# Morphological Characteristics

<table>
<thead>
<tr>
<th>No.</th>
<th>Variable</th>
<th>Symbol</th>
<th>Units</th>
<th>Existing Channel</th>
<th>Reference Reach</th>
<th>Proposed Reach</th>
<th>As Built</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Drainage area</td>
<td>DA</td>
<td>mi²</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2</td>
<td>Riffle bankfull width</td>
<td>W&lt;sub&gt;bkf&lt;/sub&gt;</td>
<td>feet</td>
<td>Mean</td>
<td>Range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Riffle bankfull mean depth</td>
<td>d&lt;sub&gt;bkf&lt;/sub&gt;</td>
<td>feet</td>
<td>Mean</td>
<td>Range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Riffle bankfull cross sectional area</td>
<td>A&lt;sub&gt;bkf&lt;/sub&gt;</td>
<td>ft²</td>
<td>Mean</td>
<td>Range</td>
<td></td>
<td></td>
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<tr>
<td>5</td>
<td>Bankfull mean velocity</td>
<td>V&lt;sub&gt;bkf&lt;/sub&gt;</td>
<td>ft/sec</td>
<td>Mean</td>
<td>Range</td>
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<tr>
<td>6</td>
<td>Bankfull discharge</td>
<td>Q&lt;sub&gt;bkf&lt;/sub&gt;</td>
<td>cfs</td>
<td>Mean</td>
<td>Range</td>
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<tr>
<td>7</td>
<td>Riffle bankfull maximum depth</td>
<td>D&lt;sub&gt;max&lt;/sub&gt;</td>
<td>feet</td>
<td>Mean</td>
<td>Range</td>
<td></td>
<td></td>
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<tr>
<td>8</td>
<td>Width of flood prone area</td>
<td>W&lt;sub&gt;fpa&lt;/sub&gt;</td>
<td>feet</td>
<td>Range</td>
<td>Mean</td>
<td>Range</td>
<td></td>
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<tr>
<td>9</td>
<td>Meander length</td>
<td>L&lt;sub&gt;m&lt;/sub&gt;</td>
<td>feet</td>
<td>Mean</td>
<td>Range</td>
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<td>10</td>
<td>Radius of curvature</td>
<td>R&lt;sub&gt;c&lt;/sub&gt;</td>
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<td>Range</td>
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<td>11</td>
<td>Roughness coefficient</td>
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<td>Range</td>
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<td>12</td>
<td>Belt width</td>
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<td>Range</td>
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<tr>
<td>13</td>
<td>Sinuosity</td>
<td>K</td>
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<td>Mean</td>
<td>Range</td>
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</table>

Continued on next page
Required Data (Proposed)

**Morphological Characteristics (continued)**

<table>
<thead>
<tr>
<th>No.</th>
<th>Variable</th>
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<th>As Built</th>
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<tbody>
<tr>
<td>14</td>
<td>Valley slope</td>
<td>$S_{val}$</td>
<td>ft/ft</td>
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<td>15</td>
<td>Average water surface slope</td>
<td>$S_{avg}$</td>
<td>ft/ft</td>
<td></td>
<td>Mean</td>
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</tbody>
</table>

**Materials**

<table>
<thead>
<tr>
<th>No.</th>
<th>Variable</th>
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<th>Units</th>
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<th>Reference Reach</th>
<th>Proposed Reach</th>
<th>As Built</th>
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</thead>
<tbody>
<tr>
<td>16</td>
<td>Particle Size Distribution Channel</td>
<td>$D_{50}$</td>
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<td></td>
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<td>$D_{84}$</td>
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<td>Particle Size Distribution Bar</td>
<td>$D_{50}$</td>
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<tr>
<td></td>
<td></td>
<td>$D_{84}$</td>
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</tr>
<tr>
<td></td>
<td>Largest Particle Size</td>
<td>$D_{max}$</td>
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</tbody>
</table>
Morphological Measurements and Ratios: Dimensions

**Flood-prone Width** ($W_{fpa}$)

**Bankfull Width** ($W_{bkf}$)

**Max Depth** ($d_{max}$)

**Bankfull Mean Depth** ($d_{bkf}$)

**CHANNEL DIMENSION MEASUREMENTS**

- Riffle Bankfull Width ($W_{bkf}$)
- Mean Riffle Bankfull Depth ($d_{bkf}$)
- Max Riffle Bankfull Depth ($D_{max}$)
- Width of Flood-Prone Area ($W_{fpa}$)
- Wetted Perimeter (channel)

**CHANNEL DIMENSION CALCULATIONS**

- Width/Depth Ratio ($W/D$ ratio)
- X-Section Area ($A_{bkf}$)
- Hydraulic Radius ($R$)
- Entrenchment Ratio ($ER$) = ($W_{fpa}$/$W_{bkf}$)
- Channel Type
Morphological Measurements and Ratios: Profile

**CHANNEL PATTERN MEASUREMENTS**
- Meander Length ($L_m$)
- Radius of Curvature ($R_c$)
- Belt Width ($W_{blt}$)

**CHANNEL PATTERN CALCULATIONS**
- Meander Length Ratio ($L_m/W_{blt}$)
- Radius of Curvature Ratio ($R_c/W_{blt}$)
- Meander Width Ratio ($W_{blt}/W_{est}$)
Required Data (Proposed)

**CHANNEL PROFILE MEASUREMENTS**
- Valley Slope (VS)
- Ave. Water Surface Slope (S)

**CHANNEL PROFILE CALCULATIONS**
- Sinuosity(k)=(VS/S)

**ADDITIONAL CALCULATIONS FROM DATA**
- Relative Roughness \( R/D_{84} \)
- Shear Velocity \( u^*=(gRS)^{1/2}; \ g=32.2 \text{ ft/sec}^2 \)
  \(\frac{u}{u^*}=\frac{R}{D_{84}}=\frac{u}{(gRS)^{1/2}}\)
- Roughness Coefficient \( n=1.4865\left(\frac{R^{2/3}S^{1/2}}{u_{b kf}}\right)\)
  \(u_{b kf}=1.4865\left(\frac{R^{2/3}S^{1/2}}{n}\right)\)
  \(Q_{b kf}=W_{b kf} \cdot d_{b kf} \cdot u_{b kf}\)
- Shear Stress \( \tau=\gamma RS; \ \gamma=62.4 \text{ lbs/ft}^2 \)
- Wetted Perimeter (estimated) = \(2 \cdot d_{b kf} + W_{b kf}\)
Additional References


Herrington, R.B., and D.K. Dunham. A Technique for Sampling General Fish Habitat Characteristics of Streams. Intermountain Forest and Range Experiment Station, Ogden, UT.


Wilcock, P.R. Sediment Transport in the Restoration of Gravel-bed Rivers. Dept. of Geography and Environmental Engineering, John Hopkins University, Baltimore, MD.
Useful Web Sites/Pages for Additional Reference Material

Minnesota Department of Natural Resources, Stream Habitat Program
http://www.dnr.state.mn.us/eco/streamhab/about.html

Michigan's Stream Team
www.mi.gov/streamteam

U.S. Forest Service Stream Systems Technology Center
http://www.stream.fs.fed.us/

U.S. Forest Service Stream Team Web Page for Stream Notes Newsletter

Guidelines for Natural Stream Channel Design for Pennsylvania Waterways

North Carolina State University Stream Restoration Program
http://www.bae.ncsu.edu/programs/extension/wqg/srp/

Regional Hydraulic Geometry Curves. Natural Resource Conservation Service
Provides links to various regional curve web sites.
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/water/manage/?&cid=nrcs143_015052

University of Louisville Stream Institute
https://louisville.edu/speed/civil/si

U.S. Fish and Wildlife Service, Chesapeake Bay Field Office
http://www.fws.gov/chesapeakebay/stream/


Stream Mechanics
www.stream-mechanics.com