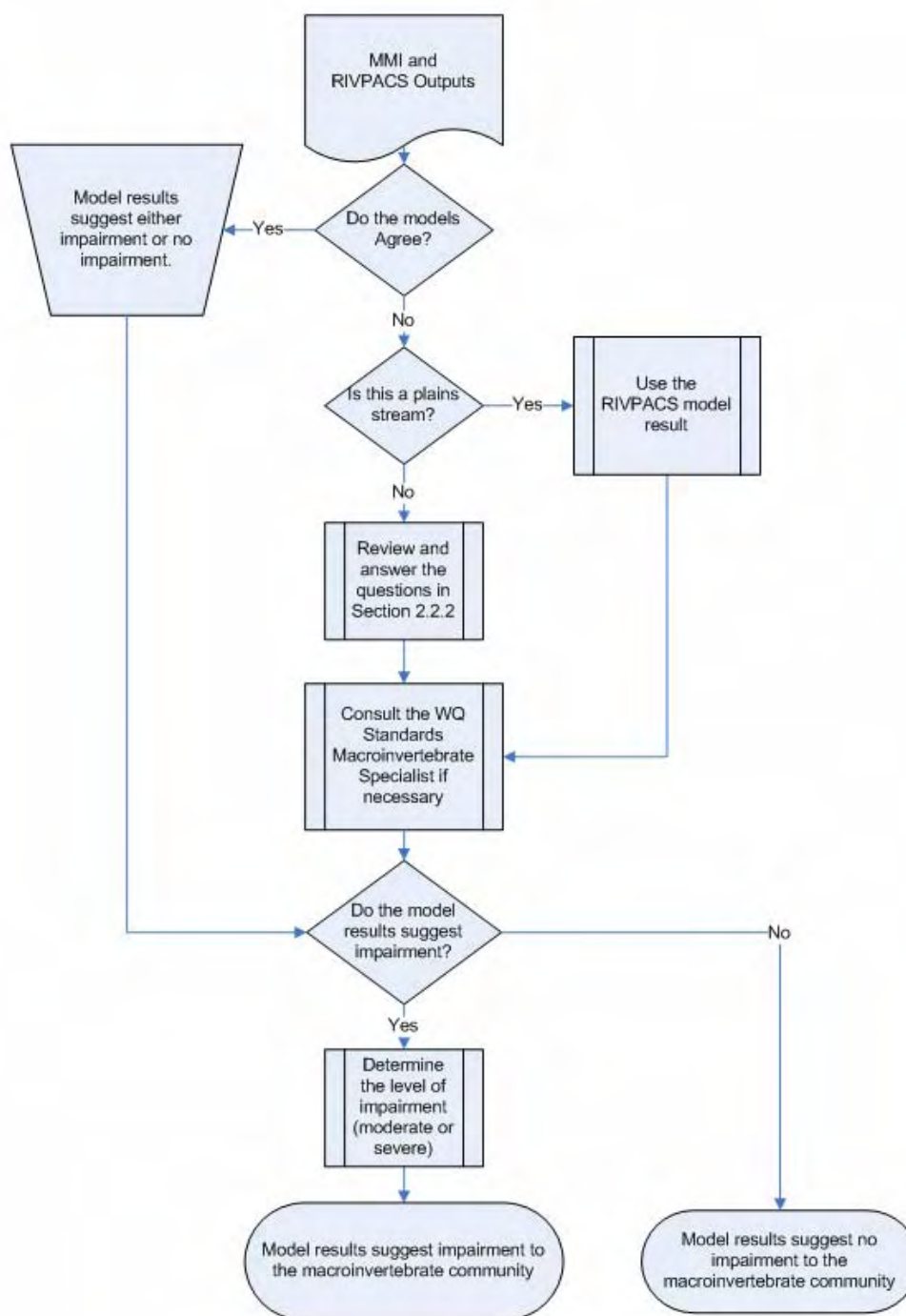
1 - If an index is based on a small sample (less than 200 organisms) the results should be down-weighted. With small sample sizes, the RIVPACS score is usually low and the MMI is unpredictable. Small sample size may be related to instream impairment or to the stream's physical characteristics which make it difficult to sample a sufficient number of macroinvertebrates. Because the models treat taxa and individuals differently, it is possible to have one sample based on a small number of individuals and the other based on a sufficient sample size. In this case, rely on indications from the index that has a larger sample.

2 - Is the site beyond the experience of the model? Samples from sites essentially different than any that were used in model calibration may yield unreliable index results. It is possible to place a site into one of the three MMI site classes, though it may not be appropriate to do so. For example, sites from the Missouri River may not be assessable because data from large rivers were not used to develop either model. RIVPACS results include a "Model Test" that qualifies the site as having a recognizable combination of site characteristics (Pass) or not (Fail). If the site is outside the experience of the model, the assessor may decide not to use the results from either model.

3 - If the two indices appear to be valid by the sample size and model test criteria, the degree of impairment (or non-impairment) in both models should be considered. If one model score is close to the impairment threshold while the other score is well within the impaired or unimpaired range, the indication of the extreme score should have greater weight. For example, if the MMI score for a mountain site is near but slightly above the threshold (at about 64) and the RIVPACS score shows severe impairment (at 0.3), then the site is impaired. Remember that the best O/E scores are near 1.0. Extremely high O/E scores (greater than 1.2) do not indicate extremely good biotic conditions and may in fact indicate impairment.

A flow diagram describes the decision points for a biological sample (Figure 5-1). If you still require assistance comparing the model results after reviewing these guidelines, consult with the Macroinvertebrate Specialist of the WQ Standards Staff.

Figure 5-1. Flowchart depicting the decision process for applying the Montana DEQ macroinvertebrate models.



5.8. Determine degrees of Impairment

Montana's Water Quality Assessment Method (WQPBWQM-001) was originally designed to consider degrees of impairment using a weight-of-evidence, independent evidence, or overwhelming evidence test; depending on the number of biological assemblages available and their status compared to reference conditions. The interpretation of results produced by the MMI and RIVPACS models follow with this design by allowing an assessor to determine the degree of impairment (i.e., moderate or severe) once an impairment decision is made for the sample.

Any MMI or RIVPACS score below the 25th percentile of *degraded sites* is severely impaired. Model scores between this severely impaired threshold and the impairment threshold is moderately impaired. Table 5-5 lists the range of model scores for both degrees of impairment.

Table 5-5. Moderate and severe impairment levels.

MMI	Moderate Impairment	Severe Impairment
Mountain	62 - 29	<29
Low Valley	47 - 38	<38
Plains	36 - 28	<28
RIVPACS	0.79 - 0.44	<0.44

6. Reporting Results

Reports written for the DEQ following the methods described herein require:

- The EDAS output and a concise one paragraph ecological interpretation. The ecological interpretation includes a description of the invertebrates found in the sample and what their presence represents in terms of water quality.
- Taxonomic lists of macroinvertebrates, including tolerance values and functional feeding group designations used for each taxon. Taxa lists should include class, order, family, genus, and species designations where possible. Taxa lists should follow the taxonomic classification scheme shown in *Appendix A* to facilitate DEQ quality assurance activities.
- Copies of taxonomic bench sheets should be included (Taxa List Template example provided in *Appendix B*.)
- Number pages on all reports, including appendices.
- A clear and concise summary of findings and conclusions.
- Clearly document the dates samples were collected in any written report.
- If an internal reference is developed for the analysis, describe the internal reference used.
- Clear documentation of the proportion of sample subsampled.
- Submit data both in hard copy and in electronic form (STORET Compatible).
- If any further analysis is needed that the metric suites cannot analyze, contact David Feldman; Water Quality Standards Section; Montana Department of Environmental Quality, PO Box 200901, Helena MT 59620- 0901 (406)-444-6764 or his replacement.

7. Glossary of Metrics

The following metric descriptions provide details for calculation and interpretation of the metrics in the MMI for each site class. Metric categories include richness, composition, functional, habit, and tolerance. References indicate literature in which the ecological rationale for using the metric is explained or its value as an indicator is demonstrated.

Ephemeroptera taxa

Description: Number of distinct mayfly taxa, usually genus or species level, rarefacted to 300
Site Class: Mountains *Metric Category:* Richness Decreaser
References: Barbour et al. 1999

Plecoptera taxa

Description: Number of distinct stonefly taxa, usually family or genus level, rarefacted to 300
Site Class: Mountains *Metric Category:* Richness Decreaser
References: Barbour et al. 1999

% EPT

Description: Percent of the individuals in the sample that are mayflies, stoneflies, and caddisflies
Site Class: Mountains *Metric Category:* Composition Decreaser
References: Barbour et al. 1999

% non-insects

Description: Percent of the individuals in the sample that are not insects
Site Class: Mountains *Metric Category:* Composition Increaser
References: Jessup and Stribling 2002

Burrower % taxa

Description: Percent of the taxa in the sample that burrow in soft sediments
Site Class: Mountains *Metric Category:* Habit Increaser
References: U.S. EPA 2006

HBI

Description: This metric represents the relative sensitivity of the sample to nutrient perturbation. It is calculated as the average tolerance value of all individuals in the sample (excluding those without tolerance values). The range of the Biotic Index values is 0-10, 0 being sensitive and 10 being pollution tolerant.

$$\text{Biotic Index} = \sum (n_i \times a_i) / N$$

Where:

"n" is the number of individuals in a taxon, "i";

"a" is the index value assigned to that taxon;

N is the number of individuals in the sample with a Biotic Index value.

Site Class: Mountains *Metric Category:* Tolerance Increaser
References: Hilsenhoff 1987, Barbour et al. 1992, Hayslip 1993, Kerans and Karr 1994

% EPT excluding hydropsychids and baetids

Description: Percent of the individuals in the sample that are mayfly, stonefly, and caddisfly larvae and pupae, excluding the relatively tolerant families Hydropsychidae (caddisfly) and Baetidae (mayfly).

Site Class: Low Valleys *Metric Category:* Composition Decreaser

References: Jessup and Stribling 2002

% Chironomidae

Description: Percent of the individuals in the sample that are midges (Diptera: Chironomidae) (note: This metric commonly increases with increasing stress, but here it decreases with increasing stress)

Site Class: Low Valleys *Metric Category:* Composition Decreaser

References: No literature citation was identified for this metric. This metric was selected based on the strength of evidence within the Montana data set.

% Crustacea & Mollusca

Description: Percent of the individuals in the sample that are Crustacea or Mollusca

Site Class: Low Valleys *Metric Category:* Composition Increaser

References: Jessup et al. 2005

Shredder Taxa

Description: Number of distinct taxa that shred coarse organic material for food (rarefacted to 300)

Site Class: Low Valleys *Metric Category:* Functional Increaser

References: U.S. EPA 2006

% Predator

Description: Percent of the individuals in the sample that prey on living food items

Site Class: Mountains & Low Valleys Decreaser

Metric Category: Functional

References: Kerans and Karr 1994

EPT Taxa

Description: Number of distinct taxa in the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (rarefacted to 300)

Site Class: Plains *Metric Category:* Richness Decreaser

References: Barbour et al. 1999

Percent Tanypodinae

Description: Percent of the individuals in the sample that are in the subfamily Tanypodinae (Diptera: Chironomidae)

Site Class: Plains *Metric Category:* Composition Decreaser

References: No literature citation was identified for this metric. This metric was selected based on the strength of evidence within the Montana data set.

Percent Orthocladiinae of Chironomidae

Description: Percent of the midge individuals in the sample that are in the subfamily Orthocladiinae

Site Class: Plains *Metric Category:* Composition Increaser

References: No literature citation was identified for this metric. This metric was selected based on the strength of evidence within the Montana data set.

Predator Taxa

Description: Number of distinct taxa that prey on living food items (rarefacted to 300)

Site Class: Plains *Metric Category:* Functional Decreaser

References: No literature citation was identified for this metric. This metric was selected based on the strength of evidence within the Montana data set.

Percent Filterers and Collectors

Description: Percent of the individuals in the sample that collect or filter their food from detritus or the water column

Site Class: Plains *Metric Category:* Functional Increaser

References: Kerans and Karr 1994

8. Literature Cited

APHA 1998, Standard Methods for the Examination of Water and Wastewater, 20th Ed., Method 1020 B

Barbour, M.T., J.L. Plafkin, B.P. Bradley, C.G. Graves, and R.W. Wisseman. 1992. Evaluation of EPA's rapid bioassessment benthic metrics: Metric redundancy and variability among reference stream sites. *Environmental Toxicology and Chemistry* 11(4):437-449.

Barbour, M.T., and J. Gerritsen. 1996. Subsampling of benthic samples: A defense of the fixed-count method. *Journal of the North American Benthological Society* 15:386-392.

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. 2nd edition. U.S. Environmental Protection Agency, EPA 841-B-99-002.

Chinnayakanahalli, K., R. Hill, J. Olson, C. Kroeber, D.G. Tarboton, and C. Hawkins. 2006. The Multi-Watershed Delineation Tool: GIS Software in Support of Regional Watershed Analyses (User's Manual). Utah State University.

Feldman, D. 2006. A Report to the DEQ Water Quality Planning Bureau on the Proper Interpretation of Two Recently Developed Macroinvertebrate Bioassessment Models. Prepared for the Montana Department of Environmental Quality, Helena, MT.

Daly, C., Gibson, W.P., M. Doggett, J. Smith, and G. Taylor. 2004. Up-to-date monthly climate maps for the conterminous United States. *Proc., 14th AMS Conf. on Applied Climatology, 84th AMS Annual Meeting Combined Preprints*, Amer. Meteorological Soc., Seattle, WA, January 13-16, 2004, Paper P5.1, CD-ROM.

Hayslip, G.A. 1993. EPA Region 10 in-stream biological monitoring handbook (for wadable streams in the Pacific Northwest). U. S. Environmental Protection Agency-Region 10, Environmental Services Division, Seattle, Washington. EPA-910-9-92-013.

Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. *Great Lakes Entomologist* 20: 31-39.

Hurlbert SH. 1971. The nonconcept of species diversity: a critique and alternative parameters. *Ecology* 52: 577-586.

Jessup, B.K., S. Moegenburg, D. Bryson, and V. Poretti. 2005. Development of the New Jersey Pinelands Macroinvertebrate Index (PMI). Prepared for U.S. EPA Office of Water, Washington, DC.

Jessup, B.K., C. Hawkins, and J.B. Stribling. 2006 (DRAFT). Biological Indicators of Stream Condition in Montana Using Benthic Macroinvertebrates. June 2006. Prepared for Montana Department of Environmental Quality, Helena, MT.

Jessup, B. K., and J. B. Stribling. 2002. Further Evaluation of the Wyoming Stream Integrity Index, Considering Quantitative and Qualitative Reference Site Criteria. Prepared for U.S. EPA Region 8, Denver, CO.

Kerans, B.L. and J.R. Karr. 1994. A benthic index of biotic integrity (B-IBI) for rivers of the Tennessee Valley. *Ecological Applications* 4:768-785.

Lazorchak JM, Hill BH, Averill DK, Peck DV, Klemm DJ, editors. 2000. Environmental Monitoring and Assessment Program-Surface Waters: Field operations and methods for measuring the ecological condition of non-wadeable rivers and streams. Cincinnati (OH): U.S. Environmental Protection Agency. Report nr EPA/620/R-00/007. 204 p.

Richards, D.C. 1996. The Use of Aquatic Macroinvertebrates as Water Quality Indicators in Mountain Streams of Montana. M.S. thesis. Montana State University, Bozeman. 166 pp.

Stribling, J. B., S. R. Moulton II, and G. T. Lester. 2003. Determining the quality of taxonomic data. *Journal of the North American Benthological Society* 22(4): 621-631.

Tetra Tech. 2006a. EDAS v3.3.2k for Montana. Microsoft Access Application. Available through DEQ Water Quality Planning Bureau, Helena, MT.

