



MassDEP

Massachusetts Department of Environmental Protection Division of Watershed Management

STANDARD OPERATING PROCEDURE

Water Quality Monitoring in Streams Using Aquatic Macroinvertebrates

CN 039.4
August 8, 2025
July 2025 - August 2027

Prepared by:	<u>/s/ Steven Bittner</u> Steven M. Bittner, Environmental Analyst/Biologist	Date:	<u>8/8/25</u>
Approved by:	<u>Shervon De Leon</u> Shervon DeLeon, Section Chief: Water Quality Monitoring	Date:	<u>8/8/25</u>
Approved by:	<u>Jasper Sha</u> Jasper Sha, Environmental Analyst/QA Officer	Date:	<u>8/8/25</u>

List of Revisions

Revision Date	Revision	Pages #s
November 20, 2007	Added quality control requirements and procedures for determining percent sorting efficiency	12
March 1, 2021	Updates to reflect multihabitat/low gradient stream sampling, implementation of new biocriteria for assessment purposes, updates to laboratory methods, and other updates.	Throughout document
January 2025	Refinements to wording, sampling methods, data management, waste disposal, etc.	Throughout document

PURPOSE

The purpose of this document is to outline the materials, methods, and quality assurance/quality control (QA/QC) measures employed by the Massachusetts Department of Environmental Protection's Division of Watershed Management, Watershed Planning Program (MassDEP, DWM, WPP) to conduct standard investigations of water quality in streams using aquatic macroinvertebrates. These procedures serve as the standard for routine biological monitoring of streams using benthic macroinvertebrates. However, if any deviations are necessary due to site-specific conditions or programmatic requirements, these must be documented in the Quality Assurance Project Plan (QAPP) with a detailed explanation and of the reasoning behind the changes.

FIELD METHODS

Determination of Collection Method

Prior to sample collection, consideration must be given to determine the type of collection method that is most appropriate for a given site.

In wadeable, higher gradient streams that typically originate in hillier terrain, have steeper slopes, faster flows, and abundant riffle habitat, the single habitat (riffle only) sampling method is generally most appropriate.

Conversely, lower gradient streams with more gradual slopes, slower flows, an abundance of vegetation and/or woody debris, and an overall lack of riffle habitat should be sampled using the multihabitat method. In some cases, this distinction may not be obvious (particularly in moderate gradient streams). It is advisable to select the collection method that is most representative of the stream reach and document this on the field sheet.

When riffle habitat comprises $\geq 30\%$ of the stream reach, the single habitat (riffle only) sampling method should be employed, whereas in rivers where riffle habitat comprises $< 30\%$ of the stream reach, the multihabitat method should be employed. In streams with $< 30\%$ riffle habitat in the stream reach but with some riffles present, it is acceptable to sample riffles in proportion to the stream reach (e.g., 10% of stream reach is riffle habitat therefore 1 kick sample is collected from the riffle and 3 are collected from woody debris, and 6 are collected from vegetation, etc.).

In large, non-wadeable rivers, other collection methods may be utilized (e.g., rock baskets or multiplates). However, please be advised that the current method used to analyze benthic macroinvertebrate data for assessment purposes is not suitable for these data types.

Single Habitat (riffle only) Sampling

For routine biomonitoring in high gradient, wadeable streams with coarse substrates (mixed gravel and cobble, or larger) and abundant ($\geq 30\%$ of sample reach) riffle habitat, benthic macroinvertebrates are collected by kicking over the substrate materials (kick sampling) in the riffle and capturing the dislodged organisms in a kick-net (500 μm mesh) pressed firmly against the stream bottom immediately downstream of the material being kicked. Where desirable, organisms may be dislodged by rubbing the substrate item. Generally, a stream sampling site is a 100 m reach with habitats that are representative of the portion of stream where data are desired. Ten kick samples from a square area with dimensions equal to the width of the net opening (i.e., 0.46 m x 0.46 m) are composited for a total area sampled of approximately two square meters.

Multihabitat Sampling

In lower-gradient streams where riffle habitat within the reach is inadequate ($< 30\%$ of sample reach) to allow for a two-square-meter composite, other productive habitats may be sampled. Examples of potential habitats that may be sampled are snags/coarse woody debris, root wads, aquatic vegetation (either fully submerged or partially emergent), undercut banks, overhanging vegetation, leaf packs or hard bottom/riffle. The kick net is used for this method. Woody debris may be scrubbed with a toilet brush to dislodge clinging organisms with the net just below. Submerged or partially submerged vegetation are sampled by bringing the kick net to the base of the plant and then

vigorously moving up the plant, usually toward the water surface. Undercut banks and overhanging vegetation are jabbed/shaken within the kick net until sufficiently sampled. Hard bottom, such as riffles or runs, are sampled using the kick net pressed firmly against the stream bottom immediately downstream of the material being kicked. In areas with little to no stream flow, it is best to help guide the flow through the net in a way that does not permit the contents of the net to spill out. On the fieldsheet, the habitat types sampled are recorded indicating the number of kicks or jabs in each habitat category that contributed to the composite sample.

For both methods (single habitat (riffle only/high gradient) sampling and multihabitat/low gradient sampling), any large debris items (rocks, sticks, etc.) caught in the net are rinsed in the net and returned to the stream, once any macroinvertebrates clinging to them are removed. The residue in the net is placed in a 2 liter wide-mouth leak-proof Nalgene bottle with enough 100% reagent alcohol (5% methanol, 5% isopropanol, and 90% ethanol or a 70% v/v solution of the reagent alcohol) added to cover the residue (in a volume roughly equal to the volume of sample materials in the bottle). Sample bottles should not be filled more than about halfway with collected materials before starting a new bottle. A label (Figure 1) indicating the site identification code, date, bottle number out of total number of bottles (e.g., 1 of 1; if there is one bottle, 1 of 2, 2 of 2; if two bottles, etc.), water body name, and the collector is placed inside the sample container. This is recorded on waterproof paper with pencil. The date, site identification code, waterbody name, and bottle number out of total number of bottles, are marked on the outside of the container and cap, as well. Upon arrival at the laboratory the sample is recorded in the *Laboratory Log-in* notebook and electronic excel tracking sheet (see “**Sample Log-in**” section) and placed in the yellow flammable cabinet.

KC01	07/20/2025
Kinderhook Creek	
Collector: Bittner	1 of 1

Figure 1. Example of label to be placed in containers with benthos samples.

Additional Considerations Prior to Sample Collection

Stream flow conditions must be assessed very carefully before a sampling operation to obtain representative and reliable data. In some cases, when stream discharge is excessive relative to normal due to recent rainstorms or other events, sampling should be postponed. High flows as a result of the flushing and washing out of benthic macroinvertebrate communities can lead to unrepresentative samples.

The sampling should be delayed for a few weeks after heavy rains or floods that produce scouring flows in order to allow adequate recolonization of benthic habitats and stabilization of sediments and vegetation in the stream channel. Two weeks is an approximate time period, and the decision should be based on gaging data from a nearby stream or historical flow statistics for the area. Similarly, sampling should be postponed for a few weeks after the stream returns to baseflow at a minimum.

The margins of streams should be sampled in a careful way because they may have been dry and just getting wet again, thus making recolonization difficult. Likewise, habitats that appear to be newly fallen, submerged, or disturbed-such as by coarse woody debris or overhanging vegetation-should be avoided to improve the chance of our sample being representative of stable benthic conditions.

Rock Baskets

For stream biomonitoring where kick or multihabitat sampling is deemed inappropriate (i.e., large, non-wadeable rivers), rock baskets may be used to collect benthic macroinvertebrates. However, as of January 2021, the current method used to analyze benthic macroinvertebrate data for assessment purposes is not suitable for rock basket data.

Baskets will contain a like amount (by weight) of “roofing stone” (not crushed rock) in the size range of 2.5 to 7.5 cm (one to three inches). The baskets will be placed on the stream bottom in a riffle or run with a current velocity of between 15 and 76 cm/s (0.5 and 2.5 ft/s). Because of this, the configuration of baskets within a sample site may not be in regular arrays or even in similar patterns at each site. Baskets will be left in-place and undisturbed for a period of six to eight weeks.

At the completion of the exposure interval each basket is retrieved by pressing a kick-net tightly against the streambed along the basket’s downstream edge. The basket is then moved carefully into the net before lifting it through the water column. Where the water is deep enough to make this procedure difficult or impossible, a cover designed to be dropped over the basket may be employed (e.g., Courtemanch 1984). Where this procedure is anticipated, a basket made with 500 µm netting on its bottom surface is used to prevent the loss of organisms through the bottom of the sampler as it is raised to the surface.

Vegetation or debris snagged on the outside of the recovered sampler is removed and the basket is placed in a large bucket or tub of water. The sampler is then opened, emptied into the bucket, rinsed inside the bucket until free of any organisms or adhering material, and set aside. Each rock is similarly rinsed and set aside. The material remaining in the bucket is then sieved through a #30 mesh (600 µm) soil screen, transferred to a sample container, and preserved in denatured 100% reagent alcohol. A label made out as described under “Kick Sampling” above (see Figure 1) is placed inside the sample container. The date, sample identification code, and bottle number out of total number of bottles, are marked on the outside of the container and cap. Upon arrival at the laboratory the sample is recorded in the *Laboratory Log-in* notebook (see “**Sample Log-in**” section) and placed in the yellow flammable cabinet.

Multiplates (Hester-Dendy)

In deep rivers or where kick or multihabitat sampling is inappropriate and rock baskets are impractical, multiplate (modified Hester-Dendy) samplers may be used. However, as of January 2021, the current method used to analyze benthic macroinvertebrate data for assessment purposes is not suitable for multiplate data. Samplers with round plates and spacers assembled to EPA specifications (Klemmet al. 1990) are used. In deep water the multiplate sampler is tethered to an anchored float so that the sampler is suspended one meter below the surface. In shallow waters the sampler may be mounted on a patio block or “four inch” cinder block; all samplers to be compared should be placed in comparable current velocities, preferably in the range 15 and 76 cm/s (0.5 and 2.5 ft/s). Samplers are left in place and undisturbed for a period of six to eight weeks.

At the end of the exposure period each sampler is harvested by enveloping it with a 500µm mesh net, plastic bag, or 2 l wide-mouth jar. The sampler is placed in a 2 liter wide-mouth jar with enough denatured 100% reagent alcohol to cover it completely, tightly capped, and transported to the laboratory. Labeling procedures are the same as for kick samples, multihabitat samples, and rock baskets (see “Kick Sampling” section and Figure 1). Upon arrival at the taxonomy laboratory the sample is recorded in the *Laboratory Log-in* notebook (see “**Sample Log-in**” section) and placed the yellow flammable cabinet.

Habitat Assessments

Recording site characteristics and rating habitat qualities is important to the interpretation of biomonitoring data. The habitat data and assessments help distinguish between pollution impacts and habitat limitations. These data can also help identify causes of habitat destruction and loss. Examples of the field sheets and assessment forms are in Appendix A.

Habitat assessment is accomplished by a visual-based method (Barbour, et al. 1999) conducted at the time of sample collection. There are two separate sets of habitat assessment sheets; one intended for high gradient streams, and one intended for low gradient streams. Each of ten habitat categories is rated from 0 (lowest, “poor”) to 20 (highest, “optimal”). The ten categories for high gradient streams are: Instream cover (fish); Epifaunal substrate (in sampled portions of reach); Embeddedness; Channel alteration; Sediment deposition; Velocity-depth combinations; Channel flow status; Bank vegetative protection (each bank scored separately for a maximum of 10 points each); Bank stability (each bank scored separately for a maximum of 10 points each); Riparian vegetated zone width (each bank scored separately for a maximum of 10 points each). The ten categories for low gradient streams are: Bottom substrate/available cover (fish and macroinvertebrates); Pool substrate characterization; Pool variability; Channel alteration; Sediment deposition; Channel sinuosity; Channel flow status; Bank vegetative protection (each bank scored separately for a maximum of 10 points each); Bank stability (each bank scored separately for a maximum of 10 points each); Riparian vegetated zone width (each bank scored separately for a maximum of 10 points each). Descriptions of the considerations for scoring each habitat category can be found in Barbour et al. (1999).

SAMPLE LOG-IN

When aquatic macroinvertebrate samples are brought into the laboratory they are recorded in the *Laboratory Log-in* notebook. Each sample is assigned a sample identification number (BenSampleID#) at the time of sample log-in. The associated habitat data (on field sheets and assessment forms) will be tagged with a matching identification number (HabSampleID#). The *BenSampleID* and *HabSampleID* are the same number except when benthic samples are collected as replicates from the same sample location. In such cases the HabSampleID number and the BenSampleID numbers start with the same seven digits, but each replicate is distinguished by adding a decimal point and a sequential number beginning with “1” (e.g., the BenSampleID for three replicates might be numbered 2002014.1, 2002014.2, 2002014.3). Upon assigning the BenSampleID and HabSampleIDs in the *Laboratory Log-in* notebook, the BenSampleID and HabSampleIDs must be written on the associated field sheet where indicated in the bottom right corner as well as on the outside of the sample bottle(s) and preferably on the bottle cap.

The log-in notebook contains the following fields, which are filled in for each sample:

- Collection date
- Field ID# (if different from BenSampleID#)
- BenSampleID#
- HabSampleID#
- Location (name of waterbody)
- Collector
- Comments (e.g., for describing sample type or purpose, number of sample containers).

After the sample has been logged-in it must be placed in the yellow flammable cabinet and the field sheets must be filed away in the organizer on top of the laboratory fridge.

SAMPLE PROCESSING & TAXONOMY

All sample processing and taxonomic identification is performed by a contract lab. The contract lab is responsible for sub-sampling each sample to a 300 organism target and performing identifications and counts of all macroinvertebrates. In addition, laboratory splits are performed on 10% of the samples in a given year and are chosen by MassDEP using a random number generator.

For the purposes of this document “macroinvertebrate” is defined to include:

- all aquatic Annelida;
- all aquatic Mollusca;
- aquatic macro Crustacea (except as noted below);
- all aquatic Arachnida; and
- the aquatic life stages of Insecta except Hemiptera and adult Coleoptera other than Elmidae.

Macroinvertebrates excluded from the above list are not used for one of three reasons: either there is insufficient ecological information on them to make them useful for biomonitoring, they are surface film dwellers, or they are capable of escaping the aquatic environment at will to avoid temporarily unfavorable conditions. One further exception is crayfish (Class Crustacea, Family Decapoda), which often are seen evacuating the immediate area as sampling begins, and even swimming out of the kick-net. Crayfish are noted when present in the sample but are not counted toward total numbers.

All taxonomic identifications are based on the most recent taxonomic keys and any nomenclature changes and taxonomic reclassifications are reported to the MassDEP biologist and MassDEP's benthic database is updated accordingly. Once all identifications are complete, all data are relayed to the MassDEP biologist electronically for subsequent data entry and QC in MassDEP's benthic database. A set of vials containing the specimens preserved in alcohol are returned to MassDEP and are stored in the flammable cabinets for reference.

Hazardous Materials Handling, Storage, and Record-Keeping

Alcohol greater than 24% v/v is a Class 1B flammable liquid requiring handling and storage in a manner consistent with local fire codes. The alcohol used for preserving benthic macroinvertebrate samples is typically either 100% reagent alcohol (5% methanol, 5% isopropanol, and 90% ethanol) or a 70% v/v solution of the reagent alcohol, and must be stored in the lab inside flammables cabinets. If one desires to dispose of vials containing specimens that are no longer needed, the used alcohol (typically no larger than a 2-4 dram vial) must be collected because of its hazardous waste status (CN 000.36). This can be accomplished by adding enough water to bring each liter of collected alcohol up to a volume of four gallons. This diluted waste then can be disposed of by pouring it down the drain.

A form (example in Appendix B) will be maintained in the microscopy lab (as well as the other two labs) to keep a daily record of each sample that is processed and the total amount of alcohol collected before dilution and disposal. These records from all three labs will be monitored to make sure the total waste generation from DWM lab operations is not exceeding the monthly limits, or to evaluate the need to reassess DWM's generator status. The forms will be collected at the end of each month and kept in a file for at least three years.

Samples that have been collected from areas where environmental data or best professional judgement suggest possible contamination with hazardous materials will be processed the same as other samples with the following exceptions:

- Alcohol used to preserve the sample will be collected and disposed of as hazardous waste.
- Solid materials from the sample likewise will be retained and disposed of as hazardous waste.

Any resultant hazardous wastes will be stored in containers with the appropriate hazardous waste labeling, and the containers will be stored in approved flammable-liquid safety cabinets until transported to Wall Experiment Station (Lawrence, MA) for disposal.

Data Analysis

All data related to aquatic macroinvertebrate samples and the associated habitats are entered into a database. The database and data management procedures are described in a separate document (MassDEP 2025).

The data generated from the 300 organism subsamples are analyzed using Indices of Biotic Integrity (IBI). Older high gradient samples that were subsampled to a 100-organism count (prior to 2013) can also be analyzed using the high gradient IBI. IBIs provide a measure of the biological condition of a given stream on a relative scale compared to least-disturbed streams within its site classification. Two IBIs for high gradient streams were developed for application in the Western Highlands and the Central Hills (Fig 2., Table 1) regions of Massachusetts, which were recognized for having naturally distinct biological expectations. The high gradient IBIs were developed and calibrated based on hundreds of samples previously collected by MassDEP biologists. Another IBI for low gradient

streams was developed for statewide application (Fig. 2, Table 1). IBIs are comprised of multiple biological metrics that are found to be responsive to a general human stressor gradient. By scoring the metrics for each sample and averaging the scores, the resulting index score indicates the biological condition of a given stream on a relative scale. Index values of historic reference sites provide reasonable expectations (reference condition) for any stream in a given region and were the basis for setting thresholds for the biological condition classes. Scores that do not resemble the reference condition are indicative of potential stressors influencing the biological condition.

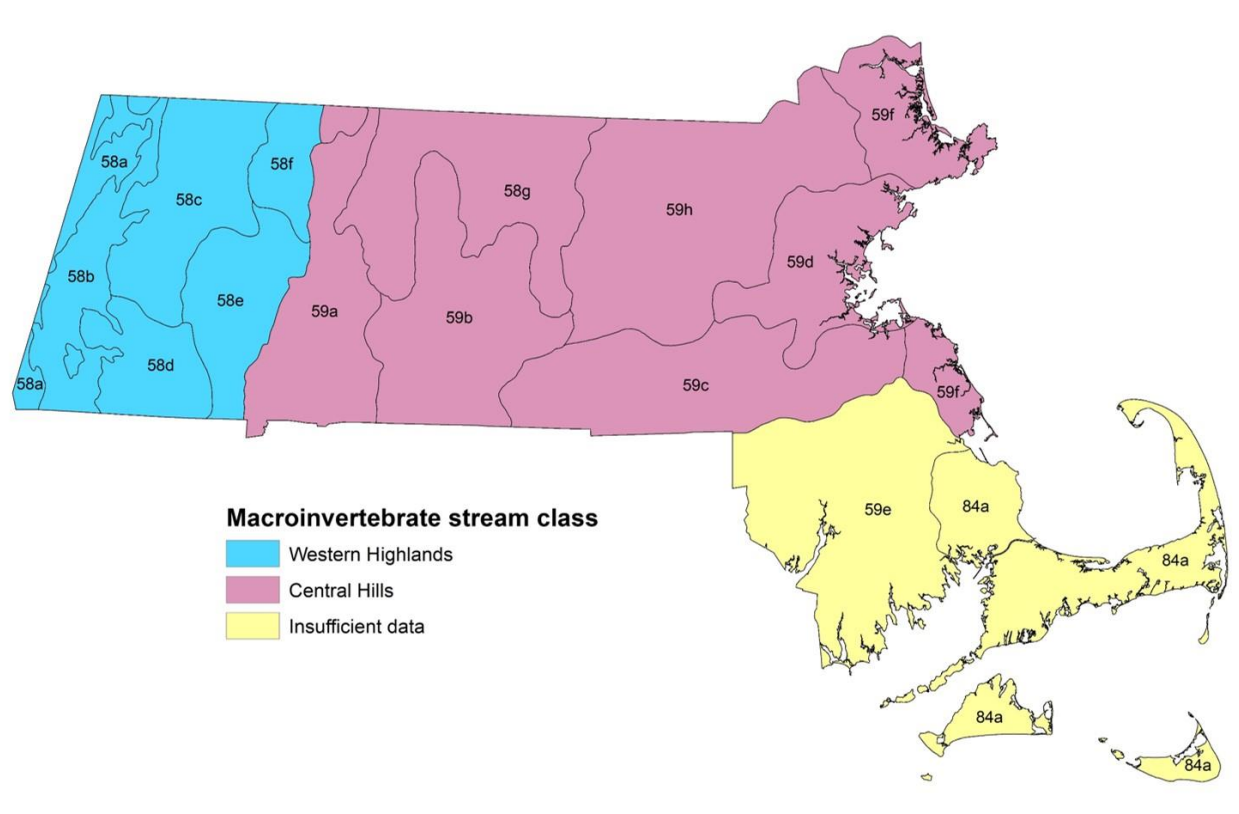


Figure 2. For IBI development, Omernik Level IV ecoregions were grouped into two regions for high gradient streams: Western Highlands and Central Hills. An IBI for each of these high gradient regions was developed. The southeastern portion of the state was grouped exclusively under the jurisdiction of the newly-developed Low Gradient IBI, as well as low-gradient streams in the two highland regions. See Table 1 for ecoregion code description. Source: Adapted from (Jessup and Stamp 2020).

Table 1. Application of Indices of Biotic Integrity (IBIs) used to evaluate benthic macroinvertebrate sample data in Massachusetts regions. The Worcester/Monadnock Plateau ecoregion (58g) was the only Northeastern Highland Level IV ecoregion that was grouped with the Central Hills. Source: Adapted from (Jessup and Stamp 2020).

Region	Level IV code	Level IV ecoregion name	IBI
Central Hills	58g	Worcester/Monadnock Plateau	Central Hills IBI for high gradient sites, Low Gradient IBI for low gradient sites
	59a	Connecticut Valley	
	59b	Lower Worcester Plateau/Eastern Connecticut Upland	
	59c	Southern New England Coastal Plains and Hills	
	59d	Boston Basin	
	59f	Gulf of Maine Coastal Lowland	
	59h	Gulf of Maine Coastal Plain	
Western Highlands	58a	Taconic Mountains	Western Highlands IBI for high gradient sites, Low Gradient IBI for low gradient sites
	58b	Western New England Marble Valleys	
	58c	Green Mountains/Berkshire Highlands	
	58d	Lower Berkshire Hills	
	58e	Berkshire Transition	
	58f	Vermont Piedmont	
Southeastern	59e	Narragansett/Bristol Lowland	Low Gradient IBI
	84a	Cape Cod/Long Island	

Table 2. IBI thresholds for four biological condition categories for the two high gradient regional IBIs and the low gradient statewide IBI. Source: (Stamp and Jessup 2020).

Index of Biotic Integrity	Biological Condition Score			
	Excellent Condition	Satisfactory Condition ³	Moderately Degraded ³	Severely Degraded
High Gradient – Central Hills ¹	100 - 75	74 - 55	54 - 35	34 - 0
High Gradient – Western Highlands ¹	100 - 75	74 - 55	54 - 35	34 - 0
Low Gradient – Statewide ²	100 - 74	73 - 60	59 - 34	33 - 0

¹ – Thresholds are appropriate for 100 and 300 count subsamples.

² – Thresholds are appropriate for only 300 count subsamples

³– Occasionally MassDEP biologists may use BPJ based on other lines of evidence for sites in the +/- 5 point range straddling the Satisfactory Condition - Moderately Degraded Condition threshold to recommend a different outcome than the one dictated by the Biological Condition Score.

Table 3. Details on the metrics used in the Central Hills and Western Highlands 300-count riffle habitat IBIs (high gradient) as well as the 300-count Low Gradient multi-habitat IBI (used statewide). These formulas were changed to account for effects of subsample size on the richness metrics. Sources: Adapted from (Block et al. 2020) and (Jessup et al. 2021).

Central Hills 300-count riffle habitat IBI (high gradient)			
Metric (abbreviation)	Category	Response to stress	Scoring formula
Total number of taxa (nt_total)	Richness	Decrease	$100 * (\text{metric}) / 55.8$
% EPT taxa (pt_EPT)	Richness	Decrease	$100 * (\text{metric}) / 54.5$
% Ephemeroptera individuals, excluding Caenidae and Baetidae (pi_Ephem NoCaeBae)	Composition	Decrease	$100 * (\text{metric}) / 13.9$
% Collector-filterer individuals (pi_ffg_filt)	Functional feeding group	Increase	$100 * (79.9 - \text{metric}) / 66.9$
% Predator taxa (pt_ffg_pred)	Functional feeding group	Decrease	$100 * (\text{metric}) / 28.5$
% Intolerant taxa, tolerance value ≤ 3 (pt_tv_intol)	Tolerance	Decrease	$100 * (\text{metric}) / 39.1$
Western Highlands 300-count riffle habitat IBI (high gradient)			
Metric (abbreviation)	Category	Response to stress	Scoring formula
Total number of taxa (nt_total)	Richness	Decrease	$100 * (\text{metric}) / 61.8$
% Plecoptera individuals (pi_Pleco)	Composition	Decrease	$100 * (\text{metric}) / 18.3$
% Collector-filterer individuals (pi_ffg_filt)	Functional feeding group	Increase	$100 * (50.5 - \text{metric}) / 40.7$
% Shredder individuals (pi_ffg_shred)	Functional feeding group	Decrease	$100 * (\text{metric}) / 23$
% Intolerant individuals, tolerance value ≤ 3 (pi_tv_intol)	Tolerance	Decrease	$100 * (\text{metric}) / 51.5$
Becks Biotic Index* (x_Becks)	Tolerance	Decrease	$100 * (\text{metric}) / 50.6$
Low Gradient 300-count multi-habitat IBI			
Metric (abbreviation)	Category	Response to stress	Scoring formula
% Plecoptera, Odonata, Ephemeroptera, and Trichoptera (POET) taxa (pt_POET)	Richness	Decrease	$100 * (\text{metric}) / 40$
% Predator taxa (pt_ffg_pred)	Functional feeding group	Decrease	$100 * (\text{metric}) / 32$
% Non-insect taxa (pt_NonIns)	Richness	Increase	$100 * (46 - \text{metric}) / 42$
% Odonata, Ephemeroptera, and Trichoptera (OET) individuals (pi_OET)	Composition	Decrease	$100 * (\text{metric}) / 49$
% Tolerant taxa (pt_tv_toler)	Tolerance	Increase	$100 * (36 - \text{metric}) / 33$
% Semivoltine taxa (pt_volt_semi)	Voltinism	Decrease	$100 * (\text{metric}) / 12$

*Beck's Biotic Index (Terrell and Perfetti 1996) = $2 * [\text{Class 1 Taxa}] + [\text{Class 2 Taxa}]$ where Class 1 taxa have tolerance values of 0 or 1 and Class 2 taxa have tolerance values of 2, 3 or 4.

In order to calculate IBI scores, Access queries were developed within the MassDEP benthic database (mabenthos) to create input tables for the MassDEP IBI calculator, an RShiny application that can be found at <https://tetrattech-wtr-wne.shinyapps.io/MassIBltools>. High gradient and low gradient samples are processed separately. Prior to using the IBI calculator, input tables are checked for completeness and accuracy. The IBI calculator provides output in the form of a results summary report, a metric score table which provides the IBI score, and a metric value table which shows how each sample scored for each metric within each respective IBI. The output files are store on a shared drive as well as in mabenthos.

QUALITY CONTROL

Sample Collection

After sampling is completed at a given site, all nets, sieves, pans, etc. that have come in contact with the sample are rinsed thoroughly, examined carefully, and picked free of organisms or adhering debris. For good measure, these materials are again examined before use at the next sampling location. These precautions help assure "cross-contamination" (specimen carry-over) between samples.

Habitat Assessments performed as part of the biological survey entail observers trained in DWM's Habitat Assessment procedures. A standardized Habitat Assessment Field Scoring Sheet will be completed at all biomonitoring stations. Disagreement in habitat parameter scoring will be discussed and resolved among the field crew before the Habitat Assessment can be considered complete.

Sample Processing and Taxonomy

While not completed in the MassDEP lab, both sorting efficacy and taxonomy/enumeration undergo a QC process within the contract lab. Percent taxonomic disagreement (PTD) quantifies the sample-based precision of taxonomic identifications by comparing taxonomic results from two independent taxonomists and is considered "passing" when PTD is < 15%. Percent difference in enumeration (PDE) quantifies the consistency of specimen counts in samples, and is determined by calculating a comparison of results from two independent taxonomists and is considered "passing" when PDE < 5%. All results of these analyses are provided to the MassDEP biologist upon receiving the dataset.

LITERATURE CITED

- Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid bioassessment protocols for use in wadeable streams and rivers: Periphyton, benthic macroinvertebrates, and fish, second edition. U.S. Environmental Protection Agency. Washington, DC. EPA 841-B-99-002.
- Block, B., J. Stamp, and B. Jessup. 2020. Calibration of Indices of Biotic Integrity for 300-organism macroinvertebrate riffle habitat samples in Massachusetts freshwater wadeable streams. Prepared for the Massachusetts Department of Environmental Protection by Tetra Tech. Montpelier, VT.
- Courtemanch, D.L. 1984. A closing artificial substrate device for sampling benthic macroinvertebrates in deep rivers. *Freshwater Invertebrate Biol.* 3(3):143-146.
- Jessup, B., B. Block, and J. Stamp. 2021. Development of an Index of Biotic Integrity for Macroinvertebrates in Freshwater Low Gradient Wadeable Streams in Massachusetts Draft Report. Prepared for the Massachusetts Department of Environmental Protection by Tetra Tech. Montpelier, VT.
- Klemm, D.J., P.A. Lewis, F. Fulk, and J.M. Lazorchak. 1990. Macroinvertebrate field and laboratory methods for evaluating the biological integrity of surface waters. U.S. Environmental Protection Agency, Cincinnati, OH. EPA/600/4-90/030.
- Nuzzo, R.M. (ed.) 2002. Benthic macroinvertebrate database descriptions and procedures (rev. 1.1). Massachusetts DEP, Division of Watershed Management. Worcester, MA. 20 p.
- MassDEP, 2025. SOP Benthic Macroinvertebrate Data Management. CN 039.5. Massachusetts Department of Environmental Protection, Bureau of Water Resources, Division of Watershed Management, Watershed Planning Program. Worcester, MA.
- Stamp, J., and B. Jessup. 2020. Establishing numeric biological condition thresholds. Prepared for the Massachusetts Department of Environmental Protection by Tetra Tech. Montpelier, VT.

River Basin _____ Stream Name _____ Unique ID: W _____ Unique ID: B _____

Investigator(s) _____ Start Time _____ End Time _____

Describe Site Location _____ Date: _____

HIGH GRADIENT**APPENDIX A****Habitat Field Sheets and Assessment Forms**

GEOMORPHOLOGY CHARACTERIZATION

• Channel Slope

- ☐ Low Gradient
☐ Moderate Gradient
☐ High Gradient

Notes _____

• % Riffle Habitat

- ☐ 0 – 30%
☐ 31 – 50%
☐ 51 – 75%
☐ 76 – 100%

ANTHROPOGENIC IMPACTS

• Local Watershed NPS Pollution

- ☐ No evidence
☐ Potential sources: _____
☐ Obvious sources: _____

• Dam present ☐ Yes ☐ No• Channelized ☐ Yes ☐ No**RIPARIAN ZONE & INSTREAM FEATURES**

• Riparian Land Use [18m]

Bottom	Middle	Top
_____ % Forest	_____ % Forest	_____ % Forest
_____ % Field/Pasture	_____ % Field/Pasture	_____ % Field/Pasture
_____ % Agriculture	_____ % Agriculture	_____ % Agriculture
_____ % Residential	_____ % Residential	_____ % Residential
_____ % Commercial	_____ % Commercial	_____ % Commercial
_____ % Industrial	_____ % Industrial	_____ % Industrial
_____ % Other	_____ % Other	_____ % Other

• Measured Stream Width

Bottom: _____ m
 Middle: _____ m
 Top: _____ m
 Average: _____ m

• Estimated Average Depth (m) by Habitat

Bottom	Middle	Top
Riffle: _____ m	Riffle: _____ m	Riffle: _____ m
Run: _____ m	Run: _____ m	Run: _____ m
Pool: _____ m	Pool: _____ m	Pool: _____ m

• Open Sky / Canopy Cover

Bottom	Middle	Top
Open: _____ %	Open: _____ %	Open: _____ %
Can. Cov: _____ %	Can. Cov: _____ %	Can. Cov: _____ %

Bottom Densimeter Reading			
CL	/ 17	LB	/ 17
CR	/ 17	RB	/ 17

Middle Densimeter Reading			
CL	/ 17	LB	/ 17
CR	/ 17	RB	/ 17

Top Densimeter Reading			
CL	/ 17	LB	/ 17
CR	/ 17	RB	/ 17

SEDIMENT/SUBSTRATE

• Odors

- ☐ None/normal
☐ Anaerobic
☐ Chemical
☐ Petroleum
☐ Sewage
☐ Other _____

• Deposits

- ☐ None
☐ Paper fiber
☐ Sand
☐ Trash
☐ Sludge
☐ Other _____

• Oils

- ☐ None
☐ Slight
☐ Moderate
☐ Profuse
☐ Other _____

INORGANIC SUBSTRATE COMPONENTS*		
Substrate Type	Size (Minshall 1984)	Sampled Area
Bedrock		%
Boulder	>256 mm (10 in)	%
Cobble	64-256 mm (2.5-10 in)	%
Pebble	16-64 mm (0.6-2.5 in)	%
Gravel	2-16 mm (0.1-0.6 in)	%
Sand	0.06-2mm (gritty)	%
Silt	0.004-0.06 mm	%
Clay *for single habitat sampling only	<0.004 mm (slick)	%

WATER CHARACTER

• Water Odors

- ☐ Normal/None
☐ Chemical/Chlorine
☐ Fishy
☐ Petroleum
☐ Raw Sewage/Untreated
☐ Other _____

• Water Surface Oils

- ☐ None
☐ Flecks
☐ Globbs
☐ Slick/Sheen

• Water Color

• Color Intensity (0-5)

None = 0; Very dark = 5

• Turbidity

[Rank 0-5] _____
 Clear = 0; Severe (opaque) = 5

DOMINANT ORGANIC COMPONENTS (check if >50%)

- ☐ Sticks/coarse woody debris, detritus
☐ Mud/muck

BenSamp ID#:

HabSamp ID#:

- **Current weather** ☐ Sleet/snow ☐ Mostly cloudy ☐ Clear
 ☐ Rain ☐ Partly cloudy
 ☐ Cloud cover _____ %

- **Water level** ☐ Low – Approx. _____ m lower than avg
 ☐ Normal
 ☐ High – approx. _____ m higher than avg

Notes: _____

• **Riparian vegetation (18 m buffer)**

Record % area covered (Bottom, Middle, Top of reach)

Bottom	Middle	Top
Trees: _____ %	Trees: _____ %	Trees: _____ %
Shrubs: _____ %	Shrubs: _____ %	Shrubs: _____ %
Herb/Grass: _____ %	Herb/Grass: _____ %	Herb/Grass: _____ %

• **Aquatic vegetation** - coverage within reach _____ %

Record relative % composition (total = 100)

_____ % rooted emergent
 _____ % rooted submerged
 _____ % rooted floating
 _____ % mosses

Free floating – rank 0 (none) to 5 (dense): _____

For entire reach: Deciduous: _____ % Coniferous: _____ %

• **Algae** (coverage within reach: _____ %)

• **Number algae samples taken:** _____

Forms	Color			Substrate				Microhabitat		
	Green	Brown	Other	Rock	Wood	Plant	Other	Pool	Riffle	Other
<input type="checkbox"/> Filamentous	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Flock	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Thin-film	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Mat	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Other	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	

HABITATS SAMPLED – MULTIHABITAT SAMPLING ONLY (#kicks/jabs; total = 10)

Hard Bottom (riffle/run)	Bank	Snags/CWD	Overhanging Veg	Submerged Veg	Emergent Veg	Other (describe):

♦ **Site Sketch**

Stream Name: _____

W#: _____

B#: _____

Describe site location: _____ Date: _____

Scoring for wadable **riffle/run dominated streams** (moderate to high gradient) with velocities approx. 30 cm/s or greater.**Check box or circle category**

Habitat parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1. Instream cover/habitat	Stable habitats comprise > 50% of reach (e.g., cobble/boulders, undercut banks, CWD, submerged aquatic vegetation). Snags/logs not newly fallen or transient. <input type="checkbox"/>	Stable habitats comprise 30-50% of reach – adequate for population maintenance. <input type="checkbox"/>	Stable habitats comprise 10-30% of reach – habitat less than desirable, frequent disturbance. <input type="checkbox"/>	Stable habitats comprise < 10% of reach – obvious lack of habitat, substrate lacking or unstable. <input type="checkbox"/>
2. Epifaunal Substrate (in sampled area only)	Riffles/runs well-developed in proportion to stream size, abundance of cobble or boulder substrates. <input type="checkbox"/>	Riffles/runs present and as wide as stream but limited in length, abundance of cobble, pebble, or gravel substrates. <input type="checkbox"/>	Riffles/runs lacking or short in width/ length (in proportion to stream size). Cobble substrates rare, gravel or bedrock dominant. <input type="checkbox"/>	Riffles or runs virtually nonexistent; bedrock prevalent; cobble lacking. <input type="checkbox"/>
3. Embeddedness (riffles/runs)	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. <input type="checkbox"/>	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. <input type="checkbox"/>	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment. <input type="checkbox"/>	Gravel, cobble, and boulder particles are > 75% surrounded by fine sediment. <input type="checkbox"/>
4. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern. <input type="checkbox"/>	Some channelization or dredging present but not recent (> 20 y). Often present as bridge abutments. <input type="checkbox"/>	New embankments present on both banks; and 40-80% of stream reach channelized and disrupted. <input type="checkbox"/>	Banks shored with cement; over 80% of the stream reach channelized and disrupted. <input type="checkbox"/>
5. Sediment Deposition	Little or no unnatural enlargement of islands or point bars and < 5% of the bottom affected by sediment deposition. <input type="checkbox"/>	Some new increase in bar formation, mostly from gravel, sand, or fine sediment from unnatural sources ; 5-30% of the bottom affected; slight deposition in pools. <input type="checkbox"/>	Moderate deposition of new gravel, sand, or fine sediment on old and new bars from unnatural sources ; 30-50% of the bottom affected; constriction and moderate deposition in pools prevalent. <input type="checkbox"/>	Heavy, unnatural deposits of fine material, well-developed bars; > 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. <input type="checkbox"/>

Habitat parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
6. Velocity-Depth Combinations 1. slow deep 2. fast deep 3. slow shallow 4. fast shallow	All 4 velocity/depth patterns present. <input type="checkbox"/>	Only 3 of 4 velocity/depth patterns present. <input type="checkbox"/>	Only 2 velocity/depth patterns present; usually lacking deep areas. <input type="checkbox"/>	Dominated by one velocity/depth pattern. Generally all flat water or shallow riffles. <input type="checkbox"/>
7. Channel Flow Status	Water reaches the base of both banks, and minimal amount of smaller substrates in channel (NOT including large boulders) are exposed. <input type="checkbox"/>	Water fills > 75% of the available channel; or < 25% of smaller channel substrates (NOT including large boulders) are exposed. <input type="checkbox"/>	Water fills 25-75% of the available channel, and/or smaller substrates (NOT including large boulders) are mostly exposed. <input type="checkbox"/>	Very little water in channel and mostly present as standing pools. <input type="checkbox"/>
8. Bank Vegetative Protection (score each bank) <i>Note: Determine left or right side by facing downstream</i>	More than 90% of the streambank surfaces covered by naturally occurring vegetation, grazing or mowing minimal or absent; almost all plants allowed to grow naturally. Left <input type="checkbox"/> Right <input type="checkbox"/>	70-90% of the streambank surfaces covered by naturally occurring vegetation, disruption evident but not affecting full plant growth potential to any great extent. Left <input type="checkbox"/> Right <input type="checkbox"/>	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common. Left <input type="checkbox"/> Right <input type="checkbox"/>	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation very high. Left <input type="checkbox"/> Right <input type="checkbox"/>
9. Bank Stability (score each bank)	Banks stable; evidence of erosion of bank failure absent or minimal; little potential for future problems. < 5% of bank affected. Left <input type="checkbox"/> Right <input type="checkbox"/>	Moderately stable; infrequent. Small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. Left <input type="checkbox"/> Right <input type="checkbox"/>	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. Left <input type="checkbox"/> Right <input type="checkbox"/>	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. Left <input type="checkbox"/> Right <input type="checkbox"/>
10. Riparian Vegetative Zone Width (score each side)	Width of riparian zone >18 m; human activities (e.g., parking lots, roadbeds, clear-cuts, lawns, crops, etc.) have not impacted zone. Left <input type="checkbox"/> Right <input type="checkbox"/>	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. Left <input type="checkbox"/> Right <input type="checkbox"/>	Width of riparian zone 6-12 m; human activities have impacted zone a great deal. Left <input type="checkbox"/> Right <input type="checkbox"/>	Width of riparian zone < 6 m; little or no riparian vegetation due to human activities. Left <input type="checkbox"/> Right <input type="checkbox"/>

Comments: _____

Stream Name: _____

W#: _____

B#: _____

Describe site location: _____ Date: _____

Scoring for streams of **low to moderate gradient**, with velocities usually < 30 cm/s (except from storm events) and predominantly fine sediments.

Check box or circle category

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1. Bottom Substrate/Available Cover	Stable habitats comprise > 50% of reach (e.g., cobble/boulders, undercut banks, CWD, submerged aquatic vegetation). Snags/logs not newly fallen or transient. <input type="checkbox"/>	Stable habitats comprise 30-50% of reach – adequate for population maintenance. <input type="checkbox"/>	Stable habitats comprise 10-30% of reach – habitat less than desirable, frequent disturbance. <input type="checkbox"/>	Stable habitats comprise < 10% of reach – obvious lack of habitat, substrate lacking or unstable. <input type="checkbox"/>
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common. <input type="checkbox"/>	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present. <input type="checkbox"/>	All mud or clay or sand bottom; little or no root mat; no submerged vegetation. <input type="checkbox"/>	Hard-pan clay or bedrock; no root mat or vegetation. <input type="checkbox"/>
3. Pool Variability 1. large shallow 2. large deep 3. small shallow 4. small deep	All 4 pool types present. <input type="checkbox"/>	Only 3 of 4 pool types present – mostly large deep. <input type="checkbox"/>	Only 2 of 4 pool types present – mostly shallow. <input type="checkbox"/>	Only 1 of 4 pool types present, or pools absent. <input type="checkbox"/>
4. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern. <input type="checkbox"/>	Some channelization or dredging present but not recent (> 20 y). Often present as bridge abutments. <input type="checkbox"/>	New embankments present on both banks; and 40-80% of stream reach channelized and disrupted. <input type="checkbox"/>	Banks shored with cement; over 80% of the stream reach channelized and disrupted. <input type="checkbox"/>
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation fine and coarse material at snags and submerged vegetation; little or no unnatural enlargement of islands or point bars. <input type="checkbox"/>	20-50% of bottom affected; moderate unnatural accumulation; substantial sediment movement only during major storm event. <input type="checkbox"/>	50-80% of affected; major unnatural deposition; pools shallow, heavily silted, frequent and substantial sediment movement during storm events. <input type="checkbox"/>	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to unnatural deposition. <input type="checkbox"/>

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Sinuosity	Natural bends in stream present, channel not incised. <input type="checkbox"/>	Natural bends in stream limited, some channel incision present. <input type="checkbox"/>	Natural bends in stream not present, substantial channel incision. <input type="checkbox"/>	Channel straight; waterway has been channelized or incised for a long distance (>60% of reach length). <input type="checkbox"/>
7. Channel Flow Status	Water reaches the base of both banks, and minimal amount of smaller substrates in channel (NOT including large boulders) are exposed. <input type="checkbox"/>	Water fills > 75% of the available channel; or < 25% of smaller channel substrates (NOT including large boulders) are exposed. <input type="checkbox"/>	Water fills 25-75% of the available channel, and/or smaller substrates (NOT including large boulders) are mostly exposed. <input type="checkbox"/>	Very little water in channel and mostly present as standing pools. <input type="checkbox"/>
8. Bank Vegetative Protection (score each bank) <i>Note: Determine left or right side by facing downstream</i>	More than 90% of the streambank surfaces covered by naturally occurring vegetation, grazing or mowing minimal or absent; almost all plants allowed to grow naturally. <input type="checkbox"/> Left <input type="checkbox"/> Right	70-90% of the streambank surfaces covered by naturally occurring vegetation, disruption evident but not affecting full plant growth potential to any great extent. <input type="checkbox"/> Left <input type="checkbox"/> Right	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common. <input type="checkbox"/> Left <input type="checkbox"/> Right	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation very high. <input type="checkbox"/> Left <input type="checkbox"/> Right
9. Bank Stability (score each bank) <i>Note: Erosion NOT Scour.</i>	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected. <input type="checkbox"/> Left <input type="checkbox"/> Right	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. <input type="checkbox"/> Left <input type="checkbox"/> Right	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. <input type="checkbox"/> Left <input type="checkbox"/> Right	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. <input type="checkbox"/> Left <input type="checkbox"/> Right
10. Riparian Vegetative Zone Width (score each side)	Width of riparian zone >18 m; human activities (e.g., parking lots, roadbeds, clear-cuts, lawns, crops, etc.) have not impacted zone. <input type="checkbox"/> Left <input type="checkbox"/> Right	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. <input type="checkbox"/> Left <input type="checkbox"/> Right	Width of riparian zone 6-12 m; human activities have impacted zone a great deal. <input type="checkbox"/> Left <input type="checkbox"/> Right	Width of riparian zone < 6 m; little or no riparian vegetation due to human activities. <input type="checkbox"/> Left <input type="checkbox"/> Right

Comments:

GEOMORPHOLOGY CHARACTERIZATION

• Channel Slope

- ☐ Low Gradient
☐ Moderate Gradient
☐ High Gradient

Notes _____

• % Riffle Habitat

- ☐ 0 – 30%
☐ 31 – 50%
☐ 51 – 75%
☐ 76 – 100%

ANTHROPOGENIC IMPACTS

• Local Watershed NPS Pollution

- ☐ No evidence
☐ Potential sources: _____
☐ Obvious sources: _____

• Dam present ☐ Yes ☐ No• Channelized ☐ Yes ☐ No**RIPARIAN ZONE & INSTREAM FEATURES**

• Riparian Land Use [18m]

Bottom	Middle	Top
_____ % Forest	_____ % Forest	_____ % Forest
_____ % Field/Pasture	_____ % Field/Pasture	_____ % Field/Pasture
_____ % Agriculture	_____ % Agriculture	_____ % Agriculture
_____ % Residential	_____ % Residential	_____ % Residential
_____ % Commercial	_____ % Commercial	_____ % Commercial
_____ % Industrial	_____ % Industrial	_____ % Industrial
_____ % Other	_____ % Other	_____ % Other

• Measured Stream Width

Bottom: _____ m
 Middle: _____ m
 Top: _____ m
 Average: _____ m

• Estimated Average Depth (m) by Habitat

Bottom	Middle	Top
Riffle: _____ m	Riffle: _____ m	Riffle: _____ m
_____ %	_____ %	_____ %
Run: _____ m	Run: _____ m	Run: _____ m
_____ %	_____ %	_____ %
Pool: _____ m	Pool: _____ m	Pool: _____ m

• Open Sky / Canopy Cover

Bottom	Middle	Top
Open: _____ %	Open: _____ %	Open: _____ %
Can. Cov: _____ %	Can. Cov: _____ %	Can. Cov: _____ %

Bottom Densiometer Reading			
CL	/ 17	LB	/ 17
CR	/ 17	RB	/ 17

Middle Densiometer Reading			
CL	/ 17	LB	/ 17
CR	/ 17	RB	/ 17

Tom Densiometer Reading			
CL	/ 17	LB	/ 17
CR	/ 17	RB	/ 17

SEDIMENT/SUBSTRATE

• Odors

- ☐ None/normal
☐ Anaerobic
☐ Chemical
☐ Petroleum
☐ Sewage
☐ Other _____

• Deposits

- ☐ None
☐ Paper fiber
☐ Sand
☐ Trash
☐ Sludge
☐ Other _____

• Oils

- ☐ None
☐ Slight
☐ Moderate
☐ Profuse
☐ Other _____

INORGANIC SUBSTRATE COMPONENTS*		
Substrate Type	Size (Minshall 1984)	Sampled Area
Bedrock		%
Boulder	>256 mm (10 in)	%
Cobble	64-256 mm (2.5-10 in)	%
Pebble	16-64 mm (0.6-2.5 in)	%
Gravel	2-16 mm (0.1-0.6 in)	%
Sand	0.06-2mm (gritty)	%
Silt	0.004-0.06 mm	%
Clay *for single habitat sampling only	<0.004 mm (slick)	%

WATER CHARACTER

• Water Odors

- ☐ Normal/None
☐ Chemical/Chlorine
☐ Fishy
☐ Petroleum
☐ Raw Sewage/Untreated
☐ Other _____

• Water Surface Oils

- ☐ None
☐ Flecks
☐ Globbs
☐ Slick/Sheen

• Turbidity

[Rank 0-5] _____
 Clear = 0; Severe (opaque) = 5

• Water Color

• Color Intensity (0-5)

None = 0; Very dark = 5

DOMINANT ORGANIC COMPONENTS (check if >50%)

- ☐ Sticks/coarse woody debris, detritus
☐ Mud/muck

HabSamp ID#:

BenSamp ID#:

- **Current weather** ☐ Sleet/snow ☐ Mostly cloudy ☐ Clear
 ☐ Rain ☐ Partly cloudy
 ☐ Cloud cover _____ %

- **Water level** ☐ Low – Approx. _____ m lower than avg
 ☐ Normal
 ☐ High – approx. _____ m higher than avg
 Notes: _____

• **Riparian vegetation (18 m buffer)**

Record % area covered (Bottom, Middle, Top of reach)

Bottom	Middle	Top
Trees: _____ %	Trees: _____ %	Trees: _____ %
Shrubs: _____ %	Shrubs: _____ %	Shrubs: _____ %
Herb/Grass: _____ %	Herb/Grass: _____ %	Herb/Grass: _____ %

• **Aquatic vegetation** - coverage within reach _____ %

Record relative % composition (total = 100)

_____ % rooted emergent
 _____ % rooted submerged
 _____ % rooted floating
 _____ % mosses

For entire reach: Deciduous: _____ % Coniferous: _____ %

Free floating – rank 0 (none) to 5 (dense): _____

• **Algae** (coverage within reach: _____ %)

• **Number algae samples taken:** _____

Forms	Color			Substrate				Microhabitat		
	Green	Brown	Other	Rock	Wood	Plant	Other	Pool	Riffle	Other
<input type="checkbox"/> Filamentous	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Flock	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Thin-film	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Mat	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> Other	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	

HABITATS SAMPLED – MULTIHABITAT SAMPLING ONLY (#kicks/jabs; total = 10)

Hard Bottom (riffle/run)	Bank	Snags/CWD	Overhanging Veg	Submerged Veg	Emergent Veg	Other (describe):

♦ **Site Sketch**

Stream Name: _____

W#: _____

B#: _____

APPENDIX B

Hazardous Waste Generation Record Form

HAZARDOUS WASTE GENERATION RECORD

Lab # _____ Year _____

[illegible]