Stream Assessment Protocols

Habitat Assessment

Each of the two members of a team should conduct habitat assessments separately, without collaboration. After each team member fills out the form separately, the two compare their scores. If the scores for any parameter differ by more than six points out of 20 (or three out of 10), then the two team members should discuss that parameter and, based on the conclusion of the discussion, adjust their scores before averaging them. The habitat assessment protocols for each metric are provided below. The field forms are provided in Appendix A.

Habitat Assessment - Riffle/Run Prevalent Streams

I. Instream Cover

Measures substrates that are available as refuge for aquatic organisms. A wide variety and/or abundance of submerged structures in the stream provides macroinvertebrates with a large number of niches, thus increasing the potential diversity. As the variety and abundance of cover decreases, habitat structure becomes monotonous, diversity decreases, and the potential for recovery following disturbance decreases.

Circle habitat types which occur at this site: fallen trees/large woody debris, deep pools, shallow pools, overhanging shrubbery in water, large rocks, cobble, undercut banks, thick root mats, dense macrophyte beds, or deep riffles with lots of turbulence (habitat type found in cold-water, mountain streams)

A. Habitat(s) expected for stream type make up >70% of reach

1. 7 habitats common	20
2. 6 habitat types common, additional habitat types rare	19
3. 5 habitat types common, additional habitat types rare	18
4. 4 habitat types common, additional habitat types rare	17
5. Less than 4 habitat types present	16

B. Habitat(s) expected for stream type make up >50% of reach

1. 7 habitats common	15
2. 6 habitat types common, additional habitat types rare	14
3. 5 habitat types common, additional habitat types rare	13
4. 4 habitat types common, additional habitat types rare	12
5. Less than 4 habitat types present	11

C. Habitat(s) expected for stream type makes up <50% of reach

a. 7-3 habitats common

1. 7 habitats common	10
2. 6 habitat types common, additional habitat types rare	9
3. 5 habitat types common, additional habitat types rare	8
4. 4 habitat types common, additional habitat types rare	7
5. 3 habitat types common, additional habitat types rare	6

b. 2-0 habitats common

1. 2 habitat types present, additional habitat types rare	5
2. 2 habitat types only and common	4
3. 1 habitat type common, additional habitat types rare	3
4. 1 habitat type only and common	2
5. 1 habitat type rare	1
6. 0 habitat types present	0

II. Epifaunal Substrate

Measures the availability of benthic habitat for macroinvertebrate (insects and snails) colonization. Riffle areas are critical for maintaining a healthy variety of insects in most riffle prevalent streams.

A. Well developed riffle-run complex. Riffle is as wide as the stream and its length extends twice the stream width. Substrate dominated by:

1.	Softball size cobble stones	20
2.	Cobble and boulder stones (>10 in.)	19
3.	Boulder stones only	18
4.	Mixture of cobble and gravel stones and/or stable woody debris	17
5.	Mixture of gravel stones and boulders/bedrock and/or stable woody debris	16

B. Riffle is as wide as the stream and its length does not extend twice the stream width. Substrate dominated by:

1.	Softball size cobble stones	15
2.	Cobble and boulder stones (>10 in.)	14
3.	Boulder stones only	13
4.	Mixture of cobble and gravel stones and/or stable woody debris	12
5.	Mixture of gravel stones and boulders/bedrock and/or stable woody debris	11

C. Riffle is not as wide as the stream and its length does not extend twice the stream width. Substrate dominated by:

1.	Softball size cobble stones	10
2.	Cobble and boulder stones (> 10 in.)	9
3.	Boulder stones only	8
4.	Mixture of boulders/bedrock and gravel stones and/or stable woody debris	7
5.	Mixture of bedrock and/or gravel stones and/or stable woody debris	6

D. Riffles or runs virtually nonexistent, no cobble substrate. Substrate dominated by:

1.	Large boulders, short runs	5
2.	Mixture of boulders and bedrock	4
3.	Rock and sand with long runs, no riffles	3
4.	Rock and sand with short runs, no riffles	2
5.	Rock and sand, no runs or riffles	1
6.	Sand with no riffles or runs	0

III. Embeddedness In Run Areas

Measures the degree to which cobble, boulders, and other rock substrate are surrounded by fine sediment. Embeddedness relates directly to the suitability of the stream substrate as habitat for macroinvertebrates and for fish spawning and egg incubation.

Fine sediments/sands range from 0.062 mm to 2 mm in size. Silt particles measure less than 0.062 mm. Sediment and silt particles smaller than 2 mm can be distinguished using "texture by feel techniques" employed in soil surveys.

A. Little or no embeddedness present by fine silt and/or sediment surrounding and covering rocks

1. <10% embeddedness	20
2. 10% embeddedness by sediment	19
3. 10% embeddedness by sediment and silt	18
4. 20% embeddedness by sediment	17
5. 20% embeddedness by sediment and silt	16

B. Fine sediment and silt surrounds and fills 25-50% of the living spaces around and in between gravel, cobble, and boulders

1. 30% embeddedness by sediment	15
2. 30% embeddedness by sediment and silt	14
3. 40% embeddedness by sediment	13
4. 40% embeddedness by sediment and silt	12
5. 50% embeddedness by sediment	11

C. Fine sediment and silt surrounds and fills 50-75% of the living spaces around and in between gravel, cobble, and boulders

1. 50% embeddedness by sediment and silt	10
2. 60% embeddedness by sediment	9
3. 60% embeddedness by sediment and silt	8
4. 70% embeddedness by sediment	7
5. 70% embeddedness by sediment and silt	6

D. Fine sediment and silt surrounds and fills more than 75% of the living spaces around and in between gravel, cobble, and boulders

1. 80% embeddedness by sediment	5
2. 80% embeddedness by sediment and silt	4
3. 90% embeddedness by sediment	3
4. 90% embeddedness by sediment and silt	2
5. 100% embeddedness by sediment	1
6. 100% embeddedness by sediment with a thick layer of silt on its surface	0

IV. Channel/Bank Alteration

Measurement of large-scale alteration of instream habitat, which affects stream biotic integrity and causes scouring. Channel alteration is present (circle or identify conditions) when: artificial embankments, rip rap, and other forms of artificial bank stabilization or structures are present; when dredging has altered bank stability; when dams and bridges are present; when banks and channels have been disturbed by livestock, other agricultural practices; or hydrology; and when other changes have occurred (list).

A. Stream follows a normal and natural meandering pattern. Alteration is absent.

1.	No evidence of disturbance with bends and riffle/runs frequent; bend angles average > 60°	20
2.	No evidence of disturbance with bends combination of riffle/runs and glide/pool habitats frequent; bend angles average between 60°- 40°	18
3.	No evidence of disturbance with bends and glide pools prevalent; bend angles average < 40°	16

B. Some minor alterations, dredging, artificial embankments, or dams present but NO evidence of recent alteration activities; mostly recovered and somewhat stable. .

1.	5% of reach has channel distrubance	15
2.	10% of reach or less has channel disturbance	14
3.	20% of reach has channel disturbance	13
4.	30% of reach has channel disturbance	12
5.	40% of reach has channel disturbance	11

C. Somewhat channelized; 40-80% of the area has been straightened, dredged, or otherwise altered.

1.	40% of reach has channel disturbance	10
2.	50% of reach has channel disturbance	9
3.	60% of reach has channel disturbance	8
4.	70% of reach has channel disturbance	7
5.	80% of reach has channel disturbance	6

D. More than 80% of the stream site has been dredged, or otherwise altered; banks most likely box-cut (Including natural U-shaped) or rip-rap or no longer have native vegetation; instream habitat highly altered.

1.	90% of reach has channel disturbance	5
2.	Channel reach 100% disturbed; with no artificial embankments	3
3.	Channel reach 100% disturbed; with artificial embankments	2
4	Channel reach 100% disturbed; with natural and manmade artificial embankments	1
5.	Channel 100% shored by gabion and/or cement	0

V. Sediment Deposition

Relates to the amount of sediment that has accumulated and the changes that have occurred to the stream bottom as a result of deposition. Sediment deposition may correlate with embededness. 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. Depositional material comes from the watershed and bank erosion (Barbour and Stribling, 1995). The growth, or appearance of bars/islands where they did not previously exist is an indication of upstream erosion. Sediment bars/islands tend to grow in depth and length with continued watershed disturbance because increased sedimentation results in increased deposition. High levels of sediment deposition create an unstable and continually changing environment that becomes unsuitable for many organisms (FL DEP, 1996).

A. No enlargements of islands/point bars present or less than 20% bottom affected by sand or silt accumulation.

1. No sediment deposition detected; especially in pools	20
2. Less than 20% sediment deposition with accumulation in pools only	18
3. Less than 20% sediment deposition with accumulation in runs and pools	17
4. Less than 20% sediment deposition with few, old, small point bars or islands made up of coarse gravel in stream channel	16

B. 20-50% bottom affected by sand or silt accumulation; slight deposition in pools; some new increase in bar and island formation.

1. 20-30% sediment deposition with gravel and/or sand	15
2. 20-30% sediment deposition with sand and/or silt	14
3. 40-50% sediment deposition with gravel and/or sand	12
4. 40-50% sediment deposition with sand and/or silt	11

C. 50-80% bottom affected with moderate deposition in pools. Number of shallow pools increases. Habitats smothered by sand, silt, and possibly coarse gravel. Deposits of fresh, fine, gravel, sand, and silt observed on old and new point bars, islands, and behind obstructions. Formation of few new bars/islands is evident and old bars are deep and wide; deposition at bends obvious.

1. 50-60% sediment deposition with gravel and/or sand	10
2. 50-60% sediment deposition with sand and/or silt	9
3 70-80% sediment deposition with gravel and/or sand	7
4 70-80% sediment deposition with sand and/or silt	6

D. More than 80% bottom affected with heavy deposition from coarse and fine gravel and sand at stream bends, constrictions, and/or pools. Extensive deposits of fine sand and/or silt on old and new bars, islands, and along banks in straight channels. Few pools are present due to siltation. Only larger rocks in riffle areas remain exposed.

1. 80-90% sediment deposition; pools almost absent due to substantial deposition; bottom silt may move with almost any flow above normal	4
2. 90-100% sediment deposition; pools almost absent	2
3. 100% sediment deposition; pools absent due to substantial deposition; bottom silt moves with almost any flow above normal	0

VI. Frequency of Riffles

Estimates the frequency of occurrence of riffles as a measure of sinuosity. 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. Divide the average distance between riffles by the average width of the stream to estimate run-to-riffle ratio.

A. Occurrence of riffles relatively frequent. Deep pools may be present and riffles are deep enough to allow passage of fish.

1. Riffles are continuous: run-to-riffle ratio = 1-2	20
2. Run-to-riffle ratio = 3-4	19
3. Run-to-riffle ratio = 5	18
4. Run-to-riffle ratio = 6	17
5. Run-to-riffle ratio = 7	16

B. Occurrence of riffles moderately frequent; adequate depth in pools and riffles.

1. Run-to-riffle ratio = 8	15
2. Run-to-riffle ratio = 10	14
3. Run-to-riffle ratio = 11	13
4. Run-to-riffle ratio = 13	12
5. Run-to-riffle ratio = 15	11

C. Infrequent riffles or bends variable bottom contours may provide some habitat.

1. Run-to-riffle ratio = 16	10
2. Run-to-riffle ratio = 18	9
3. Run-to-riffle ratio = 20	8
4. Run-to-riffle ratio = 22	7
5. Run-to-riffle ratio = 24	6

D. Generally all flat water or shallow riffles; essentially a straight and uniform depth stream; riffles are not deep enough to provide free passage for fish.

1. Run-to-riffle ratio = 25	4
2. Run-to-riffle ratio > 30 with some shallow riffles	2
3. Run-to-riffle ratio >30 with no shallow riffles	0

VII. Channel Flow Status

Is the degree to which the channel is filled with water during normal flow periods. The flow status will change as the channel enlarges or as flow decreases as a result of dams and other obstructions, diversions for irrigation, drought, or aggrading stream bottoms with actively widening channels. This is a seasonal parameter. A decrease in water will wet smaller portions of the streambed, thus decreasing available habitat for aquatic organisms. Use the toe of slope and possibly the vegetation line on the lower bank as your reference point to estimate channel flow status.

A. Water reaches the base of both lower banks and minimal amount of channel substrate is exposed (100% channel full) 20

1. > 95% channel is full 18
2. 90-95% channel is full 16

B. Water fills > 75% of the available channel (or <25% of channel substrate is exposed)

1. 90% of channel is full 15
2. 85% of channel is full 13
3. 80% of channel is full 11

C. Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed

1. 75% of channel is full 10
2. 60-65% of channel is full 9
3. 50% of channel is full 8
4. 35-40% of channel is full 7
5. 25% of channel is full 6

D. Very little water in the channel and mostly present as standing pools

1. 20% of channel is full 5
2. 10% of channel is full 4
3. < 10% of channel is full 3
4. Water present as isolated standing pools 1
5. Channel is dry 0

VIII. Bank Vegetative Protection

Measures the amount of the stream bank that is covered by vegetation. 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 those without vegetation protection and those shored up with concrete or riprap.

Four factors to consider when scoring bank vegetative protection: (1) is the vegetation native or natural or planted and introduced? (2) Is the upper story, under story, and ground cover vegetation well balanced?; (3) What is the standing crop biomass?; and (4) During which season are you conducting this assessment?

Determine left or right bank by facing downstream. Score left and right banks separately.

A. Left Bank or Right Bank

1. More than 90% stream bank surfaces is covered by native/natural vegetation. A variety of vegetation present (e.g., trees, shrubs, understory, or nonwoody macrophytes). Any bare or sparsely vegetated areas are small and evenly dispersed.

a. 100% plant cover on stream bank	10
b. > 90% plant cover on stream bank	9

2. A variety of vegetation is present and covers 70-90% of stream bank surface, but one class of plants is not well represented. Some open areas with unstable vegetation are present. Disruption evident but not affecting full plant growth potential.

a. 90% plant cover but one class of plants is not well represented	8
b. 80% plant cover with a few barren or thin areas present	7
c. 70% plant cover with a few barren or thin areas present with fewer plant species	6

3. 50-70% of stream bank surface covered by vegetation; typically composed of scattered shrubs, grasses, and forbes. Thin or bare spots visible and/or closely cropped vegetation with less that ½ plant stubble height remaining.

a. 70% vegetation cover; typically of shrubs, grasses, and forbes	5
b. 60% vegetation cover; typically of shrubs, grasses, and forbes	4
c. 50% vegetation cover; typically of shrubs, grasses, and forbes	3

4. Less than 50% stream bank surface covered by vegetation; 2 inches or less in average stubble height remaining. Any shrubs or trees on bank exist as individuals or widely scattered clumps.

a. 40% vegetation cover with many bare spots/rock	2
b. 20% vegetation cover with many bare spots/rock	1
c. No vegetation cover on stream bank	0

IX. Bank Stability

Measures the existence of or the potential for detachment of soil from the upper and lower stream banks and its movement into the stream. 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. Reinforcement of banks via rocks, artificial or natural, provides stability.

Determine left or right bank by facing downstream. Score left and right banks separately.

A. Left Bank or Right Bank

1. Bank stable; erosion absent or minimal. Side slopes are generally less than 30% and are stable. Bank may be reinforced by rock thus increasing slope >30% while providing stability.

   a. No evidence of erosion or bank failure 10
   b. Less than 5% bank affected by erosion 9

2. Moderately stable bank; small areas of erosion or bank slumping visible. Most areas are stable with only slight potential for erosion at flood stages. Side slopes up to 40% on one bank. Bank may be reinforced by rock thus increasing slope > 40% while providing stability.

   a. 5% bank has erosional areas 8
   b. 15% bank has erosional areas 7
   c. 30% bank has erosional areas 6

3. Moderately unstable bank; frequency and size of raw areas are such that high water events have eroded some areas of the bank. Medium size areas of erosion or bank slumping visible. Side slopes up to 60% on some of the bank. High erosion potential during floods.

   a. 40% - 50% bank has erosional areas 5
   b. 50% - 60% bank has erosional areas 4
   c. 60% - 70% bank has erosional areas 3

4. Unstable bank; mass erosion and bank failure is evident; erosion and pronounced undercutting present at bends and along some straight channel areas. Side slopes > 60% are common. Many raw areas present and 60-100% bank has erosional scars.

   a. 70% - 80% bank has erosional areas 2
   b. 80%-90% bank has erosional areas 1
   c. > 90% stream bank has eroded 0

X. Vegetation Buffer Zone Width

Measures the width and conditions of the vegetation or land use from the edge of the upper stream bank out through, and in some cases, beyond the flood plain and riparian zone. The vegetative zone serves as a buffer to pollutants entering a stream from runoff, and minimizes erosion. Far less useful buffer zones occur when roads, parking lots, fields, heavily used paths, lawns, bare soil, rocks, or buildings are near the bank.

Determine left or right bank by facing downstream. Score left and right banks separately.

When evaluating this parameter, walk around in the buffer area paying close attention to the amount of natural vegetation present and how deep it extends from the bank, and disturbances that may effect the transport of pollutants through the zone. Vegetated buffer zone assessment involves documenting three condition factors: 1) Vegetation Cover Type, 2) Breaks, and 3) Vegetated Zone Width. A break in the buffer zone is an area, which allows sediment or other pollutants to enter directly into the stream. Breaks refer only to the near stream portion of the buffer zone and may or may not extend into the entire buffer zone. Breaks include storm drains, culverts etc. If breaks occur, subtract 1 if moderated and 2 if substantial.

Identify Left and Right Bank Cover Conditions (circle appropriate value)

1 Width of forested vegetated buffer zone >18 meters wide and no man-made activities.

a.	Forest – generally a later successional stage or climax community with a diversity of growth forms including ground cover, vines, and shrubs.	10
b.	Man-made activities include paths, utility lines (pipes, power etc) and other minor disturbances parallel to the creek.	9

2 Width of forested vegetated buffer zone 12 - 18 meters wide. Impacts beyond 18 meters are <50% impervious and predominantly:

a.	Shrub: An earlier successional growth stage on disturbed land, mostly consisting of shrubs & a few trees.	8
b.	Old Field: Any stage of old field succession with herbaceous or shrub species (few if any trees).	7
c.	Planted lawn grass: Includes yards and other landscaped surfaces consisting of mostly lawn grass vegetation such as parks and cemeteries.	6
d.	Pasture/Agricultural: Active pasture consisting of planted grasses and forbes and land for row crops.	5
e.	Forested vegetated buffer zone 12 - 18 meters & impacts beyond 18 meters are >50% Impervious:	4

3 Width of forested vegetated buffer zone 6 - 12 meters wide. Impacts beyond 12 meters are < 25% impervious and predominantly:

a.	Shrub: An earlier successional growth stage on disturbed land, mostly consisting of shrubs & a few trees.	7
b.	Old Field: Any stage of old field succession with herbaceous or shrub species (few if any trees).	6
c.	Planted lawn grass: Includes yards and other landscaped surfaces consisting of mostly lawn grass vegetation such as parks and cemeteries.	5
d.	Pasture/Agricultural: Active pasture consisting of planted grasses and forbes and land for row crops.	4
e.	Forested vegetated buffer zone 6 - 12 meters & impacts beyond 12 meters are >25% Impervious:	3

4 Width of forested vegetated buffer zone 1 - 6 meters wide. Impacts beyond 6 meters are <20% impervious and predominantly:

a.	Shrub: An earlier successional growth stage on disturbed land, mostly consisting of shrubs & a few trees.	5
b.	Old Field: Any stage of old field succession with herbaceous or shrub species (few if any trees).	4
c.	Planted lawn grass: Includes yards and other landscaped surfaces consisting of mostly lawn grass vegetation such as parks and cemeteries.	3
d.	Pasture/Agricultural: Active pasture consisting of planted grasses and forbes and land for row crops.	2
e.	Forested vegetated buffer zone 1-6 meters & impacts beyond 6 meters are >20% Impervious:	1

5 No forested vegetated buffer zone

a.	Shrub: An earlier successional growth stage on disturbed land, mostly consisting of shrubs and a few trees.	4
b.	Old Field: Any stage of old field succession with herbaceous or shrub species (few if any trees).	3
c.	Planted lawn grass: Includes yards and other landscaped surfaces consisting of mostly lawn grass vegetation such as parks and cemeteries.	2
d.	Pasture/Agricultural: Active pasture consisting of planted grasses and forbes and land for row crops.	1
e.	>75% Impervious along creek: Includes parking lots, road, structures etc.	0

Habitat Assessment - Glide/Pool Prevalent Streams

I. Bottom Substrate / Available Cover

Measures substrates that are available as refuge for aquatic organisms. A wide variety and/or abundance of submerged structures in the stream provides macroinvertebrates with a large number of niches, thus increasing the potential diversity. As the variety and abundance of cover decreases, habitat structure becomes monotonous, diversity decreases, and the potential for recovery following disturbance decreases.

Circle habitat types which occur at this site: fallen trees/large woody debris, deep pools, shallow pools, overhanging shrubbery in water, large rocks, undercut banks, thick root mats, dense macrophyte beds, or deep riffles with lots of turbulence (habitat type found in cold-water, mountain streams)

A. Habitat(s) expected for stream type make up >70% of reach

1. 7 habitats common	20
2. 6 habitat types common, additional habitat types rare	19
3. 5 habitat types common, additional habitat types rare	18
4. 4 habitat types common, additional habitat types rare	17
5. Less than 4 habitat types present	16

B. Habitat(s) expected for stream type make up >50% of reach

1. 7 habitats common	15
2. 6 habitat types common, additional habitat types rare	14
3. 5 habitat types common, additional habitat types rare	13
4. 4 habitat types common, additional habitat types rare	12
5. Less than 4 habitat types present	11

C. Habitat(s) expected for stream type make up <50% of reach

a. 7-3 habitats common

1. 7 habitats common	10
2. 6 habitat types common, additional habitat types rare	9
3. 5 habitat types common, additional habitat types rare	8
4. 4 habitat types common, additional habitat types rare	7
5. 3 habitat types common, additional habitat types rare	6

b. 2-0 habitats common

1. 2 habitat types present, additional habitat types rare	5
2. 2 habitat types only and common	4
3. 1 habitat type common, additional habitat types rare	3
4. 1 habitat type only and common	2
5. 1 habitat type rare	1
6. 0 habitat types present	0

II. Pool Substrate Characterization

Evaluates the type and condition of bottom substrates found in pools. Firmer sediments, and material that provides "habitat structure" such as rooted aquatic plants and other organic debris (e.g., snags, leaf packs, sticks, root mats) that support a wider variety of organisms than a pool substrate dominated by mud or bedrock and no plants or no other material (snags, rocks etc.).

A. Mixture of substrate materials, with gravel and firm sand prevalent; habitat structure consists of root mats, organic debris (e.g., snags, leaf packs) or submerged vegetation common.

1. Gravel, and firm sand, >10% habitat structure	20
2. Gravel,>10% habitat structure	19
3. Gravel, <10% habitat structure	18
4. Firm sand, >10% habitat structure	17
5. Firm sand, <10% habitat structure	16

B. Mixture of soft sand, mud, or clay; mud may be dominant; some habitat structure consisting of organic debris, root mats or submerged vegetation present.

1. Firm and soft sand, >10% habitat structure	15
2. Firm and soft sand, <10% habitat structure	l4
3. Soft sand, mud, clay, >10% habitat structure	13
4. Soft sand, mud, clay, <10% habitat structure	12
5. Soft sand/mud, soft sand/clay, or clay/mud, <10% habitat structure	11

C. All mud or clay or sand bottom; little or no root mat; no submerged vegetation. Substrate consists of:

1. All sand bottom with > 10% habitat structure	10
2. All mud bottom with >10% habitat structure	9
3. All clay bottom with >10% habitat structure	8
4. All sand bottom with <10% habitat structure	7
5. All mud or clay bottom with <10% habitat structure	6

D. Hard pan clay or bedrock; with/no appreciable habitat structure

1. All hard pan clay with >10% habitat structure	4
2. All bedrock with >10% habitat structure	3
3. All hard pan clay with <10% habitat structure	1
4. All bedrock with <10% habitat structure	0

III. Pool Variability

Rates overall mixture of pool types according to size and depth thus accommodating a diverse aquatic community consisting of a variety of species and age classes. In rivers with low sinuosity (few bends) and monotonous pool characteristics, very little instream habitat variety exists to support a diverse community. The four basic types of pools are large-shallow, large-deep, small-shallow, and small-deep.

Any pool dimension (e.g., length, width) greater than half the cross-section of the stream is a large pool. Small pools have length and width dimensions less than half the width of the stream. Pool depth is relative to the size of the stream/watershed. The dimensions of a deep and small pools are proportional to the size of the stream and the average depth of stream. Generally deep pools would be at least 2 times the average depth of the streams. "Reaeration" is defined as the oxygen transfer from the atmosphere to the stream. Reaeration points are any areas where the stream surface is disturbed (e.g., dams, water falling over snags or logs or other debris, riffles),

A. All pool sizes (area and depth) present and mixed.

1. All sizes evenly mixed and below areas of reaeration 20
2. All sizes evenly mixed but can be found below and above reaeration areas 18
3. All sizes evenly mixed not below areas of reaeration 16

B. Majority of pools are large-deep; very few shallow.

1. Large and small deep pools evenly mixed and all below areas of reaeration 15
2. Majority of pools are large-deep and below areas of reaeration 14
3. Large and small deep pools evenly mixed and above and below areas of reaeration 13
4. Majority of pools are large-deep and found above and below areas of reaeration 12
5. Majority of pools are large-deep and not below areas of reaeration 11

C. Shallow pools are much more prevalent than deep pools.

1. Large and small shallow pools evenly mixed and all below areas of reaeration 10
2. Majority of pools are large-shallow and below areas of reaeration 9
3. Large and small shallow pools evenly mixed and above and below areas of reaeration 8
4. Majority of pools are large-shallow and found above and below areas of reaeration 7
5. Majority of pools are large-shallow and not below areas of reaeration 6

D. Majority of pools small-shallow or pools absent

1. Majority of pools are small-shallow and all below areas of reaeration 5
2. Majority of pools are small-shallow and above and below reaeration areas 3
3. Majority of pools are small-shallow and all above areas of reaeration 2
4. Pools absent 0

IV. Channel/Bank Alteration

Measurement of large-scale alteration of instream habitat, which affects stream biotic integrity and causes scouring. Channel alteration is present (circle or identify conditions) when: artificial embankments, rip rap, and other forms of artificial bank stabilization or structures are present; when dredging has altered bank stability ; when dams and bridges are present; when banks and channels have been disturbed by livestock, other agricultural practices; or hydrology; and when other changes have occurred (list).

A. Stream follows a normal and natural meandering pattern. Alteration is absent.

1.	No evidence of disturbance with bends and riffle/runs frequent; bend angles average > 60°	20
2.	No evidence of disturbance with bends combination of riffle/runs and glide/pool habitats frequent; bend angles average between 60°- 40°	18
3.	No evidence of disturbance with bends and glide pools prevalent; bend angles average < 40°	16

B. Some minor alterations, dredging, artificial embankments, or dams present but NO evidence of recent alteration activities;mostly recovered and somewhat stable. .

1.	5% of reach has channel disturbance	15
2.	10% of reach or less has channel disturbance	14
3.	20% of reach has channel disturbance	13
4.	30% of reach has channel disturbance	12
5.	40% of reach has channel disturbance	11

C. Somewhat channelized; 40-80% of the area has been straightened, dredged, or otherwise altered.

1.	40% of reach has channel disturbance	10
2.	50% of reach has channel disturbance	9
3.	60% of reach has channel disturbance	8
4.	70% of reach has channel disturbance	7
5.	80% of reach has channel disturbance	6

D. More than 80% of the stream site has been dredged, or otherwise altered; banks most likely box-cut (including natural U-shaped) or rip-rap or no longer have native vegetation; instream habitat highly altered.

1.	90% of reach has channel disturbance	5
2.	Channel reach 100% disturbed; with no artificial embankments	3
3.	Channel reach 100% disturbed; with artificial embankments	2
4.	Channel reach 100% disturbed; with natural and manmade artificial embankments	1
5.	Channel 100% shored by gabion and/or cement	0

V. Sediment Deposition

Relates to the amount of sediment that has accumulated and the changes that have occurred to the stream bottom as a result of deposition. 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. Depositional material comes from the watershed and bank erosion (Barbour and Stribling, 1995). The growth, or appearance of bars/islands where they did not previously exist is an indication of upstream erosion. Sediment bars/islands tend to grow in depth and length with continued watershed disturbance because increased sedimentation results in increased deposition. High levels of sediment deposition create an unstable and continually changing environment that becomes unsuitable for many organisms (FL DEP, 1996).

A. No enlargements of islands/point bars present or less than 20% bottom affected by sand or silt accumulation.

1. No sediment deposition detected; especially in pools	20
2. Less than 20% sediment deposition with accumulation in pools only	18
3. Less than 20% sediment deposition with accumulation in runs and pools	17
4. Less than 20% sediment deposition with few, old, small point bars or islands made up of coarse gravel in stream channel	16

B. 5-50% bottom affected by sand or silt accumulation; slight deposition in pools; some new increase in bar and island formation.

1. 20-30% sediment deposition with gravel and/or sand	15
2. 20-30% sediment deposition with sand and/or silt	14
3. 40-50% sediment deposition with gravel and/or sand	12
4. 40-50% sediment deposition with sand and/or silt	11

C. 50-80% bottom affected with moderate deposition in pools. Number of shallow pools increases. Habitats smothered by sand, silt, and possibly coarse gravel. Deposits of fresh, fine, gravel, sand, and silt observed on old and new point bars, islands, and behind obstructions. Formation of few new bars/islands is evident and old bars are deep and wide; deposition at bends obvious.

1. 50-60% sediment deposition with gravel and/or sand	10
2. 50-60% sediment deposition with sand and/or silt	9
3. 70-80% sediment deposition with gravel and/or sand	7
5. 70-80% sediment deposition with sand and/or silt	6

D. More than 80% bottom affected with heavy deposition from coarse and fine gravel and sand at stream bends, constrictions, and /or pools. Extensive deposits of fine sand and/or silt on old and new bars, islands, and along banks in straight channels. Few pools are present due to siltation. Only larger rocks in riffle areas remain exposed.

1. 80-90% sediment deposition; pools almost absent due to substantial deposition; bottom silt may move with almost any flow above normal	4
2. 90-100% sediment deposition; pools almost absent	2
3. 100% sediment deposition; pools absent due to substantial deposition; bottom silt moves with almost any flow above normal	0

VI. Channel Sinuosity

Measure of meandering or sinuosity. 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.

Divide the distance between bends by the average width of the stream to estimate the run-to-bend ratio. In general, low sinuosity suggests steeper channel gradient, fairly uniform cross section shapes, limited bank cutting, and limited pools. High sinuosity is associated with lower gradients, asymmetrical cross sections, overhanging banks, and bank pools on the outside curves. Channel sinuosity should be determined over a channel reach long enough to make the value meaningful.

Use a distance of 20 times the bankfull width to determine sinuosity.

Sinuosity can best be measured using aerial photography.

A. Occurrence of bends relatively frequent.

1. Run-to-bend ratio = 1-2	20
2. Run-to-bend ratio = 3-4	19
3. Run-to-bend ratio = 5	18
4. Run-to-bend ratio = 6	17
5. Run-to-bend ratio = 7	16

B. Occurrence of bends moderately frequent.

1. Run-to-bend ratio = 8	15
2. Run-to-bend ratio = 10	14
3. Run-to-bend ratio = 11	13
4. Run-to-bend ratio = 13	12
5. Run-to-bend ratio = 15	11

C. Infrequent bends; variable bottom contours may provide some habitat.

1. Run-to-bend ratio = 16	10
2. Run-to-bend ratio = 18	9
3. Run-to-bend ratio = 20	8
4. Run-to-bend ratio = 22	7
5. Run-to-bend ratio = 24	6

D. Essentially a straight and uniform depth stream.

1. Run-to-bend ratio = 25	4
2. Run-to-bend ratio = 30	2
3. Run-to-bend ratio > 30	0

VII. Channel Flow Status

Is the degree to which the channel is filled with water during normal flow periods. The flow status will change as the channel enlarges or as flow decreases as a result of dams and other obstructions, diversions for irrigation, drought, or aggrading stream bottoms with actively widening channels. This is a seasonal parameter. A decrease in water will wet smaller portions of the streambed, thus decreasing available habitat for aquatic organisms. Use the vegetation line on the lower bank as your reference point to estimate channel flow status.

Stretch a tape very tight across the channel. Level and secure tape at the base of both lower banks. This channel cross-section may help the investigator(s) estimate what percentage of the available channel is full.

A. Water reaches the base of both lower banks and minimal amount of channel substrate is exposed (100% channel full) 20
   1. > 95% channel is full 18
   2. 90-95% channel is full 16

B. Water fills > 75% of the available channel (or <25% of channel substrate is exposed)

   1. 90% of channel is full 15
   2. 85% of channel is full 13
   3. 80% of channel is full 11

C. Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed

   1. 75% of channel is full 10
   2. 60-65% of channel is full 9
   3. 50% of channel is full 8
   4. 35-40% of channel is full 7
   5. 25% of channel is full 6

D. Very little water in the channel and mostly present as standing pools

   1. 20% of channel is full 5
   2. 10% of channel is full 4
   3. < 10% of channel is full 3
   4. Water present as isolated standing pools 1
   5. Channel is dry 0

VIII. Bank Vegetative Protection

Measures the amount of the stream bank that is covered by vegetation. 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 those without vegetation protection and those shored up with concrete or riprap.

Four factors to consider when scoring bank vegetative protection: (1) Is the vegetation native or natural or planted and introduced ?; (2) Is the upper story, under story, and ground cover vegetation well balanced?; (3) What is the standing crop biomass?; and (4) During which season are you conducting this assessment?

Determine left or right bank by facing downstream. Score left and right banks separately.

A. Left Bank or Right Bank

1. More than 90% stream bank surfaces is covered by native/natural vegetation. A variety of vegetation present (e.g., trees, shrubs, understory, or nonwoody macrophytes). Any bare or sparsely vegetated areas are small and evenly dispersed.

   a. 100% plant cover on stream bank 10
   b. > 90% plant cover on stream bank 9

2. A variety of vegetation is present and covers 70-90% of stream bank surface, but one class of plants is not well represented. Some open areas with unstable vegetation are present. Disruption evident but not affecting full plant growth potential.

   a. 90% plant cover but one class of plants is not well represented 8
   b. 80% plant cover with a few barren or thin areas present 7
   c. 70% plant cover with a few barren or thin areas present with fewer plant species 6

3. 50-70% of stream bank surface covered by vegetation; typically composed of scattered shrubs, grasses, and forbes. Thin or bare spots visible and/or closely cropped vegetation with less that ½ plant stubble height remaining.

   a. 70% vegetation cover; typically of shrubs, grasses, and 5
   b. 60% vegetation cover; typically of shrubs, grasses, and forbes 4
   c. 50% vegetation cover; typically of shrubs, grasses, and forbes 3

4. Less than 50% stream bank surface covered by vegetation; 2 inches or less in average stubble height remaining. Any shrubs or trees on bank exist as individuals or widely scattered clumps.

   a. 40% vegetation cover with many bare spots/rock 2
   b. 20% vegetation cover with m. any bare spots/rock 1
   c. No vegetation cover on stream bank 0

IX. Bank Stability

Measures the existence of, or the potential for detachment of soil from the upper and lower stream banks and its movement into the stream. 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. Reinforcement of banks via rocks, artificial or natural, provides stability.

Determine left or right bank by facing downstream. Score left and right banks separately.

A. Left Bank or Right Bank

1. Bank stable; erosion absent or minimal. Side slopes are generally less than 30% and are stable. Bank may be reinforced by rock thus increasing slope >30% while providing stability.

a. No evidence of erosion or bank failure	10
b. Less than 5% bank affected by erosion	9

2. Moderately stable bank; small areas of erosion or bank slumping visible. Most areas are stable with only slight potential for erosion at flood stages. Side slopes up to 40% on one bank. Bank may be reinforced by rock thus increasing slope > 40% while providing stability.

a. 5% bank has erosional areas	8
b. 15% bank has erosional areas	7
c. 30% bank has erosional areas	6

3. Moderately unstable bank; frequency and size of raw areas are such that high water events have eroded some areas of the bank. Medium size areas of erosion or bank slumping visible. Side slopes up to 60% on some of the bank. High erosion potential during floods.

a. 40% - 50% bank has erosional areas	5
b. 50% - 60% bank has erosional areas	4
c. 60% - 70% bank has erosional areas	3

4. Unstable bank; mass erosion and bank failure is evident; erosion and pronounced undercutting present at bends and along some straight channel areas. Side slopes > 60% are common. Many raw areas present and 60-100% bank has erosional scars.

a. 70% - 80% bank has erosional areas.	2
b. 80% - 90% bank has erosional areas	1
c. > 90% stream bank has eroded	0

X. Vegetation Buffer Zone Width

Measures the width and conditions of the vegetation or land use from the edge of the upper stream bank out through, and in some cases, beyond the flood plain and riparian zone. The vegetative zone serves as a buffer to pollutants entering a stream from runoff, and minimizes erosion. Far less useful buffer zones occur when roads, parking lots, fields, heavily used paths, lawns, bare soil, rocks, or buildings are near the bank. .

Determine left or right bank by facing downstream. Score left and right banks separately.

When evaluating this parameter, walk around in the buffer area paying close attention to the amount of natural vegetation present and how deep it extends from the bank, and disturbances that may effect the transport of pollutants through the zone. Vegetated buffer zone assessment involves documenting three condition factors: 1) Vegetation Cover Type, 2) Breaks, and 3) Vegetated Zone Width. A break in the buffer zone is an area, which allows sediment or other pollutants to enter directly into the stream. Breaks refer only to the near stream portion of the buffer zone and may or may not extend into the entire buffer zone. Breaks include storm drains, culverts etc. If breaks occur, subtract 1 if moderated and 2 if substantial.

Identify Left and Right Bank Cover Conditions (circle appropriate value)

1 Width of forested vegetated buffer zone >18 meters wide and no man-made activities.

a.	Forest – generally a later successional stage or climax community with a diversity of growth forms including ground cover, vines, and shrubs.	10
b	Man-made activities include paths, utility lines (pipes, power etc) and other minor disturbances parallel to the creek.	9

2 Width of forested vegetated buffer zone 12 - 18 meters wide. Impacts beyond 18 meters are <50% impervious and predominantly:

a.	Shrub: An earlier successional growth stage on disturbed land, mostly consisting of shrubs & a few trees.	8
b.	Old Field: Any stage of old field succession with herbaceous or shrub species (few if any trees).	7
c.	Planted lawn grass: Includes yards and other landscaped surfaces consisting of mostly lawn grass vegetation such as parks and cemeteries.	6
d.	Pasture/Agricultural: Active pasture consisting of planted grasses and forbes and land for row crops.	5
e.	Forested vegetated buffer zone 12 - 18 meters & impacts beyond 18 meters are >50% Impervious:	4

3 Width of forested vegetated buffer zone 6 - 12 meters wide. Impacts beyond 12 meters are < 25% impervious and predominantly:

a.	Shrub: An earlier successional growth stage on disturbed land, mostly consisting of shrubs & a few trees.	7
b.	Old Field: Any stage of old field succession with herbaceous or shrub species (few if any trees).	6
c.	Planted lawn grass: Includes yards and other landscaped surfaces consisting of mostly lawn grass vegetation such as parks and cemeteries.	5
d.	Pasture/Agricultural: Active pasture consisting of planted grasses and forbes and land for row crops.	4
e.	Forested vegetated buffer zone 6 - 12 meters & impacts beyond 12 meters are >25% Impervious:	3

4 Width of forested vegetated buffer zone 1 - 6 meters wide. Impacts beyond 6 meters are <20% impervious and predominantly:

a.	Shrub: An earlier successional growth stage on disturbed land, mostly consisting of shrubs & a few trees.	5
b.	Old Field: Any stage of old field succession with herbaceous or shrub species (few if any trees).	4
c.	Planted lawn grass: Includes yards and other landscaped surfaces consisting of mostly lawn grass vegetation such as parks and cemeteries.	3
d.	Pasture/Agricultural: Active pasture consisting of planted grasses and forbes and land for row crops.	2
e.	Forested vegetated buffer zone 1-6 meters & impacts beyond 6 meters are >20% Impervious:	1

5 No forested vegetated buffer zone

a.	Shrub: An earlier successional growth stage on disturbed land, mostly consisting of shrubs and a few trees.	4
b.	Old Field: Any stage of old field succession with herbaceous or shrub species (few if any trees).	3
c.	Planted lawn grass: Includes yards and other landscaped surfaces consisting of mostly lawn grass vegetation such as parks and cemeteries.	2
d.	Pasture/Agricultural: Active pasture consisting of planted grasses and forbes and land for row crops.	1
e.	>75% Impervious along creek: Includes parking lots, road, structures etc.	0

Infrastructure Inventory

The infrastructure inventory is identifying and characterizing the following items: pipes, ditches, dump sites, head cuts, utility lines, obstructions, deficient buffer vegetation, erosional areas, and road and other stream crossings.

When an inventory item is identified, note it on the appropriate inventory form, with the requested information, mark it on the map with the Inventory ID (see below), and if appropriate, take a photo, and log the photo on the inventory form and the photo log. All lengths and measurements are visual estimates unless specified otherwise.

Assign impact scores to each inventory item according to the criteria listed on the bottom of each inventory form. The field forms are provided in Appendix B.

Naming Conventions for Inventory Lists – use same number for GIS Maps

(Stream code)(Reach ##).(inventory initial)(list number)

Example of Stream Codes:	Deep Run	DRC
	Fourmile Creek	FMC
Inventory initial:	Pipe	P
	Ditch	D
	Dump	M
	Head Cut	H
	Utility	U
	Obstruction	T
	Buffer	B
	Erosion	E
	Crossing	C

Example: FMC02.D04 is Fourmile Creek, Reach #2, 4th ditch (or the 4th ditch in the second reach of Fourmile Creek)

Pipes and Ditches

Pipes and ditches are recorded on the same form. They are differentiated by the inventory ID (P for pipes or D for ditches). If a pipe discharges into a ditch some distance from the channel, record it as a pipe and record the ditch width and distance from the channel in addition to the pipe characteristics. Record all pipes or ditches that are causing an impact. Record the following information.

Pipe or Ditch ID	According to naming convention.
Bank	Record bank from which pipe or ditch discharges. If the pipe is at the top of a channel, circle both.
Photo #	
Average Ditch Width	(Ditches Only) in feet
Pipe Diameter	(Pipes Only) in inches.
Distance from Channel	(Pipes Only) Distance from end of pipe to water surface in feet.

Type of Pipe	(Pipes Only) Pipe material Polyvinyl chloride (PVC) (heavy plastic), Reinforced Concrete (RCP), Corrugated metal (CMP), High Density PolyEthylene (HDPE) (thin black plastic), Iron, Clay, or Other.
Type of Discharge	If no discharge is present record if the pipe appears to be a stormwater pipe or roof drain. If discharge is present record if it appears to be sewage or some other type of illicit discharge. If the pipe or ditch is an intake pipe, record as Intake.
Discharge Quality	If there is evidence of significant sediments from erosion in the watershed record silty stormwater runoff. Otherwise if discharge is present, record as Clear, Oil Slick, Oil Sheen, or Iron Flocculent.
Source of Discharge	If discharge quality is poor and source is evident, record source.
Erosion	(Ditches Only) None, Minor, Moderate or Major. An indication of erosion within the ditch
Impact Score	0-10. An indication of impacts the pipe or ditch has on the channel. See form for scoring details.

Obstruction

Record all obstructions that are causing erosion problems or are causing flooding of manmade structures. Also record all beaver dams (impact score = 0 unless significant bank damage is evident). Record the following information.

Obstruction ID	According to naming convention.
Photo #	
Type	Material Causing Obstruction.
Impact Score	0-10. An indication of impacts the obstruction has on the channel. See form for scoring details.

Dump Sites

Record all areas where inappropriate materials have been disposed. Record the presence of cows or other domestic animals in the stream as a dump site. Record grass clippings, leaf piles, or other organic debris piles as a dump site only if it is in the stream. Record the following information.

Dump Site ID	According to naming convention.
Bank	Record bank on which materials have been dumped. If the dump site is in the stream or on both banks circle both.
Photo #	
Location	In the stream, on the banks, or in the floodplain
Description of Materials	
Impact Score	0-10. An indication of impacts the dump site has on the channel. See form for scoring details.

Head Cuts

Record only those head cuts that appear to be active. Do not record sites where bed rock or other grade control points have arrested the headcut. Record the following information.

Head Cut ID	According to naming convention.
Photo #	
Height	In feet.
Impact Score	0-10. An indication of impacts the head cut has on the channel. See form for scoring details.

Utility

Record all utility lines that are exposed. Only record manholes if they are impacting the channel. Record the following information.

Utility ID	According to naming convention.
Bank	Record bank along which utility line runs. If the utility line crosses the stream circle both.
Photo #	
Size	In inches. Approximate diameter of pipe. MH if manhole.
Type	Identify type of utility if known.
Description	Location of utility line, with respect to the channel.
Impact Score	0-10. An indication of impacts the utility line has on the channel. See form for scoring details.

Buffer

Record all buffer areas that are not forested. Record the following information.

Buffer ID	According to naming convention.
Bank	Record bank along which buffer is deficient. If deficient buffer runs along both banks record them separately.
Photo #	
Linear Feet	Length along the stream of deficient buffer, in feet.
Buffer Type	Identify type of landuse buffering the stream. Forbes are thick non-woody vegetation.
Impact Score	0-10. An indication of impacts the deficient buffer has on the channel. See form for scoring details.
Buffer Restoration Candidate	Identify buffer restoration potential based on the following criteria: • Apparent property ownership (e.g. public property has good potential) • Relative location of structures • Ease of access

Erosion

Record all active erosion problems rated as moderate (2 to 3 feet high) or worse. Record the following information.

Bank Erosion ID	According to naming convention.
Bank	Record bank which is eroded. If erosion runs along both banks record them separately.
Photo #	
Eroded Bank Height	Height, in feet, of erosional area above water surface.
Linear Feet	Length of erosion along the stream, in feet.

Impact Score	0-10. An indication of impacts the erosion has on the channel. See form for scoring details.
Restoration Potential	Identify the restoration potential associated with the erosional area based on the following criteria: • Ease of access • Benefit of restoration project • Minimizing number of property easements necessary.

Road and Other Crossing

Record all stream crossings, including foot and vehicle bridges and man made fords. Record structural integrity and upstream and downstream conditions Record the following information.

Crossing ID	According to naming convention.
Photo #	
Crossing Type	Type of culvert or bridge.
Conveyance Material	Material at invert (concrete, natural channel).
Number of Barrels	Number of culvert barrels or number of openings under a bridge.
Width or Diameter of Barrel	In feet. Width or diameter of individual barrel or opening.
Height of Barrel	In feet. Blank if round.
Conveyance Length	In feet.
Upstream and Downstream Conditions	Indication of impacts at the upstream and downstream end of the culvert. Rated None, Low, Medium, High.
Debris	Debris obstructing the openings.
Sediment	Sediment in the culvert or creating islands and bars around the openings.
Bank Erosion	
Bed Erosion	Erosion cutting below the culvert invert. Estimate depth of erosion from the invert where present.
Structure Condition	Indication of cracking, rusting, or otherwise deteriorating structural integrity.
Impact Score	0-10. An indication of impacts the erosion has on the channel. See form for scoring details.

Offline Wetland Potential

Offline wetlands are a potential management practice that can be used to improve stormwater quality. Water would be diverted out of the stream channel into the floodplain where a treatment wetland would be constructed. The opportunity occasionally exists near stream crossings where access is good and flows can more easily be diverted. Record locations near crossings where the buffer area could be converted to a wetland without significant impact and where stream banks are relatively low, allowing flows to be diverted easily. Record the following information if a site is identified:

Crossing ID	Crossing to which the wetland would be connected.
Photo #	
Bank Height	In feet.
Bank Slope	Slope of the stream bank, in ft/ft.

Length Length of potential wetland area, in feet.
Width Width of potential wetland area, in feet.

Stream Characteristics

Stream characteristics protocols capture general reach information and visual observations. The field forms are provided in Appendix C. The form is self explanatory, with the following exceptions.

- **Stream Restoration Candidate**
  - **N/A**—Stream is in good condition OR is still stabilizing and is not currently threatening other land uses/properties.
  - **Major**—Good candidate for stream restoration pilot project.
  - **Minor**—Minor bank stabilization would be appropriate to protect adjacent properties from future problems.
- **Stream Assessment**—Identify if the habitat assessment was conducted. A site may be eliminated from assessment for the following reasons:
  - **Wetland**—The forms are not responsive to wetlands.
  - **No access**—Property owner will not allow access on their property.
  - **Dangerous conditions**—Safety is always first.
  - **Pond/lake**—The forms are not responsive to impounded water.
  - **No flow**—Flow must be present for the habitat assessment.
  - **Too deep**—The majority of the steam must be wadable.
- **Infrastructure Assessment**—Identify if the infrastructure inventory was conducted. A site may be eliminated from assessment for the following reasons:
  - **Wetland**—Only if foot travel is significantly hindered.
  - **No Access**—Property owner would not allow access on their property.
  - **Dangerous conditions**—Safety is always first.
  - **Pond/Lake**—Only if foot travel is significantly hindered.
  - **Too Deep**—Only if foot travel along the banks is hindered.
- **Water Appearance**—Can be a physical indicator of water pollution. Be sure you are checking the water color and not picking up an apparent water color due to the underlying sediments.
- **Water Odor**—Can be a physical indicator of water pollution.
  - **Sewage**—May indicate the release of human waste material.
  - **Chlorine**—May indicate over chlorinated sewage treatment/water treatment plant or swimming pool discharges.
  - **Fishy**—May indicate the presence of excessive algal growth or dead fish.
  - **Rotten eggs**—May indicate sewage pollution (or the presence of a natural gas).

- **Sediment Odors**—Same categories as water.
- **Fish**—Are fish present in the stream? Fish can indicate that the stream is of sufficient quality for other organisms. Macroinvertebrates will also generally be found somewhere in a stream with fish.
- **Aquatic Plants**—Aquatic plants vary greatly. They may be floating, submerged, emergent, or rooted and have true leaves, stems, and roots. Aquatic plants can help to stabilize the bottom sediments of a stream and provide food and habitat for aquatic organisms.
- **Algae**—Algae are simple plants that do not grow true roots, stems, or leaves and that mainly live in water, providing food for the food chain. Algae may also be seen growing on the surface of substrate material. Algae naturally occurs in green and brown colors. Excessive algal growth may indicate excessive nutrients (organic matter or a pollutant such as lawn fertilizer).

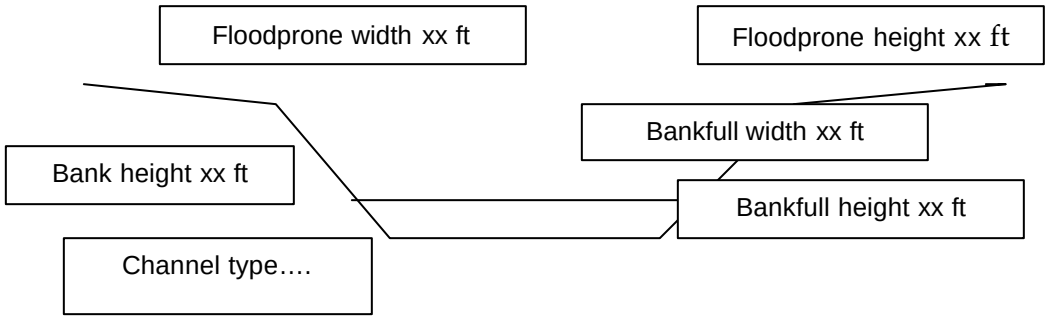
Geomorphic Classification of Stream Type

The field assessment protocols include qualitative assessment and identification of the stream type, measurements and calculations to confirm, and mapping the stream type for each reach. The Level 1 approach is intended to identify the potential number of stream types within a broad area .

Qualitative Assessment and Measurements of Stream Type

During the stream field surveys, a morphological assessment of the channel will be visually assessed and qualitative bankfull assessments will be made throughout the reach representing the typical channel conditions. The following procedures will be followed:

1. At the beginning of the reach, make a visual assessment of the stream type based on the observed morphological characteristics. This qualitative estimate will include bankfull height (see bankfull identification procedures below) and width, flood prone height and width, and bankfull cross sectional area. These estimates will be used to calculate approximate entrenchment and width to depth ratios. The visual assessment along with these calculations will be used to identify the preliminary stream type at that point.
2. Include a sketch of the channel shape and estimate shape on the field map near the point of the assessment (see example below).



3. Additional visual assessments will be made periodically at the discretion of the field team leader as the field assessment continues through the reach. The field team leader will identify a representative section of the reach being evaluated to make a bankfull measurement.

Bankfull Measurement

Bankfull measurements will be collected at one or two points in each reach type identified in the visual assessment. There are several visual or physical indicators of bankfull stage. A partial listing follows:

- The floodplain elevation of incipient flooding
- Top of depositional features (i.e., point bars, sediment, wrack lines)
- A break in slope of the banks/and or a change in particle size distribution
- Small benches
- Staining of rocks and trees
- Exposed root hairs below and intact soil layer
- Lichens
- Riparian vegetation

1. At a riffle or run, flag the bankfull stage indicators (there may be more than one bankfull stage) upstream and downstream for a distance of at least 20 times the bankfull width. One of the most consistent bankfull indicator appears to be the uppermost scour line. Other bankfull indicators include the back of a point bar, the upper break in slope of the bank, and occasionally the top of the bank. Often, there is another prominent feature known as the inner berm. The U.S. Army Corps of Engineers refers to the inner berm as the mean high water mark. This feature is usually identified as a scour line or small bench halfway between the low flow water surface and the bankfull stage (Harman, 2000). See Figure 3 below for potential inner berm features.

2. Estimate the difference between the bankfull indicator and the current water surface along the study reach. The variability of this difference should not be more than 6 inches.

3. Pull a tape from the left to the right bankfull indicator (cross section). Measure the depth to the channel bed at three equally spaced locations. One measurement should include the thalweg elevation (see Figure 4).

4. Record all measurements on field form and complete remaining information as specified (see attached).

5. Calculate the cross-sectional area (average depth of three measurements times bankfull width: $d_{bkf} \times W_{bkf}$).

6. Calculate the entrenchment ratio (width of the floodprone area divided by the width at the bankfull stage: Wfpa/Wbkf).

7. For the watershed area compare the field estimated bankfull cross sectional area to the area on the regional curve for that stream's hydrophysiographic region (piedmont of Maryland, North Carolina and Georgia). If it is close to the regression line and the

FIGURE 3. Examples of the Inner Berm and Bankfull Indicators (Harman, 2000)

2a. Mills River Gage, Henderson County, C4 stream type. The break in slope at the lower bench is the inner berm (IB). Bankfull (BKF) is the upper scour line.

2b. Rocky Branch, Wake County, G4/F4 stream type. This stream is actively building a new floodplain. The front of the bench is the inner berm and bankfull is the back of the bench.

Figure 2c. South Fork Mitchell River, Surry County, C4/E4 stream type. Bankfull is rarely the top of a point bar. However, in cases where there is an excessive upstream sediment supply, a point bar will build to bankfull as shown in this photograph. The inner berm is the lower bench.

Figure 2d. Horniny Creek, Wilson County, E5 stream type. Bankfull is the break in slope near the top of the bank. Notice the deposition on the floodplain. The inner berm is the lower bench inside the channel.

FIGURE 4. Pulling a Tape from the Left to the Right Bankfull Indicator

feature is consistent for 20 bankfull widths, then this feature is (most likely) the bankfull stage.

8. If the measured bankfull cross sectional area is not near the regression line, the following steps will be taken:

    A. Recheck calculations.

    B. If the point is below the line, make sure that the feature is not the inner berm or another anomaly. Typically, the inner berm has roughly half the cross sectional area as bankfull. Look for other features above the inner berm, such as an upper scour line or break in slope that are consistent for a longer distance upstream and downstream of the cross section.

The field forms are provided in Appendix D.

Data Collection

Identifying a Reach

A habitat assessment form and a stream characteristic form are filled out for each stream reach. Inventory items are also assigned to a specific reach through use of the inventory naming convention.

To identify and assess a reach boundary, start at downstream end. As you walk upstream, do the following:

1. Identify reach number
2. Fill out inventory forms
3. Mark-up maps with inventory IDs
4. Identify a representative cross section and take measurements
5. Take photos as required and log them on the photo log
6. Take notes on habitat information, as needed
7. Walk upstream until one of the following occurs:
    - Predominant glide-pool changes to predominant riffle-run or vice-versa
    - Stream characteristics change significantly (e.g., downcut channel vs. naturally shaped channel)
    - Change in hydrogeomorphic stream type (e.g., narrow G channel to a widened F channel)
    - Buffer changes dramatically (e.g., forested to mostly residential)
    - Encounter a confluences with a major tributary
8. At that point, stop, mark the end of the reach and fill out stream characteristics and habitat forms for the reach.

Marking the Reach

1. Locate the reaches being evaluated as accurately as possible on the GIS base maps. Use the planimetric information on the GIS maps to help identify the location.

2. In the field, identify and mark both ends of a reach with tree tags.

Forms to be Filled out for Each Reach

The following forms need to be filled out for each reach. Each form is discussed further in later sections.

- Inventory Forms as needed—Pipe/Drainage Ditch; Obstructions; Dump Sites/Head Cuts; Utility Lines; Deficient Buffers; Erosion Problems, Road Crossings
- Channel Cross Section Form
- Stream Characteristics Form
- Habitat Form (Glide-Pool or Riffle-Run)
- Photo log
- Markup of GIS Maps

Photo Log

All photos should be logged on this form. Photos should be taken of the following:

- Downstream end of reach looking upstream
- Upstream end of reach looking downstream

Each **problem** area that is entered on the inventory sheets, **not** all inventory items – the inventory sheets identify which ones to photograph.

Mark-up of GIS Maps

Each team will have a set of GIS maps. Note ends of reaches and all inventory items on this map. Points will be digitized off this map, so mark the points and the ID numbers as clearly as possible.

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Appendix A
Habitat Assessment Field Forms

Appendix B
Infrastructure Inventory Field Forms

Appendix C
Stream Characteristics Field Forms

Appendix D
Geomorphic Classification Field Forms