Tetra Tech. 2006b. EDAS User's Manual for Montana. Available through DEQ Water Quality Planning Bureau, Helena, MT.

U.S. EPA. 2002. Level III and IV Ecoregions of Montana - Draft Second Edition. Corvallis, OR

U.S. EPA. 2006. Draft Wadeable Streams Assessment: A Collaborative Survey of the Nation's Streams. Office of Water, Washington, DC. EPA 841-B-06-002.

U.S. EPA. 2000. Guidance for the Data Quality Objectives Process. EPA QA/G-4 Office of Environmental Information. Washington D.C. EPA/600/R-96/055

Phyla	Class	Order	Family	FinalID	MMI_OTU	RIVPACS_OTU	TolVal	FFG	Habit
Annelida	Annelida	Annelida	Annelida	Annelida	Annelida			unk	unk
Annelida	Hirudinea	.	.	Hirudinea	Hirudinea		9	PR	
Annelida	Hirudinea	Arhynchobdellida	Erpobdellidae	Erpobdella	Erpobdellidae	Erpobdellidae		PR	SW
Annelida	Hirudinea	Arhynchobdellida	Erpobdellidae	Erpobdellidae	Erpobdellidae	Erpobdellidae	8	PR	SW
Annelida	Hirudinea	Arhynchobdellida	Erpobdellidae	Mooreobdella	Erpobdellidae	Erpobdellidae	10	unk	SW
Annelida	Hirudinea	Arhynchobdellida	Erpobdellidae	Mooreobdella melanostoma	Erpobdellidae	Erpobdellidae			
Annelida	Hirudinea	Arhynchobdellida	Erpobdellidae	Nepheleopsis	Erpobdellidae	Erpobdellidae		unk	SW
Annelida	Hirudinea	Branchiobdellida	.	Branchiobdellida	Branchiobdellida	Branchiobdellida		CG	SW
Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae	Glossiphonia	Glossiphoniidae	Glossiphoniidae		PR	SW
Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae	Glossiphonia complanata	Glossiphoniidae	Glossiphoniidae	9	PR	SW
Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae	Glossiphoniidae	Glossiphoniidae	Glossiphoniidae	9	PR	SW
Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae	Helobdella	Glossiphoniidae	Glossiphoniidae	10	PR	SW
Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae	Helobdella stagnalis	Glossiphoniidae	Glossiphoniidae	10	PR	SW
Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae	Glossiphonia	Glossiphoniidae	Glossiphoniidae		PR	SW
Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae	Theromyzon	Glossiphoniidae	Glossiphoniidae		PR	SW
Annelida	Hirudinea	Rhynchobdellida	Piscicolidae	Piscicolidae	Piscicolidae	Piscicolidae		PR	unk
Annelida	Oligochaeta	.	.	Oligochaeta	Oligochaeta	Oligochaeta	8	CG	BU
Annelida	Oligochaeta	Haplotaxida	Enchytraeidae	Enchytraeidae	Oligochaeta	Other_Oligochaeta	4	CG	BU
Annelida	Oligochaeta	Haplotaxida	Haplotaxidae	Haplotaxidae	Oligochaeta	Other_Oligochaeta		CG	BU
Annelida	Oligochaeta	Haplotaxida	Haplotaxidae	Haplotaxis	Oligochaeta	Other_Oligochaeta		CG	BU
Annelida	Oligochaeta	Haplotaxida	Lumbricidae	Lumbricidae	Oligochaeta	Other_Oligochaeta	4	CG	BU
Annelida	Oligochaeta	Haplotaxida	Lumbricidae	Lumbricina	Oligochaeta	Other_Oligochaeta	4	CG	BU
Annelida	Oligochaeta	Haplotaxida	Naididae	Chaetogaster	Oligochaeta	Other_Oligochaeta		CG	BU
Annelida	Oligochaeta	Haplotaxida	Naididae	Chaetogaster diaphanus	Oligochaeta	Other_Oligochaeta	6	CG	BU
Annelida	Oligochaeta	Haplotaxida	Naididae	Chaetogaster limnai	Oligochaeta	Other_Oligochaeta	6	CG	BU
Annelida	Oligochaeta	Haplotaxida	Naididae	Dero digitata	Oligochaeta	Other_Oligochaeta		CG	BU
Annelida	Oligochaeta	Haplotaxida	Naididae	Naididae	Oligochaeta	Other_Oligochaeta	8	CG	BU
Annelida	Oligochaeta	Haplotaxida	Naididae	Nais	Oligochaeta	Other_Oligochaeta	9	CG	BU
Annelida	Oligochaeta	Haplotaxida	Naididae	Nais behningi	Oligochaeta	Other_Oligochaeta	8	CG	BU
Annelida	Oligochaeta	Haplotaxida	Naididae	Nais bretscheri	Oligochaeta	Other_Oligochaeta		CG	BU
Annelida	Oligochaeta	Haplotaxida	Naididae	Nais simplex	Oligochaeta	Other_Oligochaeta		CG	BU
Annelida	Oligochaeta	Haplotaxida	Naididae	Nais variabilis	Oligochaeta	Other_Oligochaeta	10	CG	BU
Annelida	Oligochaeta	Haplotaxida	Naididae	Ophidonais	Oligochaeta	Other_Oligochaeta	6	CG	BU
Annelida	Oligochaeta	Haplotaxida	Naididae	Ophidonais serpentina	Oligochaeta	Other_Oligochaeta	6	CG	BU
Annelida	Oligochaeta	Haplotaxida	Naididae	Pristina	Oligochaeta	Other_Oligochaeta	10	CG	BU
Annelida	Oligochaeta	Haplotaxida	Tubificidae	Aulodrilus	Oligochaeta	Other_Oligochaeta	10	CG	BU
Annelida	Oligochaeta	Haplotaxida	Tubificidae	Limnodrilus	Oligochaeta	Other_Oligochaeta	10	CG	BU
Annelida	Oligochaeta	Haplotaxida	Tubificidae	Limnodrilus hoffmeisteri	Oligochaeta	Other_Oligochaeta	10	CG	BU
Annelida	Oligochaeta	Haplotaxida	Tubificidae	Quistadrilus multisetosus	Oligochaeta	Other_Oligochaeta		CG	BU
Annelida	Oligochaeta	Haplotaxida	Tubificidae	Rhyacodrilus	Oligochaeta	Other_Oligochaeta		CG	BU
Annelida	Oligochaeta	Haplotaxida	Tubificidae	Tubifex	Oligochaeta	Other_Oligochaeta		CG	BU
Annelida	Oligochaeta	Haplotaxida	Tubificidae	Tubifex tubifex	Oligochaeta	Other_Oligochaeta	10	CG	BU
Annelida	Oligochaeta	Haplotaxida	Tubificidae	Tubificidae	Oligochaeta	Other_Oligochaeta	10	CG	BU
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	Eclidrilus	Oligochaeta	Other_Oligochaeta	4	CG	BU
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	Lumbriculidae	Oligochaeta	Other_Oligochaeta	4	CG	BU
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	Lumbriculus	Oligochaeta	Other_Oligochaeta		CG	BU
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	Rhynchelmis	Oligochaeta	Other_Oligochaeta		CG	BU
Arthropoda	Arachnida	Acarina	Acarina	Acarina	Acarina	Acarina	5	PR	SW/10%, CN/90%
Arthropoda	Branchiopoda	Diplostraca	.	Cladocera	Cladocera			CG/CF	SW
Arthropoda	Branchiopoda	Diplostraca	Daphniidae	Daphniidae	Cladocera			CF	SW
Arthropoda	Branchiopoda	Diplostraca	Sididae	Sididae	Cladocera				
Arthropoda	Copepoda	.	.	Calanoida	Copapoda			unk	SW
Arthropoda	Copepoda	Copepoda	Copepoda	Copepoda	Copepoda				
Arthropoda	Copepoda	Cyclopoida	.	Cyclopoida	Copapoda		8	CF	
Arthropoda	Insecta	Coleoptera	Amphizoidae	Amphizoa	Amphizoa	Amphizoa		PR	CN/50%, Floater/50%
Arthropoda	Insecta	Coleoptera	Curculionidae	Curculionidae	Curculionidae	Curculionidae			

Phyla	Class	Order	Family	FinalID	MMI_OTU	RIVPACS_OTU	TolVal	FFG	Habit
Arthropoda	Insecta	Coleoptera	Dryopidae	Dryopidae	Dryopidae			unk	CN/75%, CM/25%
Arthropoda	Insecta	Coleoptera	Dryopidae	Helichus	Helichus	Helichus	5	SC	CN/75%, CM/25%
Arthropoda	Insecta	Coleoptera	Dryopidae	Helichus striatus	Helichus	Helichus	5	SC	CN/75%, CM/25%
Arthropoda	Insecta	Coleoptera	Dytiscidae	Agabinus	Agabinus	Agabinus		PR	CM(la), SW,DI(ad)
Arthropoda	Insecta	Coleoptera	Dytiscidae	Agabus	Agabus	Agabus	5	PR	CM(la), DI,SW(ad)
Arthropoda	Insecta	Coleoptera	Dytiscidae	Colymbetes	Colymbetes	Colymbetes		PR	CM(la), DI,SW(ad)
Arthropoda	Insecta	Coleoptera	Dytiscidae	Coptotomus	Coptotomus	Coptotomus	5	PR	CM (la), DI, SW (ad)
Arthropoda	Insecta	Coleoptera	Dytiscidae	Deronectes	Deronectes	Deronectes	5	PR	CM (la), DI,SW (ad)
Arthropoda	Insecta	Coleoptera	Dytiscidae	Desmopachria	Desmopachria			PR	CM (la), DI, SW (ad)
Arthropoda	Insecta	Coleoptera	Dytiscidae	Dytiscidae	Dytiscidae		5	PR	CM (L), Divers (A)
Arthropoda	Insecta	Coleoptera	Dytiscidae	Dytiscus	Dytiscus	Dytiscus	5	PR	CM (la), DI, SW (ad)
Arthropoda	Insecta	Coleoptera	Dytiscidae	Hydroporus	Hydroporus	Hydroporus		PR	CM (la), DI, SW (ad)
Arthropoda	Insecta	Coleoptera	Dytiscidae	Hygrotus	Hygrotus	Hygrotus		PR	CM (la), DI, SW (ad)
Arthropoda	Insecta	Coleoptera	Dytiscidae	Laccophilus	Laccophilus	Laccophilus	5	PR	CM (la), DI, SW (ad)
Arthropoda	Insecta	Coleoptera	Dytiscidae	Liodessus	Liodessus	Liodessus		PR	CM (la), DI, SW (ad)
Arthropoda	Insecta	Coleoptera	Dytiscidae	Neoclypeodytes	Neoclypeodytes	Neoclypeodytes		PR	CM (la), DI, SW (ad)
Arthropoda	Insecta	Coleoptera	Dytiscidae	Oreodytes	Oreodytes	Oreodytes	5	PR	CM (la), DI, SW (ad)
Arthropoda	Insecta	Coleoptera	Dytiscidae	Rhantus	Rhantus	Rhantus		PR	CM (la), DI, SW (ad)
Arthropoda	Insecta	Coleoptera	Dytiscidae	Stictotarsus	Stictotarsus	Stictotarsus		PR	CM (la), DI, SW (ad)
Arthropoda	Insecta	Coleoptera	Elmidae	Cleptelmis	Cleptelmis	Cleptelmis	4	CG	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Cleptelmis addenda	Cleptelmis	Cleptelmis		CG	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Cleptelmis ornata	Cleptelmis	Cleptelmis	4	CG	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Dubiraphia	Dubiraphia	Dubiraphia	6	SC/CG	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Elmidae	Elmidae		4	CG	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Heterlimnius	Heterlimnius	Heterlimnius	3	SC/CG	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Heterlimnius corpulentus	Heterlimnius	Heterlimnius	3	SC/CG	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Lara	Lara	Lara	1	SH	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Lara avara	Lara	Lara	1	SH	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Microcylloepus	Microcylloepus	Microcylloepus	5	CG	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Microcylloepus pusillus	Microcylloepus	Microcylloepus	5	CG	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Narpus	Narpus	Narpus	2	CG	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Narpus concolor	Narpus	Narpus	2	CG	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Optioservus	Optioservus	Optioservus	5	SC	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Optioservus seriatus	Optioservus	Optioservus	4	SC	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Ordobrevia	Ordobrevia	Ordobrevia	5	SC/CG	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Ordobrevia nubifera	Ordobrevia	Ordobrevia	5	SC/CG	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	Stenelmis	5	SC/CG	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Stenelmis occidentalis	Stenelmis	Stenelmis			
Arthropoda	Insecta	Coleoptera	Elmidae	Zaitzevia	Zaitzevia	Zaitzevia	5	SC/CG	CN/50%, BU/50%
Arthropoda	Insecta	Coleoptera	Elmidae	Zaitzevia parvulus	Zaitzevia	Zaitzevia			
Arthropoda	Insecta	Coleoptera	Gyrinidae	Gyrinus	Gyrinus	Gyrinus	5	PR	
Arthropoda	Insecta	Coleoptera	Haliplidae	Brychius	Brychius	Brychius	5	SC	CN,CM (la), SW,CM (ad)
Arthropoda	Insecta	Coleoptera	Haliplidae	Haliplidae	Haliplidae		8	SH	CN,CM (la), SW,CM (ad)
Arthropoda	Insecta	Coleoptera	Haliplidae	Haliplus	Haliplus	Haliplus	8	PH	CN,CM (la), SW,CM (ad)
Arthropoda	Insecta	Coleoptera	Haliplidae	Peltodytes	Peltodytes	Peltodytes	8	PH	CN,CM (la), SW,CM (ad)
Arthropoda	Insecta	Coleoptera	Heteroceridae	Heteroceridae	Heteroceridae			unk	unk
Arthropoda	Insecta	Coleoptera	Hydraenidae	Gymnochthebius	Gymnochthebius				CN
Arthropoda	Insecta	Coleoptera	Hydraenidae	Hydraena	Hydraena	Hydraena		unk	CN
Arthropoda	Insecta	Coleoptera	Hydraenidae	Ochthebius	Ochthebius	Ochthebius		unk	unk
Arthropoda	Insecta	Coleoptera	Hydrochidae	Hydrochus	Hydrochus	Hydrochus	7	SH	CM
Arthropoda	Insecta	Coleoptera	Hydrophilidae	Ametor	Ametor	Ametor		unk	CN(la), DI,SW,(ad)
Arthropoda	Insecta	Coleoptera	Hydrophilidae	Anacaena	Anacaena	Anacaena	5	PR/CG	
Arthropoda	Insecta	Coleoptera	Hydrophilidae	Berosus	Berosus	Berosus	5	PH	CM(la), DI,SW(ad)
Arthropoda	Insecta	Coleoptera	Hydrophilidae	Cercyon	Cercyon	Cercyon			
Arthropoda	Insecta	Coleoptera	Hydrophilidae	Enochrus	Enochrus	Enochrus	5	CG	unk
Arthropoda	Insecta	Coleoptera	Hydrophilidae	Helophorus	Helophorus	Helophorus	5	SH	CM

