Chapter 3:
Methods for the Assessment of Habitat using the Qualitative Habitat Evaluation Index (QHEI)

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3.0 INTRODUCTION

3.0.1 Background

A general site evaluation is made while sampling each location using the Qualitative Habitat Evaluation Index (QHEI) field sheet. A listing of definitions follows to serve as a guide for the proper completion of the QHEI data sheet. These instructions will follow the QHEI field sheet in a top to bottom, left to right direction for each of the section/metrics.

The QHEI provides information on a stream's ability to support healthy fish and macroinvertebrates communities by evaluating instream habitat and the land that surrounds it. The QHEI is composed of six separate metrics each designed to evaluate a different portion of a stream site. When the 6 metrics are added together you get a total QHEI score. The higher the total score, the better the habitat. The maximum QHEI score is 100 points.

3.0.2 Scope

The QHEI data sheet is completed at the sampling site on a day of fish or macroinvertebrate community sampling. The only time you would need to complete an additional QHEI data sheet would be if a significant modification, such as the construction of a bridge or dam, occurred upstream of your sampling location. The person completing the QHEI will need to walk up and downstream of the sample location to get an accurate idea of the instream habitat and its surroundings. Therefore, it is best to complete the QHEI after you've taken your water chemistry and biological samples to avoid disturbing your sampling location. Since the QHEI is based on reach specific information, QHEI scores should be derived for large and great rivers and lake habitats based on distances of 500 m. Since traveling zone distances are 1000 m, two QHEI's should be prepared based on 0-500 m (0 to end of 400 m segment), and from 500-1000 (beginning of 500 m segment to end of 1000 m reach). This method is useful only for large and great rivers. See Simon (2000) for a modified QHEI appropriate for lake habitats.

3.1 METHODS

3.1.1 Habitat types

To complete the QHEI is will take about 30-60 minutes for the first time. The more familiar you become with the data sheet and the different metrics the less time is will take. In order to complete the QHEI accurately, you need to be familiar with the different habitats that occur in the stream and their definitions. Four habitat types are important for completing the QHEI.

1. Riffle: This is the area of a stream where the water is flowing fast! The surface of water appears to be bubbling. Water in this section of the stream is usually shallow. The bottom of the stream is rugged and can be difficult to walk in.

2. Run: A "run" usually occurs downstream of a riffle. The water slows down a bit and the surface appears smooth. Runs are deeper than riffles and the bottom of the stream is often flat.

3. Pool: This is the area that has slow moving water and is deeper than the riffle and run areas. This is usually the widest area in a stream. The bottom of a pool is often shaped like a bowl.

The following is a description of each of the six QHEI metrics and the individual metric components. Guidelines on how to score each are presented. In certain cases, the biologist completing the QHEI sheet may decide a habitat characteristic falls between the multiple choices. In cases where this is allowed (denoted by the phrase "or check two and average"), two boxes may be checked and their scores averaged.

The QHEI field sheet (which is a modification from the Ohio EPA 1989 field sheet) can be viewed in Appendix A. A new form generated by the Assessment Information Management System (AIMS) is also available in Appendix A. The new sheet generated by AIMS will replace the current field sheet when available for use. This SOP will work for either form.

3.1.2 Metrics

Metric 1: SUBSTRATE

This metric includes four components: substrate type, substrate origin, silt cover, and embeddedness.

a) Substrate type: There are two columns of substrate types (such as, boulder, cobble, gravel, artificial, and others). There are two check boxes in front of each substrate type for predominant substrate, and two blanks behind each substrate type to indicate presence of the substrate. For each substrate type, the first box and blank represents pool areas and the second box and blank represent riffle areas.

   First, determine which substrate type is most dominant (greater than 75 percent of bottom area), or functional, in the riffles and pools. Place a check mark in the box beside the dominant substrate type (first column pools, second column riffles). DO NOT check more than two boxes per column. If no pool or riffle is present, double check the most predominant substrate type present.

Second, determine ALL substrate types present by placing check marks in the blank spaces. All substrate observed per riffle and pool in the sampling area may be checked.

Third, check the total number of substrate types as either greater than 4, or less than or equal to 4 from the substrate blanks. If using the new AIMS generated form, check if more than four substrate types are present.

Substrate Types are defined as:

Bedrock – solid rock forms a continuous surface.
Boulder/Slabs – rounded stones over 256 mm (>10 inches) in diameter or large "slabs" more than 256 mm in length.
Cobble – stones from 64-256 mm (2.5-10 inches) in diameter
Gravel – mixture of rounded coarse material from 2-64 mm (1.5-2.5 inches) in diameter.
Sand – Materials 0.06-2.0 mm in diameter, generally this is fine material that feels "gritty" between fingers. Sand can be picked up and held in hand.
Silt – materials 0.004-0.06 mm in diameter, generally this is fine material that feels "greasy" between finger. Silt would not be able to be picked up or held in your hands.
Hardpan – particles less than 0.004 mm in diameter, usually known as "clay", forms dense gummy surfaces that are difficult to penetrate.
Detritus – dead unconsolidated organic material covering the bottom that might include sticks, pieces of wood, leaves, or other partially or decaying plant matter.
Muck – black, fine, flocculent, of completely decomposing organic matter. Muck makes great mud pies and can be rolled and held in your hand (sewage sludge is not considered muck).
Artificial – Banks are lined with rip rap, concrete, or other unnatural substrates.
NOTE: Sludge that originates from point sources is not included as a substrate. The substrate score is based on the underlying material. Note sludge presence on the data sheet and report to IDEM immediately.

b) Substrate Origin: Substrate origin refers to the "parent" material that the stream substrate is derived. Check one box. If the parent material is from multiple, choose the predominant sources (e.g., rip/rap and tills), check two boxes and average the score. Consulting geological maps under may be helpful to complete this metric.

Limestone – sedimentary rock consisting mainly of calcium carbonate.
Tills – glacial drift composed of rock fragments that range from clay to boulder size and randomly arranged without bedding.
Wetlands – sustrate typically rich in organic matter with stream originating in swamp or marsh.
Hardpan – general term for a relatively hard layer of soil at or just below the ground surface, impervious clay cemented together and does not become plastic when mixed with water.

Sandstone – sedimentary rock composed primarily from sediments derived from persisting rock (mostly quart grains) or fossils.
Rip-Rap – pile of large, similar sized angular boulders placed along the shore to prevent erosion by current.
Lacustrine – stream substrates influenced by lake or lentic habitats.
Shale – sedimentary rocks composed of detrital sediment particles (mostly clay grade) that tend to be red, brown, black, or gray and usually originate in relatively still waters, may be rich in fossils and is easily broken off or chipped.
Coal fines – mined area where coal influences the substrate, usually composed of dark, pyrite minerals.

c) Silt Cover: This is the extent that substrates are covered by silt. Check one box.

