MINNESOTA POLLUTION CONTROL AGENCY

Biological Monitoring Program

MPCA STREAM HABITAT ASSESSMENT (MSHA) PROTOCOL FOR STREAM MONITORING SITES

I. PURPOSE

To describe the methods used by the Minnesota Pollution Control Agency's (MPCA) Biological Monitoring Program to collect qualitative physical habitat information at stream monitoring sites for the purpose of assessing water quality and developing biological criteria.

II. SCOPE/LIMITATIONS

This procedure applies to all river and stream monitoring sites for which an integrated assessment of water quality is to be conducted. An integrated assessment involves the collection of biological (fish and macroinvertebrate communities), physical habitat, and chemical information to assess stream condition.

III. GENERAL INFORMATION

Sites may be selected for monitoring for a number of reasons including: 1) sites selected for condition monitoring as part of Intensive Watershed Monitoring (IWM), 2) sites randomly selected as part of the Environmental Monitoring and Assessment Program (EMAP), 3) sites selected for the development and calibration of biological criteria, and 4) sites selected for stressor identification. Although the reasons for monitoring a site vary, the MSHA protocol described in this document applies to all monitoring sites unless otherwise noted.

IV. REQUIREMENTS

A. Qualifications of crew leaders: The crew leader must be a professional aquatic biologist with a minimum of a Bachelor of Science degree in aquatic biology or closely related specialization. He or she must have a minimum of six months field experience in physical habitat sampling methodology. Field crew leaders should also possess excellent map reading skills and a demonstrated proficiency in the use of a GPS (Global Positioning System) receiver and orienteering compass.

B. Qualifications of field technicians/interns: A field technician/intern must have at least one year of college education and coursework in environmental and/or biological science.

C. General qualifications: All personnel conducting this procedure must have the ability to perform rigorous physical activity. It is often necessary to wade through streams and/or wetlands, canoe, or hike for long distances to reach a sampling site.

V. RESPONSIBILITIES

A. Field crew leader: Implement the procedures outlined in the action steps and ensure that the data generated meets the standards and objectives of the Biological Monitoring Program.

B. Technicians/interns: Implement the procedures outlined in the action steps, including maintenance and stocking of equipment, data collection and recording.

VI. QUALITY ASSURANCE AND QUALITY CONTROL

Compliance with this procedure will be maintained through annual internal reviews. Technical personnel will conduct periodic self-checks by comparing their results with other trained personnel.

In addition to adhering to the specific requirements of this sampling protocol and any supplementary site specific procedures, the minimum QA/QC requirements for this activity are as follows:

A. Control of deviations: Deviation shall be sufficiently documented to allow repetition of the activity as performed.

B. QC samples: Ten percent of sites sampled in any given year are resampled as a means of determining sampling error and temporal variability.

C. Verification: The field crew leader will conduct periodic reviews of field personnel to ensure that technical personnel are following procedures in accordance with this SOP.

VII. TRAINING

A. All inexperienced personnel will receive instruction from a trainer designated by the program manager. Major revisions in this protocol require that all personnel be re-trained in the revised protocol by experienced personnel.

B. The field crew leader will provide instruction in the field and administer a field test to ensure personnel can execute this procedure.

VIII. ACTION STEPS

A. Equipment list: Verify that either a form and pencil, or a field computer is present before commencement of this procedure.

B. Data collection method: The location and length of the sampling reach is determined during site reconnaissance (see SOP--"***Reconnaissance Procedures for Initial Visit to Stream Monitoring Sites***"). Unless otherwise instructed, observations of physical habitat characteristics should be limited to the sampling reach. Sampling is conducted during daylight hours within the summer index period of mid-June through mid-September. Sampling should occur when streams are at or near base-flow. The habitat evaluation is conducted immediately after fish sampling in order to provide the evaluator a perspective of the fish habitat within the reach.

Habitat characteristics are recorded using a qualitative, observation based method (modified from: Rankin 1989. The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application. Ohio EPA, Division of Water Quality Planning and Assessment, Ecological Analysis Section, Columbus, Ohio.). The Ohio QHEI is a physical habitat index designed to provide an empirical evaluation of the lotic macrohabitat characteristics that are important to fish communities and which are generally important to other aquatic life. Although similar to the Ohio QHEI, the MSHA has been modified to more adequately assess important characteristics influencing Minnesota streams. The MSHA incorporates measures of watershed land use, riparian quality, bank erosion, substrate type and quality, instream cover, and characteristics of channel morphology, stability, and development.

