Vegetation Monitoring Protocol for the Upper Missouri River in the Upper Missouri River Breaks National Monument

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Upper Missouri River Breaks National Monument

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Introduction

This monitoring protocol is an expansion and modification of Technical Reference 1737-23 "Multiple Indicator Monitoring (MIM) of Stream Channels and Streamside Vegetation" (Burton et al. 2011) for application on riparian areas along the Upper Missouri River (UMR) in the Upper Missouri River Breaks National Monument (UMRBNM). From hereafter in this document, 1737-23 will be referred to as "the MIM protocol." This modified protocol was created as a result of input and decisions made by the following state and local Bureau of Land Management (BLM), National Riparian Service Team (NRST), and United States Geological Survey (USGS) representatives during a monitoring design meeting held in the spring of 2011:

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Steve Smith (Team Leader & Rangeland/Riparian Specialist, NRST, BLM)
Mike Philbin (Hydrologist, Montana State Office, BLM)
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The first draft of this protocol was developed in 2011. Field testing was completed in both 2011 and 2012 which led to some useful refinements.

An effective monitoring approach must answer key questions regarding the condition and trend of resource attributes and what effect management may be having on those attributes. The primary intent of this monitoring protocol is to help address questions at the site (allotment) scale; however, most of these questions also apply to the reach scale. Among these questions are:

1) What are the woody species size classes and are they recruiting where they are expected?
2) What are the use levels (livestock and wildlife) on both woody and herbaceous vegetation and what effect are use levels having on those communities?
3) What is the composition of the plant communities on the riverbank and how are they being affected by management?

Due to the unique nature of the Upper Missouri River, the design group determined that a customized monitoring approach is needed and should be based on, to the extent possible, currently approved and tested BLM monitoring protocols. The MIM protocol met this requirement. In addition, for consistency and simplicity, the team concluded that the monitoring approach should employ the same basic procedure at each site or Designated Monitoring Area (DMA); and should have enough instructional detail so that the procedures can be implemented by most field practitioners. These considerations are built into this protocol.

Although the MIM protocol was designed for and tested on small stream systems (usually less than 10 meters wide), with some modifications, several procedures described in MIM can be used to obtain meaningful data on large river systems such as the UMR. For application on the Upper Missouri River, it was necessary to modify the DMA configuration and layout of the transects (each DMA on the UMR only includes one riverbank or side of the river) and slightly alter some of the rules for data collection. In addition, a procedure for monitoring ice and beaver damage to woody plants was added. Not all of the procedures in the MIM protocol are appropriate for the Missouri River; due to the size of the UMR and the active nature of the fluvial processes of the river, streambank alteration, streambank stability and cover, greenline-to-greenline width, substrate, and residual pool depth and pool frequency are all inappropriate for the UMR.

This document is intended to be a companion to the MIM protocol. Although this field guide provides stand-alone instructions for establishing DMAs and recording data, it does not include all of the detail contained in the MIM technical reference.

The MIM protocol has considerably more information regarding the purpose and background of the indicators, statistics, data analysis information, and other details. Therefore, this document must be used in concert with the MIM protocol described in the technical reference. In addition, for data collection and analysis, customized (Excel) electronic data entry and data analysis modules were built for this application.

Stratification of Complexes

Stage-Discharge Zones

Three stage-discharge zones were identified along the UMR for the Proper Functioning Condition (PFC) assessment completed in 2010 (Krause et al. 2012). These zones are used to help define the four riparian complex types that comprise the monitoring stratification approach.

Zone 1 (Bank Zone) - from the scour line (the lower limit of sod-forming or perennial vegetation on depositional banks) to bankfull discharge (the stream discharge generally considered to be the single discharge that is most effective for moving sediment, forming or removing bars, and forming or changing bends and meanders, all of which result in the average morphological characteristics of channels). Bankfull on the Upper Missouri River roughly coincides with the 2-year return interval discharge.

Zone 2 (Lower Flood Zone) - from bankfull to approximately the 20-year return-interval discharge. This intermediate zone is between the frequently wetted area along the river and upland areas found on older, more elevated river terraces. This zone is dominated by plants that are equally likely to occur in wetlands or non-wetlands.

Zone 3 (Upper Flood Zone) – from approximately the 20-year return interval discharge to the uplands. This zone is very infrequently flooded but may contain relic riparian species such as mature cottonwoods that were established at lower elevations before the surface was elevated through sediment accretion.

Complex Types

For the purposes of monitoring, the river was stratified into 4 riparian complex types. These 4 riparian complex types occur as repeating sequences of individual sub-areas or subsections along the length of the river and include:

A. Confined, steep banked reaches with little or no riparian vegetation (figure 1).

B. Confined, moderately steep banked reaches with a narrow band of riparian vegetation. Zones 1 and 2 are ≤20 meters wide (figure 2).

C. Confined, moderately steep to gently sloping banked reaches with a narrow band of riparian vegetation. Zones 1 and 2 are ≥20 meters wide (figure 3).

D. Unconfined reaches associated with tributary junctions and abandoned back channels. Zones 1 and 2 are ≥ 20 meters wide (figure 4).

Complexes A and B are subject to frequent disturbances from water, ice, and sediment deposition/scour. These areas are so frequently disturbed by fluvial processes that detecting changes in streamside zones because of changes in management would be problematic; in addition, complexes A and B have limited potential for developing riparian habitat. Complexes C and D have the highest potential for riparian vegetation development, will exhibit detectable changes that can be linked to management impacts (primarily livestock and wildlife grazing/browsing), and are consistently used by livestock and wildlife. **For these reasons, only complex types C and D will be sampled. Individual complex sub-areas must be at least 125 meters in length to be considered for the establishment of a DMA.** Individual sub-areas that are less than 125 meters long are considered inclusions of the adjacent larger complex.

Because of their unique nature and limited distribution, some tributary junctions and most of the abandoned back channels in the "D" complex type will only be Critical DMAs (*not representative* of a larger area but important enough that specific information is needed to evaluate the site). Some "D" complex types could be used as Reference DMAs for other "D" complex types within the same geomorphic reach of the UMR. For example, a "D" complex type within an exclosure could be used as a Reference DMA for a "D" complex type available for use by livestock within the same reach. However, this should only be done with careful consideration and evaluation of the sites by the interdisciplinary (ID) team.