Silt heavy – means that nearly the entire stream bottom is layered with a deep covering of silt (greater than one inch thick).
Silt Moderate – includes extensive covering of silt, but with some areas of clean substrates (e.g., riffle areas).
Silt Normal – includes areas where silt is deposited in small amounts along the stream margin, or is present as a "dusting" that appears to have little functional significance.
Silt Free – should be checked if substrates are exceptionally clean throughout the sampling area.

d) Embeddedness: Emdeddedness is the degree that gravel, cobble, boulder substrates are surrounded, or covered by fine materials (sand and silt). Substrates should be considered embedded if greater than 50 percent of their surfaces are surrounded by fine material. Embedded substrates cannot be easily dislodged. Naturally sandy streams are not considered embedded. However, sand predominated streams as the result of human activities are considered embedded. Check one box

Extensive – is greater than 75 percent of sampling area embedded.
Moderate – is 50-75 percent of the sampling area embedded.
Low/Normal – is 25-50 percent of sampling area embedded.
None is less than 25 percent of sampling area embedded.

Substrate Metric Score: Although the theoretical maximum metric score is greater than 20, the maximum score allowed for this QHEI metric is limited to 20 points. The minimum score is zero.

Metric 2: INSTREAM COVER

This metric consists of two components, including instream cover types and the amount (availability) of instream cover.

a) Type: Check ALL of the cover types present in the stream. The types should be present in greater than 5 percent of sampling area. Cover should not be counted when it occurs in areas of the stream with insufficient depth (less than 20 cm), or dry portions of the stream.

   Cover types include undercut banks, overhanging vegetation, shallows in slow water (less than 20 cm), rootmats, logs or woody debris, deep pools (greater than 70 cm), oxbows, boulders, aquatic macrophytes, and rootwads (tree roots that extend into stream). **NOTE: Do not check undercut banks and rootwads unless undercut banks exist along with rootwads as a major component.**

b) Amount: Check one box. If cover is thought to be intermediate in amount between two categories, check two boxes and average the score.

   Extensive – cover is present throughout the sampling area, generally greater than 75 percent of the sampling area.
   Moderate – cover occurs in 25-75 percent of the sampling area.
   Sparse – cover is present in less than 25 percent of the sampling area (usually exists in isolated patches).
   Nearly absent – cover does not occur in any large patches for any type anywhere in the sampling area. This situation is usually found in recently channelized streams or other highly modified reaches (e.g., ship canals).

Instream Cover Metric Score: Although the theoretical maximum is greater than 20 points, the maximum score assigned for the QHEI metric instream cover is limited to 20 points.

Metric 3: CHANNEL MORPHOLOGY

This metric emphasizes the quality of the stream channel that relates to the creation and stability of the instream habitat. This metric has five categories: channel sinuosity, channel development, channelization, stability, and modifications. One box beneath each category should be checked; however, if the conditions are intermediate between categories, then check two and average the scores.

a) Sinuosity: This is the degree that a stream meanders.

   High – sinuosity is more than 2or 3 well defined outside bends within the sampling area with deep areas outside and shallow areas inside the bends.
   Moderate – sinuosity is more than 2 outside bends, with at least one bend well defined.

Low – sinuosity is a channel with only 1 or 2 poorly defined outside bends in sampling area, or slight meandering within modified banks.
No – sinuosity is a straight channel.

b) Development: This is the development of riffle/pool complexes.

Excellent – development of riffles with well developed larger substrates, e.g., gravel, cobble, or boulder; pools have variation in depth that includes a maximum depth of greater than 1 m, and riffle and run depths greater than 0.5 m.
Good – similar to excellent with following exceptions, pools show variability in depth and a distinct transition exists between pools and riffles.
Fair – riffles poorly developed, or absent; however, pools are more developed with greater variation in depth.
Poor – riffles are absent, or if present, shallow with sand and fine gravel substrates, pools are shallow (less than 0.2 m) and are absent.

c) Channelization: Refers to the influence of anthropogenic disturbance by the straightening of channels.

None – No man made channel modifications present.
Recovered – streams have been channelized in the past and have recovered most of their natural channel characteristics within the channelized levees (e.g., riffle/pool complexes, sinuosity, etc.).
Recovering – channelized streams are in the process of regaining natural characteristics; however, habitats are still degraded.
Recent or no recovery -- streams that were recently channelized or show no sign of recovery of habitats (e.g., no regrowth of trees, duff (bare dirt) along banks, rock rip-rapped banks).

d) Stability: Channel stability is determined by the lack of erosion and bank instability.

High – stable banks and substrates, with little or no erosion and no moving bedload.
Moderate – stable riffle/pool and channel characteristics, but exhibit some symptoms of instability, e.g., high bedload, eroding banks, or show effects of fluctuating water levels that cause widening of the stream channel.
Low – unstable and severely eroding banks, possess fine substrates in riffles that often change location and high bedload that slowly moves downstream.

e) Modifications/Other: This category identifies specific channel disturbances and habitat modifications in the sampling area. Check all that apply but these are not scored.

Channel Morphology Metric Score: The maximum QHEI metric score for Channel Morphology is 20 points.

Metric 4: RIPARIAN ZONE AND BANK EROSION

This metric emphasizes the quality of the riparian buffer zone and the quality of the floodplain vegetation. Each of the three components requires scoring the LEFT and RIGHT banks (looking downstream). The AVERAGE score of the LEFT and RIGHT banks, per category, is the recorded value. Check one box per bank unless conditions are considered to be intermediate between two categories, then check two boxes and average the scores.

a) Riparian Width: This is the width of the stream bank vegetation, old fields, and shrub or forest areas. Urban, residential, construction, pasture, and row crops are not included in the width of the riparian zone. Check one box per stream bank and average the scores.

b) Floodplain Quality: Floodplain means the areas immediately outside of the riparian zone, or greater than 100 ft (30.48 m) from each side of the stream. These are areas adjacent to the stream that have direct runoff and erosional effects. Check one box per bank for the predominant floodplain quality type and average the score.

c) Bank Erosion: The alteration of the streambank either by water flow or animals. False banks are used in the sense of Platts et al. (1983) to mean banks that are no longer adjacent to the normal flow of the channel, but have been moved back into the floodplain most commonly as a result of livestock trampling. Check one box per bank and average the scores.