Phyla	Class	Order	Family	FinalID	MMI_OTU	RIVPACS_OTU	TolVal	FFG	Habit
Arthropoda	Insecta	Coleoptera	Hydrophilidae	Hydrobius	Hydrobius	Hydrobius			
Arthropoda	Insecta	Coleoptera	Hydrophilidae	Hydrophilidae	Hydrophilidae		5	PR	CN,SP,CM,BU(la),DI,SW(ad)
Arthropoda	Insecta	Coleoptera	Hydrophilidae	Laccobius	Laccobius	Laccobius		unk	unk
Arthropoda	Insecta	Coleoptera	Hydrophilidae	Paracymus	Paracymus	Paracymus		unk	BU(la), DI,SW(ad)
Arthropoda	Insecta	Coleoptera	Hydrophilidae	Tropisternus	Tropisternus	Tropisternus		PR	CN,SP,CM(la), DI,SW(ad)
Arthropoda	Insecta	Coleoptera	Lampyridae	Lampyridae	Lampyridae				
Arthropoda	Insecta	Diptera	.	Diptera	Diptera			unk	unk
Arthropoda	Insecta	Diptera	Athericidae	Athericidae	Atherix	Atherix	2	PR	SP/BU
Arthropoda	Insecta	Diptera	Athericidae	Atherix	Atherix	Atherix	5	PR	SP/BU
Arthropoda	Insecta	Diptera	Athericidae	Atherix pachypus	Atherix	Atherix	4	PR	SP/BU
Arthropoda	Insecta	Diptera	Blephariceridae	Agathon	Blephariceridae	Blephariceridae	0	SC	CN
Arthropoda	Insecta	Diptera	Blephariceridae	Bibiocephala	Blephariceridae	Blephariceridae	0	SC	CN
Arthropoda	Insecta	Diptera	Blephariceridae	Bibiocephala grandis	Blephariceridae	Blephariceridae	0	SC	CN
Arthropoda	Insecta	Diptera	Blephariceridae	Blephariceridae	Blephariceridae	Blephariceridae	0	SC	CN
Arthropoda	Insecta	Diptera	Blephariceridae	Philorus	Blephariceridae	Blephariceridae		SC	CN
Arthropoda	Insecta	Diptera	Ceratopogonidae	Atrichopogon	Forcipomyiinae	Forcipomyiinae		CG/SC	SP/CN
Arthropoda	Insecta	Diptera	Ceratopogonidae	Bezzia	Ceratopogoninae	Ceratopogoninae		PR	BU/SW
Arthropoda	Insecta	Diptera	Ceratopogonidae	Ceratopogonidae	Ceratopogonidae		6	PR/CG	SP/BU/SW
Arthropoda	Insecta	Diptera	Ceratopogonidae	Ceratopogoninae	Ceratopogoninae	Ceratopogoninae	6	PR/CG	SP/BU/SW
Arthropoda	Insecta	Diptera	Ceratopogonidae	Culicoides	Ceratopogoninae	Ceratopogoninae	10	PR	BU/SW
Arthropoda	Insecta	Diptera	Ceratopogonidae	Forcipomyiinae	Forcipomyiinae	Forcipomyiinae	6	PR/CG/SC	sp
Arthropoda	Insecta	Diptera	Chaoboridae	Chaoboridae	Chaoboridae		8	PR	SW/SP
Arthropoda	Insecta	Diptera	Chaoboridae	Chaoborus	Chaoborus	Chaoborus		PR	SW/SP
Arthropoda	Insecta	Diptera	Chironomidae	Ablabesmyia	Tanypodinae	Tanypodinae	8	PR/CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Acalcarella	Chironominae	Chironominae	8	CG	BU
Arthropoda	Insecta	Diptera	Chironomidae	Acricotopus	Orthoclaadiinae	Orthoclaadiinae	6	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Apedilum	Chironominae	Chironominae		CG	BU
Arthropoda	Insecta	Diptera	Chironomidae	Apsectrotanypus	Tanypodinae	Tanypodinae	8	PR	BU/SP
Arthropoda	Insecta	Diptera	Chironomidae	Axarus	Chironominae	Chironominae		CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Boreochlus	Podonominae	Podonominae	1	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Boreoheptagya	Diamesinae	Diamesinae		CG	CN
Arthropoda	Insecta	Diptera	Chironomidae	Brillia	Orthoclaadiinae	Orthoclaadiinae	4	SH	BU/SP
Arthropoda	Insecta	Diptera	Chironomidae	Brundiniella	Tanypodinae	Tanypodinae	3	PR	BU/SP
Arthropoda	Insecta	Diptera	Chironomidae	Campitocladius	Orthoclaadiinae	Orthoclaadiinae	6	CG	
Arthropoda	Insecta	Diptera	Chironomidae	Cardiocladius	Orthoclaadiinae	Orthoclaadiinae	5	PR	BU/CN
Arthropoda	Insecta	Diptera	Chironomidae	Cardiocladius albiplumus	Orthoclaadiinae	Orthoclaadiinae	5	PR	
Arthropoda	Insecta	Diptera	Chironomidae	Chaetocladius	Orthoclaadiinae	Orthoclaadiinae	6	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Chironomidae	Chironomidae		10	CG/PR	BU/SP
Arthropoda	Insecta	Diptera	Chironomidae	Chironominae	Chironominae	Chironominae		7	CG/CF/PR
Arthropoda	Insecta	Diptera	Chironomidae	Chironominae	Chironominae	Chironominae		6	CG
Arthropoda	Insecta	Diptera	Chironomidae	Chironomus	Chironominae	Chironominae	10	CG/PR	BU/SP
Arthropoda	Insecta	Diptera	Chironomidae	Cladopelma	Chironominae	Chironominae		CG	BU
Arthropoda	Insecta	Diptera	Chironomidae	Cladotanytarsus	Chironominae	Chironominae	7	CG	CN
Arthropoda	Insecta	Diptera	Chironomidae	Conchapelopia	Tanypodinae	Tanypodinae	6	PR	
Arthropoda	Insecta	Diptera	Chironomidae	Constempellina	Chironominae	Chironominae	8	CG	BU
Arthropoda	Insecta	Diptera	Chironomidae	Corynoneura	Orthoclaadiinae	Orthoclaadiinae	7	CG	BU
Arthropoda	Insecta	Diptera	Chironomidae	Cricotopus	Orthoclaadiinae	Orthoclaadiinae	8	CG/SH	CN
Arthropoda	Insecta	Diptera	Chironomidae	Cricotopus (Cricotopus)	Orthoclaadiinae	Orthoclaadiinae	8	CG/SH	CN
Arthropoda	Insecta	Diptera	Chironomidae	Cricotopus (Isocladius)	Orthoclaadiinae	Orthoclaadiinae	8	CG/SH	CN
Arthropoda	Insecta	Diptera	Chironomidae	Cricotopus (Nostococcladius)	Orthoclaadiinae	Orthoclaadiinae	8	CG/SH	BU
Arthropoda	Insecta	Diptera	Chironomidae	Cricotopus bicinctus	Orthoclaadiinae	Orthoclaadiinae	9	CG/SH	CN
Arthropoda	Insecta	Diptera	Chironomidae	Cricotopus tremulus	Orthoclaadiinae	Orthoclaadiinae	8	CG/SH	CN
Arthropoda	Insecta	Diptera	Chironomidae	Cricotopus trifascia	Orthoclaadiinae	Orthoclaadiinae	8	CG/SH	CN
Arthropoda	Insecta	Diptera	Chironomidae	Cricotopus trifasciatus	Orthoclaadiinae	Orthoclaadiinae	8	CG/SH	CN
Arthropoda	Insecta	Diptera	Chironomidae	Cryptochironomus	Chironominae	Chironominae	8	PR	BU/SP
Arthropoda	Insecta	Diptera	Chironomidae	Cryptotendipes	Chironominae	Chironominae	6	PR	SP

Phyla	Class	Order	Family	FinalID	MMI_OTU	RIVPACS_OTU	TolVal	FFG	Habit
Arthropoda	Insecta	Diptera	Chironomidae	Demicryptochironomus	Chironominae	Chironominae	8	CG	BU
Arthropoda	Insecta	Diptera	Chironomidae	Diamesa	Diamesinae	Diamesinae	5	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Diamesinae	Diamesinae	Diamesinae	4	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Dicrotendipes	Chironominae	Chironominae	8	CG	BU
Arthropoda	Insecta	Diptera	Chironomidae	Diplocladius	Orthoclaadiinae	Orthoclaadiinae	5	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Einfeldia	Chironominae	Chironominae	8	CG	BU
Arthropoda	Insecta	Diptera	Chironomidae	Endochironomus	Chironominae	Chironominae	10	CG/SH	CN
Arthropoda	Insecta	Diptera	Chironomidae	Chironomidae	Orthoclaadiinae	Orthoclaadiinae		CG/PA	SP
Arthropoda	Insecta	Diptera	Chironomidae	Eukiefferiella	Orthoclaadiinae	Orthoclaadiinae	4	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Eukiefferiella brehmi	Orthoclaadiinae	Orthoclaadiinae	2	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Eukiefferiella claripennis	Orthoclaadiinae	Orthoclaadiinae	5	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Eukiefferiella coerulescens	Orthoclaadiinae	Orthoclaadiinae	4	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Eukiefferiella devonica	Orthoclaadiinae	Orthoclaadiinae	4	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Eukiefferiella gracei	Orthoclaadiinae	Orthoclaadiinae	4	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Eukiefferiella pseudomontana	Orthoclaadiinae	Orthoclaadiinae			
Arthropoda	Insecta	Diptera	Chironomidae	Eukiefferiella similis	Orthoclaadiinae	Orthoclaadiinae			
Arthropoda	Insecta	Diptera	Chironomidae	Glyptotendipes	Chironominae	Chironominae	10	CG/SH	BU/CN
Arthropoda	Insecta	Diptera	Chironomidae	Harnischia	Chironominae	Chironominae		CG	CN
Arthropoda	Insecta	Diptera	Chironomidae	Heleniella	Orthoclaadiinae	Orthoclaadiinae	6	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Heterotrissocladius	Orthoclaadiinae	Orthoclaadiinae	0	CG/SC	SP/BU
Arthropoda	Insecta	Diptera	Chironomidae	Heterotrissocladius marcidus	Orthoclaadiinae	Orthoclaadiinae		CG/SC	SP/BU
Arthropoda	Insecta	Diptera	Chironomidae	Hydrobaenus	Orthoclaadiinae	Orthoclaadiinae	8	SC	SP
Arthropoda	Insecta	Diptera	Chironomidae	Krenosmittia	Orthoclaadiinae	Orthoclaadiinae	1	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Labrundinia	Tanypodinae	Tanypodinae	7	PR	SP
Arthropoda	Insecta	Diptera	Chironomidae	Larsia	Tanypodinae	Tanypodinae	6	PR	SP
Arthropoda	Insecta	Diptera	Chironomidae	Limnophyes	Orthoclaadiinae	Orthoclaadiinae	6	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Lopescladius	Orthoclaadiinae	Orthoclaadiinae	2	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Macropelopia	Tanypodinae	Tanypodinae	6	PR	SP
Arthropoda	Insecta	Diptera	Chironomidae	Mesosmittia	Orthoclaadiinae	Orthoclaadiinae		CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Metriocnemus	Orthoclaadiinae	Orthoclaadiinae		CG	BU/SP
Arthropoda	Insecta	Diptera	Chironomidae	Micropsectra	Chironominae	Chironominae	4	CG	CN/SP
Arthropoda	Insecta	Diptera	Chironomidae	Dicrotendipes	Chironominae	Chironominae	6	CF	CN
Arthropoda	Insecta	Diptera	Chironomidae	Monodiamesa	Prodiamesinae	Prodiamesinae	7	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Nanocladius	Orthoclaadiinae	Orthoclaadiinae	3	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Natarsia	Tanypodinae	Tanypodinae		PR	SP
Arthropoda	Insecta	Diptera	Chironomidae	Nilotanypus	Tanypodinae	Tanypodinae	7	PR	SP
Arthropoda	Insecta	Diptera	Chironomidae	Odontomesa	Prodiamesinae	Prodiamesinae	4	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Orthoclaadiinae	Orthoclaadiinae	Orthoclaadiinae		CG/SC	SP/BU
Arthropoda	Insecta	Diptera	Chironomidae	Orthoclaadius	Orthoclaadiinae	Orthoclaadiinae	7	CG	SP/BU
Arthropoda	Insecta	Diptera	Chironomidae	Orthoclaadius annectens	Orthoclaadiinae	Orthoclaadiinae		CG	SP/BU
Arthropoda	Insecta	Diptera	Chironomidae	Orthoclaadius rivulorum	Orthoclaadiinae	Orthoclaadiinae			
Arthropoda	Insecta	Diptera	Chironomidae	Pagastia	Diamesinae	Diamesinae	1	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Parachaetocladius	Orthoclaadiinae	Orthoclaadiinae		CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Parachironomus	Chironominae	Chironominae	10	PR/CG/PA	SP
Arthropoda	Insecta	Diptera	Chironomidae	Paracladius	Orthoclaadiinae	Orthoclaadiinae	8	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Paracladopolma	Chironominae	Chironominae	7	PR/CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Paracricotopus	Orthoclaadiinae	Orthoclaadiinae		CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Parakiefferiella	Orthoclaadiinae	Orthoclaadiinae	6	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Paralauterborniella	Chironominae	Chironominae	8	CG	CN/BU
Arthropoda	Insecta	Diptera	Chironomidae	Paramerina	Tanypodinae	Tanypodinae		PR	SP
Arthropoda	Insecta	Diptera	Chironomidae	Parametriocnemus	Orthoclaadiinae	Orthoclaadiinae	5	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Paraphaenocladius	Orthoclaadiinae	Orthoclaadiinae	4	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Paratanytarsus	Chironominae	Chironominae	6	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Paratendipes	Chironominae	Chironominae	10	CG	BU
Arthropoda	Insecta	Diptera	Chironomidae	Parochlus	Podoniminae	Podoniminae	1	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Parorthocladius	Orthoclaadiinae	Orthoclaadiinae	6	CG	SP