Figure 1. Example of the “A” complex type.

Figure 2. Example of the “B” complex type.

Figure 3. Example of the "C" complex type.

Figure 4. Example of the "D" complex type.

Sampling Approach

Although the stage-discharge zones are useful for stratification purposes and because different riparian plant communities generally correspond to these distinct riverbank/flood zones, sampling exclusively in the center of each zone is problematic as some sites have multiple plant communities within a single zone in the C and D complex types. In addition, frequent erosional/depositional events in these complex types can make it difficult to clearly identify the zones. Because the intent of this approach is to monitor how these distinct communities may be changing over time and they are easy to identify in the field, sampling will focus on "communities of interest" regardless of the zone they occupy. Because zone 3 is not as sensitive to management as zones 1 and 2 (due to a lack of riparian-wetland plant communities), zone 3 will not be sampled with this protocol (qualitative monitoring will be done in Zone 3).

Relatively homogenous plant communities along the UMR occupy unique and distinct moisture zones associated with elevation surfaces and distances to the river (that are oriented roughly parallel to the river channel). Because these relatively homogenous plant communities respond differently to management, and because it is important to obtain an adequate number of samples within a homogenous community in order to characterize its condition and trend, longitudinal transects oriented parallel to the river will be nested within each distinct plant community. Sampling across multiple moisture zones and plant communities as is typically done with vegetation cross sections, does not provide the necessary information to accurately characterize a distinct riparian community. Therefore, one of the transects will be located 1 meter above the river scour line and the others are centered within the distinct plant communities of interest affected by management. Sampling 1 meter above the scour line places this "streambank transect" within the well-established dense, perennial streambank vegetation and also allows woody age class data to be collected slightly above the active channel (as opposed to sampling within the active channel).

The greenline location used as the datum for monitoring vegetation in the MIM protocol was not used for the UMR because it would result in sampling within the active channel. This area is so frequently disturbed that sampling would regularly occur in a shifting zone of colonizing riparian-wetland plants that is little affected by management.

DMA Establishment and Transect Layout

Critical, representative, and reference DMAs will be established by an ID team in accordance with the DMA selection process in the MIM protocol. Once DMAs are selected, the ID team should document the process used to stratify reaches and select the DMAs.

Practitioners should set up the DMAs and transect layout as described below for all sites. Although there may be instances where this configuration may need to be slightly modified for very unique sites, users are encouraged to make every effort to maintain this configuration and avoid modifying the set-up, layout, or sampling procedures. This is important to avoid future data inconsistencies. If the configuration is modified, the same "blueprint" approach should be used and a layout sketch should reflect the modification.

Step 1: Randomly locate the complex sub-area and DMA in accordance with the MIM protocol (Burton et al. 2011, pp. 5-9): This can be generated in the office with GIS and validated in the field by the ID team. If previously established monitoring sites correspond closely to the selected DMA, use established monitoring site for the DMA. Proceed to the selected complex sub-area and establish the DMA. Establishing DMAs and sampling vegetation should be done after annual high flows have receded. **Individual complex sub-areas must be at least 125 meters in length to be considered for the establishment of a DMA.**

Step 2: Collectively identify the river scour line with the monitoring team. The commonly used definition for the scour line of a stream was modified slightly for the UMR and is as follows: *The lowest <u>consistent</u> limit of dense, sod forming perennial vegetation or the ceiling of undercut banks along straight reaches. On the UMR, the scour line is generally associated with the highest extent of aquatic emergents, horsetail (equisetum spp.), spike-rush (eleocharis spp.), or other pioneering communities (see photos in appendix A). This also generally corresponds to the lowest extent of sedges, bulrushes, and sometimes sandbar willow.* To identify the scour line, it is helpful to look up and down the reach to find a consistent line from which to extrapolate.

Step 3: Establish and Permanently Mark the DMA in accordance with the following instructions (see figures 6 and 7):

a. At the downstream end (bottom) of the DMA, locate a reference stake identifying the bottom of the DMA/start of the transects. The reference stakes will be located at the top of the river terrace in zone 3 in a location where zones 1 and 2 are visible (if possible). Permanently monument the reference location and place a pin flag (or flagging) at the reference stake so this marker remains visible for the photos.

b. From the downstream end (bottom) reference stake, **set the compass declination at zero (0)** and take a compass bearing (azimuth) perpendicular to the valley bottom looking towards the river. If the DMA is not in a campground, it is useful to place a permanent alignment stake 2 meters behind the reference monument to help align the downstream end of the transects.

c. Along this compass bearing, **locate the center of each plant community of interest** (within zones 1 and 2) and place a pin flag (or flagging) at those locations identifying the head marker or starting point of each transect (T2 and T3). The distinct plant communities separate themselves reasonably well moving away from the river and are usually not difficult to locate (figure 5). Much of the bank zone along the UMR is dominated by obligate and facultative-wet herbaceous plants (three-square bulrush, wooly sedge, hardstem bulrush, and others). Moving away from the river, communities of sandbar, peachleaf, and yellow willow and cottonwood occur in greater abundance. Although these species often occur in the same community, commonly, one or more of these woody species is more dominant than the others in a given community (the plant community name is based on the dominant plant species which distinguishes it from other communities).

