Metric 5: Pool/Glide and Riffle-Run Quality

This metric emphasizes the quality of the pool, glide and/or riffle-run habitats. This includes pool depth, overall diversity of current velocities (in pools *and* riffles), pool morphology, riffle-run depth, riffle-run substrate, and riffle-run substrate quality.

A) **Pool/Glide Quality**

1) *Maximum depth of pool or glide*; check one box only (Score **0** to **6**). Pools or glides with maximum depths of *less than* 20 cm are considered to have lost their function and the *total metric* is scored a **0**. No other characteristics need be scored in this case.

2) *Current Types* - check each current type that is present in the stream (including riffles and runs; score - **2** to **4**), definitions are:

Torrential - extremely turbulent and fast flow 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 detectable 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 circular current motion usually formed in pools immediately downstream from riffle-run areas.

Interstitial - water flow that is perceptible only in the interstitial spaces between substrate particles in riffle-run areas.

Intermittent - no flow is evident anywhere leaving standing pools that are separated by dry areas.

4) *Morphology* - Check *Wide* if pools are wider than riffles, *Equal* if pools and riffles are the same width, and *Narrow* if the riffles are wider than the pools (Score **0** to **2**). If the morphology varies throughout the site *average* the types. If the entire stream area (including areas outside of the sampling zone) is pool or riffle, then check riffle = pool.

Although the theoretical maximum score is > 12 the maximum score assigned for the QHEI for the Pool Quality metric is limited to **12 points.**

B) **Riffle-Run Quality**

(score **0** for this metric if no riffles are present)

1) *Riffle/Run Depth* - select one box that most closely describes the depth characteristics of the riffle (Score **0 to 4**). If the riffle is generally less than 5 cm in depth riffles are considered to have loss their function and the entire riffle metric is scored a **0**.

2) *Riffle/Run Substrate Stability*—select one box from each that best describes the substrate type and stability of the riffle habitats (Score **0** to **2**).

3) *Riffle/Run Embeddedness*—**Embeddedness** is the degree that cobble, gravel, and boulder substrates are surrounded or covered by fine material (sand, silt). We consider substrates embedded if >50% of surface of the substrates are embedded in fine material—these substrates cannot be easily dislodged. This also includes substrates that are concreted. Boxes are checked for *extensiveness* (riffle area of sampling

zone) with embedded substrates: **Extensive** — > 75% of stream area, **Moderate** — 50-75%, **Sparse** — 25-50%, **Low** — < 25%.

The maximum score assigned for the QHEI for the Riffle/Run Quality metric is **8 points**.

Metric 6: Map Gradient

Local or map gradient is calculated from USGS 7.5 minute topographic 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 contour 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 at least one mile should be used. Some judgement may need to be exercised in certain anomalous areas (*e.g.* in the vicinity of waterfalls, impounded areas, etc.) and this can be compared to an in-field, visual estimate which is recorded on the back of the habitat sheet.

Scoring for ranges of stream gradient takes into account the varying influence of gradient with stream size, preferably measured as drainage area in square miles or stream width. Gradient classifications (Table V-4-3) were modified from Trautman (p 139, 1981) and scores were assigned, by stream size category, after examining scatterplots of IBI vs natural log of gradient in feet/mile. Scores are listed in Table V-4-3

The maximum QHEI metric score for Gradient is **10 points**.

*Computing the Total **QHEI** Score:*

To compute the total **QHEI** score, add the components of each metric to obtain the metric scores and then sum the metric scores to obtain the total **QHEI** score. The **QHEI** metric scores cannot exceed the Metric Maximum Score indicated below.

QHEI SCORING (Maximum = 100)

QHEI Metric	Metric Component	Component Scoring Range	Metric Max. Score
1) Substrate	a) Type	0 to 21	20
	b) Quality	-5 to 3	
2) Instream Cover	a) Type	0 to 10	20
	b) Amount	1 to 11	
3) Channel Morphology	a) Sinuosity	1 to 4	20
	b) Development	1 to 7	
	c) Channelization	1 to 6	
	d) Stability	1 to 3	
4) Riparian Zone	a) Width	0 to 4	10
	b) Quality	0 to 3	
	c) Bank Erosion	1 to 3	
5a) Pool Quality	a) Max. Depth	0 to 6	12
	b) Current	-2 to 4	
	c) Morphology	0 to 2	
5b) Riffle Quality	a) Depth	0 to 4	8
	b) Substr Stab.	0 to 2	
	c) Substr Embd.	-1 to 2	
6)Gradient		2 to 15	10
TOTAL	Maximum Score		100

Additional Information

Additional information is recorded on the reverse side of the Site Description Sheet (Fig. V-4-6) and is described as follows:

1) *Additional Comments/Pollution Impacts* - Different types of pollution sources (*e.g.* wastewater treatment plant, feedlot, industrial discharge, nonpoint source

Table V-4-3. Classification of stream gradients for Ohio, corrected for stream size. Modified from Trautman (p 139, 1981). Scores were derived from plots of IBI versus the natural log of gradient for each stream size category.

