

# **Stream Geometry and Sketch Map**

**Stream Geometry and Sketch Map Overview**

**Example sketch map, Figure A-20.**

**Geometry Instructions**

**Team Task List and Forms (2 copies)**

# Stream Geometry and Sketch Map

The measured geometry and sketch map characterize and document the plan form of the stream through the study reach. All measurements should represent the range and average values for the geometry variables.

## Geometry Instructions

1. Develop familiarity of the designated reach by walking the entire length while looking at a recent, large-scale aerial photograph; observe floodplains, terraces, abandoned channels, bedrock outcrops and laterally-confining hillslopes or roads.
2. Draw the reach to scale on sheets provided and include items in **Table 7**. Note any changes that have occurred since the aerial photograph was taken.
3. Using the aerial photograph, measure *sinuosity*, *belt width*, *stream meander length*, *linear wavelength*, and *radius of curvature*. Field measure any areas where the channel has shifted substantially since the date of the aerial photograph.
4. Record all geometry measurements on the data form and on the sketch map.

## Sketch Map

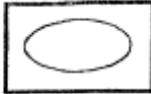
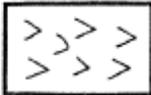
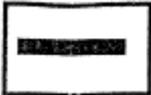
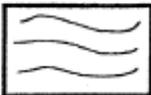
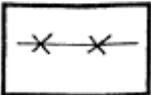
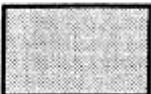
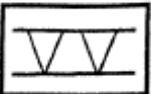
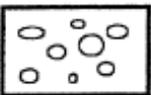
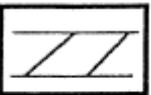
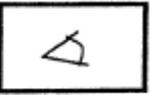
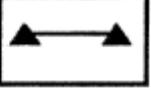
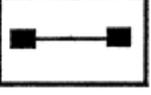
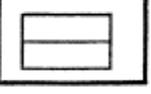
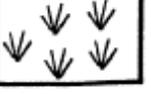
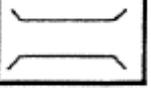
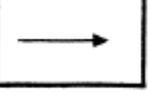
The sketch map documents the location of the study reach, cross-section, and measurement sites in relation to the landscape and verifies that the plan form of the stream has not significantly changed since the aerial photograph was taken. A broad-level valley cross-section showing channel, floodplains, and terrace features in relation to the plan view are included on the sketch map. **Table 7** lists the items necessary to include on the sketch map, and **Figure 20** is an example sketch map.

**Table 7.** List of minimum items to include on sketch map.

Sketch Map Items	
<ul style="list-style-type: none"> <li>• Stream name and location</li> <li>• Date</li> <li>• Surveyors</li> <li>• North arrow</li> <li>• Scale of map</li> <li>• Legend</li> <li>• Direction of streamflow</li> <li>• Benchmark locations</li> <li>• Floodplain boundaries</li> <li>• Terrace features</li> <li>• Vegetation</li> </ul>	<ul style="list-style-type: none"> <li>• Landmarks (including trees, logs, rocks, debris, and dams)</li> <li>• Valley cross-section (including floodplain and terrace features)</li> <li>• Cross-section locations</li> <li>• Longitudinal profile stationing</li> <li>• Pebble count locations or transects</li> <li>• Meander geometry measurements</li> <li>• Bar features and bar sample locations</li> <li>• Abandoned channels</li> </ul>



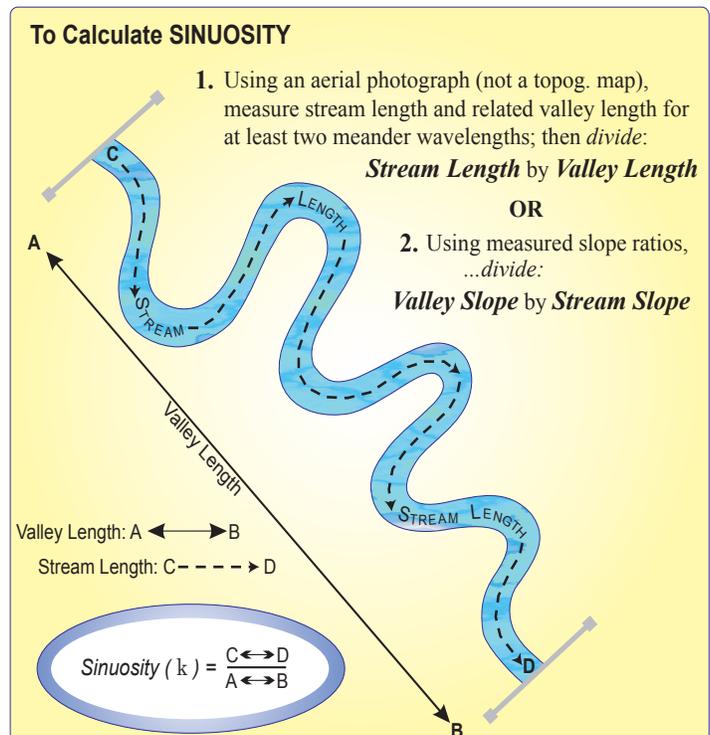
### Geomorphic Map Symbols

	Pool		Fallen Tree
	Riffle		Utility Crossing
	Run		Fence
	Sand		Raw Steep Bank
	Gravel		Stable Sloped Bank (angle of line represents angle of bank)
	Boulder		Camera Shot
	Bedrock		Outfall
	Baltimore City Cross Section		Individual Tree
	U.S. Fish and Wildlife Service Cross Section		Group of Trees
	Building		Herbaceous
	Bridge Crossing		Wetland
	Flow Direction		Project Reach Limits

## Sinuosity ( $k$ )

Sinuosity is the only plan-form parameter used in the initial delineation of stream types at Level II (**Worksheet 1**). *Sinuosity* describes how the stream has adjusted its slope in relation to the slope of its valley and is quantitatively described as the ratio of stream length ( $L_{st}$ ) to valley length ( $L_{val}$ ) and also as the ratio of valley slope ( $S_{val}$ ) to average water surface slope ( $S$ ). The stream and valley lengths are measured from two common points in a direction that is parallel with the fall line of the valley (**Figure 21**). Valley slope ( $S_{val}$ ) is measured as the water surface elevation difference between the same bed features (e.g., riffle to riffle) along the fall line of the valley divided by the valley length between the selected bed features.