> **None/Little –** streambanks are stable and not altered by water flows or animals (e.g., livestock). Less than 25 percent of the streambank is receiving any kind of stress. Less than 25 percent of the streambank is false, broken down, or eroding.
> **Moderate –** streambanks are receiving moderate alteration along the transect line. At least 50 percent of the streambank is in a natural stable condition, and less than 50 percent of the streambank is false, broken down, or eroding.
> **Heavy/Severe –** streambanks are receiving major alterations along the transect line. Less than 50 percent of the streambank is in a stable condition and greater than 50 percent of the stream bank is false, broken down, or eroding.

The maximum score for Riparian Zone and Bank Erosion metric is 10 points.

Metric 5: POOL and RIFFLE/RUN QUALITY

This metric emphasizes the quality of the pool or riffle/run habitats. There are six categories, which include depth, diversity of current velocities, morphology, substrate stability, and embeddedness in the riffle and run areas.

a) Maximum Pool Depth: Pools with maximum depths of less than 20 cm are considered to have lost function and the total metric score is 0. **NOTE: If maximum depth is < 20 cm, then no other characteristic needs to be scored.** Check one box.

b) Morphology: Check one box.

c) Current Velocity: (Pools and Riffles): Check ALL that are present in the sampling area.

> **Torrential** – extremely turbulent and fast flowing water with large standing waves. Water surface is very broken with no definable, connected surface; usually limited to gorges and dam spillway tailwaters.
> **Fast** – mostly non-turbulent flow with small standing waves in riffle-run areas. Water surface may be partially broken, but there is a visibly connected surface.
> **Moderate** – non-turbulent flow that is detected and visible (i.e., floating objects are readily transported downstream). Water surface is visibly connected.
> **Slow** – water flow is perceptible, but very sluggish.
> **Eddies** – small areas of reverse circular current motion, usually formed in pools immediately downstream from riffle-run areas.
> **Interstitial** – water flow is perceptible only in the interstitial spaces between substrate particles in riffle-run areas.
> **Intermittent** – no flow is evident anywhere, standing pools are separated by dry areas.

The maximum score assigned to the Pool Quality metric is 12 points with a minimum of zero.

d) Riffle/Run Depth: Check one box for the depth of riffle and runs. Score 0 if no riffles are present, or less than 5 cm in depth. **NOTE: No other characteristics need to be scored if no riffle is present or the maximum depth is < 5 cm.**

e) Riffle/Run Substrate: Check one box that best describes the substrate and stability of the riffle habitats.

f) Riffle/Run Embeddedness: This category is used to describe embeddedness in the riffle areas. Use the same criteria as used to evaluate embeddedness in Metric 1 (SUBSTRATE). Check only one box.

The maximum score assigned to the Riffle/Run Quality section is 8 points with a minimum of zero.

Metric 6: GRADIENT

a) Average width: Determine the representative width of the stream. Measurements are taken from wetted edge to wetted edge at a point that best represents the typical stream width in the sampling area. Average narrow riffles and wide pools. Record width to the nearest meter for large and great rivers.

b) Local gradient is calculated from 7.5-minute U.S. Geological Survey topographical maps by measuring the elevation drop through the sampling area. This is done by measuring the stream length between the first contour line upstream and the first countour line downstream of the sampling site and dividing the distance by the contour interval. If the contour lines are closely "packed" a minimum distance of a least one mile should be used. Some judgement may be necessary in certain anomalous areas (e.g., vicinity of waterfalls, impounded areas).

c) Drainage area is calculated using "Drainage Areas of Indiana Streams" (Hoggatt 1975). Drainage area of a stream at a specified location is that area, measured in a horizontal plane, enclosed by a topographic divide influenced by direct surface runoff from precipitation normally drained by gravity into the stream above the specified location. Estimate drainage area by using Arcview or find the point along the stream in Hoggatt (1975). Use a 1:24,000 scale topographical map (7.5-minute scale) to estimate drainage area. The drainage area for a specific point on a stream includes the water drained from the left and right banks up to the highest elevation in the surrounding area upstream from the site. Looking at the contour lines, draw the area on the map by extending lines out from the site up to the highest elevation or hill including all of the areas drained into the site at that location. The township lines encompass one square mile so estimate how many square miles are in the watershed up to the site location to calculate drainage area.

Scoring for ranges of stream gradient accounts for varying influences of gradient with stream size, preferable measured as drainage area in square miles or stream width. Score criteria are found in Table 3.1.

The maximum score assigned for Gradient Quality metric is 10 points.

Table 3.1 Classification of stream gradient corrected for stream size.

Average stream width				
0.3-4.7	4.8-9.2	9.2-13.8	13.9-30.6	>30.6
Drainage Area (sq. miles)				
0-9.2	9.2-41.6	41.6-103.7	103.7-622.9	>622.9
Gradient (ft/mile)				
Very Low				
0-1.0 2	0-1.0 2	0-1.0 2	0-1.0 4	-- --
Low				
1.1-5.0 4	1.1-3.0 4	1.1-2.5 4	1.1-2.0 6	0-0.5 6
Low-Moderate				
5.1-10.0 6	3.1-6.0 6	2.6-5.0 6	2.1-4.0 8	0.6-1.0 8
Moderate				
10.1-15.0 8	6.1-12.0 10	5.1-7.5 8	4.1-6.0 10	1.1-2.5 10
Moderate-High				
15.1-20.0 10	12.1-18.0 10	7.6-12.0 10	6.1-10.0 10	2.6-4.0 10
High				
20.1-30.0 10	18.0-30.0 8	12.1-20.0 8	10.1-15.0 8	4.1-9.0 10
Very High				
30.1-40.0 8	30.1-40.0 6	20.1-30.0 6	15.1-25.0 6	>9.0 8

Any site with a gradient greater than the upper bound of the “very high” gradient classification is assigned a score of 4.

3.1.3 Impacts/ Miscellaneous

All other information included on the QHEI field sheet is not required to calculate a total QHEI score, but is needed to assist in making biological assessments. These measures indicate the cause or source of any possible impairments.

Additional Information is recorded on the reverse side of the QHEI field sheet and is described as **Impacts/Miscellaneous**.

