

Field Guide

Riparian Area Management Multiple Indicator Monitoring (MIM) of Stream Channels and Streamside Vegetation

TECHNICAL REFERENCE 1737-23
April 2011

Timothy A. Burton, Fisheries Biologist/Hydrologist
Retired USDI Bureau of Land Management/USDA Forest Service

Steven J. Smith, Team Leader and Rangeland/Riparian Specialist,
National Riparian Service Team, USDI Bureau of Land Management

Ervin R. Cowley, Range Management/Riparian Specialist
Retired USDI Bureau of Land Management

This field guide provides the rules used to locate the greenline, and monitor indicators. It is intended to be carried in the field and used to maintain consistent application of the rules. **The field guide should only be used after gaining a knowledge of the Technical Reference and appropriate training.** The Technical Reference provides detailed information concerning the monitoring protocols and examples of various conditions that may be encountered.

10. Residual Pool Depth and Pool Frequency:

Step 1. Identify the Riffle Crest: Starting at the downstream marker of the DMA, proceed upstream and identify the first riffle crest (pool tail). The riffle crest is best identified when viewed from downstream and is the upstream end of shallow, rippling water where it exits or spills from a pool. To be classified as a pool it must be at least as wide as one-half the wetted width of the stream (small pocket pools are not counted). The distance from the lower marker in the DMA to the first riffle crest is not measured. An effective technique is to have one individual wade in advance of the observer to sense the maximum or thalweg depths of the channel.

Step 2. Determine the Thalweg Depth of the Riffle Crest: The observer measures and records the thalweg depth. The depth measurement is made in the thalweg or deepest part of the channel in the stream cross section.

Step 3. Measure the Distance from the Riffle Crest to Pool Bottom and the Pool Bottom Depth: Proceed upstream into the pool bottom (the deepest point in the pool) and record the distance from the riffle crest to the pool bottom. The pool should occupy at least one-half of the stream width. The depth of the pool at the deepest point is also measured and recorded. Continue measuring and recording both the distance between riffle crests and pool bottoms and the depth of each at the thalweg until reaching the top of the DMA. When a riffle crest is within the DMA and the pool bottom is beyond the upstream DMA marker, measure and record the riffle crest depth, the distance to the pool bottom and the pool bottom depth of the pool upstream of the upper marker.

Rules to Establish the Greenline Location

The greenline is a linear grouping of live perennial vascular plants, embedded rock, or anchored wood above the waterline on or near the water's edge (adapted from Winward 2000). It often forms a relatively continuous line of perennial vegetation adjacent to the stream (Cagney 1993). However, the greenline can also be patches of vegetation on sandbars and other areas where new vegetation is growing. Individual linear groupings are considered part of the greenline when they meet the rules described in this chapter. The greenline can also be composed partially or entirely of embedded rock and/or anchored wood. The greenline is commonly located at the edge of the floodplain or at the lip of the first bench above the water line. Entrenched streams, the greenline may be located above the floodplain on a terrace (Winward 2000). In these cases, the greenline may include, or be limited to, nonhydic species, i.e., upland species. See appendix A for greenline examples.

Greenline Rules:

a. Perennial Herbaceous Vegetation, Shrub/Tree Seedlings, Embedded Rock, Anchored Wood: The greenline can be comprised of any combination of perennial herbaceous vegetation, shrub/tree seedlings, embedded rock, or anchored wood provided that there are **no patches of bare ground (rocks smaller than 15 cm are considered bare ground), litter, or nonvascular plants greater than 10 by 10 cm within the plot:**

1) Perennial Herbaceous Vegetation, Shrub/Tree Seedlings: There must be at least 25 percent foliar cover of live perennial herbaceous vegetation and/or shrub/tree seedlings rooted in the plot. Foliar cover (live plant parts, stems, and leaves over the ground) is the shadow cast if the sun was directly overhead. Small openings in the canopy or overlap within the plant are excluded. Shrub and tree seedlings are defined as woody plants less than 0.5 m tall.

2) Embedded Rock: The greenline may include rock that is at least 15 cm in diameter and at least partially embedded in the streambank with no evidence of erosion behind it, talus slopes, and bedrock. **Rock must be above the scour line and not in the active channel** (see appendix A, figures A20 and A21).