Phyla	Class	Order	Family	FinalID	MMI_OTU	RIVPACS_OTU	TolVal	FFG	Habit
Arthropoda	Insecta	Diptera	Chironomidae	Pentaneura	Tanypodinae	Tanypodinae	6	PR	SP
Arthropoda	Insecta	Diptera	Chironomidae	Pentaneurini	Tanypodinae	Tanypodinae	6	PR	
Arthropoda	Insecta	Diptera	Chironomidae	Phaenopsectra	Chironominae	Chironominae	7	SC	BU
Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum	Chironominae	Chironominae	6	SH	CN
Arthropoda	Insecta	Diptera	Chironomidae	Potthastia	Diamesinae	Diamesinae	2	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Potthastia gaedii	Diamesinae	Diamesinae	3	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Potthastia longimana	Diamesinae	Diamesinae	4	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Procladius	Tanypodinae	Tanypodinae	9	PR	SP
Arthropoda	Insecta	Diptera	Chironomidae	Prodiamesa	Prodiamesinae	Prodiamesinae	3	CG	BU
Arthropoda	Insecta	Diptera	Chironomidae	Psectrocladius	Orthoclaadiinae	Orthoclaadiinae	8	CG	BU
Arthropoda	Insecta	Diptera	Chironomidae	Psectrotanypus	Tanypodinae	Tanypodinae	10	PR	SP
Arthropoda	Insecta	Diptera	Chironomidae	Pseudochironomus	Chironominae	Chironominae	5	CG	BU
Arthropoda	Insecta	Diptera	Chironomidae	Pseudodiamesa	Diamesinae	Diamesinae	2	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Pseudorthocladus	Orthoclaadiinae	Orthoclaadiinae	0	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Pseudosmittia	Orthoclaadiinae	Orthoclaadiinae	6	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Rheocricotopus	Orthoclaadiinae	Orthoclaadiinae	4	CG/SH/PR	SP
Arthropoda	Insecta	Diptera	Chironomidae	Rheosmittia	Orthoclaadiinae	Orthoclaadiinae		CG/SH/PR	SP
Arthropoda	Insecta	Diptera	Chironomidae	Rheotanytarsus	Chironominae	Chironominae	6	CF	CN
Arthropoda	Insecta	Diptera	Chironomidae	Robackia	Chironominae	Chironominae	4	CG	unk
Arthropoda	Insecta	Diptera	Chironomidae	Saetheria	Chironominae	Chironominae	8	CG	BU
Arthropoda	Insecta	Diptera	Chironomidae	Stempellina	Chironominae	Chironominae	2	CG	BU
Arthropoda	Insecta	Diptera	Chironomidae	Stempellinella	Chironominae	Chironominae	4	CG	BU
Arthropoda	Insecta	Diptera	Chironomidae	Stenochironomus	Chironominae	Chironominae	5	CG	BU
Arthropoda	Insecta	Diptera	Chironomidae	Stictochironomus	Chironominae	Chironominae	5	unk	BU
Arthropoda	Insecta	Diptera	Chironomidae	Stilocladius	Orthoclaadiinae	Orthoclaadiinae	6	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Sublettea	Chironominae	Chironominae	2	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Symposiocladius	Orthoclaadiinae	Orthoclaadiinae	6	unk	unk
Arthropoda	Insecta	Diptera	Chironomidae	Sympotthastia	Diamesinae	Diamesinae	2	CG/SC	SP
Arthropoda	Insecta	Diptera	Chironomidae	Synendotendipes	Orthoclaadiinae	Chironominae		CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Synorthocladus	Orthoclaadiinae	Orthoclaadiinae	2	CG	SP
Arthropoda	Insecta	Diptera	Chironomidae	Tanypodinae	Tanypodinae	Tanypodinae		PR	SP/BU
Arthropoda	Insecta	Diptera	Chironomidae	Tanypus	Tanypodinae	Tanypodinae	10	PR	SP
Arthropoda	Insecta	Diptera	Chironomidae	Tanytarsini	Chironominae	Chironominae	6	CF/CG	
Arthropoda	Insecta	Diptera	Chironomidae	Tanytarsus	Chironominae	Chironominae	6	CF	CN
Arthropoda	Insecta	Diptera	Chironomidae	Thienemanniella	Orthoclaadiinae	Orthoclaadiinae	6	unk	SP
Arthropoda	Insecta	Diptera	Chironomidae	Thienemannimyia	Tanypodinae	Tanypodinae		unk	SP
Arthropoda	Insecta	Diptera	Chironomidae	Thienemanniola	Chironominae	Chironominae		unk	BU
Arthropoda	Insecta	Diptera	Chironomidae	Tribelos	Chironominae	Chironominae		unk	BU
Arthropoda	Insecta	Diptera	Chironomidae	Tvetenia	Orthoclaadiinae	Orthoclaadiinae	5	unk	SP
Arthropoda	Insecta	Diptera	Chironomidae	Tvetenia bavarica	Orthoclaadiinae	Orthoclaadiinae			
Arthropoda	Insecta	Diptera	Chironomidae	Tvetenia discoloripes	Orthoclaadiinae	Orthoclaadiinae			
Arthropoda	Insecta	Diptera	Chironomidae	Tvetenia vitracies	Orthoclaadiinae	Orthoclaadiinae		unk	SP
Arthropoda	Insecta	Diptera	Chironomidae	Xenochironomus	Chironominae	Chironominae	4	unk	BU
Arthropoda	Insecta	Diptera	Chironomidae	Zavrelimyia	Tanypodinae	Tanypodinae	8	unk	SP
Arthropoda	Insecta	Diptera	Culicidae	Aedes	Culicidae	Culicidae	7	CG	SW
Arthropoda	Insecta	Diptera	Culicidae	Anopheles	Culicidae	Culicidae	10	CF	SW
Arthropoda	Insecta	Diptera	Culicidae	Culex	Culicidae	Culicidae	10	CF	SW
Arthropoda	Insecta	Diptera	Culicidae	Culicidae	Culicidae	Culicidae	10	CF/CG	SW
Arthropoda	Insecta	Diptera	Deuterophlebiidae	Deuterophlebia	Deuterophlebia	Deuterophlebia	0	SC	CN
Arthropoda	Insecta	Diptera	Dixidae	Dixa	Dixa	Dixa	4	CG	SW
Arthropoda	Insecta	Diptera	Dixidae	Dixella	Dixella	Dixella		CG	SW
Arthropoda	Insecta	Diptera	Dixidae	Dixidae	Dixidae		4	CG	SW
Arthropoda	Insecta	Diptera	Dixidae	Meringodixa	Meringodixa	Meringodixa		CG	SW
Arthropoda	Insecta	Diptera	Dolichopodidae	Dolichopodidae	Dolichopodidae	Dolichopodidae	4	PR	SP
Arthropoda	Insecta	Diptera	Empididae	Chelifera	Chelifera_Metachela_Neoplasta	Chelifera_Metachela_Neoplasta	5	unk	SP
Arthropoda	Insecta	Diptera	Empididae	Clinocera	Clinocera	Clinocera	5	unk	CN

Phyla	Class	Order	Family	FinalID	MMI_OTU	RIVPACS_OTU	TolVal	FFG	Habit
Arthropoda	Insecta	Diptera	Empididae	Empididae	Empididae		6	PR	SP
Arthropoda	Insecta	Diptera	Empididae	Hemerodromia	Hemerodromia	Hemerodromia	6	PR	SP
Arthropoda	Insecta	Diptera	Empididae	Neoplasta	Chelifera_Metachela_Neoplasta	Chelifera_Metachela_Neoplasta	6	unk	SP
Arthropoda	Insecta	Diptera	Empididae	Oreogeton	Oreogeton	Oreogeton	4	PR	SP
Arthropoda	Insecta	Diptera	Empididae	Trichoclinocera	Trichoclinocera	Trichoclinocera		PR	unk
Arthropoda	Insecta	Diptera	Empididae	Wiedemannia	Wiedemannia	Wiedemannia		PR	CN
Arthropoda	Insecta	Diptera	Ephydriidae	Ephydriidae	Ephydriidae	Ephydriidae	6	CG	BU
Arthropoda	Insecta	Diptera	Muscidae	Limnophora	Muscidae	Muscidae	7	PR	BU
Arthropoda	Insecta	Diptera	Muscidae	Muscidae	Muscidae	Muscidae	9	PR	SP/BU
Arthropoda	Insecta	Diptera	Pelecorhynchidae	Glutops	Pelecorhynchidae	Glutops	1	PR	SP
Arthropoda	Insecta	Diptera	Psychodidae	Pericoma	Pericoma/Telmatoscopus	Pericoma_Telmatoscopus	4	CG	unk
Arthropoda	Insecta	Diptera	Psychodidae	Psychoda	Psychoda	Psychoda	4	CG	BU
Arthropoda	Insecta	Diptera	Psychodidae	Psychodidae	Psychodidae		4	CG	BU
Arthropoda	Insecta	Diptera	Ptychopteridae	Ptychoptera	Ptychopteridae	Ptychopteridae	7	CG	BU
Arthropoda	Insecta	Diptera	Sciomyzidae	Sciomyzidae	Sciomyzidae	Sciomyzidae		PR	BU
Arthropoda	Insecta	Diptera	Simuliidae	Ectemnia	Simuliidae	Simuliidae		unk	unk
Arthropoda	Insecta	Diptera	Simuliidae	Prosimulium	Simuliidae	Simuliidae	3	CF	CN
Arthropoda	Insecta	Diptera	Simuliidae	Simuliidae	Simuliidae	Simuliidae	6	CF	CN
Arthropoda	Insecta	Diptera	Simuliidae	Simulium	Simuliidae	Simuliidae	5	CF	CN
Arthropoda	Insecta	Diptera	Simuliidae	Twinnia	Simuliidae	Simuliidae	7	SC	CN
Arthropoda	Insecta	Diptera	Stratiomyidae	Caloparyphus	Caloparyphus_Euparyphus	Caloparyphus_Euparyphus	7	CG	SP
Arthropoda	Insecta	Diptera	Stratiomyidae	Euparyphus	Caloparyphus_Euparyphus	Caloparyphus_Euparyphus	7	CG	SP
Arthropoda	Insecta	Diptera	Stratiomyidae	Nemotelus	Nemotelus	Nemotelus	7	CG	SW
Arthropoda	Insecta	Diptera	Stratiomyidae	Odontomyia	Hedriodiscus/Odontomyia	Hedriodiscus_Odontomyia		CG	SP
Arthropoda	Insecta	Diptera	Stratiomyidae	Stratiomyidae	Stratiomyidae		7	CG	SP
Arthropoda	Insecta	Diptera	Stratiomyidae	Stratiomys	Stratiomys	Stratiomys		CG	unk
Arthropoda	Insecta	Diptera	Tabanidae	Chrysops	Tabanidae	Tabanidae	10	PR	SP
Arthropoda	Insecta	Diptera	Tabanidae	Tabanidae	Tabanidae	Tabanidae	10	PR	SP
Arthropoda	Insecta	Diptera	Tabanidae	Tabanus	Tabanidae	Tabanidae	10	PR	SP
Arthropoda	Insecta	Diptera	Tanyderidae	Protanyderus	Tanyderidae	Tanyderidae	5	unk	BU
Arthropoda	Insecta	Diptera	Thaumaleidae	Thaumalea	Thaumaleidae	Thaumaleidae		SC	CN
Arthropoda	Insecta	Diptera	Thaumaleidae	Thaumaleidae	Thaumaleidae	Thaumaleidae		SC	CN
Arthropoda	Insecta	Diptera	Tipulidae	Antocha	Antocha	Antocha	3	CG	CN
Arthropoda	Insecta	Diptera	Tipulidae	Cryptolabis	Cryptolabis	Cryptolabis		unk	BU
Arthropoda	Insecta	Diptera	Tipulidae	Dicranota	Dicranota	Dicranota	0	PR	SP
Arthropoda	Insecta	Diptera	Tipulidae	Erioptera	Erioptera		7	CG	BU
Arthropoda	Insecta	Diptera	Tipulidae	Hesperoconopa	Hesperoconopa	Hesperoconopa	1	unk	BU
Arthropoda	Insecta	Diptera	Tipulidae	Hexatoma	Hexatoma	Hexatoma	2	PR	BU
Arthropoda	Insecta	Diptera	Tipulidae	Limnophila	Limnophila	Limnophila	3	PR	BU
Arthropoda	Insecta	Diptera	Tipulidae	Limonia	Limonia	Limonia		SH	BU
Arthropoda	Insecta	Diptera	Tipulidae	Molophilus	Molophilus	Molophilus		unk	BU
Arthropoda	Insecta	Diptera	Tipulidae	Ormosia	Ormosia	Ormosia	6	CG	BU
Arthropoda	Insecta	Diptera	Tipulidae	Pedicia	Pedicia	Pedicia	6	PR	BU
Arthropoda	Insecta	Diptera	Tipulidae	Pilaria	Pilaria	Pilaria	7	PR	BU
Arthropoda	Insecta	Diptera	Tipulidae	Rhabdomastix	Rhabdomastix	Rhabdomastix	1	unk	BU
Arthropoda	Insecta	Diptera	Tipulidae	Tipula	Tipula	Tipula	4	SH	BU
Arthropoda	Insecta	Diptera	Tipulidae	Tipulidae	Tipulidae		3	SH	BU
Arthropoda	Insecta	Ephemeroptera	.	Ephemeroptera	Ephemeroptera			unk	unk
Arthropoda	Insecta	Ephemeroptera	Acanthametropodidae	Analetis eximia	Analetis			unk	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Ameletidae	Ameletus	Ameletus	Ameletus	0	SC	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Ametropodidae	Ametropus	Ametropus	Ametropus		CF	SW/CN
Arthropoda	Insecta	Ephemeroptera	Baetidae	Acentrella	Acentrella	Acentrella	4	CG	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Acentrella insignificans	Acentrella	Acentrella	4	CG	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Acentrella turbida	Acentrella	Acentrella	4	CG	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Acerpenna	Acerpenna	Acerpenna		SC	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Acerpenna pygmaea	Acerpenna	Acerpenna		SC	SW/10%, CN/90%

Phyla	Class	Order	Family	FinalID	MMI_OTU	RIVPACS_OTU	TolVal	FFG	Habit
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetidae	Baetidae		4	CG	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis	Baetis	Baetis	5	CG	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis alius	Baetis	Baetis	1	CG/SC	
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis bicaudatus	Baetis	Baetis	2	CG	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis flavistriga	Baetis	Baetis	5	CG	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis intercalaris	Baetis	Baetis		CG	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis propinquus	Baetis	Baetis	6	CG	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis punctiventris	Baetis	Baetis			
Arthropoda	Insecta	Ephemeroptera	Baetidae	Baetis tricaudatus	Baetis	Baetis	4	CG	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Callibaetis	Callibaetis	Callibaetis	9	CG	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Camelobaetidius	Camelobaetidius	Camelobaetidius	4	CG	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Centroptilum	Centroptilum	Centroptilum	2	CG	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Dipheter hageni	Dipheter	Dipheter	5	CG	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Fallceon quilleri	Fallceon	Fallceon	5	CG	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Labiobaetis	Labiobaetis	Labiobaetis		CG	SW
Arthropoda	Insecta	Ephemeroptera	Baetidae	Paracloeodes	Paracloeodes	Paracloeodes		SC	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Plauditus	Plauditus	Plauditus	5	SC	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Plauditus punctiventris	Plauditus	Plauditus	5	SC	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Procloeon	Procloeon	Procloeon	7	unk	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetidae	Pseudocloeon	Pseudocloeon	Pseudocloeon	4	CG	SW/10%, CN/90%
Arthropoda	Insecta	Ephemeroptera	Baetiscidae	Baetisca	Baetisca	Baetisca		CG	SP/CN
Arthropoda	Insecta	Ephemeroptera	Caenidae	Brachycercus	Brachycercus	Brachycercus	3	CG	SP/75%, CM/90%
Arthropoda	Insecta	Ephemeroptera	Caenidae	Caenidae	Caenidae		8	unk	SP/75%, CM/90%
Arthropoda	Insecta	Ephemeroptera	Caenidae	Caenis	Caenis	Caenis	8	CG	SP/75%, CM/90%
Arthropoda	Insecta	Ephemeroptera	Caenidae	Caenis latipennis	Caenis	Caenis	7	CG	SP/75%, CM/90%
Arthropoda	Insecta	Ephemeroptera	Caenidae	Caenis youngi	Caenis	Caenis	8	unk	SP/75%, CM/90%
Arthropoda	Insecta	Ephemeroptera	Caenidae	Cercobrachys	Cercobrachys	Cercobrachys		CG	SP/75%, CM/90%
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Attenella	Attenella	Attenella	3	CG	CN
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Attenella delantala	Attenella	Attenella		CG	CN
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Attenella margarita	Attenella	Attenella	3	CG	CN
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Caudatella	Caudatella	Caudatella	0	CG	CN
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Caudatella cascadia	Caudatella	Caudatella		CG	CN
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Caudatella edmundsi	Caudatella	Caudatella	0	CG	CN
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Caudatella heterocaudata	Caudatella	Caudatella	0	CG	CN
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Caudatella hystrix	Caudatella	Caudatella	0	CG	CN
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Drunella	Drunella		1	SC/PR	CN/75%, SP/25%
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Drunella coloradensis	Drunella coloradensis/flavilinea	Drunella_coloradensis_flavilinea	0	SC	CN/75%, SP/25%
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Drunella doddsi	Drunella doddsi	Drunella_doddsi	1	SC	CN/75%, SP/25%
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Drunella flavilinea	Drunella coloradensis/flavilinea	Drunella_coloradensis_flavilinea	2	SC	CN/75%, SP/25%
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Drunella grandis	Drunella grandis	Drunella_grandis	2	PR	CN/75%, SP/25%
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Drunella spinifera	Drunella spinifera	Drunella_spinifera	0	PR	CN/75%, SP/25%
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	Ephemerella	Other_Ephemerella	2	CG	CN/SW
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Ephemerella aurivillii	Ephemerella aurivillii	Ephemerella_aurivillii	0	CG	CN/SW
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Ephemerella inermis	Ephemerella	Other_Ephemerella	4	CG	CN/SW
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Ephemerella infrequens	Ephemerella	Other_Ephemerella	2	SH	CN/SW
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Ephemerellidae	Ephemerellidae	Other_Ephemerella	1	CG	CN
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Serratella	Serratella	Serratella	2	CG	CN
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Serratella micheneri	Serratella	Serratella	0	CG	CN
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Serratella tibialis	Serratella	Serratella	2	CG	CN
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Timpanoga	Timpanoga	Timpanoga_hecuba	2	CG	CN/SP
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae	Timpanoga hecuba	Timpanoga	Timpanoga_hecuba	2	CG	CN/SP
Arthropoda	Insecta	Ephemeroptera	Ephemeridae	Ephemera	Ephemera	Ephemera	2	CG	BU
Arthropoda	Insecta	Ephemeroptera	Ephemeridae	Ephemera simulans	Ephemera	Ephemera	1	unk	BU
Arthropoda	Insecta	Ephemeroptera	Ephemeridae	Ephemeridae	Ephemeridae		4	unk	BU
Arthropoda	Insecta	Ephemeroptera	Ephemeridae	Hexagenia	Hexagenia	Hexagenia	6	CG	BU
Arthropoda	Insecta	Ephemeroptera	Ephemeridae	Hexagenia limbata	Hexagenia	Hexagenia	6	CG	BU