Major Suspected Impacts – different types of pollution sources that could be a major factor influencing the habitat characteristics affecting the biological integrity.
Subjective rating – Rating from 1-10 on the functionality of the stream for aquatic organisms. One being poor habitat and 10 being great habitat for diverse aquatic community.
Aesthetic rating – Rating from 1-10 that is based on the appeal of the stream and not the functionality (i.e., how well you expect the stream to be for diverse organisms prior to actual sampling). Streams rated a "1" would likely be poor habitat with steep eroding banks, turbid water, no riparian zones, while a "10" would include a meandering stream with excellent riffle/pool development that flows through forested riparian corridors and has clear water visibility.
Canopy Cover (% Open) – This is the percentage of the smaping site that is **not** covered or shaded by woody bank vegetation. The cover will be determined by using a spherical densiometer following manufacturers instructions. Streams with an average width of 10 m or less will have a single reading from mid-channel. Readings are made facing upstream, downstream, left bank, and right bank from the "most typical" canopy area representing the sample reach. Streams with a width greater than 10 m will have three readings taken at mid-channel, left bank, and right bank of the stream.
Percent Pool, Riffle, Run – Estimate the percentage across the entire reach per habitat type. Cumulative total cannot exceed 100%.
Is reach representative of the stream – Answer YES if the stream reach where the biological sample is collected resembles areas upstream and downstream of the reach.
General QHEI Notes – Record any special comments concerning the habitat including any pollution or obvious problems.
Stream drawing – Draw the entire sampled section so that the stream is sketched in the area provided. Important physical features are noted on the map with standard symbols. Include direction (N), direction of flow, floodplain and riparian zone characteristics, pools, riffles, runs, denote deep areas with an "X", and indicate where sampling begins and stops.

3.1.4 Quality Assurance

At the conclusion of the field season, two rounds of quality control will be done on the calculations to determine the total QHEI score. Appendix B explains the calculations.

After all data sheets have been QC'd, the data will be entered into the recommended habitat data base provided by IDEM. For additional information on QA/QC, see Appendix C.

3.2 LITERATURE CITED

Hoggatt, R.E. 1975. *Drainage Areas of Indiana streams*. U.S. Geological Survey, Indianapolis, Indiana.

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Rankin, E.T. 1995. Habitat indices in water resource quality assessments. Pp. 181-208. In W.S. Davis and T.P. Simon (eds.). *Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making.* Lewis Publishers, Boca Raton, FL.

APPENDIX A

Office of Water Quality modified version of the Qualitative Habitat Evaluation Index (QHEI) for flowing waters based on Rankin (1995).

IDEM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample # | bioSample # | Stream Name | Location

Surveyor | Sample Date | County | Macro SampleType | ☐ Habitat Complete | QHEI Score:

1-Substrate (20 points maximum)

Substrate Score:

Check 1 Predominant Pool & 1 Predominant Riffle
Check all that are present — P=Pool, R=Riffle

Predominant P	Predominant R	Present P	Present R	
☐	☐	☐	☐	Bldrs/Slabs(10)
☐	☐	☐	☐	Boulders(9)
☐	☐	☐	☐	Cobble(8)
☐	☐	☐	☐	Gravel(7)
☐	☐	☐	☐	Sand(6)
☐	☐	☐	☐	Bedrock(5)
☐	☐	☐	☐	Hardpan(4)
☐	☐	☐	☐	Detritus(3)
☐	☐	☐	☐	Muck(2)
☐	☐	☐	☐	Silt(2)
☐	☐	☐	☐	Sludge(1)
☐	☐	☐	☐	Artificial(0)

Substrate Quality (check only 1, or check 2 and AVERAGE)

Substrate Origin

☐ Limestone(1) ☐ Hardpan(0) ☐ Lacustrine(0)
☐ Tills(1) ☐ Sandstone(0) ☐ Shale(-1)
☐ Wetlands(0) ☐ Rip/Rap(0) ☐ Coal fines(-2)

Silt Cover

☐ Silt heavy(-2)
☐ Silt moderate(-1)
☐ Silt normal(0)
☐ Silt free(1)

Embeddedness

☐ Extensive(-2)
☐ Moderate(-1)
☐ Low/Normal(0)
☐ None(1)

NOTE: ignore sludge originating from point sources; score based on natural substrates

☐ >4 substrates present(2)

Comments:

2-Instream Cover (20 points maximum

Instream Cover Score:

Type (check ALL that apply)

☐ Undercut banks(1) ☐ Deep pools(2) ☐ Oxbows(1)
☐ Overhanging vegetation(1) ☐ Rootwads(1) ☐ Aquatic macrophytes(1)
☐ Shallows(in slow water)(1) ☐ Boulders(1) ☐ Logs and woody debris(1)
☐ Rootmats(1)

Comments:

Amount (check only 1, or 2 and AVERAGE)

☐ Extensive >75% (11)
☐ Moderate 25-75% (7)
☐ Sparse 5-25% (3)
☐ Nearly absent <5% (1)

3-Channel Morphology (20) (check only one per category, OR two and AVERAGE)

Channel Score:

Sinuosity	Development	Channelization	Stability	Modifications/Other	
☐ High (4)	☐ Excellent (7)	☐ None (6)	☐ High (3)	☐ Snagging	☐ Impound
☐ Moderate (3)	☐ Good (5)	☐ Recovered (4)	☐ Moderate (2)	☐ Relocation	☐ Islands
☐ Low (2)	☐ Fair (3)	☐ Recovering (3)	☐ Low (1)	☐ Canopy Removal	☐ Leveed
☐ None (1)	☐ Poor (1)	☐ Recent or no recovery (1)		☐ Dredging	☐ Bank shaping

Comments:

☐ One side channel modifications

4-Riparian Zone & Bank Erosion (10 points maximum)

Riparian Score:

Left/Right banks looking downstream (For each category, check only one per bank, OR two per bank and AVERAGE).

Riparian width L	Riparian width R (per bank)	Erosion/Runoff-Floodplain quality (past 100 ft Riparian) L	Erosion/Runoff-Floodplain quality R (most predominant per bank)		Bank Erosion L	Bank Erosion R (per bank)	
☐	☐	☐	☐	Forest, Swamp (3)	☐	☐	None or little (3)
☐	☐	☐	☐	Shrub or Old field (2)	☐	☐	Moderate (2)
☐	☐	☐	☐	Residential, Park, New field (1)	☐	☐	Heavy/Severe (1)
☐	☐	☐	☐	Fenced pasture (1)			
☐	☐	☐	☐	Conservation Tillage (1)			
☐	☐	☐	☐	Urban or Industrial (0)			
☐	☐	☐	☐	Mining, Construction (0)			
☐	☐	☐	☐	Open Pasture/Rowcrop (0)			

Wide >50m (4)
Moderate 10-50m (3)
Narrow 5-10m (2)
Very narrow <5m (1)
None (0)

Comments:

5a-Pool/Glide Quality (12 points maximum

Pool/Glide Score:

Max pool depth (check one)

☐ >1m (6)
☐ 0.7-1m (4)
☐ 0.4-0.7m (2)
☐ 0.2-0.4m (1)
☐ <0.2m (pool=0)

Morphology (check only one, OR check two and AVERAGE)

☐ Pool width > riffle width (2)
☐ Pool width = riffle width (1)
☐ Pool width < riffle width (0)

Pool/Run/Riffle current velocity (check all that apply)

☐ Eddies (1) ☐ Torrential (-1)
☐ Fast (1) ☐ Interstitial (-1)
☐ Moderate (1) ☐ Intermittent (-2)
☐ Slow (1) ☐ No pool (0)

Comments:

5b-Riffle/Run Quality (8) (check only one per category, OR two and AVERAGE)

Riffle/Run Score:

Riffle/run depth (check one)

☐ Generally>10cm, Max>50cm (4)
☐ Generally>10cm, Max<50cm(3)
☐ Generally 5-10cm (1)
☐ Generally<5cm (riffle=0)

Riffle/run substrate

☐ Stable-e.g. cobble, boulder (2)
☐ Mod. stable-e.g. pea gravel (1)
☐ Unstable-e.g. sand, gravel (0)

Riffle/run embeddedness

☐ Extensive (-1) ☐ Normal/Low (1)
☐ Moderate (0) ☐ None (2)
☐ No riffle (0)

Comments:

6-Gradient (10 points maximum)

Gradient Score:

Average width: | Gradient: (ft/mile) | Drainage Area: (square miles)

Comments:

IDEM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	bioSample #	Stream Name	Location

Surveyor	Sample Date	County	Macro SampleType	☐ Habitat Complete	QHEI Score:

Impacts/Miscellaneous

Major Suspected Impacts (Check all that apply)

- ☐ None
- ☐ Industrial
- ☐ WWTP
- ☐ Agricultural
- ☐ Livestock
- ☐ Silviculture
- ☐ Construction
- ☐ Urban Runoff
- ☐ Suburban
- ☐ Channelization
- ☐ Riparian Removal
- ☐ Flow Alteration
- ☐ CSOs
- ☐ Mining
- ☐ Landfills
- ☐ Natural

Pollution Impact Comments:

Miscellaneous QHEI Information

Subjective rating (1-10): ☐ % Riffle: ☐

Aesthetic rating (1-10): ☐ % Run: ☐

% Glide: ☐

Canopy Cover (% Open): ☐ % Pool: ☐

Is reach representative of stream? ☐

General QHEI Notes:

APPENDIX B

Quality Assurance and quality control quick reference for evaluating QHEI scoring

QHEI

Qualitative Habitat Evaluation Index

QA/QC

Quick Reference

NOTE:

- The maximum total score allowed for the QHEI is 100.
- Only one box per column should be checked. However, when two or more boxes per column are checked, an average score for that column is used in the calculation.
- Metric and total scores are whole numbers.
- Round to the nearest whole number (if the number ends in 0.5, round up to the nearest whole number).
- If a category has been left blank try to ask the individual who completed the form. If unavailable, calculate the metric as is.
- When in doubt, ask!

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	bioSample #	Stream Name	Location
AA56791	01-202	Buck cr	Anderson Rd

Surveyor	Sample Date	County	Macro SampleType	Habitat Complete	QHEI Score:
RJB	7-3-02	Monroe	Kick	☑	69

1-Substrate (20 points maximum)

Substrate Score: 14

Check 1 Predominant Pool & 1 Predominant Riffle

Check all that are present — P=Pool, R=Riffle

Predominant P	Predominant R	Present P	Present R		Predominant P	Predominant R	Present P	Present R
☐	☐	☐	☐	Bldrs/Slabs(10)	☐	☐	☐	☐ Hardpan(4)
☐	☐	☐	☐	Boulders(9)	☐	☐	☐	☐ Detritus(3)
☐	☑	☐	☑	Cobble(8)	☐	☐	☐	☐ Muck(2)
☐	☐	☐	☑	Gravel(7)	☐	☐	☐	☐ Silt(2)
☑	☐	☑	☑	Sand(6)	☐	☐	☐	☐ Sludge(1)
☐	☐	☑	☐	Bedrock(5)	☐	☐	☐	☐ Artificial(0)

Substrate Quality (check only 1, or check 2 and AVERAGE)

Substrate Origin

☐ Limestone(1)	☐ Hardpan(0)	☐ Lacustrine(0)
☑ Tills(1)	☐ Sandstone(0)	☐ Shale(-1)
☐ Wetlands(0)	☐ Rip/Rap(0)	☐ Coal fines(-2)

Silt Cover

- ☐ Silt heavy(-2)
- ☐ Silt moderate(-1)
- ☑ Silt normal(0)
- ☐ Silt free(1)

Embeddedness

- ☐ Extensive(-2)
- ☑ Moderate(-1)
- ☐ Low/Normal(0)
- ☐ None(1)

NOTE: ignore sludge originating from point sources; score based on natural substrates

☐ >4 substrates present(2)

Comments:

2-Instream Cover (20 points maximum

Instream Cover Score: 12

Type (check ALL that apply)

- ☐ Undercut banks(1)
- ☑ Overhanging vegetation(1)
- ☑ Shallows(in slow water)(1)
- ☐ Rootmats(1)
- ☑ Deep pools(2)
- ☐ Rootwads(1)
- ☐ Boulders(1)
- ☐ Oxbows(1)
- ☐ Aquatic macrophytes(1)
- ☑ Logs and woody debris(1)

Comments:

Amount (check only 1, or 2 and AVERAGE)

- ☐ Extensive >75% (11)
- ☑ Moderate 25-75% (7)
- ☐ Sparse 5-25% (3)
- ☐ Nearly absent <5% (1)

3-Channel Morphology (20) (check only one per category, OR two and AVERAGE)

Channel Score: 15

Sinuosity	Development	Channelization	Stability	Modifications/Other	
☐ High (4)	☐ Excellent (7)	☑ None (6)	☐ High (3)	☐ Snagging	☐ Impound
☑ Moderate (3)	☑ Good (5)	☐ Recovered (4)	☑ Moderate (2)	☐ Relocation	☐ Islands
☐ Low (2)	☑ Fair (3)	☐ Recovering (3)	☐ Low (1)	☑ Canopy Removal	☑ Leveed
☐ None (1)	☐ Poor (1) 4	☐ Recent or no recovery (1)		☐ Dredging	☑ Bank shaping
				☐ One side channel modifications	

Comments:

4-Riparian Zone & Bank Erosion (10 points maximum)

Riparian Score: 7

Left/Right banks looking downstream (For each category, check only one per bank, OR two per bank and AVERAGE).