Observations are recorded on the **MPCA Stream Habitat Assessment Worksheet**. A copy is attached and guidelines for filling out this data sheet are described in the following pages.

C. MPCA Stream Habitat Assessment Data Sheet

This data sheet describes the presence and abundance of instream physical habitat and riparian characteristics within the sampling reach. The variables recorded are as follows:

C.1. Stream Documentation

a) *Field Number* – A seven-digit code that uniquely identifies the station. The first two digits identify the year of sampling, the second two identify the major river basin, and the last three are numerically assigned in sequential order (example: 02UM001).

b) *Stream Name* – The name of the stream as shown on the most recent USGS 7.5" topographic map. Include all parts of the name (i.e. South Branch Wild Rice River).

c) *Date* – The date habitat sampling is conducted in month/day/year format (MM/DD/YY).

d) *Person Scoring* – The personnel completing the MSHA. This person(s) should have walked or boated the entire stream reach paying particular attention to habitat features.

e) *Water Level* – An estimation of water level as it relates to summer base flow expectations. In most streams, the "normal" water level can be determined with relative ease by observing channel characteristics.

C.2. Surrounding Land Use or Floodplain Quality: Record the predominant land use on each bank within approximately 2 to 3 square miles. For rivers that cross HUC8 boundaries, the emphasis is on the area of land adjacent to the stream channel that experiences flooding during periods of high discharge. Wide extent aerial imagery on the site file should be used to determine land use. Check either the most predominant land use, or choose two and average the scores. Land use categories are as follows:

Forest, Wetland, Prairie, Shrub: Land that is dominated by trees, low-lying areas saturated with water, grasses and forbs, or woody vegetation less than 3 m. in height (i.e. natural land uses).

Old Field/Hay Field: Land that is used for agricultural purposes other than row crops or pasture.

Fenced Pasture: Land that is regularly grazed by livestock and is fenced to prevent livestock from entering stream.

Residential/Park: Land that has been modified for residential use (housing, residential lawns, city parks).

Conservation Tillage, No Till: Land that is currently in agricultural production, but retains the vegetative material from the previous year's crop to protect the soil.

Diked Wetland: Areas that have been diked from the main stream channel and are wetland in nature. A dike is an embankment constructed of earthen or other suitable material to protect land against overflow or to regulate water. It is more common to see this land use activity on very large rivers.

Urban/Industrial: Land that has been modified for commercial or industrial use (parking lots, malls).

Open Pasture: Land that is regularly grazed by livestock, but is not fenced to prevent livestock from entering stream.

Mining/Construction: Land affected by mining and/or current construction activity (open pits, tailings).

Row Crop: Land that is currently in intensive agricultural production, and doesn't use any conservation tactics (corn, soybeans, sugar beets, potatoes).

C.3. Riparian Zone (check the most appropriate category for each bank)

a) *Riparian Width* – Estimate the width (m) of the minimally disturbed vegetative zone adjacent to the stream. Beneficial vegetation types include stable grasses, trees, and shrubs with low runoff potential. Examples of minimal disturbance include a footpath next to the stream, a few horses in a pasture, an infrequently mowed trail, or a hayfield that is infrequently cut. Disturbed vegetation is not included in the riparian width (i.e. frequently mowed residential/commercial/municipal grass, grazed pasture). For channelized streams, estimate the width of the grass buffer from the water's edge, along the angle of the ditch bank to the top of bank, and beyond to the point where the buffer is disturbed.

b) *Bank Erosion* – Estimate the percentage of the stream bank that is actively eroding as it relates to the portion of the left and right bank that are likely or have the potential to be eroded (i.e. outside bends and high banks but not naturally occurring depositional point bars along inside bends). For channelized reaches, both sides of the

straight channel may be prone to potential flow-related erosion, so include the total length of each bank showing signs of active erosion. To be considered as erosion, the banks must be actively eroding through break down, soil sloughing, or false banks. False banks are natural banks that have been cut back, usually by livestock trampling.

c) *Shade* – Estimate the percentage of overhead canopy cover that is shading the stream channel. Canopy cover can be from trees, shrubs or tall grasses that provide shade to the stream at different times of the day. Shade rating is based on actual percentage of shade covering the stream, not adjusted for "expected" shade based on stream size.