Phyla	Class	Order	Family	FinalID	MMI_OTU	RIVPACS_OTU	TolVal	FFG	Habit
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Cinygma	Cinygma	Cinygma	0	SC	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Cinygmula	Cinygmula	Cinygmula	0	SC	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Epeorus	Epeorus	Epeorus	2	CG	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Epeorus albertae	Epeorus	Epeorus	2	CG	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Epeorus deceptivus	Epeorus	Epeorus	0	unk	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Epeorus grandis	Epeorus	Epeorus	0	unk	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Epeorus longimanus	Epeorus	Epeorus	1	CG	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Heptagenia	Heptagenia	Heptagenia	4	SC	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Heptageniidae	Heptageniidae		2	SC	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Ironodes	Ironodes	Ironodes	0	SC	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Leucrocota	Leucrocota		1	SC	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Nixe	Nixe	Nixe	4	SC	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Nixe criddlei	Nixe	Nixe	2	SC	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Nixe simplicoides	Nixe	Nixe	4	unk	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Rhithrogena	Rhithrogena	Rhithrogena	0	CG	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Rhithrogena robusta	Rhithrogena	Rhithrogena	0	SC	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Stenacron	Stenacron	Stenacron	4	SC/CG	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Stenonema	Stenonema	Stenonema	4	SC	CN
Arthropoda	Insecta	Ephemeroptera	Heptageniidae	Stenonema terminatum	Stenonema	Stenonema	4	SC	CN
Arthropoda	Insecta	Ephemeroptera	Isonychiidae	Isonychia	Isonychia	Isonychia	2	CF	SW/CN
Arthropoda	Insecta	Ephemeroptera	Leptohyphidae	Asioplax	Asioplax	Asioplax		CG	CN/SP
Arthropoda	Insecta	Ephemeroptera	Leptohyphidae	Asioplax edmundsi	Asioplax	Asioplax		CG	CN/SP
Arthropoda	Insecta	Ephemeroptera	Leptohyphidae	Tricorythodes	Tricorythodes	Tricorythodes	4	CG	CN/SP
Arthropoda	Insecta	Ephemeroptera	Leptohyphidae	Tricorythodes minutus	Tricorythodes	Tricorythodes	4	CG	CN/SP
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	Choroterpes	Choroterpes	Choroterpes	2	CG	CN/SP
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	Choroterpes albiannulata	Choroterpes	Choroterpes	2	CG	CN/SP
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	Leptophlebia	Leptophlebia	Leptophlebia	3	CG	SW/CN/SP
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	Leptophlebiidae	Leptophlebiidae		2	CG	SW/CN/SP
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	Neochoroterpes	Neochoroterpes	Neochoroterpes	2	CG	CN/SP
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	Paraleptophlebia	Paraleptophlebia	Paraleptophlebia	1	CG	SW/CN/SP
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	Paraleptophlebia bicornuta	Paraleptophlebia	Paraleptophlebia	2	unk	SW/CN/SP
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	Paraleptophlebia debilis	Paraleptophlebia	Paraleptophlebia	1	unk	SW/CN/SP
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	Paraleptophlebia heteronea	Paraleptophlebia	Paraleptophlebia	1	CG	SW/CN/SP
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	Paraleptophlebia temporalis	Paraleptophlebia	Paraleptophlebia	1	unk	SW/CN/SP
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	Traverella	Traverella	Traverella	2	CF	CN
Arthropoda	Insecta	Ephemeroptera	Oligoneuriidae	Lachlania	Oligoneuriidae	Oligoneuriidae		CF	CN
Arthropoda	Insecta	Ephemeroptera	Polymitarcyidae	Ephoron	Ephoron	Ephoron	2	CG	BU
Arthropoda	Insecta	Ephemeroptera	Polymitarcyidae	Ephoron album	Ephoron	Ephoron	2	CG	BU
Arthropoda	Insecta	Ephemeroptera	Siphonuridae	Siphonurus	Siphonuridae	Siphonuridae	2	CG	SW/CM
Arthropoda	Insecta	Ephemeroptera	Tricorythidae	Tricorythidae	Tricorythidae		4	unk	unk
Arthropoda	Insecta	Hemiptera	Belostomatidae	Belostomatidae	Belostomatidae	Belostomatidae	10	PR	SW/CM
Arthropoda	Insecta	Hemiptera	Belostomatidae	Lethocerus	Belostomatidae	Belostomatidae	10	PR	SW
Arthropoda	Insecta	Hemiptera	Corixidae	Callicorixa	Corixidae	Corixidae		PR	SW
Arthropoda	Insecta	Hemiptera	Corixidae	Cenocorixa	Corixidae	Corixidae		unk	SW
Arthropoda	Insecta	Hemiptera	Corixidae	Corisella	Corixidae	Corixidae		PR	SW
Arthropoda	Insecta	Hemiptera	Corixidae	Corisella tarsalis	Corixidae	Corixidae			
Arthropoda	Insecta	Hemiptera	Corixidae	Corixidae	Corixidae	Corixidae	9	PH/PR	SW
Arthropoda	Insecta	Hemiptera	Corixidae	Hesperocorixa	Corixidae	Corixidae		PH	SW
Arthropoda	Insecta	Hemiptera	Corixidae	Hesperocorixa laevigata	Corixidae	Corixidae	9	PR	unk
Arthropoda	Insecta	Hemiptera	Corixidae	Palmarcorixa	Corixidae	Corixidae	9	unk	unk
Arthropoda	Insecta	Hemiptera	Corixidae	Palmarcorixa buenoi	Corixidae	Corixidae	9	unk	unk
Arthropoda	Insecta	Hemiptera	Corixidae	Palmarcorixa gillettei	Corixidae	Corixidae	9	unk	unk
Arthropoda	Insecta	Hemiptera	Corixidae	Sigara	Corixidae	Corixidae	9	PH	SW
Arthropoda	Insecta	Hemiptera	Corixidae	Sigara alternata	Corixidae	Corixidae		unk	SW
Arthropoda	Insecta	Hemiptera	Corixidae	Sigara decorata	Corixidae	Corixidae			
Arthropoda	Insecta	Hemiptera	Corixidae	Sigara decoratella	Corixidae	Corixidae			

Phyla	Class	Order	Family	FinalID	MMI_OTU	RIVPACS_OTU	TolVal	FFG	Habit
Arthropoda	Insecta	Hemiptera	Corixidae	Sigara grossolineata	Corixidae	Corixidae			
Arthropoda	Insecta	Hemiptera	Corixidae	Sigara lineata	Corixidae	Corixidae			
Arthropoda	Insecta	Hemiptera	Corixidae	Trichocorixa	Corixidae	Corixidae	9	PR	unk
Arthropoda	Insecta	Hemiptera	Corixidae	Trichocorixa borealis	Corixidae	Corixidae	9	unk	unk
Arthropoda	Insecta	Hemiptera	Gerridae	Gerridae			6	PR	
Arthropoda	Insecta	Hemiptera	Gerridae	Gerris			8	PR	
Arthropoda	Insecta	Hemiptera	Mesoveliidae	Mesovelia					
Arthropoda	Insecta	Hemiptera	Naucoridae	Ambrysus	Naucoridae	Naucoridae	3	PR	CN
Arthropoda	Insecta	Hemiptera	Naucoridae	Ambrysus mormon	Naucoridae	Naucoridae	3	PR	unk
Arthropoda	Insecta	Hemiptera	Nepidae	Ranatra	Ranatra	Ranatra	7	PR	unk
Arthropoda	Insecta	Hemiptera	Notonectidae	Buenoa	Notonectidae	Notonectidae		PR	unk
Arthropoda	Insecta	Hemiptera	Notonectidae	Notonecta	Notonectidae	Notonectidae	5	PR	SW
Arthropoda	Insecta	Hemiptera	Notonectidae	Notonectidae	Notonectidae	Notonectidae	7	PR	SW
Arthropoda	Insecta	Hemiptera	Pleidae	Neoplea	Pleidae	Pleidae		unk	unk
Arthropoda	Insecta	Hemiptera	Saldidae	Saldula	Saldula			unk	CM
Arthropoda	Insecta	Hemiptera	Sialidae	Sialis	Sialis		4	PR	CN,CM,BU
Arthropoda	Insecta	Lepidoptera	Pyalidae	Acentria	Lepidoptera	Lepidoptera		SH	CM
Arthropoda	Insecta	Lepidoptera	Pyalidae	Petrophila	Lepidoptera	Lepidoptera	5	SC	CN
Arthropoda	Insecta	Odonata	Aeshnidae	Aeshna	Aeshna	Aeshna		PR	CM
Arthropoda	Insecta	Odonata	Aeshnidae	Aeshnidae	Aeshnidae		5	PR	CM
Arthropoda	Insecta	Odonata	Aeshnidae	Anax	Anax	Anax	5	PR	CM
Arthropoda	Insecta	Odonata	Aeshnidae	Anax junius	Anax	Anax		PR	unk
Arthropoda	Insecta	Odonata	Calopterygidae	Hetaerina americana	Calopterygidae	Calopterygidae		PR	unk
Arthropoda	Insecta	Odonata	Coenagrionidae	Amphiagrion	Amphiagrion	Amphiagrion	7	PR	CM
Arthropoda	Insecta	Odonata	Coenagrionidae	Argia	Argia	Argia	7	PR	CN
Arthropoda	Insecta	Odonata	Coenagrionidae	Coenagrion	Coenagrionidae	Other_Coenagrionidae		PR	CM
Arthropoda	Insecta	Odonata	Coenagrionidae	Coenagrionidae	Coenagrionidae	Other_Coenagrionidae	7	PR	CM
Arthropoda	Insecta	Odonata	Coenagrionidae	Enallagma	Coenagrionidae	Other_Coenagrionidae	7	PR	CM
Arthropoda	Insecta	Odonata	Coenagrionidae	Ischnura	Coenagrionidae	Other_Coenagrionidae	7	PR	CM
Arthropoda	Insecta	Odonata	Cordulegastridae	Cordulegaster	Cordulegaster	Cordulegaster		PR	BU
Arthropoda	Insecta	Odonata	Cordulegastridae	Cordulegastridae	Cordulegastridae			PR	unk
Arthropoda	Insecta	Odonata	Corduliidae	Corduliidae	Corduliidae	Corduliidae		unk	SP
Arthropoda	Insecta	Odonata	Corduliidae	Neurocordulia	Corduliidae	Corduliidae		unk	unk
Arthropoda	Insecta	Odonata	Gomphidae	Erpetogomphus	Gomphidae	Gomphidae	3	PR	
Arthropoda	Insecta	Odonata	Gomphidae	Gomphidae	Gomphidae	Gomphidae	2	PR	BU
Arthropoda	Insecta	Odonata	Gomphidae	Gomphus	Gomphidae	Gomphidae		PR	BU
Arthropoda	Insecta	Odonata	Gomphidae	Octogomphus	Gomphidae	Gomphidae		PR	bu
Arthropoda	Insecta	Odonata	Gomphidae	Ophiogomphus	Gomphidae	Gomphidae	5	PR	BU
Arthropoda	Insecta	Odonata	Gomphidae	Stylurus	Gomphidae	Gomphidae		PR	unk
Arthropoda	Insecta	Odonata	Lestidae	Archilestes	Archilestes	Archilestes	9	PR	unk
Arthropoda	Insecta	Odonata	Lestidae	Lestes	Lestes	Lestes	9	PR	SW
Arthropoda	Insecta	Odonata	Libellulidae	Leucorrhinia	Libellulidae	Libellulidae		PR	unk
Arthropoda	Insecta	Odonata	Libellulidae	Libellula	Libellulidae	Libellulidae	9	PR	SP
Arthropoda	Insecta	Odonata	Libellulidae	Libellulidae	Libellulidae	Libellulidae	9	PR	SP
Arthropoda	Insecta	Odonata	Libellulidae	Perithemis	Libellulidae	Libellulidae		PR	unk
Arthropoda	Insecta	Odonata	Libellulidae	Symptetrus	Libellulidae	Libellulidae	9	PR	unk
Arthropoda	Insecta	Plecoptera	Capniidae	Capniidae	Capniidae	Capniidae	1	SH	CN
Arthropoda	Insecta	Plecoptera	Chloroperlidae	Chloroperlidae	Chloroperlidae	Other_Chloroperlidae	1	PR	CN
Arthropoda	Insecta	Plecoptera	Chloroperlidae	Chloroperlinae	Chloroperlidae	Other_Chloroperlidae			
Arthropoda	Insecta	Plecoptera	Chloroperlidae	Kathroperla	Kathroperla	Kathroperla	1	CG	unk
Arthropoda	Insecta	Plecoptera	Chloroperlidae	Kathroperla perdita	Kathroperla	Kathroperla	1	unk	unk
Arthropoda	Insecta	Plecoptera	Chloroperlidae	Neaviperla	Chloroperlidae	Other_Chloroperlidae	1	unk	unk
Arthropoda	Insecta	Plecoptera	Chloroperlidae	Paraperla	Paraperla	Paraperla	1	unk	unk
Arthropoda	Insecta	Plecoptera	Chloroperlidae	Suwallia	Chloroperlidae	Other_Chloroperlidae	1	PR	unk
Arthropoda	Insecta	Plecoptera	Chloroperlidae	Sweltsa	Chloroperlidae	Other_Chloroperlidae	0	PR	CN
Arthropoda	Insecta	Plecoptera	Chloroperlidae	Triznaka	Chloroperlidae	Other_Chloroperlidae		PR	unk