Riparian width L	Riparian width R (per bank)	Erosion/Runoff-Floodplain quality (past 100 ft Riparian) L	Erosion/Runoff-Floodplain quality (past 100 ft Riparian) R (most predominant per bank)	Bank Erosion L	Bank Erosion R (per bank)
☐	☐ Wide >50m (4)	☐	☑ Forest, Swamp (3)	☑	☐ None or little (3)
☐	☑ Moderate 10-50m (3)	☐	☐ Shrub or Old field (2)	☐	☐ Moderate (2)
☑	☐ Narrow 5-10m (2)	☐	☐ Residential, Park, New field (1)	☐	☐ Heavy/Severe (1)
☐	☐ Very narrow <5m (1)	☐	☐ Fenced pasture (1) 2	☐	☐ Open Pasture/Rowcrop (0) 2.5
☐	☐ None (0) 2.5				

Comments:

5a-Pool/Glide Quality (12 points maximum

Pool/Glide Score: 7

Max pool depth (check one)

- ☐ >1m (6)
- ☐ 0.7-1m (4)
- ☑ 0.4-0.7m (2)
- ☐ 0.2-0.4m (1)
- ☐ <0.2m (pool=0)

Morphology (check only one, OR check two and AVERAGE)

- ☑ Pool width > riffle width (2)
- ☐ Pool width = riffle width (1)
- ☐ Pool width < riffle width (0)

Pool/Run/Riffle current velocity (check all that apply)

- ☐ Eddies (1)
- ☑ Fast (1)
- ☑ Moderate (1)
- ☑ Slow (1)
- ☐ Torrential (-1)
- ☐ Interstitial (-1)
- ☐ Intermittent (-2)
- ☐ No pool (0)

Comments:

5b-Riffle/Run Quality (8) (check only one per category, OR two and AVERAGE)

Riffle/Run Score: 4

Riffle/run depth (check one)

- ☐ Generally>10cm, Max>50cm (4)
- ☐ Generally>10cm, Max<50cm(3)
- ☑ Generally 5-10cm (1)
- ☐ Generally<5cm (riffle=0)

Riffle/run substrate

- ☑ Stable-e.g. cobble, boulder (2)
- ☑ Mod. stable-e.g. pea gravel (1)
- ☐ Unstable-e.g. sand, gravel (0) 1.5

Riffle/run embeddedness

- ☐ Extensive (-1)
- ☐ Moderate (0)
- ☑ Normal/Low (1)
- ☐ None (2)
- ☐ No riffle (0)

Comments:

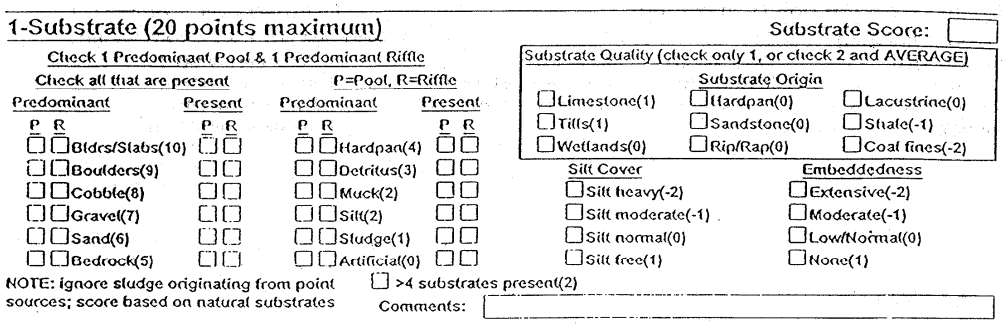
6-Gradient (10 points maximum)

Gradient Score: 10

Average width: 5.7 Gradient: 8.3 (ft/mile) Drainage Area: 20.6 (square miles)

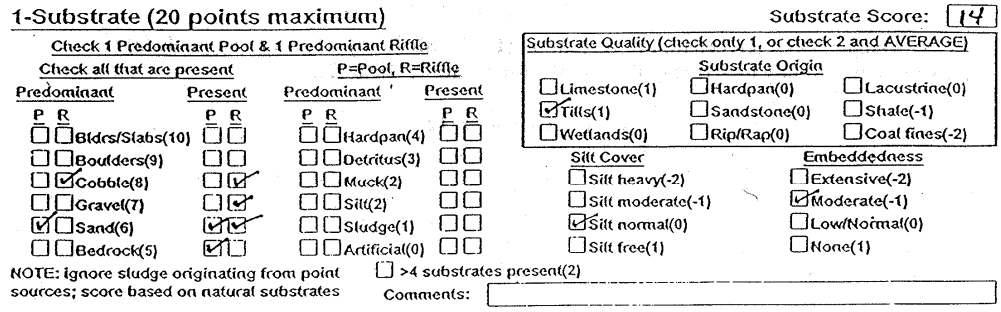
Comments:

SUBSTRATE: The maximum points allowed for this metric is **20**. The **Substrate Score** is derived by the *sum* of the **TYPE** {pool-left column *plus* riffle-right column} *plus* **TOTAL NUMBER OF SUBSTRATE TYPES** *plus* **SUBSTRATE ORIGIN** *plus* **SILT COVER** *plus* **EXTENT EMBEDDEDNESS**.



In the substrate TYPE category a check mark is placed in one box per column (note: the type category has two parts to fit page), and the total number of substrates present are checked off in the blank spaces (multiple checks). For Substrate Origin, Silt Cover, and extent of Embeddedness, check one or check two and average.

EXAMPLE



In the example: pool type [left column] **Sand (6)** *plus* riffle type [right column] **Cobble (8)** *plus* number of type spaces [cobble, gravel, sand, and bedrock] checked are **< = 4 (0)** *plus* substrate origin **Tills (1)** *plus* silt cover **Normal (0)** *plus* embeddedness **Moderate (-1).**

6 + 8 + 0 + 1 + 0 + (-1) = 14

INSTREAM COVER: The maximum points allowed for this metric is **20**. The **Instream Cover** score is derived by the *sum* of all **TYPE** *plus* **AMOUNT** [an average may be needed].