C.4. Instream Zone

a) *Substrate* – Document the two predominant substrate types for each channel type present within the reach. One substrate type may be recorded where > 80% of the channel is dominated by a single substrate type. For each channel type present within the reach, estimate the percent of the stream channel represented by that channel type. The percentages should add up to 100. For example, if the majority of your reach was a run, with a few pools and one riffle, the percentage could be 75% run, 20% pool, and 5% riffle. Lastly, note the presence of all substrate types observed within the reach in a significant amount (>5%) in the space provided. The definitions for each channel and substrate type are as follows:

Channel Types

Pool: Water is slow and generally deeper than a riffle or run. Water surface is smooth, no turbulence. A general rule that can be used to distinguish a pool from a run or riffle is if two or more of the following conditions apply; the stream channel is wider, deeper, or slower than average.

Riffle: Higher gradient areas where the water is fast and turbulent, water depths are relatively shallow, and substrates are comprised of boulder, cobble, or gravel. Water surface is visibly broken.

Run: The water may be moderately fast to slow but the water surface typically appears smooth with little or no surface turbulence. Generally, runs are deeper than a riffle and shallower than a pool.

Glide: Similar to a run, but where there is no visible flow and the channel is too shallow for a pool. Examples include a channelized stream with a uniform depth and flow. This term should not be used in conjunction with pools, riffles, and runs in a natural stream setting.

Substrate Types

Boulder: Large rocks ranging from 250 mm to 4000 mm in diameter (basketball to car size).

Cobble: Rocks ranging in diameter from 64 mm to 250 mm (tennisball to basketball).

Gravel: Rocks varying in diameter from 2 mm to 64 mm (BB to tennisball).

Sand: Inorganic material that is visible as particles and feels gritty between the fingers, .06 to 2.0 mm in size.

Clay: Very fine inorganic material. Individual particles are not visible or are barely visible to the naked eye. Will support a person's weight and retains its shape when compacted.

Bedrock: A solid slab of rock, > 4000 mm in length (larger than a car).

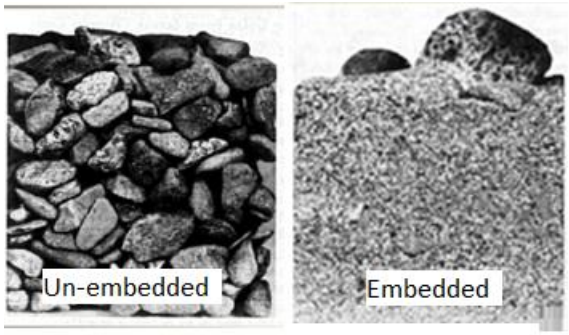
Silt: Fine inorganic material that is typically dark brown in color. Feels greasy between fingers and does not retain its shape when compacted into a ball. A person's weight will not be supported if the stream bottom consists of silt.

Muck: A fine layer of black, completely decomposed vegetative organic matter.

Detritus: Decaying organic material such as macrophytes, leaves, finer woody debris, etc. that may appear similar to silt when very fine.

Sludge: A thick layer of organic matter of animal or human origin, often originating from wastewater.

b) *Embeddedness* –Indicate the average percentage to which coarse substrates are vertically surrounded by or covered with fine sediments throughout the reach. Coarse substrates consist of gravel, cobble, and boulders of sizeable extent and consistency to be viable for spawning and/or habitat. A few scattered coarse substrates intermixed with sand does not constitute enough viable coarse substrate to be considered for embeddedness. An embeddedness rating of 0% corresponds to very little or no fine sediments surrounding coarse substrates. Check if coarse substrates are overlain with fine sediment by inserting your fingers into the substrate and pulling up the first inch or so of fine material. Coarse substrate material completely surrounded and covered with sediment is considered 100% embedded. If coarse substrates are not present in the reach, check "no coarse substrate".



c) *Siltation* – Indicate the extent that substrates are covered by a silt layer. Silt cover differs from the embeddedness metric in that it considers silt deposition over the entire stream bed and pertains only to fine silt size particles whereas embeddedness evaluates the degree to which sand and other fines are covering coarse substrates only. Low gradient streams often naturally have a high silt load rate this according to observed levels of siltation, do not correct for stream type. The ratings of siltation are as follows:

Silt Free: Substrates are exceptionally clean of silt.

Silt Low: Silt is deposited in small amounts along the stream margin or is present as a light covering in expected areas that appears to have little functional significance.

Silt Moderate: Extensive covering by silts, but with some areas of cleaner substrates (riffles and fast runs).

Silt Heavy: Nearly the entire stream bottom is layered with a significant covering of silt (pools/glides and all but the fastest areas of riffle/runs).

d) *Substrate Types* – Record the number of substrate types present within the reach (see checkboxes in section A. Substrates); either greater than or equal to 4, or less than 4.

e) *Cover Type* – Indicate the types of cover available to fish within the reach (check all that apply). Cover for fish consists of objects or features that provide complete or partial shelter from stream current or concealment from predators or prey at the time of the sample. In order to be considered cover, the water depth must be sufficient to support associated fish species where the cover is located. Note any observed cover type that is present in the sampling reach and "functional" at the time of sampling. Cover types are as follows:

Undercut Banks: Stream banks where the stream channel has cut underneath the bank. The bank could overhang the water surface when water levels are low. The undercut bank must overhang (horizontally) the wetted stream channel a minimum of 15 cm and the bottom of the undercut bank must be no more than 15 cm above the water level in order to be considered cover for fish.

Overhanging Vegetation: Terrestrial vegetation overhanging the wetted stream channel. Vegetation must be no more than 15 cm above the water level to be considered cover for fish.

Deep Pools: Area where the channel is particularly deep, often near a bend. Deep pools are judged relative to the stream size being assessed. As a general rule, a deep pool is at least four times deeper than the shallowest part of the thalweg.

Logs or Woody Debris: Logs, branches, or aggregations of smaller pieces of wood in contact with or submerged in water.

Boulders: Large rocks as described under *Substrate Type* and providing shelter from stream current.

Rootwads: Aggregation of tree roots that extend into the stream and provide concealment or shelter from current.

Oxbows, Backwaters: Remnant of a former channel meander within the floodplain or other adjacent and connected area with little or no current.

Shallows (in slow water): Habitats in shallow slackwater that provide nursery areas for small fish. These areas are often apparent when walking the stream or electrofishing by the presence of small and young of year fish.

Macrophytes: Check the box for macrophytes if the amount or density of plants is sufficient to provide cover for fish and check the box for each type present (i.e. emergent, floating leaf, submergent).

Emergent Macrophytes: Vascular plants that typically have a significant portion of their biomass above the water surface. Examples include cattail, bulrush, and wild rice.

Floating Leaf Macrophytes: Vascular plants with a significant amount of their biomass floating on the water in the form of leaves and flowers. Examples include duckweed and water lily.

Submergent Macrophytes: Vascular plants that have all of their biomass (except flowers) at or below the surface of the water and are of a sufficient density to provide cover for fish. Examples include coontail, vallisneria, and Potamogeton species. Filamentous algae is also included if it is dense enough to provide cover for small fish.

f) *Cover Amount* – Estimate the total percentage of fish cover within the reach. Cover amount is the percentage of the stream with usable fish cover as it relates to the "*Cover Types*" metrics. Many "*Cover Types*" does not necessarily mean that the "*Cover Amount*" will be extensive. If the channel is completely filled with aquatic vegetation, check the "choking vegetation only" option. Note: A stream that has at least a small raceway or path adequate for fish to navigate through aquatic vegetation is not considered "choking vegetation only." Rate the actual percentage of the stream that has functional cover.

C.5. Channel Morphology (check the most appropriate category for each)

a) *Depth Variability* – The difference in thalweg depth between the shallowest stream cross section and the deepest stream cross section. The thalweg depth is the deepest point along a stream cross section. Indicate the degree to which the thalweg depths vary within the stream reach. Please note: for very shallow streams that are moderate in width (8 to 10 m), consider whether the depth variability is less than what you would expect to find. For example, if the water depth is only 4 inches at the shallowest thalweg point and 20 inches at the deepest, but the stream is overwidened with excess sedimentation, do not score as >4 times.

b) *Channel Stability* – The ability of a stream channel to maintain its bed and banks, without aggrading (increase in bedload), or degrading (scouring sediments and moving downstream). Stable streams typically have access to the floodplain and stream banks that are resistant to erosion because of rooted vegetation such as prairie grasses, woody vegetation, or coarse material. Unstable streams often have one or more of the following: a

high degree of bank erosion, a mobile bedload, a high degree of embeddedness, sloughing banks, diminished pool depth, diagonal riffles and non-vegetated point bars. Low gradient streams may have high levels of siltation but the bed and banks may be stable if the stream has access to floodplain. The ratings of channel stability are as follows:

High: Channel with access to the floodplain, stable banks and substrates. Little or no erosion of the banks, and little or no mobile bedload within the stream. Artificial channels (e.g. concrete) may exhibit a high degree of stability even though they typically have a negative effect on biological communities. To be rated high, a stream must demonstrate high bed and bank stability.

Moderate/High: Channel has largely maintained stable banks and stream bed. A minor amount of bank erosion or mobile bedload (e.g., slight degree of embeddedness in higher gradient streams) than would be expected for natural streams in the region. In a ditch with low stream power (low gradient) there may be less bed load mobility.

Moderate: Channel that exhibits some instability characterized by exacerbated bank erosion (actively sloughing or eroding) and an increase in mobile bedload (higher degree of embeddedness than would be expected, some degree of pool infilling in a higher gradient stream). Access to the floodplain may be diminished due to ditching or incision resulting from increased stream power. In ditches with high stream power, more bedload mobility is present.

Low: Channels that have a high degree of mobile bedload and severely eroding banks. In a natural stream that has low stability, the stream bed may be characterized by highly mobile substrates. Examples may include a stream bed characterized by shifting sand and gravel substrates that are spongy or easily moved, pool infilling resulting in a lack of depth variability, lateral riffles, and sand dunes or "ripples." To score low, the stream has to demonstrate both bank erosion and high bedload.

c) *Velocity Types* – Indicate which flow types are present within the reach (check all that apply). Velocity types are as follows:

Fast: Mostly non-turbulent flow with small standing waves in riffle-run areas, water surface may be partially broken.

Moderate: Non-turbulent flow that is detectable (i.e. floating objects are visibly moved downstream).

Slow: Water flow is detectable, but barely perceptible.

Eddies: Areas of circular motion within the current, usually formed in pools immediately downstream of riffles/runs.

Torrential: Extremely turbulent and fast flow; water surface is broken, usually limited to gorges and dam spillways.

None: Water flow is not detectable.

Interstitial: Water flow that infiltrates a streambed, and moves through gravel substrates in riffle-run areas.

Intermittent: No flow is present, with standing pools separated by dry reaches.

d) *Sinuosity* – Indicate the degree to which the stream meanders. Sinuosity is defined as the ratio of stream channel distance to straight line distance between two points on a stream. For wide streams or rivers it may be necessary to consider a longer stream reach, as the true meander cycle is often not adequately represented in these systems within the sampling reach. Use both aerial maps and instream observations to rate sinuosity. Rate of sinuosity are as follows:

Excellent: Streams exhibiting a high degree of meandering.


Good: Stream with well-defined bends and meandering.


Fair: Channel with poorly defined outside bends, or slight meandering. Channelized reaches that demonstrate some degree of meandering are considered fair.




Poor: Straight channel with no bends in the reach. Channelized streams or ditches are often rated as poor.


e) *Pool Width/Riffle Width* – Indicate the ratio of pool width to riffle width within the reach. If there is no riffle or pool within the sampling reach, select "no riffle" and/or "no pool". If the sampling reach is predominantly impounded by an anthropogenic structure (i.e. dam), select "impounded". Impounded characteristics within the sampling reach caused by beaver dams or other natural occurrences are not penalized.

f) *Channel Development* – Indicate the complexity of the stream channel or the degree to which the stream has developed different channel types, creating sequences of riffles, runs, and pools. This metric is a measure of channel complexity and the degree of distinct transition between riffles, runs, and pools.

Excellent: To be considered excellent the stream must have riffles, runs and pools and meet the following guidelines: Well defined riffles present; pools vary in depth, and there is a clear transition between pools, riffles, and runs. Multiple sequences of riffles, runs, and pools are present within the reach.

Good: If riffles, runs, and pools are all present, they occur with less frequency, and are less distinct. Riffles and pools have some variation in depth. Streams without riffles may be rated as Good if there are distinct transitions between run and pools.

Fair: Riffles are absent or poorly developed. Deeper pools may exist, but transitions are not well defined.

Poor: Riffles are absent; pools if present are shallow or lack variation in depth. Channelized streams generally have poor channel development.

g) *Modifications* – Indicate any modifications made within or along the stream or river reach (check all that apply). Modification types are as follows:

Leveed: A stream or river reach in which a levee or levees have been constructed. A levee is an embankment or floodbank that is an artificially constructed fill or wall, which regulates water levels. It is usually earthen and often parallel to the course of a river in its floodplain. They are often constructed to prevent flooding or to slow natural course changes in a waterway.

Dredged/Straightening: Excavation activity or operation usually carried out at least partly underwater with the purpose of gathering bottom sediments and disposing of them at a different location. This technique is often used to keep waterways navigable or facilitate the movement of water. For example, channelized stream reaches where habitat has been adversely affected by recent or past dredging and/or straightening activities.

Bank Shaping: Excavation activity that involves the removal of soil to increase the slope of stream banks to a more stable angle but the bottom may show signs of excess sediment deposition and lack depth variability. This should be also be checked for channelized trapezoidal channels with high banks where habitat has been and continues to be adversely affected by recent or past bank shaping activities.

Railroad Ties: Railroad beds and other railroad infrastructure are common along many waterways, especially larger navigational rivers. Railroad ties have also been commonly used as waterfront retaining walls or for stream bank stabilization.

Cemented: A stream bed or bank that has been reinforced with cement. Typically, this type of modification only occurs in very urbanized areas where any movement of the stream bed or bank is greatly discouraged.

Bulkheads: Sheet steel used for erosion control, seawall construction, soil stabilization, construction, bridge foundations and cofferdams, and to armor stream banks. Often used as a retaining wall along a waterfront or in large navigational rivers to allow barges or freighters adequate shore-to-shore navigation.

Rip Rap: Stream reaches that have rock material used to armor streambanks, bridge abutments, pilings and other shoreline structures against scour, water or ice erosion. Also utilized in various stream stabilization projects including creation of artificial riffles, rock weirs, cover structures, etc. Rip rap is made from a variety of rock types and occasionally concrete rubble from building and paving demolition.

Const. Island: Constructed island(s) - in large navigational rivers man-made islands are often created or re-created to provide habitat or dispose of dredge material.

Wood Pilings: A column of wood or logs that have been driven into the stream bed or bank. Typically, this was done to provide support for a structure or bank protection.

C.5. Aquatic Vegetation: Indicate presence and abundance of aquatic vegetation present within the wetted width of the stream channel as follows: Abundant=[3]; Moderate=[2]; Sparse=[1].

a) *Beneficial Aquatic Vegetation* – Indicate the presence and abundance of beneficial aquatic vegetation including; pond lilies (*Nymphaea*/*Nuphar*), sedge (*Carex*), wild celery (*Vallisneria*), wild rice (*Zizania*), pond weed (*Potamogeton*), bulrush (*Scirpus*), waterweed (*Elodea*), coontail (*Ceratophyllum*), water cress (*Nasturtium*), water milfoil (*Myriophyllum*), and arrowhead (*Sagittaria*).

b) *Invasive and Negative Aquatic Vegetation* – Indicate the presence and abundance of invasive and negative aquatic vegetation including; Eurasian milfoil (*Myriophyllum*), purple loosestrife (*Lythrum*), reed canary (*Phalaris*), cattails (*Typha*), duckweed (*Lemna*).

c) *Algae* – Indicate the presence and abundance of algae including; algae (floating mats), algae (planktonic), and algae (benthic). Filamentous algae could be present in a stream as benthic and/or floating mat algae. The distinction between the two will often depend on flow conditions and substrate. Filamentous algae attached to rocks should be noted as algae (benthic). Filamentous algae that form large mats at or near the surface, often in slow moving or stagnant streams and ditches, should be noted as algae (floating mats).

If no aquatic vegetation is present, or not in sufficient density or quantity to provide cover, check the box for "no vegetation noted". Provide any additional comments regarding vegetation/algae in the space provided.

D. Scoring the MSHA

Following are instructions on how to score the completed MSHA form. The maximum score is 100.

D.1. Surrounding Land Use: Average the scores of the two banks. For example, if residential/park was the land use selected on the left bank, and forest, wetland, prairie, shrub was selected on the right bank, then the land use score would be (2+5)/2=3.5. In the case of two land uses selected for one bank, the two scores are averaged together, and then averaged with the score of the other bank. The maximum land use score is 5.

D.2. Riparian Zone: Average the scores of the two banks for Riparian Width, Bank Erosion, and Shade; then add the three scores. For example, if moderate riparian width (3) was chosen for the left bank and very narrow (1) on the right bank; little bank erosion (4) on the left bank, and moderate (3) on the right bank; heavy shade (5) on the left bank, and substantial (4) on the right bank; the riparian zone score would be: [(3+1)/2] + [(4+3)/2] + [(5+4)/2] = 10. The maximum riparian score is 14.

D.3. Instream Zone

a) *Substrate, Embeddedness, Siltation, and Substrate Types* – Add the scores of substrate, embeddedness, siltation and substrate type. The substrate score is calculated by adding the two substrate scores for each channel type, multiplying by the percentage of the channel type, and adding the scores for each channel type present. If only one substrate type is chosen because it makes up more than 80% of the channel type, multiply the one substrate score by 2 before multiplying it by the percentage of the channel type. The maximum substrate score is 28.

c) *Cover Type and Cover Amount* – Add the scores of cover type and cover amount. The cover type score can range from 0 to 9. The highest macrophyte score is 1, even if all three macrophyte types are present. The maximum cover score is 18.

D.4. Channel Morphology: Add the scores of Depth Variability, Channel Stability, Velocity Types, Sinuosity, Pool Width/Riffle Width, Channel Development, and Modifications. The modifications score can range from -8 to 3. The maximum channel morphology score is 35.

D.5. Total Score: Add the Surrounding Land Use, Riparian Zone, Instream Zone, and Channel Morphology scores together to get the total MSHA score for the site. The maximum MSHA score is 100

MPCA STREAM HABITAT ASSESSMENT (MSHA)

(revised April 2017)

1. Stream Documentation

MSHA SCORE

Field Number: _____ Stream Name: _____ Date: _____

Person Scoring: _____ Water Level (circle one): Flood / High / Normal / Low / Interstitial

Max=100

2. Surrounding Land Use (Streams) or Floodplain Quality (Rivers)

(check the most predominant or check two and average scores)

[L=left bank/R =right bank, facing downstream]

L	R			L	R		
☐	☐	Forest, Wetland, Prairie, Shrub	[5]	☐	☐	Diked Wetland	[2]
☐	☐	Old Field/Hay Field	[3]	☐	☐	Urban/Industrial	[0]
☐	☐	Fenced Pasture	[2]	☐	☐	Open Pasture	[0]
☐	☐	Residential/Park	[2]	☐	☐	Mining/Construction	[0]
☐	☐	Conservation Tillage, No Till	[2]	☐	☐	Row Crop	[0]

Land Use

Max=5

3. Riparian Zone (check the most predominant)

A. Riparian Width

L	R			
☐	☐	Extensive	> 100 m	[5]
☐	☐	Wide	50-100 m	[4]
☐	☐	Moderate	10-50 m	[3]
☐	☐	Narrow	5-10 m	[2]
☐	☐	Very Narrow	1-5 m	[1]
☐	☐	None		[0]

B. Bank Erosion

L	R			
☐	☐	None		[5]
☐	☐	Little	5-25%	[4]
☐	☐	Moderate	25-50%	[3]
☐	☐	Heavy	50-75%	[1]
☐	☐	Severe	75-100%	[0]

C. Shade

L	R			
☐	☐	Heavy	>75%	[4]
☐	☐	Substantial	50-75%	[3]
☐	☐	Moderate	25-50%	[2]
☐	☐	Light	5-25%	[1]
☐	☐	None		[0]

Riparian

Max=14

4. Instream Zone

A. Substrate (check two for each channel type)

	[10] Boulder	[9] Cobble	[8] Gravel	[6] Sand	[5] Clay	[5] Bedrock	[2] Silt	[1] Muck	[1] Detritus	[0] Sludge	Channel Type %
Pool	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____
Riffle	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____
Run	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____
Glide	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____
Note	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Presence (>5%)

B. Embeddedness

☐	None	[5]
☐	Light 25-50%	[3]
☐	Moderate 50-75%	[1]
☐	Severe 75-100%	[-1]
☐	No coarse substrate	[0]

C. Siltation

☐	Silt Free	[1]
☐	Silt Low	[0]
☐	Silt Moderate	[-1]
☐	Silt Heavy	[-2]

D. Substrate Types

☐	≥4	[2]
☐	<4	[0]

Substrate

Max=28

E. Cover Type (check all that apply)

☐	Undercut Banks	[1]
☐	Overhanging Vegetation	[1]
☐	Deep Pools	[1]
☐	Logs or Woody Debris	[1]
☐	Boulders	[1]
☐	Rootwads	[1]
☐	Oxbows, Backwaters	[1]
☐	Shallows (in slow water)	[1]
☐	Macrophytes	[1]
☐	Submergent	
☐	Emergent	
☐	Floating Leaf	

F. Cover Amount (check one)

☐	Extensive >50%	[9]
☐	Moderate 25-50%	[7]
☐	Sparse 5-25%	[3]
☐	Nearly Absent	[0]
☐	Choking Vegetation only	[-1]

Cover

Max=18

5. Channel Morphology

A. Depth Variability

☐	Greatest Depth >4X Shallow Depth	[4]
☐	Greatest Depth 2-4X Shallow Depth	[2]
☐	Greatest Depth <2X Shallow Depth	[0]

B. Channel Stability

☐	High	[9]
☐	Moderate/High	[6]
☐	Moderate	[3]
☐	Low	[0]

C. Velocity Types (check all that apply)

☐	Fast	[1]
☐	Moderate	[1]
☐	Slow	[1]
☐	Eddies	[1]
☐	Torrential	[-1]
☐	None	[-1]
☐	Interstitial	[-1]
☐	Intermittent	[-2]

D. Sinuosity

☐	Excellent	[4]
☐	Good	[3]
☐	Fair	[2]
☐	Poor	[0]

E. Pool Width/Riffle Width

☐	Pool Width > Riffle Width	[2]
☐	Pool Width = Riffle Width	[1]
☐	Pool Width < Riffle Width	[0]
☐	No Riffle	[0]
☐	No Pool	[0]
☐	Impounded	[-2]

F. Channel Development

☐	Excellent	[9]
☐	Good	[6]
☐	Fair	[3]
☐	Poor	[0]

G. Modifications (check all that apply)

☐	Leveed	[-1]	☐	Rip Rap	[1]
☐	Dredged	[-1]	☐	Const. Island	[1]
☐	Bank Shaping	[-1]	☐	Wood Pilings	[1]
☐	Railroad Ties	[-1]			
☐	Cemented	[-2]			
☐	Bulkheads	[-2]			

Channel

Max=35

Aquatic Vegetation (indicate as follows for observed abundance: Abundant=[3]; Moderate=[2]; Sparse=[1])

A. Beneficial Aquatic Vegetation

____ Pond Lilies (*Nymphaea*/*Nuphar*) ____ Sedge (*Carex*) ____ Wild Celery (*Vallisneria*)
____ Wild Rice (*Zizania*) ____ Pond Weed (*Potamogeton*) ____ Bulrush (*Scirpus*)
____ Waterweed (*Elodea*) ____ Coontail (*Ceratophyllum*) ____ Water Cress (*Nasturtium*)
____ Water Milfoil (*Myriophyllum*) ____ Arrowhead (*Sagittaria*)

B. Invasive and Negative Aquatic Vegetation

____ Eurasian Milfoil (*Myriophyllum*) ____ Purple Loosestrife (*Lythrum*) ____ Reed Canary Grass (*Phalaris*)
____ Cattails (*Typha*) ____ Duckweed (*Lemna*)

C. Algae

____ Algae (Floating Mats) ____ Algae (Planktonic) ____ Algae (Benthic)

No Vegetation Noted ☐

MSHA / Veg Comments: _____