Phyla	Class	Order	Family	FinalID	MMI_OTU	RIVPACS_OTU	TolVal	FFG	Habit
Arthropoda	Insecta	Plecoptera	Leuctridae	Despaxia	Leuctridae	Leuctridae	2	unk	unk
Arthropoda	Insecta	Plecoptera	Leuctridae	Despaxia augusta	Leuctridae	Leuctridae	2	SH	CN
Arthropoda	Insecta	Plecoptera	Leuctridae	Leuctridae	Leuctridae	Leuctridae	1	SH	CN
Arthropoda	Insecta	Plecoptera	Leuctridae	Moselia infuscata	Leuctridae	Leuctridae		SH	
Arthropoda	Insecta	Plecoptera	Leuctridae	Paraleuctra	Leuctridae	Leuctridae	2	unk	CN
Arthropoda	Insecta	Plecoptera	Leuctridae	Perlomyia	Leuctridae	Leuctridae		unk	CN
Arthropoda	Insecta	Plecoptera	Nemouridae	Amphinemura	Amphinemura	Amphinemura	2	SH	CN
Arthropoda	Insecta	Plecoptera	Nemouridae	Amphinemura banksi	Amphinemura	Amphinemura	2	SH	unk
Arthropoda	Insecta	Plecoptera	Nemouridae	Malenka	Malenka	Malenka	1	unk	CN
Arthropoda	Insecta	Plecoptera	Nemouridae	Nemouridae	Nemouridae		2	SH	CN
Arthropoda	Insecta	Plecoptera	Nemouridae	Podmosta	Podmosta	Podmosta	2	SH	CN
Arthropoda	Insecta	Plecoptera	Nemouridae	Prostoia besametsa	Prostoia	Prostoia	3	SH	CN
Arthropoda	Insecta	Plecoptera	Nemouridae	Visoka cataractae	Visoka	Visoka	0	SH	CN
Arthropoda	Insecta	Plecoptera	Nemouridae	Zapada	Zapada	Zapada	2	SH	CN
Arthropoda	Insecta	Plecoptera	Nemouridae	Zapada cinctipes	Zapada	Zapada	3	SH	CN
Arthropoda	Insecta	Plecoptera	Nemouridae	Zapada columbiana	Zapada	Zapada	2	SH	CN
Arthropoda	Insecta	Plecoptera	Nemouridae	Zapada frigida	Zapada	Zapada	1	SH	CN
Arthropoda	Insecta	Plecoptera	Nemouridae	Zapada Oregonensis	Zapada	Zapada		SH	CN
Arthropoda	Insecta	Plecoptera	Peltoperlidae	Yoraperla	Yoraperla	Yoraperla	0	SH	CN
Arthropoda	Insecta	Plecoptera	Peltoperlidae	Yoraperla brevis	Yoraperla	Yoraperla		unk	unk
Arthropoda	Insecta	Plecoptera	Perlidae	Acroneuria	Acroneuria	Acroneuria	0	PR	CN
Arthropoda	Insecta	Plecoptera	Perlidae	Acroneuria abnormis	Acroneuria	Acroneuria	2	PR	CN
Arthropoda	Insecta	Plecoptera	Perlidae	Calineuria californica	Calineuria	Calineuria	2	PR	CN
Arthropoda	Insecta	Plecoptera	Perlidae	Claassenia	Claassenia sabulosa	Claassenia_sabulosa	2	PR	CN
Arthropoda	Insecta	Plecoptera	Perlidae	Claassenia sabulosa	Claassenia sabulosa	Claassenia_sabulosa	3	PR	CN
Arthropoda	Insecta	Plecoptera	Perlidae	Doroneuria	Doroneuria	Doroneuria	0	unk	CN
Arthropoda	Insecta	Plecoptera	Perlidae	Doroneuria theodora	Doroneuria	Doroneuria	0	unk	CN
Arthropoda	Insecta	Plecoptera	Perlidae	Hesperoperla pacifica	Hesperoperla	Hesperoperla	1	PR	CN
Arthropoda	Insecta	Plecoptera	Perlidae	Perlidae	Perlidae		2	PR	CN
Arthropoda	Insecta	Plecoptera	Perlodidae	Cascadoperla trictura	Cascadoperla	Cascadoperla_trictura	2	unk	CN
Arthropoda	Insecta	Plecoptera	Perlodidae	Cultus	Cultus	Cultus	2	PR	CN
Arthropoda	Insecta	Plecoptera	Perlodidae	Diura	Diura	Diura	2	SC	CN
Arthropoda	Insecta	Plecoptera	Perlodidae	Diura knowltoni	Diura	Diura	2	SC	CN
Arthropoda	Insecta	Plecoptera	Perlodidae	Isogenoides	Isogenoides	Isogenoides	3	PR	CN
Arthropoda	Insecta	Plecoptera	Perlodidae	Isogenoides elongatus	Isogenoides	Isogenoides	3	PR	CN
Arthropoda	Insecta	Plecoptera	Perlodidae	Isoperla	Isoperla	Isoperla	2	PR	CN
Arthropoda	Insecta	Plecoptera	Perlodidae	Isoperla fulva	Isoperla	Isoperla	3	PR	CN
Arthropoda	Insecta	Plecoptera	Perlodidae	Isoperla sobria	Isoperla	Isoperla	2	PR	CN
Arthropoda	Insecta	Plecoptera	Perlodidae	Kogotus	Kogotus	Kogotus	1	PR	CN
Arthropoda	Insecta	Plecoptera	Perlodidae	Megarcys	Megarcys	Megarcys	1	PR	CN
Arthropoda	Insecta	Plecoptera	Perlodidae	Perlinodes	Perlinodes	Perlinodes	1	unk	CN
Arthropoda	Insecta	Plecoptera	Perlodidae	Perlinodes aurea	Perlinodes	Perlinodes	1	unk	CN
Arthropoda	Insecta	Plecoptera	Perlodidae	Perlodidae	Perlodidae		2	PR	CN
Arthropoda	Insecta	Plecoptera	Perlodidae	Setvena	Setvena	Setvena	0	PR	CN
Arthropoda	Insecta	Plecoptera	Perlodidae	Setvena bradleyi	Setvena	Setvena	0	unk	CN
Arthropoda	Insecta	Plecoptera	Perlodidae	Skwala	Skwala	Skwala	3	PR	CN
Arthropoda	Insecta	Plecoptera	Pteronarcyidae	Pteronarcella	Pteronarcella	Pteronarcella	4	SH	CN
Arthropoda	Insecta	Plecoptera	Pteronarcyidae	Pteronarcella badia	Pteronarcella	Pteronarcella	3	SH	CN
Arthropoda	Insecta	Plecoptera	Pteronarcyidae	Pteronarcyidae	Pteronarcyidae		2	SH	CN
Arthropoda	Insecta	Plecoptera	Pteronarcyidae	Pteronarcys	Pteronarcys	Pteronarcys	2	SH	CN
Arthropoda	Insecta	Plecoptera	Pteronarcyidae	Pteronarcys californica	Pteronarcys	Pteronarcys	2	SH	CN
Arthropoda	Insecta	Plecoptera	Pteronarcyidae	Pteronarcys dorsata	Pteronarcys	Pteronarcys	2	unk	unk
Arthropoda	Insecta	Plecoptera	Pteronarcyidae	Pteronarcys princeps	Pteronarcys	Pteronarcys	2	SH	CN
Arthropoda	Insecta	Plecoptera	Taeniopterygidae	Taenionema	Taeniopterygidae	Taeniopterygidae	2	unk	CN
Arthropoda	Insecta	Plecoptera	Taeniopterygidae	Taeniopterygidae	Taeniopterygidae	Taeniopterygidae	2	SH	CN
Arthropoda	Insecta	Trichoptera	.	Trichoptera	Trichoptera			unk	unk

Phyla	Class	Order	Family	FinalID	MMI_OTU	RIVPACS_OTU	TolVal	FFG	Habit
Arthropoda	Insecta	Trichoptera	Apataniidae	Apatania	Apatania	Apatania	3	SC	CN
Arthropoda	Insecta	Trichoptera	Brachycentridae	Amiocentrus	Amiocentrus	Amiocentrus	3	CG	CN
Arthropoda	Insecta	Trichoptera	Brachycentridae	Amiocentrus aspilus	Amiocentrus	Amiocentrus	3	CG	CN
Arthropoda	Insecta	Trichoptera	Brachycentridae	Brachycentridae	Brachycentridae		1	CF	CN
Arthropoda	Insecta	Trichoptera	Brachycentridae	Brachycentrus	Brachycentrus	Brachycentrus	1	CF	CN
Arthropoda	Insecta	Trichoptera	Brachycentridae	Brachycentrus americanus	Brachycentrus	Brachycentrus	1	CF	CN
Arthropoda	Insecta	Trichoptera	Brachycentridae	Brachycentrus occidentalis	Brachycentrus	Brachycentrus	2	CF	CN
Arthropoda	Insecta	Trichoptera	Brachycentridae	Micrasema	Micrasema	Micrasema	1	SH	CN
Arthropoda	Insecta	Trichoptera	Brachycentridae	Micrasema bacro	Micrasema	Micrasema	1	unk	CN
Arthropoda	Insecta	Trichoptera	Glossosomatidae	Agapetus	Agapetus	Agapetus	0	SC	CN
Arthropoda	Insecta	Trichoptera	Glossosomatidae	Anagapetus	Anagapetus	Anagapetus	0	SC	CN
Arthropoda	Insecta	Trichoptera	Glossosomatidae	Culoptila	Culoptila		2	SC	CN
Arthropoda	Insecta	Trichoptera	Glossosomatidae	Glossosoma	Glossosoma	Glossosoma	0	SC	CN
Arthropoda	Insecta	Trichoptera	Glossosomatidae	Glossosoma traviatum	Glossosoma	Glossosoma	0	unk	CN
Arthropoda	Insecta	Trichoptera	Glossosomatidae	Glossosoma velona	Glossosoma	Glossosoma	0	unk	unk
Arthropoda	Insecta	Trichoptera	Glossosomatidae	Glossosomatidae	Glossosomatidae		0	SC	CN
Arthropoda	Insecta	Trichoptera	Glossosomatidae	Protoptila	Protoptila		1	SC	CN
Arthropoda	Insecta	Trichoptera	Goeridae	Goeracea	Goeridae	Goeridae		SC	CN
Arthropoda	Insecta	Trichoptera	Helicopsychidae	Helicopsyche	Helicopsyche	Helicopsyche	3	SC	CN
Arthropoda	Insecta	Trichoptera	Helicopsychidae	Helicopsyche borealis	Helicopsyche	Helicopsyche	3	SC	CN
Arthropoda	Insecta	Trichoptera	Helicopsychidae	Helicopsychidae	Helicopsychidae		3	unk	unk
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Arctopsyche	Arctopsyche	Arctopsyche	2	CF	CN
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Arctopsyche grandis	Arctopsyche	Arctopsyche	2	CF	CN
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Arctopsychinae	Arctopsychinae			unk	unk
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Ceratopsyche	Hydropsyche_Ceratopsyche	Hydropsyche_Ceratopsyche	5	unk	unk
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche	Cheumatopsyche	5	CF	CN
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche_Ceratopsyche	Hydropsyche_Ceratopsyche	5	CF	CN
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche bronta	Hydropsyche_Ceratopsyche	Hydropsyche_Ceratopsyche	5	unk	CN
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche cockerelli	Hydropsyche_Ceratopsyche	Hydropsyche_Ceratopsyche	4	unk	CN
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche morosa	Hydropsyche_Ceratopsyche	Hydropsyche_Ceratopsyche	6	unk	CN
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche occidentalis	Hydropsyche_Ceratopsyche	Hydropsyche_Ceratopsyche	5	unk	CN
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche osleri	Hydropsyche_Ceratopsyche	Hydropsyche_Ceratopsyche	4	unk	CN
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche simulans	Hydropsyche_Ceratopsyche	Hydropsyche_Ceratopsyche			
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsyche slossonae	Hydropsyche_Ceratopsyche	Hydropsyche_Ceratopsyche	4	unk	unk
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsychidae	Hydropsychidae		4	CF	CN
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsychinae	Hydropsychinae			CF	
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Parapsyche	Parapsyche	Parapsyche	0	CF	CN
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Parapsyche almota	Parapsyche	Parapsyche		unk	CN
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Parapsyche elsis	Parapsyche	Parapsyche	1	CF	CN
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Potamyia	Potamyia	Potamyia	4	CF	
Arthropoda	Insecta	Trichoptera	Hydroptilidae	Agraylea	Agraylea	Agraylea	8	PH	CM
Arthropoda	Insecta	Trichoptera	Hydroptilidae	Hydroptila	Hydroptila	Hydroptila	6	PH	CN
Arthropoda	Insecta	Trichoptera	Hydroptilidae	Hydroptilidae	Hydroptilidae		4	PH	CN
Arthropoda	Insecta	Trichoptera	Hydroptilidae	Ithytrichia	Ithytrichia		4	SC	unk
Arthropoda	Insecta	Trichoptera	Hydroptilidae	Leucotrichia	Leucotrichia	Leucotrichia	2	SC	CN
Arthropoda	Insecta	Trichoptera	Hydroptilidae	Leucotrichia pictipes	Leucotrichia	Leucotrichia	2	SC	CN
Arthropoda	Insecta	Trichoptera	Hydroptilidae	Mayatrichia	Mayatrichia	Mayatrichia	1	SC	CN
Arthropoda	Insecta	Trichoptera	Hydroptilidae	Metrichia	Metrichia	Metrichia		SH	unk
Arthropoda	Insecta	Trichoptera	Hydroptilidae	Neotrichia	Neotrichia	Neotrichia	2	SC	CN
Arthropoda	Insecta	Trichoptera	Hydroptilidae	Ochrotrichia	Ochrotrichia	Ochrotrichia	4	CG	CN
Arthropoda	Insecta	Trichoptera	Hydroptilidae	Oxyethira	Oxyethira	Oxyethira	3	PH	CM
Arthropoda	Insecta	Trichoptera	Hydroptilidae	Zumatrichia	Zumatrichia	Zumatrichia	3	unk	unk
Arthropoda	Insecta	Trichoptera	Hydroptilidae	Zumatrichia notosa	Zumatrichia	Zumatrichia	3	unk	unk
Arthropoda	Insecta	Trichoptera	Lepidostomatidae	Lepidostoma	Lepidostoma	Lepidostoma	1	SH	CM/SP
Arthropoda	Insecta	Trichoptera	Lepidostomatidae	Lepidostoma cascadenae	Lepidostoma	Lepidostoma		unk	SP/50%, CM/50%
Arthropoda	Insecta	Trichoptera	Lepidostomatidae	Lepidostoma pluviale	Lepidostoma	Lepidostoma		unk	SP/50%, CM/50%