Average Stream Width (m)	Drainage Area (sq mi)	Gradient (ft/mile)						
		Very Low	Low	Low-Moderate	Moderate	Moderate High	High	Very High[1]
0.3-4.7	0-9.2	0-1.0 2	1.1-5.0 4	5.1-10.0 6	10.1-15.0 8	15.1-20 10	20.1-30 10	30.1-40 8
4.8-9.2	9.2-41.6	0-1.0 2	1.1-3.0 4	3.1-6.0 6	6.1-12.0 10	12.1-18.0 10	18.0-30 8	30.1-40 6
9.2-13.8	41.6-103.7	0-1.0 2	1.1-.2.5 4	2.6-5.0 6	5.1-7.5 8	7.6-12.0 10	12.1-20 8	20.1-30 6
13.9-30.6	103.7-622.9	0-1.0 4	1.1-2.0 6	2.1-4.0 8	4.1-6.0 10	6.1-10.0 10	10.1-15 8	15.1-25 6
>30.6	>622.9	-	0-0.5 6	0.6-1.0 8	1.1-2.5 10	2.6-4.0 10	4.1-9.0 10	>9.0 8

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

Figure V-4-6. Reverse side of the Ohio EPA Site Description Sheet for evaluating the geographical and physical characteristics of fish sampling locations. This is used to record additional information about the sampling site and adjacent area.

Is Reach Representative of Stream? (Y/N)_____ If Not: _____

Additional Comments/Pollution Impacts: _____

	GEAR	DISTANC	WATER CLARITY	WATER STAGE
FIRST PASS				
SECOND PASS				
THIRD PASS				

SUBJECTIVE RATING (1-10) ☐ AESTHETIC RATING (1-10) ☐

CANOPY (%OPEN) _____ GRADIENT: Ó–LOW Ó–MODERATE Ó–HIGH PHOTOS: _____

STREAM MEASUREMENTS: AVERAGE WIDTH:_____ AVERAGE DEPTH:_____ MAX. DEPTH _____

LENGTH	WIDTH	DEPTHS ▷										POOL;GLD;RIF;RUN

CROSS-SECTIONS OF STREAM

DRAWING OF STREAM

inputs) are noted with their proximity (in 0.1 mile increments) to the sampling site; any evidence of litter either instream or on the stream bank is also noted.

2) *Sampling Gear/Distance Sampled* - The type of fish sampling gear used during each pass is specified (See Table V-4-1) and any variation in sampling procedures is noted (*e.g.*, sampler type A specifies sampling along one shoreline of 0.5 km, but due to local restrictions, sampling may be performed on both shorelines to accumulate 0.5 km); the total sampling distance in kilometers for each sampling site for each pass is recorded.

3) *Water Clarity* - The following descriptions can be used as a guide:

a) Clear - bottom is clearly visible (if shallow enough) and the water contains no apparent color or staining.

b) Stained - usually a brownish (or other) color to the water; the bottom may be visible in shallow areas.

c) Turbid - bottom seldom visible at more than a few inches; caused by suspended sediment particles.

The apparent source of stained (*e.g.* tannic acid, leaf decay, etc.) and turbid (*e.g.* runoff [clay/silt], algae/diatoms, sewage, etc.) may be specified under additional comments.

4) *Water Stage* - This is the general water level of the stream during each pass; suggested descriptors are: a) flood, b) high, c) elevated, d) normal, e) low, and f) interstitial. (Note: sampling should not be conducted during flood or high flows).

5) *Canopy* - This is the percentage of the sampling site that is *not* covered or shaded by woody bank vegetation. In wide streams and rivers this determination should be made along both sides of the river or stream (*i.e.*, the percent of the sampling path that is open).

6) *Gradient* - Check the box that best describes the gradient at the site. This will be used to check the accuracy of gradients taken from topographic maps.

7) *Field Crew* - The names of all individuals involved with the sampling/site description at each site are included.

8) *Photographs* - The number of each photograph taken is recorded; the subject of the photograph is briefly described.