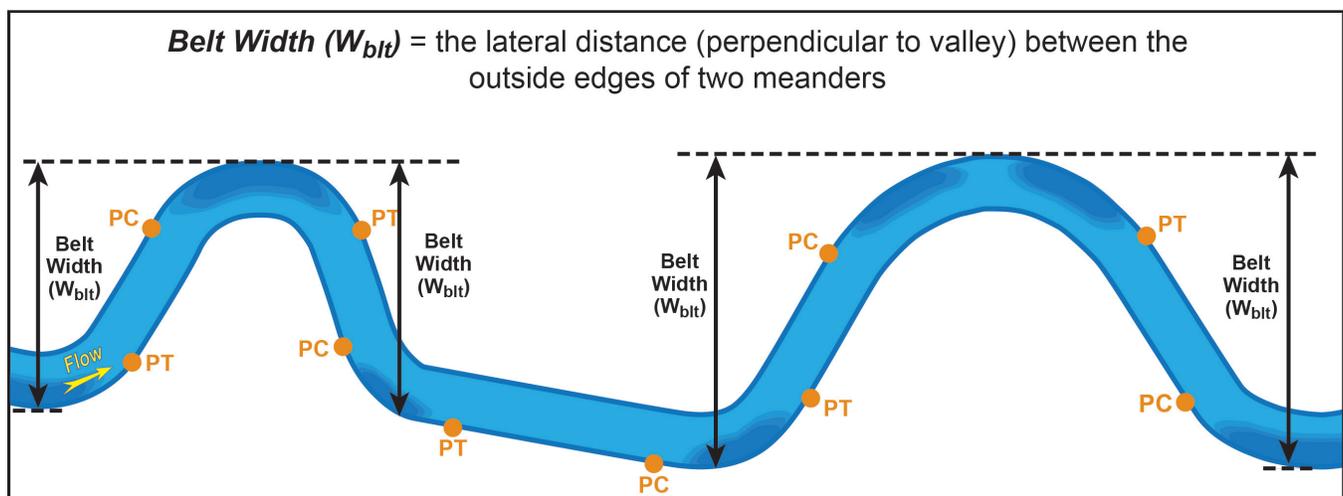
A third method can also be used to estimate sinuosity for reaches less than 40 bankfull widths, calculated as Stream Meander Length ( $L_m$ ) divided by Linear Wavelength ( $\lambda$ ).



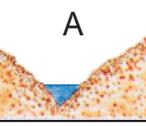
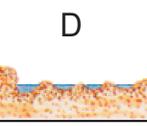
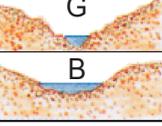
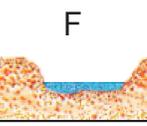
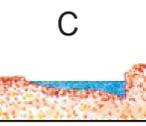
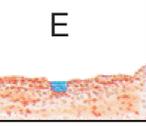
**Figure A-21.** Sinuosity diagram.

## Belt Width ( $W_{bit}$ )

*Belt width* is the lateral distance (perpendicular to valley) between the outside edges of two meanders that occupy opposite sides of the valley (**Figure 22**). Belt width is used as an index of the lateral containment or confinement of a stream when compared with the width of the channel. *Meander Width Ratio (MWR)* is the belt width divided by the bankfull width. Various meander width ratios by stream type are shown in **Figure 23**.



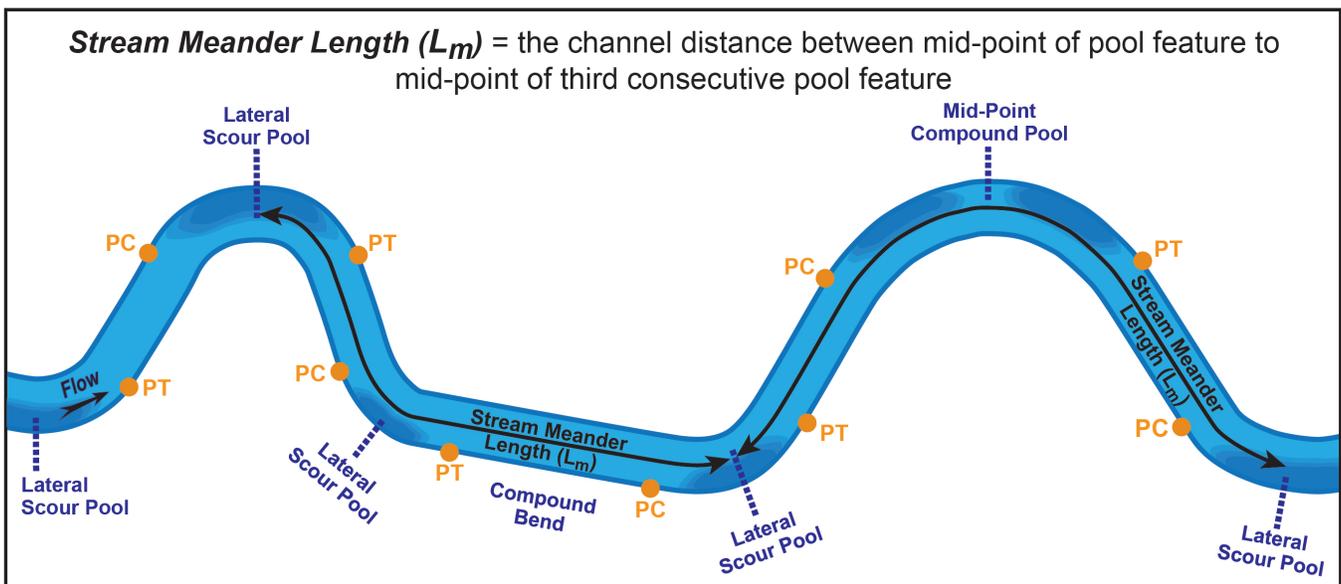
**Figure 22.** Meander geometry diagram for Belt Width ( $W_{bit}$ ) measurements.

Meander Width Ratio (MWR) by Stream Type Categories						
Stream Type	A	D	B & G	F	C	E
Plan View						
Cross-Section View						
Average Values	1.5	1.1	3.7	5.3	11.4	24.2
Range	1 – 3	1 – 2	2 – 8	2 – 10	4 – 20	20 – 40

**Figure 23.** Meander Width Ratio (belt width to bankfull width) by stream type.

### Stream Meander Length ( $L_m$ )

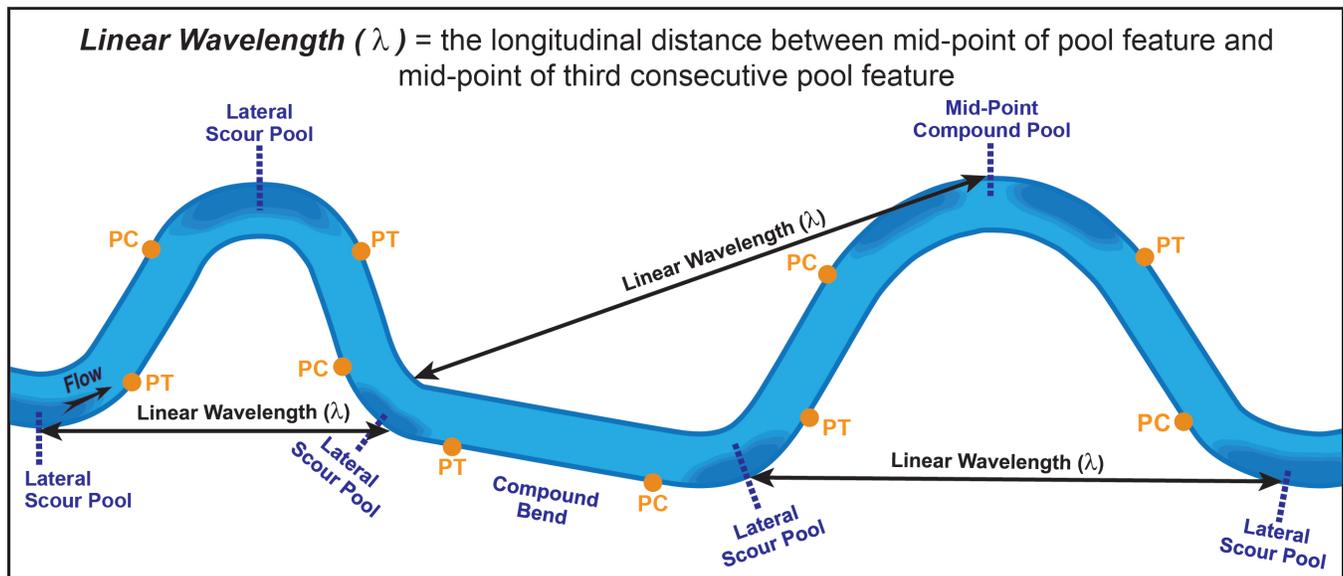
Stream Meander Length is the channel distance between mid-point of pool feature to mid-point of third consecutive pool feature (separated by riffles) in riffle-pool systems (Figure 24). Meander length ratio is the stream meander length divided by the bankfull width ( $L_m / W_{bkf}$ ).



**Figure 24.** Meander geometry diagram for Stream Meander Length ( $L_m$ ) measurements.

## Linear Wavelength ( $\lambda$ )

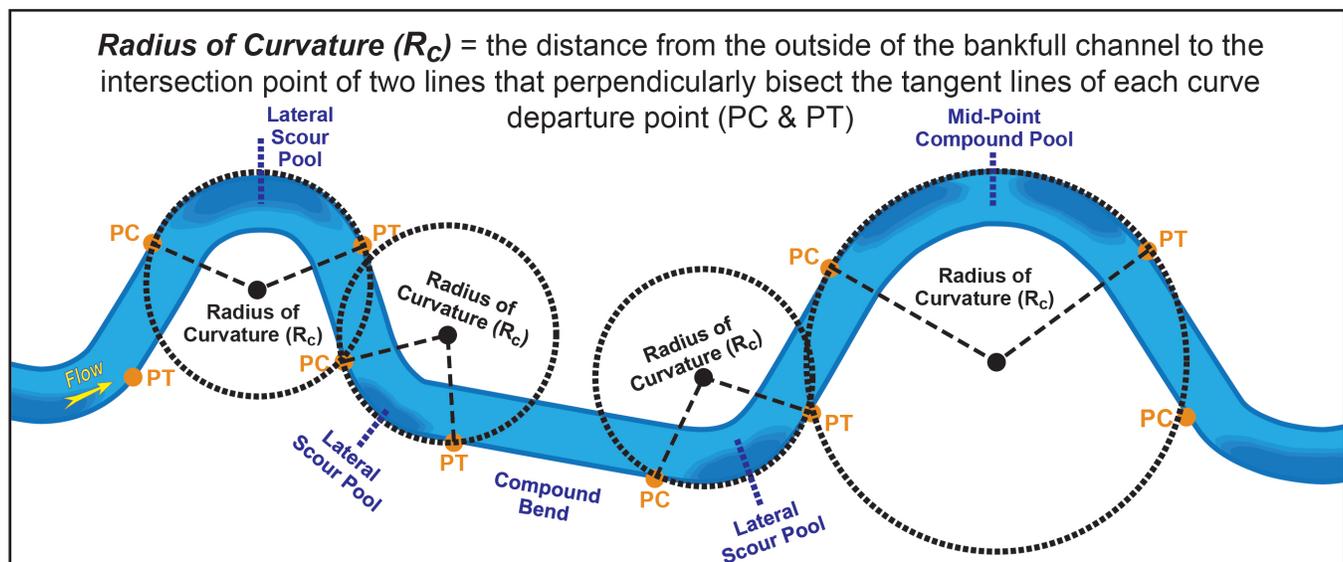
*Linear wavelength* is the longitudinal distance between mid-point of pool feature to mid-point of third consecutive pool feature (separated by riffles) in riffle-pool systems (**Figure 25**). *Linear wavelength* is negatively correlated with sinuosity and is expressed as a ratio to the bankfull width ( $\lambda / W_{bkf}$ ).



**Figure 25.** Meander geometry diagram for Linear Wavelength ( $\lambda$ ) measurements.

## Radius of Curvature ( $R_c$ )

*Radius of curvature* is a measure of the “tightness” of an individual meander bend in riffle-pool systems. Radius of curvature is measured from the outside of the bankfull channel to the intersection point of two lines that perpendicularly bisect the tangent lines of each curve departure point (**Figure 26**). Measurements taken in compound pools *vs.* compound bends are also shown in **Figure 26**. Radius of curvature is negatively correlated with sinuosity and is expressed as a ratio to the bankfull channel width ( $R_c / W_{bkf}$ ).



**Figure 26.** Meander geometry diagram for Radius of Curvature ( $R_c$ ) measurements.



# Stream Geometry and Sketch Map

The measured geometry and sketch map characterize and document the plan form of the stream study reach. The sketch map is very important and documents the plan form (overhead view) of the reach and the locations of cross-section and measurement sites. As such, sketch maps are useful in reports. Plan form geometry may be best measured initially with recent, large-scale aerial photographs. All measurements should represent the range (min, max) and average values for the geometry variables.

## Tasks – Day 2 Survey Practical Exercise

1. Lay out a longitudinal tape using chaining pins (note, your stream bag only has 10 chaining pins). This action will measure the stream length.
2. Each person draws a simple sketch map that includes the
  - a. stream pattern with “stationing” (distance from upstream site boundary to features taken from longitudinal tape)
  - b. valley cross-section
  - c. valley axis in degrees (from azimuth reading on compass)
3. As a group of six, measure stream meander lengths
4. Break into two teams of three. Each team makes all geometry measurements and places the data on the appropriate places of the sketch map and on the data form.
5. Measure stream attributes (either on aerial or on the ground) and record on data sheet
  - a. Stream length ( $L_{st}$ )
  - b. Valley length ( $L_{val}$ )
  - c. Belt Width ( $W_{blt}$ )
  - d. Stream Meander Length ( $L_m$ )
  - e. Linear Wavelength( $\lambda$ )
  - f. Radius of Curvature ( $R_c$ )
6. Calculate ratios and record on data sheet
  - a. Sinuosity ( $L_{st}/L_{val}$ )
  - b. Meander Width Ratio ( $W_{blt}/W_{bkf}$ )
  - c. Meander Length Ratio ( $L_m/W_{bkf}$ )
  - d.  $\lambda/ W_{bkf}$
  - e.  $R_c/ W_{bkf}$

## Equipment

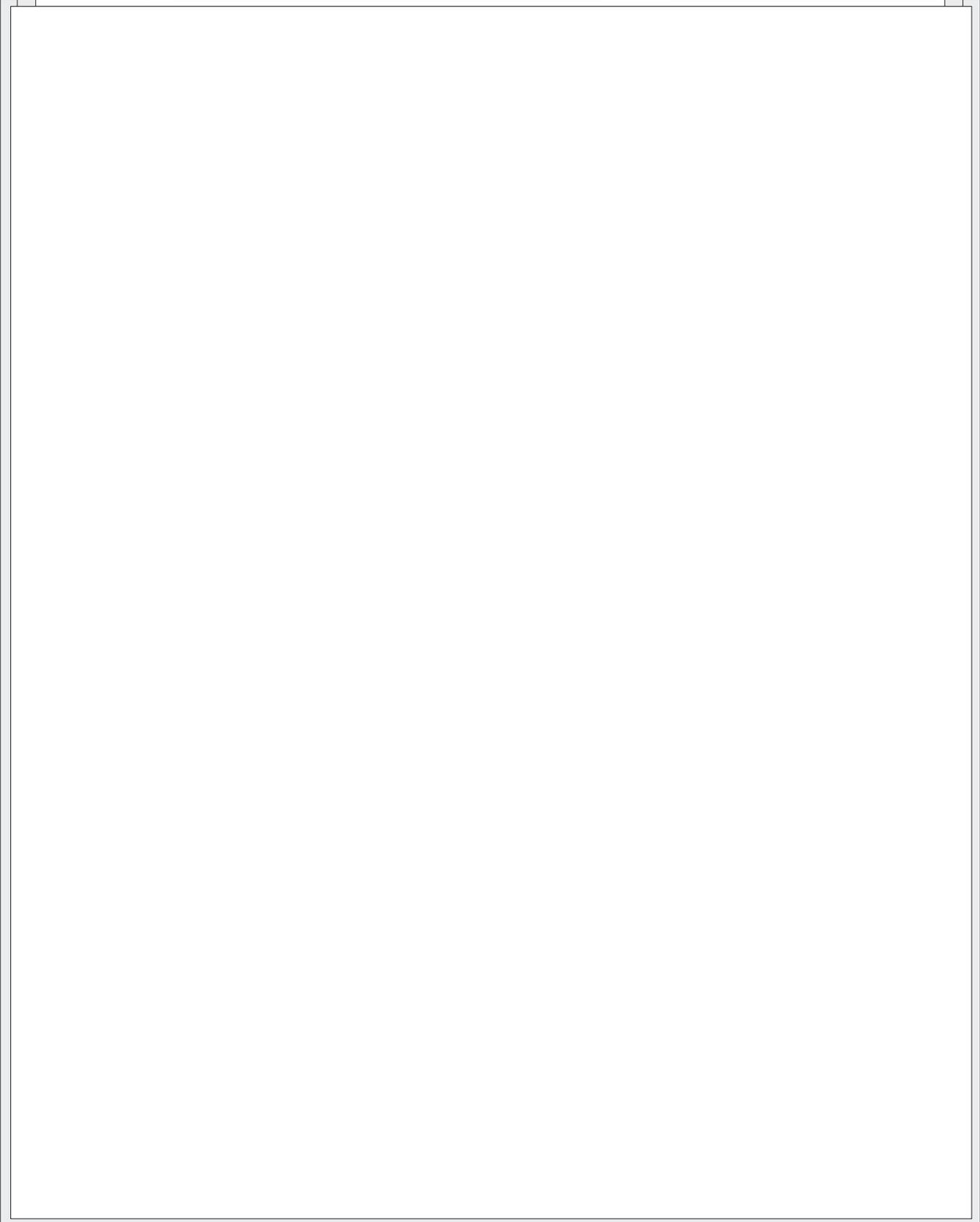
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| (6) Engineer's scales  | (2) Calculators      |
| (6) Compasses  | (1) Bundle Pin flags |
| (10) Chaining pins   | (6) Pencils          |
| (4) 300' Fiberglass tapes (2 for stream length, 2 for valley length) | (6) Clipboards       |
| (4) 300' Fiberglass tapes w/Alan                                     |                      |



***AREA-SITE LOCATION....REACH MAP***

Stream: \_\_\_\_\_ Reach: \_\_\_\_\_

Drawn By: \_\_\_\_\_ Date: \_\_\_\_\_





***AREA-SITE LOCATION...REACH MAP***

Stream: \_\_\_\_\_ Reach: \_\_\_\_\_

Drawn By: \_\_\_\_\_ Date: \_\_\_\_\_

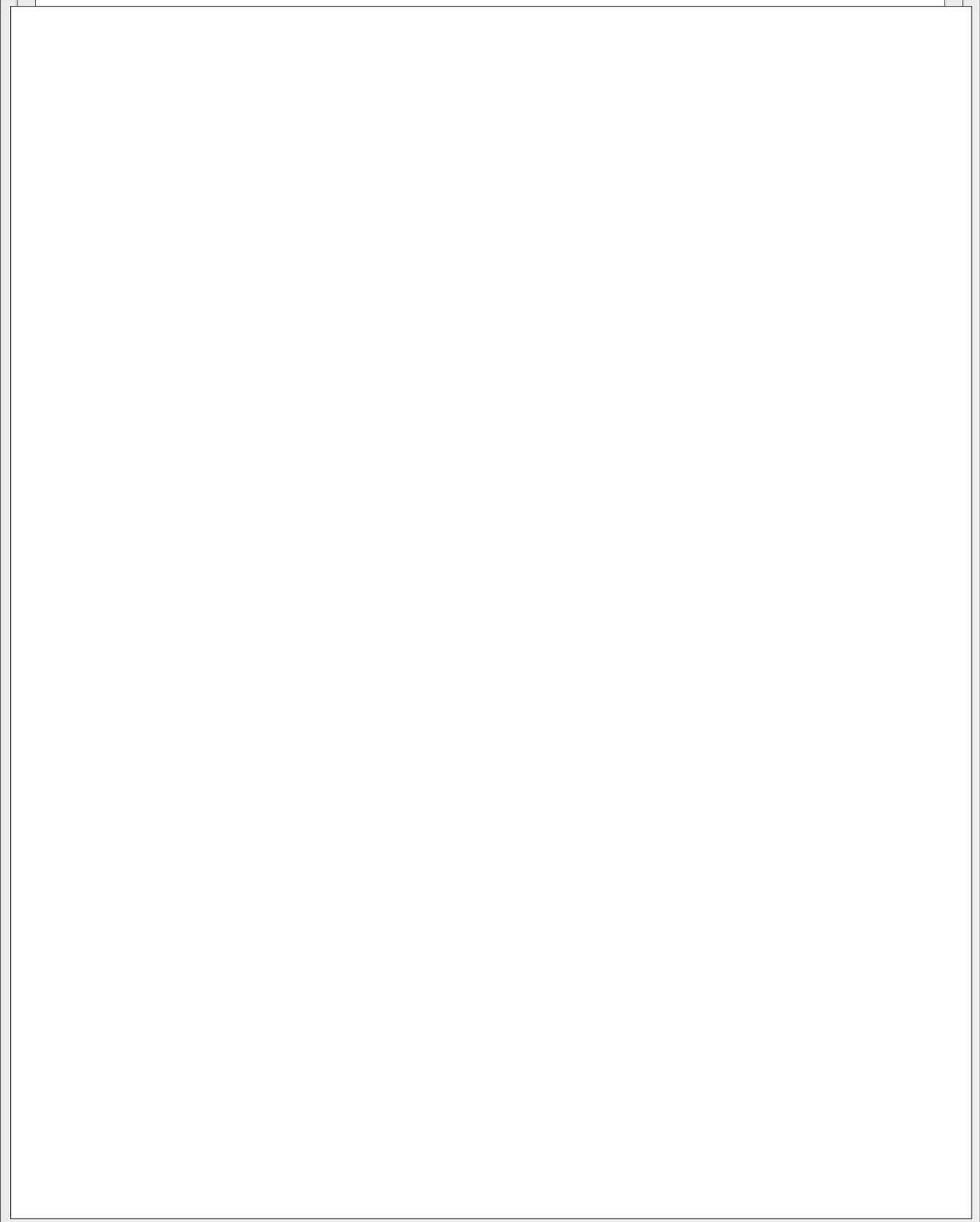




***AREA-SITE LOCATION....REACH MAP***

Stream: \_\_\_\_\_ Reach: \_\_\_\_\_

Drawn By: \_\_\_\_\_ Date: \_\_\_\_\_





## Geometry Measurements

Stream name/location: \_\_\_\_\_

Date: \_\_\_\_\_ Team members: \_\_\_\_\_

Attribute	Measurement 1	Measurement 2	Measurement 3	Measurement 4	Measurement 5	Range	Average
<b><i>Belt Width</i></b> <i>(<math>W_{bit}</math>)</i>							
<b><i>Stream Meander Length</i></b> <i>(<math>L_m</math>)</i>							
<b><i>Linear Wavelength</i></b> <i>(<math>\lambda</math>)</i>							
<b><i>Radius of Curvature</i></b> <i>(<math>R_c</math>)</i>							

Attribute	Measurement 1
<b><i>Stream length</i></b> <i>(<math>L_{st}</math>)</i>	
<b><i>Valley length</i></b> <i>(<math>L_{val}</math>)</i>	



## Calculate Ratios

Stream name/location: \_\_\_\_\_

Date: \_\_\_\_\_ Team members: \_\_\_\_\_

Bankfull width ( $W_{bkf}$ ) at Representative Riffle: \_\_\_\_\_

Attribute	# 1	# 2	# 3	# 4	# 5	Min	Max	Average
<b>Sinuosity (<math>k</math>)</b> <i>(<math>L_{st}/L_{val}</math>)</i>								
<b>Meander Width Ratio</b> ( $W_{bit}/W_{bkf}$ )								
<b>Meander Length Ratio</b> ( $L_m/W_{bkf}$ )								
$\lambda/W_{bkf}$								
$R_c/W_{bkf}$								

$R_c$  = radius of curvature

$\lambda$  = Linear wavelength

$L_m$  = Stream meander length

$W_{bit}$  = Belt width



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  - c. Belt Width ( $W_{blt}$ )
  - d. Stream Meander Length ( $L_m$ )
  - e. Linear Wavelength( $\lambda$ )
  - f. Radius of Curvature ( $R_c$ )
6. Calculate ratios and record on data sheet
  - a. Sinuosity ( $L_{st}/L_{val}$ )
  - b. Meander Width Ratio ( $W_{blt}/W_{bkf}$ )
  - c. Meander Length Ratio ( $L_m/W_{bkf}$ )
  - d.  $\lambda/ W_{bkf}$
  - e.  $R_c/ W_{bkf}$

## Equipment

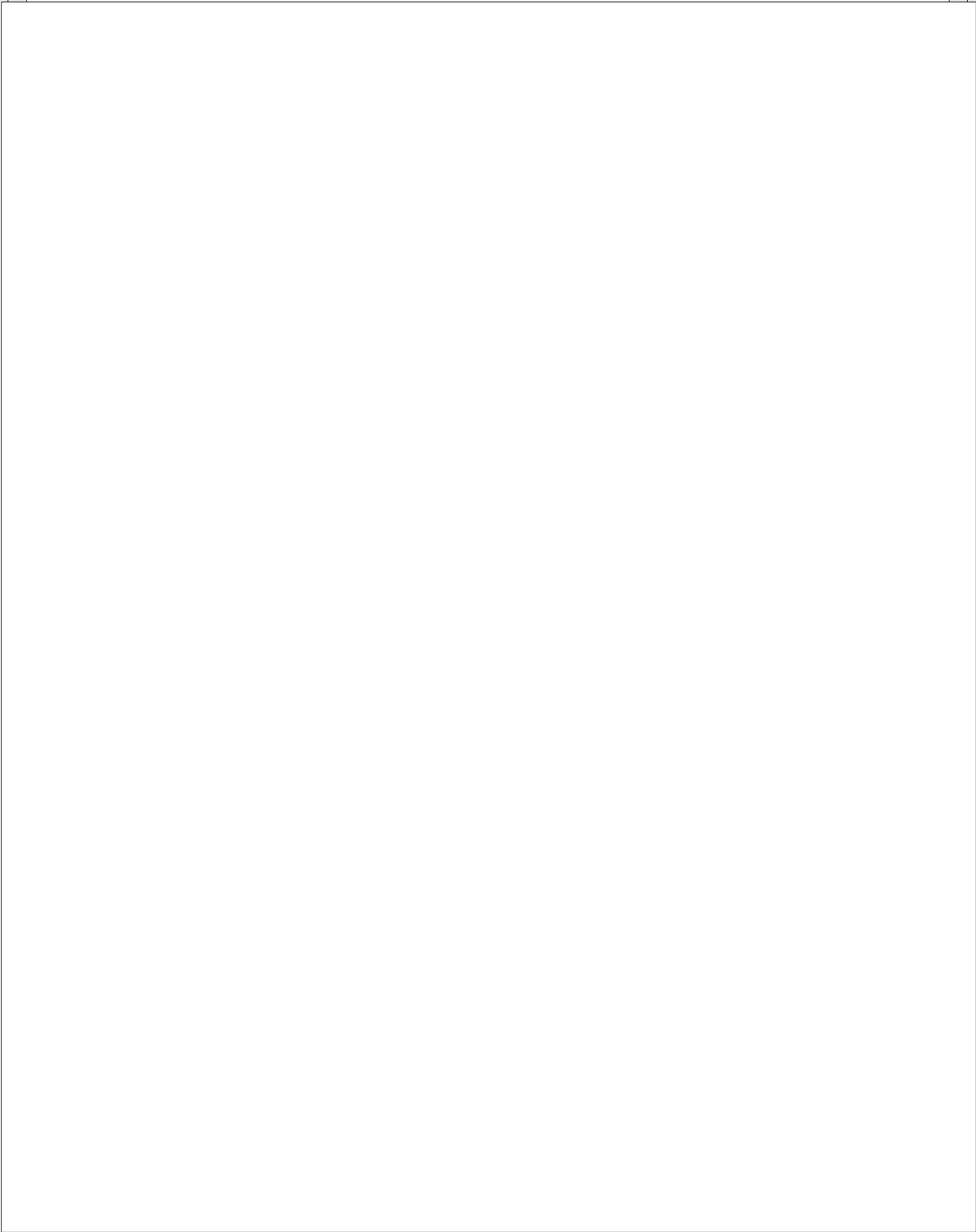
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| (6) Engineer's scales  | (2) Calculators      |
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| (10) Chaining pins   | (6) Pencils          |
| (4) 300' Fiberglass tapes (2 for stream length, 2 for valley length) | (6) Clipboards       |
| (4) 300' Fiberglass tapes w/Alan                                     |                      |



***AREA-SITE LOCATION....REACH MAP***

Stream: \_\_\_\_\_ Reach: \_\_\_\_\_

Drawn By: \_\_\_\_\_ Date: \_\_\_\_\_

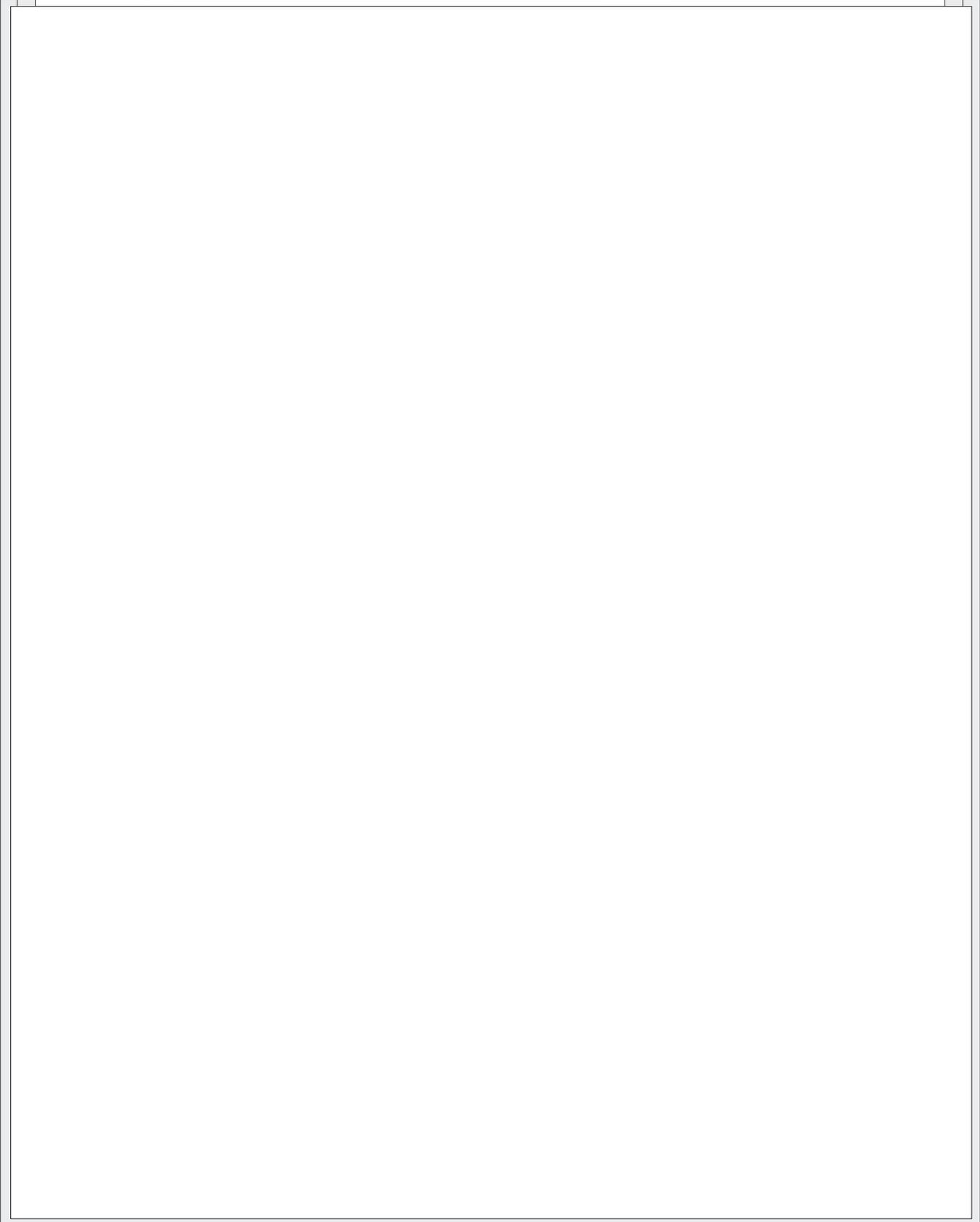




***AREA-SITE LOCATION....REACH MAP***

Stream: \_\_\_\_\_ Reach: \_\_\_\_\_

Drawn By: \_\_\_\_\_ Date: \_\_\_\_\_

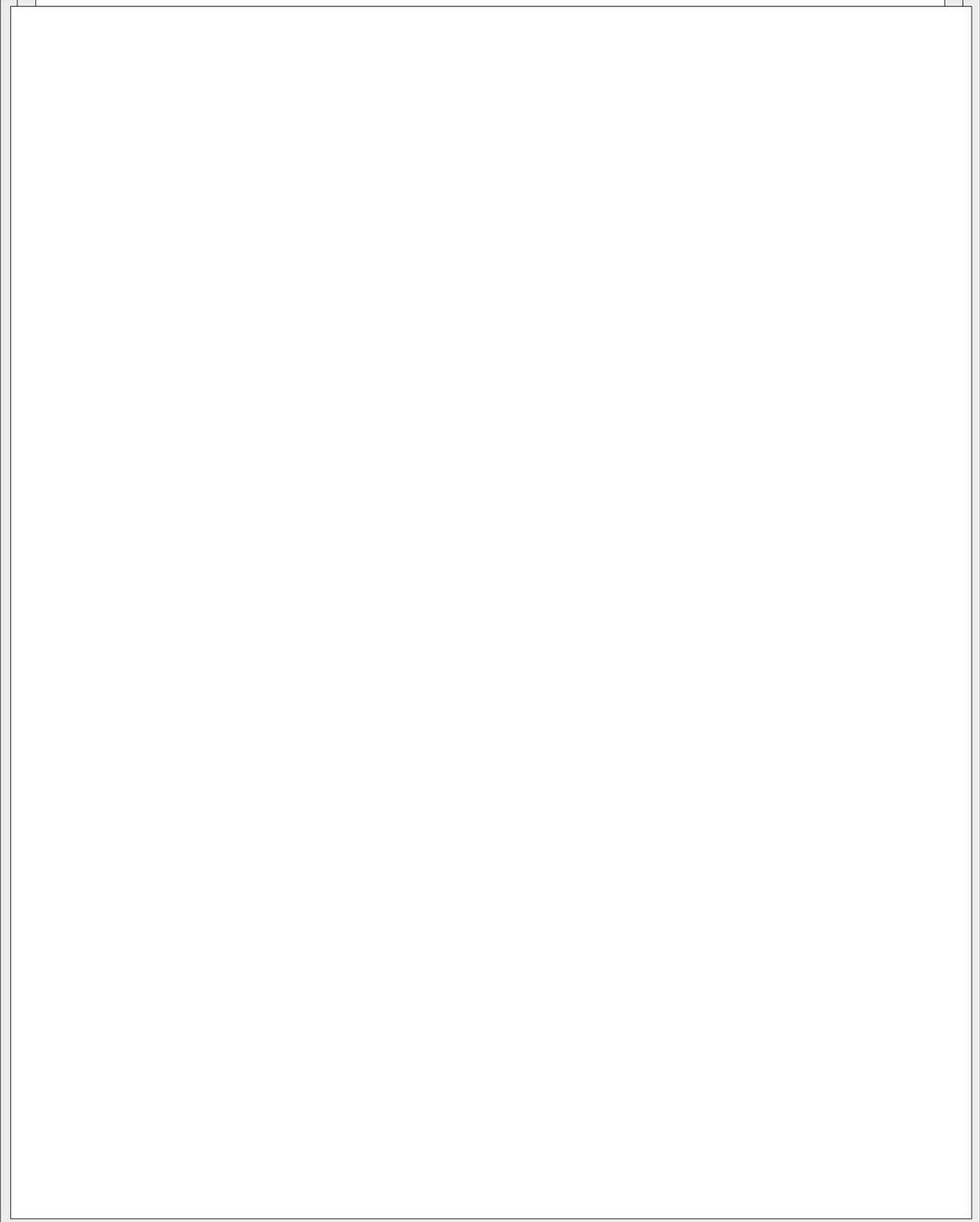




***AREA-SITE LOCATION....REACH MAP***

Stream: \_\_\_\_\_ Reach: \_\_\_\_\_

Drawn By: \_\_\_\_\_ Date: \_\_\_\_\_





## Geometry Measurements

Stream name/location: \_\_\_\_\_

Date: \_\_\_\_\_ Team members: \_\_\_\_\_

Attribute	Measurement 1	Measurement 2	Measurement 3	Measurement 4	Measurement 5	Range	Average
<b><i>Belt Width</i></b> <i>(<math>W_{bit}</math>)</i>							
<b><i>Stream Meander Length</i></b> <i>(<math>L_m</math>)</i>							
<b><i>Linear Wavelength</i></b> <i>(<math>\lambda</math>)</i>							
<b><i>Radius of Curvature</i></b> <i>(<math>R_c</math>)</i>							

Attribute	Measurement 1
<b><i>Stream length</i></b> <i>(<math>L_{st}</math>)</i>	
<b><i>Valley length</i></b> <i>(<math>L_{val}</math>)</i>	



## Calculate Ratios

Stream name/location: \_\_\_\_\_

Date: \_\_\_\_\_ Team members: \_\_\_\_\_

Bankfull width ( $W_{bkf}$ ) at Representative Riffle: \_\_\_\_\_

Attribute	# 1	# 2	# 3	# 4	# 5	Min	Max	Average
<b>Sinuosity (<math>k</math>)</b> <i>(<math>L_{st}/L_{val}</math>)</i>								
<b>Meander Width Ratio</b> ( $W_{bit}/W_{bkf}$ )								
<b>Meander Length Ratio</b> ( $L_m/W_{bkf}$ )								
$\lambda/W_{bkf}$								
$R_c/W_{bkf}$								

$R_c$  = radius of curvature

$\lambda$  = Linear wavelength

$L_m$  = Stream meander length

$W_{bit}$  = Belt width