Phyla	Class	Order	Family	FinalID	MMI_OTU	RIVPACS_OTU	TolVal	FFG	Habit	
Arthropoda	Insecta	Trichoptera	Lepidostomatidae	Lepidostomatidae	Lepidostomatidae		1	SH	CM	
Arthropoda	Insecta	Trichoptera	Leptoceridae	Ceraclea	Ceraclea	Ceraclea	3	CG	SP/CN	
Arthropoda	Insecta	Trichoptera	Leptoceridae	Leptoceridae	Leptoceridae		4	CG	CM	
Arthropoda	Insecta	Trichoptera	Leptoceridae	Mystacides	Mystacides	Mystacides	4	CG	SP	
Arthropoda	Insecta	Trichoptera	Leptoceridae	Nectopsyche	Nectopsyche	Nectopsyche	2	SH	CM/SP/CN	
Arthropoda	Insecta	Trichoptera	Leptoceridae	Oecetis	Oecetis	Oecetis	8	PR	CN/SP	
Arthropoda	Insecta	Trichoptera	Leptoceridae	Trienodes	Trienodes	Trienodes	6	SH	SW/CM	
Arthropoda	Insecta	Trichoptera	Leptoceridae	Ylodes	Ylodes	Ylodes		SH	CM	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Amphicosmoecus canax	Amphicosmoecus	Amphicosmoecus		SH	CN	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Anabolia	Anabolia	Anabolia		unk	CM	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Chyrandra	Chyrandra	Chyrandra	2	SH	SP	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Chyrandra centralis	Chyrandra	Chyrandra	2	unk	SP	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Cryptochia	Cryptochia	Cryptochia	3	SC	SP	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Dicosmoecus	Dicosmoecus	Dicosmoecus	2	SC	SP	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Dicosmoecus atripes	Dicosmoecus	Dicosmoecus	2	SC	CN	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Dicosmoecus gilvipes	Dicosmoecus	Dicosmoecus		SC	CN	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Ecclisocosmoecus	Ecclisocosmoecus	Ecclisocosmoecus		SC	unk	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Ecclisomyia	Ecclisomyia	Ecclisomyia	4	CG	CN/SP/CM	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Eocosmoecus	Eocosmoecus	Eocosmoecus		SH	CN	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Glyphopsyche	Glyphopsyche		1	unk	SP	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Hesperophylax	Hesperophylax	Hesperophylax	3	SH	SP/CN	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Homophylax	Homophylax	Homophylax	2	SH	CN/SP	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Limnephilidae	Limnephilidae		3	SH	CM	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Limnephilus	Limnephilus	Limnephilus	3	SH	CM/SP	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Nemotaulius	Nemotaulius	Nemotaulius	3	SH	unk	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Onocosmoecus	Onocosmoecus	Onocosmoecus	3	SH	SP/75%, CG/25%	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Onocosmoecus unicolor	Onocosmoecus	Onocosmoecus	3	unk	SP	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Philarctus quaeris	Philarctus			unk	unk	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Psychoglypha	Psychoglypha	Psychoglypha	0	CG	SP	
Arthropoda	Insecta	Trichoptera	Limnephilidae	Pycnopsyche	Pycnopsyche			SH	SP	
Arthropoda	Insecta	Trichoptera	Molannidae	Molanna	Molanna	Molanna	6	SC	SP	
Arthropoda	Insecta	Trichoptera	Philopotamidae	Chimarra utahensis	Chimarra	Chimarra	4	unk	CN	
Arthropoda	Insecta	Trichoptera	Philopotamidae	Dolophilodes	Dolophilodes	Dolophilodes		0	CF	CN
Arthropoda	Insecta	Trichoptera	Philopotamidae	Philopotamidae	Philopotamidae		3	CF	unk	
Arthropoda	Insecta	Trichoptera	Philopotamidae	Wormaldia	Wormaldia	Wormaldia		0	CF	CN
Arthropoda	Insecta	Trichoptera	Phryganeidae	Phryganea	Phryganeidae	Phryganeidae		SH	CM/SP	
Arthropoda	Insecta	Trichoptera	Phryganeidae	Phryganeidae	Phryganeidae	Phryganeidae	4	SH	CM	
Arthropoda	Insecta	Trichoptera	Phryganeidae	Ptilostomis	Phryganeidae	Phryganeidae		SH	CM/SP	
Arthropoda	Insecta	Trichoptera	Polycentropodidae	Neureclipsis	Polycentropodidae	Other_Polycentropodidae	6	CF	CN	
Arthropoda	Insecta	Trichoptera	Polycentropodidae	Nyctiophylax	Polycentropodidae	Other_Polycentropodidae	5	PR	CN	
Arthropoda	Insecta	Trichoptera	Polycentropodidae	Polycentropodidae	Polycentropodidae	Other_Polycentropodidae	6	CF	CN	
Arthropoda	Insecta	Trichoptera	Polycentropodidae	Polycentropus	Polycentropus	Polycentropus	6	PR	CN	
Arthropoda	Insecta	Trichoptera	Psychomyiidae	Psychomyia	Psychomyia	Psychomyia	2	CG	CN	
Arthropoda	Insecta	Trichoptera	Psychomyiidae	Psychomyia flavida	Psychomyia	Psychomyia	2	unk	CN	
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila	Rhyacophila		1	PR	CN	
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila alberta	Rhyacophila alberta gr.	Rhyacophila_alberta_group	0	PR	CN	
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila angelita	Rhyacophila angelita gr.	Rhyacophila_angelita_group	0	PR	CN	
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila arnaudi	Rhyacophila arnaudi	Rhyacophila_arnaudi		PR	CN	
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila betteni	Rhyacophila betteni gr.	Rhyacophila_betteni_group	1	PR	CN	
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila blarina	Rhyacophila sibirica gr.	Rhyacophila_sibirica_group		PR	CN	
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila brunnea	Rhyacophila brunnea/vemna Gr.s	Rhyacophila_brunnea_vemna_groups	0	PR	CN	
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila coloradensis	Rhyacophila coloradensis gr.	Rhyacophila_coloradensis_group	0	PR	CN	
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila hyalinata	Rhyacophila hyalinata gr.	Rhyacophila_hyalinata_group	1	PR	CN	
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila iranda	Rhyacophila vofixa gr.	Rhyacophila_vofixa_group			CN	
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila narvae	Rhyacophila sibirica gr.	Rhyacophila_sibirica_group	0	PR	CN	
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila nevadensis	Rhyacophila nevadensis gr.	Rhyacophila_nevadensis_group		PR	CN	

Phyla	Class	Order	Family	FinalID	MMI OTU	RIVPACS OTU	TolVal	FFG	Habit
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila pellisa	Rhyacophila sibirica gr.	Rhyacophila sibirica_group	0	PR	CN
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila rotunda	Rhyacophila rotunda gr.	Rhyacophila rotunda_group		PR	CN
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila sibirica	Rhyacophila sibirica gr.	Rhyacophila sibirica_group		PR	CN
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila vagrita	Rhyacophila vagrita gr.	Rhyacophila vagrita_group	0	PR	CN
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila verrula	Rhyacophila verrula gr.	Rhyacophila verrula_group	0	PR	CN
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophila vofixa	Rhyacophila vofixa gr.	Rhyacophila vofixa_group	0	PR	CN
Arthropoda	Insecta	Trichoptera	Rhyacophilidae	Rhyacophilidae	Rhyacophilidae		0	PR	CN
Arthropoda	Insecta	Trichoptera	Uenoidae	Neophylax	Neophylax	Neophylax	3	SC	CN
Arthropoda	Insecta	Trichoptera	Uenoidae	Neophylax occidentis	Neophylax	Neophylax		SC	
Arthropoda	Insecta	Trichoptera	Uenoidae	Neophylax rickert	Neophylax	Neophylax	3	unk	CN
Arthropoda	Insecta	Trichoptera	Uenoidae	Neophylax splendens	Neophylax	Neophylax		unk	unk
Arthropoda	Insecta	Trichoptera	Uenoidae	Neothremma	Neothremma	Neothremma	1	SC	CN
Arthropoda	Insecta	Trichoptera	Uenoidae	Oligophlebodes	Oligophlebodes	Oligophlebodes	3	SC	CN
Arthropoda	Insecta	Trichoptera	Uenoidae	Sericostriata	Sericostriata	Sericostriata		unk	CN
Arthropoda	Insecta	Trichoptera	Uenoidae	Sericostriata surdickae	Sericostriata	Sericostriata		unk	CN
Arthropoda	Insecta	Trichoptera	Uenoidae	Uenoidae	Uenoidae		2	SC	CN
Bryozoa	Tubellaria	.	.	Bryozoa	Bryozoa				
Coelenterata	Hydrozoa	.	.	Hydrozoa	Hydrozoa		5	PR	
Coelenterata	Hydrozoa	Hydroida	Hydridae	Hydra	Hydridae		5	PR	
Crustacea	Malacostraca	Amphipoda	.	Amphipoda	Amphipoda			CG	SW/50%, SP/50
Crustacea	Malacostraca	Amphipoda	Crangonyctidae	Crangonyx	Crangonyx	Crangonyx		CG	SW/50%, SP/50%
Crustacea	Malacostraca	Amphipoda	Gammaridae	Gammaridae	Gammaridae		4	CG	SW
Crustacea	Malacostraca	Amphipoda	Gammaridae	Gammarus	Gammarus	Gammarus	4	CG	SW/50%, SP/50%
Crustacea	Malacostraca	Amphipoda	Hyalellidae	Hyalella azteca	Hyalella	Hyalella	8	CG	SW/50%, SP/25%, BU/25%
Crustacea	Malacostraca	Amphipoda	Hyalellidae	Hyalellidae	Hyalellidae	Hyalella	8	CG	unk
Crustacea	Malacostraca	Amphipoda	Talitridae	Hyalella	Hyalella	Hyalella	8	CG	SW/SP
Crustacea	Malacostraca	Decapoda	.	Decapoda	Decapoda		6	CG	SW/50%, SP/50%
Crustacea	Malacostraca	Decapoda	Astacidae	Pacifastacus	Astacidae	Astacidae	6	CG	SP/75%, BU/25%
Crustacea	Malacostraca	Decapoda	Astacidae	Pacifastacus leniusculus	Astacidae	Astacidae		CG	SP/75%, BU/25%
Crustacea	Malacostraca	Decapoda	Cambaridae	Cambaridae	Cambaridae	Cambaridae		CG	SP/75%, BU/25%
Crustacea	Malacostraca	Decapoda	Cambaridae	Orconectes	Cambaridae	Cambaridae		CG	SP/75%, BU/25%
Crustacea	Malacostraca	Isopoda	Asellidae	Caecidotea	Asellidae	Asellidae	8	CG	SW/25%, SP/75%
Crustacea	Ostracoda	.	.	Ostracoda	Ostracoda			unk	SW
Mollusca	Bivalvia	Corbiculacea	Corbiculidae	Corbicula	Corbicula	Corbicula		CF	SP
Mollusca	Bivalvia	Unionida	Unionidae	Unionidae	Unionidae	Unionidae		CF	BU
Mollusca	Bivalvia	Veneroida	Pisidiidae	Pisidiidae	Pisidiidae	Pisidiidae	8	CF	BU
Mollusca	Bivalvia	Veneroida	Pisidiidae	Pisidium	Pisidiidae	Pisidiidae	8	CF	BU
Mollusca	Bivalvia	Veneroida	Pisidiidae	Pisidium milium	Pisidiidae	Pisidiidae	8	unk	unk
Mollusca	Bivalvia	Veneroida	Pisidiidae	Sphaerium	Pisidiidae	Pisidiidae	8	CF	BU
Mollusca	Bivalvia	Veneroida	Sphaeriidae	Sphaeriidae	Sphaeriidae	Sphaeriidae	8	CF	
Mollusca	Gastropoda	Basommatophora	Ancylidae	Ferrissia	Ferrissia	Ferrissia	6	SC	CN
Mollusca	Gastropoda	Basommatophora	Ancylidae	Ferrissia parallelus	Ferrissia	Ferrissia	6	unk	CN
Mollusca	Gastropoda	Basommatophora	Lymnaeidae	Fossaria	Lymnaeidae	Other_Lymnaeidae	6	SC	CN
Mollusca	Gastropoda	Basommatophora	Lymnaeidae	Lymnaeidae	Lymnaeidae	Other_Lymnaeidae	6	CG	CN
Mollusca	Gastropoda	Basommatophora	Lymnaeidae	Pseudosuccinea	Lymnaeidae	Other_Lymnaeidae		CG	CN
Mollusca	Gastropoda	Basommatophora	Lymnaeidae	Radix auricularia	Radix auricularia	Radix auricularia		CG	CN
Mollusca	Gastropoda	Basommatophora	Lymnaeidae	Stagnicola	Lymnaeidae	Other_Lymnaeidae	6	CG	CN
Mollusca	Gastropoda	Basommatophora	Physidae	Aplexa	Aplexa	Aplexa		CG	CN
Mollusca	Gastropoda	Basommatophora	Physidae	Physa	Physa Physella	Physa Physella		CG	CN
Mollusca	Gastropoda	Basommatophora	Physidae	Physella	Physa Physella	Physa Physella	8	CG	CN
Mollusca	Gastropoda	Basommatophora	Physidae	Physidae	Physidae	Physa Physella	8	CG	CN
Mollusca	Gastropoda	Basommatophora	Planorbidae	Gyraulus	Planorbidae	Planorbidae	8	CG	CN
Mollusca	Gastropoda	Basommatophora	Planorbidae	Helisoma	Planorbidae	Planorbidae	6	SC	CN
Mollusca	Gastropoda	Basommatophora	Planorbidae	Helisoma anceps	Planorbidae	Planorbidae	7	SC	
Mollusca	Gastropoda	Basommatophora	Planorbidae	Menetus	Planorbidae	Planorbidae		SC	CN
Mollusca	Gastropoda	Basommatophora	Planorbidae	Planorbella	Planorbidae	Planorbidae		SC	CN

Phyla	Class	Order	Family	FinalID	MMI_OTU	RIVPACS_OTU	TolVal	FFG	Habit
Mollusca	Gastropoda	Basommatophora	Planorbidae	Planorbidae	Planorbidae	Planorbidae	6	CG	CN
Mollusca	Gastropoda	Basommatophora	Planorbidae	Planorbula	Planorbidae	Planorbidae		SC	CN
Mollusca	Gastropoda	Heterostropha	Valvatidae	Valvata	Valvata	Valvata	3	SC	CM
Mollusca	Gastropoda	Heterostropha	Valvatidae	Valvatidae	Valvatidae		3	unk	unk
Mollusca	Gastropoda	Neotaenioglossa	Hydrobiidae	Amnicola	Hydrobiidae	Other_Hydrobiidae		SC	unk
Mollusca	Gastropoda	Neotaenioglossa	Hydrobiidae	Fluminicola	Hydrobiidae	Other_Hydrobiidae		SC	unk
Mollusca	Gastropoda	Neotaenioglossa	Hydrobiidae	Hydrobiidae	Hydrobiidae	Other_Hydrobiidae		SC	CN
Mollusca	Gastropoda	Neotaenioglossa	Hydrobiidae	Potamopyrgus antipodarum	Potamopyrgus	Potamopyrgus_antipodarum		SC	unk
Mollusca	Gastropoda	Neotaenioglossa	Hydrobiidae	Pyrgulopsis	Hydrobiidae	Other_Hydrobiidae		SC	unk
Mollusca	Ostracoda	.	.	Mollusca	Mollusca				
Nematoda	Polychaeta	.	.	Nematoda	Nematoda	Nematoda	5	unk	BU
Nematoda	Polychaeta	Mermithida	Mermithidae	Mermithidae	Nematoda	Nematoda	5	unk	BU
Nematomorpha	Polychaeta	.	.	Nematomorpha	Nematomorpha	Nematomorpha		unk	SP
Nemertea	Enopla	Hoplonemertea	Tetrastemmatidae	Prostoma	Nemertea	Nemertea		unk	unk
Platyhelminthes	Tubellaria	.	.	Polycelis coronata	Turbellaria	Turbellaria	4	unk	unk
Platyhelminthes	Tubellaria	.	.	Turbellaria	Turbellaria	Turbellaria	4	CG/PR	SP
Platyhelminthes	Tubellaria	Tricladida	.	Tricladida	Turbellaria	Turbellaria	4	PR	unk
Platyhelminthes	Tubellaria	Tricladida	Planariidae	Dugesia	Turbellaria	Turbellaria		unk	unk
Platyhelminthes	Tubellaria	Tricladida	Planariidae	Planariidae	Turbellaria	Turbellaria		PR	SP
Porifera	Hydrozoa	.	.	Porifera	Porifera			unk	unk

Taxonomist(s): _____

TAXA LIST TEMPLATE

Page 1 of 2

[illegible]

Taxonomist(s): _____

TAXA LIST TEMPLATE

Page 2 of 2

Total for This Page :	
-----------------------	--

Total # Organisms ID'd: _____

Rarefaction

Taxa diversity is dependent on the number of individuals identified in a sample. Larger samples tend to have greater diversity than smaller samples (Barbour and Gerritsen 1996). Rarefaction is a tool used to standardize the number of taxa counted from subsamples of varying sizes. For Montana benthic macroinvertebrate assessments, rarefaction is applied in metrics that count numbers of taxa in samples containing more than 300 organisms. It reduces the taxa counts by an amount that would occur if no more than the target subsample size were identified. It does not affect samples in which less than 300 individuals were collected. It is not applied in metrics of percent composition, as these metrics are not sensitive to sample size (Barbour and Gerritsen 1996).

Rarefaction is a statistical method for estimating the number of species expected ($E(S_n)$) to be present in a random sample of individuals taken from a sample larger than the specified target size. The number of species, S_n , that can be expected from a random sample of n individuals, drawn without replacement from N individuals distributed among S species, is given by

$$E(S_n) = \sum_{i=1}^S \left[1 - \left(\frac{N - N_i}{n} \right) \div \left(\frac{N}{n} \right) \right]$$

where S is the total number of species found in the collection, and N_i is the number of individuals of the i^{th} species (Hurlbert 1971). The formula computes the expected number of species in a random sample of n individuals as the sum of the probabilities that each species will be included in the sample.

