# Methods Protocol
# Erosion Assessment

# ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM-SURFACE WATERS: FIELD OPERATIONS AND METHODS FOR MEASURING THE ECOLOGICAL CONDITION OF WADEABLE STREAMS

As presented by James M. Lazorchak, Donald J. Klemm, and David V. Peck

Historically the protocol edited by Lazorchak, Klemm and Peck presented twelve habitat parameters to rank habitat condition: (in order parameters 1-12) in-stream cover (fish), epifaunal substrate, embeddedness, velocity/depth regimes, channel alteration, sediment deposition, frequency of riffles, channel flow status, condition of banks, bank vegetation protection, grazing or other disruptive pressure, and riparian vegetation zone with (least buffered side). The twelve habitat parameters have now been reduced to 10 and the order has changed as follows:

1. in-stream cover (fish) combined with epifaunal substrate
2. embeddedness
3. velocity/depth regimes
4. sediment deposition
5. channel flow status
6. channel alteration
7. frequency of riffles
8. condition of banks
9. bank vegetation protection
10. grazing or other disruptive pressure combined with riparian vegetation zone width (least buffered side).

The remainder of the protocol remains the same including visual assessment methods.

*** (For full document in PDF format go to http://www.epa.gov/emap/html/pubs/docs/groupdocs/surfwatr/field/Sec14.PDF) ***

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# ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAMSURFACE WATERS:
# FIELD OPERATIONS AND METHODS FOR MEASURING THE ECOLOGICAL CONDITION OF WADEABLE STREAMS

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## SECTION 14
## RAPID HABITAT AND VISUAL STREAM ASSESSMENTS

by
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After all other samples and field data have been collected, the field team conducts an overall habitat assessment of the stream, makes a general visual assessment of the stream, and performs a final check of the data forms and samples before leaving the stream site (see Section 15). The habitat assessment protocol used is adapted from EPA's “rapid” bioassessment protocols (Plafkin et al, 1989), and has been refined from various applications across the country. The approach focuses on integrating information from specific parameters on the structure of the physical habitat. The objective of the visual stream assessment is to record field team observations of catchments and stream characteristics that are useful for data validation, future data interpretation, ecological value assessment, development of associations, and verification of stressor data. The observations and impressions of field teams are extremely valuable.

### 1.1 RAPID HABITAT ASSESSMENT

Based on the perception gained from collecting samples and measurements from throughout the sampling reach, classify the stream as either "Riffle/run" or "Pool/glide" prevalent based on your visual impression of the dominant habitat type. Choose the prevalent habitat type based on which habitat type occupies the majority of the length of the sampling reach. A different field data form is completed depending upon the prevalent habitat type. For each prevalent habitat type, twelve characteristics (termed "parameters") of habitat are considered and evaluated as part of the rapid habitat assessment. These parameters are described in Table 14-1. Most of the parameters are evaluated similarly for both types of prevalent habitats. In four cases, the same parameter is evaluated differently, or a different (but ecologically equivalent) parameter is evaluated in riffle/run prevalent versus pool/glide prevalent streams. Epifaunal substrates are evaluated differently in riffle/run and pool/glide prevalent streams. Substrate embeddedness is evaluated in riffle/run prevalent streams, while pool substrate composition is evaluated in pool/glide prevalent streams. The presence of four potential types of microhabitat types based on combinations of depth and current velocity is evaluated in riffle/run prevalent streams, while the presence of four potential types of pool microhabitat based on depth and area are evaluated in pool/glide prevalent streams. The frequency of riffles is evaluated in riffle/run prevalent streams, while channel sinuosity is evaluated in pool/glide prevalent streams.

The procedure for conducting the rapid habitat assessment is presented in Table 14-2. For each of the twelve parameters, rate the overall quality of the sampling reach on a scale of 0 to 20. For riffle/run prevalent streams, record your scores for each parameter on the riffle/run version of the Rapid Habitat Assessment Form as shown in Figures 14-1 and 14-2. If the stream is classified as a pool/glide prevalent stream, record your scores for each parameter on the pool/glide version of the Rapid Habitat Assessment Form as shown in Figures 14-3 and 14-4. Transfer the scores assigned for each parameter to the box in the left-hand column of the form. Sum the scores for each parameter and record the total score in the box at the top of page 1 of the form.

## 14.2 VISUAL STREAM ASSESSMENTS

The objective of the visual stream assessment is to record field crew observations of catchments/stream characteristics useful for future data interpretation, ecological value assessment, development of associations, and verification of stressor data. Observations and impressions of field crews are extremely valuable. Thus, it is important that these observations about stream characteristics be recorded for future data interpretation and validation. The assessment form is designed as a template for recording pertinent field observations. It is by no means comprehensive and any additional observations should be recorded in the Comments section of the form.

Complete the assessment form after all other sampling and measurement activities have been completed. Take into account all observations the sampling team has made while at the site. The assessment includes the following components: watershed activities and

**TABLE 14-1. DESCRIPTIONS OF HABITAT PARAMETERS USED IN THE RAPID ASSESSMENT OF STREAMS**

| Habitat Parameter | Prevalent Habitat Type<br>R=Riffle/run<br>P=Pool/glide | Description and Rationale |
|---|---|---|
| 1. Instream Cover (fish) | R<br>P | Includes the relative quantity and variety of natural structures in the stream (e.g., fallen trees, logs, and branches, large rocks, and undercut banks) that are available for refugia, feeding, or spawning. A wide variety of submerged structures in the stream provide fish with a large number of niches, thus increasing assemblage diversity. |
| 2. Epifaunal Substrate (benthic invertebrates) | R | Essentially the amount of niche space or hard substrates (rocks, snags) available for insects and snails. Numerous types of insect larvae attach themselves to rocks, logs, branches, or other submerged substrates. As with fish, the greater the variety and number of available niches or attachments, the greater the variety of insects in the stream. Rocky-bottom areas are critical for maintaining a healthy variety of insects in most high gradient streams. |
| | P | The abundance, distribution, and quality of substrate and other stable colonizing surfaces (e.g., old logs, snags, aquatic vegetation) that maximize the potential for colonization. |
| 3A. Embeddedness | R | The extent to which rocks (gravel, cobble, and boulders) are covered or sunken into the silt, sand, or mud of the stream bottom. Generally, as rocks become embedded, the surface area available to macroinvertebrates and fish for shelter, spawning, and egg incubation is decreased. To estimate the percent of embeddedness, observe the amount of silt or finer sediments overlying and surrounding the rocks. If kicking does not dislodge the rocks or cobble, they may be greatly embedded. It is useful to observe the extent of |

| | | |
|---|---|---|
| | | the dark area on their underside of a few rocks. |
| 3B. Pool Substrate Characterization | P | Evaluates the type and condition of bottom substrates found in pools. Firmer sediment types (e.g., gravel, sand) and rooted aquatic plants support a wider variety of organisms than a pool substrate dominated by mud or bedrock and no plants. In addition, a stream that has a uniform substrate in its pools will support far fewer types of organisms than a stream that has a variety of substrate types. |
| 4A. Velocity and Depth Regimes | R | There are four primary current and depth combinations: (1) slow-deep, (2) slow shallow, (3) fast-deep, and (4) fast-shallow. The best streams in high gradient regions will have all four combinations present. The presence or availability of these four habitats relates to the ability of the stream to provide and maintain a stable aquatic environment. In general use a depth of 0.5 m to separate shallow from deep and a current velocity of 0.3 m/sec to separate fast from slow. |
| 4B. Pool Variability | P | Rates the overall mixture of pool types found in streams, according to size and depth. The four basic types of pools are large-shallow, large-deep, small-shallow, and small-deep. A stream with many pool types will support a wide variety of aquatic species. Rivers with low sinuosity (few bends) and monotonous pool characteristics do not have sufficient quantities and types of habitat to support a diverse aquatic community. As a general guideline, consider a pool deep if it is greater than 1 m deep, and large if its length, width, or oblique dimension is greater than half the stream width. |
| 5. Channel Alteration | R<br>P | Basically a measure of large-scale changes in the shape of the stream channel. Many streams in urban and agricultural areas have been straightened, deepened, or diverted into concrete channels, often for flood control purposes. Such streams have far fewer natural habitats for fish, macroinvertebrates, and plants than do naturally meandering streams. Channel alteration is present when the stream runs through a concrete channel; when artificial embankments, riprap, and other forms of artificial bank stabilization or structures are present; when the stream is very straight for significant distances; when dams and bridges are present; and when other such changes have occurred. |

**TABLE 14-1 (Continued)**

| **Habitat Parameter** | **Prevalent Habitat Type**<br>**R=Riffle/run**<br>**P=Pool/glide** | **Description and Rationale** |
|---|---|---|
| 6. Sediment Deposition | R<br>P | The amount of sediment that has accumulated and the changes that have occurred to the stream bottom as a result of the deposition. Deposition occurs from large-scale movement of sediment caused by watershed erosion. Sediment deposition may cause the formation of islands, point bars (areas of increased deposition usually at the beginning of meanders that increase in size as the channel is diverted toward the outer bank) or shoals or result in the filling of pools. Increased sedimentation also results in increased deposition. Usually this is evident in areas that are obstructed by natural or man-made debris and areas where the stream flow decreases, such as bends. High levels of sediment deposition create an unstable and continually changing environment that becomes unsuitable for many organisms. |
| 7A. Frequency of Riffles | R | The sequence of riffles occurring in a stream. Riffles are a source of high-quality habitat and diverse fauna; therefore, an increased frequency of occurrence greatly enhances the diversity of the stream community. For areas where riffles are uncommon, a run/bend ratio can be used as a measure of sinuosity. A large degree of sinuosity provides for diverse habitat and fauna, and the stream is better able to handle the high energy flows that result from storms than are relatively straight streams. |
| 7B. Channel Sinuosity | P | Evaluates the meandering or relative frequency of bends of the stream. Streams that meander provide a variety of habitats for aquatic organisms, whereas straight stream segments are characterized by monotonous habitats that are prone to flooding. A high degree of sinuosity creates a variety of pools and reduces the energy from surges when the stream flow fluctuates. The absorption of this energy by bends protects the stream from excessive erosion and flooding. In "oxbow" streams of coastal areas and deltas, meanders are highly exaggerated and transient. Natural conditions are shifting channels and bends. Alteration of these streams is usually in the form of flow regulation and diversion. |
| 8. Channel Flow Status | R<br>P | The degree to which the channel is filled with water. The flow status will change as the channel enlarges or as flow decreases as a result of dams and other obstructions, diversions for irrigation, or drought. When water does not cover much of the streambed, the amount of useable substrate for aquatic organisms is limited. |
| 9. Condition of Banks | R<br>P | The stream banks are eroded (or have the potential for erosion). Steep banks are more likely to collapse and suffer from erosion than are gently sloping banks and are therefore considered to be unstable. Signs of erosion include crumbling, unvegetated banks, exposed tree roots, and exposed soil |

| | | |
|---|---|---|
| 10. Bank Vegetative Protection | R P | The amount of the stream bank that is covered by vegetation. The root systems of plants growing on stream banks help hold soil in place, thereby reducing the amount of erosion that is likely to occur. This parameter supplies information on the ability of the bank to resist erosion, as well as some additional information on the uptake of nutrients by the plants, the control on instream scouring, and stream shading. Banks that have full, natural plant growth are better for fish and macroinvertebrates than are banks without vegetative protection or those shored up with concrete or riprap. |
| 11. Grazing or Disruptive Pressure | R P | Disruptive changes to the riparian zone because of grazing or human interference (e.g., mowing). In areas of high grazing pressure from livestock or where residential and urban development activities disrupt the riparian zone, the growth of a natural plant community is impeded. Residential developments, urban centers, golf courses, and rangeland are the common causes of anthropogenic effects on the riparian zone. |
| 12. Riparian Vegetated Zone Width | R P | The width of natural vegetation from the edge of the stream bank (riparian buffer zone). The riparian vegetative zone serves as a buffer zone to pollutants entering a stream from runoff, controls erosion, and provides stream habitat and nutrient input into the stream. A relatively undisturbed riparian zone reflects a healthy stream system; narrow, far less useful riparian zones occur when roads, parking lots, fields, lawns, bare soil, rocks, or buildings are near the stream bank. The presence of "old fields" (i.e., a previously developed field allowed to convert to natural conditions) will rate higher than fields in continuous or periodic use. Paths and walkways in an otherwise undisturbed riparian zone may be judged to be inconsequential to destruction of the riparian zone. |

**TABLE 14-2. PROCEDURE FOR CONDUCTING THE RAPID HABITAT ASSESSMENT**

1. Based on observations during previous sample collection and field measurement activities, classify the sampling reach as predominantly flowing water habitat ("Riffle/run") or slow water habitat ("Pool/glide").

2. Select the appropriate version of the Rapid Habitat Assessment Form ("Riffle/Run Prevalence" or "Pool/Glide Prevalence") based on the classification in Step 1.

3. For each of the 12 habitat parameters, determine the general "quality" category ("POOR", "MARGINAL", "SUB-OPTIMAL", or "OPTIMAL") of the entire sampling reach. Assign and circle a score from the values available within each quality category. For each parameter, the sampling reach can be scored from 0 (worst) to 20 (best).

4. After the sampling reach has been scored for all parameters, transfer the score circled for each category to the corresponding "SCORE" boxes in the "HABITAT PARAMETER" column of the assessment form.

5. Sum the scores recorded in Step 4 over all 12 habitat parameters. Record the total score for the sampling reach in the "TOTAL SCORE" box on page 1 of the assessment form. The total score can range from 0 to 240.

observed disturbances, reach characteristics, water body character, general assessment, and local anecdotal information. The procedure for conducting the visual assessment of the sampling reach is presented in Table 14-3. Record data and observations for each component of the assessment on the Assessment Form as shown in Figures 14-5 and 14-6.

Each watershed activity or disturbance is rated into one of four categories of abundance or influence: not observed, low, medium, or high. Leave the line blank for any activity or disturbance type not observed. The distinction between low, medium, and high will be subjective. For example, if there are 2-3 houses on a stream, the rating for "Houses" would be low. If the stream is in a suburban housing development, rate it as high. Similarly, a small patch of clear cut logging on a hill overlooking the stream would be rated as low. Logging activity right on the stream shore, however, would be rated as high.

When assessing reach characteristics, make your best estimate as to the percent of the sampling reach (40 channel widths) that had each type of listed riparian zone land use immediately adjacent to the stream. Also rate the water clarity, including whether you believe the clarity is influenced by recent storm events (see Section 4). Water body character is defined as "the physical habitat integrity of the water body, largely a function of riparian and littoral habitat structure, volume change, trash, turbidity, slicks, scums, color, and odor." Water body character is assessed using two attributes, the degree of human development, and aesthetics. Rate each of these attributes on a scale of 1 to 5. For development, give the stream a "5" rating if it is pristine, with no signs of any human

development. A rating of "1" indicates a stream which is totally developed (e.g., the entire stream is lined with houses, or the riparian zone has been removed). For aesthetics, base your decision on any factor about the stream that bothers you (e.g., trash, algal growth, weed abundance, overcrowding).

The general assessment component includes any observations that will help in data interpretation in the pertinent section. General assessment comments can include comments on wildlife observed, diversity of terrestrial vegetation, age class of forest, or any other observation. Comments from locals are often useful and should be recorded in the "LOCAL ANECDOTAL INFORMATION" section. The back side of the form (Figure 14-6) is available for general comments.

**TABLE 14-3. PROCEDURE FOR CONDUCTING THE FINAL VISUAL ASSESSMENT OF A STREAM**

1. After all other sampling and measurement activities are completed; fill out the header section of an Assessment Form. Use your perceptions obtained during the course of the day, while at the stream or driving/walking through the catchment to complete the remainder of the form.

2. WATERSHED ACTIVITIES AND DISTURBANCES OBSERVED: Rate each type of activity or disturbance listed on the form as either "Not observed", "Low", "Medium", or "High", and record the rating on the Assessment Form. Keep in mind that ratings will be somewhat subjective and that an extensive effort to quantify the presence and intensity of each type of stressor is not required. General categories of activities and types of disturbance are described below:

• Residential: The presence of any of the listed disturbances adjacent to or near the stream.
• Recreational: The presence of organized public or private parks, campgrounds, beaches or other recreation areas around the stream. If there are signs of informal areas of camping, swimming or boating around the stream (e.g., swimming hole), record them as "primitive" parks, camping.
• Agriculture: The presence of cropland, pasture, orchards, poultry, and/or livestock.
• Industrial: Any industrial activity (e.g., canning, chemical, pulp), commercial activity (stores, businesses) or logging/mining activities around the stream or in the catchment. Describe in more detail in the comments section.
• Management: Any evidence of liming activity, water treatment, dredging or channelization, flow control structures, etc.

Any oddities or further elaboration should be recorded in the Comments section.

3. REACH CHARACTERISTICS: For each type of riparian vegetation cover or land use category listed on the Assessment Form, estimate the proportion of the sampling reach immediately adjacent to the stream that is affected. Place and "X" in the appropriate extent class box (Rare [< 5%], Sparse [5 to 25%], Moderate [25 to 75%], and Extensive [> 75%]) on the form.

4. Classify the overall water clarity within the sampling reach as clear, murky, or highly turbid. Place an "X" in the appropriate box on the "WATER CLARITY" line of the Assessment Form. If you believe that water clarity has been influenced by a recent storm event, also place an "X" in the "STORM INFLUENCED" box.

5. WATER BODY CHARACTER: Assign a rating of 1 (highly disturbed) to 5 (pristine) based on your general impression of the intensity of impact from human disturbance. Place an "X" in the box next to the assigned rating on the Assessment Form. Assign a rating to the stream based on overall aesthetic quality, based on your opinion of how suitable the stream water is for recreation and aesthetic enjoyment today. Place and "X" in the box next to the assigned rating on the Assessment Form.

5. Beautiful, could not be any nicer.
4. Very minor aesthetic problems; excellent for swimming, boating, enjoyment.
3. Enjoyment impaired.
2. Level of enjoyment substantially reduced.
1. Enjoyment nearly impossible.

Add any comments you feel might aid data interpretation in the Comments Section.

6. GENERAL ASSESSMENT: record comments on wildlife observed, perceived diversity of terrestrial vegetation, and the estimated age class of forest (0 to 25 yr, 25 to 75 yr, or > 75 yr.) on the Assessment Form.

7. LOCAL ANECDOTAL INFORMATION: Record any information regarding the past or present characteristics or condition of the stream provided by local residents.

# Appendix II

1. Description of Habitat Parameters
2. Habitat Assessment Field Data Sheet
3. Standardized Erosion Form
4. Standardized Bank Erosion Potential Form

## DESCRIPTION OF HABITAT PARAMETERS

The habitat assessment approach used in this protocol is adapted from EPA's Rapid Bioassessment approach and refined from various applications across the country. The approach focuses on integrating information from specific parameters on the structure of the physical habitat. The field data sheets that summarize the major attributes of each parameter are attached. Specific instruction and training are necessary for an adequate assessment of habitat quality. The following information describes the various parameters used to assess the habitat based on the prevalence of the habitats within the stream--riffle/run prevalent habitats or glide/pool habitats.

If riffle/run habitats are prevalent, the following parameters are used to assess the stream:

(1) *Instream Cover for Fish* includes the relative quantity and variety of natural structures in the stream, such as fallen trees, logs, and branches, large rocks, and undercut banks, that are available as refugia, feeding, or laying eggs. A wide variety of submerged structures in the stream provides the fish with a large number of niches, thus increasing the diversity.

(2) *Epifaunal Substrate for Macroinvertebrates* are essentially the amount of niche space or hard substrates (rocks, snags) available for insects and snails. Numerous types of insect larvae attach themselves to rocks, logs, branches, or other submerged substrates. As with fish, the greater the variety and number of available niches or attachment sites, the greater the variety of insects in the stream. Rocky-bottom areas are critical for maintaining a healthy variety of insects in most high gradient streams.

(3) *Embeddedness* refers to the extent to which rocks (gravel, cobble, and boulders) are covered or sunken into the silt, sand, or mud of the stream bottom. Generally, as rocks become embedded, the surface area available to macroinvertebrates and fish (shelter, spawning, and egg incubation) is decreased. To estimate the percent of embeddedness, observe the amount of silt or finer sediments overlying and surrounding the rocks. If kicking does not dislodge the rocks or cobble, they may be greatly embedded. It may be useful to lift a few rocks and observe the extent of the dark area on their underside.

(4) *Varying Velocity and Water Depth* examines the availability of each of the four primary current/depth combinations: (1) slow-deep, (2) slow-

shallow, (3) fast-deep, and (4) fast-shallow. The best streams in high gradient regions will have all four habitat types present. The presence or availability of these four habitats relates to the stream's ability to provide and maintain a stable aquatic environment. The general guidelines are 0.5 m depth to separate shallow from deep, and 0.3 m/sec to separate fast from slow.

(5) *Channel Alteration* is basically a measure of large-scale changes in the shape of the stream channel. Many streams in urban and agricultural areas have been straightened, deepened, or diverted into concrete channels, often for flood control purposes. Such streams have far fewer natural habitats for fish, macroinvertebrates, and plants than do naturally meandering streams. Channel alteration is present when the stream runs through a concrete channel; when artificial embankments, riprap, and other forms of artificial bank stabilization or structures are present; when the stream is very straight for significant distances; when dams and bridges are present; and when other such changes have occurred.

(6) The *Sediment Deposition* parameter measures the amount of sediment that has accumulated and the changes that have occurred to the stream bottom as a result of the deposition. Deposition occurs from large-scale movement of sediment caused by watershed erosion. Sediment deposition may cause the formation of islands, point bars (areas of increased deposition usually at the beginning of a meander that increase in size as the channel is diverted toward the outer bank) or shoals, or result in the filling of pools. Increased sedimentation also results in increased deposition. Usually this is evident in areas that are obstructed by natural or man-made debris and areas where the stream flow decreases, such as bends. High levels of sediment deposition create an unstable and continually changing environment that becomes unsuitable for many organisms.

(7) *Frequency of Riffles* is a way to measure the sequence of riffles occurring in a stream. Riffles are a source of high-quality habitat and diverse fauna, therefore, an increased frequency of occurrence greatly enhances the diversity of the stream community. For areas where riffles are uncommon, a run/bend ratio can be used as a measure of sinuosity. A large degree of sinuosity provides for diverse habitat and fauna, and the stream is better able to handle the high energy flows that result from storms than are relatively straight streams.

(8) *Channel Flow Status* is the degree to which the channel is filled with water. The flow status will change as the channel enlarges or as flow

decreases as a result of dams and other obstructions, diversions for irrigation, or drought. When water does not cover much of the streambed, the amount of viable substrate for aquatic organisms is limited.

(9) *Condition of Banks* measures whether the stream banks are eroded (or the potential for erosion). Steep banks are more likely to collapse and suffer from erosion than are gently sloping banks and are therefore considered to be unstable. Signs of erosion include crumbling, unvegetated banks, exposed tree roots, and exposed soil.

(10) *Bank Vegetative Protection* measures the amount of the stream bank that is covered by vegetation. The root systems of plants growing on stream banks help hold soil in place, thereby reducing the amount of erosion that is likely to occur. This parameter supplies information on the ability of the bank to resist erosion, as well as some additional information on the uptake of nutrients by the plants, the control of instream scouring, and stream shading. Banks that have full, natural plant growth are better for fish and macroinvertebrates than are banks without vegetative protection or those shored up with concrete or riprap.

(11) *Grazing/Disruptive Pressure* is a measure of disruptive changes to the riparian zone because of grazing or human interference (e.g., mowing). In areas of high grazing pressure from livestock or where residential and urban development activities disrupt the riparian zone, the growth of a natural plant community is impeded. Residential developments, urban centers, golf courses, and rangeland are the common causes of anthropogenic pressure on the riparian zone.

(12) The *Riparian Vegetative Zone Width* measures the width of natural vegetation from the edge of the stream bank (riparian buffer zone). The riparian vegetative zone serves as a buffer zone to pollutants entering a stream from runoff, controls erosion, and provides stream habitat and nutrient input into the stream. A relatively undisturbed riparian zone reflects a healthy stream system; narrow, far less useful riparian zones occur when roads, parking lots, fields, lawns, bare soil, rocks, or buildings are near the stream bank. The presence of "old fields" (i.e., a previously developed fields allowed to convert to natural conditions) will rate higher than fields in continuous or periodic use. Paths and walkways in an otherwise undisturbed riparian zone may be judged to be inconsequential to destruction of the riparian zone.

# Habitat Assessment Field Data Sheet

HABITAT ASSESSMENT FIELD DATA SHEET

*RIFFLE/RUN PREVALENC*

| Habitat Parameter | Category | | | |
|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor |
| Instream Cover (Fish) | Greater than 50% mix of boulder, cobble, submerged logs, undercut banks, or other stable habitat. | 30-50% mix of boulder, cobble, or other stable habitat; adequate habitat. | 10-30% mix of boulder, cobble, or other stable habitat; habitat availability less than desirable. | Less than 10% mix of boulder, cobble, or other stable habitat; lack of habitat is obvious. |
| SCORE ___ | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| Epifaunal Substrate | Well-developed riffle and run; riffle is as wide as stream and length extends two times the width of stream; abundance of cobble. | Riffle is as wide as stream but length is less than two times width; abundance of cobble; boulders and gravel common. | Run area may be lacking; riffle not as wide as stream and its length is less than 2 times the stream width; gravel or large boulders and bedrock prevalent; some cobble present. | Riffles or run virtually nonexistent; large boulders and bedrock prevalent; cobble lacking. |
| SCORE ___ | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| Embeddedness | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment. | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. |
| SCORE ___ | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| Velocity/Depth Regimes | All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low). | Dominated by 1 velocity/depth regime (usually slow-deep). |
| SCORE ___ | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| Channel Alteration | No channelization or dredging present. | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present. | New embankments present on both banks; and 40 to 80% of stream reach channelized and disrupted. | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. |
| SCORE ___ | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| Sediment Deposition | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools. | Moderate deposition of new gravel, coarse sand on old and new bars; 30-50% of the bottom affected; sediment deposits at obstruction, constriction, and bends; moderate deposition of pools prevalent. | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. |
| SCORE | [illegible] | | | |

1

2

3

6

4

| | Habitat Parameter | Category | | | |
|---|---|---|---|---|---|
| | | Optimal | Suboptimal | Marginal | Poor |
| #7 | Frequency of Riffles | Occurrence of riffles relatively frequent; distance between riffles divided by the width of the stream equals 5 to 7; variety of habitat. | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream equals 7 to 15. | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is between ratio >25. |
| | SCORE ____ | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| #5 | Channel Flow Status | Water reaches base of both lower banks and minimal amount of channel substrate is exposed. | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed. | Very little water in channel and mostly present as standing pools. |
| | SCORE ____ | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| #8 | Condition of Banks | Banks stable; no evidence of erosion or bank failure. | Moderately stable; infrequent, small areas of erosion mostly healed over. | Moderately unstable; up to 60% of banks in reach have areas of erosion. | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; on side slopes, 60-100% of bank has erosional scars. |
| | SCORE ____ | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| #9 | Bank Vegetative Protection | More than 90% of the streambank surfaces covered by vegetation. | 70-90% of the streambank surfaces covered by vegetation. | 50-70% of the streambank surfaces covered by vegetation. | Less than 50% of the streambank surfaces covered by vegetation. |
| | SCORE ____ | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 10 | Grazing or Other Disruptive Pressure | Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally. | Disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | Disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | Disruption of streambank vegetation is very high; vegetation has been removed to 2 inches or less in average stubble height. |
| | SCORE ____ | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| #10 | Riparian Vegetative Zone Width | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. |
| | SCORE ____ | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |

Total Score ____

# Standardized Erosion Data Sheets

MEL ZIMMERMAN - erosion form.xls Page 2

| | | Bank Height | | | Bank Angle | | | Density of Roots | | | Particle Size | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site #: | RB | L | M | H | L | M | H | L | M | H | L | M | H |
| Site Type: | LB | L | M | H | L | M | H | L | M | H | L | M | H |

Width of Stream (Feet) 10-25___ 26-50___ 51-100___ 101-150___ 150+___
Length of Site (Feet) 0-50___50-100___101-250___251-500___501-1000___1000+____

RB Dist. Erosion to Structure (Feet) 0-25___ 26-50___ 51-100___ 100+___
RB Structure Type - House___ Garage___ Bridge___ Culvert___ Road___ Other_____
LB Dist. Erosion to Structure (Feet) 0-25___ 26-50___ 51-100___ 100+___
LB Structure Type - House___ Garage___ Bridge___ Culvert___ Road___ Other_____

| Side | Right Bank | Left Bank |
|---|---|---|
| Length Bank | | |
| Height Bank | | |
| Adjacent Land Use Pasture/Fenced/ Machine Accessible | | |
| Soil Texture | | |
| Stream Alignment | | |
| Vegetation | | |
| Stream Gradient | | |
| Slope | | |
| Slope Depo Bar | | |
| Position of Erosion Feature | Lat: | Lon: |

Picture #'s Taken:
Comments:

| | | Bank Height | | | Bank Angle | | | Density of Roots | | | Particle Size | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site #: | RB | L | M | H | L | M | H | L | M | H | L | M | H |
| Site Type: | LB | L | M | H | L | M | H | L | M | H | L | M | H |

Width of Stream (Feet) 10-25___ 26-50___ 51-100___ 101-150___ 150+___
Length of Site (Feet) 0-50___50-100___101-250___251-500___501-1000___1000+____

RB Dist. Erosion to Structure (Feet) 0-25___ 26-50___ 51-100___ 100+___
RB Structure Type - House___ Garage___ Bridge___ Culvert___ Road___ Other_____
LB Dist. Erosion to Structure (Feet) 0-25___ 26-50___ 51-100___ 100+___
LB Structure Type - House___ Garage___ Bridge___ Culvert___ Road___ Other_____

| Side | Right Bank | Left Bank |
|---|---|---|
| Length Bank | | |
| Height Bank | | |
| Adjacent Land Use Pasture/Fenced/ Machine Accessible | | |
| Soil Texture | | |
| Stream Alignment | | |
| Vegetation | | |
| Stream Gradient | | |
| Slope | | |
| Slope Depo Bar | | |
| Position of Erosion Feature | Lat: | Lon: |

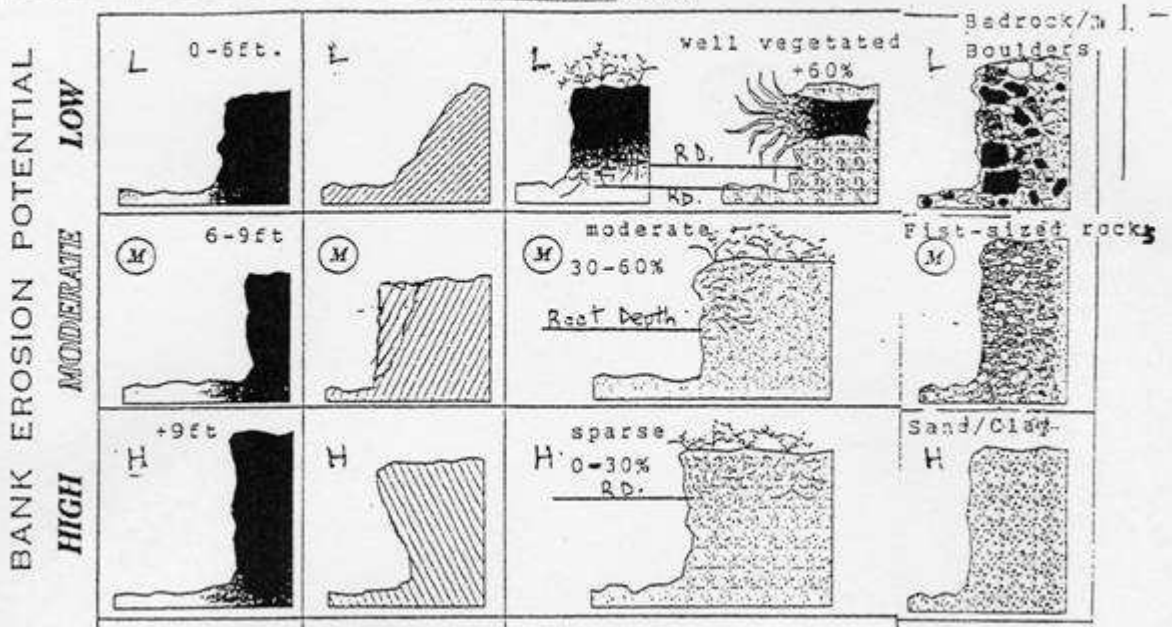
Picture #'s Taken:

# Standardized Bank Erosion Potential

Stream Name_____

Page 1 of __

## Bank Erosion Potential




| Facing Downstream<br>RB-Right Bank<br>LB-Left Bank<br>H-High Potential<br>M-Moderate L-Low | Bank | Bank Height | Bank Angle | Density of Roots | Particle Size |
|---|---|---|---|---|---|
| Site#<br>Site Type<br>Comments | RB | H___M___L___ | H___M___L___ | H___M___L___ | H___M___L___ |
| | LB | H___M___L___ | H___M___L___ | H___M___L___ | H___M___L___ |

Stream Width (Feet) (Floodway) 10-25__ 26-50__ 51-100__ 101-150__ 150+__
Length of Site (Feet) 0-50__ 51-100__101-250__251-500__ 501-1000__ 1000+__

RB Dist. Erosion to Structure (Feet) 0-25__ 26-50__ 51-100__ 100+__
RB Structure Type- House__ Garage__ Bridge__ Culvert__ Road__Other_____
LB Dist. Erosion to Structure (Feet) 0-25__ 26-50__ 51-100__ 100+__
LB Structure Type- House__ Garage__ Bridge__ Culvert__ Road__Other_____

Picture #'s Taken

| | | | | | |
|---|---|---|---|---|---|
| Site#<br>Site Type<br>Comments | RB | H___M___L___ | H___M___L___ | H___M___L___ | H___M___L___ |
| | LB | H___M___L___ | H___M___L___ | H___M___L___ | H___M___L___ |

Stream Width (Feet) (Floodway) 10-25__ 26-50__ 51-100__ 101-150__ 150+__
Length of Site (Feet) 0-50__ 51-100__101-250__251-500__ 501-1000__ 1000+__

RB Dist. Erosion to Structure (Feet) 0-25__ 26-50__ 51-100__ 100+__
RB Structure Type- House__ Garage__ Bridge__ Culvert__ Road__Other_____
LB Dist. Erosion to Structure (Feet) 0-25__ 26-50__ 51-100__ 100+__
LB Structure Type- House__ Garage__ Bridge__ Culvert__ Road__Other_____

Picture #'s Taken

# Standardized Erosion Data Sheet

# In-stream Island and Gravel Bar Sheet

| Site # | Site Type | Sediment | Latitude | Longitude | Vegetation | Length (ft) | Width (ft) |
|---|---|---|---|---|---|---|---|
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