9) *Stream Measurements (optional)* - When measuring the individual sampling sites, length, width, and average and maximum depth information should be recorded; each measurement should be recorded as either a riffle, run, or pool or glide by placing an X in the correct box to the right of where measurements are recorded (Figure V-4-6); see the introduction for definitions of riffles, runs, etc.

The number of width measurements is left to the discretion of the field crew leader. Short riffles may require only one or two width measurements while long pools will probably require more depending on the degree of variation that exists in the stream's width. Depth measurements should be made in association with individual width measurements. Depths should be taken at the stream margins and various points across the stream. Up to nine depth measurements may be taken depending on the variability in the stream bottom. Maximum depth is the deepest spot in the stream section sampled. One purpose of this information is to calculate pool volume.

10) *Stream Diagram - Cross-sections:* Two or three cross-sections of the stream are drawn to provide information on features of the stream bank, stream bottom, stream channel, and floodplain. A series of well defined stream channels (downstream view) are shown in Figure V-4-7. Definitions of these terms follow Platts *et al.* (1983):

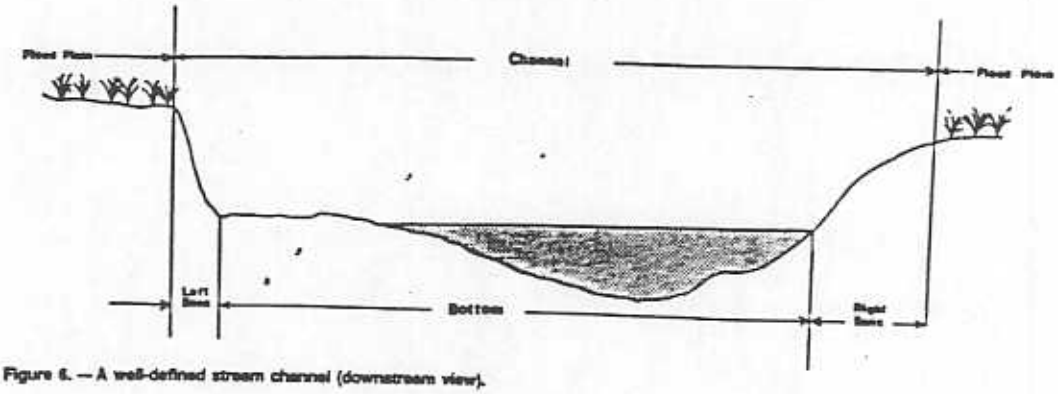

Figure 6. — A well-defined stream channel (downstream view).

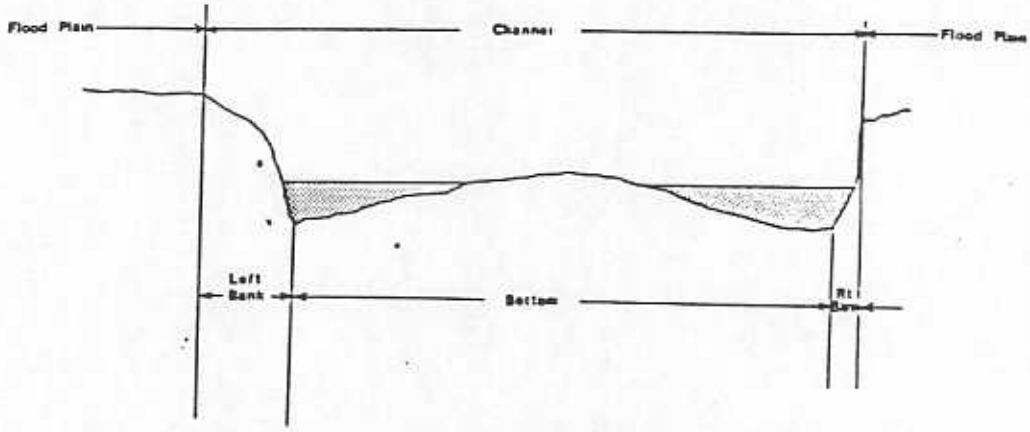

Figure 7. — A well-defined stream channel with concentrated low flows and exposed bottom (downstream view).

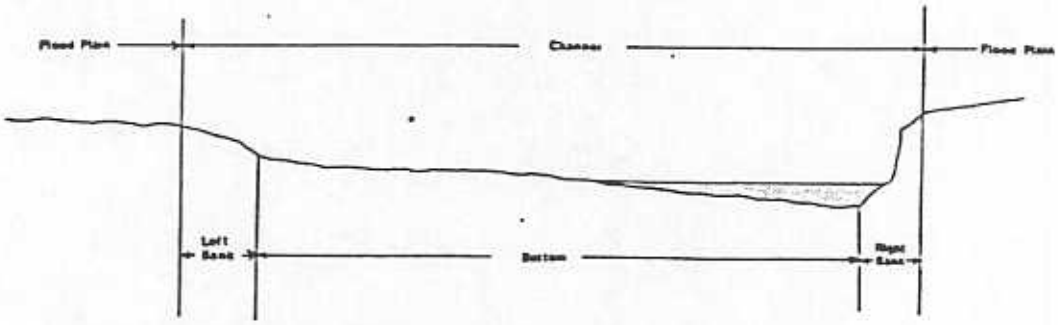

Figure 8. — Stream channel cross channel section on a bend in a stream.

Figure V-4-7. Three variations of a well defined stream channel (downstream view) (from Platts et al. 1983; Figs. 6-8).

Channel - The cross-section containing the stream that is distinct from the surrounding area due to breaks in the general slope of the land, lack of terrestrial vegetation, and changes in the composition of the substrate materials. The channel is made up of streambanks and stream bottoms.

Banks - The portion of the channel cross-section that tends to restrict lateral movement of water. The banks often have a slope steeper than 45° and exhibit a distinct break in slope from the stream bottom.Also, an obvious change in substrate materials is a reliable delineation of the bank.

Stream bottom - The portion of the channel cross-section not classified as bank. The bottom is usually composed of stream sediments or water transported debris and may be covered by rooted or clinging aquatic vegetation. In some geologic formations, the stream bottom may consist of bedrock rather than sediments.

Flood plain - The area adjacent to the channel that is seasonally submerged under water. Usually the flood plain is a low area covered by various types of riparian vegetation.

Stream Map

The entire sampling zone is sketched in the area provided. Important physical features are noted on the map with standard symbols used where possible. The sampling path taken is described along with any other pertinent information

Part C): Laboratory Methods

1) Handling Preserved Materials

a) Preservation Techniques - Fish that are preserved for subsequent identification or for vouchers are immersed in a fixative solution as soon as possible after capture. This helps retain chromatophore patterns which aid in identification. The recommended fixative is a solution of one part commercially prepared formalin and nine parts water with one teaspoon of borax added per 1/2 gallon of fixative. The borax acts as a buffer which neutralizes the acidic effect of the formalin, retarding shrinkage, preventing the hardening of soft body parts, and preventing decalcification of the tissues (Lagler *et al.* 1962). Temperatures greater than 80°F (26.7°C) necessitate a stronger solution of one part formalin to seven or eight parts water. Large fish or containers with closely packed fish also require stronger concentrations of formalin. Strong solutions of formalin can cause gaping or distortion of the mouth and gills, thus care should be taken to obtain correct concentrations when making up the solutions. Specimens more than a few inches long should be slit along the right side of the abdomen prior to preservation; fish heavier than 1 - 2 pounds should also be injected in the muscles on each side of the backbone. Fish normally remain in the formalin solution for at least 2-3 weeks to fix the tissues. Fish are then rinsed in clean water to wash off any excess formalin. The fish are allowed to drain for one-half hour. The fish are then placed in a 35% alcohol wash for 2-3 weeks, switched to a 50% alcohol wash for 2-3 weeks, and placed in a 70% aqueous solution of ethyl alcohol for permanent storage.

Preserving containers are labelled as soon as the fish are collected detailing essential aspects of the sample as completely as possible. Minimum information to be recorded is the stream or river name, location, date, river mile, and principal collector. This information may be written on the initial preserving container with a waterproof marker. If paper is used for making labels it should be 100% rag (which is waterproof) and labeled with India ink or a soft lead pencil.

b) Laboratory Identification and Verification - As discussed previously, fish are field identified by the field crew leader and *when the identification is certain.* However, if there is

any uncertainty the fish are preserved and brought back to the laboratory for verification. In the Ohio EPA laboratory, keys available in Becker (1983), Clay (1975), Pflieger (1975), Scott and Crossman (1973), and Trautman (1957, 1981) are used to identify the preserved fish. Scientific nomenclature follows the recommendations of the American Fisheries Society (Robins *et al.* 1980).

Identifications are verified in-house by at least two trained, full-time Ohio EPA staff. Once taxonomic verification is made, the information is transferred to the fish data sheet for the respective location and either entered into or corrected in FINS. If there remains any question as to the identity of a specimen, it is taken to the Ohio State Museum of Zoology (OSUMZ) for identification by the Curator of Fishes.

c) Disposition -.Ohio EPA maintains an up-to-date reference collection of Ohio and midwestern U.S. region fishes at the Ohio EPA Fish Laboratory. New species or unique specimens are added to the collection as they are encountered. Duplicate specimens are deposited in the OSUMZ where they are permanently catalogued.

2) Data Handling and Analysis

a) Data sheets - Fish data sheets (see example, Figure V-4-4) are completed in the following manner:

1) *Field Crew* - **Sampler** is the individual who actually nets the fish; **Recorder** is the individual who records the data; and **Driver** is the individual who either drives the field vehicle or assists with netting.

2) *Time* - military time sampling started and completed.

3) *River/Stream* - major river or stream being sampled.

4) *Location* - location described as adjacent to, upstream or downstream from a notable landmark.

5)*Date* - month/date/year.

6) *River Code* - assigned number found in FINS RIVLST printout, originally derived from Ohio Gazetteer of Streams (**NOTE:** *contact Central Office Data Coordinator for unnamed or unlisted stream codes*).

7) *River Mile* - river mile (from the *middle* of the electrofishing zone) to the nearest 0.1 mile determined by inspection of PEMSO river mile index maps.

8) *Distance* - electrofishing distance in kilometers to the nearest 0.01 km.

9) *Sampler Type* - sampler type letter code should be noted here (letter codes can be found in Table V-4-1).

10) *Depth* - average depth for the sampling zone to the nearest 10 cm, determined by measuring at 10 random locations with marked depth poles.

11) *Data Source* - two digit code designating the group responsible for data collection, *i.e.* Central Office, Southwest District Office, etc. (**NOTE:** *contact Central Office for Data Source codes*).

12) *Time Fished* - actual time devoted to sampling fish *in seconds.*

13) *Number of Species* - number of species of fish captured during each sampling (hybrids and exotics are *not* included and should be indicated separately).

14) *Species Codes* - each species and any hybrids are recorded by a family-species code following the system presented in Table V-4-5 (located at the end of **Subsection** 4). External anomalies if any, are recorded, for each species according to guidance stated previously.

Additional information that can be entered into FINS includes purpose of the data, latitude and longitude, site drainage area (sq. mi.), local gradient, sample designation, flow, temperature (^{o}C), and dissolved oxygen (mg/l) (Figure V-4-7).

b) Data Storage and Compilation

All completed fish data sheets are logged by the field crew leaders to prevent loss and assure that all sites are sampled according to the plan of study. The data sheets are filed

according to survey, river mile, and date, in that order, at the Ohio EPA Fish Laboratory. The Fish Evaluation Group Leader then logs the data sheets onto master tracking sheets kept at the Ohio EPA Fish Laboratory. Data is then entered into the Fish Information System (FINS) which was developed by Ohio EPA for the purpose of storing and analyzing fish relative abundance data. Data are entered in the format presented in Figure V-4-7. Each data entry is then logged by basin-river code, date of entry, river mile, and date of sampling by the Surface Water Section Data Coordinator. Both the fish data sheet and log book are then initialed by the data entry operator. The data sheets are then assembled in a notebook along with site description sheets, maps of the sampling sites and the preliminary study plans. This is then filed for future reference at the Ohio EPA Fish Laboratory. Any subsequent changes that are made to the fish data sheets are initialed and dated. After all data for a survey have been entered into FINS the entered data are proofread by the field crew leader for accuracy. All corrections or updates are then entered into FINS. Occasionally data from a sampling run may be considered invalid for calculating IBI and modified Iwb scores (*e.g.* due to elevated water levels during sampling, etc.). Although these data are entered into FINS they are designated as invalid samples for calculating community evaluation indices.

c) Analytical Methods

Relative abundance data are analyzed for both community (all species included) and population (single species) parameters. FINS is designed to perform a wide array of analyses. Presently, summarized data from FINS is downloaded to a Sperry PC/IT microcomputer for further detailed analyses. Relative abundance is expressed in terms of numbers/unit distance (or time for passive gear) and weight (kg)/unit distance (or time for passive gear). Community analyses include the number of species per sample, cumulative species per sampling location, Shannon indices (H) based on numbers and weight, the modified Index of Well-Being (Iwb), and the Index of Biotic Integrity modified for application to Ohio waters and Ohio EPA sampling methods. The specific details of how these indices and evaluations are derived is described in the "Users Manual for Biological Field Evaluation of Ohio Surface Waters" (Ohio EPA 1987).