3) Anchored Wood: The greenline may include logs or root wads that are anchored into the streambank and large enough such that high flows are not likely to move them. There should be no evidence of erosion behind them. **Wood must be above the scour line and not in the active channel** (see appendix A, figures A21 and A22).

b. Overstory (Young and/or Mature Shrubs or Trees): If young or mature woody plants are located closer to the water's edge than qualifying perennial herbaceous vegetation, rock, or wood (as described above), the greenline is located at the base of young or mature shrubs or trees as shown in figure 6. Young and mature shrubs and trees are defined as woody plants at least 0.5 m tall. Foliar cover of young and mature shrubs and trees is not considered for identifying the greenline. When there is no understory beneath the shrub/tree canopy, the greenline is located at the rooted base of the shrubs or trees or beneath the shrub/tree canopy along a simulated line connecting the rooted base of adjacent shrubs and/or trees roughly parallel to the stream (see figures 7 and 8 and appendix A, figures A10 and A11).

c. Exposed Roots: Exposed live shrub or tree roots above the scour line of the stream are part of the greenline (see appendix A, figure A16).

d. Flooded Greenline: Avoid sampling when the greenline is flooded during high streamflow (see appendix A, figure A12).

e. Perennial Vegetation Growing in Water: Some perennial vegetation, e.g., spike rush, sedges, rushes, or willows, may grow in the margins of the stream and in slow backwaters or even inside the wetted channel at seasonal low flow. When this occurs, **the greenline will be at the edge of the water** (see appendix A, figures A13 and A14).

f. Plants Occupying the Entire Wetted Channel: For dewatered channels and channels with very low flows, if the vegetation occupies the entire width of the channel, **the greenline is at the deepest part of the channel** (see figure A15).

g. Floating Plant Species: Some species that commonly float on or are submerged in the water have minimal root systems and are *not* part of the greenline. These species may include, but are not limited to, whorlgrass or brookgrass (*Catabrosa aquatica*), white water crowfoot (*Ranunculus aquatilis*), watercress (*Rorippa nasturtiumaquaticum*), American speedwell (*Veronica americana*), water knotweed (*Polygonum amphibium*), and other species that have similar rooting characteristics (see appendix A, figures A17, A18, and A19). **NOTE:** When whorlgrass or brookgrass (*Catabrosa aquatica*) is rooted above the water level on the streambank above seasonal low waterflow, it is considered part of the greenline and should be recorded in the greenline vegetation composition.

h. Detached Blocks of Vegetation: Blocks of vegetation detached from the streambanks (slump blocks) are not the greenline. When deep-rooted hydric vegetation covers the block from the water's edge to the terrace wall, creating a new floodplain (false bank), the greenline is the edge of the vegetation along the stream (see appendix A, figures A23, A24, and A25). To be detached or separated from the bank, a block or section of streambank must have slipped down or broken away from the bank wall so that there is less than 25 percent foliar cover of perennial vegetation in the area between the block and the bank wall.

i. Islands: Islands are defined as areas surrounded by water at summer low flow or bounded by a channel that is scoured frequently enough to keep perennial vegetation from growing. **The greenline follows the outside channel on each side of the island and does not cross onto an island** (see appendix A, figures A26, A27, and A28).

j. No Greenline Present: When the greenline is not present within **6 m from the water's edge**, the greenline is considered absent at that plot (NG is recorded in the vegetation composition column in the Data Entry Module or on the MIM Field Data Sheet shown in appendix B). The monitoring frame is then placed on the edge of the first bench above the waterline, and the other indicators are read (e.g., streambank alteration, streambank stability, etc.). If there is no bench present, the frame is placed at the position on the streambank 6 m from the water's edge, and the other appropriate indicators are read (see appendix A, figure A29). In instances where the waterlines are less than 6 m apart due to the presence of a sharp meander bend with a peninsula between them, and the greenline rules cannot be met between the waterlines, the frame is placed at the top of the peninsula.

9. Substrate:

Beginning with the second plot in the survey, samples are collected at every other plot location (or 20 total transects), evenly spaced along the entire length of the DMA. Transects are located at even numbered plots, from plot 2 to plot 40, in the upstream direction of the survey only. Collect and measure the diameter of 10 pebbles at each transect. Samples should be collected within the active channel only. Never sample a particle above the scour line. Depositional features (e.g., point bars) that are not covered by vegetation and located below the scour line are considered streambed material and should be included in the sample.

Step 1. Determine the Interval Length to Obtain 10 Particles in the Cross Section: Use a measuring rod or tape stretched across the stream at the plot location. Divide the width of the active channel by 10 (the active channel is located between the scour lines of the stream). Alternatively, if a measuring rod or tape is not used, count the number of heel-to-toe steps across the active channel width, divide by 10, and collect samples at each division. For very small streams, collect five samples on each of two crossings (i.e., cross once, move upstream 0.5 m, then cross again).

Step 2. Determine the First Sample Location and Begin Sampling Particles: Start the cross channel transect at one-half the interval length, and then collect all subsequent particles at the full interval length. For example, if the width of the active channel at the sample location is 5 m, the sample interval is 0.5 m and the first sample is collected at 0.25 m from the scour line. All subsequent samples are collected at 0.5-m intervals, and the last sample, or particle number 10, should be approximately 0.25 m from the scour line on the opposite side of the channel. The observer locates the sample interval, places the index finger at that point, and without looking at the streambed, reaches into the stream and obtains the first particle in the substrate that touches the index finger. Sample the entire streambed width at each transect. If pacing, measure to the starting point (i.e., 0.25 m as above) with the rod, collect the first sample there, and then pace at approximately 0.5-m intervals from that location to the other sample points across the channel.

Step 3. Measure the Diameter of Samples Collected: Place the particle in the smallest slot in the template through which it will pass, or if a template is not used, measure the middle width (intermediate or "B" axis) of the particle in millimeters. Visualize the B axis as the smallest width of a square hole that the particle could pass through. A template is an excellent tool for measuring particle sizes and is highly recommended to reduce subjectivity in selecting and measuring the B axis. If a small particle falls into the fines category, is touched in between larger particles, and the observer is unable to collect it, the particle size can be estimated (i.e., <6 mm).

Spacing between particles must be greater than the largest particle within the cross section to avoid double sampling of the same particle, which may bias the sample or cause serial correlation towards larger particles. If it is not possible to obtain 10 particles in one pass, move upstream 0.5 m (or at least a distance to avoid the same boulders), and use the sampling interval estimated as the channel width divided by the remaining number of particles. More than two passes may be required for some small streams.

8. Greenline-to-Greenline Width (GGW):

Step 1. Measure the Distance between the Greenlines on Each Side of the Stream and Perpendicular to the Waterflow at Each Plot Location: Using a laser rangefinder is the most expedient way of measuring the distance but may be difficult in woody vegetation. A rangefinder reduces the time required to do the measurements by about two-thirds. Other less expensive options include using measuring rods and tape measures. Measure from the greenline associated with the center bar on the monitoring frame (near the toe of the boot) (see appendix A, figure A1), to the greenline on the opposite side of the stream. The measurement is usually taken from only one side of the stream. If there is an inadequate number of samples, measurements may be taken from the opposite side of the stream. Measure the width to the nearest 0.1 meter.

Step 2. Subtract Vegetated Island Measurements: When a vegetated island (with at least 25 percent foliar cover) is encountered along the line, determine the total distance between the greenlines and deduct the length of the vegetated portion of the island to determine the nonvegetated GGW (see appendix G, figures G1, G3, and G5). Nonvegetated islands are included in the GGW measurement even if they consist of embedded rock or anchored wood (see appendix G, figure G5, line A).

NOTE: Do not measure GGW when no greenline (NG) is recorded. Leave the MIM Field Data Sheet (or electronic data entry) blank.

1. Stubble Height:

Step 1. Determine Key Species: An interdisciplinary team should select the key species, as defined earlier, prior to monitoring. Deeper rooted plants, such as hydric species, are preferred because of their contributions to stability. If palatable hydric graminoids are severely lacking or absent, palatable mesic graminoids are chosen. Measure the stubble height of each key species occurring within the monitoring frame. More than one key species may be used if necessary.

Step 2. Select Plants: After placing the frame, select the key species that occur nearest the handle of the frame (figure 11). Most riparian key species grow tightly together, forming dense mats with little distinct separation of individual plants. As a result, the sampling method uses a 3-inch-diameter circle of the vegetation for a single species (figure 12). When the key species does not occur in a mat near the handle of the frame but as an individual plant or several individual plants less than 3 inches in diameter, select the key species plant within the plot that is nearest the handle (see figure 13). Measure the average height of all the leaves of the plant(s). When a key species does not occur within the quadrat, **leave the cell blank** (on the MIM Field Data Sheet or in the Data Entry Module).