For each richness metric query in EDAS, the rarefaction expression references the “probhits” procedure. The queries refer to the condensed list of enumerated taxa for each sample. All richness queries except “total taxa” limit the taxa list by some criterion (e.g., order = “Ephemeroptera”). The expression for rarefied taxa counts is:

Number Taxa (Rarefied) = Sum(probhits(300,[TotalIndividuals],[NumberIndividuals])).

This is summing “probhits” for each taxon meeting the criterion. In this case, 300 is the target sample size, TotalIndividuals is the number of individuals in the sample (parent), and NumberIndividuals is the number of individuals per taxon (parenthits). “Probhits” is a public function of EDAS written in Visual Basic as follows:

```

.....
Function probhits(subsample As Integer, Parent As Integer, parenthits As Integer) As Double
    'Parent = TotalIndividuals, parenthits = Individuals per taxon
    Dim nohits As Double
    Dim proportion As Double
    Dim j As Integer
    nohits = 1

    If (subsample >= Parent) Then          'No need to rarefy because the sample size is at or below target.
        probhits = 1
        Exit Function
    End If

    If (parenthits = 0) Then                'No need to rarefy because no individuals meet criterion.
        probhits = 0
        Exit Function
    End If

    proportion = parenthits / Parent
    If (Exp(-proportion * subsample) < 0.001) Then    'If relatively large proportion (> ~ 7%)
        probhits = 1 - Exp(-proportion * subsample)    'Use Poisson distribution
        Exit Function
    End If

    'If smaller proportion of total individuals
    'Probability of not finding the taxon
    For j = 1 To subsample
        nohits = nohits * (j + Parent - parenthits - subsample) / (j + Parent - subsample)
    Next j

    probhits = 1 - nohits

End Function
.....

```

The looped function was written by Jeroen Gerritsen as a computer-friendly translation of the combinatoric equation of Hurlbert (1971). It may be described as the number of combinations of (TotalIndividuals - IndividualsPerTaxon) taken 300 at a time, minus the combinations of (TotalIndividuals) taken 300 at a time. The function returns the expected number of species we would find in a 300 organism subsample from a larger parent sample, without replacement. It includes two approximations:

- Abundant species with high probability of occurrence in the subsample use the Poisson approximation to avoid the large number of iterations in the combinatoric equation.
- Hurlbert used the binomial combinatoric equation and summed over all species, rather than the more proper multinomial. This use of the binomial assumes complete independence among species in the subsample, which is not quite true, but probably acceptable because we are concerned with the number of species and not their identities.

Example Output for the MMI and the RIVPACS

The following pages show output from EDAS (Tetra Tech 2006a) and from the USU website (<http://www.cnr.usu.edu/wmc/>). These are used to illustrate index results for samples. The EDAS reports (Figures D-1 and D-2) show station and sample information in the upper portion, MMI results with metric values and scores in the middle section, and RIVPACS results in the lower section. Screen shots from the USU website show tabular results of index values (Figures D-3) and model performance (Figures D-4) for samples identified by their BenSampID and Replicate Number.

Montana Bioassessment Report

Waterbody Name: East Fork Bull River		Benthic Sample ID: 11596
Station ID: REFEFBR		Rep. Num 0
Reference Status: Ref		STORET Activity ID: EFBR-0819-MT
Site Classification: Mountains		Collect. Date: 08/19/2003
Latitude: 48.125	GIS_LAT: 48.125000004	Collect Method: MAC-T-500
Longitude: -115.7275	GIS_LONG: -115.7275	Total Individuals in Sample: 619

	<i>Metric:</i>	<i>Value</i>	<i>Score</i>
<i>Mountain MMI:</i> 83.0	Ephemeroptera Taxa:	9	87.9
	Plecoptera Taxa:	7	100.0
	EPT Percent:	79.5	88.3
	Non-Insect Percent:	6.1	78.1
	Predator Percent:	18.1	46.4
	Burrower Taxa %:	14.8	96.0
	HBI:	2.43	84.6

Predictive Model Results

O/E_p>0.5:	1.160048	Model Test:	P
		Total Individuals:	300

Figure D-1. MMI report from EDAS, example 1.

Montana Bioassessment Report

Waterbody Name: E.F. Meadow		Benthic Sample ID: 14689
Station ID: SHB-182		Rep. Num 0
Reference Status: Ref		STORET Activity ID: 114218
Site Classification: Mountains		Collect. Date: 01/01/1955
Latitude: 47.1271	GIS_LAT: 47.1271	Collect Method: USFS
Longitude: -112.8	GIS_LONG: -112.8	Total Individuals in Sample: 55

	<i>Metric:</i>	<i>Value</i>	<i>Score</i>
Mountain MMI: 63.2 Small sample size! MMI values may be distorted.	Ephemeroptera Taxa:	2	20.0
	Plecoptera Taxa:	3	42.9
	EPT Percent:	52.7	58.6
	Non-Insect Percent:	1.8	93.5
	Predator Percent:	16.4	42.0
	Burrower Taxa %:	22.2	85.6
	HBI:	1.37	100.0

Predictive Model Results

O/E $p > 0.5$: 0.465403	Model Test:	P	
	Total Individuals:	38	Small sample size! The O/E values may be distorted.

Figure D-2. MMI report from EDAS, example 2, showing warnings of a small sample size.

O Over E						
SITES	P > 0.0			P > 0.5		
	O	E	O/E	O	E	O/E
11333-0	20.000000	22.688585	0.881501	7.000000	6.996061	1.000563
11334-0	22.000000	22.824162	0.963891	5.000000	7.020303	0.712220
11335-0	27.000000	23.427847	1.152475	9.000000	8.838820	1.018235
11336-0	22.000000	23.625942	0.931180	7.000000	8.976555	0.779809
11338-0	17.000000	20.674253	0.822279	8.000000	7.949555	1.006346
11339-0	16.000000	21.462477	0.745487	3.000000	6.685871	0.448707
11340-0	20.000000	21.354742	0.936560	5.000000	6.709810	0.745178
11341-0	32.000000	21.957001	1.457394	8.000000	7.011681	1.140953
11342-0	28.000000	21.315762	1.313582	8.000000	6.721534	1.190205
11345-0	19.000000	20.766779	0.914923	6.000000	7.909235	0.758607
11346-0	26.000000	20.773464	1.251597	9.000000	7.906629	1.138285
11348-0	18.000000	20.669460	0.870850	10.000000	7.951373	1.257645
11349-0	23.000000	20.662411	1.113132	8.000000	7.949512	1.006351
11351-0	29.000000	20.702332	1.400808	7.000000	7.938190	0.881813
11352-0	17.000000	20.667263	0.822557	4.000000	7.951221	0.503067

Figure D-3. Screen shot of index values (O/E scores) from the USU website. The critical values to be interpreted for Montana assessments are the O/E for P>0.5.

Site Test Results

SITE	GIS_LAT	GIS_LONG	log_KM2	CRB	TMAX_PT	MODEL TEST	TOTAL # BUGS
11333-0	46.520000	-112.790001	3.030000	1.000000	129.000000	P	300
11334-0	46.810001	-113.800003	3.970000	1.000000	122.000000	P	300
11335-0	46.689999	-113.660004	3.350000	1.000000	124.000000	P	300
11336-0	46.900002	-113.750000	3.770000	1.000000	119.000000	P	284
11338-0	47.290001	-115.089996	4.440000	1.000000	151.000000	F	300
11339-0	48.490002	-114.120003	3.600000	1.000000	119.000000	P	61
11340-0	48.500000	-113.989998	3.390000	1.000000	121.000000	P	300
11341-0	48.320000	-114.269997	2.640000	1.000000	124.000000	P	300
11342-0	48.040001	-113.970001	3.240000	1.000000	126.000000	P	300
11345-0	48.590000	-115.919998	3.290000	1.000000	136.000000	P	300
11346-0	48.349998	-115.309998	3.330000	1.000000	136.000000	P	231
11348-0	45.540001	-112.330002	4.090000	0.000000	147.000000	P	300
11349-0	45.889999	-111.599998	4.390000	0.000000	153.000000	F	300
11351-0	46.509998	-111.940002	2.690000	0.000000	134.000000	P	249
11352-0	47.189999	-112.080002	2.920000	0.000000	145.000000	P	57

Figure D-4. Screen shot of model performance variables from the USU website. The sample identifier is in the left column as a combination of the BenSampID and Replicate Number. The next five columns are the model predictor variables. “Model Test” indicates whether the variables are within the experience of the model (“P”) or not (“F”). “Total # Bugs” is the number of individuals in the sample. Samples with less than 200 will yield model results that should be interpreted with caution.

ATTACHMENT 1

SOP WQPBWQM-009
DEQ SITE VISIT FORM

Place Site Visit
Label Here

Site Visit Form

(One Station per page)

STORET Project ID: _____

Trip ID : _____

Date: _____ Time: _____ Personnel: _____

Waterbody: _____ Location: _____

Station ID: _____ Visit #: _____ HUC: _____ County: _____

Latitude: _____ Longitude: _____ Lat/Long Verified? ☐ By: _____

Elevation (m): _____ GPS Datum: NAD27 **NAD83** WGS84

Samples Collected:	Sample ID (Provide for all samples):	Sample Collection Information/Preservation:
Water ☐		GRAB
Test reqd.:		Preservative: HNO ₃ H ₂ SO ₄ HCL None
Test reqd.:		Preservative: HNO ₃ H ₂ SO ₄ HCL None
Test reqd.:		Preservative: HNO ₃ H ₂ SO ₄ HCL None
Test reqd.:		Preservative: HNO ₃ H ₂ SO ₄ HCL None
Test reqd.:		Preservative: HNO ₃ H ₂ SO ₄ HCL None
Sediment ☐		SED-1
Test reqd.:		
Chlorophyll a ☐		C=Core H=Hoop T=Template N= No Sample
Chlorophyll a Transect:	1____ 2____ 3____ 4____ 5____ 6____ 7____ 8____ 9____ 10____ 11____	
Phytoplankton ☐		PHYTOPLANK Volume Filtered (mL):
Algae/Macrophytes ☐		PERI-1 OTHER:
Macroinvertebrate ☐		KICK HESS JAB OTHER:
Kick/Jab Length (ft):	Kick Duration/# Jabs:	# of Jars: Mesh Size: 1200 1000 500 OTHER:

Field Measurements:	Field Assessments:
Temp: W °C °F A °C °F	Habitat Assessment: Reach Scale ☐ Site Scale ☐
pH:	EMAP Assessment ☐
SC: (umho/cm)	Substrate: Pebble Count ☐ Percent Fines ☐ RSI ☐
DO: (mg/L)	Channel Cross-Section ☐
Turbidity: Clear ☐ Slight ☐ Turbid ☐ Opaque ☐	Photographs: Digital ☐ Film ☐
Flow: (cfs)	Other Assessments:
Flow Method: Meter ☐ Float ☐ Gage ☐ Visual Est. ☐	
Flow Comments: Dry Bed ☐ No Measurable Flow ☐	
Other Flow Comments:	

Site Visit Comments:

Chemistry Lab Information:		
Lab Samples Submitted to:	Account #:	Date Submitted:
Invoice Address:		
Contact Name & Phone:		
EDD ☒ Format: SIM Compatible	Term Contract Number:	
Relinquished By & Date/Time:	Shipped By & Date/Time:	Received By & Date/Time:
Relinquished By & Date/Time:	Shipped By & Date/Time:	Received By & Date/Time:

Lab Use Only - Delivery Temperature (°C): _____

Site Visit Form Instructions

1. Place a Site Visit Code label in the upper left corner.
2. Place a Trip Label in the upper right corner. (Covering Project ID and Trip ID with label is alright.)
3. **STORET Project ID:** If you do not have a Trip Label, enter the Project ID assigned by Data Management. If you do not know the Project ID contact the STORET Database Manager.
4. **Trip ID:** If you do not have a Trip Label, enter the Trip ID assigned by Data Management. If you do not know the Trip ID contact the STORET Database Manager.
5. **Date/Time:** Enter the date and time of the station visit.
6. **Personnel:** Enter the first and last name(s) of the personnel conducting field activities.
7. **Waterbody:** Enter the name of the waterbody such as "Missouri River".
8. **Location:** Description of sample location such as "upstream from bridge on Forest Service road 100". For confidentiality please DO NOT use proper names of people in the location field.
9. **Station ID:** If you have a Trip Label, enter the established ID or assign a new ID by using the station prefix found on the Trip Label. If you do not have a Trip Label and do not have a Station ID, leave the field blank and Data Management will generate a Station ID when SVF is submitted.
10. **Visit #:** Enter "1" if this is a new station. Leave blank if visit number is unknown.
11. **HUC:** If you do not have a Trip Label, enter the fourth code (8 digit) HUC the station falls within.
12. **County:** If you do not have a Trip Label, enter the county in which the station falls within.
13. **Lat/Long:** Latitude and Longitudes should be obtained in decimal degrees using a GPS unit reading **NAD83** whenever possible. If a lat/long is obtained by another method, the datum and method must be recorded in the Site Visit Comments.
14. **Lat/Long Verified:** Latitudes and Longitudes should be verified immediately upon return from the field. Verify by plotting on a paper map or using a mapping website. Once the lat/long has been verified check the Verified box and enter initials after "By".
 - Do not make minor adjustments to measured values during verification; they are assumed to be correct within the limitations of the measurement system.
 - Gross errors should be corrected as follows: 1) Draw a single line through the erroneous value(s) and initial. Do not erase the original reading. 2) Write the corrected value in the comment field along with the method and datum used to derive the corrected value.
15. **Elevation:** Record elevation collected by GPS and circle the GPS datum used. If elevation is obtained by another method, the datum and method must be recorded in the Site Visit Comments.
16. **Samples Collected:** Check the box next to each activity that is collected during the station visit.
17. **Sample ID:** Write the Sample ID (Site Visit Code-sample identifier) for all of the samples collected.
18. **Sample Collection Procedure:** Circle the appropriate Sample Collection Procedure ID.
 - For Chlorophyll a, record the sample collection ID for each transect in the spaces provided.
19. **Analysis Requested:** Record the requested laboratory analysis for each chemistry sample and circle the preservative used.
20. **Field Measurements:** Record your field measurements in the spaces provided.
21. **Field Assessments:** Check the boxes next to each type of field assessment completed.
22. **Site Visit Comments:** Record general comments about the station visit, samples, and field measurements.
23. **Chemistry Lab Information:** If chemistry lab samples were taken, complete this section.
 - Lab Samples Submitted to: Enter name of laboratory where samples will be sent.
 - Account #: Enter account number at laboratory where samples will be sent.
 - Date Submitted: Record date the samples were received by the laboratory.
 - Sign and date the form each time the samples change possession.

**Attachment 2 - PHOTOGRAPH LOCATIONS AND DESCRIPTIONS
OF REACH AND/OR SITES**

Date:

Site Visit Code(s):

Waterbody:

STORET Station ID:

Personnel:

Photo No: _____ Lat _____ Long _____

Description: _____

Photo No: _____ Lat _____ Long _____

Description: _____

Photo No: _____ Lat _____ Long _____

Description: _____

Photo No: _____ Lat _____ Long _____

Description: _____

Photo No: _____ Lat _____ Long _____

Description: _____

Photograph Locations and Descriptions - Continued

Photo No: _____ Lat _____ Long _____

Description: _____

Photo No: _____ Lat _____ Long _____

Description: _____

Photo No: _____ Lat _____ Long _____

Description: _____

Photo No: _____ Lat _____ Long _____

Description: _____

Photo No: _____ Lat _____ Long _____

Description: _____

Attachment 3 - Site Sketch

Date:

Site Visit Code:

Waterbody:

Personnel: