Appendix C:
Habitat Analysis

Habitat Analysis

Both the quality and quantity of available habitat affects the macroinvertebrate community. A healthy biological community not only requires good water quality, but also a supporting habitat. The effect of habitat can be minimized by sampling in areas where habitats are similar. This way impacts to the biological community can be attributed to water quality.

Beginning with the 1993 study, each sampling station's habitat has been rated. There are two types of rating systems for 2009. One is for a riffle/run prevalent stream, like most of the streams in Monroe County, which incorporates three categories for a total of twelve parameters, whereas the parameters for the low gradient streams utilize 9 parameters. Seven sites in this study were evaluated using the latter system. The following is an explanation of the habitat parameters:

Habitat Parameter Descriptions

Riffle/Run Community

Substrate/Instream Cover

1. **Instream Cover:**
   This is a measure of quantity and variety of natural structures in the stream that will provide a habitat for fish. This would include fallen trees, logs, and branches, undercut banks and large rocks. A wide variety of substrate will support greater diversity.

2. **Substrate for Benthic Macroinvertebrates:**
   This measures the amount of hard substrate available for insects and snail habitat. Many insect larvae attach themselves to submerged substrate. Areas with rocky bottoms are critical for maintaining a healthy variety of insects.

3. **Embeddedness:**
   This refers to the degree to which rocks are covered or sunken into the silt, sand or mud. As substrates become embedded in the stream bottom, the amount of adequate surface space for insects to attach themselves decreases and the quantity and quality of the macroinvertebrate community is predicted to decrease.

4. **Velocity/Depth Regime:**
   There are four basic velocity/depth combinations:
   (1) Slow-deep
   (2) Slow-shallow
   (3) Fast-deep
   (4) Fast-shallow
   General guidelines are as follows: 0.5 m separates deep from shallow: 0.3 m/s separates fast from slow. Streams that contain all four regimes are considered optimal.

Channel Morphology (form and structure)

5. **Channel Alteration:**
This parameter is a measure of changes to the shape of the stream channel. Streams that run through agricultural or urban areas may have been altered several times. When streams have been altered in any way (i.e., straightened, deepened, diverted, concrete channelized, artificial embankments or stabilization, dams or bridges), it can affect the macroinvertebrate community. Streams that have been altered provide fewer natural habitats for fish, macroinvertebrates and plants.

6. **Sediment Deposition:**
This parameter measures the sediment, which has accumulated on the stream bottom as a result of deposition. Deposition occurs as a result of large-scale movement of sediment caused by watershed erosion. This deposition may cause the formation of islands or point bars in the stream, which decreases the available habitat for macroinvertebrates.

7. **Frequency of Riffles:**
This parameter assumes that a stream with riffles or bends provides more diverse habitat than any straight or uniform depth stream. The ratio is calculated by dividing the average distance between riffles or bends by the average depth. The smaller ratio is an indicator of good habitat.

8. **Channel Flow Status:**
This is a measure of the degree to which the channel is filled with water. When the water reaches the base of both banks and a minimal amount of channel substrate is exposed, optimal conditions exist.

Riparian and Bank Structures

9. **Condition of Banks:**
This parameter addresses stream bank erosion (or potential for erosion). Steep banks are generally more susceptible to erosion and failure. Signs of erosion include crumbling and unvegetated banks and exposed tree roots and soil.

10. **Bank Vegetative Protection:**
This measures the amount of stream bank, which is covered by vegetation. Plant root systems on stream banks facilitate soil stability, which reduces the stream bank erosion. This parameter also provides information such as stream shading and nutrient uptake. Banks that support full natural plant growth are indicative for supporting a healthier habitat for macroinvertebrates and fish.

11. **Grazing Disruptive Pressure:**
This parameter measures the impact to the riparian zone, due to livestock grazing or human activities such as, urbanization, golf courses and residential developments.

12. **Riparian Zone Width:**
This is a measure of the width of the natural vegetation from the edge of the stream bank. This zone serves as a buffer to pollutants entering the stream from runoff and erosion. It also provides nutrients to the stream. An undisturbed riparian zone is reflective of a healthy stream, while a narrow riparian zone is not as healthy for a stream. Roads, parking lots, fields, lawns, rocks, bare soil or buildings near a stream bank have a detrimental effect on habitat.

Multihabitat (low gradient) Community

Substrate/Instream Cover

1. **Epifaunal Substrate for Macroinvertebrates:**
   The substrate in muddy bottom streams consists mostly of submerged logs, snags and aquatic vegetation.

2. **Pool Substrate Characterization:**
   This is an evaluation of the type and condition of bottom substrates found in pools. Firm sediment types such as gravel and sand as well as rooted aquatic plants support a wider variety of organisms. A pool substrate dominated by mud or bedrock will not support a diverse community. A variety of substrate is needed for a diverse community.

3. **Pool Variability:**
   This parameter rates the overall mixture of pool types found in the streams. The four basic types of pools are:
   (1) Large-shallow
   (2) Large-deep
   (3) Small-shallow
   (4) Small-deep

   General guidelines are as follows: greater than one half the cross-section to separate large from small and one meter separating shallow and deep.

Channel Morphology (form and structure)

4. **Sediment Deposition:**
   This parameter measures the sediment, which has accumulated on the bottom as a result of deposition. Deposition occurs as a result of large-scale movement of sediment caused by watershed erosion. This deposition may cause the formation of islands or point bars in the stream, which decreases the available habitat for macroinvertebrates.

5. **Channel Flow Status:**
   This is a determination of the percent of the channel that is filled with water. The flow status changes as the channel enlarges or as flow is decreased as a result of dams or obstructions, diversions for irrigation, or drought. When water does not cover as much of the streambed the available habitat is decreased.

6. Channel Alteration:
   This parameter is a measure of changes to the shape of the stream channel. Streams that run through agricultural or urban areas may have been altered many times. When streams have been changed in any way (i.e., straightened, deepened, diverted, concrete channelized, artificial embankments or stabilization, dams or bridges) it can affect the macroinvertebrate community. Streams that have been altered have fewer natural habitats for fish, macroinvertebrates and plants.

Riparian and Bank Structure

7. **Bank Stability:**
This parameter addresses stream bank erosion (or potential for erosion). Steep banks are generally more susceptible to erosion and failure. Signs of erosion include crumbling and unvegetated banks and exposed tree roots and soil.

9. **Vegetative Protection:**
This measures the amount of stream bank, which is covered by vegetation. Plant root systems on stream banks facilitate soil stability, which reduces the stream bank erosion. Banks that support full natural plant growth are indicative for supporting a healthier habitat for macroinvertebrates and fish.

10. **Riparian Vegetative Zone Width:**
Refer to riffle/run definition.

Each sampling station's habitat is rated using the previously discussed parameters. Each parameter is scored from 0-20 as follows:

Score	Category
0-5	Poor
6-10	Marginal
11-15	Suboptimal
16-20	Optimal

Each parameter is added for a final habitat score for a particular station.

Score	Score	Category
Freestone riffle-run	Multihabitat	
0-60	0-44	Poor
72-120	45-89	Marginal
132-180	90-134	Suboptimal
192-240	135-180	Optimal

The habitat is a major factor in determining the potential of the aquatic community. A marginal or poor habitat is not expected to support the quantity and quality of macroinvertebrates that an optimal habitat will. The following tables are presented according to sampling order for the evaluated habitat assessments, which depict how each site scored according to the above categories per sampling procedure. Table 9 below, displays the habitat assessments for the past 4 years.

Habitat Results

Table 9. This table is a comparison of habitat scores for trending purposes 2006 -2009.

Habitat Comparison				
Site ID	2006	2007	2008	2009
AQUACR11	*	*	137	144
AQUACR13	*	*	*	158
BRODCR01	181	194	202	201
BRODCR13	151	151	170	183
BRODCR16	*	*	170	179
BRODCR17	*	*	172	188
BRODCR18	*	*	220	212
BRODCR19	*	*	*	186
BRODCR20	*	*	*	193
BRODCR21	*	*	*	196
BRODCR22	*	*	*	227
BUCKCR01	162	168	179	185
BUCKCR06	*	*	144	203
BUCKCR07	*	*	179	198
BUCKCR08	*	*	*	182
CHERCR06	*	*	*	152
CHERCR14	*	*	190	193
CHERCR15	*	*	*	149
DEHOCR04	176	173	195	198

Habitat Comparison				
Site ID	2006	2007	2008	2009
DEHOCR05	*	*	202	215
LEHIRI01	215	209	197	207
LEHIRI02	185	183	184	201
MARSCR13	*	*	178	188
MCMICR34	*	*	*	180
PARACR08	*	*	211	228
POCOCR14	158	192	205	202
POCOCR16	151	185	185	193
POCOCR17	177	174	180	173
POCOCR18	175	185	190	196
POCOCR20	199	209	230	219
REDRU03	166	152	145	153
SAMBCR06	*	*	*	143
SCOTCR04	150	156	168	162
TOBYCR01	192	182	192	201
TOBYCR14	177	186	189	198
TROUCR03	*	*	*	212
TUNKCR03	200	208	227	224
TUNKCR07	*	177	128	156

* No data