Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers: *Visual Habitat Assessment*

Clean Water Team

Bioassessment Protocols for Use in
Wadeable Streams and Rivers
EPA 841-B-99-002

Rapid Bioassessment Protocols (RBP) Visual Assessment Scores:

For Basic Bioassessment Physical Habitat Monitoring, or as an Optional Supplement to the Full Physical Habitat Assessment.

- Use the EPA-Rapid Bioassessment Procedures.

  Bioassessment Protocols for Use in Wadeable Streams and Rivers EPA 841-B-99-002

> "This was part of prior California Steam Bioassessment Protocols (CSBP). Citizen Monitors are encouraged to continue to use this method. It will be useful for comparison with legacy data. The criteria also have a useful didactic role since they help force the user to quantify key features of the physical environment where bioassessment samples are collected."

From : SOP for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California.

SWAMP, SWRCB, 2007

SUGGESTED EQUIPMENT/SUPPLIES FOR VISUAL HABITAT ASSESSMENT AND PHYSICAL/WATER QUALITY CHARACTERIZATION

•Physical Characterization and Water Quality Field Data Sheet*

•Habitat Assessment Field Data Sheet*

•Clipboard

•Pencils or waterproof pens

•Tape measure

•Camera and or video camera

•Arrows (indicating upstream, downstream…) or comment board for use in photographs

•Velocity (flow) meter or other

•GPS unit

* Water-resistant paper suggested

THE APPROACH

A generic habitat assessment approach based on visual observation can be separated into 2 basic approaches, one designed for high-gradient streams and one designed for low-gradient streams.

THE APPROACH FOR HIGH GRADIENT STREAMS

High-gradient or riffle/run prevalent streams are those in moderate to high gradient landscapes. Natural high-gradient streams have substrates primarily composed of coarse sediment particles (i.e., gravel or larger) or frequent coarse particulate aggregations along stream reaches.

High gradient channels usually have greater than a 1% slope and will always contain pool-riffle sequences with a ratio high enough to contain at least 3 riffles per 100 m (300 ft) and must be at least 1 m (3 ft) wide with flow velocities greater than 0.3 m/sec (1 ft/sec).

THE APPROACH FOR LOW GRADIENT STREAMS

Low-gradient or glide/pool prevalent streams are those in low to moderate gradient landscapes. Natural low-gradient streams have substrates of fine sediment or infrequent aggregations of more coarse (gravel or larger) sediment particles along stream reaches. Low gradient channels usually have less than a 1% grade and will never have more than two riffles within a 100 m (300 ft) length of stream. These channels can be as deep as 1.5 m, but with low enough water velocity to allow safe wading. **Channels greater than 1.5 m deep, with swift water velocities and/or which can not be accessed on at least one bank will require a boat as they are not wade-able**.

THE APPROACH CONTINUED

The entire sampling reach is evaluated for each parameter. The reach length is 150m if the stream's wetted width is 10m or less. The reach will be 250m in length if the wetted width is greater than10m.

Descriptions of each parameter and its relevance to instream biota are presented in the following discussions.

A brief set of decision criteria is given for each parameter corresponding to each of the 4 categories reflecting a continuum of conditions on the field sheet (optimal, suboptimal, marginal, and poor).

PROCEDURE FOR PERFORMING HABITAT ASSESSMENT

1. Select the reach to be assessed. Some parameters require an observation of a broader section of the catchment than just the sampling reach.

2. Complete the station identification section of each field data sheet and habitat assessment form.

3. It is best for the investigators to obtain a close look at the habitat features to make an adequate assessment. If the physical and water quality characterization and habitat assessment are done before the biological sampling, care must be taken to avoid disturbing the sampling habitat.

4 Complete the **Habitat Assessment Field Data Sheet**, in a team of 2 or more, if possible, to come to a consensus on determination of quality. Those parameters to be evaluated on a scale greater than a sampling reach require traversing the stream corridor to the extent deemed necessary to assess the habitat feature. As a general rule-of-thumb, use 2 lengths of the sampling reach to assess these parameters.

Note: Please take care in trying to not trample the site.

QUALITY ASSURANCE PROCEDURES

If your visually collected data is to be used, be certain to include its acquisition within your Monitoring Plan and Quality Assurance Project Plan (QAPP)

1. Each monitor is to be **trained** in the visual based habitat assessment technique.

2. The judgment criteria for each habitat parameter are **calibrated** for the stream classes under study. Some text modifications may be needed on a regional basis.

3. Periodic **checks of assessment results** are completed using pictures of the sampling reach and discussions among the monitors in the program.

4. **Field audits** may be conducted by knowledgeable persons not affiliated with the monitoring program.

EPIFAUNAL SUBSTRATE/AVAILABLE COVER PART ONE

Includes the relative quantity and variety of **natural structures in the stream**, such as cobble (riffles), large rocks, fallen trees, logs and branches, and undercut banks, available as refugia, feeding, or sites for spawning and nursery functions of aquatic macrofauna.

A wide variety and/or abundance of submerged structures in the stream provides macroinvertebrates and fish with a large number of **niches**, thus increasing habitat diversity. As variety and abundance of **cover** decreases, habitat structure becomes monotonous, diversity decreases, and the potential for recovery following disturbance decreases.

EPIFAUNAL SUBSTRATE/AVAILABLE COVER PART TWO

Riffles and runs are critical for maintaining a variety and abundance of insects in most high-gradient streams and serving as spawning and feeding refugia for certain fish. The extent and quality of the riffle is an important factor in the support of a healthy biological condition in high-gradient streams. Riffles and runs offer a diversity of habitat through variety of particle size, and, in many small high-gradient streams, will provide the most stable habitat.

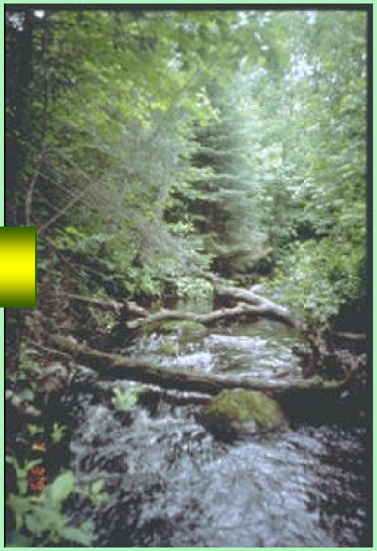
Snags and submerged logs are among the most productive habitat structure for macroinvertebrate colonization and fish refugia in low-gradient streams. However, “new fall” will not yet be suitable for colonization.

1a. Epifaunal Substrate/Available Cover-

High Gradient Streams

Optimal	Suboptimal	Marginal	Poor
Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential.	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization.	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
20 19 18 17 16	**15 14 13 12 11**	**10 9 8 7 6**	**5 4 3 2 1 0**

Optimal



Poor

1b. Epifaunal Substrate/Available Cover-
Low Gradient Streams

Optimal

Poor

2a. EMBEDDEDNESS- High Gradient Streams

Embeddedness refers to the extent to which rocks (gravel, cobble, and boulders) and snags 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. Embeddedness is a result of large-scale sediment movement and deposition, and is a parameter evaluated in the riffles and runs of high gradient streams. The rating of this parameter may be variable depending on where the observations are taken. To avoid confusion with sediment deposition (another habitat parameter), observations of embeddedness should be taken in the upstream and central portions of riffles and cobble substrate areas.

2a. Embeddedness- High Gradient Streams

Optimal	Suboptimal	Marginal	Poor
Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provided diversity of niche space.	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.
20 19 18 17 16	**15 14 13 12 11**	**10 9 8 7 6**	**5 4 3 2 1 0**

Optimal

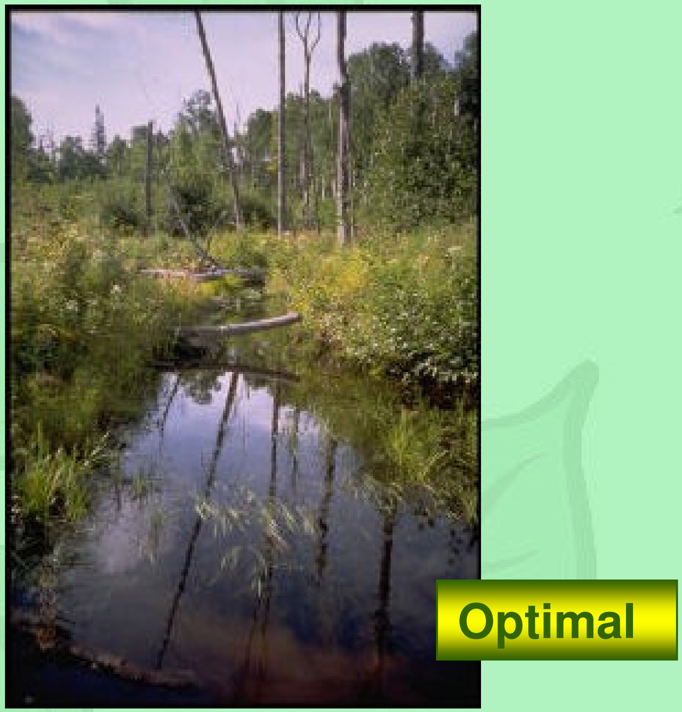
Poor

2b. POOL SUBSTRATE CHARACTERIZATION- Low Gradient Streams

Evaluates the type and condition of bottom substrate 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.

2b. Pool Substrate Characterization- Low Gradient Streams

Optimal	Suboptimal	Marginal	Poor
Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay: mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0



3 VELOCITY/DEPTH COMBINATIONS-

High Gradient Streams

Patterns of velocity and depth are included for high-gradient streams under this parameter as an important feature of habitat diversity. The best streams in most high-gradient regions will have 4 patterns present.

The occurrence of these 4 patterns relates to the stream’s ability to provide and maintain a stable aquatic environment.

3a. VELOCITY/DEPTH COMBINATIONS- High Gradient Streams

The 4 patterns are:.

(1)slow-deep

(2) slow-shallow

(3) fast-deep

(4) fast-shallow

The general guidelines are, less than 0.5 m depth to separate shallow from deep and greater than 0.3 m/sec to separate fast from slow.

3a. Velocity/Depth Regime-High Gradient Streams

Optimal	Suboptimal	Marginal	Poor
All four velocity/depth regime present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is <0.3m/s, deep is>0.5m)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than 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).
20 19 18 17 16	**15 14 13 12 11**	**10 9 8 7 6**	**5 4 3 2 1 0**

Optimal

Poor

Arrows emphasize different velocity/depth regimes.

3b. POOL VARIABILITY-
Low Gradient Streams

Rates the overall mixture of pool types found in streams, according to size and depth. The 4 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. General guidelines are any pool dimension (i.e., length, width, oblique) greater than half the cross-section of the stream for separating large from small and 1 m depth separating shallow and deep.

3b. Pool Variability- Low Gradient Streams

Optimal	Suboptimal	Marginal	Poor
Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of the pools large deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
20 19 18 17 16	**15 14 13 12 11**	**10 9 8 7 6**	**5 4 3 2 1 0**

Optimal

Poor

Arrows emphasize different velocity/depth regimes.

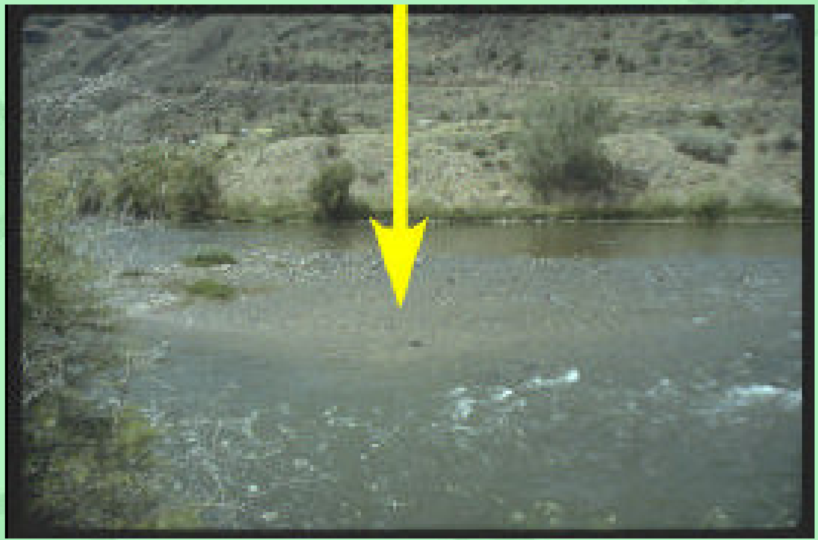
4 SEDIMENT DEPOSITION- High and Low Gradient Streams

Measures the amount of sediment that has accumulated in pools and the changes that have occurred to the stream bottom as a result of deposition. Deposition occurs from large-scale movement of sediment. 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 runs and pools. Usually deposition is evident in areas that are obstructed by natural or manmade debris and areas where the stream flow decreases, such as bends. High levels of sediment deposition are symptoms of an unstable and continually changing environment that becomes unsuitable for many organisms.

4a. Sediment Deposition- High Gradient Streams

Optimal	Suboptimal	Marginal	Poor
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 gravel, sand or fine sediment: 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constructions and bends; moderate deposition o pools prevalent.	Dominated by 1 velocity/depth regime (usually slow-deep).
20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Optimal



Poor

Arrow pointing to sediment deposition.

4b. Sediment Deposition- Low Gradient Streams

Optimal

Poor

Arrows pointing to sediment deposition.

5 CHANNEL FLOW STATUS- High and Low Gradient Streams

The degree to which the channel is filled with water. The flow status will change as the channel enlarges (e.g., aggrading stream beds with actively widening channels) 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 suitable substrate for aquatic organisms is limited. In high-gradient streams, riffles and cobble substrate are exposed; in low-gradient streams, the decrease in water level exposes logs and snags, thereby reducing the areas of good habitat.

Channel flow is especially useful for interpreting biological condition under abnormal or lowered flow conditions. This parameter becomes important when more than one biological index period is used for surveys or the timing of sampling is inconsistent among sites or annual periodicity.

5a. Channel Flow Status High Gradient

Optimal	Suboptimal	Marginal	Poor
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.
20 19 18 17 16	**15 14 13 12 11**	**10 9 8 7 6**	**5 4 3 2 1 0**

Optimal

Poor

Arrow showing that water is not reaching both banks; leaving much of channel uncovered.

5b. Channel Flow Status- Low Gradient Streams

Optimal

Poor

6 CHANNEL ALTERATION- High and Low Gradient Streams

Channel alteration is 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 or irrigation purposes. Such streams have far fewer natural habitats for fish, macroinvertebrates, and plants than do naturally meandering streams.

Channel alteration is present 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. Scouring is often associated with channel alteration.

6a. Channel Alteration

Optimal	Suboptimal	Marginal	Poor
Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge, abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yrs) may be present but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40-80% of stream reach channelized and disrupted,	Bank shored with gabion or cement; over80%fo the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
20 19 18 17 16	**15 14 13 12 11**	**10 9 8 7 6**	**5 4 3 2 1 0**

Optimal

Poor

Arrows showing channel alteration impacts.

6b. Channel Alteration- Low Gradient Streams

Optimal

Poor

7a. FREQUENCY OF RIFFLES (OR BENDS)- High Gradient Streams

Is a way to measure the sequence of riffles and thus the heterogeneity 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 high gradient streams where distinct riffles are uncommon, a run/bend ratio can be used as a measure of meandering or sinuosity (see 7b). A high degree of sinuosity provides for diverse habitat and fauna, and the stream is better able to handle surges when the stream fluctuates as a result of storms. The absorption of this energy by bends protects the stream from excessive erosion and flooding and provides refugia for benthic invertebrates and fish during storm events. To gain an appreciation of this parameter in some streams, a longer segment or reach than that designated for sampling should be incorporated into the evaluation. In some situations, this parameter may be rated from viewing accurate topographical maps. The “sequencing” pattern of the stream morphology is important in rating this parameter. In headwaters, riffles are usually continuous and the presence of cascades or boulders provides a form of sinuosity and enhances the structure of the stream. A stable channel is one that does not exhibit progressive changes in slope, shape, or dimensions, although short-term variations may occur during floods (Gordon et al. 1992).

7(a) Frequency of Riffles (Or Bends)-

High Gradient Streams

Optimal	Suboptimal	Marginal	Poor
Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to15.	Occasional riffle or bend; bottom continuous 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 a ration of >25
20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Optimal

Arrows showing frequency of riffles and bends.

Poor

7b. CHANNEL SINUOSITY- Low Gradient Streams

Evaluates the meandering or sinuosity of the stream. A high degree of sinuosity provides for diverse habitat and fauna, and the stream is better able to handle surges when the stream fluctuates as a result of storms. The absorption of this energy by bends protects the stream from excessive erosion and flooding and provides refugia for benthic invertebrates and fish during storm events. To gain an appreciation of this parameter in low gradient streams, a longer segment or reach than that designated for sampling may be incorporated into the evaluation. In some situations, this parameter may be rated from viewing accurate topographical maps. The “sequencing” pattern of the stream morphology is important in rating this parameter. In "oxbow" streams of coastal areas and deltas, meanders are highly exaggerated and transient. Natural conditions in these streams are shifting channels and bends, and alteration is usually in the form of flow regulation and diversion. A stable channel is one that does not exhibit progressive changes in slope, shape, or dimensions, although short-term variations may occur during floods (Gordon et al. 1992).

7b. Channel Sinuosity- Low Gradient

Optimal	Suboptimal	Marginal	Poor
The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note- channel braiding is considered normal in coastal plains and other low lying areas. This parameter is not easily rated in these area)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in straight line.	Channel Straight; waterway has been channelized for a long distance.
20 19 18 17 16	**15 14 13 12 11**	**10 9 8 7 6**	**5 4 3 2 1 0**

Optimal

Poor

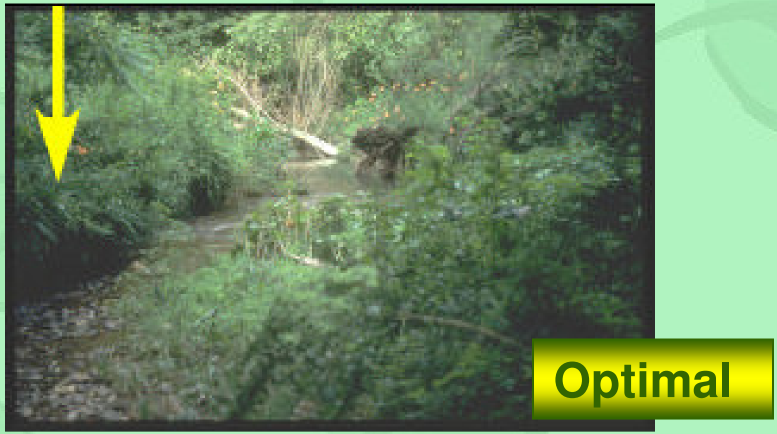
8 BANK STABILITY (Condition of Banks)- High and Low Gradient Streams

Measures whether 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, un-vegetated banks, exposed tree roots, and exposed soil. Eroded banks indicate a problem of sediment movement and deposition, and suggest a scarcity of cover and organic input to streams. Each bank is evaluated separately and the cumulative score (right and left) is used for this parameter.

8a. Bank Stability- High Gradient Streams

Optimal	Suboptimal	Marginal	Poor
Bank stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas infrequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
Left Bank * 10 9	**8 7 6**	**5 4 3**	**2 1 0**
Right Bank 10 9	**8 7 6**	**5 4 3**	**2 1 0**

* Note: Determine left of right side by facing downstream.



Arrow pointing to stable streambanks.

Arrow highlighting unstable streambanks.

8b. Bank Stability (Condition of Banks)- Low Gradient Streams

Optimal

Poor

Arrow highlighting unstable streambanks.

9 BANK VEGETATIVE PROTECTION- High and Low Gradient Streams

Measures the amount of vegetative protection afforded to the stream bank and the near-stream portion of the riparian zone. 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.

This parameter is made more effective by defining the native vegetation for the region and stream type (i.e., shrubs, trees, etc.). In some regions, the introduction of exotics has virtually replaced all native vegetation. The value of exotic vegetation to the quality of the habitat structure and contribution to the stream ecosystem must be considered in this parameter. 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 and can extend to the bank vegetative protection zone. Each bank is evaluated separately and the cumulative score (right and left) is used for this parameter.

9a. Vegetative Protection- High Gradient Streams

Optimal	Suboptimal	Marginal	Poor
More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs or non woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of streambank surfaces covered by native vegetation, but one class of plants is not well represented; disruption evidence but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5centimeters or less in average stubble height.
Left Bank 10 9	**8 7 6**	**5 4 3**	**2 1 0**
Right Bank 10 9	**8 7 6**	**5 4 3**	**2 1 0**

* Note: determine left of right side by facing downstream

Optimal

Poor

9b. Bank Vegetative Protection—Low Gradient

Optimal

Poor

Arrow pointing to channelized streambank with no vegetative cover.

10a. Riparian Vegetative Zone Width-High Gradient Streams

Optimal	Suboptimal	Marginal	Poor
Width of riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clear-cut, 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.
Left Bank 10 9	**8 7 6**	**5 4 3**	**2 1 0**
Right Bank 10 9	**8 7 6**	**5 4 3**	**2 1 0**

* Note: determine left of right side by facing downstream

Arrow emphasizing an undisturbed riparian zone.

Arrow emphasizing lack of riparian zone.

10b. Riparian Vegetative Zone Width- Low Gradient Streams

Optimal

Arrow emphasizing an undisturbed riparian zone.

Poor

Arrow emphasizing lack of riparian zone.

California Stream Bioassessment Protocol, 1999

Visual Physical Habitat Form Page 1:

CALIFORNIA DEPARTMENT OF FISH AND GAME
AQUATIC BIOASSESSMENT LABORATORY

WATER POLLUTION CONTROL LABORATORY
REVISION DATE-- MAY 1999

PHYSICAL HABITAT QUALITY
(California Stream Bioassessment Procedure)

WATERSHED/ STREAM: ____________________________ DATE/ TIME: ____________________________

COMPANY/ AGENCY: ____________________________ SAMPLE ID NUMBER: ____________________________

SITE DESCRIPTION: ____________________________

Circle the appropriate score for all 20 habitat parameters. Record the total score on the front page of the CBW.

Parameters to be evaluated within the sampling reach

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
1. Epifaunal Substrate/ Available Cover	Greater than 70% (50% for low gradient streams) of substrate favorable for epifaunal colonization and fish cover; most favorable is a mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% (30-50% for low gradient streams) mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% (10-30% for low gradient streams) mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% (10% for low gradient streams) stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	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.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/ Depth Regimes *(deep<0.5 m, slow<0.3 m/s)*	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).
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	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.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Visual Physical Habitat Form Page 2

Parameters to be evaluated in an area longer than the sampling reach

HABITAT PARAMETER	CONDITION CATEGORY: OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	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.	Channelization may be extensive; embankments or shoring structures 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. Instream habitat greatly altered or removed entirely.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 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 a ratio of >25.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left of right side by facing downstream	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	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 haveimpacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Source of Text and Images:

Bioassessment Protocols for Use in Wadeable Streams and Rivers, EPA 841-B-99-002

Physical Habitat Field Data Form (California Stream Bioassessment Procedure); California Department of Fish and Game, Aquatic Bioassessment Laboratory, Water Polution Control Laboratory- May 1999
http://www.dfg.ca.gov/cabw/Field/csbpwforms.html

www.waterboards.ca.gov/water_issues/programs/swamp/cwt_volunteer.shtml