Step 3. Measure Key Species: Using the frame handle (or a ruler) with 1-inch (or 2-cm) increments, measure the average leaf length of the vegetation within the circle (figure 11 and 13) and round it to the nearest inch (or 2 cm). Grazed and ungrazed leaves are measured from the ground surface to the top of the remaining leaves. All leaves within the circle should be lifted to determine their length. Account for very short leaves as well as tall leaves. **Do not measure seed stalks (culms).** Determining the "average" residual vegetation height will take some practice. Be sure to include all of the key species' leaves within the sample. The easiest method of doing this is to grasp the sample, stand the leaves upright, and then measure the average height (figure 12).

2. Streambank Alteration:

Step 1. Locate the Intercept Lines: This procedure uses the entire 42- by 50-cm monitoring frame. Five lines are projected across the frame perpendicularly to the center bar of the frame (figure 14).

Step 2. Count the Lines that Intercept Alteration: Look down at the entire frame and determine the number of lines within the plot that intersect streambank alteration (see appendix D). The streambank is considered altered when:

- Streambanks are covered with vegetation and have hoofprints that depress the soil and expose bare soil at least 13 mm deep (measured from the top of the displaced soil to the bottom of the hoof impression).
- Streambanks exhibit broken vegetation cover resulting from animals walking along the streambank that have a hoofprint at least 13 mm deep.
- Streambanks have compacted soil caused by animals repeatedly walking over the same area even though the animals' hooves sink into and/or displace the soil less than 13 mm.

Step 3. Record the Number of Lines that Intersect Streambank Alteration:

Record only one occurrence of alteration, trampling, or shearing per line. **Record only the current year’s streambank disturbance—disturbance features that are obvious (old features tend to be nondistinct).** Follow these guidelines when determining which number to record:

- When there is a vertical or near-vertical wall, pace in the stream or along the greenline on top of the terrace, and place the center of the frame along the greenline. Record only direct alteration occurring on the vertical wall (hoof on the streambank, and/or at the base of the vertical wall as viewed down the slope within the plot (see appendix D, figure D5).
- Hoofprints or trampling on streambanks with fully developed, deep-rooted hydric vegetation (e.g., *Carex* spp., *Juncus* spp., and *Salix* spp.) is not recorded as alteration unless plant roots or bare soil is exposed. Hoof shearing along the streambank is considered alteration.
- Compacted livestock trails on or crossing the greenline, that are the obvious result of the current season’s use, are counted as trampling (see appendix D, figure D3).
- When there is no greenline identified within 6 m from the water’s edge and “NG” (no greenline) is recorded, the frame is placed on the first slope break (bench) above the waterline for measuring the streambank alteration (and other appropriate indicators). If no bench is present, place the frame at the position on the streambank 6 m from the water’s edge.

This process is repeated at the predetermined interval on each side of the stream.

7. Woody Species Age Class:

Step 1. Determine Plot Placement: The woody species plot is 0.42 m wide by 2 m long (1 m on each side of the greenline), with the frame placed perpendicular to the greenline as shown in figure 17. Place the frame end-to-end on each side of the greenline so that the entire 2 m are sampled.

Step 2. Distinguish Individual Plants:

It is sometimes difficult to distinguish individual plants from one another when shrubs have multiple stems close together. In such cases, consider all stems within 0.3 m of each other at ground level as the same plant and record the age class of the entire shrub to which that stem is connected, even if part of the shrub is outside of the plot. The presence of even one stem within the frame requires the observer to determine if that stem is connected to others outside of the frame.

Step 3. Determine Age Class: Place the end of the monitoring frame on and perpendicular to the greenline, and determine the age class (see tables 10 and 11) of each woody plant by species **rooted** within the monitoring frame. Record the number of all woody plants by species according to their age class. Do not count woody species overstory not rooted within the frame.

Step 4. Record Woody Root Sprouting and Rhizomatous Species: It is difficult to age class rhizomatous and root sprouting species such as coyote willow (*S. exigua*), wild rose (*Rosa* spp.), snowberry (*Symphoricarpos* spp.), cottonwood root sprouting (*Populus* spp.) and golden currant (*Ribes aureum*), etc.; therefore, if root sprouting and rhizomatous species occur in the plot, record a 1 in the rhizomatous column.

Step 5. Record Low-Growing Shrubs: Some low-growing shrubs are considered mature when they are less than 0.5 m tall. etc. When a question arises, use the plant growth form descriptions in the literature to determine the appropriate age class.

Table 10. Woody Species Age Class for Single-Stemmed Species [e.g., birch (*Betula* spp.), alder (*Alnus* spp.), and cottonwood or aspen (*Populus* spp.)]

Age Class	Single Stem Species
Seedling	Stem is <1 m tall or <2.5 cm in diameter at 50% of height from ground level.
Young	Stem is >1 m tall and 2.5 cm to 7.6 cm in diameter at 50% of height from ground level.
Mature	Stem is > 1 m tall and >7.6 cm in diameter at 50% of height from ground level.

Table 11. Multistemmed (Clumpy) Woody Species Age Class (e.g., most willows, alder, and birch)

Age class	Stems and Height
Seedling	1 stem <0.5 cm in diameter at the base and <0.5 m tall.
Young	2 to 10 stems less than 1 m tall or 1 stem >0.5 cm in diameter at the base and less than 1 m tall
Mature	>10 stems over 1 m tall

3) Is the streambank stable? This applies to erosional banks only. For depositional banks, leave this cell blank. The Data Entry and Analysis Modules allow only one code in each cell, so the observer records "Fracture," "Slump," "Slough," "Eroding," or "Absent" for the single most prominent feature:

- **Fracture (F):** This applies to the top of the bank where a visible crack is observed. The fracture has not separated into two separate components or blocks of a bank. Cracks indicate a high risk of breakdown. **The fracture feature must be at least one-fourth of a frame length.**
- **Slump (S):** This applies to a streambank that has obviously slipped down resulting in a separate block of soil/sod separated from the bank. **The slump feature must be obvious and at least one-fourth of a frame length.**
- **Slough or "Sluff" (SL):** This applies to banks where soil or sod material has been shed or cast off and has fallen from and accumulated near the base of the bank. "Slough" typically occurs on banks that are steep and bare. **The slough must be obvious and at least one-fourth of a frame length.** Slumps and sloughs may be created by excessive animal trampling (see appendix E, figures E8 and E9).
- **Eroding (E):** This applies to banks that are bare and steep (within 10 degrees of vertical), usually located on the outside curves of meander bends in the stream. Undercut banks are scoured or eroded below the elevation of the base of sod or the roots of vegetation, and because such erosion occurs mostly below the scour line, it is not considered "eroding" bank. Such undercut banks are stable as long as there is no slough, slump, fracture, and/or erosion above the scour line or ceiling of the undercut bank. **The erosion feature must be obvious and at least one-fourth of a frame length.**

3. Woody Species Use:

Step 1. Establish the Plot Size: Woody species use is observed within a plot 2 m wide (1 m on each side of the greenline) by the length of the interval between quadrats (figure 15). It is helpful to use the measuring rod or handle of the frame to determine if a plant is rooted within the plot.

Step 2. Determine the Available Current Year's Growth: Available woody species are plants having more than one-half (50 percent) of the current year's leaders within reach of the grazing animal. When the first plant has more than 50 percent of the current year's leaders above the reach of the grazing animal, the shrub is considered unavailable for grazing and the plant is not considered for woody species use. The observer(s) would only consider key woody plants that have most of their current year's leaders below 1.5 meters. Woody plants with over 50 percent of the current year's leaders above 5 feet are considered unavailable for cattle.

Step 3. Evaluate the Closest Plant: Observer(s) evaluate the first available key woody plants rooted within the plot for grazing use (see figure 15). If the first plant of a species is not available, go to the next closest plant within the plot. Common key woody species include most species of willow, alder, birch, dogwood, cottonwood, and aspen. If no key woody plants are encountered within the plot, leave the cell in the MIM Field Data Sheet blank.

Step 4. Determine the Woody Species Use Class: Plants are classified into a "use class" (see table 2). These use class descriptions are the standards by which use is judged. This process is repeated for each key woody species within the plot. Review grazing class descriptions periodically while reading the plots to maintain precision and accuracy. Record by species the midpoint (see table 2) for the appropriate use class.

Step 3. Evaluate the Closest Plant: Observer(s) evaluate the first available key woody plants rooted within the plot for grazing use (see figure 15). If the first plant of a species is not available, go to the next closest plant within the plot. Common key woody species include most species of willow, alder, birch, dogwood, cottonwood, and aspen. If no key woody plants are encountered within the plot, leave the cell in the MIM Field Data Sheet blank.

Step 4. Determine the Woody Species Use Class: Plants are classified into a "use class" (see table 2). These use class descriptions are the standards by which use is judged. This process is repeated for each key woody species within the plot. Review grazing class descriptions periodically while reading the plots to maintain precision and accuracy. Record by species the midpoint (see table 2) for the appropriate use class.

Table 2. Woody Species Use Classes and Descriptions (adapted from the landscape appearance method, USDI, BLM 1999b)

Class	Midpoint	Description
Unavailable	Blank	Shrubs and trees that have most (over 50%) of their actively growing stems over 1.5 m (5 feet) tall for cattle grazing. This should be adjusted if the questions to be answered involve other herbivores (see table 1).
Slight (0%-20%)	10	Browse plants appear to have little or no use. Available leaders may show some use, but 20% or less of the current year's leaders have use.
Light (21%-40%)	30	There is obvious evidence of use of the current year's leaders. The available leaders appear cropped or browsed in patches and 60%-79% of the available current year's leaders of browse plants remain intact.
Moderate (41%-60%)	50	Browse plants appear rather uniformly used and 40%-59% of the available current year's leaders remain intact.
Heavy (61%-80%)	70	The use of the browse gives the general appearance of complete search by grazing animals. Most available leaders are used and some terminal buds remain on browse plants. Between 20% and 39% of the available current year's leaders remain intact.
Severe (81%-100%)	90	The use of the browse gives the appearance of complete search by grazing animals. There is grazing use on second and third years' leader growth. Plants show a club-like appearance, indicating that most active leaders have been removed. Only between 0% and 19% of the current year's leaders remain intact.

6. Streambank Stability and Cover:

Step 1. Determine Streambank Location: Streambanks are defined as that part of the channel between the scour line and the edge of the first relatively flat bench above the scour line. The figures in appendix E provide examples of streambank locations.

Step 2. Observe Factors Influencing Stability on the Streambanks Associated with the Frame: The plot (area observed for streambank stability) extends parallel to the stream a distance of one frame length (50 cm) and perpendicular to the stream between the scour line and the lip of the first bench. Typical scour line indicators are the elevation of the ceiling of undercut banks at or slightly above the summer low-flow elevation or, on depositional banks, the lower limit of sod-forming or perennial vegetation. The lip of the first bench is at the point on the bench where the slope changes from the relatively flat top to the slope toward the stream.

Step 3. Answer the Following Questions: Each of the following questions is answered with a letter abbreviation (such as "D" for depositional). One set of questions is answered for the streambank associated with each plot location and the answers are entered into columns F, G, and H of the "DMA" worksheet in the Data Entry Module or on the MIM Field Data Sheet (appendix B, part 2).

1) What kind of streambank is it? The choices are "Depositional" or "Erosional":

- **Depositional (D):** This applies to all streambanks associated with sand, silt, clay, or gravel deposited by the stream. These are recognizable as "bars" in the channel margins adjacent to the greenline and at or above the scour line. Stream bars are typically lenticular-shaped mounds of deposition on the bed of the stream channel adjacent to or on the streambank. Depositional streambanks are usually at a low angle from the water surface and are not associated with a bench.
- **Erosional (E):** This applies to all banks that are not "Depositional." Erosional streambanks are normally at a steep angle to the water surface and are usually associated with a bench and/or terrace. Such banks typically occur on the outside of meander bends and on both sides of the stream in straight reaches. When there is sufficient stream energy, they may also occur on the inside bank of a meander bend.

2) Is the streambank covered? The choices are "Covered" or "Uncovered":

- **Covered (C):** This applies to banks with at least 50 percent foliar cover of perennial vegetation (including roots); at least 50 percent cover of rocks 15 cm or larger; at least 50 percent cover of anchored large woody debris (LWD) with a diameter of 10 cm or greater; or a combination of the vegetation, rock, and/ or LWD covering at least 50 percent of the bank area (50 cm wide from the scour line to the first bench).
- **Uncovered (U):** This applies to all banks that are not "Covered."

5. Woody Species Height Class:

Record the height class of each woody species plant with cover over the plot using the ranges from PIBO-EM (2008) as shown in table 8. Record the tallest height class (inside or outside the plot) of an individual with at least some cover over the plot. For example, if a willow has one branch hanging over the plot at 1 m above the ground, yet when looking at the entire plant, it is 3 m high at its tallest point, record class 4 (2.01 to 4 m). When multiple layers of woody plants occur over the plot, record the height class for each woody species listed in the greenline composition.

Table 8. Woody Species Height Class (PIBO-EM 2008)

Height Class	Height Range
1	0 – 0.5 m
2	0.51 – 1 m
3	1.01 – 2 m
4	2.01 – 4 m
5	4.01 – 8 m
6	> 8 m

4. Greenline Composition:

Step 1. Develop a Species List: Prior to collecting vegetation data on the greenline, it is critical for observers to identify the plant species located on the site. Complete a reconnaissance of the site to identify and make a list of all vascular plant species that may occur along the greenline before sampling the plants.

Step 2. Record Herbaceous Vascular Plants (Perennial): Viewing from directly above the plot at 90 degrees to the ground surface, record by species the relative amount of foliar cover for herbaceous plants rooted in the plot having 10 percent or more foliar cover by composition. The monitoring frame is marked to provide references for 10-, 25-, and 50-percent areal extent (see figure 16). For example, if a plot contains 25 percent foliar cover of Nebraska sedge and 25 percent cover of Kentucky bluegrass with 50 percent bare ground, the observer would record compositions of 50 percent Nebraska sedge and 50 percent Kentucky bluegrass. Embedded rock and anchored wood compositions would also reflect their relative contributions to cover. For example, if a plot contained 25 percent foliar cover of Nebraska sedge, 25 percent cover of Kentucky bluegrass, 25 percent bare ground, and 25 percent embedded rock, the relative compositions would be 33 percent Nebraska sedge, 33 percent Kentucky bluegrass, and 33 percent embedded rock. Nothing is recorded for bare ground, litter, or nonvascular plants. The total for all understory combinations (herbaceous plants, and/or embedded rock and/or wood, and/or woody plant seedlings) must not exceed 100 percent.

Step 3. Record Woody Species Understory: Seedling woody plants, as defined in tables 10 and 11 in the "Woody Species Age Class" section, are not considered overstory and are recorded as percent foliar cover by composition along with the understory herbaceous vegetation.

Step 4. Record Woody Species Overstory: Overstory includes all young and/or mature woody plant species, as defined in tables 10 and 11 in the "Woody Species Age Class" section, either rooted in or overhanging the plot. Woody plants overhanging the plot must be rooted on the side of the stream being sampled. Do not record plants that are rooted on the opposite bank. Foliar cover is not used for woody species overstory composition. If any part of a woody plant occurs in the overstory directly above the plot, it is counted as part of the composition. The observer does not attempt to estimate its relative cover but records 100 percent if there is one species in the overstory, 50 percent for each if there are two species in the overstory, 33 percent for each if there are three species in the overstory, and so forth.

Step 5. Record Embedded Rock and Anchored Wood: Rock that is at least 15 cm in diameter and at least partially embedded in the streambank with no evidence of erosion behind it, talus slopes, and bedrock and/or logs or root wads that are anchored into the streambank and large enough such that high flows are not likely to move them are considered. Record the percentage of the total of understory vegetation, rock, and/or wood.

Step 6. Record Grouped Plants: To the extent possible, all plants with 10 percent or more foliar cover should be identified by species. When individual plant species are less than 10 percent, but together comprise at least 10 percent of the foliar cover, they may be combined into groups, such as mesic forbs (MFE for early seral and MFL for late seral) or mesic graminoids (MG), dry shrubs (DS) or dry grass (DG), sedge (CAREXRH for rhizomatous and CAREXTF for tufted), and rush (JUNCUS).

Step 7. Record Important Plants with Less Than 10 Percent Foliar Cover: Do not record any plant species with less than 10 percent foliar cover in the data entry form. Any important plants, such as noxious weeds or rare plants, may be recorded in the comments sheet by plot number.

Step 8. Record No Greenline Cover: When no greenline cover exists (i.e., vegetation, embedded rock, or wood) within 6 m of the water's edge, record "NG." The Data Analysis Module uses values of bare ground, early ecological status, and a greenline streambank stability rating of "0."