

Michigan Trout Unlimited *River Keepers* Program Volunteer Manual



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Chapter 1 – *River Keepers Program Overview*

1.1 Scope of this Manual

This manual contains methods and tools for volunteer monitoring of water temperature, in-stream habitat characteristics, aquatic macroinvertebrate based water quality indices, in-stream flow, and fisheries populations. Some of the methods and training techniques are specific to Michigan; in these instances chapters outside of Michigan should consult with their local agency biologists about modifying methods to meet their needs. This manual is intended for use by Trout Unlimited (TU) chapters across the country, although it was written specifically for Michigan and includes examples and methods specific to Michigan.

The methods included in this manual are standard to governmental agencies in Michigan. For most types of data the methods presented should work across the country. Methods for water temperature, in-stream flow, and in-stream habitat are standard and should work throughout the nation with little modification unless otherwise noted. However, methods for sampling macroinvertebrates and fisheries survey techniques are specific to those required by the Michigan Departments of Natural Resources and Environment (MI DNRE). Chapters outside of Michigan interested in monitoring macroinvertebrates and/or fish should contact local agencies to determine what methods are standard for stream monitoring in their area.

It is a good idea to contact local agencies and fisheries biologists early on in the planning process regardless of which variables you are monitoring. Maintaining a good relationship and open communication with agency staff is very beneficial. It will make setting up most aspects of a volunteer stream monitoring program easier. In addition, in most cases, one of the goals of stream monitoring is to provide data to state and/or federal agencies. Communication about how they would like the data collected and delivered is critical to ensuring that the data will get used in future fisheries and habitat management decisions.

1.2 Stream Monitoring, A New Opportunity for TU Volunteers

One of the important identities of TU is the hands-on stream restoration that its members achieve through volunteer efforts. Through the past decades this has been a hallmark of TU, incredibly beneficial to our rivers and streams, and has provided a critical means for TU volunteers to directly contribute to our mission in a meaningful and valuable manner. In many parts of the country, this hands-on stream restoration work is still the foundation of TU work. Michigan Trout Unlimited (MITU) is fortunate to have a wealth of highly productive partners in conservation and in particular, stream restoration. Many of our watershed councils and conservation districts (and the RC&D's) possess a high level of capacity, have many fulltime technical staff, and are very productive in performing

stream restoration projects. We are fortunate for this, as performing stream restoration projects in Michigan has become administratively demanding (engineering design requirements, grant subcontracting, etc.), at least for a volunteer-based organization such as TU. Hands-on volunteer involvement is not always needed for these projects. Fortunately, volunteer stream monitoring offers TU members an ideal opportunity to contribute in a hands-on manner while capitalizing on the greatest strength of TU, its large number of members who are knowledgeable about specific trout streams. The volunteer stream monitoring program also comes at a time when governmental agencies need this type of assistance more than at any other time in history. MITU's large number of members and wide distribution across Michigan provide MITU with a unique opportunity to conduct widespread stream monitoring. Monitoring coldwater streams across the state will provide a wealth of valuable information.

Volunteer stream monitoring engages members, educates them about coldwater resources, and contributes needed information that is the foundation to achieving any component of our conservation mission. The MITU *River Keepers* stream monitoring program was created with this premise in mind. The three primary goals of the *River Keepers Program* are to collect data that will help guide future coldwater conservation and restoration efforts, to provide hands-on volunteer opportunities for Trout Unlimited members, and to provide meaningful data to the MI DNRE. This program will allow MITU to conduct conservation and restoration projects based in science. The ultimate goal of the *River Keepers Program* is to improve coldwater conservation in MI while strengthening MITU's working relationship with the MI DNRE.

Each subsequent chapter of this manual focuses on one type of monitoring: 2) temperature, 3) river habitat mapping, 4) Adopt-A-Station habitat monitoring, 5) macroinvertebrates, 6) in-stream flow, and 7) fish. Objectives and methods for monitoring each type of data can be found in subsequent chapters.

1.3 Recording Volunteer Time and Travel

It is very important to know how many active volunteers are participating in *River Keepers*, how many hours each volunteer is putting in, and how far each volunteer is traveling by car. This information is very important for leveraging funds and for use as match when writing grants. Please keep track of your time and travel each time you volunteer for the *River Keepers Program*. A volunteer time and travel log can be found in Appendix 1A.

Chapter 4 – MI DNRE Adopt-A-Station Habitat Monitoring

Prepared by Bill Wellenkamp MI DNRE.

The general methods presented in this chapter are standard protocols for habitat transect sampling. These techniques may be used around the country. However, methods for large woody debris counts and bank erosion indices are specific to the MI DNRE. Contact local agencies to determine the preferred method for quantifying wood and classifying river banks in your area.

4.1 Objectives

These standard protocols for habitat monitoring are intended to be used to increase the amount of habitat data available for Michigan's coldwater streams. This document is designed to provide standard protocols for monitoring habitat that can be used by trained volunteers participating in the MITU *River Keepers Program* in cooperation with the MI DNRE Adopt-A-Station habitat monitoring program.

This habitat monitoring procedure is designed to address several objectives:

- Increase available habitat information for Michigan's coldwater streams for use by MI DNRE staff.
- Provide procedural information for the MI DNRE Adopt-A-Station program
- Provide data that will aid in conserving, protecting, and restoring coldwater fisheries in Michigan.

Use of Habitat Transects Versus Habitat Mapping

For the purposes of the MITU *River Keepers Program* habitat mapping will be appropriate in most instances. However, there are some cases where habitat transect sampling is more appropriate. Habitat transects will be used in cooperation with the DNRE Adopt-A-Station Program. At the time this manual was written this program had limited availability. Habitat transects also may be appropriate in cases where a specific part of a stream needs in depth monitoring. For example, in a stream where habitat improvement has recently been conducted and in depth monitoring of a small section of stream is needed.

4.2 Training

Instruction sheets are included in each kit. A training session with a MI DNRE staff person or a MITU staff person may be available. In most cases training will consist of instruction sheets and a session with a MITU staff member.

4.3 Equipment

Equipment needed for sampling includes:

- A fiberglass or nylon tape measure

- A yard stick and/or a foldable ruler
- Clipboard
- Pencils
- Data sheets
- Hand held thermometer

4.4 Preparation

a. Site Selection

At this time watersheds are primarily chosen by MI DNRE fisheries biologists. It is a good idea to contact your local DNRE fisheries biologist to determine what coldwater systems are priorities in your area. From those options choose a watershed that is of interest to your chapter.

It is important to choose sites in a way that provides a representative sample of the watershed. For example it is good to have sites in major tributaries within a watershed and to have sites in the main river below where those major tributaries enter. It is also important to make sure the river is adequately covered from the upstream to the downstream end. Your area DNRE biologist may also be able to help with site selection.

b. Site Setup

Before sampling occurs sites should be marked with semi-permanent markers. This may include marking the beginning and end of each site with a numbered tag nailed into a tree. Always make sure to ask permission from landowners before marking trees. Flagging can also be used but should be considered a temporary marker not semi-permanent. GPS coordinates of the beginning and end of the site should also be recorded at the time the site is setup.

Each site should be 300 feet from start to finish. A marker should be placed at 0 feet and 300 feet.

4.5 Procedures

This section was prepared by the MI DNRE staff at the Baraga DNRE office for the Adopt-A-Station program in 2008.

a. Habitat Survey

You will assess water type, channel width, depth, and substrate every 60 feet throughout the section, beginning at 0 feet and ending at 300 feet (6 transects). At each transect point you should begin by determining the dominant water type (pool, riffle, run).

Dominant water type:

- Pool – 1.5 times deeper than the prevailing depth with slow current and no surface disturbance

- Riffle – shallow, disturbed rolling surface and relatively fast current
- Run – moderate depth with moderate to fast flow, little surface disturbance

Choose water type that best fits the majority of the transect.

Total channel width:

Total channel width includes islands, sand bars, exposed bedrock, shelves and all water within the stream channel.

Wetted channel width:

Only the **WET** width measured from bank to bank. If an island or dry ground is present, you would measure the water on **BOTH** sides of the island and add them to get your wetted width.

Depth:

Use a yard stick or folding rule to measure depth to a tenth-foot at $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$, from Left bank when facing upstream.

IN THE WATER – Set rule on “flat” bottom – avoid placing it on top of structures that would give “unusual” measurements. Do not measure the depth on dry ground/islands – only where there is water.

Bottom type:

Across transect (underneath tape measure), determine the percent composition of various substrates. Percents must add up to 100. Include islands and dry ground in your percentage (“I”).

At each transect you will classify the percent of the bottom that is B-bedrock, BO-boulder (>10”), Co-cobble (3”-10”), G-gravel (1/8-3”), S-sand, O-organic (silt, detritus, muck), C-clay, or I-island/Dry. Determine the percentage of the bottom that is covered by each type of substrate and record it on the data sheet.

Embeddedness:

WHERE GRAVEL (or cobble) IS PRESENT, what percentage of the gravel or cobble is buried/embedded with fine silt and/or sand? How “buried” in sand/silt is the cobble and gravel?

You will need to determine the average percent embeddedness for all the gravel and small cobble in the transect. To determine embeddedness look where gravel and small cobble is present, in that area what percentage of gravel or cobble particles are embedded (buried) in silt/sand? If an area is 75% embedded you would only be able to see the top 25% of the rocks the rest of the rocks would be covered in sand or silt.

The rest of the observations are the entire stream Station (not just at each individual transect)

Each number corresponds to a numbered section on the Adopt-A-Station datasheet (Appendix 4A).

1. **Water Types:** Over the **entire station**, what percent of water is Pool, riffle and run? Must add up to 100 percent total. See “Visual Aids/Definitions” in survey kit for examples.
2. **Stream Observations table:** Circle ONE description for the amount of the respective characteristic.

3. **Wood Debris:** Estimate the percent of stream bottom covered by woody debris throughout the entire station.
4. **Riparian Vegetation:** Determine respective percentages of the vegetation types listed for Left and Right bank separately. Percents should add up to 100 percent for EACH BANK.
5. **Aquatic Vegetation:** Of all aquatic vegetation observed within the station, what is the percent composition of each type? (i.e. if there is simply watercress and eel-grass present, but far more eel grass, list high percentage of eel-grass (75%) and low watercress (25%). See “Visual Aids/Definitions” in survey kit for plant examples.
6. **Fish and Wildlife Observations:** Record numbers of animals and/or animal-signs, especially amphibians, reptiles, fishes, beavers, moose, etc.
7. **Water color** (circle one).
8. **Turbidity** (“low”, “moderate”, “high”) is degree to which water loses its transparency *due to suspended particles*, the murkier the water appears, the HIGHER the turbidity.
9. **Level** (“low”, “NORMAL”, “high”): Unless you are aware of an unusual situation (drought, flooding, storm event, etc.) this will be “normal”.
10. **Temp:** Take temp **6 inches under water surface in shade**.
11. **Air Temp:** Take 6 inches above water surface in shade.
12. **Time of Day:** Record when temperatures were measured.
13. **Preceding weather:** Please note recent rainfall, general temperature trends, etc. (i.e. “Past 3 days clear, 85 degrees, no rain”)
14. **Days since Rain:** How long since any substantial rain (not just a “sprinkle”)
15. **Stream flow:** Select a distance between two transects (they do not need to be the transects that you measured earlier, they may only be 10’ or 20’ apart depending on stream size) to drift a small stick down the river, unimpeded. **“Float Distance”** is the distance between transects. Avoid areas with pools, bends or logs. Measure the **wetted-width** at your two selected transects. Then, at each transect, get your **Average Depth** by measuring the depth at $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ from left bank, add them together and **divide by 4** to (divide by “4” to account for stream shore depth of “0”).
Area: Multiply your transect Width by your transect Average Depth.
Average Area is the area of your two transects, added together and divided by 2.
Float time is found by timing how long it takes (in seconds) for your stick to pass between the two transects (take the average of three, unimpeded floats).
Current Velocity is the Float Distance divided by the Float time in feet/sec multiplied by 0.9 (roughness coefficient).
Discharge is calculated by multiplying the average Area by the velocity by **0.9**.
16. **Aquatic Invertebrates:** Collect invertebrates for about 15 minutes using small aquarium net, tweezers, eye droppers and pan (if available). I.D. if possible and return bugs to stream after recording number of each type identified. (See “Visual Aids/Definitions” in survey kit for examples.) If unable to ID bugs, place them into plastic jars WITH ALCOHOL and label with station # on outside or with paper labels for insertion into jars. (Return jars to MI DNRE.)

- 17. Comments / Observations:** Record ANYTHING UNUSUAL or INTERESTING. Examples: unusual land use, observed recreational activities (fishing, swimming, ORV crossings, etc.), dead fishes, evidence of human use, springs, tributaries, fishing success, local development, etc, etc.

b. Large Woody Debris Count

Large Woody Debris is recorded **throughout the entire 300 foot station.**

1. Only count log sections that are greater than 6 inches wide AND greater than 6 feet long
2. Debris must be in 6 inches of water or more for 6 feet of length.

EXAMPLES: (assume all examples are in 6+ inches of water)

- A 15' log that is 7" wide along its entire length:

Diameter	1 (6')	2 (12')	3 (18')
>6"		I	
>6"			
>12"			
>12"			

- A 36' log where ½ of the log is 12-18" wide and ½ the log is 6-12" wide:

Diameter	1 (6')	2 (12')	3 (18')
>6"			I
>6"			
>12"			I
>12"			
>18"			

- A 19' log with 6' being less than 6", another 5' being 6-12" and the final 8' being 12-14"

Diameter	1 (6')	2 (12')	3 (18')
>6"	I		
>6"			
>12"	I		
>12"			
>18"			

Note: The first 6' is less than 6" wide so it is not counted at all. You are then left with 13' to take into account. That 13' is all greater than 6", with at least one section (6') being greater than 12" (put a mark in the >12" diameter/ 6' length box) . That leaves you with 7' of log that is greater than 6" wide, so you put a mark in the upper-left hand box.

Natural log jams, beaver dams, and brush deposits

Record the areal dimensions of each jam to the nearest 3 feet. A log jam is defined as 3 or more large diameter (>6") intermingled logs in water at least 6 inches deep. Record the type of log jam – log jam, beaver dam or brush deposit and the length and width of the structure on the data sheet.

Artificial Structures

Record the areal dimensions of each structure and the type of structure. Record linear feel for wing deflectors. Record the type of structure, width, and length.

c. Bank Erosion Hazard Index

BEHI- (Bank Erosion Hazard Index): Observe the AVERAGE values 30 feet upstream and downstream of **each transect** on **BOTH banks** (see *left Bank* and *Right Bank* on the data sheets. There should be several data sheets to account for both banks at each of the 6 transects.)

BANK - from water's edge to where the water would flow over bank at High water events (usually where bank angle changes dramatically or vegetation begins).

Root DEPTH (% of Bank Height): If bare soil on bank is present, then the roots can be seen and a percent can be determined by *direct* observation. If not readily visible, you must use some intuition to determine how deep the roots probably go. If, vegetation extends from the top of the bank to the water's edge, then the percent will be high as there are roots from the top of the bank all the way deep down to the water's edge. Example: on a grassy bank with no soil exposed, the root depth percent is going to be "90-100%"

Root Density: *Where there are roots present*, what percent of the area is occupied with the roots vs. soil? (i.e. very few roots within lots of dirt is low % -5-14%. Densely packed roots with a little soil between, such as grass, will be high %.) Example – If tag-alder covers the bank but you can still see exposed soil in between the "trunks", then the density will be moderate or sparse (30-79%).

Surface Protection: The percent of streambank that is covered and therefore protected by vegetation, large woody debris, sod mats, plant roots, branches, boulders and / or rocks. **BEDROCK IS TO BE COUNTED AS HIGHLY PROTECTED – 100%**

Bank Angle (degrees): This is the average bank angle from the water's edge to where the river would overflow its banks during high water events. The angle is measured from shore as opposed to the center of the stream. (Example: A nearly flat bank will have an very acute angle, i.e. 5 – 20 degrees. Banks with an undercut or overhang will have a value greater than 90 degrees....**The more vertical the bank, the greater the angle value.**)

Examples of Different Bank Conditions:



Root Depth/Bank Height
≈ 90-100%

Root Density ≈ 55-79%

Bank Angle ≈ 21-60
degrees

Surface Protection ≈ 55-
79% at least.



Root Depth/Bank Height ≈ 90-100%

Root Density ≈ 80-100%

Bank Angle ≈ 0-20°

Surface Protection ≈ 80-100%



Root Depth/Bank Height ≈ 90-100%

Root Density ≈ 30-54%, not counting sod
slump

Bank Angle ≈ 81-90°

Surface Protection ≈ 30-54%

Note sod slumping into channel – a sure
indication of an unstable bank,
presumably because streamside
vegetation = mowed grass, not woody
vegetation. Otherwise the channel is in
pretty good shape.



Root Depth/Bank Height \approx 5-30% at best

Root Density \approx 5-14%

Bank Angle \approx 81-90°

Surface Protection \approx 5-14%

Appendix 4A – Habitat Datasheet

Adopt-A-Station Stream Station Description - Field Form

Station # _____ Date _____ Surveyors _____
Upstream GPS _____ Downstream GPS _____

1	Transect No.	Distance from Origin (ft.)	Dominant Water Type *	Total Channel Width (ft)	Wetted Channel Width (ft)	Depth (to the tenth of foot.)			Bottom Type % ‡							***Emb. %		
						1/4	1/2	3/4	B	BO	Co	G	S	O	C		I	
downstream	1	0																
	2	60																
	3	120																
	4	180																
	5	240																
upstream	6	300																
	Total	300																
	Average	60																

2. Water Types: Estimated % for entire Station - % pool _____ %riffle _____ %run _____

3. Stream Observations:

Foam	Abundant	Moderate	Sparse	Absent
Oil Sheen	Abundant	Moderate	Sparse	Absent
Filamentous algae	Abundant	Moderate	Sparse	Absent
Trash	Abundant	Moderate	Sparse	Absent

Undercut Banks	Abundant	Moderate	Sparse	Absent
Overhang. Veg.	Abundant	Moderate	Sparse	Absent
Deep Pools	Abundant	Moderate	Sparse	Absent
Boulders (>10")	Abundant	Moderate	Sparse	Absent

4. Woody debris estimate % for entire station - _____ %

5. Riparian vegetation (type, %) Left Bank: _____
Right Bank: _____

Riparian vegetation classes

YD - yard/lawn

AP - Agriculture, pasture

AR - Agriculture, row crops

GF - Grassland/Forb

TA - Tag alder types

SC - Small coniferous trees (up to 6 inch diameter)

LC - Large coniferous trees (> 6 inch diameter)

SD - Small deciduous trees (up to 6 inch diameter)

LD - Large deciduous trees (> 6 inch diameter)

6. Aquatic vegetation:

Watercress _____% Lilly pads / duckweed _____% Cattails _____%
pondweed _____% eelgrass / aquatic grass _____% Other: _____%

7. Fish and Wildlife Observations / Evidence: _____

8. Water color (green, black, brown, clear) _____ 9. Turbidity (low, moderate, high) _____ 10. Level (low, normal, high) _____
11. Water temperature (degrees F) _____ 12. Air temperature (degrees F) _____ 13. Time of day _____
14. Preceding weather: _____ 15. Days since rain _____

16. Streamflow

Transect	Wet. Width	Ave. Depth	Area (WxD)
1			
2			

Float distance = _____ ft.
Float time = _____ sec. (Ave. of 3 floats)
Current velocity = ft./sec. X 0.9 = _____ ft./sec.

Average Area = _____ sq. ft.
Discharge = Average Area x Current velocity
Discharge = _____ cfs

17. Aquatic invertebrates (# observed and returned to stream):
mayfly _____ stonefly _____ blackfly _____ scuds _____ dragonfly _____ damselfly _____
midges _____ worms _____ caddisfly _____ crayfish _____ leeches _____ hellgrammites _____
Other: _____

18. Comments and observations: _____

* pool (1.5 times deeper than prevailing depth); riffle (disturbed, roiling surface), run
**Channel Depths are measured from the LEFT BANK while FACING UPSTREAM...i.e. first depth is taken 2.5 feet from left shore if the wetted width is 10ft.
*** Embeddedness for gravel: Where gravel is present, what percentage of gravel or small cobble particles is embedded (buried) in silt/sand?
‡ B-Bedrock, BO-Boulder (>10"), Co-Cobble (3"-10"), G-Gravel (1/8-3"), S-Sand, O-Organic (silt, detritus, muck), C- Clay, I- Island / Dry
3. Deep pool is 1.6x the prevailing depth of station.
4. Observe vegetation within 30' of bank for whole Station length.
16. Record # of each type of insect you found and ID'd. **ONLY use jars for unidentified bugs!** Label your preservation jar with Station #.
17. Please record "unusual" sightings. Examples: Eroded banks, buffer area infringement, ORV crossings, etc.
All measurements occur starting at downstream origin, and banks (left, right) are determined while facing UPSTREAM
Depth measurements taken in English units to the tenth of a foot.

Appendix 4B – Large Woody Debris Datasheet

**Adopt-A-Station
Large Woody Debris Count Data**

Station #: _____ Date: _____

Crew: _____

*Individual logs at least 6 feet long in contact with water at least 6 inches deep.
Measure portion of log in water 6+'' deep.*

Diameter	Length Classes (# of full 6' stick lengths) -- One mark per observation							
	1 (6')	2 (12')	3 (18')	4 (24')	5 (30')	6 (36')	7 (42')	8 (48')
>6"								
>6"								
>12"								
>12"								
>18"								
>24"								

Natural log jams (NLJ) and beaver dams (Dam) & brush deposits (BD)

Record areal dimensions of each jam to the nearest 3'

Log jam definition: 3 or more large diameter (>6'') intermingled logs in water at least 6 inches deep

Individual Log Jam dimensions (length x width in ft.)

Type	Length (ft)	Width (ft)

Type	Length (ft)	Width (ft)

Artificial structures- record areal dimensions of each structure (lineal feet for wing deflectors)

Type codes- Log Jam (LJ), Lunker Structure (LS), Raft (R), RipRap (RR), Stump clumps (S),

Wing deflectors (W),

- Individual log (Log)

Only record area of structure in water > 6'' deep

Type	Length (ft)	Width (ft)

Type	Length (ft)	Width (ft)

Appendix 4C – Bank Erosion Datasheet

Modified Bank Erosion Hazard Index (BEHI) Field Form

Date: _____ Station #: _____

Distance of Transect from Origin*: **0'**

****LEFT Bank** (Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	5-14	91-119
< 5	< 5	< 10	> 119

Comments: _____

****RIGHT Bank** (Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	5-14	91-119
< 5	< 5	< 10	> 119

Comments: _____

Distance of Transect from Origin: **60'**

LEFT Bank (Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	5-14	91-119
< 5	< 5	< 10	> 119

Comments: _____

Distance of Transect from Origin: **60'**

RIGHT Bank (Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	5-14	91-119
< 5	< 5	< 10	> 119

Comments:

Distance of Transect from Origin: **120'**

LEFT Bank (Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	5-14	91-119
< 5	< 5	< 10	> 119

Comments:

RIGHT Bank (Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	5-14	91-119
< 5	< 5	< 10	> 119

Comments:

Distance of Transect from Origin: **180'**

LEFT Bank (Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	5-14	91-119
< 5	< 5	< 10	> 119

Comments:

RIGHT Bank (Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	5-14	91-119
< 5	< 5	< 10	> 119

Comments:

Distance of Transect from Origin: **240'**

LEFT Bank (Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	5-14	91-119
< 5	< 5	< 10	> 119

Comments:

Distance of Transect from Origin: **240'**

RIGHT Bank (Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	5-14	91-119
< 5	< 5	< 10	> 119

Comments:

Distance of Transect from Origin: **300'**

LEFT Bank (Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	5-14	91-119
< 5	< 5	< 10	> 119

Comments:

RIGHT Bank (Circle one in each column)

Root Depth (% of BH)	Root Density (%)	Surface Protection (Avg. %)	Bank Angle (degrees)
90-100	80-100	80-100	0-20
50-89	55-79	55-79	21-60
30-49	30-54	30-54	61-80
15-29	15-29	15-29	81-90
5-14	5-14	5-14	91-119
< 5	< 5	< 10	> 119

Comments:

* Origin is Downstream Endpoint

** Bank side determined while facing UPSTREAM.