2-Instream Cover (20 points maximum

Instream Cover Score: ☐

Type (check ALL that apply)

☐Undercut banks(1) ☐Deep pools(2) ☐Oxbows(1)

☐Overhanging vegetation(1) ☐Rootwads(1) ☐Aquatic macrophytes(1)

☐Shallows(in slow water)(1) ☐Boulders(1) ☐Logs and woody debris(1)

☐Rootmats(1) Comments:

Amount (check only 1, or 2 and AVERAGE)

☐Extensive >75% (11)

☐Moderate 25-75% (7)

☐Sparse 5-25% (3)

☐Nearly absent <5% (1)

EXAMPLE

2-Instream Cover (20 points maximum

Instream Cover Score: 12

Type (check ALL that apply)

☐Undercut banks(1) ☑Deep pools(2) ☐Oxbows(1)

☑Overhanging vegetation(1) ☐Rootwads(1) ☐Aquatic macrophytes(1)

☑Shallows(in slow water)(1) ☐Boulders(1) ☑Logs and woody debris(1)

☐Rootmats(1) Comments:

Amount (check only 1, or 2 and AVERAGE)

☐Extensive >75% (11)

☑Moderate 25-75% (7)

☐Sparse 5-25% (3)

☐Nearly absent <5% (1)

In the example: types [**Overhanging vegetation (1)** *plus* **Shallows (1)** *plus* **Deep pools (2)** *plus* **Logs and woody debris (1)**] *plus* amount **Moderate 75-25% (7).**

1 + 1 + 2 + 1 + 7 = 12

RIPARIAN ZONE & BANK EROSION: The maximum points allowed for this metric is **10**. The **Riparian** score is derived by the *sum* of **RIPARIAN WIDTH** [average L and R columns] *plus* **EROSION/RUNOFF-FLOODPLAIN QUALITY** [average L and R columns] *plus* **BANK EROSION** [average L and R columns].

4-Riparian Zone & Bank Erosion (10 points maximum) Riparian Score: ☐

Left/Right banks looking downstream (For each category, check only one per bank, OR two per bank and AVERAGE).

Riparian width	Erosion/Runoff-Floodplain quality (past 100 ft Riparian)		Bank Erosion
L R (per bank)	L R (most predominant per bank)	L R	L R (per bank)
☐☐Wide >50m (4)	☐☐Forest, Swamp (3)	☐☐Conservation Tillage (1)	☐☐None or little (3)
☐☐Moderate 10-50m (3)	☐☐Shrub or Old field (2)	☐☐Urban or Industrial (0)	☐☐Moderate (2)
☐☐Narrow 5-10m (2)	☐☐Residential, Park, New field (1)	☐☐Mining, Construction (0)	☐☐Heavy/Severe (1)
☐☐Very narrow <5m (1)	☐☐Fenced pasture (1)	☐☐Open Pasture/Rowcrop (0)	
☐☐None (0)	Comments:		

EXAMPLE

4-Riparian Zone & Bank Erosion (10 points maximum) Riparian Score: 7

Left/Right banks looking downstream (For each category, check only one per bank, OR two per bank and AVERAGE).

Riparian width	Erosion/Runoff-Floodplain quality (past 100 ft Riparian)		Bank Erosion
L R (per bank)	L R (most predominant per bank)	L R	L R (per bank)
☐☐Wide >50m (4)	☐☑Forest, Swamp (3)	☑☐Conservation Tillage (1)	☐☑None or little (3)
☐☑Moderate 10-50m (3)	☐☐Shrub or Old field (2)	☐☐Urban or Industrial (0)	☑☐Moderate (2)
☑☐Narrow 5-10m (2)	☐☐Residential, Park, New field (1)	☐☐Mining, Construction (0)	☐☐Heavy/Severe (1)
☐☐Very narrow <5m (1)	☐☐Fenced pasture (1) 2	☐☐Open Pasture/Rowcrop (0)	2.5
☐☐None (0) 2.5	Comments:		

In the example: riparian width **Moderate 10-50m (3) & Narrow 5-10m (2)** [L and R average of 2.5] *plus* erosion/runoff **Forest, swamp (3) & Conservation tillage (1)** [L and R average of 2] *plus* bank erosion **None or little (3) & Moderate (2)** [L and R average of 2.5].

$$2.5 + 2 + 2.5 = 7$$

POOL/GLIDE & RIFFLE/RUN QUALITY: The maximum points allowed for each metric are **12** and **8**, respectively. An average per column may be needed except under Pool/Run/Riffle velocity in which <u>all</u> are counted.

The **Pool/Glide** score is derived by the *sum* of **MAX POOL DEPTH** *plus* **MORPHOLOGY** *plus* **POOL/RUN/RIFFLE CURRENT VELOCITY** [*sum* of all]. Note: If Max Pool Depth is less than 0.2m the metric score is zero.

5a-Pool/Glide Quality (12 points maximum Pool/Glide Score: ☐

Max pool depth (check one)	Morphology (check only one, OR check two and AVERAGE)	Pool/Run/Riffle current velocity (check all that apply)	
☐ >1m (6)	☐ Pool width > riffle width (2)	☐ Eddies (1)	☐ Torrential (-1)
☐ 0.7-1m (4)	☐ Pool width = riffle width (1)	☐ Fast (1)	☐ Interstitial (-1)
☐ 0.4-0.7m (2)	☐ Pool width < riffle width (0)	☐ Moderate (1)	☐ Intermittent (-2)
☐ 0.2-0.4m (1)		☐ Slow (1)	☐ No pool (0)
☐ <0.2m (pool=0)			

Comments:

The **Riffle/Run** score is derived by the *sum* of **RIFFLE/RUN DEPTH** *plus* **RIFFLE/RUN SUBSTRATE** *plus* **RIFFLE/RUN EMBEDDEDNESS**. Note: if Riffle/Run Depth is <5cm the metric score is zero. Check one or two and average (if allowable) for all three categories.