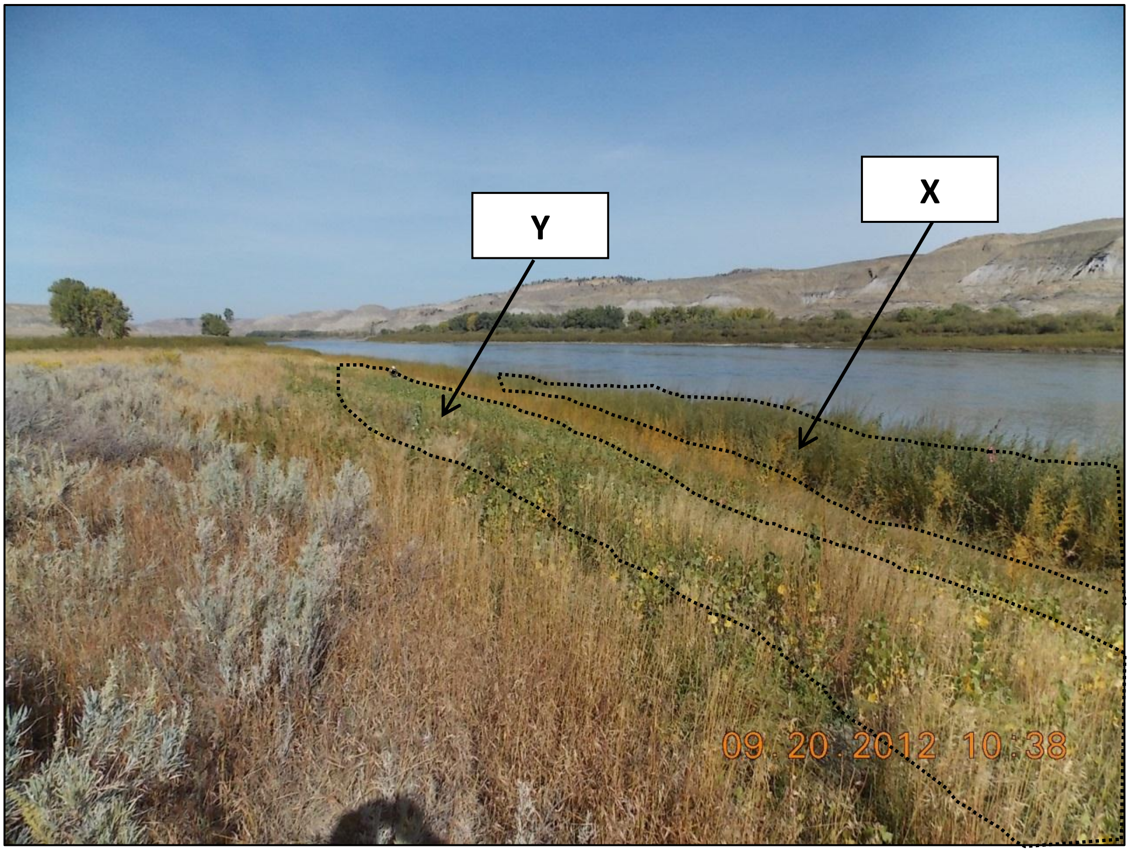

Figure 5. Homogenous plant communities along the UMR. Plant community X is dominated by sandbar willow and plant community Y is dominated by plains cottonwood (seedlings). Transects are centered in and longitudinally oriented in these distinct plant communities (exception is transect 1, which is always located 1-m from the scour line).

d. Locate transect 1 (T1) 1 meter above the scour line or water level (whichever is highest). T1 samples the streambank zone and will always be at 1 meter above the scour line/water level – additional transects are numbered in sequence from T1 up the bank (e.g. T2 may be in the sandbar willow community and T3 in the cottonwood). **"C" complex types will generally only have one plant community above the bank zone and therefore will only have 2 transects (T1 and T2) (figure 6). "D" complex types will often have 3 transects as more than one plant community often occurs above the bank zone (figure 7).**

Modification for laying out and sampling abandoned back channels: T1 will be sampled along the mainstem of the river as described above. Because the communities of interest are often located adjacent to the back channel instead of the mainstem of the river, T2 will often need to be placed adjacent to and in close proximity to the backchannel.

No permanent markers will be placed on the transects as they will be nearly impossible to find in the future due to erosional/depositional processes.

e. From the bottom marker pin flag (or flagging) for T2, measure or pace upstream **100 meters while remaining in the center of the plant community to be sampled.** Place a pin flag (or flagging) in the center of the identified plant community establishing the end marker or top of transect 2. Occasionally, T2 may be very close to T1 and the end markers may actually converge on some sites due to the curvature of the river bank.

f. Proceed to the river terrace and, using a compass, establish the top reference stake perpendicular to the valley bottom in a straight line alignment with the top of T2. Locate T1 and T3 (if used). Transects do not need to be precisely parallel to each other; orientation is established after top and bottom markers are located in the center of the plant community. Ensure that T1, T2, and T3 are in the center of each plant community of interest and aligned with the top reference stake, Install the reference monument and alignment stake (if used) and place a pin flag or flagging at the reference stake.

g. Use rigid stakes and install a tag line from the stake locations at the bottom of T2 to the top of T2 – stretch tight (repeat for T3 if installed). These will serve as the transect alignment for T2 and T3.

h. GPS both the bottom and top reference stakes and measure the **horizontal distances** from the reference stake to the transect head markers using a tape or laser rangefinder. Record the GPS coordinates, the distances to the transect head markers, and the compass bearing on the data entry header form.

i. <u>Note:</u> This configuration will result in T1 always being longer than T2 and T3 because T1 follows the sinuosity of the channel. This will result in T1 having more samples than T2 and T3.

j. Ensure that all information is entered into the header form in the Data Entry module including a short narrative of the DMA selection process and description of the plant communities of interest selected for sampling.

k. <u>Take Photographs:</u> After the DMA markers are placed, photographs should be taken before data are collected because the monitoring process may result in some visible disturbance to the site. **At a minimum**, take photographs at the following locations:

- One overview photo of DMA from a high point if possible (try to frame entire DMA).
- From both the downstream and upstream reference stakes: 1 photo looking towards the river along the compass bearing where the transect markers are located.
- **Each transect:** 6 photos, 3 each from the top and 3 from the bottom. From both the top and bottom - 1 photo looking up/down the transect, 1 towards the river and 1 looking away from the river – both oriented along the compass bearing where the transect markers are placed.

Relocating an Established DMA:

a. Using maps, photographs, and a GPS, locate the DMA and both the top and bottom reference stakes and mark with a pin flag (or flagging) (ensure that previous photos and data sets are present when rereading the transects).

b. Using the photos, the established compass bearing (zero declination), and a laser rangefinder, repeat the sequence of locating T2/T3 in the center of the plant communities to be sampled and T1 1 meter above the scour line/water level and place pin flags (or flagging) at the top and bottom of T1 and T2. Record the horizontal distances from the reference stakes to the transect head and end markers. Note: Because T1 will always be sampled 1 m from the scour line and T2/T3 always sampled in the center of the plant communities of interest, the distances from the reference stake to the transect locations may have shifted due to erosional/depositional processes. If this occurs, make a note in the comment field in the DMA header (e.g. "2012 study: T2 was 8.5 m from the reference stake and T1 was 12.2 m from the reference stake. In 2016, distances changed to 9.7 to T2 and 13.9 to T1. This indicates that the river banks and flood zones have shifted.

c. Use rigid stakes and install the tag line from the bottom of T2/T3 to the top of T2/T3 as before.

d. Take Photographs: If reading trend (repeating all of the long-term procedures), retake the same photo sequence as done for prior readings. **If only reading stubble height and/or woody species use, not all photos need to be repeated. In those instances, photos looking up and down each transect should be taken along with a few close-up photos to demonstrate use intensity.**

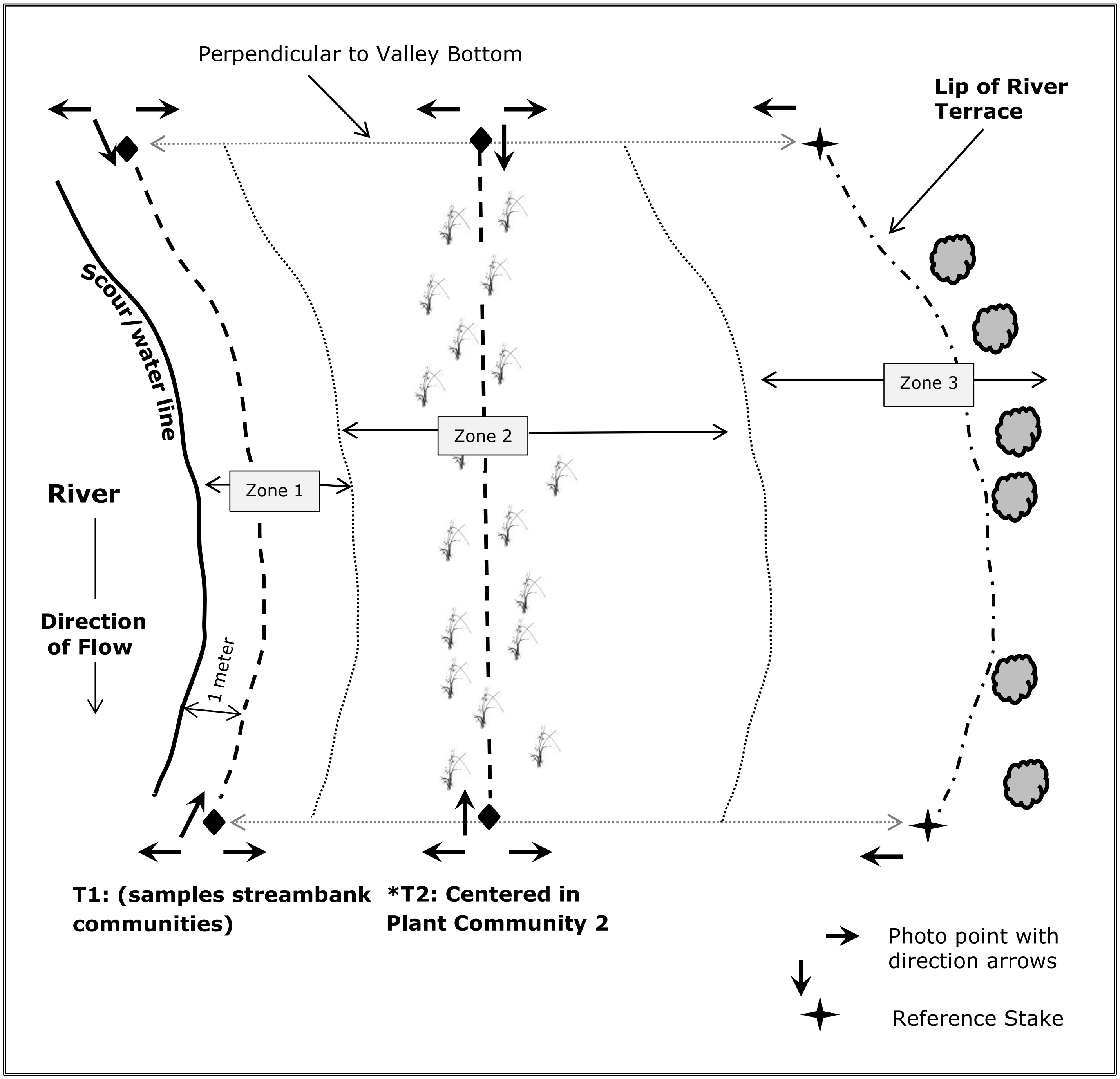

Figure 6. DMA Configuration (C Complex Types). Transects do not need to correspond to zones. Zones are displayed for reference only.

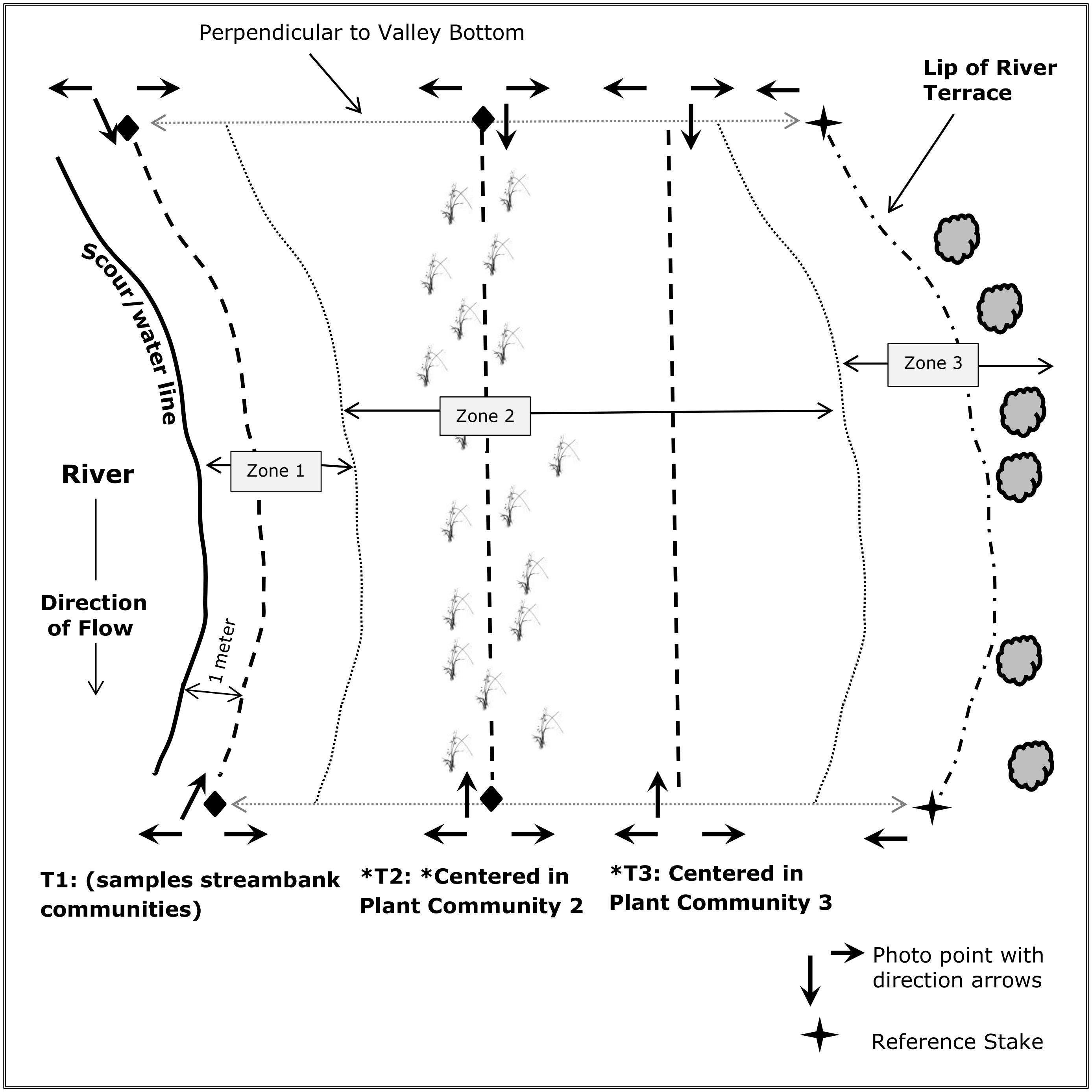

Figure 7. DMA Configuration (D Complex Types). Transects do not need to correspond to zones. Zones are displayed for reference only. **Transects do not need to be precisely parallel to each other as shown. The exact orientation is established after top and bottom markers are *located in the center of the plant community.***

Sampling Procedure

Step 1. Develop a Species List: Prior to data collection, do a reconnaissance of the vegetation within the DMA and record species and species codes, which may be found in the Data Entry Module. If the code is not in the Data Entry Module, use the official plant codes in the PLANTS Database (USDA, Natural Resources Conservation Service 2010). Collect plants for identification if not known in the field.

Step 2. Measure the Sampling Interval: The sampling interval will be 2.0 meters. This will result in approximately 50 plots/transect (more along the bank in zone 1). The sampling frame handle or a 2-m rod can be used to measure the interval.

Step 3. Establish the Location of the First Sample: From each head stake looking upstream, pick a random number between 1 and 10. Proceed up the transect for that random number of steps and place the frame on the ground. For T1, place the plot frame 1 meter from the scour line, aligned with the scour line (figure 8). For T2 & T3, place the center bar of the frame directly on or below the tag line. If the tag line is suspended in the air, use the frame handle or the 2-m rod to plumb down from the tag line to the plot location on the ground (figure 9).

Figure 8. Using the 2-m rod to locate the plot on T1 (1m from the scour line).

Figure 9. Using the frame handle to guide the plot directly under the tag line (T2 & T3).

Step 4. Read the Appropriate Indicators: Stubble height, riparian composition, and woody species height class are read in a 20 cm by 50 cm plot **on the streambank or upland side of the center bar**; woody species age class and woody damage are read in a 2 m by 42 cm plot; woody species use is read in a 2 m x 1 m plot (figure 10). Monitoring of indicators should be completed in the following order to minimize movement of the frame:

1. Riparian Composition
2. Woody Species Height Class
3. Stubble Height
4. Woody Species Age Class
5. Woody Damage
6. Woody Species Use

All data are recorded at this location, and subsequent plots are spaced at equal intervals (**2.0 meters apart**) from this first sample. Continue reading plots to the end marker.

Read only the indicators for plots where the appropriate vegetation is present (or where vegetation, or rock, or wood is present when reading riparian composition). If the 20 cm by 50 cm plot is c*ompletely* devoid of vegetation, rock, or wood, leave the cells blank for those indicators and read the 2 m by 42 cm plot; if this plot is devoid of woody plants, leave the cells blank for those indictors and read only the 2 m by 2.0 m plot; if this plot is devoid of woody plants, leave the woody species use cells blank and proceed 2.0 m to the next plot location.

<u>**All transects will be read in an upstream direction.**</u> In most cases, the long term and short term indicators will be read during different visits as short-term indicators will be collected more frequently than the long term indicators. Although it is not necessary to collect the long term indicators each time the short term indicators are read, it is best to collect the short term indicators along with the long term indicators (does not add much time).

Step 5. Ensure the Appropriateness of the Sample Size: After the transect is completed, the sample-size estimator at the top of the "DMA" worksheet in the Data Entry Module may indicate that more samples are needed to achieve the desired level of precision (this does not work for composition as no mean is calculated). If a few additional samples are needed to meet the desired level of precision, read the additional plots while on the site. Do not collect additional samples if the required number is unreasonably high (less than about 15 additional samples is reasonable).

To determine the number of additional samples needed, subtract the number of samples taken from the number of samples indicated on the sample-size estimator for each indicator. Divide the DMA reach length by the number of samples (plus 1) for the indicator needing the most additional samples. For example, if the sample-size estimator indicates an additional 6 samples are needed for an indicator, divide the DMA length (100 m) by 7, which equals 14.3 m (note that 1 sample is added before dividing to ensure that the last plot is not always at the end marker of the transect). Beginning at the lower transect marker, measure or pace 14.3 m upstream, place the monitoring frame along the same line used earlier and read the plot. Continue sampling (in this case using a 14.3 m interval) until adequate samples are collected. Collect additional samples for all indicators each time an additional plot is read – even if the sample-size estimator indicates an adequate sample size for that particular indicator.

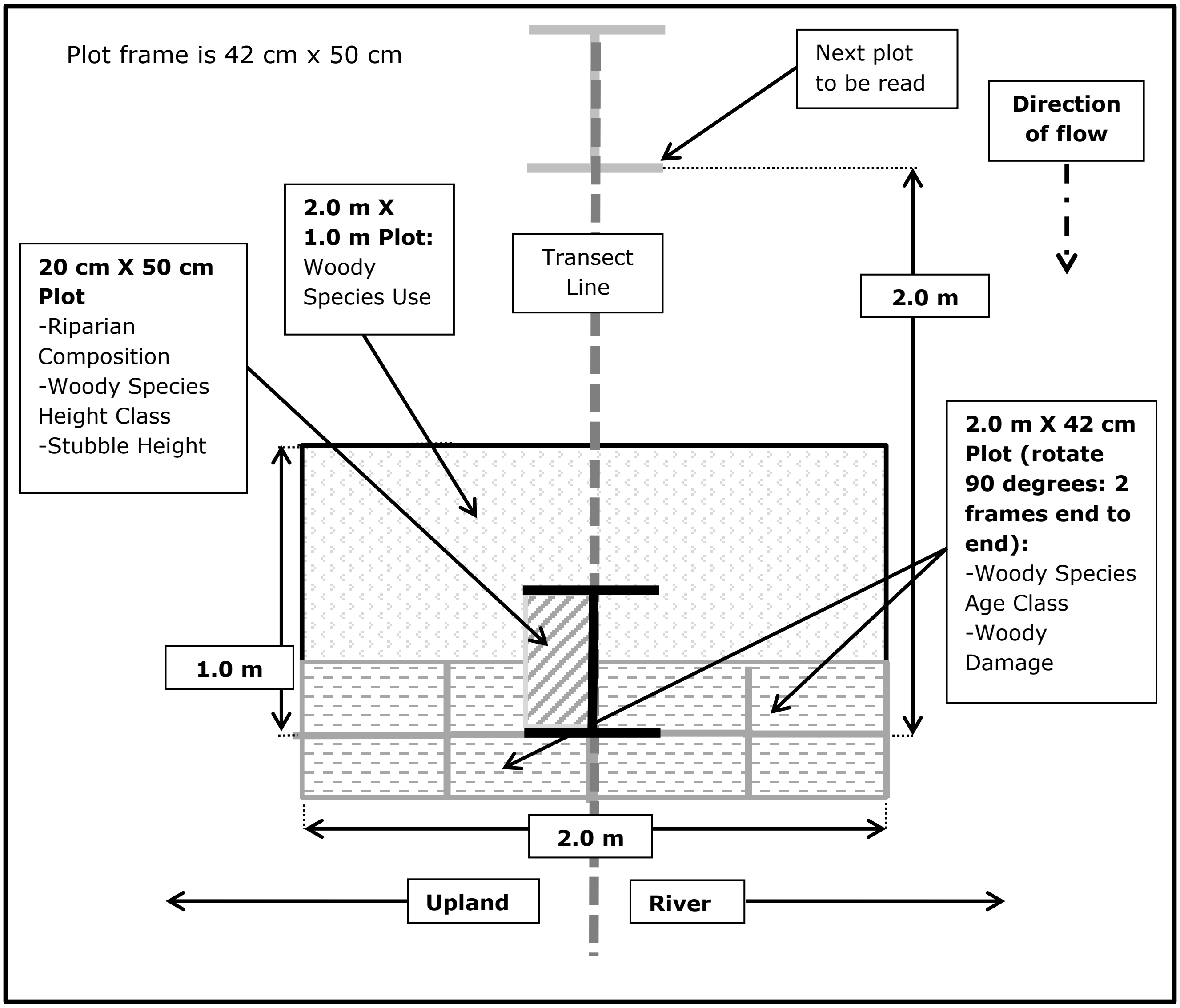

Figure 10. Plot layout

Short-Term Livestock/Wildlife Use Indicators

Short-term indicators used for the UMR will be **Stubble Height** and **Woody Species Use**. **Other than the difference in the transects and plot locations, these indicators will be sampled identically to how they are described in the MIM protocol with the following exception: <u>The plot size and procedure for evaluating livestock and wildlife use levels on woody plants is modified (see "Woody Species Use" step 2)</u>.**

Stubble Height

<u>Stubble-Height Plot</u>: The stubble height plot is 20-cm by 50-cm plot on the streambank side of the center bar of the frame (towards the upland – the same plot used for riparian composition and woody species height).

Step 1. Determine Key Species: 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 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 occurs nearest the handle of the frame. 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. 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. 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 (figures 11, 12, and 13 in Burton et al. 2011, p.25) 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.

Woody Species Use

<u>Woody Species Use Plot:</u> The woody species use plot is 2 m wide (1 m on each side of the center bar of the frame) by 1 m long. It is helpful to use the measuring rod or handle of the frame to determine if a plant is rooted within the plot.

Note: If observers are only recording woody species use, the plot frame is not necessary. Use a 2-m rod to gauge the plot from the scour line or water level (for T1) and centered on the tag line (for T2/T3). If stubble height and/or woody damage are also collected however, the plot frame will be necessary.

Step 1. 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 (5 feet). Woody plants with over 50 percent of the current year's leaders above 1.5 m (5 feet) are considered unavailable for cattle.

Step 2. By Species, Evaluate all Available Woody Plants Rooted within the Plot: Evaluate all woody species with a least part of the plant rooted within the 2 m x 1 m plot (root crown in the plot). Do not double sample individual plants that are rooted in two plots. 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 Field Data Sheet blank.**

Step 3. Determine the Woody Species Use Class: By species, all plants within the plot are collectively observed, averaged, and classified into a "use class" (see table below). 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 for the appropriate use class.

Table 1. Woody Species Use Class and Descriptions

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.
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 clublike appearance, indicating that most active leaders have been removed. Only between 0% and 19% of the current year's leaders remain intact.

Long-Term Condition Indicators

Long term indicators used for the UMR will be **Riparian Composition, Woody Species Height Class, Woody Species Age Class, and Woody Species Ice/Beaver Damage. Other than the difference in the transects and plot locations, all long term condition indicators will be sampled identically to how they are described in the MIM Protocol with one exception: A <u>maximum number of 50 plants are recorded per plot (see: "Woody Species Age Class" step 2).</u>** The Woody Damage Indicator is specific to the UMR and is not a MIM procedure.

Riparian Composition (Vegetation, Rock, Wood)

<u>Riparian Composition Plot:</u> The riparian composition plot is 20-cm by 50-cm on the upland side of the center bar of the frame (the same plot used for stubble height and woody species height).

Step 1. Develop a Species List: Prior to collecting vegetation data, complete a reconnaissance of the site to identify and make a list of all vascular plant species that may occur along the transect before sampling.

Step 2. Record All Herbaceous Vascular Plants: 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.

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 34 percent embedded rock (add 1% to one of the three to equal 100%). 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 located 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 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.

<u>Note: The total for all understory combinations (herbaceous plants, woody plant seedlings, rock, and wood) must not exceed 100 percent.</u> If no vegetation, rock, or wood is encountered within the plot, leave the cell in the UMR MIM Field Data Sheet blank.

Step 5. Record Woody Species Overstory: Overstory includes all young and/or mature woody plant species, as defined in "Woody Species Age Class" section, that is either rooted in or overhanging the plot. 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 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 6. **Record Grouped Plants:** When individual plant species comprise less than 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.

Woody Species Height Class

<u>Woody Species Height Class Plot:</u> The woody species height class plot is the 20-cm by 50-cm plot on the upland side of the center bar of the frame (the same plot used for riparian composition and stubble height).

Procedure: Record the height class of each woody plant recorded in the composition plot (20 cm by 50 cm) using the ranges in Table 2. Record the tallest height class (inside or outside the plot) of an individual with at least some cover in or 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 (>2.0 to 4.0 m). When multiple layers of woody plants occur over the plot, record the height class for each woody species listed in the riparian composition. If more than one plant of the same species is rooted in or hanging over the plot, record the height of the tallest plant.

If individual woody plants cannot be distinguished, as is often the case with rhizomatous/root sprouting woody species (e.g. sandbar willow), record the height of the tallest stem of that species that is either rooted in or overhanging the plot. **If no woody plants are either rooted in or overhanging the plot, leave the cell in the MIM Field Data Sheet blank.**

Table 2. Woody Species Height Classes

Height Class	Height Range
1	0.0-0.5 m
2	>0.5-1.0 m
3	>1.0-2.0 m
4	>2.0-4.0 m
5	>4.0-8.0
6	>8.0 m

Woody Species Age Class

Woody Species Age Class Plot: The woody species age class plot is 0.42 m wide by 2 m long (1 m on each side of center bar of the frame), with the frame placed perpendicular to the scour line for T1 and perpendicular to the transect tag lines in T2 and T3. Place the frame end to end on each side of the center bar so that the entire 2 m are sampled. **For sites with few woody plants, double the plot size from 42 cm by 2 m to 84 cm by 2 m.** To do this, the observer would place the frame immediately beyond the original plot (further towards the end of the transect – see plot layout). **Record this modification in the comments field of the DMA header.**

Step 1. Distinguish Individual Plants: For multi-stemmed woody species, it is sometimes difficult to distinguish individual plants from one another when shrubs have multiple stems close together. In such cases, when it is difficult to distinguish individual plants, 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. **Seedlings commonly germinate and initiate growth very close together and are clearly individual plants and they should be recorded as such.**

Step 2. Determine Age Class: Place the end of the monitoring frame on and perpendicular to the scour line (or transect tag line), and determine the age class of each woody plant by species **rooted** within the described plot (see tables 3 & 4). Record the number of all woody plants by species according to their age class. Do not count woody species overstory not rooted in the plot. **On the UMR, one plot can contain several hundred seedlings. If this is encountered, record a maximum of 50.**

Step 3. Record Woody Root Sprouting and Rhizomatous Species: It is difficult to age class rhizomatous and root sprouting species such as coyote/sandbar willow (S. exigua), wild rose (Rosa spp.), snowberry (Symphoricarpos spp.), cottonwood (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.

If no woody plants are encountered within the plot, leave the cell in the MIM Field Data Sheet blank.

Table 3. Woody Species Age Class for Single-Stemmed Species (cottonwood, etc)

Age Class	Stem Height and Diameter
Seedling	Stem is <1m tall or <2.5 cm in diameter at 50% of height from ground level
Young	Stem is ≥1m tall or 2.5 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 4. Woody Species Age Class for all UMR Willows

Age Class	Stem Height and Diameter
Seedling	1 stem <0.5 cm in diameter at the base and <0.5 m tall
Young	2-10 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 ≥ 1 m tall

Woody Damage (Ice and/or Beaver Damage - not a procedure in MIM)

This procedure can be considered both a short term indicator and a long term indicator. Because of the frequent nature of ice and beaver impacts, it may be useful to record woody damage data at the same time stubble height and/or woody species use data is gathered.

Woody Damage (Ice and/or Beaver) Plot: The woody damage plot is 0.42 m wide by 2 m long (1 m on each side of center bar of the frame), with the frame placed perpendicular to the scour line. This is the same plot used for Woody Species Age Class (see figure 10).

Procedure: If *any* of the woody plant species identified in the woody species age class plot show **obvious** indications of **recent** shearing by ice or gnawing by beaver, Record a "1" in the Ice/Beaver Damage Column for that species. If no damage is evident, record a "0." **If no woody plants are encountered within the plot, leave the cell in the UMR MIM Field Data Sheet blank.**

Data Entry and Data Analysis

To facilitate data recording and analysis, the two Microsoft Excel applications in the MIM protocol were modified for the UMR. The Data Entry Module is for entering data into handheld computers using Windows Mobile in the field. The Data Analysis Module provides calculations of various metrics (see Burton et al. 2011, chapter V.) and permits analysis of the data. These metrics are used as indicators of streamside vegetation use and vegetation and stream channel conditions.

The Data Analysis Module requires a computer with full versions of Excel. Data analysis using this modification of the MIM protocol addresses precision, the ability to detect change, and minimizing observer variability and subjectivity through an emphasis on strict compliance with rule sets and required training. Refer to the MIM protocol for details on data entry and analysis.

Tools and Materials Needed

BLM monument markers or rebar stakes with caps (or rebar stakes with “candy-cane top”)
Flagging
Pin flags
PVC MIM frame
2-100 m Tag Lines
4-Rigid stakes
4-4 ft boat straps
Laser rangefinder (or 100 m tape with survey pins or stakes)
Field data recorder (with MIM data entry module with UMR version installed)
Small sledge hammer
Digital camera
GPS (with compass) or auxiliary compass
Plant keys/books
Field notebook
Hard copies of data entry forms (for backup)
Clipboard for hard copy entry
Maps and aerial photos
Previous data and photos (for re-reading transects)

References

Burton, T.A., S.J. Smith, and E.R. Cowley. 2011. Riparian area management. Multiple Indicator Monitoring (MIM) of stream channels and streamside vegetation. Technical Reference 1737-23. BLM/OC/ST-10/003+1737. U.S. Department of the Interior, Bureau of Land Management, National Operations Center, Denver, CO. 155pp.

Krause, Chad, Mitch Forsyth, Wayne Elmore, Abby Hall, Jody Peters, and Steve Smith. 2012. Upper Missouri River Riparian Proper Functioning Condition (PFC) Assessment Report. Upper Missouri River Breaks National Monument. BLM/MT/ST-12/005+1737. U.S. Department of the Interior, Bureau of Land Management, Upper Missouri River Breaks National Monument, Lewistown, MT. 53pp.

Appendix A – Scour Line Examples

Figure A1. The dashed line is the scour line. Only small, sparse, infrequent clumps of sedge plants are below the scour line.

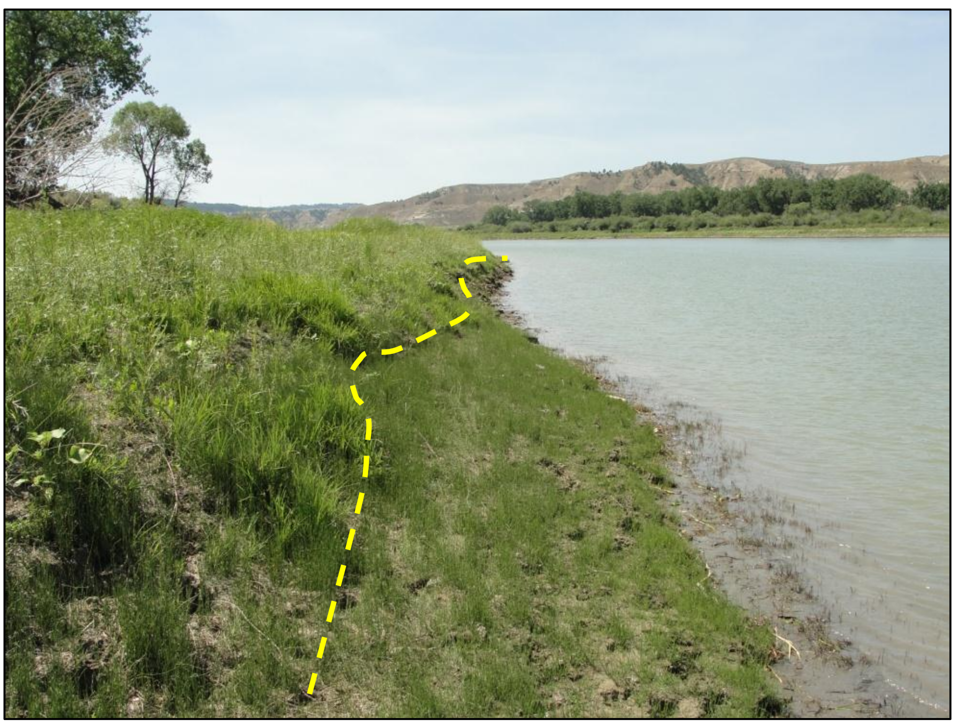

Figure A2. The dashed line is the scour line identified by the lowest consistent limit of sedge plants. Horsetail *(Equisetum spp.)* is below the scour line.

Figure A3. The dashed line is the scour line identified by the lowest consistent limit of sedge plants and sandbar willow (*Salix exigua*). No vegetation is below the scour line.

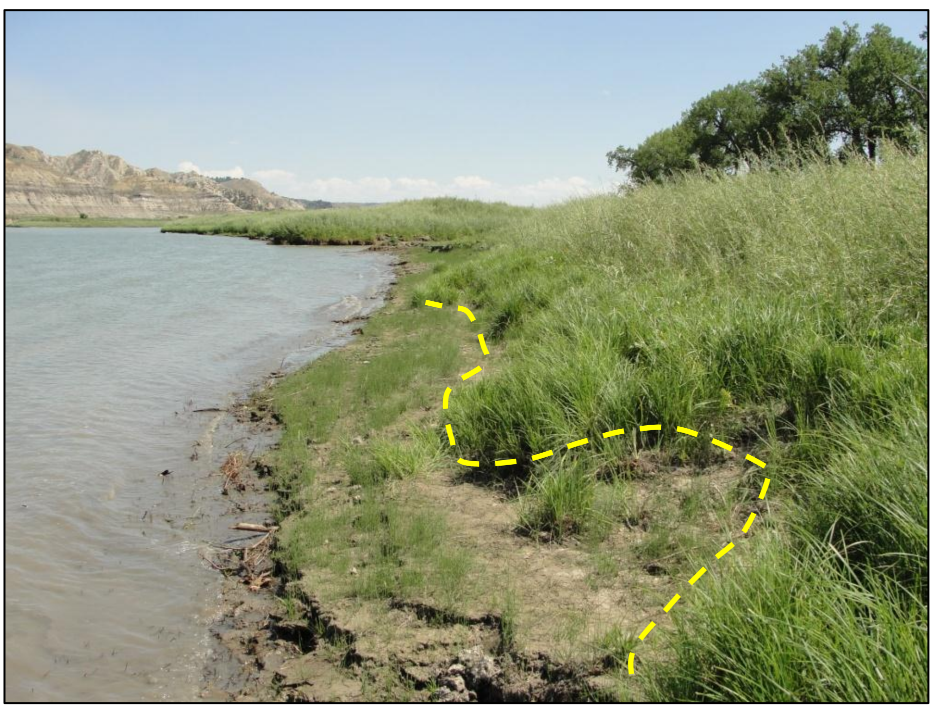

Figure A4. The dashed line is the scour line identified by the lowest consistent limit of sedge plants. Horsetail *(Equisetum spp.)* and sparse sedge clumps are below the scour line.