Interim Level 2- Stream Conditional Assessment Procedure for Intermittent Streams with Perennial Pools, Perennial Streams and Wadeable Rivers with Impacts Greater than 500 Linear Feet

2.0 Stream Impact Site Assessment

Regulated impacts are proposed to various types and qualities of streams. Therefore, it is important to assess the condition of the stream being impacted and use this condition as a baseline in determining the appropriate compensation. To assess the condition of a perennial stream or wadeable river, six parameters are sampled in the field. These six parameters are: 1) Visual Channel Assessment; 2) Riparian Buffer Assessment; 3) Visual Channel Alteration Assessment; 4) Rapid In-Stream Macroinvertebrate Observation (perennial pools, perennial streams and wadeable rivers only); and 5) Regionalized Index of Biotic Integrity for Fish (perennial pools, perennial streams and wadeable rivers only). A wadeable river is defined as a river that may be sampled under normal conditions without a boat.

2.0.1 Stream Assessment Transect

The fundamental unit for evaluating stream impacts is the stream assessment transect (Transect). Application of Transects is an important step in the assessment process and may affect the score. To simply the process, a fixed length transect of 350 feet will be placed within set intervals commensurate with the project. Transects must be placed no less than 125 feet apart and no greater than 200 feet apart. The following guidelines will be applied for the placement and number of transects to assure accuracy and precision of the assessment:

Table 1: Stream Assessment Transect (Transect) Requirements

Impact Length (in linear feet)	Number of Transects
501-1499	6
1500-2499	8
2500-4000	10
Greater than 4000	Contact Corps

2.1 Channel Condition Parameter

While streambank erosion is a natural process, anthropogenic modification within the stream or its watershed influence the flow hydraulics, sediment patterns and channel morphology of the stream. These anthropogenic influences results can increase stream channel instability, reduce the physical and biological function of rivers, increase land loss from erosion and becomes a major source of non-point pollution associated with the increased sediment supply. For example, conversion of forests to croplands causes about a tenfold increase in sediment yield. Streambank erosion processes, although complex, are driven by two major components: stream bank characteristics (erodibility) and hydraulic/gravitational forces.

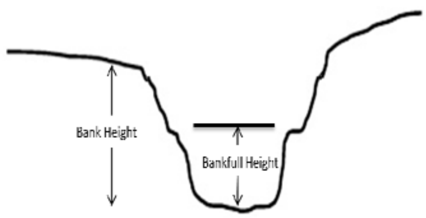
2.1.1 Channel Condition

For a Level 2 Stream Condition Assessment, channel condition is assessed based on the *A Practical Method of Computing Streambank Erosion Rate* (Rosgen 2001), which involves collecting field data on streambank characteristics to calculate a **bank erosion hazard index (BEHI).** The BEHI procedure consists of five metrics: 1) bank height ratio; 2) root depth ratio 3) root density, in percent; 4) bank angle, in degrees; and 5) surface protection, in percent. Each of these five metrics are used to compute an erosion risk index, and then the individual erosion risk indices are summed to provide a total erosion risk index for use in identifying the Channel Condition Variable.

2.1.2 Bank Erosion Hazard Index Metrics

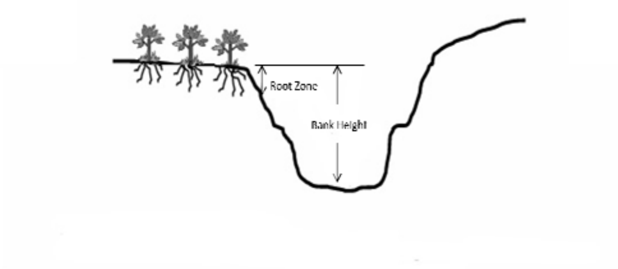
The following is a detailed description of the procedure for assessing each metric. Each metric will result in a value that has a corresponding index, as seen in Table 2.

Bank Height Ratio. The bank height ratio value is a ratio of the maximum bankfull height and the bank height of the lowest bank. This is the most challenging of the BEHI metrics, as it requires accurate identification of bankfull indicators to determine the bankfull depth. Bankfull is the flow stage of a river in which the stream completely fills its channel and the elevation of the water surface coincides with the bank margins. Common bankfull indicators are located on the point on the bank or shore up to which the presence and action of water is so continuous as to leave a distinct mark either by erosion, destruction of terrestrial vegetation or other easily recognizable characteristics. Bankfull indicators in unstable streams (i.e., incising or aggrading streams) can be more difficult to identify, but are usually less than bank height. For this ratio, the bankfull height is measured from the thalweg, or deepest part of the stream. Bank height is the vertical measure from the bank toe to the top of the lower bank lip, irrespective of changes in the water level. Bank toe is the inflection or bending point between the bank face and stream bed. The euqation is as follows:



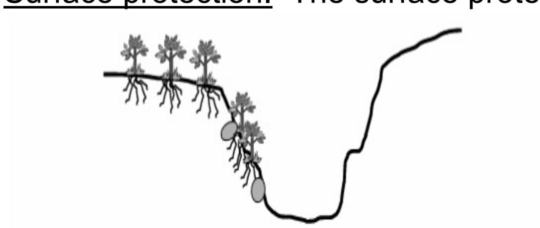
Lower Bank Height (ft) ÷Maximum Bankfull Height (ft) = Bank Height Ratio

<u>Ratio of root depth to bank height</u>. The root depth value is the ratio of the average plant root depth to the maximum bank height, expressed as a percent (e.g., roots extending 2' into a 4' tall bank = 0.50.) The ratio provides indication of the bank protection provided by live plant roots. Very Low Values of root depth indicate high bank erosion potential. Values of rooting depth ratio near 1 indicate relatively low bank erosion potential. The equation is as follows:



Root Depth (ft) ÷Lowest bank Height (ft) = Ratio of Root Depth to Bank Height

<u>Surface protection.</u> The surface protection value is the percentage of the stream bank covered (and therefore protected) by plant roots, downed logs and branches, rocks, etc. In many low gradient streams, surface protection and root density are synonymous. This variable is sampled visually by the observer.



<u>Root density.</u> Root density, expressed as a percent, is the proportion of the stream bank surface covered (and protected) by plant roots (e.g., a bank whose slope is half covered with roots = 50%). Like surface protection, this variable is sampled visually by the observer.

<u>Bank angle.</u> Bank angle is the angle of the "lower bank" – the bank from the waterline at base flow to the top of the bank, as opposed to benches that are higher on the floodplain. Bank angles great than 90º occur on undercut banks. Bank angle can be measured with an inclinometer (Figure 1), though given the broad bank angle categories (Table 1), visual estimates are generally sufficient. Bank angle is perhaps the metric most often estimated incorrectly.

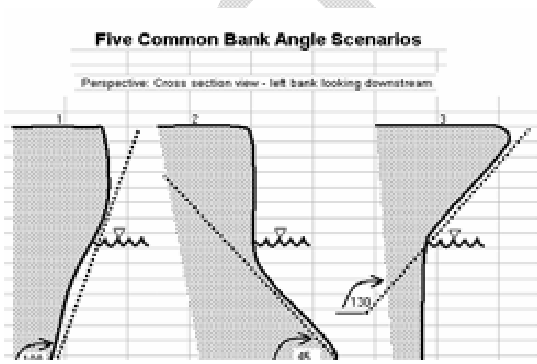


Table 2. Bank Erosion Hazard Index Calculation

Stream Bank Hazard or Risk Rating		Bank Height to Bankfull Height (Ratio)	Root Depth to Bank Height (Ratio)	Root Density (%)	Bank Angle (Degrees)	Surface Protection (%)	Index Totals
Very Low	*Value*	1.0-1.1	1.0-0.9	100-80	0-20	100-80	
	Index	1.0-1.9	1.0-1.9	1.0-1.9	1.0-1.9	1.0-1.9	5-9.5
Low	*Value*	1.11-1.19	0.89-0.5	79-55	21-60	79-55	
	Index	2.0-3.9	2.0-3.9	2.0-3.9	2.0-3.9	2.0-3.9	10-19.5
Moderate	*Value*	1.2-1.5	0.49-0.3	54-30	61-80	54-30	
	Index	4.0-5.9	4.0-5.9	4.0-5.9	4.0-5.9	4.0-5.9	20-29.5
High	*Value*	1.6-2.0	0.29-0.15	29-15	81-90	29-15	
	Index	6.0-7.9	6.0-7.9	6.0-7.9	6.0-7.9	6.0-7.9	30-39.5
Very High	*Value*	2.1-2.8	0.14-0.05	14-5.0	91-119	14-10	
	Index	8.0-9.0	8.0-9.0	8.0-9.0	8.0-9.0	8.0-9.0	40-45
Extreme	*Value*	> 2.8	< 0.05	< 5	< 119	< 10	
	Index	10	10	10	10	10	46-50

2.1.3 Channel Condition Variable

The Channel Conditional Variable (CV) is assessed by summing the index totals from the BEHI resulting in a point range. A stream may have particular values that are determined to be an extreme hazard while other values result in a less hazardous score. A stream need not be scored the same hazard rating in all five metrics to be categorized.

***Very Low*-CV Score 6**
These channels have an index total between 5 and 9.5.

***Low*-CV Score 5**
These channels have an index total between 10 and 19.5

***Moderate*- CV Score 4**
These channels have an index total between 20 and 29.5

***High- Score*-CV Score 3**
These channels have an index total between 30 and 39.5

***Very High*- CV Score 2**
These channels have an index total between 40 and 45

***Extreme*- CV Score 1**
These channels have an index total between 46 and 50

2.2 Riparian Buffer Parameter

A Riparian buffer is defined as the zone of vegetation adjacent to streams, rivers, creeks or bayous. These vegetated zones are important in intercepting and controlling nutrients and sediment entering into the system. As such, they are considered a best management practice for inclusion in a compensatory mitigation plan and are an important consideration in the review of proposed impacts to the stream. Buffer width is positively related to nutrient removal effectiveness by influencing retention through plant sequestration or removal through microbial denitrification. For the purpose of this assessment, the buffer is measured from the verified ordinary high water mark of the stream. This parameter is not intended to be a detailed vegetative cover survey, but instead, is a qualitative evaluation of the cover types that make up the riparian buffer. The Buffer Value (BV) for this parameter is determined by evaluating what cover type occupies what percent of the total riparian buffer area for 100 feet on each side of the stream channel within the Transect. The left bank (LB) and right bank (RB) are determined by facing downstream. The Riparian Buffer measurement is taken along the ground and is not an aerial distance from the stream bank.

The ideal riparian buffer would be 100% coverage of the assessment area by native vegetation with no additional land use. If the buffer is a mixed land use (example: 33% forested, 33% cropland, and 34% pavement), it is possible that the buffer could contain multiple condition categories. In that case, each condition category present within the buffer is scored and weighted by the percent it occupies within the buffer. An estimate of the percent area that each cover type occupies may be made from visual estimates made on-the-ground or by measuring each different area to obtain its dimensions. Multiple intrusions of roads, parks, houses, etc., into the 100-foot zone may require more detailed measurements to determine percentages. The observed cover types should be categorized and scored accordingly, based upon the parameter category description.

2.2.1 Riparian Buffer Condition

The Transect is assessed for the condition of the Riparian Buffer to calculate the Riparian Buffer Variable (BV) using the five categories described below.

***Optimal*-BV Score 5**

Native plant species represent greater than 60% coverage with wetlands present within the Transect. No maintenance and/or grazing within the buffer. Riparian buffers that have been cleared of native plant species within two years of the assessment will automatically score *Optimal.*

Suboptimal

High Suboptimal-BV Score 4.5: Native plant species represent greater than 60% coverage *with no* wetlands present within the buffer and no maintenance or grazing within the buffer OR native community species represent between 30-59% coverage *with* wetlands present and no maintenance or grazing within the buffer.

Low Suboptimal-BV Score 4: Native plant species between 30-59% coverage with no wetlands present and no maintenance or grazing activities present within the buffer.

Marginal-

High Marginal – BV Score 3.5: Native plant species represents less than 30% coverage of native plant species *with* wetlands present and no maintenance or grazing activities present.

Low marginal – BV Score 3: Native plant species represents less than 30% coverage of native plant species *with no* wetlands present and no maintenance or grazing activities present.

***Poor*-BV Score 2**

The area consists of one or more of the following: lawns; mowed or maintained right-of-way; grazing; sparsely vegetated non-maintained area; or other comparable condition**.** The presence or absence of wetlands and/or the presence of native plant communities does not affect this score.

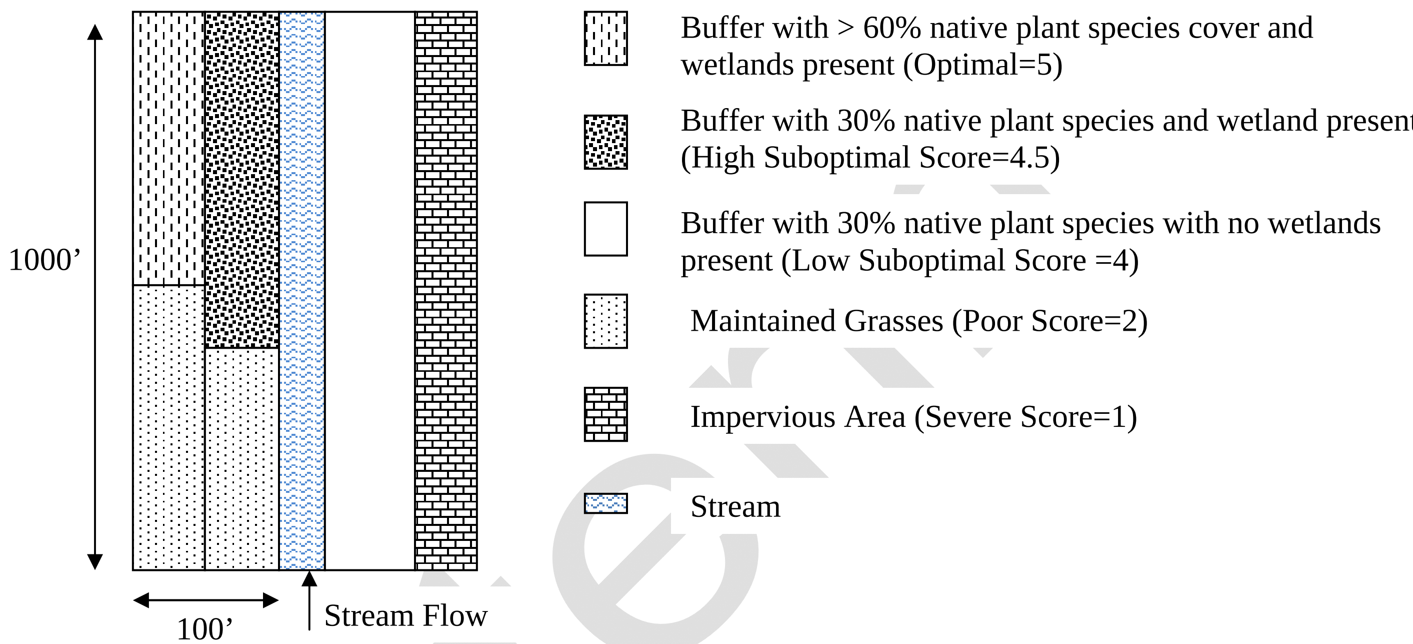
***Severe*-BV Score 1**

The area consists of one or more of the following; impervious surfaces; mine spoil lands; denuded surfaces; row crops; active feed lots; or other comparable conditions. The presence or absence of wetlands and/or the presence of native plant communities does not affect this score.

2.2.2 Identifying Riparian Buffer Condition

When a buffer is simply one vegetation community, determining the appropriate buffer condition variable is simple. However, often times the buffer in the Transect is a mixed community. Since a single variable is required for the calculations, the example below will help you understand how to calculate a multiple condition buffer.

EXAMPLE 1: Calculating Multiple Condition Riparian Buffer



<u>Right Buffer</u>

The buffer located on the right bank is comprised of:

1) A 60-foot by 1000-foot (or 60%) Low Suboptimal Score (or 4) area
2) A 40-foot by 1000-foot (or 40%) Severe Score (or 1) area.

Therefore, the equation to calculate the Right Buffer is:

$$(0.60 * 4) + (0.40 * 1) = 2.8$$

<u>Left Buffer</u>

The buffer located on the left bank is comprised of:

1) A 50-foot by 500-foot (or 25%) Optimal Score (or 5) area,
2) A 50-foot by 750-foot (or 37.5%) High Suboptimal (or 4.5) area
3) One 50-foot by 500-foot and one 50-foot by 250-foot (or a total of 37.5%) of Poor Score (or 2) area.

Therefore, the equation to calculate the Left Buffer is:

$$(0.25 * 5) + (0.375 * 4.5) + (0.375 * 2) = 3.68$$

The final variable for BV is calculated by averaging to the two buffer scores.

2.3 Visual Channel Alteration

This parameter considers direct impacts to the stream channel from anthropogenic sources. The Transect may or may not have been altered throughout its entire length.

Examples of channel alterations evaluated in this parameter that may disrupt the natural conditions of the stream include, but are not limited to, the following:

- Straightening of channel or other channelization
- Stream crossings (bridges and bottomless culverts)
- Riprap, articulated matting, concrete aprons, gabions, or concrete blocks along streambank or in streambed
- Manmade embankments on streambanks, including spoil piles
- Constrictions to stream channel or immediate flood prone area such as any culverts, levees, weirs, and impoundments
- Livestock impacted channels (i.e., hoof tread, livestock in stream,)

It is important to note that this parameter evaluates the physical alteration, separate from the impact the alteration is having on the assessment reach. Any impact to the assessment reach resulting from the alteration (i.e. scouring, head cuts, vertical banks, etc.) is accounted for in the Channel Condition Parameter. Any revegetation or natural re-stabilization of the channel is also accounted for in the Channel Condition Parameter. For example, consider two TRANSECTs, each with similar bridges: the first reach shows no adverse effects to the stream channel or banks; the second shows significant scouring. The alteration is the bridge, not the effects of the bridge; therefore it is the length of bridge relative to the length of the assessment reach that is evaluated.

The presence of a structure does not necessarily result in a reduced score. For instance, a bridge that completely spans the floodplain would not be considered an alteration. Also, the stream evaluator is cautioned not to make assumptions about past alterations. Incision can be mistaken for channelization.

2.3.1 Visual Channel Alteration Variable

The Transect is assessed for the extent of anthropogenic channel alterations to determine the appropriate Channel Alteration Variable (AV) using the following four categories. The evaluator selects the category most representative of the assessment reach.

***Negligible*-AV Score 5**

Channelization, dredging, alteration, or hardening absent. Stream has unaltered pattern or has normalized. No dams, dikes, levees, culverts, riprap, bulkheads, armor, drop structures or withdrawal structures. No channel incision.

Minor

High Minor-AV Score 4.5: Less than 20% of the stream reach is impacted by any of the channel alterations listed above. Alteration or channelization is present, usually adjacent to structures such as bridge abutments or culverts. Evidence of past alteration may be present, but stream pattern and stability have recovered; recent alteration is not present. Withdrawals present, but no notable affect on flow.

Low Minor-AV Score 4: Between 20-40% of the stream reach is impacted by any of the channel alterations listed above. Alteration or channelization is present, usually adjacent to structures such as bridge abutments or culverts. Evidence of past alteration may be present, but stream pattern and stability have recovered; recent alteration is not present. Withdrawals present, but no notable affect on flow.

Moderate

High Moderate-AV Score 3: Between 41 - 60% of reach is impacted by any of the channel alterations listed above. If the stream has been channelized, normal stable stream meander pattern has not recovered. Withdrawals, although large enough to affect flow, have no observable affects on habitat or biota.

Low Moderate-AV Score 2: Between 61 - 80% of reach is impacted by any of the channel alterations listed above. If the stream has been channelized, normal stable stream meander pattern has not recovered. All Transects, regardless of percent of channel alteration, where withdrawals affect flow, habitat, and biota will be scored as *Low Moderate*.

***Severe*-AV Score 1**

Greater than 80% of reach is impacted by any of the channel alterations listed above. Greater than 80% of banks shored with matting, gabion, riprap, or cement. Channels entirely lined with riprap. Withdrawals are large enough to have severe loss of flow and little to no habitat or biota. The channel is deeply channelized or structures are present that prevent access to the floodplain or dam operations prevent flood flows.

2.4 In-Stream Macroinvertebrate Observation

This assesment, adapted from the *National Water and Climate Center Technical Note 99–1-Stream Visual Assessment Protocol (Barbour et al 1999)* and *Surface Water Quality Monitoring Procedures, Volume 2: Methods for Collecting and Analyzing Biological Assemblage and Habitat Data (TCEQ 2007, An Improved Biotic Index of Organic Stream Pollution*, *Rapid Field Assessment of Organic Pollution With a Family-Level Biotic Index and Seasonal Correction Factors for the Biotic Index*(Hilsenhoff 1987, 1988a, 1988b respectively), is used to evaluate biological integrity of the stream using a rapid sampling method for benthic macroinvertebrate species. The recognized benefits of utilizing macroinvertebrate populations to assess function of streams include the following: they are an important part of the food chain; they are indicator species of water pollution; and they are relatively easy to collect.

2.4.1 Sample Collection Procedures

When the predominant substrate type is gravel and cobble, sampling shall be done in accordance to the standard kicknet sampling method in riffles, runs, and glides. When the predominant substrate type is sand or silt the snag sample collection method is the primary collection method; however, the snag sample method shall be used as a supplemental method for collection in the ruffles and runs. The sampling goal is to collect, preserve/photograph, identify, and enumerate a minimum of 100 individual benthic macroinvertebrates. A Texas Parks and Wildlife Department (TWPD) Scientific Collection Permit is required for the collection of certain state-protected, native mussels and oysters, shrimp, clams, mussels, and crabs that are subject to TPWD license requirements and harvest regulations

2.4.1.1 Standard Kicknet Sampling Procedure - Use a standard D-frame kicknet with mesh size ≤590 μm t, collect the kicknet sample by placing the straight edge of the kicknet on the stream bottom, close to the stream bank at the downstream end of a riffle or run, with the opening facing upstream.

Using the toe or heel of the boot, disturb the substrate in an area covering approximately 0.3 square feet immediately upstream of the net. Allow the dislodged material to be carried into the net by the current. It may be necessary to pick up and rub or brush larger substrate particles to remove attached organisms. After all of the dislodged material has been collected in the net, move a short distance upstream, toward the opposite bank, and repeat procedure. Continue this technique for 5minutes of actual “kick time” in a “zig-zag” pattern beginning at the downstream end of the riffle or run, and proceeding upstream making sure to cover as much of the length and width of the riffle as possible.

2.4.1.2 Snag Sampling Procedure – Snags are submerged woody debris (for example: sticks, logs, or roots) that are exposed to the current, and submerged in the stream for a minimum of two weeks. Moss, algae, or fungal growth on the snags can be taken as evidence that the snag has been in the stream for an adequate time period to allow colonization by benthic macroinvertebrates.

For snag samples, collect woody debris accumulated in debris piles or jams in areas exposed to flow. Use lopping shears to cut off sections of submerged woody debris. Avoid depositional zones (for example: pools) and backwater areas. Place a D-frame net immediately downstream of the snag while cutting to minimize loss of macroinvertebrates. Once cut, place the snag immediately in sorting tray, sieve bucket, or net with No. 30 or smaller mesh size($\leq$590 µm).

Emergent vegetation and rootwads in undercut banks that are exposed to flow may be sampled by sweeping the kicknet under the roots and agitating them by hand or by a jabbing motion with the net. Place the dislodged macroinvertebrates and associated debris in the sorting tray or sieve bucket along with any woody debris or other kicknet sample. Using a squirt bottle, wash the surface of the snags. Collect the dislodged benthic macroinvertebrates and associated debris in a sorting tray. Carefully inspect the snag, including cracks, crevices, and under loose bark for any remaining macroinvertebrates. Place any organisms found in the sorting pan along with the rest of the sample.

2.4.2 Macroinvertebrate Variable Categories

The Macroinvertebrate Variable (MV) is assessed by the Hilsenhoff Biotic Index (HBI). This metric incorporates taxon abundance and a tolerance (i.e., sensitivity to pollution) score into an overall biotic index score for evaluating biological integrity. Tolerance/intolerance metrics, such as the HBI, are intended to be representative of relative sensitivity to perturbation. Metrics that are considered the most effective are those that have a response across a range of human influence. Once a sufficient amount of macroinvertebrates are collected, the following metric is used to calculate MV.

The HBI metric is based on the following calculation: $HBI = \Sigma (t_i * x_i) / N$, where t_i is the tolerance value for an individual taxon, $\mathbf{x_i}$ is the number of individuals in that taxon for all samples, and **N** is the total number of individuals in all samples. Tolerance values are assigned on a scale of zero to ten (1–10), with increasing tolerance values reflecting increasing tolerance to physicochemical degradation. **N** must include counts of organisms only from those taxa that have assigned tolerance values. The index weights the relative abundance of each taxon in terms of its pollution tolerance in determining a community score. In general, the index increases as the relative abundance of tolerant taxa increases. The increase of these tolerant taxa is due to increasing degradation of physicochemical conditions.

Table 3. Tolerance Values for Calculation of Hilsenhoff Biotic Index

Organism	Taxonomic Level	Tolerance Value
Fishfly, Dobsonfly (hellgrammite)	Family (Corydalidae)	5
Riffle beetle	Family (Elmidae)	3
Mayfly	Order (Ephemeroptera)	3
Stonefly	Order (Plecoptera)	1
Caddisfly*	Order (Trichoptera)	3
Water penny beetle	Family (Psephenidae)	4
Gilled snail	Order (Mesogastropoda)	3
Mussel	Order (Heterodonta)	6
Net-spinning caddisfly	Family (Hydropsychidae)	4
Crane fly	Family (Tipulidae)	4
Crayfish	Family (Cambaridae)	5
Damselfly	Suborder (Zygoptera)	7
Dragonfly	Suborder (Anisoptera)	5
Alderfly	Family (Sialidae)	4
Whirligig beetle	Family (Gyrinidae)	6
Watersnipe fly	Family (Athericidae)	4
Sowbug	Order (Isopoda)	9
Scud	Order (Amphipoda)	6
Lunged snail	Order (Limnophila)	7
Aquatic worm	Class (Oligochaeta)	8
Black fly	Family (Simuliidae)	3
Leech	Order (Hirudinea)	8
Midge fly	Family (Chironomidae)	6

***** Based on the TCEQ's methods: "Among the Trichoptera, the family Hydropsychidae is perhaps most commonly collected. Further, the Hydropsychidae tend to be among the most tolerant of Trichoptera. This metric is based on the observation that samples from reference streams in Texas typically contain representatives of Hydropsychidae as well as representatives from other families in the orderTrichoptera. Thus, a high relative percent of total Trichoptera accounted for by the Hydropsychidae likely reflects physicochemical degradation." Therefore, bet spinning caddisflies in the Family Hydropsychidae are excluded from this Tolerance value.

Section 2.4.3 Macroinvertebrate Variable
Once the HBI has been calculated for the Transect, score Macroinvertebrate variable using one of the following 5 categories.

***Optimal* – MV Score 5**
These transects have an HBI value of < 3.77

***Suboptimal* – MV Score 4**
These transects have an HBI value of HBI 3.77-4.52

***Marginal* – MV Score 3**
These transects have an HBI value of HBI 4.53-5.27

***Poor* – MV Score 2**
These transects have an HBI value of HBI > 5.27

***Severe* – MV Score 1**
No taxa are present; stream is devoid of macroinvertebrate species.

Example 2: To calculate the Hilsenhoff Biotic Index (HBI), multiply the number of individuals of a taxon (t_i) by the its assigned Tolerance value (n_i). Total these values and divide by the total number of individuals of each taxon assigned a tolerance value.

Taxon	Count (t_i)	Tolerance value	Subtotal
Psephenidae	10	4	40
Plecoptera	10	1	10
Heterodonta	5	6	30
Elmidae	20	3	60
Amphipoda	5	6	30
Totals	50		170
HBI Value	170 ÷ 60 = 2.83 or MV = Optimal		

2.5 Regionalized Index of Biotic Integrity (Fish)

This variable utilizes sampling of fish populations to evaluate biological integrity of the stream and has been adapted from *Regionalization of the Index of Biotic Integrity for Texas Stream (*Linam *et al. 2002)*. The recognized benefits of utilizing fish populations to assess function of perennials streams and perennial pools on intermittent streams include the following: 1) some fish families possess long life spans; 2) fishes occur in a wide variety of habitats; 3) there is a large amount of published information regarding their occurrence, life history, and habitats; 4) fishes exhibit a wide range of feeding habits, reproductive traits, and tolerances to environmental perturbations; 5) fishes are relatively easy to identify to the species level; 6) many fish species are familiar to the general public and provide recreational opportunities; 7) and their presence/absence, growth, and recruitment data analysis may detect acute and sublethal stream conditions.

2.5.1 Sampling Fish

The goal of the fish sampling effort is to collect a representative sample of the species present in their relative abundances. Given the variability of habitats, flow regimes, and water chemistry, professional judgment should be used to assess the sampling effort necessary for an adequate characterization of the fish assemblage. Seines and electrofishing should be employedas the primary collection methods. Six effective seine hauls and 15 minutes of actual shocking time per Transect is the minimum effort; however, sampling shall be continued until species additions cease and all habitats are sampled in near proportion to their presence in the Transect. Whenever possible, sampling should occur upstream of any bridge or road crossing and should be located away from the influences of major tributaries.

Electrofishing shall be conducted in an upstream direction to eliminate effects of turbidity caused by bottom sediment disturbance. Seining shall be the primary method employed in streams where specific conductivities were greater than those feasible for electrofishing. In other sites, it shall only serve as a complementary technique, used to sample habitats where electrofishing might not be as effective such as deep pools where wading would be difficult or shallow riffles where staking out a seine and kicking would more effectively capture fish. The principal seine employed in these collections should measure 4.6 m x 1.8 m with 4.8 mm mesh; however, conditions in a number of streams may dictate complementary seining with the following size seines: 9.1 m x 1.8 m (6.4 mm mesh) and 1.8m x 1.2 m (3.2 mm mesh).

When collecting with an electrofishing unit, the Transect is sampled with a single, upstream pass and includes all habitats present. The sampling crew wades in an upstream direction to eliminate the effects of turbidity caused by disturbing bottom sediment. An electrofishing crew consists of a minimum of two persons but is more effective with three or more. Actual shocking (trigger) time as recorded by the electrofishing unit's timer must be a <u>minimum</u> of 900 seconds and shocking **must** continue as long as new species are being collected. Electricity should be discontinuously applied as fishes outside of the field may be herded and will not be susceptible to collection. For example, electrical current could be applied along the length of an undercut bank and then turned off until another discreet habitat type is encountered. The netters must follow and attempt to capture all stunned fishes, placing them in live wells (or buckets) for subsequent identification and enumeration. Record the number of all positively-identified species that are observed but not captured.

After electrofishing is completed, all habitats present within the Transect are then sampled with a 3/16-inch mesh, straight seine net. A seining crew consists of a minimum of two persons but is more effective with three. The Transect is sampled with a minimum of six 30-foot seine hauls and must continue as long as new species are being collected. If the seine gets caught on woody debris or the net is lifted in a manner that may allow fish to escape, the haul must be considered ineffective and not counted as viable. Capturing no fish would not necessarily constitute an ineffective haul. Keep any fish collected even if the haul is ineffective. Seining may be conducted in either an upstream or downstream direction depending on current velocity and habitat. Count and record all fish collected by the seine or put them in a container with fixative and attach a label. Fish are often so small and numerous that it is preferable to bring the entire catch back to the laboratory for identification and enumeration.

Streams should only be sampled between June and September. By limiting sampling to these months, it is generally assured that sampling would be conducted during low flow, high temperature periods that are critical for regulatory considerations and observing steady state conditions. This period also has the added advantage if increased since fish sampling is more efficient during low flows. Fishes that are easily identified may be enumerated and released in the field. All others should be preserved in 10% formalin and transported to the office for positive identification. All fishes should be examined for external deformities, disease, lesions, tumors, and skeletal abnormalities. And categorized into trophic and tolerance categories in accordance with the following tables.

Surface Water Quality Monitoring Procedures, Volume 2: Methods for Collecting and Analyzing Biological Assemblage and Habitat Data (TCEQ 2007) should be consulted for additional information and guidance on fish sampling and processing.

Anyone conducting fish surveys in Texas must possess or be listed on a valid TPWD Scientific Collection Permit (SCP). Contact TPWD in Austin at 512-389-4491 for more information, to apply for a SCP, and to notify TPWD not less than 24 hours in advance of a fish collection event.

2.5.2 Calculating Aquatic Life Scores

Once the fish are sampled using the appropriate sampling methods and accurately identified, an aquatic life score shall be calculated using the following metrics calibrated for that ecoregion. The first step is to identify the appropriate Level III Ecoregion and its metrics using the map below. The Level III Ecoregions located within the Galveston District include: 1) Southern Texas Plains; 2) Texas Blackland Prairies; 3) East Central Texas Plains; 4) Western Gulf Coastal Plains; and 5) South Central Plains. The second step is to determine the appropriate individual score for each metric utilizing the regionalized metrics below. Each metric result scores a 5, 3 or 1 based on the sample. The sum of these scores is the Aquatic Life Use Score. Finally, the Aquatic Life Use Score may then be translated into the Fish Variable (FV) which is used in the final calculations.

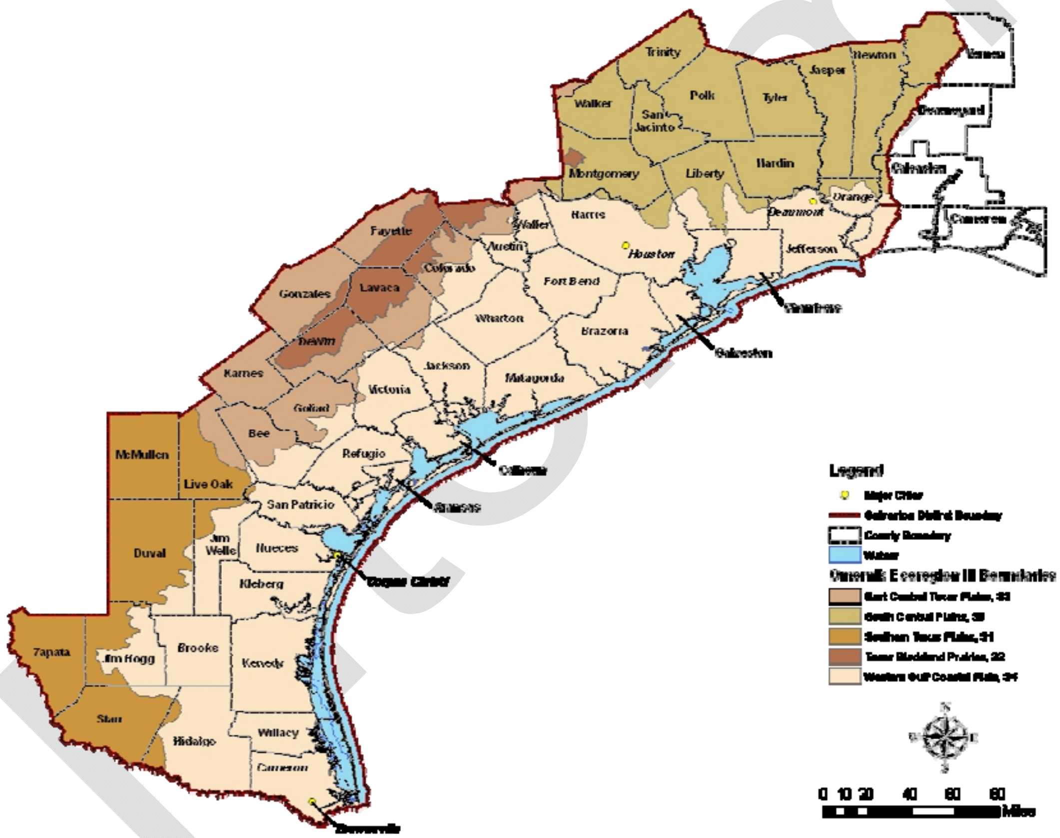


Figure 1: Level III Ecoregions of Texas Map

Ecoregion 31: Southern Texas Plains

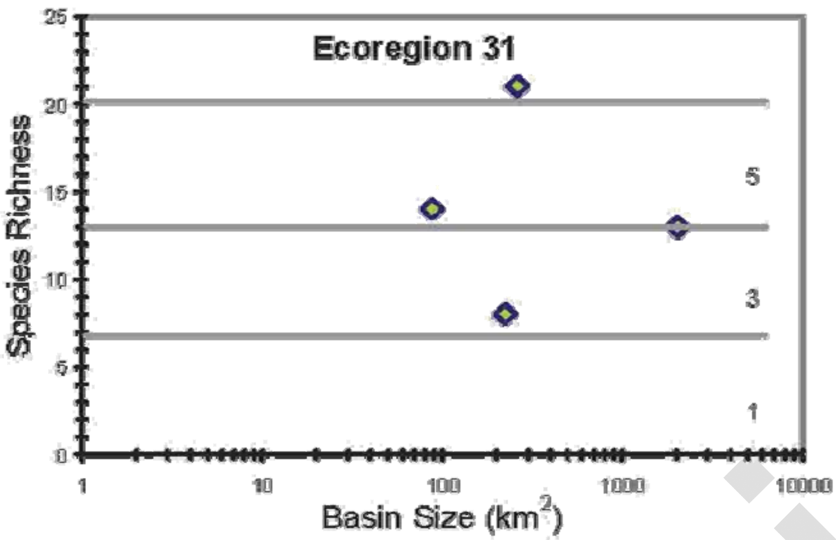


Figure 2. Fish Species richness versus drainage basin size in Southern Plains streams.

Table 4. Scoring Criteria to assess stream fish assemblages in Southern Plains streams.

Metric	Scoring Criteria		
	5	3	1
1. Total number of fish species	See Figure 1		
2. Number of native cyprinid species	>5	3-5	<3
3. Number of benthic invertivore species	>2	2	<2
4. Number of sunfish species	>4	3-4	<3
5. Percent of individuals as tolerant species (excluding western mosquitofish *Gambusia affinis)*	<26%	26-50%	>50 %
6. Percent of individuals as omnivores	<9%	9-16%	>16 %
7. Percent of individuals as invertivores	>65%	33-65%	<33 %
8. Percent of individuals as piscovores	>9%	5-9%	<5 %
9. Number of individuals in sample			
a. Number of individuals per seine haul	>39.5	19.7-39.5	<19.7
b. Number of individuals per minute electrofishing	>8.9	4.4-8.9	<4.4
10. Percent of individuals as non-native species.	<1.4 %	1.4-2.7%	>2.7
11. Percent of individuals with disease or other anomaly	<0.6 %	0.6-1.0%	>1.0
Aquatic Life Use Score : ≥42 Exceptional; 37-41 High; 25-36 Intermediate; <25 Limited			

Ecoregion 32: Texas Blackland Prairie

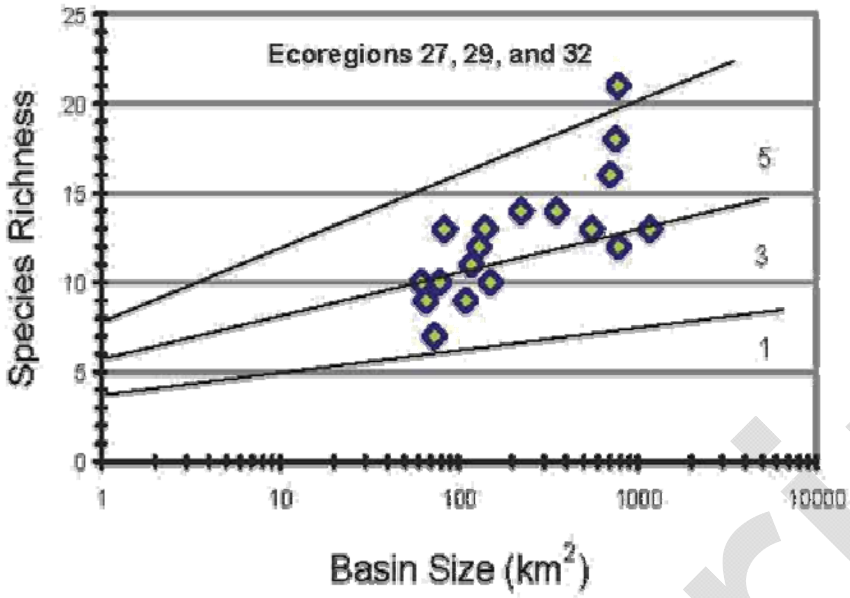


Figure 3. Fish Species richness versus drainage basin size in Texas Blackland Prairie streams.

Table 5. Scoring Criteria to assess stream fish assemblages in Texas Blackland Prairie streams.

Metric	Scoring Criteria		
	5	3	1
1. Total number of fish species	See Figure 2		
2. Number of native cyprinid species	>3	2-3	<2
3. Number of benthic invertivore species	>1	1	0
r of sunfish species	>3	2-3	<2
5. Percent of individuals as tolerant species (excluding western mosquitofish *Gambusia affinis)*	<26%	26-50%	>50%
6. Percent of individuals as omnivores	<9%	9-16%	>16%
7. Percent of individuals as invertivores	>65%	33-65%	<33%
8. Percent of individuals as piscovores	>9%	5-9%	<5%
9. Number of individuals in sample			
a. Number of individuals per seine haul	>87	36-87	<36
b. Number of individuals per minute electrofishing	>7.1	3.3-7.1	<3.3
10. Percent of individuals as non-native species.	<1.4%	1.4-2.7%	>2.7
11. Percent of individuals with disease or other anomaly	<0.6%	0.6-1.0%	>1.0
Aquatic Life Use Score: ≥49 Exceptional; 41-48 High; 35-40 Intermediate; <35 Limited			

Ecoregion 34: Western Gulf Coastal Plains

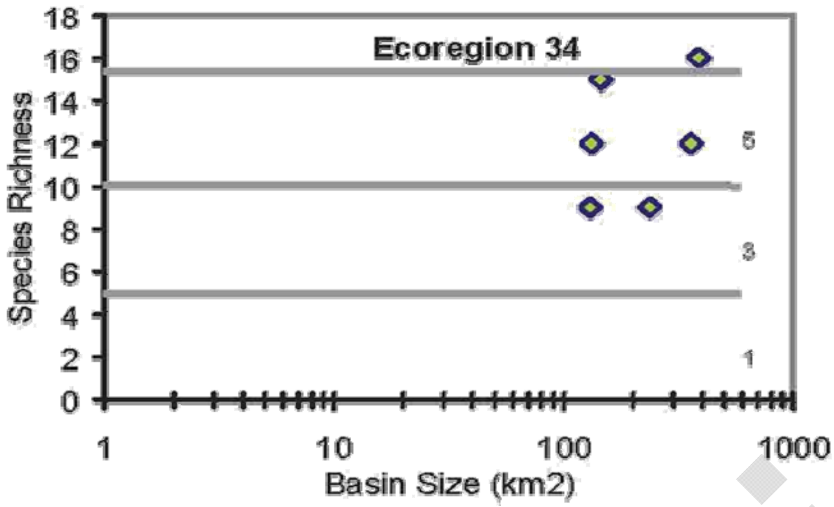


Figure 4. Fish Species richness versus drainage basin size in Western Gulf Coastal Plains streams.

Table 6. Scoring Criteria to assess stream fish assemblages in Western Gulf Coastal Plains streams.

Metric	Scoring Criteria		
	5	3	1
1. Total number of fish species	See Figure 3		
2. Number of native cyprinid species	>2	2	<2
3. Number of benthic invertivore species	>1	1	0
4. Number of sunfish species	>3	2-3	<2
5. Number of intolerant species	>1	-	0
6. Percent of individuals as tolerant species (excluding western mosquitofish *Gambusia affinis)*	<26%	26-50%	>50%
7. Percent of individuals as omnivores	<9%	9-16%	>16%
8. Percent of individuals as invertivores	>65%	33-65%	<33%
9. Number of individuals in sample			
a. Number of individuals per seine haul	>174.7	87.4-174.7	<97.4
b. Number of individuals per minute electrofishing	>7.7	3.9-7.7	<3.9
10. Percent of individuals as non-native species.	<1.4%	1.4-2.7%	>2.7
11. Percent of individuals with disease or other anomaly	<0.6%	0.6-1.0%	>1.0
Aquatic Life Use Score : ≥40 Exceptional; 39-48 High; 31-48 Intermediate; <31 Limited			

Ecoregions 33 & 35: East Central Texas Plains &South Central Plains

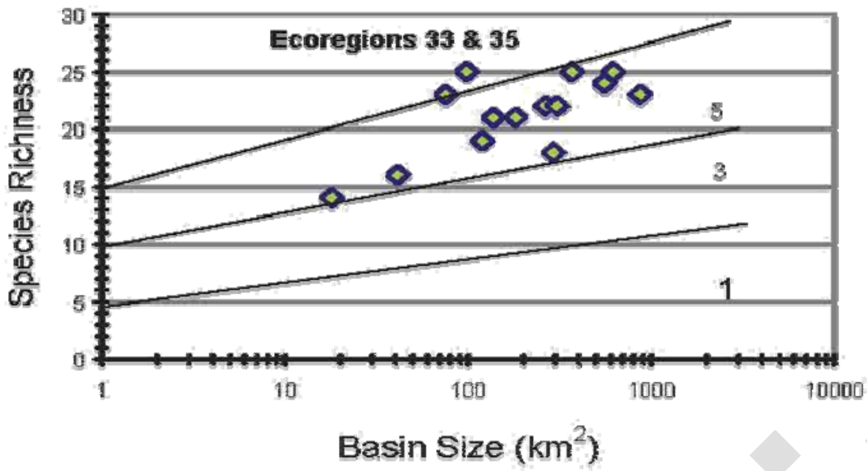


Figure 5. Fish Species richness versus drainage basin size in East Central Texas Plains and South Central Plains streams.

Table 7. Scoring Criteria to assess stream fish assemblages in East Central Texas Plains and South Central Plains streams.

Metric	Scoring Criteria		
	5	3	1
1. Total number of fish species	See Figure 4		
2. Number of native cyprinid species	>4	2-4	<2
3. Number of benthic invertivore species	>4	3-4	<3
4. Number of sunfish species	>4	3-4	<3
5. Number of intolerant species	>3	2-3	<2
6. Percent of individuals as tolerant species (excluding western mosquitofish *Gambusia affinis)*	<26%	26-50%	>50%
7. Percent of individuals as omnivores	<9%	9-16%	>16%
8. Percent of individuals as invertivores	>65%	33-65%	<33%
9. % of individuals as piscivores	>9%	5-9%	<5%
10. Number of individuals in sample			
a. Number of individuals per seine haul	>28	14-28	<14
b. Number of individuals per minute electrofishing	>7.3	3.6-7.3	<3.6
11. Percent of individuals as non-native species.	<1.4%	1.4-2.7%	>2.7
12. Percent of individuals with disease or other anomaly	<0.6%	0.6-1.0%	>1.0
Aquatic Life Use Score: ≥52 Exceptional; 42-51 High; 36-41 Intermediate; <36 Limited			

2.5.2 Fish Variable Scores

***Exceptional* Aquatic Life Use-FV Score 5**

An exceptionally high species richness and diversity with a balanced trophic structure and exceptional or unusual species assemblage.

***High* Aquatic Life Use –FV Score 4**

A high species richness and diversity with a balanced to slightly imbalanced trophic structure and an usual association of regionally expected species assemblage.

***Intermediate* Aquatic Life Use –FV Score 3**

A moderate species richness and diversity with an imbalanced trophic structure and an expected species assemblage.

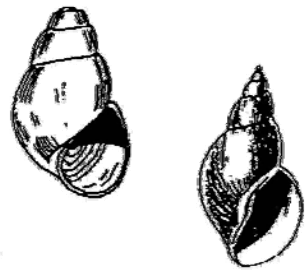
***Limited* Aquatic Life Use –FV Score 2**

A low species richness and diversity with a severely imbalanced trophic structure and absence of expected species.

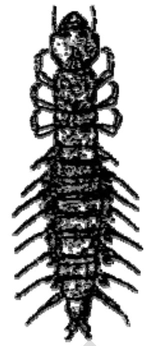
***Severe* Aquatic Life Use –FV Score 1**

No taxa are present; stream is devoid of vertebrate species. No Aquatic Life Use score calculated.

Attachment A
Common Macroinvertebrates

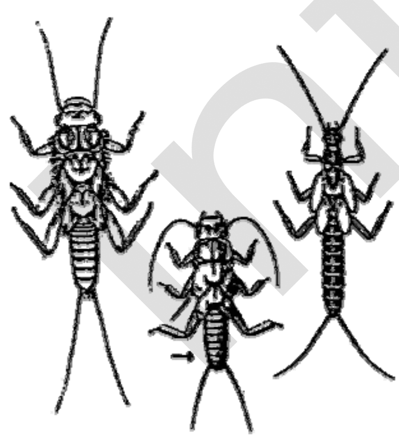


Gilled Snail: Order Mesogastropoda. Single shell opening covered by operculum (hard end cover). When opening is facing you, shell usually opens on right

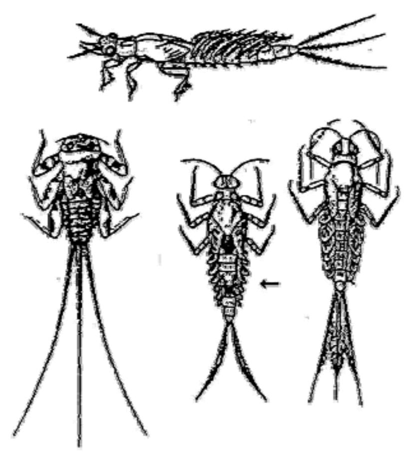


Dobsonflyand Fishfly (hellgrammite): Family Corydalidae. 3/4 " to 4" large pinching jaws, 6 jointed legs, 8 pairs of filaments on lower half of body with paired cotton-like gill tufts along underside, short antennae, 2 short "tails", and

Net-spinning caddisfly (Family – Hydropsychidae)
Up to 1"; 6 legs on upper third of body; 2 hooks at back end; branched gills present on underside of lower half of body. Free-living – does not live in a mobile case.

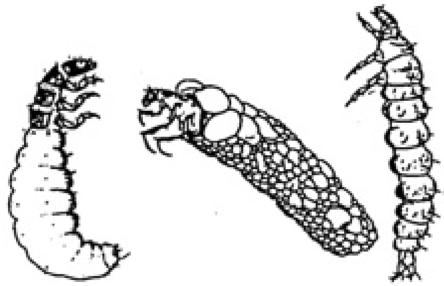


Stonefly Order Plecoptera. 1/2" to 1 1/2", 6 legs with hooked antenna, only 2 long " tails". Smooth (no cotton-like tufts) on lower half of body (see arrow)

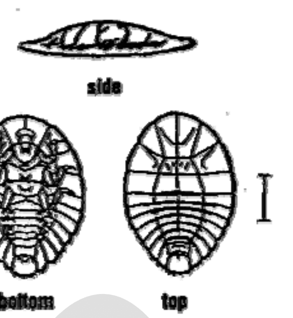


Mayfly: Order Ephemeroptera. 1/4" to 1", 6 legs, antennae, 2 or 3 long hair-like tails. Tails may be webbed together. Cotton-like tufts present on lower half of body.

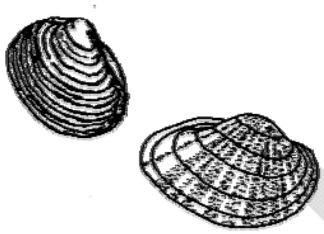
Common Macroinvertebrates cont.



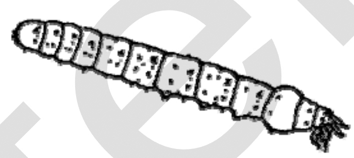
Caddisfly: Order Trichoptera. Up to 1", 6 legs on upper third of body, 2 hooks at back end. Lacks branched gills on underside of lower half of body, may have fluffy gill tufts on underside. Free-living or on a mobile case made of pebbles, sand grains, sticks or other materials with its head sticking out.



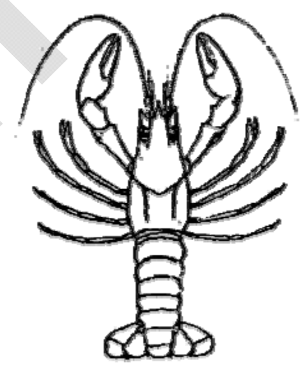
Water penny: Family Psephenidae. 1/4", 6 legs and feathery gills on underside covered by flat saucer-shaped body with a raised bump on top side.



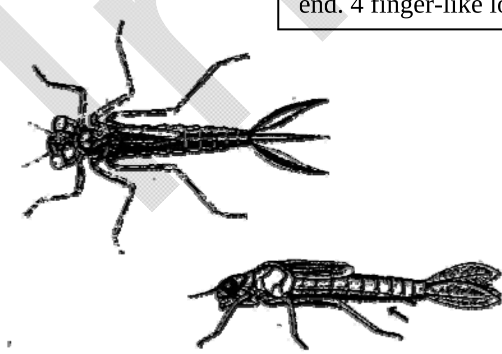
Mussel (live). Order Heterodonta. Hinged double.



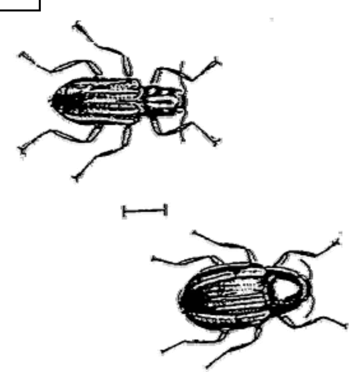
Crane fly: Family Tipulidae. 1/3" to 2"; segmented; appears to lack head, lacks legs, antennae, and filaments; 103 pairs of 4 finger-like lobes at back end. 4 finger-like lobes at back end



Crayfish: Family Cambaridae. Up to 6", 2 large claws on front, 1 large claws, 8 legs, resembles small lobster.

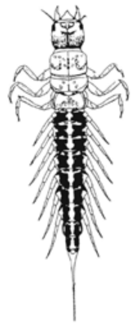


Damselfly: Suborder Zygoptera. 1/2" to 1" large eyes, head slightly narrower than lower body; 3 long “tails”; 6 jointed legs.

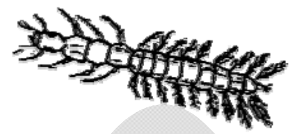


Riffle Beetle: Order Coleoptera. 1/4", oval body covered with tiny hairs, line down middle of back, 6 legs, antennae; walks slowly underwater; does not swim on surface.

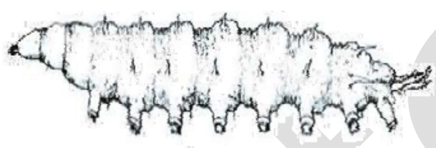
Common Macroinvertebrates cont



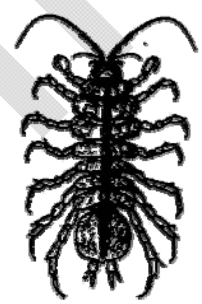
Alderfly: Family Sialidae. 1" long. Resembles small hellgramite but has 7 pairs of filaments on lower half of body and a single, long “tail”; no cotton-like gill tufts along underside.



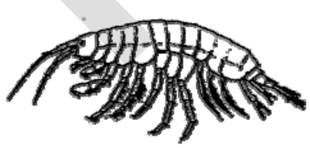
Whirligig beetle: Family Gyrinidae. 1/4" to 1", 6 legs on upper half of body; antennae; 9 pairs of filaments on lower half of body.



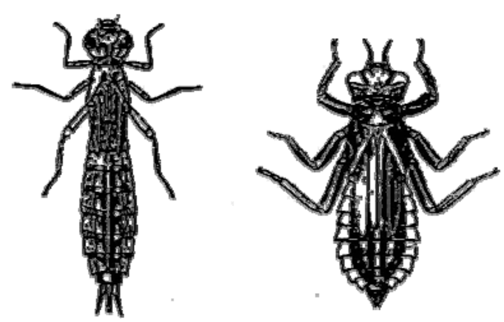
Watersnipe fly larva: Family Atherici-dae 1/4" to 1", segmented; appears to lack head; lacks antennae and jointed legs; 8 pairs of stub-like structures along underside of body; 2 feathery filaments on back end. Caterpillar like appearance.



Sowbug: Order Isopoda. 1/4" to 3/4", 7 pairs of jointed legs; pair of branched, tail-like structures on back end of body.

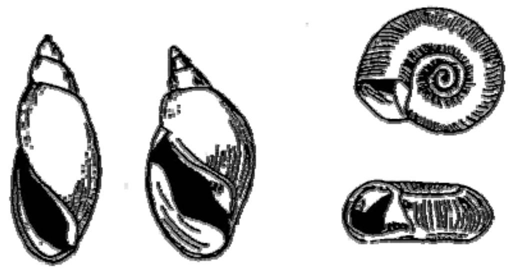


Scud: Order Amphipoda. 1/4". 7 pairs of jointed legs, swims sideways; shrimp-like appearance.

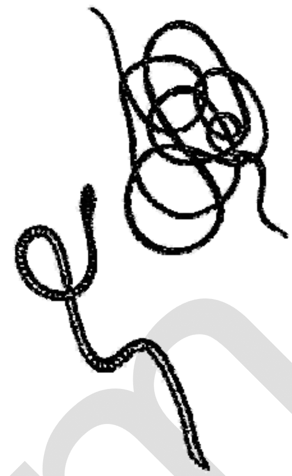


Dragon fly: Suborder Anisoptera. 1/2" to 2". large eyes, head slightly narrower than lowers body; lacks 3 long “tails”; extendable lower jaw formed into a scoop-like structure; 6 jointed legs.

Common Macroinvertebrates cont

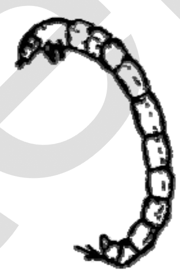


Lunged Snails: Order Limnophila. Single shell; no operculum (hard end cover); breathe air; shell coils in one plane when opening is facing you, shell usually opens on left.

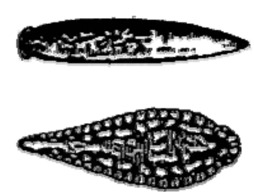


Aquatic Worm: Class Oligochaeta. 1/4" to 2". Thin segmented body can be very small..

Blackfly: Family Simulidae. Up to 1/4", distinct head; pair of fan-like structures only near head along underside of body, lower end of body wider than upper end of body; ring of hooks on back end



Midge fly: Family Chironmidae. Up to 1/4". Distinct head, no fan-like structures on head; pair of stub-like structures along underside of body located near head and near back; no difference in diameter along body; no ring of hooks on back end.



Leech: Order Hirudinea. 1/4" to 2".flattened body; ends with suction pads.