5b-Riffle/Run Quality (8) (check only one per category, OR two and AVERAGE) Riffle/Run Score: ☐

Riffle/run depth (check one)	Riffle/run substrate	Riffle/run embeddedness	
☐ Generally>10cm, Max>50cm (4)	☐ Stable-e.g. cobble, boulder (2)	☐ Extensive (-1)	☐ Normal/Low (1)
☐ Generally>10cm, Max<50cm(3)	☐ Mod. stable-e.g. pea gravel (1)	☐ Moderate (0)	☐ None (2)
☐ Generally 5-10cm (1)	☐ Unstable-e.g. sand, gravel (0)		☐ No riffle (0)
☐ Generally<5cm (riffle=0)			

Comments:

EXAMPLE

5a-Pool/Glide Quality (12 points maximum Pool/Glide Score: 7

Max pool depth (check one)	Morphology (check only one, OR check two and AVERAGE)	Pool/Run/Riffle current velocity (check all that apply)	
☐ >1m (6)	☑ Pool width > riffle width (2)	☑ Eddies (1)	☐ Torrential (-1)
☐ 0.7-1m (4)	☐ Pool width = riffle width (1)	☑ Fast (1)	☐ Interstitial (-1)
☑ 0.4-0.7m (2)	☐ Pool width < riffle width (0)	☑ Moderate (1)	☐ Intermittent (-2)
☐ 0.2-0.4m (1)		☑ Slow (1)	☐ No pool (0)
☐ <0.2m (pool=0)			

Comments:

5b-Riffle/Run Quality (8) (check only one per category, OR two and AVERAGE) Riffle/Run Score: 4

Riffle/run depth (check one)	Riffle/run substrate	Riffle/run embeddedness	
☐ Generally>10cm, Max>50cm (4)	☑ Stable-e.g. cobble, boulder (2)	☐ Extensive (-1)	☑ Normal/Low (1)
☐ Generally>10cm, Max<50cm(3)	☑ Mod. stable-e.g. pea gravel (1)	☐ Moderate (0)	☐ None (2)
☑ Generally 5-10cm (1)	☐ Unstable-e.g. sand, gravel (0) 1.5		☐ No riffle (0)
☐ Generally<5cm (riffle=0)			

Comments:

In the example: max pool depth **0.4-0.7m (2)** *plus* morphology **Pool width > riffle width** (2) *plus* pool/run/riffle velocity **Fast (1), Moderate (1), and Slow (1).**

2 + 2 + 1 + 1 + 1 = 7

Example continued: max riffle/run depth **Generally 5-10cm (1)** *plus* riffle/run substrate **Stable (2) & Mod. Stable (1)** [average of 1.5] *plus* riffle/run embeddedness **Low (1)**.

1 + 1.5 + 1 = 3.5 rounded to 4

GRADIENT: The maximum points allowed is **10**. The **Gradient Score** is determined through the use of the table shown below. Enter the table from the top line using the **average width** [meters], or **drainage area** (square miles) if average width is not measured. Move down that column until the range of gradient values are located containing the **gradient** value [feet/mile] from the QHEI form. Beneath each range of gradients are the corresponding **Gradient Score** values to be used in the QHEI calculation.

Classification of stream gradient for Ohio, corrected for stream size. Modified from Trautman. Scores were derived from plots of IBI versus the natural log of gradient in feet per mile. Scores are listed below.

Average Stream Width				
0.3-4.7	4.8-9.2	9.2-13.8	13.9-30.6	> 30.6
Drainage Area (Sq. Miles)				
0-9.2	9.2-41.6	41.6-103.7	103.7-622.9	>622.9
Gradient (ft/Mile)				
Very Low				
0-1.0	0-1.0	0-1.0	0-1.0	--
2	2	2	4	--
Low				
1.1-5.0	1.1-3.0	1.1-2.5	1.1-2.0	0-0.5
4	4	4	6	6
Low-Moderate				
5.1-10.0	3.1-6.0	2.6-5.0	2.1-4.0	0.6-1.0
6	6	6	8	8
Moderate				
10.1-15.0	6.1-12.0	5.1-7.5	4.1-6.0	1.1-2.5
8	10	8	10	10
Moderate High				
15.1-20.0	12.1-18.0	7.6-12.0	6.1-10.0	2.6-4.0
10	10	10	10	10
High				
20.1-30.0	18.0-30.0	12.1-20.0	10.1-15.0	4.1-9.0
10	8	8	8	10
Very High				
30.1-40.0	30.1-40.0	20.1-30.0	15.1-25.0	>9.0
8	6	6	6	8

Any site with a gradient > than the upper bound of the "very high" gradient classification is assigned a score of 4.

EXAMPLE

6-Gradient (10 points maximum) Gradient Score: 10

Average width: 5.7 Gradient: 8.3 (ft/mile) Drainage Area: 20.6 (square miles)

Comments:

In the example: the average stream width is **5.7 meters** [from the QHEI]; enter the second column from right. The gradient is **8.3 feet per mile** [from the QHEI]; the applicable range of gradients is **6.1-12.0**. The corresponding score is **10**.

APPENDIX C
QA/QC Routing slip for Qualitative Habitat Evaluation Index (QHEI) used by Indiana Department of Environmental Management

IDEM
OWQ-ASSESSMENT BRANCH
BIOLOGICAL STUDIES SECTION

QA/QC ROUTING SLIP FOR QUALITATIVE HABITAT EVALUATION INDEX (QHEI)

Project Name:_____ **(Please initial and date in the space provided.)**

1.) QC Data Sheet

a.) Complete QHEI with Drainage Area & Gradient if not already done
b.) Compute Total Score in all applicable fields (See SOP for QHEI scoring)
c.) Calculate Total QHEI Score
d.) Check that all applicable narrative information is entered
-Check Sample # and bioSample #
-On the back check that the following are filled in:
*Major suspected impacts, subjective rating, aesthetic rating, % canopy open, percentages of "Pool, Riffle, etc." equal 100%, and representative of stream
*Insure there is a sketch

Round One of Data Sheet QC _____
Round Two of Data Sheet QC _____

_____ **2.) Data Certified for Data Entry**

a.) Open AIMS, select the project information button, and type in the project name, hit enter.
b.) Go to Project Field Data Tab, Select schedule week/group : All schedule week/groups
c.) Click on the fish field data tab and find the folder for the AA# and site
d.) Click on QHEI tab and fill out the header. Most of the information in the header is linked to other tables in AIMS EXCEPT Scorer Initials and Sample number. Fill out the header completely and then go to the QHEI tabs (Substrate, Cover, etc.).
e.) Click on the Substrate tab. You can move from one field to the next in the tabbed form by using the tab key or using the mouse. You can select or deselect the check boxes by hitting the space bar or clicking on it with the mouse. The form is setup for you to use the mouse if you're a mouse person or the tab key if you're a keyboard person.
f.) After you have entered all of the data on the field sheet for that sample (don't forget the back!), sign the data sheet at the bottom:Details entered, your initials and the date(i.e.Entered SLS 4-8-02) and check the habitat complete box in the header.
g.) To begin entering data for a new sample, simply double click on the AA# or sample number at the top of the screen and type in the new AA#. This will automatically get you to the QHEI form for that sample number. Repeat the process again starting at step d.

*Data Entry_____
*Round One QC of Data Entry _____
_____*Corrections to Database
*Round Two QC of Data Entry
_____*Corrections to Database _____

_____ **3.) Data Certified for Analysis**

Comments: